

**T293 Economic strategies for stocking rate and supplementation of stockers grazing rye-ryegrass pastures.** F. M. Rouquette, Jr.\*<sup>1</sup> and L. Ortega<sup>2</sup>, <sup>1</sup>Texas A&M University System Agricultural Research & Extension Center, Overton, <sup>2</sup>Agronomy Department, University of Zulia, Venezuela, Zulia, Venezuela.

Increasing stocking rates to maximize gain per unit land area, and use of supplements to substitute for forage availability and increase ADG are management strategies used by stocker operators to increase economic return. The objective of this stocking rate (SR) x supplement (SUP) study was to quantify ADG and gain per ha as a database for assessing economic returns with variable input costs of fertilizer, supplement, and purchase-selling price of stocker cattle grazing 'Maton' rye and 'TAM-90' annual ryegrass. Two pasture replicates of 3.7 (LO), 5.2 (ME), and 7.2 (HI) hd/ha (270 kg initial BW/hd) received a daily, hand-fed ration of 98% cracked corn plus Rumensin 80 at 0 (PAS), 0.4% BW (.4 SUP), and 0.8% BW (.8 SUP). The 150-day ADG ranged from 1.5 kg/d for stockers at LO SR plus .8 SUP to .5 kg/d for stockers at HI SR and PAS ( $P < .01$ ), with respective gain/ha at 1130 kg/ha and 560 kg/ha. Based on actual input costs and animal prices at time of the winter pasture grazing in 2004-2005, respective animal plus pasture costs/kg gain for LO, ME, and HI SR were \$.68, \$.79, and \$1.39/kg for PAS; \$.73, \$.73, and \$.99/kg for .4 SUP; and \$.84, \$.77, and \$1.06/kg for .8 SUP. With initial purchase price of \$2.77/kg for steers and \$2.53/kg for heifers, the break-even selling price ranged from about \$1.83/kg on all LO SR regardless of SUP to \$2.10/kg on all HI SR plus SUP and \$2.38/kg on HI SR without SUP. The net returns ranged from \$622/ha for ME SR and .8 SUP to -\$131/ha for HI SR and PAS. The differential returns/ha among SR and SUP strategies showed that an additional \$753/ha was obtained by decreasing SR from HI to ME plus SUP at .8% BW. Using .8 SUP at HI SR increased ADG by .45 kg/hd, over PAS, and showed an additional \$385/ha advantage due to SUP. Increasing costs of nitrogen fertilizer and corn reduced net returns/ha but had less effect than reduced animal prices and reduced purchase-sell margin.

**Key Words:** Ryegrass, Stocking Rate, Supplementation

**T294 Development of a model for noninvasive evaluation of energy profiles in beef cows.** J. F. Odhiambo\*, E. E. Felton, R. Helmondollar, J. Y. Pritchard, P. I. Osborne, and R. A. Dailey, West Virginia University, Morgantown.

Body condition scores (BCS) indicate body energy reserves. However, variations among scorers and regional scoring systems prompted examination of utility of other non-invasive techniques. Spring-calving cross-bred Angus and Hereford cows ( $n = 150$ ) were evaluated using body weight measurements, BCS, and ribfat and rumpfat ultrasonic scans. Cows were assigned randomly within age to two treatments, early or normal weaning 45 days apart to provide a range of energy states. Data were collected at early weaning, normal weaning, precalving, postcalving and breeding using an electronic weighing system and BCS evaluation by a single observer. Images were collected by positioning the 5.0 MHz transducer directly above the interface of the Biceps femoris and Gluteus medius (rumpfat) and at 75% of the distance from the medial to lateral end of the 12th to 13th intercostal space (ribfat). Data were examined by repeated measures for a split plot design using PROC MIXED procedures of SAS with treatment, age, and treatment x age in the main plot and period and its interactions in the subplot. Although ribfat ( $P = 0.001$ ) and rumpfat ( $P = 0.01$ ) differed between treatments, cow weight and BCS did not. Age was linearly related to weight ( $P = 0.0001$ ), BCS ( $P = 0.001$ ), ribfat ( $P = 0.002$ ), and rumpfat ( $P = 0.001$ ). Age x treatment effects were significant ( $P = 0.04, 0.001, 0.005$  and  $0.02$  for weight, BCS, ribfat and rumpfat, respectively). Age x treatment x period effect was highly significant for rumpfat ( $P = 0.0001$ ) followed by ribfat ( $P = 0.01$ ) and weight ( $P = 0.05$ ) but not BCS ( $P = 0.5$ ). Rumpfat was highly correlated to ribfat ( $r = 0.83$ ), to BCS ( $r = 0.65$ ), to weight ( $r = 0.60$ ) and fairly correlated to age,  $r = 0.27$  ( $P = 0.0001$ ). In conclusion, rumpfat provided a more sensitive measure for energy profiles than cow weight, while BCS was least effective. Because rumpfat and ribfat were highly correlated, assessing effects of both variables was counterproductive in evaluating energy status.

**Key Words:** BCS, Weight, Rumpfat

## Ruminant Nutrition II

**T295 Effects of waste products from plant materials on *in vitro* rumen fermentation.** D. Tedesco\*, S. Stella, L. Garavaglia, C. Barbieri, and S. Galletti, University of Milan, Italy.

The industrial processing of fruits, vegetables and the extraction of phyto-therapeutic compounds from plants produce many tons of organic wastes that could include valuable compounds (e.g. pectin, poly-phenols, flavonoids). The objectives of the present study were to evaluate specific post-processing derivative waste products from plant residues (SAFEWASTES, EU project n. 513949) on rumen microbial fermentation by batch incubator system. The *in vitro* batch culture was carried out with rumen fluid withdrawn from three rumen-fistulated non-lactating dairy cows. The rumen fluid was added to a mineral salt buffer, mixed in a bottle warmed at 39°C, purged with anaerobic grade N<sub>2</sub>/CO<sub>2</sub> (80/20, v/v) and standardized at pH  $6.8 \pm 0.1$ . 100 mL of solution were placed in glass bottles supplied with a substrate for microbial growth (0.8 g/100mL alfalfa hay and 0.2 g/100mL corn meal). In this study, a total of 52 SAFEWASTES by-products were tested at three different concentrations. Each test was evaluated in

duplicate. The bottles were incubated in a water shaking bath at 39°C for 24 h. The pH was determined at 0, 4, 9, 24h of incubation. At 0 and 9h of incubation the production of VFA and of ammonia N were determined. Total Bacterial Count (TBC) was evaluated at 0h and after 24h of incubation. Statistical analysis was performed using PROC MIXED of SAS. None of the tested substances negatively affected rumen microbial fermentation. TBC value remained stable after 24h of incubation. Among the 52 tested substances, one caused a significant decrease ( $P < 0.05$ ) in ammonia N production in all the concentrations tested. Considering VFA production, an increase in acetic acid yield ( $P < 0.05$ ) was observed following incubation with two SAFEWASTES by-products. These *in vitro* results permitted to identify the substances that will be further evaluated in the *in vivo* trials. Furthermore, if positive physiological functions will be evidenced in other studies (e.g. as anti-inflammatory, immunostimulant), these substances could potentially have a use as feed additives.

**Key Words:** Waste Products From Plant Materials, VFA, Rumen Fermentation

**T296 Rumens degradation ratios: comparison of frost-damaged wheat with normal wheat.** P. Yu\* and V. Racz, *University of Saskatchewan, Saskatoon, SK, Canada.*

In this study, rumen degradation ratios of structural carbohydrates (SC), non-structural carbohydrate (starch: ST) and crude protein (CP) in the frost-damaged wheat were determined in dairy cows, using Tamminga Rumen Degradation Ratio System. The rumen degradation ratios were compared with the optimum ratio range. The overall test weight losses of the frost-damaged wheat were around 24%. The results showed that: 1) Rumen available insoluble N (EN), SC (ESC) and ST (EST) were 14 vs. 11 ( $P < 0.05$ ), 133 vs. 254 ( $P < 0.05$ ), and 441 vs. 326 g kg<sup>-1</sup> DM ( $P < 0.05$ ), respectively, between the normal and frost-damaged wheat; 2) Rumen available soluble N (SN), SC (SSC) and ST (SST) were 3 vs. 6 ( $P < 0.05$ ), 0 vs. 0, and 86 vs. 84 g kg<sup>-1</sup> DM ( $P > 0.05$ ), respectively; 3) Total rumen available N (FN), SC (FSC) and ST (FST) were 17 vs. 17 ( $P > 0.05$ ), 139 vs. 254 ( $P < 0.05$ ), and 527 vs. 410 g kg<sup>-1</sup> DM ( $P < 0.05$ ), respectively. The degradation ratios were calculated between the total rumen available N and carbohydrates (FN/FCHO), rumen available soluble N and carbohydrates (SN/SCHO), and rumen available insoluble N and carbohydrates (EN/ECHO). The ratios showed a significant difference between the normal and frost-damaged wheat in EN/ECHO ratio (24 vs. 18 g kg<sup>-1</sup>,  $P < 0.05$ ). The frost-damaged wheat had numerically higher ratio of SN/SCHO (89 vs. 35 g kg<sup>-1</sup>,  $P > 0.05$ ) and similar FN/FCHO (25 vs. 25 g kg<sup>-1</sup>) than the normal wheat. These results indicated that the normal and frost-damaged wheat differed in degradation utilization, however, both exhibited an optimal rumen fermentation ratio (optimum: FN/FCHO = 25 to 33 g N kg<sup>-1</sup> CHO).

**Key Words:** Optimal Rumen Fermentation, Degradation Ratio, Frost-Damaged Wheat

**T297 Available protein, structural and non-structural carbohydrates: comparison of frost-damaged wheat with normal wheat.** P. Yu\* and V. Racz, *University of Saskatchewan, Saskatoon, SK, Canada.*

In 2004, more than 50% of wheat was frost-damaged, rendering millions of tons of wheat unsuitable for human consumption. So far, little systematic research has been conducted to determine the magnitude of the differences in nutritive value between frost-damaged and normal wheat. In this study, rumen degradation characteristics of structural carbohydrates (SC), non-structural carbohydrate (starch: ST) and crude protein (CP) in the frost-damaged wheat were determined in dairy cows. Measured ruminal degradation characteristics were soluble fraction (S: ST and CP), undegradable fraction (U: SC and CP), lag time (T<sub>0</sub>: SC and CP) and rate of degradation (K<sub>d</sub>: SC, ST and CP) of the insoluble but degradable fraction (D: SC, ST and CP). The overall test weight losses of the frost-damaged wheat were around 24%. The measured characteristics showed significant differences between the normal and frost-damaged wheat. For protein, the frost-damaged wheat was lower ( $P < 0.05$ ) in D (612 vs. 878 g kg<sup>-1</sup> CP) and higher ( $P < 0.05$ ) in S (263 vs. 122 g kg<sup>-1</sup> CP) and U (125 vs. 0 g kg<sup>-1</sup> CP). It was also higher in total available soluble N (6 vs. 3 g kg<sup>-1</sup> DM), lower in total available insoluble N (11 vs. 14 g kg<sup>-1</sup> DM) than the normal wheat samples. No significant differences were found on T<sub>0</sub>, K<sub>d</sub>, and total available N between the normal and frost-damaged wheat. For non-structural carbohydrate, the frost-damaged wheat tended to be higher ( $P < 0.10$ ) in K<sub>d</sub> of ST (45.11 vs. 32.39 % h<sup>-1</sup>), lower ( $P < 0.05$ )

in rumen available insoluble ST (326 vs. 441 g kg<sup>-1</sup> DM), and total rumen available ST (410 vs. 527 g kg<sup>-1</sup> DM). There is no difference in rumen available soluble ST (average 85 g kg<sup>-1</sup> DM). For structural carbohydrate, the frost-damaged wheat contained higher potentially degradable SC (297 vs. 180 g kg<sup>-1</sup> DM,  $P < 0.10$ ), rumen available insoluble SC (254 vs. 133 g kg<sup>-1</sup> DM,  $P < 0.05$ ) and total rumen available SC (254 vs. 139 g kg<sup>-1</sup> DM). The D, U, K<sub>d</sub> and T<sub>0</sub> were similar ( $P > 0.05$ ). The results showed that the normal and frost-damaged wheat showed different degradation kinetics, which indicates different nutrient availability.

**Key Words:** Degradation Kinetic, Frost-damaged Wheat, Protein/Carbohydrate

**T298 Modelling nutrient supply to dairy cattle from normal and frozen sheat: Comparison of the National Research Council-2001 model with the DVE/OEB system.** P. Yu\*, R. Racz, and J. McKinnon, *University of Saskatchewan, Saskatoon, SK, Canada.*

The objective of this study was to 1) predict nutrient supply of frozen wheat to dairy cattle in comparison with normal wheat, and 2) compare the DVE/OEB system (DVE = truly absorbed protein in the small intestine; OEB = degraded protein balance) and the NRC-2001 model in the prediction of nutrient supply to dairy cows from different types of frozen wheat and normal wheat. Comparisons were made in terms of (1) ruminally synthesized microbial CP, (2) endogenous protein, (3) rumen undegraded feed protein, (4) truly absorbed protein in the small intestine, and (5) degraded protein balance. The results showed that the predicted values from the DVE/OEB system and the NRC-2001 model had significant correlations with high R (> 0.90) values. However, using the DVE/OEB system, the overall average microbial protein supply was 13.7% higher (65.2 vs. 56.3 g/kg DM), the digestible rumen undegraded feed protein was 10.0% higher (43.4 vs. 39.0 g/kg DM), endogenous protein was 65% higher (12.3 vs. 4.3 g/kg DM) than that predicted by the NRC-2001 model. However, the truly absorbed protein in the small intestine was similar (96.2 vs. 99.6 g/kg). The difference was also found in the prediction of the degraded protein balances, which was 78% higher based on data from the NRC-2001 model (-16.7 vs. -3.7 g/kg DM). These differences are due to considerably different factors used in calculations in the two models, although both are based on similar principles. This indicates that a further refinement is needed for a modern protein evaluation and prediction system. In addition, this study showed that the normal wheat had no difference in DVE and OEB values, but significant difference in metabolizable protein value (108.1 vs. 95 g/kg DM,  $P < 0.05$ )

**Key Words:** Modelling Nutrient supply, Dairy Cows, Frozen Wheat

**T299 Feed values of barley varieties could be determined using in vitro gas production technique.** M. Rinne<sup>1</sup>, S. Ahvenjärvi<sup>1</sup>, M. Holma<sup>2</sup>, and P. Huhtanen<sup>\*1,3</sup>, <sup>1</sup>*MTT Agrifood Research Finland, Jokioinen, Finland*, <sup>2</sup>*RehuRaisio Ltd., Raisio, Finland*, <sup>3</sup>*Cornell University, Cornell, NY.*

Fiber (NDF) from cereal grains can in some feeding situations form a considerable proportion of ruminant diets. The in vitro gas production technique provides a method to study separately digestion kinetics of concentrate NDF and cell solubles, which is not achievable in vivo.

Information of NDF digestion is important as it is more variable than digestion of cell solubles. Fourteen barley grain samples representing different varieties grown in the Nordic countries were ground and ND solution was used to extract cell solubles. Indigestible NDF was estimated by a 12 d ruminal in situ incubation (nylon bag pore size 17 µm). In vitro gas production of the intact samples and the NDF residues were determined for 72 h with a 15 min. measurement interval in triplicate runs. The gas curve for cell solubles was calculated by subtraction. The two-pool Gompertz function was fitted to the gas curves, and digestibility of the potentially digestible NDF (pdNDF) was estimated using a dynamic rumen simulation model. The first-order rate of digestion was calculated from the pdNDF digestibility. Concentrations of NDF and iNDF of the samples were 198 (s.d. 22.6) and 34 (s.d. 8.1) g/kg DM, respectively. The rate of digestion of cell solubles was faster than that of digestible fiber [0.143 (s.d. 0.0090) vs. 0.075 (s.d. 0.0097) per h]. The digestibility of pdNDF was on average 0.761 (s.d. 0.0291) and that of cell solubles 0.884 (s.d. 0.0090). There were significant differences between the varieties and especially a hullless variety had a fast rate of pdNDF digestion. The concentration of NDF was negatively correlated to the rate of pdNDF ( $r = -0.562$ ) and calculated ME concentration ( $r = -0.867$ ) of the samples. In vitro gas production technique shows potential for studying the differences in digestion properties and feeding value of grain samples.

**Key Words:** Rate of Digestion, Indigestible Fiber, Cell Solubles

**T300 Effect of an exogenous fibrolytic enzyme on in vivo digestibility of King grass hay.** J. H. Avellaneda-Cevallos<sup>\*1</sup>, G. Quintana-Zamora<sup>1</sup>, F. Espinoza-Torrico<sup>1</sup>, O. Montañez-Valdez<sup>2</sup>, I. Espinoza-Guerra<sup>1</sup>, R. Luna-Murillo<sup>1</sup>, S. González-Muñoz<sup>3</sup>, and J. Tuárez-Cobeña<sup>1</sup>, <sup>1</sup>Facultad de Ciencias Pecuarias, Unidad de Investigación Científica y Tecnológica, Universidad Técnica Estatal de Quevedo, Quevedo, Los Rios, Ecuador, <sup>2</sup>División de Bienestar y Desarrollo Regional, Departamento de Desarrollo Regional, Universidad de Guadalajara, Ciudad Guzmán, Municipio de Zapotlán, Jalisco, México, <sup>3</sup>Colegio de Postgraduados, Texcoco, Estado de México, México.

The effect of a enzymatic fibrolytic exogenous compound in the digestibility in vivo (DIV), and nitrogen balance in sheep fed with hay of King grass (*Pennisetum hybridum*) cut at 35 and 70 days was evaluated. Four Pelibuey × Chatadin sheep were used (35±4 Kg BW) in a 4 × 4 Latin square design with a 2 × 2 factorial treatment arrangement (two cutting dates and two levels of enzymes; 0 and 1 g of Fibrozyme/Kg of DM). Four treatments were established: T1: King grass cut at 35 d with enzyme; T2: King grass cut at 35 d without enzyme; T3: King grass cut at 70 d with enzyme; T4: King grass cut at 70 d without enzyme. The DIV of DM (T1: 67.04a, T2:68.25a, T3: 65.08a, T4: 64.33; P>0.05; SEM=2.59), OM (T1: 72.13a, T2: 75.01a, T3: 69.04b, T4: 68.38b; P <0.05; SEM= 1.31) and protein (T1: 68.06a, T2: 69.59a, T3: 58.66b, T4: 58.84b; P<0.05; SEM= 2.22) was substantial on the hay cut at 35 d compared to the hay cut at 70 d, which was not influenced by the enzyme fibrolytic exogenous compound. The retention of nitrogen was superior (P>0.05) for the 35 vs 70 d hay without being influenced by the enzyme compound. In conclusion the enzyme fibrous exogenous do not affect the digestion of the nutrients in the King grass hay.

**Key Words:** King Grass Hay, Fibrolytic Enzymes, Digestibility

**T301 Effects of Bovazyme WPTM on microbial efficiency and metabolism in continuous culture of rumen contents.** B. P. House\*, L. Holden, and G. A. Varga, *The Pennsylvania State University, University Park.*

A continuous culture study was conducted to evaluate the effect of BovaZyme™ (BVZ, York Ag Products, Inc.), a concentrated source of enzymes and other fermentation enhancers, on ruminal microbial metabolism. Diets were formulated to be similar in nutrient composition and consisted of a basal diet without BVZ (control) and a diet with BVZ, equivalent to 2.5g/head/day. Continuous culture fermenters were fed 100g DM/d and conditions included a liquid dilution rate of 13%/hr, solids dilution rate of 4.55%/hr, and a solids retention time of 22 hr. The BVZ significantly increased ruminal digestibility of acid detergent fiber by 16.2% (P=0.05). Though not significant, neutral detergent fiber digestibility numerically increased by 14.6% for BVZ compared to the control. Rumen by-pass nitrogen was decreased 12% (P=0.05), while crude protein digestibility was increased by 9% (P=0.04) for fermenters provided BVZ. Microbial nitrogen (N) production/d of the BVZ diet was 12% higher (P=.04) than the control. There was no change in conversion of feed N to microbial N, however, volatile fatty acids (VFA) produced/unit of microbial N was lower (P=.04) in the BVZ diet, indicating a tendency to partition more feed organic matter to microbes rather than VFA. Total VFA production was not changed due to BVZ, but increases were observed in acetate and butyrate production along with a decrease in propionate production for fermenters provided BVZ compared to the control. As a result, the acetate-propionate ratio increased from 1.60 to 2.14 (P=.09). Comparing changes in pH over time between treatments illustrated that BVZ attenuated a rapid rise in pH 2-3 hours post feeding compared to the control resulting in a more continuous supply of nutrients. Addition of BVZ to the diet resulted in improved rate and extent of fiber digestibility, greater microbial growth and an improved VFA profile compared to the control.

**Key Words:** Continuous Culture, Feed Enzyme Additive

**T302 Effects of yeast and type of starch on pH fluctuation, nutrient digestion and microbial fermentation in a dual flow continuous culture system.** D. Moya\*, S. Calsamiglia, A. Ferret, and M. C. Fuentes, *Universitat Autònoma de Barcelona, Barcelona, Spain.*

Eight 1320-mL dual flow continuous culture fermenters were used in a 2 × 2 factorial design in two replicated periods of 9 d (6 for adaptation and 3 for sampling) to determine the effect of live yeast and type of starch on rumen microbial fermentation and nutrient digestibility. Main factors were live yeast (*Saccharomyces cerevisiae* CNCM I-1077, Levucell®SC): no yeast (NY) vs 1.3 × 10<sup>6</sup> CFU of yeast/g of diet (Y); and type of starch: slow degradable (S, a 55% ground corn diet, 17.2% CP, 27.8% NDF) vs rapidly degradable (R, a 89.2% barley diet, 16.1% CP, 16.1% NDF). All fermenters were fed 80 g DM/day of a 10 to 90 forage to concentrate diet in three equal amounts along the day. Fermentation temperature (38.5°C) and liquid (12%/h) and solid (5%/h) dilution rates were maintained constant. The pH was allowed to fluctuate with an upper (6.6) and lower (5.5) limit controlled by infusion of 3 N HCl or 5 N NaOH. Effluent samples were taken from a composite of the three sampling days, and bacteria were isolated from fermenter flasks on the last day of each period for chemical analysis. Treatment R increased (P < 0.01) the true digestion of DM and OM,

and decreased ( $P < 0.01$ ) the NDF and ADF digestion. Ammonia N flow and CP degradation was higher ( $P < 0.05$ ) and dietary N flow was lower ( $P < 0.01$ ) in R compared with S. Treatment Y decreased ammonia ( $P < 0.05$ ) and dietary ( $P < 0.10$ ) N flow, and increased ( $P < 0.05$ ) bacterial N flow, CP degradation ( $P < 0.10$ ) and the efficiency of microbial protein synthesis ( $P < 0.10$ ). Treatment R reduced the min to minimum pH ( $P < 0.05$ ) and increased the area under pH 6.0 ( $P < 0.01$ ). Treatment Y increased the min until minimum pH in the two types of starch and reduced the area under pH 6.0 in R treatment ( $P < 0.05$ ). Results from the comparison between R and S were expected. Treatment Y improved N metabolism and reduced the drop of pH after feeding a rapidly degradable starch diet.

**Key Words:** Yeast, Starch, Microbial Fermentation

**T303 Screening for the effects of commercial additives at two pH levels on in vitro rumen microbial fermentation of a high-concentrate beef cattle diet.** D. Moya\*, S. Calsamiglia, A. Ferret, and J. I. Fandiño, *Universitat Autònoma de Barcelona, Barcelona, Spain.*

Ten commercial additives were screened at 3 doses (low, medium and high) and 2 levels of pH (7.0 and 6.0) in a duplicate  $10 \times 3 \times 2$  factorial arrangement of treatments to determine their effects on rumen microbial fermentation profile. Treatments were: two sources of tannins (TAN1 and TAN2), three sources of saponins (SAP1, SAP2 and SAP3), two sources of yeast (YEA1 and YEA2), rice fatty acids (RFA), garlic powder (GAR) and one source of natural plant alkaloids (sanguinarine and chelerytrine, NPA). Treatments were tested in triplicate in two consecutive periods in batch cultures. Ruminal fluid was taken from two feedlot steers, mixed with an equal volume of artificial saliva and adjusted to pH 7.0 or 6.0 with 3 N HCl and 5 N NaOH. All tubes were supplied with 0.5 g of DM of a 10 to 90 forage to concentrate diet (16.6% CP, 22.0% NDF, 12.4% ADF). Tubes were filled with 50 ml of fluid, infused with CO<sub>2</sub> to remove O<sub>2</sub>, stamped with gas-release rubber stoppers, and incubated for 24 h at 39°C. Samples were collected for ammonia N and volatile fatty acid (VFA) determinations. Differences were declared at  $P < 0.05$ . When pH was 7.0, TAN1, TAN2, SAP2, SAP3 and NPA increased total VFA concentration; TAN1, TAN2, SAP2, YEA1, YEA2, GAR and NPA increased the acetate to propionate ratio; and TAN1 and TAN2 reduced ammonia N concentration, whereas SAP2 and NPA increased it. In contrast, when pH was 6.0, TAN1 reduced total VFA; TAN2, SAP1 and SAP3 increased the acetate to propionate ratio; and TAN1, TAN2 and YEA1 reduced ammonia N concentration, whereas NPA increased it. Results indicate that the effects of commercial additives on rumen fermentation in beef cattle diets may differ depending on rumen pH. When pH was 7.0 most of commercial additives tested had more activity. The increase in total VFA concentration and the reduction in ammonia N concentration observed with tannins suggest that they may be useful in modifying rumen microbial fermentation.

**Key Words:** Rumen pH, Fermentation, Commercial Additives

**T304 Effect of fibrolytic enzyme application to diets differing in concentrate proportion on the performance of lactating dairy cattle.** K. G. Arriola\*, A. T. Adesogan, S. C. Kim, T. W. Kang, C. M. Huisden, and C. R. Staples, *University of Florida, Gainesville.*

This study examined the effect of dietary application of a fibrolytic enzyme preparation containing xylanase, cellulase and esterase activities (Dyadic International Inc., Jupiter, FL) in lactating dairy cows consuming diets with high (48% of dietary DM) or low (33% of dietary DM) proportions of concentrate. Sixty lactating Holstein cows were classified according to milk production and randomly assigned at 22 DIM to four treatment groups arranged in a  $2 \times 2$  factorial design. The trial lasted for 77 d, the first 14 d were used for adaptation to diets and the last 63 d for measurements. Dietary treatments included the following: 1) Low concentrate diet (LC); 2) LC plus enzyme (LCE); 3) High concentrate diet (HC); 4) HC plus enzyme (HCE). The enzyme was sprayed at a rate of 3.4 mg/g of DM on the TMR daily. Four ruminally-fistulated cows were used to measure dietary effects on the ruminal environment. Enzyme application did not affect DM intake (DMI) ( $P > 0.05$ ) but tended to increase milk yield ( $P = 0.06$ ; 32.8 vs. 34.7 kg/d) and therefore increased the efficiency of milk production (1.36 vs. 1.55 kg milk/kg DMI;  $P = 0.008$ ). Increasing the concentrate level increased ( $P < 0.05$ ) DMI (22.0 vs. 25.5 kg/d), milk yield (32.5 vs. 35.0 kg/d), and milk protein yield (0.92 vs. 1.01 kg/d), but reduced ruminal pH ( $P < 0.01$ ; 6.31 vs. 6.06) and tended to reduce the efficiency of milk production ( $P = 0.108$ ; 1.51 vs. 1.40 kg milk/kg DMI). Compared to cows fed HC, those fed LCE had lower DMI ( $P = 0.009$ ; 21.2 vs. 25.6 kg/d), greater ruminal pH ( $P = 0.01$ ; 6.36 vs. 6.10) and similar milk yield ( $P = 0.693$ ; 33.2+1.0 kg/d). Consequently the efficiency of milk production was greater in cows fed the LCE diet than those fed the HC diet ( $P = 0.003$ ; 1.62 vs. 1.32 kg milk/kg DMI). Therefore this mixture of fibrolytic enzymes increased the amount and efficiency of milk production by dairy cows.

**Key Words:** Fibrolytic Enzyme, Milk Production, Esterase

**T305 Effect of a ruminal buffer and an amilolytic enzymes mixture added to a sorghum grain diet on finishing Criollo lambs.** H. A. Lee-Rangel<sup>1</sup>, G. D. Mendoza-Martínez<sup>2</sup>, S. S. González\*<sup>1</sup>, G. Ramírez-Valverde<sup>1</sup>, and J. H. Avellaneda-Cevallos<sup>3</sup>, <sup>1</sup>*Colegio de Postgraduados, Montecillo, Edo. México, México*, <sup>2</sup>*UAM Xochimilco, México D.F.*, <sup>3</sup>*Universidad Técnica Estatal de Quevedo, Quevedo, Ecuador.*

The objective of this trial was to determine the effect of an amilolytic enzymes mixture (enzyme) from *Aspergillus niger* (Glucozime® L-400, Takaterm) and *Bacillus licheniformis* ( $\alpha$ -1, 4 D-glucan hydrolase) (ENMEX, México) plus a buffer (Acid buf®) on finishing lambs performance. The enzyme was sprinkled on ground sorghum (2.6 g/kg DM) and the buffer was added (0.85% DM) to the diet which contained 72% sorghum, 10% corn stover, 9% cane molasses and 7% SBM. The experiment lasted 50 days and treatments (T) were: T1, control (no enzyme or buffer); T2, enzyme; T3, buffer; T4, enzyme + buffer. The experimental design was completely randomized and data were analyzed using PROC MIXED (SAS) with initial BW as a covariable. The experimental units were 32 Criollo lambs ( $25 \pm 2.5$  kg initial BW) housed in individual metabolic cages. There were no significant differences (Tukey;  $P \geq 0.01$ ) for ADG (264.7, 262.7, 282.5, 284.5  $\pm$  0.02 g/d), DMI (1124.7, 1127.5, 1200.1, 1216.9  $\pm$  65.8 g/d), and feed conversion (4.75, 4.39, 5.3, 4.65  $\pm$  0.47). Therefore, addition of an amilolytic enzymes mixtures plus a buffer did not change performance of finishing Criollo lambs fed a sorghum grain diet.

**Key Words:** Amilolytic Enzymes, Buffer, Criollo Lambs

**T306 Effects of exogenous amylase from *Bacillus licheniformis* on sheep performance and starch digestion.** M. M. Crosby<sup>1</sup>, G. D. Mendoza\*<sup>2</sup>, L. M. Melgoza<sup>2</sup>, J. R. Barcena<sup>1</sup>, and F. X. Plata<sup>2</sup>, <sup>1</sup>*Colegio de Postgraduados, Montecillo, Mexico, Mexico*, <sup>2</sup>*Universidad Autonoma Metropolitana Xochimilco, Mexico, D.F., Mexico*.

An experiment was conducted to determine the effects of exogenous amylase dose in sheep performance and starch digestion and with a sorghum based diet (68% of the diet). Thirty-six sheep (Creole × Suffolk, 21.66 ± 6.5 kg BW) were assigned the following doses of amylase from *B. Licheniformis* (g enzyme /kg dry matter of grain): 0.0, 0.6, 1.2, 1.8, 2.4 and 3.0. In vivo starch digestion was not different when dose was increased (94.8, 97.4, 96.0, 95.4, 96.0, 96.8%). No differences were detected ( $P \geq 0.05$ ) in daily gain (215, 206, 223, 220, 222, 209 g/d) among treatments for the increasing doses (0 to 3.0 g respectively). Feed conversion was not affected by enzyme dose (4.54, 4.34, 4.47, 4.43, 4.38 and 4.47 for the same doses respectively). Sheep performance and starch digestion were not improved with the exogenous amylolytic enzyme.

**Key Words:** Starch, Digestion, Enzyme

**T307 Effect of feeding Fermenten<sup>®</sup> on rumen fermentation in cows fed different concentrations of sucrose.** G. B. Penner\*<sup>1</sup>, L. L. Guan<sup>1</sup>, K. A. Beauchemin<sup>2</sup>, and M. Oba<sup>1</sup>, <sup>1</sup>*University of Alberta, Edmonton, Alberta, Canada*, <sup>2</sup>*Agriculture and Agri-Food Canada, Lethbridge, Alberta, Canada*.

A study was conducted to determine the effect of feeding Fermenten<sup>®</sup> on rumen fermentation and microbial populations in lactating Holstein cows fed diets differing in sucrose concentration. We hypothesized that Fermenten<sup>®</sup> would decrease propionate concentration in ruminal fluid, and increase rumen ammonia production; however, these effects would be altered by dietary sucrose concentration. Eight multiparous ruminally cannulated cows (163 ± 55 DIM) were used in a replicated 4 × 4 Latin square design with 21-d periods. Treatments were arranged as a 2 × 2 factorial: Fermenten<sup>®</sup> inclusion (FERM vs. control) and dietary sucrose concentration (6.5 vs. 2.0% DM). Diets were formulated to contain 18.7% CP, 23.2% forage NDF and were offered ad libitum. Cracked corn replaced sucrose for the low sugar diets, and urea and soybean meal replaced Fermenten<sup>®</sup> in the control diets. Ruminal pH was measured for 72 h continuously using the Lethbridge Research Centre Ruminal pH System. No detectable differences were observed for microbial diversity using PCR-DGGE analysis. Ruminal pH parameters were not affected by treatment with mean pH averaging 6.23. Although, FERM did not alter individual VFA concentrations, there tended ( $P < 0.10$ ) to be interactions between FERM and sucrose for propionate and acetate:propionate ratio. For high sucrose diets, FERM tended to increase propionate concentration (21.5 vs. 20.4% of total VFA) and decrease the acetate:propionate ratio (2.82 vs. 3.01), whereas for low sucrose diets, FERM tended to decrease propionate concentration (20.9 vs. 21.8% of total VFA) and increase the acetate:propionate ratio (2.80 vs. 2.95). FERM inclusion increased ( $P < 0.01$ ) ruminal ammonia concentration (18.4 vs. 15.7 mg/dl) over the control. These data indicate that Fermenten<sup>®</sup> affects N metabolism in the rumen regardless of dietary sucrose concentration. However, the effect of Fermenten<sup>®</sup> on the ruminal VFA profile is dependent on the concentration of sucrose in the diet.

**Key Words:** Fermentent, Sucrose, Rumen Fermentation

**T308 Influence of encapsulation of ascorbic acid to fermentation by rumen bacteria, in vitro.** J. E. Garrett\*<sup>1</sup>, G. Oenga<sup>1</sup>, A. Tayal<sup>1</sup>, and T. M. Webster<sup>2</sup>, <sup>1</sup>*Balchem Corporation, New Hampton, NY*, <sup>2</sup>*West Virginia University, Morgantown*.

The feeding of ascorbic acid to ruminants has been difficult due to the destructive nature of the rumen bacteria to this easily oxidized compound. The objective of this study was to evaluate the stability of ascorbic acid (AA) to rumen bacterial fermentation in vitro when protected by a lipid encapsulation. Raw ascorbic acid (RAA) was compared with two different encapsulation methods, rumen protected ascorbic acid (RPAA, Vitashure C, Balchem Corporation), and rumen protected ascorbic acid with a high melting point (RPAA-HM, Vitashure 140, Balchem Corporation). Individual samples of each ascorbic acid type were incubated in 50 ml test tubes in triplicate following a modified method of Tilley and Terry (1963) for 30 min, 6 h, 12 h and 24 h. Each tube contained .3 g of equal parts corn and SBM with .01 g of equivalent AA. Blanks were run for naturally occurring AA in the feeds. Each sample was freeze dried after incubation and held for analysis. Blanks and RAA were water extracted to obtain any residual AA. Chloroform was used to dissolve the lipid coating. Distilled water, centrifugation and filtration were used to obtain residual AA from the encapsulated samples. All samples were then immediately analyzed by HPLC for AA. RAA had significantly less ( $P < .05$ ) recovery after 30 min than either RPAA or RPAA-HM (37.3 vs 65.3 and 79.0%, respectively). After 30 min, RAA had 3.05% or less of the initial AA at the other incubation times which was significantly less ( $P < .05$ ) than either encapsulated product. Recovery of AA from RPAA and RPAA-HM was not significantly different ( $P > .05$ ) from each other at the 6, 12 and 24 h incubations, averaging from 43 to 65% recovery. RPAA-HM did have numerically higher recoveries of AA for all time points measured. RAA is extensively degraded by rumen bacteria in less than 6 h. Both encapsulation methods proved to be an effective means of protecting 50% or more of the AA exposed to rumen bacterial fermentation through 24 h.

**Key Words:** Ascorbic Acid, Encapsulation, Rumen Bacteria

**T309 Quantification of *Streptococcus bovis* and *Megasphaera elsdenii* in ruminal fluid of dairy cows and beef heifers by real time PCR technique.** M. Blanch\*, S. Calsamiglia, and A. Castello, *Universitat Autonoma de Barcelona, Spain*.

The objective of this study was to develop quantitative real time PCR (qRT-PCR) assays to: a) detect and quantify two rumen bacteria involved in ruminal acidosis: *Streptococcus bovis* and *Megasphaera elsdenii* (Exp. 1); and b) determine the variability due to animal, day and hour of sampling (Exp. 2). In Exp. 1, the assays were evaluated using DNA from pure cultures and rumen fluid samples from Exp. 2. The efficiency of the real time PCR assay was 88% and 99% for *S. bovis* and *M. elsdenii*, respectively. The specificity of the two primer-probe combinations was confirmed using different bacterial pure cultures as negative controls. In Exp. 2, a comparative study of *S. bovis* and *M. elsdenii* rumen populations was conducted using 4 cows and 4 beef heifers (696 ± 94 and 221 ± 17 kg BW, respectively). Cows were fed a 69:31 forage to concentrate total mixed ration ad libitum (15.6% CP, 35.4% NDF) and 3 kg of concentrate (25.8% CP, 21.7% NDF), and beef heifers were fed a 10:90 forage to concentrate ratio diet (15.7% CP, 22.3% NDF). During 5 consecutive days, samples of ruminal fluid were collected at 0, 4, 8 and 12 h after the morning

feeding. *S. bovis* was 145-fold higher in cows than in heifers. *M. elsdenii* was 13-fold lower in cows than in heifers. The *S. bovis*:*M. elsdenii* ratio was not associated with changes in ruminal pH, because in spite of observing different ratios between heifers and cows (0.83 and 12.3, respectively), their pH was similar (averaged  $6.26 \pm 0.305$ ). The coefficients of variation were large and always higher in heifers than in cows (from 45.2% to 156.7% in heifers, and from 25.0% to 94.8% in cows), and differed depending on the factor. In heifers, the most variable factor was animal, followed by day and hour. In cows, the factor with the highest variation was day, followed by hour and animal. The qRT-PCR may become a powerful tool to study changes in rumen microbial populations associated to dietary treatments.

**Key Words:** Rumen Acidosis, *Streptococcus Bovis*, *Megasphaera Elsdenii*

**T310 The effect of heat stress on rumen microbial composition analyzed by sequence-specific rRNA cleavage method.** Y. Uyeno<sup>\*1,3</sup>, Y. Sekiguchi<sup>1</sup>, K. Tajima<sup>2</sup>, A. Takenaka<sup>2</sup>, M. Kurihara<sup>2</sup>, and Y. Kamagata<sup>1</sup>, <sup>1</sup>National Institute of Advanced Industrial Science and Technology, Tsukuba, Japan, <sup>2</sup>National Institute of Livestock and Grassland Science, Tsukuba, Japan, <sup>3</sup>National Federation of Dairy Co-operative Associations, Tokyo, Japan.

It is recognized that ruminal microbial fermentation characteristics alter in response to the nutritional shift of the animal under heat-stress conditions. We evaluated the changes of the ruminal bacterial community composition in cows under heat-stress conditions by applying an RNA-based method (sequence-specific small-subunit rRNA cleavage method), which was optimized for the comprehensive description of predominant bacterial groups inhabiting the rumen. The same four Holstein cows were subjected to two separate experiments with the different age and relative humidity (RH) (Experiment 1, nine months, 80% RH; Experiment 2, 15 months, 60% RH). In each experiment, the cows were kept under three temperatures (20°C, 28°C, 33°C) in a climatic chamber for two weeks each. The cattle were offered a mixed ration (45% Italian ryegrass hay silage, 5% alfalfa hay cube, and 50% concentrate) twice a day. Rumen fluid samples were used for total RNA extraction. For quantitative detection, we applied a set of 15 oligonucleotide probes including those which targeted clusters comprised of uncultured rumen bacteria (URB) belonging to the low-GC Gram-positive bacteria phylum. The total amount of 16S rRNAs of those targeted groups accounted for 93% max of the total bacterial 16S rRNAs. The *E. rectale* - *C. coccoides* group and the genus *Streptococcus* increased, and the genus *Fibrobacter* decreased in response to increasing temperature. In addition, the population of one defined URB cluster was higher at 33°C compared to 20°C, whereas one of the other URB clusters decreased with the temperature rise. These results indicate that exposure to a hot temperature can affect the composition of the ruminal microbial community and that uncultured rumen bacteria play a critical role in ruminal fermentation which can respond to temperature change.

**Key Words:** Rumen Microbial Community, Heat-Stress, 16S rRNA

**T311 Application of carbohydrase inhibitors to moderate rumen fermentation: Continuous culture evaluation.** S. M. Speight<sup>\*1</sup>, D.

L. Harmon<sup>1</sup>, and J. M. Tricarico<sup>2</sup>, <sup>1</sup>University of Kentucky, Lexington, <sup>2</sup>Alltech Biotechnology, Nicholasville, KY.

While carbohydrase inhibitors have been widely investigated for regulating human carbohydrate assimilation, their application to animal nutrition has been ignored. Two continuous culture experiments were conducted to determine how microbial-derived  $\alpha$ -amylase and  $\alpha$ -glucosidase inhibitors affect rumen fermentation. Rumen fluid from two mature Holstein steers ( $1045 \pm 8.0$  kg BW) fed a 50% concentrate, 50% forage diet was strained, mixed, and loaded into 1-l single-flow continuous culture fermenters. McDougall's buffer was continuously infused via a peristaltic pump (60 mL/h). Treatments in Exp. 1 consisted of: no additive, 88 mg and 166 mg acarbose/d. Treatments in Exp. 2 consisted of: no additive, 4 mg, 8 mg, and 12 mg trestatin/d. Treatments were added to a purified diet (90% corn starch, 10% casein salt) that was fed to each vessel twice daily. Each experiment consisted of a 3-d adaptation period followed by a 3-d sampling period. Ammonia, VFA, and pH were measured twice daily. Effluent outflow was collected daily and frozen for subsequent lab analyses. Acarbose and trestatin linearly increased ( $P \leq 0.02$ ) pH and ammonia concentrations. Lactate decreased linearly ( $P = 0.02$ ) with acarbose but was unaffected by trestatin. Acarbose did not affect acetate or propionate but did quadratically decrease ( $P < 0.05$ ) butyrate, valerate and tended ( $P = 0.09$ ) to linearly decrease total VFA concentrations. Acarbose quadratically increased ( $P = 0.03$ ) the molar proportions of acetate and tended to decrease ( $P = 0.06$ ) the molar proportions of propionate. Trestatin linearly decreased ( $P = 0.03$ ) valerate concentrations and increased the molar proportion of acetate (linear;  $P = 0.02$ ). Starch disappearance and effluent N decreased linearly ( $P \leq 0.05$ ) with both treatments. Acarbose increased (linear;  $P = 0.03$ ) effluent energy (kcal/d) whereas trestatin decreased effluent energy (linear;  $P = 0.05$ ). Carbohydrase inhibitors can modify fermentation in a dose dependent manner. They may offer the potential to either moderate the rate of fermentation and/or shift digestion to the small intestine.

**Key Words:** Carbohydrase Inhibitors, Rumen Fermentation Modulators, Continuous Culture

**T312 Efficacy of *Prevotella bryantii* 25A and a mixture of *Enterococcus faecium* and *Saccharomyces cerevisiae* to control sub-clinical acidosis in dairy cows.** J. Chiquette<sup>\*1</sup>, M. J. Allison<sup>2</sup>, and M. A. Rasmussen<sup>3</sup>, <sup>1</sup>Dairy and Swine Research and Development Centre, Lennoxville, Quebec, Canada, <sup>2</sup>Iowa State University, Ames, <sup>3</sup>SarTec Corporation, Anoka, MN.

The objectives of this study were 1) to evaluate *Prevotella bryantii* strain 25A (P) and a mixture of *Enterococcus faecium* and *Saccharomyces cerevisiae* (ES) as probiotics to sustain higher ruminal pH; 2) to study their effect on animal feed intake, milk production and composition, in dairy cows submitted to a sub-acute rumen acidosis (SARA) challenge. Six ruminally-fistulated Holstein dairy cows in mid-lactation were equally distributed between the following treatments, in a replicated  $3 \times 3$  Latin square design: 1) Control (C), animals were fed a total mixed ration (TMR); 2) TMR + 2g/head/day of ES ( $5 \times 10^9$  CFU); 3) TMR + 25 ml/head/day of P ( $2 \times 10^{11}$  cells/dose). The Latin square consisted of 3 weeks (wks) of adaptation, 4 days during which a specific feeding procedure was used to induce SARA and 10 resting days during which the animals were back to the control TMR with no probiotic supplementation. Rumen pH was recorded every 10 min over a

24h-period during each of the three wks of adaptation and during the wk of resting and continuously during the 4 days of SARA. All pH parameters averaged over treatments were different when comparing adaptation wks and challenge wks ( $P < 0.001$ ). ES tended ( $P < 0.10$ ) to increase median pH values obtained during 24h periods (5.6 vs 5.4, for ES and control, respectively). Maximum pH recorded during 24-h periods tended ( $P < 0.06$ ) to be higher when animals received ES than when they were controls (6.6 vs 6.3). Percentage of time during which rumen pH was below the threshold of 5.2 and 5.6 was numerically less with ES than with C (22 vs 35% of time below 5.2 and 46 vs 62% of time below 5.6, with ES and C, respectively). There was no effect of probiotics on dry matter intake. Milk production and composition were not affected by treatments. Treatment P increased ( $P < 0.05$ ) ammonia concentration compared to C during the first day of challenge. Results from this study indicate that ES tended to sustain higher ruminal conditions when animals were induced with SARA, further research is needed to confirm its efficacy in the prevention of SARA.

**Key Words:** Sub-Acute Ruminal Acidosis, Probiotics, Dairy Cows

**T313 Differential effects of supplying reductant as hydrogen, formate or a combination of these on the methane-inhibiting activity of select nitrocompounds in vitro.** N. A. Kruegar\*, R. C. Anderson, T. R. Callaway, T. S. Edrington, R. B. Harvey, and D. J. Nisbet, *USDA/ARS, Food & Feed Safety Research Unit, College Station, TX.*

Short chain nitrocompounds markedly inhibit ruminal methane ( $\text{CH}_4$ ) production, a digestive inefficiency resulting in losses of up to 12% of gross energy intake, but little is known regarding their mechanism of activity. Here, we report the effects of supplying reductant as  $\text{H}_2$ , formate or both (60  $\mu\text{mol/ml}$  ruminal fluid each) on  $\text{H}_2$  and  $\text{CH}_4$  accumulation during 24 h incubation (39°C) of ruminal fluid with or without 12 mM 2-nitro-1-propanol, 3-nitro-1-propionic acid, nitroethanol or nitroethane in vitro ( $n=3$ ). Reductants were supplied as sodium formate or  $\text{H}_2:\text{CO}_2$  (80:20); cultures without added  $\text{H}_2$  were incubated with 100%  $\text{CO}_2$ . Analysis of variance revealed main effects ( $P < 0.0001$ ) of nitrocompound, reductant and their interaction on both  $\text{H}_2$  and  $\text{CH}_4$  accumulation. When reductant was supplied as formate, all nitrocompounds reduced ( $P < 0.05$ )  $\text{CH}_4$  production >99% from that produced by controls incubated with formate alone (13.55 $\pm$ 0.9  $\mu\text{mol/ml}$ ). Accumulation of  $\text{H}_2$  did not differ between any of the incubations containing reductant as added formate alone and averaged 1.07 $\pm$ 0.6  $\mu\text{mol/ml}$ . This suggests that the nitrocompounds markedly inhibited methanogenic oxidation of formate and likely inhibited its catabolism to  $\text{H}_2$  by other bacteria as well. Conversely, nitro-supplementation decreased ( $P < 0.05$ )  $\text{CH}_4$  production 58 to 97% from that of controls containing no added nitrocompound (11.62 $\pm$ 0.9 and 8.43 $\pm$ 1.3  $\mu\text{mol/ml}$ , respectively) when reductant was supplied as  $\text{H}_2$  or  $\text{H}_2$  plus added formate. In this case, however, nitro-supplementation increased ( $P < 0.05$ )  $\text{H}_2$  accumulations >77 to 98% higher than that in non-nitrocompound containing controls (1.66 $\pm$ 1.6 and 0.23 $\pm$ 0.1  $\mu\text{mol/ml}$ , respectively). These results show that nitro-supplementation more effectively reduced  $\text{CH}_4$  production in non-adapted ruminal populations when reductant was supplied as formate rather than  $\text{H}_2$  and in both cases inhibited the ability of methanogens to oxidize these reductants.

**Key Words:** Methane, Nitrocompound, Rumen

**T314 Effect of level of dietary malic acid supplementation on rumen methanogenesis and fermentation in beef cattle.** P. Foley, J. Callan, D. Kenny\*, T. Boland, and F. O'Mara, *University College Dublin, Dublin, Ireland.*

The objective of this study was to determine the effect of level of dietary malic acid (MA) on rumen methanogenesis and fermentation in beef cattle. Two Latin square designed experiments took place. In experiment 1 (Exp1) 6 heifers were assigned to one of 3 levels (0%, 3.75%, and 7.5% DMI) of MA inclusion over 3 periods. In experiment 2 (Exp2) 4 fistulated steers were assigned to 1 of 4 levels of MA (0%, 2.5%, 5.0% and 7.5% DMI) over 4 periods, diets consisted of 40:60 Forage:Concentrate ratio with grass silage as the forage. Experimental periods consisted of 28 d, incorporating a 13 d acclimatization period, followed by a 5 d period for Exp1 during which methane ( $\text{CH}_4$ ) output was measured using the SF6 tracer gas technique and digestibility was measured by use of the chromic oxide tracer technique dosing twice daily before each feed with 1g  $\text{Cr}_2\text{O}_3$ , followed by a 10 d rest period. Faeces sub samples were collected from d 16 to 18, dried and analysed for chromium. In Exp2 rumen fluid (RF) was collected from the reticulum area, on d 16 to 18, immediately prior to feeding then 2, 4, 6 & 8 hours post feeding. pH was immediately determined and samples taken for protozoa count, VFA and  $\text{NH}_3$  analysis. DMI was recorded daily for both experiments. The dietary inclusion of MA led to a linear reduction ( $P < 0.05$ ) in DMI and in total daily  $\text{CH}_4$  emissions. The highest level of MA led to a 9% reduction ( $P < 0.05$ ) in  $\text{CH}_4$  emissions per kg DMI when compared to the control diet. There was no effect on ruminal concentrations of VFA with the exception of a tendency towards an decrease in acetate and butyrate with increasing dietary MA. There was a tendency towards lower  $\text{NH}_3$  with decreasing dietary MA ( $P=0.05$ ). Rumen pH was lower ( $P < 0.05$ ) on 5 and 7.5% MA compared with either 0 or 2.5%. However there was no difference between any other treatment comparisons in pH ( $P > 0.05$ ). Protozoal numbers were higher ( $P < 0.05$ ) on 0% MA compared with either 5 or 7.5% MA. Results suggest scope for MA to reduce  $\text{CH}_4$  emissions however advantages may be negated by depressed DMI.

**T315 Usefulness of infrared imaging as a predictor of heat loss and methane production in dairy cows.** Y. R. Montanholi\*, N. E. Odongo, K. C. Swanson, F. S. Schenkel, B. W. McBride, and S. P. Miller, *University of Guelph, Guelph, Ontario, Canada.*

Infrared images (IRI) have proved useful for the assessment of certain phenomena such as the detection of inflammatory illnesses and prediction of meat quality. Conversely, it is less clear if IRI could be used to predict feed efficiency or to assess dietary effects. Herein, relationships among IRI, heat loss (HE) and methane production (CH) were investigated. Four lactating Holstein dairy cows (live weight: 609 + 60.0 kg; milk yield: 27 + 5.1 kg/d; days in milk: 92.5 + 2.6) housed in a tie-stall facility were fed a total mixed ration (TMR) with a forage:concentrate of 60:40 and  $\text{NE}_L$  of 1.55 Mcal/kg. Cows were allocated to 1 of 2 treatments: TMR plus a control placebo premix (CO) or TMR plus monensin premix (24 mg/kg DM) (MO) offered for ad libitum intake. Each pair of cows (one from each treatment) was monitored 1 day/month (from 09:00 a.m. to 3:30 p.m.) for 6 months. On the sampling days, IRI from the left and right flank (LFK and RFK) and from the rear area (RAR) of the cows were taken every 20 minutes. As well, CH and oxygen consumption were simultaneously monitored around the timing of each set of IRI using an indirect calorimetry unit with two ventilated head-hoods. The oxygen consumption was later

used to calculate heat loss (HE). Heat loss was correlated with LFK and RFK temperatures ( $r = 0.25$  and  $0.16$ ;  $P < 0.01$ ) but not with RAR temperature ( $r = 0.09$ ;  $P < 0.10$ ) across treatments. Within treatment the correlation between HE and CH was higher in the CO vs. MO ( $r = 0.50$  vs.  $0.17$ ;  $P < 0.01$ ). HE and CH were more closely associated with RFK and LFK temperatures in CO than in MO-treated cows (HE:  $r = 0.43$  and  $0.30$  vs.  $0.13$  and  $0.12$ ; CH:  $r = 0.45$  and  $0.42$  vs.  $0.29$  and  $0.28$ ;  $P < 0.01$ ). Correlations among IRI and HE and CH observed within days and treatments were not uniform. Infrared images may be useful in the assessment of heat losses, methane production and dietary treatment effects but further investigations are warranted.

**Key Words:** Feed Efficiency, Greenhouse Gas Emissions, Monensin

**T316 Profiling energy substrate metabolism in isolated rumen epithelial and duodenal mucosal cells from beef cattle.** S. W. El-Kadi<sup>1</sup>\*, R. L. Baldwin<sup>2</sup>, K. R. McLeod<sup>3</sup>, N. E. Sunny<sup>1</sup>, S. L. Owens<sup>1</sup>, and B. J. Bequette<sup>1</sup>, <sup>1</sup>University of Maryland, College Park, <sup>2</sup>USDA-ARS, Beltsville, MD, <sup>3</sup>University of Kentucky, Lexington.

The aim of this study was to determine the relative contribution of substrates to Krebs cycle metabolism by rumen epithelial (REC) and duodenal mucosal (DMC) cells. Another aim was to determine the influence of diet type on the selection and metabolism of substrates. Two groups of Angus bulls ( $n = 6$ /group) were fed either a 75% Orchardgrass silage (HF) or a 75% concentrate mix (HC) diet for 4 w prior to slaughter. Isolated REC and DMC were incubated in media containing all amino acids, and [ $U$ - $^{13}C$ ] labeled forms of either glucose, glutamate (GLU), glutamine (GLN), leucine (LEU) or valine (VAL) at four levels. There was a diet  $\times$  tissue effect on glucose metabolism ( $P < 0.001$ ). For REC, glucose contributed 12% of lactate synthesis in cattle fed the HF diet, compared to 25% in cattle fed the HC diet. Although 25% of lactate synthesis by DMC derived from glucose, diet had no effect and no glucose carbon contributed to Krebs metabolism. There was a diet  $\times$  tissue effect ( $P < 0.01$ ) on LEU metabolism. LEU contributed 45% to ketoisocaproate synthesis in REC from cattle fed the HC diet but only 35% in REC from the HF group and 35% in DMC from the HC and HF groups. VAL contribution to ketoisovalerate synthesis was greater ( $P < 0.001$ ) in REC (58%) compared to DMC (40%), irrespective of diet ( $P = 0.13$ ). For both LEU and VAL, there was no contribution to Krebs metabolism. There was a diet  $\times$  tissue  $\times$  level effect on GLU metabolism ( $P < 0.01$ ); its metabolism to  $\alpha$ -ketoglutarate was greater in REC from the HC compared to the HF group, whereas GLU metabolism to  $\alpha$ -ketoglutarate was lower for DMC from the HC compared to the HF group. The contribution of GLU to  $\alpha$ -ketoglutarate flux ranged from 3% to 63% whereas that of GLN did not exceed 3%. The results indicate that glucose is partially metabolized by isolated REC and DMC, but only to lactate. And, although GLU is a significant contributor to REC and DMC Krebs cycle flux, there is limited catabolism of GLN by these isolated cells for entry into the Krebs cycle.

**Key Words:** Gastrointestinal, Amino Acids, Glucose

**T317 Rumen wall morphology and the change in bovine rumen absorptive capacity induced by varying digesta volume and pH.** L. Q. Melo, F. Lopes, M. N. Pereira\*, M. C. Guerreiro, S. F. Costa, and J. C. Resende Júnior, Universidade Federal de Lavras.

Effects of digesta volume and pH on VFA absorption, and its correlation with rumen wall morphology, were evaluated. Nine fistulated cows formed three conditions. C1 had Holsteins, yielding 25.9 kg/d, and fed on a high grain TMR. C2 had Holstein-Zebu crossbreds, yielding 12.3 kg/d, and fed on corn silage, tropical pasture and concentrate. C3 had non-lactating, grazing Jerseys. The aim was to obtain disparity in rumen morphology. Within each condition, a sequence of three treatments was applied in 3x3 Latin Squares, with seven-day periods: High Volume, High pH (HVHP); Low Volume, High pH (LVHP); and Low Volume, Low pH (LVLP). High Volume was obtained by putting back the whole evacuated rumen digesta (59.5 kg), and Low Volume by returning only 25 kg. Low pH was obtained with a 50%  $H_2SO_4$  solution, capable of decreasing rumen pH to 5 (170 ml, on average). Rumen wall was biopsied on day 1 of period 1. Morphometrics involved four macroscopic and four microscopic variables. Rumen VFA absorption was estimated by the Valerate-CrEDTA technique. Digesta with markers was returned after closing the reticulum-omasum orifice with a sponge. The exponential decay rate in rumen valerate to Cr ratio ( $k$  Val/Cr) was estimated with digesta samples obtained every 20-minute for 4 hours. There was strong rumen morphology variability among the groups of cows. Well fed Holsteins had increased rumen wall absorptive surface area and basal cells mitotic index, and decreased thickness of the epithelium and of the keratin layer. Mean rumen pH throughout the four hour sampling period were: 6.78 for HVHP, 7.08 for LVHP and 5.90 for LVLP ( $P < 0.01$ ). The  $k$  Val/Cr values for treatments HVHP, LVHP and LVLP were, respectively ( $\%h^{-1}$ ): -19.6, -23.9 and -35.0 ( $SEM=2.01$ ;  $P=0.21$  for contrast HVHP vs. LVHP and  $<0.01$  for contrast LVHP vs. LVLP). Rumen valerate clearance by absorption was faster in low pH, while decreasing digesta volume did not elicit such a response. The correlation between the absorptive surface area per  $cm^2$  of rumen wall, and the mean of the three  $k$  Val/Cr values of each cow, was -0.90 ( $P < 0.01$ ).

Funded by Fapemig and Capes

**Key Words:** Rumen Epithelium, Volatile Fatty Acids, Dairy Cows

**T318 Morphophysiologic evaluation of absorption and metabolism of volatile fatty acids by bovine forestomach.** J. L. P. Daniel and J. C. Resende Júnior\*, Universidade Federal de Lavras, Lavras, MG, Brazil.

The absorptive surface of the reticulum-rumen ( $7.7m^2$ ) is higher than that of the omasum ( $2.1m^2$ ), however, the absorption potential of each compartment is not known. The purpose of this study was to compare, *in vitro*, the VFA absorption and metabolism capacity of the rumen and omasum. After the slaughter, fragments of the rumen wall and omasum laminae were taken from eight adult cross-breed bovines. The fragments were dissected and an isolated fragment of the mucosa was fit in a tissue diffusion chamber. 25mM of valeric acid and 1mM of Cr-EDTA was added to the ruminal fluid and placed on the mucosal side (pH=6.8) and Krebs-Ringer bicarbonate buffer on the serosal side (pH=7.4). The fractional absorption rates were measured by the exponential decay rate of the VFA:Cr. The percentage of metabolized acid was determined by the difference between VFA concentration on mucosal and serosal sides. The absorption surface of the rumen fragment ( $57.6cm^2$ ) was higher ( $P < 0.001$ ) than that of the omasum ( $2.5cm^2$ ), because of the ruminal papillae. The fractional absorption rate was higher ( $P < 0.001$ ) in the omasum ( $9.1\% \cdot h^{-1} \cdot cm^{-2}$ ) than in the rumen ( $0.4\% \cdot h^{-1} \cdot cm^{-2}$ ). When the total area was considered the



absorption potential of the omasum was higher ( $P < 0.001$ ) than the rumen. The percentage of metabolized acetate (10.9%) was lower than propionate (31.1%) which was lower than butyrate (39.8%) and valerate (42.6%). When the mucosae areas were considered, there was an interaction ( $P < 0.001$ ) between the percentage of metabolized VFA and the forestomach compartments. In the rumen, the percentage of metabolized VFA was similar ( $0.68\% \cdot \text{cm}^{-2}$ ), but in the omasum, the valerate ( $15.5\% \cdot \text{cm}^{-2}$ ) was more metabolized than butyrate ( $14.6\% \cdot \text{cm}^{-2}$ ) which was higher than propionate ( $11.58\% \cdot \text{cm}^{-2}$ ) and acetate ( $4.33\% \cdot \text{cm}^{-2}$ ). The estimated metabolism considering the total area was higher ( $P < 0.001$ ) in the omasum than in the rumen. The VFA absorption potential of the omasum is higher than that of the rumen and this could explain, at least partially, the higher VFA metabolism rate found in the omasum wall.

**Key Words:** Rumen, Omasum

**T319 Evaluation of procedures for isolation of ruminant enterocytes.** P. R. Regmi\*, W. T. Dixon, and M. Oba, *University of Alberta, Edmonton, AB, Canada.*

The objective of this study was to evaluate the procedures for isolation of ruminant duodenal mucosal cells (DMC) to be used for *in vitro* studies. Duodenal segments were obtained from a local abattoir immediately after slaughter. The DMC were isolated using three different procedures previously used for sheep (procedure A), pig (procedure B) and cow (procedure C). In the procedure A, the mucosal scrapings collected from the duodenal segment were incubated at  $37^{\circ}\text{C}$  for 20 minutes in a solution containing collagenase, dispase, and  $\text{CaCl}_2$ . In the procedure B, the duodenal segment was filled with Krebs Henseleit buffer containing EDTA without enzymes, and incubated at  $37^{\circ}\text{C}$  for 50 minutes. In the procedure C, the duodenal segment filled with Krebs-Ringer HEPES buffer (KRB-HEPES) containing bovine serum albumin (BSA) was incubated at  $37^{\circ}\text{C}$  for 15 minutes and after discarding the buffer, it was again filled with KRB-HEPES containing hyaluronidase and BSA for 2 minutes to isolate the DMC. The total viable cells per isolation from 50 cm long duodenal segment were significantly higher ( $P < 0.05$ ) for the procedure C ( $1.85 \times 10^9 \pm 0.04 \times 10^9$ ) compared to the procedures A ( $1.66 \times 10^9 \pm 0.04 \times 10^9$ ) and B ( $1.58 \times 10^9 \pm 0.07 \times 10^9$ ). The cell viability immediately after isolation were significantly lower ( $P < 0.05$ ) for the procedure B ( $78.7 \pm 1.8\%$ ) compared to the procedures A ( $85.5 \pm 0.8\%$ ) and C ( $88.5 \pm 1.7\%$ ) and the cell viability after 6 hours was  $84.0 \pm 0.7$ ,  $75.0 \pm 1.7$  and  $86.0 \pm 1.7\%$ , respectively for procedures A, B and C. These observations indicate that all the procedures can isolate sufficient viable ruminant DMC for *in vitro* studies, however the number of viable DMC 6 hours after isolation was highest for the procedure using KRB-HEPES containing hyaluronidase.

**Key Words:** Ruminants, Duodenal Mucosal Cells, Cell isolation

**T320 Ruminant, but not abomasal, infusion of starch differentially increases expression of concentrative nucleoside transporter (CNT) mRNA by small intestinal (SI) epithelia of forage-fed beef steers.** S. F. Liao\*, M. J. Alman, E. S. Vanzant, E. D. Miles, D. L. Harmon, K. R. McLeod, J. A. Boling, and J. C. Matthews, *University of Kentucky, Lexington, KY, USA.*

This experiment was conducted to determine if expression of SI concentrative nucleoside transport proteins (CNT1, 2, 3) are responsive to luminal supply of rumen-derived bacteria (hence, nucleic acid substrate), energy, or both. Eighteen ruminally and abomasally catheterized Angus steers (BW $\sim$ 250 kg) were assigned (n=6) to either water (control) or ruminally or abomasally corn starch ( $\alpha$ -amylase hydrolysate, at 20% of ME intake) infusion treatments and fed an alfalfa-cube diet at  $1.5 \times \text{NE}_m$  requirement. After a 14 to 17-d infusion period, steers were killed and duodenal (D), jejunal (J), and ileal (I) epithelia were harvested for total RNA extraction. Real-time PCR analyses were conducted to quantify the relative RNA (CNT:18S) expression of CNT1, CNT2, and CNT3 mRNA. Within control steers (n=6), 1.2- and 2.5-fold more ( $P < 0.02$ ) CNT1 was expressed by J than by D or I, respectively. For both CNT2 and CNT3, more ( $P < 0.01$ ) mRNA was expressed by D (9.8- and 1.9-fold) and J (11.4- and 3.1-fold) than by I, respectively. Within a tissue site, the expression of CNT1 or CNT2 mRNA was not affected by infusion treatments, but CNT3 mRNA expression by D (0.65- and 0.69-fold) and I (2.3- and 1.1-fold) of the ruminally starch-infused steers was greater ( $P < 0.04$ ) than by the water- or abomasally starch-infused steers, respectively. These results indicate that these known CNT mRNA are expressed throughout SI epithelia and that CNT3 mRNA expression by D and I epithelia likely is upregulated in the presence of increased nucleoside supply, but not of increased luminal energy (starch) supply.

**Key Words:** Bovine, Regulated gene expression, SLC28

**T321 Effect of hybrid (high starch content vs. high NDF digestibility) and maturity of corn silage on dairy cow performance.** R.L.G. Zom\*<sup>1</sup>, H.A. van Schooten<sup>1</sup>, and H. van Laar<sup>2</sup>, <sup>1</sup>*ASG Wageningen University & Research Centre, Lelystad, Netherlands,* <sup>2</sup>*Nutreco Ruminant Research Centre, Boxmeer, Netherlands.*

A  $2 \times 2$  factorial designed experiment was conducted to evaluate the effects of hybrid (S: high starch content vs. F: high NDF digestibility) and maturity (30 vs. 36% DM) of corn silage on *in situ* degradation and dairy cow performance. Seventy-two HF cows were assigned to four silage treatments and individually fed. Mixtures containing one of the corn silages, haylage and soy bean meal (70:18:12 DM basis) were offered *ad libitum*. Additionally, each cow received 7 kg/d of concentrate. Intake, milk yield and milk composition were analyzed for wk 1 until wk 15 of lactation. The treatment period was from wk 5 to wk 15 of lactation. Pre-treatment data (wk 1 to 4) were used as covariates. In addition, fresh silage samples were ruminally incubated to determine the rate and extent of starch and NDF degradation. Maturity increased starch content and proportion of rumen by-pass starch. Proportion of rumen by-pass starch in hybrid S was 33% and 54% for 30 and 36% DM, respectively, and in hybrid F 23% and 33%. NDF content was higher for hybrid F than for S. All silages had similar NDF degradation characteristics. Despite corn hybrids were from different selection traits, within maturity, starch content was similar. Maturity decreased NDF intake (8.5 vs. 8.2 kg/d;  $p < 0.05$ ) and increased starch intake (4.4 vs. 5.0 kg/d;  $p < 0.001$ ). Maturity had no effect on yields of milk and milk components. Hybrid S increased the intakes of NEL (158 vs. 164 MJ/d;  $p < 0.05$ ), starch (4.6 vs. 4.9 kg/d;  $p < 0.05$ ) and DM (23.1 vs. 23.9 kg/d;  $p < 0.1$ ). Hybrid S improved the yields of milk (39.6 vs. 37.9 kg/d;  $p < 0.05$ ), protein (1.28 vs. 1.21 kg/d;  $p < 0.01$ ) and lactose (1.86 vs. 1.78 kg/d;  $p < 0.01$ ) compared to hybrid F. Observed differences may be associated with a more efficient energy utilization due to a shift in starch digestion from the rumen

to the intestine for hybrid S as indicated by the higher proportion of by-pass starch.

**Key Words:** Corn Silage, Starch, NDF

**T322 Effects of a bacterial inoculant on fermentation, nutritive quality and degradability of corn, soybean and combined corn-soybean silages.** L. O. Abdelhadi\*<sup>1</sup> and J. M. Tricarico<sup>2</sup>, <sup>1</sup>*Est. El Encuentro, Research & Extension in Ruminant Nutrition, Cnel. Brandsen, Argentina*, <sup>2</sup>*Alltech Inc., Nicholasville, KY*.

A randomized complete block design with a 2x3 factorial treatment arrangement was used to evaluate the effects of a bacterial inoculant (Sil-All<sup>®</sup>, Alltech Inc., Nicholasville, KY) on fermentation, nutrient composition and OM degradability (OMD) of ensiled corn (DK682RR, Dekalb, Colon, Argentina), soybean (DM4800, Don Mario, Chacabuco, Argentina) and the corn-soybean combination (56% corn and 44% soybean, DM basis). Inoculation (0 or 5 g/ton fresh matter) and ensiled crop (corn, soybean or combination) were the factors examined. All crops were fine chopped (9 mm) and ensiled in polyethylene bags (70m long x 2.75m diameter) using a forage inlay machine. Bacterial inoculation was randomly assigned to each crop or crop combination within a bag and applied directly with the chop harvester applicator. Composite samples (9 sub-samples) were collected for each treatment combination in each block before and after ensiling for 60 d. Samples were analyzed for DM, OM, CP, NDF, WSC, starch, EE and OMD after incubation with ruminal fluid for 3, 6, 12, 24, 48 and 72h. True protein, pH and NH<sub>3</sub>-N were also determined on silage samples. Digestible DM yield (tons/ha) before ensiling was similar for corn (13.7) and the combination (12.3) and lower ( $P<.05$ ) for soybean (5.7). As expected, nutrient composition for the crop combination was intermediate between corn and soybean both before and after ensiling. No interactions (inoculation x crop) for nutrient composition, fermentation or OMD were detected. Silage pH was lower ( $P<.05$ ) for corn (3.90), intermediate for the combination (4.17) and greater for soybean (4.84). Inoculation increased ( $P<.05$ ) true protein (60.5 vs. 54.4 %CP) and WSC (8.47 vs. 6.08 %DM) concentrations and the total amount of digestible OM (66.7 vs. 61.2 %OM) across all silages without changing the rate of OMD. We conclude that ensiling corn and soybean in combination provides a single feedstuff with intermediate nutrient composition without negatively affecting yield or total nutrient supply to the ruminant. In addition, bacterial inoculation improved silage nutritive quality across all crops.

**Key Words:** Corn Silage, Soybean Silage, Inoculant

**T323 Effects of a bacterial inoculant on fermentation, nutritive quality and degradability of combined corn-soybean silages in different geographical regions across Argentina.** L. O. Abdelhadi\*<sup>1</sup> and J. M. Tricarico<sup>2</sup>, <sup>1</sup>*Est. El Encuentro, Research and Extension in Ruminant Nutrition, Cnel. Brandsen, Argentina*, <sup>2</sup>*Alltech Inc., Nicholasville, KY*.

A randomized complete block design with a 2x5 factorial treatment arrangement was used to evaluate the effects of a bacterial inoculant (Sil-All<sup>®</sup>, Alltech Inc., Nicholasville, KY) on fermentation, nutrient composition and OM degradability (OMD) of corn (DK684RR2,

Dekalb, Colon, Argentina) and soybeans (Groups 5.5 grain varieties) ensiled in combination. Bacterial inoculation (0 or 7.5 g/ton fresh material) and geographical-climatological location (Castelli, Jesús María, Pehuajó, Río Cuarto, Tucumán) were the two factors examined. The corn-soybean combination was harvested at each location when corn was at half milk line of grain maturity and soybean was at R6 stage of growth (full seed). Crops were chopped together at harvest (30±1.5% soybean inclusion on a DM basis in all silages) and ensiled in polyethylene bags (70 m long x 2.75 m diameter) using a forage inlay machine. Bacterial inoculation was randomly assigned within each block and applied directly with the chop harvester applicator. Composite samples (9 sub-samples) were collected for each treatment in each block before and after ensiling for 60 d. Samples were analyzed for DM, OM, CP, NDF, WSC, starch, true protein and OMD after incubation with ruminal fluid for 3, 6, 12, 24, 48 and 72h, and pH was also determined on silage samples. As expected, geographical location had a dramatic influence on digestible DM yield, nutrient composition and OMD of the combined crop before ensiling. No interactions (location x inoculation) were detected for fermentation, nutrient composition or OMD. Inoculation had no effects on pH, DM, OM, NDF, or ADF concentrations, but increased ( $P<.05$ ) CP (9.8 vs. 9.1 %DM), true protein (49.7 vs. 47 %CP) and starch (17.2 vs. 15.1 %DM) concentrations and the total amount of digestible OM (71.4 vs. 66.7 %OM) across all locations without changing the rate of OM digestion. We conclude that bacterial inoculation improved silage nutritive quality and OM digestibility of the corn-soybean combination across all geographical locations.

**Key Words:** Corn Silage, Soybean Silage, Inoculant

**T324 Effects of a bacterial inoculant on fermentation, nutritive quality and degradability of different sorghum silage hybrids.** L. O. Abdelhadi\*<sup>1</sup> and J. M. Tricarico<sup>2</sup>, <sup>1</sup>*Est. El Encuentro, Research and Extension in Ruminant Nutrition, Cnel. Brandsen, Argentina*, <sup>2</sup>*Alltech Inc., Nicholasville, KY*.

Two studies were conducted on consecutive years (2005 and 2006) to evaluate the effects of a bacterial inoculant (Sil-All<sup>®</sup>, Alltech Inc., Nicholasville, KY) on silage fermentation, nutrient composition and OM degradability (OMD) of different sorghum hybrids. Four hybrids (ABMR = sweet brown mid rib sorghum, FBMR = forage brown mid rib sorghum, GRAN = grain sorghum, SUDG = sudangrass sorghum) were ensiled in 2005 and five hybrids (idem 2005 plus SGRA = high grain sudangrass sorghum) in 2006. A randomized complete block design with a factorial treatment arrangement was used in each study. Bacterial inoculation (0 or 5 g/ton fresh material) and sorghum hybrid were the two factors examined. Data were analyzed separately for each year. Sorghum was harvested at early dough stage of grain maturity, fine chopped (9 mm) and ensiled in polyethylene bags (70 m long x 2.75 m diameter). Bacterial inoculation was randomly assigned within each block and applied directly with the chop harvester applicator. Composite samples (9 sub-samples) were collected for each inoculation x hybrid combination in each block before and after ensiling for 60 d. Samples were analyzed for DM, OM, CP, NDF, WSC, starch, true protein and OMD after incubation with ruminal fluid for 3, 6, 12, 24, 48 and 72h, pH and NH<sub>3</sub>-N were also determined on silage samples. As expected, hybrid had a dramatic influence on nutrient composition and OMD in both studies. Inoculation had no effects on nutrient composition or OMD in 2005. Inoculation increased ( $P<.05$ ) the concentrations of DM, NDF and the rate of OMD in 2006. The hybrid

x inoculation interaction was significant for starch and pH. Inoculation reduced ( $P < .05$ ) starch concentration on high grain hybrids but not on low grain hybrids. Inoculation decreased ( $P < .05$ ) pH in all hybrids except ABMR and SGRA. We conclude that bacterial inoculation effects were inconsistent across studies but improved silage fermentation and the rate of OM digestibility in 2006.

**Key Words:** Sorghum Silage, Sorghum Hybrids, Inoculant

**T325 Effect of alfalfa silage storage structure and roasting corn on production and ruminal metabolism of lactating dairy cows.** S. J. Krizsan<sup>\*1</sup>, G. A. Broderick<sup>2</sup>, R. E. Muck<sup>2</sup>, C. Promkot<sup>3</sup>, S. Colombini<sup>4</sup>, and A. T. Randby<sup>1</sup>, <sup>1</sup>Norwegian University of Life Sciences, Ås, Norway, <sup>2</sup>US Dairy Forage Research Center, Madison, WI, <sup>3</sup>Khon Kaen University, Khon Kaen, Thailand, <sup>4</sup>University of Milano, Milano, Italy.

The objective of this study was to determine if feeding roasted corn as the principal concentrate source would improve production and nutrient utilization when supplemented to lactating cows fed one of 3 different alfalfa silages (AS). Forty-two lactating Holstein cows (6 fitted with ruminal cannulas) averaging 77 DIM and producing 43 kg milk/d pretrial were assigned to 2 cyclic change-over designs. Treatments were AS, ensiled in bag, bunker, or O<sub>2</sub>-limiting tower silo supplemented with ground shelled corn (GSC) or roasted GSC (RGSC). Experimental diets contained 40% AS, 15% corn silage and 35% of either GSC or RGSC on DM basis. No significant interactions between AS and corn sources were detected for any production trait. Although chemical composition of the 3 AS was similar, feeding AS from the O<sub>2</sub>-limiting tower silo elicited positive production responses ( $P < 0.01$ ). Yields of 3.5% FCM and fat were increased 1.7 kg/d and 150 g/d, and milk fat content was increased 0.3%, when cows were fed diets based on AS from the O<sub>2</sub>-limiting silo compared with the other 2 AS. The responses in milk fat were paralleled by an average increase in ADF digestibility of 270 g/d for cows fed AS from the O<sub>2</sub>-limiting silo. However, ruminal concentrations of lipogenic VFA were unchanged with AS source. Cows fed RGSC consumed 0.6 kg/d more DM and yielded 30 g/d more protein and 50 g/d more lactose than cows fed GSC diets ( $P = 0.02$ ). There was no evidence of increased total tract digestibility of OM or starch, or reduced ruminal NH<sub>3</sub> concentration, when feeding RGSC. Free AA increased, and isovalerate decreased in rumen fluid from cows fed RGSC diets ( $P < 0.01$ ). However, responses in production with roasted corn were mainly due to increased DMI, which increased the supply of energy and nutrients available for synthesis of milk and milk components.

**Key Words:** Alfalfa Silage Storage Structure, Milk Production, Roasted Corn

**T326 Changes in fermentation end products and the use of real-time quantitative PCR to monitor the dynamics of *Lactobacillus buchneri* in alfalfa silage.** R. J. Schmidt<sup>\*</sup>, J. A. Mills, W. Hu, C. M. Klingergerman, E. E. McDonnell, and L. Kung Jr., University of Delaware, Newark.

This study was conducted to determine the fermentation profile and the growth of lactic acid bacteria (LAB) and *L. buchneri* in alfalfa

silage treated with 1) nothing (C), 2) *Lactobacillus buchneri* 40788 (400,000 cfu/g) (Lallemand Animal Nutrition, Milwaukee, WI) (LB), or 3) *L. buchneri* 40788 (400,000 cfu/g) and *Pediococcus pentosaceus* (100,000 cfu/g) (Lallemand Animal Nutrition) (LBC). Wilted (45% DM), chopped and treated forage was packed and vacuum-sealed in polystyrene bags and ensiled for 2, 5, 45, 90 and 180 d. The experiment was a completely randomized design and data were analyzed using the GLM procedure of the SAS. Lactic acid bacteria (LAB) in forage and silage were quantified on MRS media, and *L. buchneri* was quantified by qPCR using a unique set of oligonucleotide primers. Fresh forage had 5.52 log cfu/g of LAB and 3.79 log cfu/g of *L. buchneri*. After 2 d of ensiling, numbers of LAB increased to more than 8 log cfu/g for all treatments. In contrast, the numbers of *L. buchneri* in C remained below 4 log cfu/g but was about 7 log cfu/g in LB and LBC. As ensiling progressed, numbers of *L. buchneri* in C remained lower than 6 log cfu/g but approached 9 log cfu/g in LB and LBC ( $P < 0.05$ ). The pH was lowest ( $P < 0.05$ ) in LBC when compared to C and LB after 2 and 5 d of ensiling but pH was lowest ( $P < 0.05$ ) for C compared to LB and LBC thereafter. Treatments LB and LBC had more acetic acid than C at 45 d of ensiling ( $P < 0.05$ ), which coincided with detectable amounts of 1,2 propanediol. From day 5 onward, LB and LBC had less residual water soluble carbohydrates but more NH<sub>3</sub>-N than C ( $P < 0.05$ ). Although naturally occurring amounts of *L. buchneri* can be detected in alfalfa, this population is unable to dominate silage fermentation. Inoculation with *P. pentosaceus* provided a faster rate of fermentation in the early stages of ensiling and did not impair the later effects of *L. buchneri* on the silage fermentation.

**Key Words:** Alfalfa Silage, *L. buchneri*, Real-Time qPCR

**T327 Effect of feeding corn silage based diets deficient in either predicted ruminal nitrogen or metabolizable protein on nitrogen utilization and efficiency.** E. B. Recktenwald<sup>\*</sup>, D. A. Ross, and M. E. Van Amburgh, Cornell University, Ithaca, NY.

The objective of this experiment was to evaluate nitrogen (N) utilization in high producing lactating dairy cattle under conditions of a predicted (1) negative rumen N balance (Diet T), (2) negative metabolizable protein (MP) balance (Diet N), or (3) positive rumen N and MP balances (Diet P). Eighty-eight multiparous lactating Holstein cows (83 ± 20 DIM), were blocked by milk yield and parity and assigned to three diets differing in N content. The diets were formulated with CPM Dairy V3 using library values for all feeds except corn silage. The diets consisted of approximately 50% corn silage, 2% wheat straw and 48% of a diet specific mix. Monensin was included in the diets at 300 mg/cow/d. A transition period of 7 d preceded the treatment period of 100 d. The study was analyzed as a mixed model with repeated measures by week using Proc Mixed (SAS, 2004) and orthogonal contrasts were used to assess differences. Body weight and body condition score did not differ. Dry matter intake and 3.5% FCM were lower for cows fed Diet T however feed efficiency was higher. Plasma urea N values were different among treatments and reflected the amount of N intake. Milk fat depression (MFD) was observed in all cows. To assess the impact of monensin on MFD, 11, 15, and 16 cows from the N, P, and T diets, respectively, were maintained on the diet after the treatment period with no monensin and milk fat percent increased by 30%. Nitrogen efficiency was improved through diet manipulation; however the data suggest greater improvements are possible.

**Table 1.**

	Diet T	Diet N	Diet P	Contrast P values		
				T vs N	T vs P	N vs P
Diet CP, % DM	14.1	14.0	16.3			
Predicted MP balance, g/d	91	-145	264			
Predicted rumen N balance, g/d	-39	27	29			
DMI, kg/d	24.2	25.5	25.7	0.08	0.03	0.93
Milk, kg/d	43.3	42.6	45.0	0.80	0.23	0.06
3.5% FCM, kg/d	36.4	36.5	39.1	0.99	0.05	0.07
Fat, %	2.54	2.67	2.68	0.45	0.44	1.00
Protein, %	2.90	2.92	2.93	0.93	0.84	0.98
PUN, mg/dL	7.13	8.40	11.31	<0.01	<0.01	<0.01
Milk N: Intake N	0.36	0.33	0.31	<0.01	<0.01	<0.01

**Key Words:** Nitrogen, Efficiency, Metabolizable Protein

**T328 Effects of cutting height and bacterial inoculation on fermentation, nutritive quality and degradability of two corn hybrids.** L. O. Abdelhadi\*<sup>1</sup> and J. M. Tricarico<sup>2</sup>, <sup>1</sup>*Est. El Encuentro, Research & Extension in Ruminant Nutrition, Cnel. Brandsen, Argentina*, <sup>2</sup>*Alltech Inc., Nicholasville, KY*.

A randomized complete block design with a factorial arrangement of treatments was used to evaluate the effects of a bacterial inoculant (Sil-All<sup>®</sup>, Alltech Inc., Nicholasville, KY) on fermentation, nutrient composition and OM degradability (OMD) of two corn hybrids harvested at 20 or 40 cm from the ground. The study included one high grain yield (DK682RR, Dekalb, Colon, Argentina) and one high forage yield (DK790S, Dekalb) hybrid. Hybrids were grown in three 2-hectare plots (block) and harvested at half milk-line stage of grain maturity. Fine chopped (9 mm) corn plant was stored in polyethylene bags (70m long x 2.75m diameter) using a forage inlay machine. Inoculation (0 or 5 g/ton fresh matter) was randomly assigned to each hybrid x cutting height combination within a bag. A composite sample (9 sub-samples) was collected for each treatment combination in each block before and after ensiling for 60 d. All samples were analyzed for DM, OM, CP, NDF, WSC, starch, and OMD after incubation with ruminal fluid for 3, 6, 12, 24, 48 and 72h. True protein, EE, pH and NH<sub>3</sub>-N were also determined on silage samples. No interactions were observed before ensiling. Digestible DM (tons/ha) only tended ( $P < .14$ ) to increase in high grain over high forage yield corn (13.1 vs. 13.0) or 20 over 40 cm cutting height (13.8 vs. 12.3), suggesting the importance of grain concentration on total nutrient supply. High grain yield corn had greater ( $P < .05$ ) pH, and concentrations of true protein, WSC, and starch but lower NH<sub>3</sub>-N and NDF than the high forage yield corn. The rate of OMD was also greater ( $P < .05$ ) in high grain than in high forage yield corn. Cutting height had no effects on silage fermentation, nutritive value or OMD. Inoculation increased ( $P < .05$ ) silage CP and true protein concentrations and the total amount of digestible OM in both corn hybrids without changing digestion rate. We conclude that cutting height did not affect silage quality, while bacterial inoculation improved it regardless of hybrid or cutting height. In addition, high grain yield corn provided more nutrients than high forage yield corn after ensiling.

**Key Words:** Corn Silage, Cutting Height, Inoculant

**T329 Continuous culture fermentation of a corn silage-based total mixed ration with additional forage from pasture.** R. E. Vibart\*, V. Fellner, and S. J. McLeod, *North Carolina State University, Raleigh*.

Cultures of mixed ruminal microorganisms were used to examine fermentation profile of diets consisting of either a nutritionally-balanced TMR (**100T**) or one of the following three TMR-pasture combinations: 1) 85% TMR plus 15% pasture (**85T**), 2) 70% TMR plus 30% pasture (**70T**), and 3) 55% TMR plus 45% pasture (**55T**). The pasture portion of the three TMR-restricted diets was annual ryegrass harvested at a height that simulated animal grazing. The forage:concentrate ratio ranged from 40:60 (100T) to 67:33 (55T). Increasing the amount of forage offered to the fermentors altered the molar proportions and daily production of volatile fatty acids (VFA). Total VFA tended ( $P = 0.08$ ) to be greatest (108.0 mmol/d) for 55T compared to all other treatments (92.5 mmol/d). Reduced ( $P < 0.05$ ) apparent and true OM degradability was reported for the diets that exhibited the lowest pH values (5.65 and 5.68 for treatments 70T and 100T, respectively). Increasing the amount of forage offered to continuous cultures resulted in increased ( $P < 0.05$ ) ratios of acetate to propionate and decreased methane production. There was a linear increase ( $P < 0.05$ ) in the flow of microbial biomass with increasing proportion of forage from pasture. Our data suggest that increased forage from pasture improved ruminal fermentation by supporting greater fermentation and ruminal pH. Despite similar ammonia-N concentrations, increasing the proportion of forage from pasture enhanced nitrogen capture and increased microbial protein flow.

**Key Words:** Pasture, Total Mixed Ration, Mixed Ruminal Cultures

**T330 Partial mixed rations (PMR) as alternative feeding systems for lactating dairy cows in southeastern U.S.** R. E. Vibart\*, V. Fellner, J. C. Burns, G. B. Huntington, and J. T. Green, *North Carolina State University, Raleigh*.

Beginning March 2005, thirty lactating Holstein cows were used in a randomized complete block design to evaluate the partial replacement of a total mixed ration (TMR) by ryegrass pasture on animal responses over an eight week period. Cows averaged 36.6 ± 1.5 kg milk, 125.7 ± 6.7 days in milk, 1.9 ± 0.2 lactations, 607.3 ± 11.9 kg bodyweight, and 2.88 ± 0.06 body condition score at the initiation of the trial. Cows were assigned to an all-TMR diet (**100T**, no access to ryegrass pasture) or one of the following three formulated (actual) PMR: 1) 85% (89%) TMR + 15% (11%) pasture, **85T**; 2) 70% (79%) TMR + 30% (21%) pasture, **70T**; and 3) 55% (65%) TMR + 45% (35%) pasture, **55T**. Cows on pasture grazed as a single group for 7 h/d between the a.m. and p.m. milking. Pasture intakes were measured weekly on one cow selected randomly from each grazing treatment. Pasture dry matter intake was different ( $P < 0.05$ ) among grazing treatments and averaged 6.9, 4.2, and 2.2 kg/d for 55T, 70T, and 85T, respectively. Fat corrected milk yield was greatest ( $P < 0.05$ ) for 85T (34.0 kg/d) and lowest for 70T (29.8 kg/d). Milk fat from cows with the greatest pasture intake had greater concentrations of conjugated linoleic acids and decreased concentrations of saturated fatty acids. By week eight, concentrations of plasma nonesterified fatty acids (185.3 vs. 92.5 µeq/L) and plasma urea nitrogen (12.4 vs. 6.7 mg/dl) were greater for 100T compared to the three grazing treatments, respectively, but plasma glucose concentrations did not differ among treatments. Offering pasture did not replace TMR, but lowering TMR intakes lowered total dry matter

intake. Feed efficiencies (kg feed/kg milk) were 0.60, 0.61, 0.56, and 0.68 for treatments 55T, 70T, 85T, and 100T, respectively. Our data shows that cows on a PMR with 11% pasture resulted in the best lactation performance. Although the two treatments offered the greatest amounts of TMR resulted in greater milk yields, all three grazing treatments exhibited enhanced feed efficiencies compared to an all-confinement diet.

**Key Words:** Total Mixed Ration, Pasture, Lactation Performance

**T331 Variability in total mixed ration neutral-detergent fiber analysis among commercial laboratories.** A. N. Hristov<sup>\*1</sup>, S. Zaman<sup>1</sup>, M. Vander Pol<sup>1</sup>, W. J. Price<sup>1</sup>, and D. Mertens<sup>2</sup>, <sup>1</sup>University of Idaho, Moscow, <sup>2</sup>U.S. Dairy Forage Research Center, Madison, WI.

The objective of this study was to test the variability in amylase-treated NDF (aNDF) of TMR samples among commercial feed analysis laboratories. Two TMR were prepared that varied in the DM proportion of concentrates (corn and barley grains) replacing forage (alfalfa hay and corn silage): 55% (HCD diet) vs. 40% (LCD diet). Replicated TMR and individual feed samples were dried at 65°C to constant weight and ground through a 4-mm screen. Aliquots were sent to 12 commercial and 2 research laboratories for aNDF analysis; all laboratories, except one, re-ground the samples and used amylase and sodium sulfite. The aNDF contents of TMR were estimated based on aNDF content of the individual feeds reported by each laboratory. Results were analyzed statistically using the UNIVARIATE and MIXED procedures of SAS. Method of analysis (crucible vs. filter bag) was used as a classification variable in the statistical analysis. Concentration of aNDF in HCD and LCD by laboratories using the crucible method was 29.2±0.28 and 33.7±0.20%, respectively (n=48). Laboratories using filter bags reported 29.9±0.37 and 33.9±0.39% aNDF, respectively (n=36). Method of analysis had no effect ( $P = 0.520$ ) on the aNDF values, but variability among laboratories was significant ( $P = 0.032$  and  $0.038$ , HCD and LCD, respectively). The variance estimates for the two methods of aNDF analysis were not statistically significant ( $P = 0.229$  and  $0.208$ , crucibles and filter bags, respectively). There was a significant variability in the analysis of some feeds: barley grain averaged 20.3±1.15% (min=14.0, max=31.0%) and whole cottonseed averaged 45.6±1.51% aNDF (min=35.5, max=56.2%). Estimated aNDF of TMR, based on analysis of individual feeds, were slightly greater than analyzed aNDF values (by 0.32±0.170,  $P = 0.067$  and 0.42±0.135%,  $P = 0.003$  for HCD and LCD, respectively).

**Key Words:** Neutral-Detergent Fiber, Total Mixed Ration, Analysis

**T332 Nutritional quality of sugar cane treated with calcium oxide.** A. W. P. Freitas<sup>\*1</sup>, F. C. Rocha<sup>2</sup>, J. L. Fagundes<sup>1</sup>, and R. Fonseca<sup>2</sup>, <sup>1</sup>APTA Regional, Adamantina, São Paulo, Brazil, <sup>2</sup>Unesp - Dracena, Dracena, São Paulo, Brazil.

The aim of this research was to determine the effect of application of different levels of CaO (0.25; 0.5; 1.0; 2.0 and 4.0%) on the nutritional quality of sugar cane. The sugar cane, variety IAC 86-2480, was harvested manually, and chopped in 2 cm lengths with a stationary chopping machine. Each parcel consisted of 50 kg of chopped sugar

cane. Individual samples were collected before treatment application (time 0), and after 9 hours. Samples were dried at 70 °C for 48 h in an oven and ground to pass a 1 mm screen. Dry matter content, ash, crude protein, NDF, ADF, water soluble carbohydrate (WSC), lignin and hemicelluloses concentration and in vitro dry matter digestibility (IVDMD) were determined as described by Silva and Queiroz (2002) and pH as described by Bolsen et al. (1992). The results were analyzed by one-way analysis of variance and regression analysis using SAEG 9.1. The forage dry matter decreased linearly ( $P < 0.01$ ) with the increase of calcium hydroxide levels, while NDF, Hemicelluloses and DMIVD adjusted to a quadratic ( $P < 0.01$ ) model. The data show that application of increasing levels of calcium oxide affects the forage in two steps. First, there was a solubilization of the WSC, resulting in the observed increase in cell wall components concentration. Secondly, the higher levels of the alkali start to affect the cell wall components, which can be observed by the decreasing concentrations of hemicelluloses and NDF. A rather unexpected finding from the experiment was the quadratic behavior of the IVDMD, with a maximum estimated value of 68.5% of IVDMD for the calcium oxide level of 1.75%. This observation can be explained by the degradation of the WSC, with the increasing levels of calcium oxide, which is the most digestible part of the sugar cane. It is concluded that 1.75% is the optimal level of calcium oxide to enhance the nutritional quality of sugar cane for ruminants.

**Key Words:** Alkali, Hydrolyses, Ruminant

**T333 Effects of increasing level of corn distiller's dried grains plus solubles on in situ disappearance in steers offered medium-quality grass hay.** J. L. Leupp<sup>\*</sup>, G. P. Lardy, and J. S. Caton, North Dakota State University, Fargo.

Five ruminally and duodenally cannulated beef steers (446 ± 42 kg of initial BW) were used in a 5 × 5 Latin square to evaluate effects of increasing level of supplemental corn distiller's dried grains with solubles (DDGS; 25.4% CP, 9.8% fat, DM basis) on in situ rate of DM, NDF, and ADF disappearance and CP kinetic parameters of hay and DDGS. Dietary treatments consisted of grass hay (10.2% CP; DM basis) offered ad libitum, free access to water and trace mineral salt block, and one of five levels of DDGS (0, 0.3, 0.6, 0.9, and 1.2% BW DDGS; DM basis). Diets met or exceeded DIP requirements (microbial yield = 10.5%). All supplements were fed at 0600 before hay. Steers were adapted to diets for 14 d followed by a 7-d collection period. Hay DM disappearance responded cubically ( $P = 0.02$ ) with the greatest rate of disappearance at 0.9% DDGS and least at 1.2% DDGS. Hay NDF and ADF disappearance were not affected ( $P \geq 0.23$ ; 3.74 ± 0.45%/h and 3.72 ± 0.46%/h, respectively) by treatment. Hay CP degradation rate increased (linear;  $P = 0.0025$ ) with increasing DDGS while extent of CP degradation decreased quadratically ( $P = 0.02$ ) with the lowest extent at 0.9% DDGS. Hay soluble and slowly degradable CP fractions were similar ( $P \geq 0.93$ ; 25.5 ± 1.7% and 63.0 ± 1.7%, respectively) across treatments. A cubic effect ( $P = 0.03$ ) was noted for DDGS DM disappearance with the greatest disappearance at 0.9% and the least at 0.6% DDGS. No differences ( $P \geq 0.45$ ) among treatments were observed for DDGS NDF or ADF disappearance (3.04 ± 0.71%/h and 3.19 ± 0.94%/h, respectively). Soluble CP degradation fraction decreased (linear;  $P = 0.01$ ) and slowly degradable CP fraction increased (linear;  $P = 0.002$ ) with increasing DDGS. A linear increase ( $P < 0.0001$ ) was observed for CP degradation rate with increasing DDGS. Treatment did not affect ( $P = 0.23$ ) extent of DDGS CP

degradability ( $99.8\% \pm 0.2$ ). Using moderate to high levels of DDGS in forage diets resulted in increased degradation rates of CP. Results indicate up to 1.2% BW DDGS can be fed in forage-based diets without adverse effects.

**Key Words:** Distiller's Dried Grains with Solubles, Medium-Quality Forage, Steers

**T334 Evaluation of corn and soybean co-products in beef cattle finishing diets.** P. M. Walker<sup>\*1</sup>, D. Adams<sup>1</sup>, and L. A. Forster<sup>2</sup>, <sup>1</sup>*Illinois State University, Normal*, <sup>2</sup>*Archer Daniels Midland, Co., Decatur, IL*.

Dried distillers grains with solubles (DDGS) and soy hull (SH) supplies have increased due to renewable fuels legislation. This trial evaluated the effects of diets containing 0, 25, or 40% DDGS and 44% SH, and length of time on feed (156, 187, or 263d) on the feedlot performance of 192 Angus crossbred steers (initial wt =  $348 \pm 1.9$  kg). Following an 84d receiving period (P1) in which steers were fed diets containing either shelled corn (SC), SH, or DDGS at 1 or 2% BW, steers were blocked by intake level and assigned within blocks to six dietary treatments (P2) with 4 replicates (24 pens, 6 or 10 steers/pen). Treatments were: 70.5% SC, 13.5% grass hay (GH), 13.5% soybean meal (T1); 59.0% SC, 13.5%GH, 25% DDGS (T2); 40.0% DDGS, 44.0% SH, 13.5%GH (T3); T3 fed for 28d (T4), 56d (T5), or 84d (T6) followed by T2 fed to harvest. Steers were harvested after 156, 187, or 232d on the P2 diets. Data were analyzed using previous dietary treatment (P1) and harvest date as covariates; no interactions were observed between covariates and P2 treatments. Carcass measurements were similar between P2 treatments except for liver abscess scores [T1 higher ( $P < 0.05$ ) than T2-T6]. Length of time on feed increased carcass wt, rib fat, KHP, marbling score and yield grade. Total DMI was similar between T1 and T2 but was higher ( $P < 0.05$ ) for T3-T6. ADG ( $\mu = 1.51 \pm 0.02$ kg) and feed efficiency (G:F) ( $\mu = 0.12 \pm 0.005$ ) were similar between T1 and T2 but lower ( $P < 0.05$ ) for T3-T6 (ADG  $\mu = 1.45 \pm 0.02$ kg, G:F  $\mu = 0.11 \pm 0.005$ ). No significant differences in cost of gain were observed between treatments. Mean carcass measurements were: carcass wt =  $403 \pm 0.8$ kg, rib fat =  $20.57 \pm 0.01$ mm, ribeye area =  $84.3 \pm 0.9$  sq cm, KHP =  $2.8 \pm 0.1\%$ , marbling score =  $7.64 \pm 0.1$  (7 = avg choice), yield grade =  $4.24 \pm 0.1$ , liver score =  $1.5 \pm 0.2$  (range = 1-5) and dressing percent =  $62.5 \pm 0.2$ . These data suggest that feeding cattle higher rates of DDGS and SH will result in similar quality and yield grades but will require higher total feed intake with lower ADG than diets containing whole shelled corn or limited to 25% DDGS.

**Key Words:** DDGS, SH, Finishing Steers

**T335 Effects of dietary fat concentration and wet sorghum distiller's grains plus solubles on feedlot performance and carcass characteristics of finishing heifers.** J. C. Silva<sup>\*1</sup>, N. A. Cole<sup>2</sup>, M. S. Brown<sup>1</sup>, D. L. Mitchell<sup>1</sup>, C. H. Ponce<sup>1</sup>, and D. R. Smith<sup>1</sup>, <sup>1</sup>*West Texas A&M, Canyon*, <sup>2</sup>*USDA ARS CPRL, Bushland, TX*.

Three hundred ninety-eight crossbred yearling heifers (initial BW = 373.5 kg) were used in two experiments to examine the effect of dietary fat concentration on the feeding value of wet sorghum distiller's grains plus solubles (WSDGS). Treatments included two 92% concentrate diets based on steam-flaked corn (SFC) with 0% or 3% added fat from

yellow grease and three diets with 15% WSDGS and either 0, 1.5, or 3% added fat from yellow grease (4 pens/treatment within study). Heifers were fed an average of 106 d before slaughter. Overall DMI was 6.1% greater ( $P < 0.01$ ) for heifers fed WSDGS than for those fed SFC. Among heifers fed WSDGS, DMI was greatest for heifers fed 1.5% fat ( $P = 0.04$ ; quadratic). Overall ADG was 5% greater ( $P = 0.04$ ) for WSDGS compared to SFC. Among WSDGS, ADG tended to be greater for 1.5% fat ( $P = 0.12$ ; quadratic). The ADG:DMI did not differ between SFC with 0 or 3% fat, nor was ADG:DMI altered by replacing a portion of SFC with WSDGS ( $P > 0.36$ ). However, ADG:DMI increased linearly as more fat was added to WSDGS diets ( $P = 0.06$ ). Hot carcass weight was increased an average of 5 kg ( $P = 0.05$ ) when WSDGS replaced a portion of SFC, but carcass weight was greatest for heifers fed WSDGS with 1.5% fat ( $P = 0.09$ , quadratic). Heifers fed SFC without fat had a larger LM area, lower marbling score, less rib fat, and a lower yield grade ( $P < 0.08$ ) than heifers fed SFC with 3% fat. Heifers fed WSDGS had more rib fat and a higher yield grade ( $P < 0.03$ ) than heifers fed SFC. Inclusion of fat in SFC diets did not alter the distribution of carcass quality grades, but SFC with 3% fat produced fewer ( $P = 0.01$ ) yield grade 1 carcasses than when fat was not fed. Feeding WSDGS did not alter carcass quality grade distribution compared to feeding SFC, but WSDGS produced fewer yield grade 3 carcasses ( $P = 0.03$ ) than SFC. Heifers fed WSDGS had a higher DMI and greater ADG than heifers fed SFC, but gain efficiency did not differ. Adding more than 1.5% fat to diets containing WSDGS tended to reduce growth performance.

**Key Words:** Fat, Growth Performance, Sorghum Distiller's Grains

**T336 Using high-lysine proteins to supplement diets based on dried distillers grains with solubles did not improve lactation performance.** E. A. French<sup>\*</sup>, M. He, and L. E. Armentano, *University of Wisconsin, Madison*.

The objectives of this study were to compare production responses of lactating dairy cows fed dried distillers grains with solubles (DDGS) combined with other protein sources varying in lysine content. Twenty four lactating Holstein cows (six primiparous and eighteen multiparous) were used in four, replicated  $6 \times 6$  Latin Squares, with 21-d periods. All diets contained 37% corn silage, 18% alfalfa silage, 5% cottonseed and 40% concentrate (DM basis). DDGS at 13% and 18% of diet DM was supplemented with Aminoplus<sup>®</sup>, a soy-based bypass protein source (13AP and 18AP). DDGS (18% of diet DM) was also supplemented with commodity soybean meal (18SBM), blood meal (18Bl), blood and fish meal (18BIF) and Aminoplus<sup>®</sup> and blood meal (18APBl). Diets were formulated to have similar NDF and fat concentration. The 18APBl positive control diet was 18.5% CP but the other five diets were isonitrogenous (17.0% to 17.4% CP). No significant differences were found across treatments for DMI (25.3 kg/d), yield of milk (44.5 kg/d), milk protein (1346 g/d), fat (1458 g/d) and lactose (2170 g/d) or milk fat concentration (3.28%). Milk protein percent was higher for the 18APBl diet vs 18AP (3.05% vs. 3.00%;  $P < 0.05$ , one-tailed). This last result implies the cows in this study could respond to added protein, albeit slightly. Therefore, either our hypothesis that diets containing more available lysine would cause increased production responses was incorrect, or the diets did not improve the lysine status of the cows. In either case the quality of the protein in all these 18% DDGS diets appears similar.

**Key Words:** Dried Distillers Grains with Solubles, Dairy Cows

**T337 Effect of feeding dry glycerin to early postpartum Holstein dairy cows on milk production and metabolic profiles.** Y.-H. Chung\*<sup>1</sup>, D. E. Rico<sup>1</sup>, A. Martinez<sup>1</sup>, K. S. Heyler<sup>1</sup>, C. M. Martinez<sup>1</sup>, T. W. Cassidy<sup>1</sup>, V. Noiro<sup>2</sup>, A. Ames<sup>3</sup>, and G. A. Varga<sup>1</sup>, <sup>1</sup>Dairy and Animal Science, The Pennsylvania State University, University Park, <sup>2</sup>Phodé, Albi, France, <sup>3</sup>NutriLinx, LLC, Montpelier, VT.

Effect of feeding dry glycerin to 39 multiparous Holstein dairy cows (control: n = 19 and glycerin: n = 20; lactation number =  $2.2 \pm 1.3$  SD) on lactational performance and metabolic profiles was investigated. Dry glycerin (minimal 63% of glycerol) was fed at the level of 250 g/cow/d as a topdress to the common lactating TMR from parturition to 21 days postpartum. Individual milk was sampled from 2 consecutive milkings weekly and analyzed for components. Blood was sampled from the coccygeal vein at 4, 7, 14 and 21 days in milk and analyzed for glucose and blood urea nitrogen (BUN). Urine was tested for acetoacetate level weekly using ketostix. Feed intake, milk production and BUN were not affected by glycerin. Percentage of milk protein tended to be lower numerically ( $P = 0.17$ ) and % of milk fat tended ( $P = 0.07$ ) to decrease at a faster rate for glycerin supplemented cows than control cows, however yield of milk protein or fat was not different indicating a dilution effect. Cows receiving glycerin tended to have numerically lower urine ketones compared to control cows (6.8 vs. 17.9 mg/dL;  $P = 0.18$ ). A tendency for treatment by time interaction ( $P = 0.14$ ) was observed on urine ketones showing that cows receiving glycerin tended to have lower urine ketones on wk 1 and 2 of lactation compared to cows receiving no glycerin. Plasma glucose on wk 2 of lactation corresponded to urine ketones results showing that cows receiving glycerin tended to have higher plasma glucose than cows receiving no glycerin. Results from urine ketones and plasma glucose indicated that at the same level of production, cows receiving glycerin were in a better metabolic status than cows receiving no glycerin. Urine ketones for all cows at any sampling time were below the moderate level (40 mg/dL) for urine ketones during the experimental period.

**Key Words:** Dry Glycerin, Early Postpartum

**T338 Variation over one year of nutrient content of wet brewers grains from a commercial brewery.** J. E. Wohl\* and M. L. Westendorf, Rutgers University, New Brunswick, NJ.

Trailer shipments of wet brewers grains from Anheuser-Busch, Inc., Newark, NJ were sampled daily and composited weekly for 12 months. Both wet and pressed grains were produced at this site. The 48 samples were analyzed at Cumberland Valley Analytical Services, Morgansville, MD. Results for all nutrients are reported as mean (%), SD, and range, respectively. Four of 48 samples contained greater than 40% DM. DM averages of the 48 samples were 34.5%, 4.9 and 27.7 to 51.0 for mean, standard deviation, and range, respectively. Protein fractions were: CP %/DM 33.6, 1.9, and 29.6 to 37.4; soluble protein %/CP 8.3, 1.9, and 4.4 to 12.2; TA-NPN%/CP 9.6 3.7, and 2.9 to 26.6; degradable protein %/CP 28.8, 2.5, and 24.4 to 35.3. The COV for soluble protein and TA-NPN exceeded 20%. Carbohydrate fractions were: starch %/DM 4.3, 1.1, and 2.9 to 7.5; sugar %/DM 4.8, 1.5, and 2.4 to 8.2 with COV exceeding 25%. Fiber fractions were: ADF %/DM 29.9, 1.9, and 18.1 to 25.5; NDF %/DM 48.5, 1.7, and 44.3 to 52.1; lignin %/DM 5.5, 0.3, and 4.9 to 6.2. Fat was: 9.0%, 0.5, and 8.0 to 9.8. Ash was: 7.2%, 2.4, and 3.9 to 9.8 with a COV of 33.0%. Small amounts of macrominerals were present (% of DM): Ca 0.21, 0.02, and 0.17 to 0.26; P 0.55, 0.02,

and 0.50 to 0.62; Mg 0.20, 0.02, and 0.16 to 0.24; K 0.09, 0.01, and 0.07 to 0.13; Na 0.010, 0.002, and 0.007 to 0.015. Data illustrate that the nutrient content of wet grains from a single supplier can vary. Simply analyzing or monitoring DM content will not be sufficient when formulating diets.

**Key Words:** Brewers Grains, Nutrient Content, Variability

**T339 The effect of feeding dried distillers grains plus solubles to lactating dairy cows on milk production and excretion of urinary purine derivatives.** B. N. Janicek\*<sup>1</sup>, P. J. Kononoff<sup>1</sup>, A. M. Gehman<sup>1</sup>, and P. H. Doane<sup>2</sup>, <sup>1</sup>University of Nebraska, Lincoln, <sup>2</sup>ADM Animal Nutrition Research, Decatur, IN.

The objective of this experiment was to evaluate the effects of feeding dried distillers grains plus solubles (DDGS) on lactational performance of Holstein dairy cows. In addition, we evaluated urinary excretion of purine derivatives (PD) as an indirect estimator of ruminal microbial crude protein production (MCP). Twenty one multiparous and thirteen primiparous mid-to-late lactation cows averaging  $178 \pm 36$  DIM and  $651 \pm 65$  kg BW were randomly assigned to one of two diets in a three period cross-over design. During each of the 21-d periods, cows were offered one of two diets which were chemically similar but differed by the rate of inclusion of DDGS. Dietary treatments were either control (no DDGS) or 30% of diet DM as DDGS. Dried distillers grains plus solubles replaced a portion of dietary forages and concentrates. Diets were formulated to contain similar amounts of CP, NDF, and energy. Dry matter intake was not different ( $P = 0.19$ ) between treatments ( $22.8$  and  $24.0 \pm 0.65$  kg/d) nor was 3.5% FCM ( $34.4$  and  $34.9 \pm 1.24$  kg/d;  $P = 0.69$ ). Percentages of milk fat and true protein did not differ between treatments averaging  $3.67 \pm 0.07\%$  and  $2.99 \pm 0.03\%$ . The ratio of PD to creatinine was not affected ( $P = 0.83$ ) by DDGS feeding ( $2.43$  and  $2.45 \pm 0.07$ ). Similarly, allantoin to creatinine ratios were not different ( $P = 0.57$ ) between diets ( $2.23$  and  $2.28 \pm 0.07$  respectively). Estimated MCP was not affected ( $P = 0.80$ ) by DDGS addition ( $1636$  and  $1656 \pm 58$  g/d). In conclusion, purine excretion and estimates of rumen microbial crude protein production were not affected by feeding higher amounts of DDGS. Production results suggest that dairy diets may be formulated to contain DDGS at 30% of the diet DM and maintain acceptable DMI, milk production and milk composition.

**Key Words:** Dairy Cow, Distillers Grains Plus Solubles, Urinary Purine Derivatives

**T340 Effects of Optigen® on fermentation, digestion, and N partitioning in rumen-simulating fermenters fed diets with distillers dried grains.** G. A. Harrison\*, J. M. Tricarico, M. D. Meyer, and K. A. Dawson, Alltech Biotechnology, Nicholasville, KY.

The effects of Optigen® (blended, controlled-release urea) on ruminal fermentation, digestion, and N flow in diets with and without distillers dried grains (DDG) were investigated in single-flow rumen-simulating fermenter cultures. Data from 5 experiments (44 cultures) were included in this meta-analysis. Cultures were fed 50% forage diets (corn silage and alfalfa hay), DDG at 0 (DDG0) or 20% (DDG20), and 2 levels of Optigen (0 and 0.55% DM). NPN from Optigen replaced 7.6% of dietary N. Cultures were fed 12.5 g as fed of experimental

diets twice daily for 6 days. Target dilution rate was 0.045 h<sup>-1</sup>. Samples were collected from cultures prior to morning feeding during the last 3 d of experiments for fermentation analysis. Effluent weights were recorded each day and a composite sample for each fermenter used for DM, OM, and NDF disappearance determination. Nitrogen flow measures were estimated by using purine to N ratios for effluent DM and bacteria. Data were analyzed using the PROC MIXED Model of SAS. Least-square means were compared using Scheffe's test for simultaneous inference. Culture fluid pH, ammonia, and digestion were similar between all-natural protein and Optigen cultures ( $P > 0.10$ ). Cultures receiving Optigen had greater protein degradability (64.0 vs. 67.6,  $P < 0.01$ ) than all-natural protein cultures. Bacterial N yields (0.352 vs. 0.359 g,  $P > 0.10$ ) were not affected by protein source. Cultures fed DDG20 diets had lower ammonia concentrations (5.25 vs. 3.29 mg/dl,  $P < 0.01$ ) and lower true DM digestibility (63.4 vs. 61.1%,  $P < 0.01$ ). DDG20 cultures degraded less protein (68.8 vs. 62.8% of CP,  $P < 0.01$ ) and produced less bacterial N (0.362 vs. 0.349 g/d,  $P < 0.05$ ), but were more efficient (35.1 vs. 36.9 g bacterial N/kg fermentable carbohydrate,  $P < 0.01$ ) than DDG0 cultures. Negative effects of 20% DDG dietary inclusion on N flow in rumen-simulating fermenters were partially negated by addition of Optigen.

**Key Words:** Non-Protein Nitrogen, Optigen, Distillers Dried Grains

**T341 Performance of dairy cows fed glycerol as a primary feed ingredient.** S. S. Donkin<sup>\*1</sup>, M. R. Pallatin<sup>1</sup>, P. H. Doane<sup>2</sup>, M. J. Cecava<sup>2</sup>, H. M. White<sup>1</sup>, E. Barnes<sup>1</sup>, and S. L. Koser<sup>1</sup>, <sup>1</sup>*Purdue University, West Lafayette, IN*, <sup>2</sup>*ADM Animal Nutrition Research, Decatur, IN*.

Growth of the corn ethanol industry is creating a need for inexpensive feed energy alternatives for lactating dairy cows while concurrent expansion in soydiesel production is expected to promote favorable pricing for glycerol, a primary coproduct material. The objective of this study was to determine the feeding value of glycerol for lactating dairy cattle as a replacement for corn. Sixty lactating Holstein cows, housed in individual tie stalls, were fed a base diet consisting of corn silage, legume forages, corn grain, soyhulls, roasted soybean and protein supplements. After a 2-week acclimation period, cows were fed diets containing 0, 5, 10 or 15% glycerol on a DMB. Glycerol and corn gluten feed in a ratio of 6.25:1 replaced an equivalent amount of corn grain to achieve desired percentages of glycerol in the diet. Cows were milked twice daily and weekly milk samples were analyzed for fat, protein, lactose, total solids, milk urea N, and somatic cells. Body weights and body condition scores were obtained at the beginning and the end of the study. Milk production was 37.0, 36.9, 37.3, 36.4 ± 0.6 kg/d and feed intake was 24.0, 24.5, 24.6, 24.1 ± 0.5 kg/d for 0, 5, 10 and 15% glycerol treatments respectively and did not differ ( $P > 0.05$ ) except for a modest reduction in feed intake during the first 7 days of the trial for 15% glycerol (treatment x time effect;  $P < 0.05$ ). Milk composition was not altered in response to glycerol with the exception of decreased ( $P < 0.05$ ) milk urea nitrogen from 12.5 ± 0.4 mg/dl to an average of 10.6 ± 0.4 mg/dl with glycerol addition. Cows fed 10 and 15% glycerol gained more weight ( $P < 0.05$ ) than those fed 0 or 5% glycerol; however, body condition scores did not differ among treatments. The data indicate that glycerol is a suitable replacement for corn grain in diets for lactating dairy cattle. Glycerol can be included at rates up to 15% of diet DM without adverse effects on milk production or milk composition.

**Key Words:** Glycerol, Milk, Biofuels

**T342 Evaluation of protein fractionation and ruminal and intestinal digestibility of corn milling co-products.** J. M. Kelzer<sup>\*1</sup>, P. J. Kononoff<sup>1</sup>, K. Karges<sup>2</sup>, and M. L. Gibson<sup>2</sup>, <sup>1</sup>*University of Nebraska, Lincoln*, <sup>2</sup>*Dakota Gold Research Association, Sioux Falls, SD*.

Inputs for the Cornell-Penn-Miner Dairy model require feed protein to be divided into five fractions: A = non-protein nitrogen; B1 = rapidly degraded true protein; B2 = moderately degraded true protein; B3 = slowly degraded true protein; and C = undegraded true protein. The objectives of this study were to characterize feed protein fractions and evaluate differences in rumen undegradable protein (RUP), RUP digestibility (dRUP), and amino acid concentration in the RUP of seven corn milling co-products. The corn co-products and their respective CP (% DM) included Germ (16.3), Bran (13.5), High Protein Dried Distillers Grains (HPDDGS; 47.2), Dried Distillers Grains (DDGS1; 30.1), Dried Distillers Grains (DDGS2; 28.9), Wet Corn Gluten Feed (WCGF; 26.7), and Wet Distillers Grains (WDGS; 29.9). Two ruminally and duodenally fistulated Holstein steers averaging 665 kg were used to determine RUP and dRUP. Samples of each feed were ruminally incubated for 16 hours. After simulated abomasal digestion, designated samples were inserted into the duodenum and collected in the feces. Protein fractions A, B1, B2, B3, and C are characterized as follows (% CP): Germ = 30.0, 15.0, 38.1, 13.5, 3.4; Bran = 33.5, 4.0, 54.3, 6.0, 2.2; HPDDGS = 7.4, 0.6, 82.4, 8.8, 0.8; DDGS1 = 17.0, 7.0, 67.0, 4.8, 4.2; DDGS2 = 17.9, 2.1, 41.0, 11.1, 27.9; WCGF = 36.6, 15.9, 33.2, 10.1, 4.1; and WDGS = 18.6, 2.4, 53.1, 11.0, 14.9. The proportions of RUP ( $P < 0.01$ ) and dRUP ( $P < 0.01$ ) were different and are reported as follows (% CP): Germ = 16.5, 66.8; Bran = 20.7, 65.8; HPDDGS = 55.2, 97.7; DDGS1 = 33.2, 92.0; DDGS2 = 56.3, 91.9; WCGF = 11.5, 51.0; and WDGS = 44.7, 93.1. The concentrations of Lys ( $P < 0.01$ ) and Met ( $P < 0.10$ ) in the RUP were different and are listed as follows (%CP): Germ = 2.9, 1.9; Bran = 3.2, 1.4; HPDDGS = 2.0, 3.2; DDGS1 = 1.9, 2.0; DDGS2 = 1.9, 2.4; WCGF = 3.5, 1.6; and WDGS = 1.9, 2.3. Comparison of the co-products defined differences in protein fractions, RUP, dRUP, and post-ruminal Lys supply.

**Key Words:** Protein, Dairy, Co-Products

**T343 Evaluation of ruminal fermentability of corn milling co-products using in vitro gas production.** P. J. Kononoff<sup>\*1</sup>, L. O. Tedeschi<sup>2</sup>, M. L. Chizzotti<sup>2</sup>, J. M. Kelzer<sup>1</sup>, K. Karges<sup>3</sup>, and M. L. Gibson<sup>3</sup>, <sup>1</sup>*University of Nebraska, Lincoln*, <sup>2</sup>*Texas A & M University, College Station*, <sup>3</sup>*Dakota Gold Research Association, Sioux Falls, SD*.

The kinetics of ruminal fermentation influences the feeding value of corn milling co-products. The objective of this study was to evaluate kinetics of gas production in vitro and fermentability of 7 corn milling co-products. For each feed, the concentration of NDF with sodium sulfite, lignin, starch, and sugar (%DM) were: Germ = 30.1, 4.4, 28.8, 9.2 %, Bran = 21.2, 2.85, 32.0, 5.0 %, High Protein Corn Distillers Grains (HPDDGS) = 22.5, 4.55, 9.50, 0.85 %, Dried Distillers Grains (DDGS1) = 30.2, 4.4, 7.4, 3.5 %, Dried Distillers Grains (DDGS2) = 33.9, 10.1, 6.9, 4.8 %, Wet Corn Gluten Feed (WCGF) = 36.9, 3.2, 9.8, 4.5 %, and Wet Distillers Grains (WDGS) = 30.8, 5.9, 3.7, 3.0 %. Feed samples (200 mg each) were inoculated with rumen fluid and media in an anaerobic condition and fermented in vitro for 48 h. Gas production was continuously measured using a computerized system and data was fitted to an exponential model:  $y = a \times (1 - \text{Exp}(-b \times (\text{time} - c)))$ , where  $y$  = gas production (ml),  $a$  is the asymptote of gas



production (ml), b is the rate of degradation (1/h), and c is the lag time. The asymptote (a) of gas production was different among feeds ( $P = 0.04$ ), with a mean and SEM of  $52.1 \pm 3.9$  ml for Germ,  $50.1 \pm 3.4$  ml for Bran,  $37.5 \pm 3.4$  ml for HPDDGS,  $38.6 \pm 3.4$  ml for DDGS1,  $40.1 \pm 3.0$  ml for DDGS2,  $39.0 \pm 3.4$  ml for WCGF, and  $40.7 \pm 3.4$  ml for WDGS. The lag (c) of gas production was not different among feeds ( $P = 0.15$ ), with a mean and SEM of  $1.42 \pm 0.34$  h for Germ,  $1.25 \pm 0.29$  h for Bran,  $0.65 \pm 0.30$  h for HPDDGS,  $0.38 \pm 0.30$  h for DDGS1,  $0.60 \pm 0.27$  h for DDGS2,  $0.89 \pm 0.30$  h for WCGF, and  $0.35 \pm 0.30$  h for WDGS. Fractional gas production rates (b) were significantly different among feeds ( $P < 0.01$ ), with a mean and SEM of  $19.3 \pm 1.8$  for Germ,  $16.2 \pm 1.5$  for Bran,  $16.1 \pm 1.5$  for HPDDGS,  $14.6 \pm 1.5$  for DDGS1,  $10.3 \pm 1.4$  for DDGS2,  $11.9 \pm 1.5$  for WCGF, and  $9.1 \pm 1.5$  for WDGS. Results of this study demonstrate that corn milling co-products differ in chemical composition and that differences also exist in the pattern of ruminal fermentation and nutrient availability.

**Key Words:** Gas Production, Rumen Fermentation, Corn Milling Co-products

**T344 Blood metabolites profiles of dairy cows fed wet corn distillers grains during early lactation.** G. S. Mpapho\*, A. R. Hippen, K. F. Kalscheur, and D. J. Schingoethe, *South Dakota State University, Brookings.*

Multiparous Brown Swiss (n=16), and Holstein (n=18) cows were used in a randomized complete block design to evaluate glucose, cholesterol, and blood urea nitrogen (BUN) concentrations for cows fed wet distillers grains (WDG) at 15% of diet dry matter during early lactation. Cows were paired during the close up period by breed and anticipated calving date and randomly assigned to 1) Control (CON): containing 0% WDG and 2) WDG included at 15% of diet dry matter. Energy density and crude protein content of diets were 1.44 and 1.58 Mcal NEI/kg and 14.5 and 17.2 % for pre- and postpartum diets, respectively, and were similar for CON and WDG. Prepartum diets were fed from 28 d until calving whereas postpartum diets were fed from calving to 70 days in milk (DIM). Diets were offered for ad-libitum intake. Blood was sampled approximately 4 h after feeding at 4, 7, 14, 21, 28, 35, 42, 49 and 56 DIM. Blood samples were analyzed for glucose, cholesterol, and BUN. Dry matter intake (DMI) and energy corrected milk (ECM) for cows fed WDG and CON were unaffected by dietary treatments during the first 70 DIM (23.2 vs 22.5 kg/d;  $P = 0.46$  and 40.1 vs 41.6 kg/d;  $P = 0.41$ ), respectively. Cows fed WDG had greater glucose concentration ( $P < 0.05$ ) than those fed CON (64.4 and 60.0 mg/dL). Glucose concentrations in the blood were greater in Holstein than Brown Swiss cows (64.7 and 59.7 mg/dL;  $P = 0.04$ ). Glucose also varied by DIM with lowest concentrations at 21 DIM (57.6 mg/dL) and greatest at 49 DIM (71.2 mg/dL). Plasma cholesterol was not affected by treatment (114.9 and 118.7 mg/dL;  $P = 0.74$ ) for both the WDG and CON, respectively. Cholesterol varied by DIM with lowest concentrations at 4 DIM (104.2 mg/dL) and greatest at 56 DIM (137.9 mg/dL). BUN was affected by diet (13.8 and 12.1 mg/dL;  $P = 0.04$ ), for WDG and CON. No interactions of diet and other main effects were observed for glucose, cholesterol and BUN. Relative to CON, feeding WDG at 15% of ration DM led to a more favorable metabolic profile postpartum as evidenced by increased concentrations of plasma glucose in early lactation.

**Key Words:** Distillers Grains, Glucose, Cholesterol

**T345 Rumen fermentation with dried distillers grains versus soybean protein as a source of rumen undegraded protein for lactating dairy cows.** B. W. Pamp\*, K. K. Kalscheur, A. R. Hippen, and D. J. Schingoethe, *South Dakota State University, Brookings.*

The objective of this research was to evaluate the effect of level and source of rumen-undegraded protein (RUP) on lactation performance and rumen fermentation. Evaluation of source of RUP was accomplished by comparing dried corn distillers grains with solubles (DDGS) to soybean protein. Five ruminally cannulated Holstein cows ( $122 \pm 45$  DIM) were used in a  $5 \times 5$  Latin square with 28 d periods. Diets were formulated to provide 3 concentrations of dietary RUP (% of DM) from 2 different sources: 1) 5.3% RUP (control), 2) 6.8% RUP from soybean protein, 3) 6.8% RUP from DDGS, 4) 8.3% RUP from soybean protein, and 5) 8.3% RUP from DDGS. All diets were formulated to contain 10% RDP. Diets consisted of 38.5% corn silage, 16.5% alfalfa hay, and 45% concentrate (DM basis). DMI increased ( $P < 0.05$ ) with the addition of supplemental RUP (21.0, 21.7, 22.6, 22.7, and 23.1 kg/d). Milk production was greater ( $P < 0.01$ ) for cows fed diets containing DDGS vs. soybean protein (31.8, 32.3, 34.8, 32.6, and 36.7 kg/d). Protein yield increased ( $P < 0.01$ ) when soy protein was replaced with DDGS (0.86, 0.86, 0.94, 0.87, and 0.99 kg/d). MUN increased ( $P < 0.01$ ) as dietary RUP increased (13.6, 15.1, 14.9, 19.0, and 18.7 mg/dl). Increasing dietary RUP increased ( $P < 0.01$ ) ruminal  $\text{NH}_3$  concentrations (4.76, 5.19, 5.39, 6.75, and 5.66 mg/dl). Ruminal concentrations of propionate decreased ( $P < 0.01$ ) when soy protein was replaced with DDGS and increased ( $P < 0.01$ ) when the dietary RUP concentration was increased (22.1, 26.0, 23.1, 23.9, and 23.2 mg/dl). Concentrations of butyrate in the rumen increased ( $P < 0.01$ ) when DDGS replaced soy protein (11.2, 10.9, 12.1, 11.3, and 13.0 mg/dl). The ratio of acetate to propionate increased ( $P < 0.01$ ) when DDGS replaced soy protein. Increasing RUP in the form of DDGS increased milk production and  $\text{NH}_3$  concentrations but decreased propionate concentrations to a greater extent than RUP supplied by soybean protein.

**Key Words:** Dried Distillers Grains, Soybean Protein, Rumen Fermentation

**T346 Effects of alcohol-fermented feedstuff supplemented with chitooligosaccharide on growth performance, blood metabolites and meat composition of Korean steers.** B. K. Park<sup>1</sup>, I. S. Yuh\*<sup>2</sup>, S. K. Hwang<sup>2</sup>, B. J. Hong<sup>2</sup>, and J. S. Shin<sup>2</sup>, <sup>1</sup>National Livestock Research Institute, Rural Development Administration, Pyeongchang, Korea, <sup>2</sup>College of Animal Life Sciences, Kangwon National University, Chuncheon, Korea.

Fifty Korean steers (average body weight=592.0±45.8kg) were used in the experiment to determine the effects of supplementing chitooligosaccharide (COS) on growth performance, blood metabolites and meat composition in Korean steers fed alcohol-fermented feedstuff (AFF). Steers were randomly assigned to feeding groups of AFF without COS (T1), AFF supplemented with 0.01% of COS (T2), AFF supplemented with 0.02 % of COS (T3), AFF supplemented with 0.05 % of COS (T4), and AFF supplemented with 0.1 % of COS (T5). Average daily gain (ADG) was lower in T5 than in T1 ( $p < 0.05$ ). Concentration of blood albumin was lower in T2 than in the other treatments ( $p < 0.05$ ). Concentration of blood glucose was lower in T1 than in the other treatments ( $p < 0.05$ ). Concentrations of blood low density lipoprotein (LDL)-cholesterol and triglyceride were lower in

T4 than in T1 ( $p < 0.05$ ). Back fat thickness was higher in T2 than in T1 or T5 ( $p < 0.05$ ). Longissimus muscle area was higher in T5 than in T1 ( $p < 0.05$ ). Marbling score, meat color, fat color, maturity, and texture were similar between treatments ( $p > 0.05$ ). Protein content of longissimus muscle was higher in T4 than in T3 or T5 ( $p < 0.05$ ). Cholesterol and linolenic acid contents of longissimus muscle were higher in T1 than in the other treatments ( $p < 0.05$ ). Arachidonic and docosahexanoic acid contents of longissimus muscle were higher in T5 than in T1 ( $p < 0.05$ ). Lightness among surface colors of longissimus muscle was lower in T1 than in T5 ( $p < 0.05$ ), and hue angle was lower in T1 than in the other treatments ( $p < 0.05$ ). Present results indicate that 0.05 or 0.1% supplementation of COS to AFF is more favorable in terms of blood metabolite, carcass characteristics and composition, and surface color of longissimus muscle.

**Key Words:** Alcohol-fermented Feedstuff, Chitooligosaccharide, Korean Steers

**T347 Effects of added yeast culture on lactating dairy cows with subacute ruminal acidosis.** M. S. Douglas\*, O. AlZahal, S. L. Greenwood, M. Or-Rashid, and B. W. McBride, *University of Guelph, Guelph, Ontario, Canada.*

Of the many challenges today's dairy producers face, subacute ruminal acidosis (SARA) is of increasing concern as producers try to maximize production with higher grain diets. It was hypothesized that inclusion of a yeast culture (Diamond V XP, Yeast Culture, Diamond V, Cedar Rapids, Iowa) *Saccharomyces cerevisiae* (*S. cerevisiae*) in the diet would have a stabilizing affect on the animals' rumen pH and DMI (dry matter intake). The objective of the study was to examine the effect of SARA and added yeast culture interaction on rumen pH, DMI and milk yield. Six multiparous, ruminally fistulated Holstein cows (639 + 51 kg BW) were blocked by DIM (early, moderate and late) and then randomly assigned to a SARA diet ( $n=3$ ) or control diet ( $n=3$ ). The trial consisted of 2 weeks pre-yeast followed by 2 weeks of 112g yeast addition into the rumen through the fistula. Rumenal pH was continuously recorded, milk samples were taken 3 d/wk and milk yield and DMI were recorded daily. Data were averaged by week and analyzed by yeast addition using PROC MIXED of SAS with repeated measures where the effect of yeast addition was tested by the contrast describing the time (wk) and time by diet interaction. The results show no effect of week or week by diet interaction on mean rumen pH, time spent below pH 6.0, 5.8 and 5.6, DMI or milk yield.

**Table 1. The effect of yeast culture on ruminal pH, dry matter intake, and milk yield in Holstein dairy cows.**

Item/wk	Control		SARA		SEM	Diet	P Value	
	1	2	1	2			wk	wk x Diet
Mean pH	6.11	6.06	5.77	5.85	0.05	0.03	0.78	0.32
< 6.0, min/d	509	614	1055	1007	63.51	0.02	0.64	0.25
< 5.8, min/d	253	259	630	638	58.15	0.02	0.92	0.99
< 5.6, min/d	97	104	368	283	86.22	0.14	0.64	0.59
DMI, kg/d	21.9	22.2	24.5	25.0	1.5	0.33	0.43	0.75
Milk, kg/d	32.8	32.8	32.1	32.5	6.06	0.96	0.71	0.71

**Key Words:** Yeast Culture, SARA, Rumen pH

**T348 Effect of feeding system on lactation characteristics and milk components in dairy cattle.** M.-C. Ferland\*<sup>1</sup>, D. Lefebvre<sup>2</sup>, and K. M. Wade<sup>1</sup>, <sup>1</sup>*McGill University, Montreal, QC, Canada*, <sup>2</sup>*Valacta, Ste. Anne de Bellevue, QC, Canada.*

The objective of this study was to evaluate the effect of two different feeding systems on the milk composition of dairy cattle. A total 9,163,240 test-day records from 570,083 Holstein cows from 5191 different herds, and 434,018 test-day records from 27,110 Ayrshire cows from 652 different herds covering a period of five years were obtained from the Québec dairy herd improvement agency (Valacta). In addition to test-day records, information on lactation, feed composition and feeding systems was also available. For both Ayrshire and Holstein cows the feeding system had an effect on milk yield and milk urea nitrogen (MUN) concentration on a test-day basis. Cows served a diet prepared with a Total mixed ration (TMR) compared to cows served a diet in a Traditional way (TRAD) tended to produce more milk. Average milk yields for Holsteins in the respective feeding systems were 26.29 kg/day and 29.28 kg/day; the equivalent values for Ayrshire were 21.44 kg/day and 23.23 kg/day. Peak milk yield for cows fed TRAD was generally lower and achieved earlier in lactation (45 - 60 DIM) compared to cows fed TMR (60 - 75 DIM). Lower MUN concentrations were observed when cows were fed TMR compared to TRAD. Holstein averages were 11.45 mg/dL and 10.61 mg/dL while Ayrshire averages were 12.40 mg/dL and 11.04 mg/dL for TRAD and TMR respectively. Over the lactation period the differences in MUN concentration between TMR fed and TRAD fed cows are even more pronounced beyond 30 DIM. Ayrshire cows also displayed a small difference in milk protein content between the two types of feeding system. TRAD fed cows had lower milk protein content (3.40%) compared to TMR fed cows (3.45%) but when milk protein content was observed over the lactation period, greater differences were observed beyond 90 DIM. When the lactose content of Holstein test-day records was studied over the lactation period, TMR fed cows had a better persistency of lactose content than TRAD fed cows after 90 DIM although the average lactose content only showed small numerical differences (4.52% and 4.57% for TRAD and TMR respectively).

**Key Words:** Dairy Feeding System, Milk Urea Nitrogen, Milk Components

**T349 Effect of rumen protected choline (Reashure®) and rumen protected methionine on milk yield, and composition in lactating dairy cows.** S. Emanuele\*<sup>1</sup>, T. Hickley<sup>1</sup>, and R. Carvalho Bicalho<sup>2</sup>, <sup>1</sup>*Balchem, New Hampton, NY*, <sup>2</sup>*Cornell University, Ithaca, NY.*

Holstein cows were used to evaluate the impact of rumen protected choline (Reashure®), (18 g/cow/day) and rumen protected methionine (Smartamine®), (18 g/cow/day) on milk yield and composition in a well-managed commercial herd. Experimental treatments were 1) control, no rumen protected choline or methionine, 2) rumen protected methionine (RPMET) and 3) rumen protected choline (RPC). Cows were assigned to treatment groups based on DIM and parity. The experimental period was 10 weeks which included a 2 week pretrial covariate period. DIM at the start of the trial were 224, 212 and 217 for control, RPMET and RPC treatments. Diets were formulated using CNCPS model software. Lysine and methionine as a percent of metabolizable protein (MP) was estimated using CNCPS software and was 7.17 and 2.03% in control and RPC diets. Lysine and methionine as a percent of MP in the RPMET diet was 7.12 and 2.41%. Weekly

averages for milk yield data were analyzed using the mixed model procedure of SAS (SAS Institute, Inc., Cary, NC). Covariates used in the analysis were pretrial milk yield, parity and DIM. Supplementing rumen protected choline (RPC) to late lactation cows increased milk yield compared to RPMET ( $P < 0.05$ ). There was a trend for increased milk fat % on the RPC treatment ( $P < 0.09$ ). Supplementing RPMET increased milk protein % compared to RPC ( $P < 0.05$ ). There was no difference among treatments for milk protein yield. Actual milk fat yield was increased 4.9% on RPC treatment compared to control. Milk income per cow was increased by 2.5% when RPC was fed to late lactation cows.

**Table 1. Effect of treatments on animal performance**

Item	Control, n=254	RPMET, n=263	RPC, n=253	SE
Milk Yield, kg/d	37.6 <sup>a</sup>	36.5 <sup>b</sup>	38.0 <sup>a</sup>	0.57
Milk Fat, %	3.60 <sup>e</sup>	3.54 <sup>e</sup>	3.70 <sup>d</sup>	0.04
Milk Protein, %	3.06 <sup>a</sup>	3.10 <sup>a</sup>	3.00 <sup>b</sup>	0.02
Milk fat yield, lbs./d	2.86	2.83	3.00	
Milk Income per cow, \$	10.01	10.10	10.26	

<sup>ab</sup>Values in the same row with different superscripts are different ( $P < 0.05$ ) <sup>de</sup>Values in the same row with different superscripts are different ( $P < 0.09$ )

**Key Words:** Choline, Methionine, Dairy

**T350 Effects of choline and rumen protected choline (Reashure<sup>®</sup>) on milk production, milk composition and blood metabolites of lactating dairy cows.** A. Toghdory<sup>1</sup>, S. Emanuele<sup>\*2</sup>, T. Ghoorchi<sup>3</sup>, and A. Naserian<sup>4</sup>, <sup>1</sup>Islamic Azad University, Gorgan, Iran, <sup>2</sup>Balchem Corporation, New Hampton, NY, <sup>3</sup>Gorgan University of Agricultural Sciences, Gorgan, Iran, <sup>4</sup>Ferdowsy University, Mashhad, Iran.

Eight multiparous Holstein cows with an average milk production of 34.6 kg/d and body weight of 662.5 kg were used to evaluate the effect of choline chloride or rumen protected choline (Reashure<sup>®</sup>) on animal performance. The experimental design was a 4X4 Latin Square with 21 day periods. Experimental treatments were: 1) no choline (NC), 2) choline chloride (CC) fed at 50 g/d, 3) rumen protected choline (RPC 25) fed at 25 g/d and 4) rumen protected choline (RPC 50) fed at 50 g/d. Rumen protected choline was blended with 0.25kg of ground corn and fed once per day. Diets contained 17.4% crude protein, 21% ADF, 34% NDF and 41% NFC. Diet content of lysine and methionine as a percent of metabolizable protein was 6.48 and 1.9%, estimated using CPM ration software. Animals were milked three times per day. Milk yield was measured at each milking during the last 7 days of each period. Individual milk samples for component analysis were collected on the last 2 days of each period and pooled from 3 consecutive samples. Dry matter intake as a percentage of body weight was 3.52% and not different among treatments. Supplementing cows with choline chloride did not affect animal performance compared to control. Supplementing cows with rumen protected choline (RPC 50) increased milk yield, 4% FCM, milk fat % and milk fat yield compared to cows not receiving choline.

**Table 1. Effect of treatments on animal performance**

Item	NC	CC	RPC 25	RPC 50	SE
Milk Yield, kg/d	34.3 <sup>b</sup>	34.9 <sup>ab</sup>	34.4 <sup>ab</sup>	36.0 <sup>a</sup>	0.53
4% FCM, kg/d	31.7 <sup>b</sup>	31.6 <sup>b</sup>	32.7 <sup>ab</sup>	34.4 <sup>a</sup>	0.74
Milk fat yield, kg/d	1.20 <sup>b</sup>	1.17 <sup>b</sup>	1.26 <sup>ab</sup>	1.33 <sup>a</sup>	0.038
Milk protein yield, kg/d	1.03	1.06	1.04	1.09	0.019
Total solids yield, kg/d	4.05 <sup>b</sup>	4.02 <sup>b</sup>	4.11 <sup>ab</sup>	4.31 <sup>a</sup>	0.082
Milk fat, %	3.50 <sup>ab</sup>	3.37 <sup>b</sup>	3.68 <sup>a</sup>	3.69 <sup>a</sup>	0.089
Milk protein, %	3.02	3.06	3.02	3.03	0.024
Blood Glucose, mg/dl	42.1	44.7	44.1	43.6	1.70

<sup>ab</sup>Values in the same row with different superscripts are different ( $P < 0.05$ )

**Key Words:** Choline, Dairy Cow, Reashure

**T351 Effect of rumen protected choline (Reashure<sup>®</sup>) supplemented to high-producing cows on milk production, milk components, and intake.** M. B. de Ondarza<sup>\*1</sup>, S. Emanuele<sup>2</sup>, and D. Putnam<sup>2</sup>, <sup>1</sup>Paradox Nutrition, West Chazy, NY, <sup>2</sup>Balchem Corporation, New Hampton, NY.

The objective of the trial was to determine if feeding a small amount of rumen protected choline to lactating multiparous Holstein cows would affect milk components and milk yield. Half of the cows (n=153) received Reashure<sup>®</sup> (12.3 g/cow/day) and half did not (n=158) for the four week study. The study was conducted in a well managed commercial herd. Daily pen dry matter intakes were monitored. Daily milk production of individual cows was recorded. Milk was sampled on weeks 3 and 4 of the study and analyzed for milkfat, true protein, SCC, and MUN content. All diets contained Alimet<sup>®</sup> and monensin. The control diet contained 7.06% lysine and 2.01% methionine as a percent of MP estimated by CPM ration software. Cows fed rumen protected choline consumed significantly less dry matter than control cows (23.00 vs. 23.82 kg/cow/day for Reashure<sup>®</sup> vs. control cows ( $P < 0.001$ ). Overall milk production was not affected by treatment ( $P > 0.20$ ), 43.92 kg/day and 43.85 kg/day for the Reashure<sup>®</sup> and control diets. There was no difference due to treatment in 3.5% FCM ( $P > 0.20$ ). However, cows between 101 and 200 DIM produced significantly more 3.5% FCM ( $P < 0.01$ ). Milkfat (%) was affected positively by Reashure<sup>®</sup> ( $P = 0.011$ ) with 3.63% milkfat for cows fed Reashure<sup>®</sup> and 3.44% for cows on the control diet. Production of milkfat was increased by treatment with 1.57 kg/day for cows fed Reashure<sup>®</sup> and 1.49 kg/day for cows fed the control diet ( $P = 0.067$ ). Cows between 101 and 200 DIM produced significantly more milkfat when fed Reashure<sup>®</sup> ( $P < 0.01$ ). Cows on the Reashure<sup>®</sup> and control diets produced milk with a similar percentage of true milk protein (2.87% vs. 2.86%, ( $P > 0.20$ ). However there was a trend for greater milk protein % in cows between 0 and 100 DIM, ( $P < 0.09$ ) for cows fed Reashure<sup>®</sup>. There was no difference among treatments in true milk protein yield, MUN (mg/dl), or SCC ( $P > 0.20$ ). These data suggest that supplementation of rumen protected choline to high-producing cows may improve efficiency of milk production and milkfat synthesis.

**Key Words:** Rumen-Protected Choline, Milk Production, Reashure

**T352 Effects of rumen protected choline during transition phase on metabolic profile and ovarian activity in Italian Friesian dairy cows.** F. Abeni<sup>1</sup>, M. G. Terzano<sup>2</sup>, M. Speroni<sup>1</sup>, L. Migliorati<sup>1</sup>, P. Cavassini<sup>3</sup>, and G. Pirlo<sup>\*1</sup>, <sup>1</sup>*CRA Istituto Sperimentale per la Zootecnia, Cremona, Italy*, <sup>2</sup>*CRA Istituto Sperimentale per la Zootecnia, Roma Monterotondo, Italy*, <sup>3</sup>*Ascor Chimici s.r.l, Bertinoro, Italy*.

The objective of this paper was to report the effects of supplementation of rumen protected choline (RPC) to transition cows on plasma metabolites and ovarian activity resumption (OAR). Twenty-two Italian Friesian cows were randomly assigned by expected calving date, parity, and previous milk yield to either be supplemented with RPC from d -21 relative to expected parturition until 35 DIM, or to consume basal diet only (CON). Treatment with RPC was obtained adding 50 g of RPC top dressed product (Sta-Chol<sup>®</sup>, Ascor Chimici, Italy, with 50% choline as choline chloride) per cow, just after TMR distribution. Jugular blood samples were collected before feeding, once just before the trial start, and then weekly until the 10th wk of lactation. Pre and postpartum data were analyzed separately. Effects of treatment were measured on plasma glucose, NEFA, cholesterol, BHBA, triglycerides, and OAR (monitored by plasma progesterone). Statistical analysis was performed by a randomized block design, with supplementation (RPC vs. CON), and week of trial as main factor, with cow repeated in time, while OAR data were analyzed by one-way ANOVA. Cows fed RPC had higher plasma urea (4.06 vs. 3.54 mmol/L;  $P<0.05$ ) during prepartum. Plasma glucose was lower (3.26 vs. 3.52 mmol/L;  $P<0.05$ ) and BHBA was higher (0.496 vs. 0.390 mmol/L;  $P<0.05$ ) in RPC cows at the beginning of lactation, but without differences in clinical signs of ketosis (absent in both groups). Postpartum plasma triglycerides level was higher (0.104 vs. 0.084 mmol/L;  $P<0.05$ ), and there was a trend ( $P<0.10$ ) showing lower plasma values of NEFA and NEFA/cholesterol ratio in RPC cows, reaching significant difference at 4 wk ( $P<0.05$ ) for both items. No significant difference was observed in DIM at OAR. Supplementation with RPC improved metabolic profile of peripartum dairy cows in order to prevent the risk to develop fatty liver syndrome.

**Key Words:** Choline, Dairy Cow, Metabolic Profile

**T353 Effects of rumen protected choline during transition phase on production responses in Italian Friesian dairy cows.** F. Abeni<sup>1</sup>, M. Speroni<sup>1</sup>, M. G. Terzano<sup>2</sup>, L. Migliorati<sup>1</sup>, P. Cavassini<sup>3</sup>, and G. Pirlo<sup>\*1</sup>, <sup>1</sup>*CRA Istituto Sperimentale per la Zootecnia, Cremona, Italy*, <sup>2</sup>*CRA Istituto Sperimentale per la Zootecnia, Roma Monterotondo, Italy*, <sup>3</sup>*Ascor Chimici s.r.l, Bertinoro, Italy*.

The objective of this paper was to report the effects of supplementation of rumen protected choline (RPC) to transition cows on production responses. Twenty-two Italian Friesian cows were randomly assigned by expected calving date, parity, and previous milk yield to either be supplemented with RPC from d -21 relative to expected parturition until 35 DIM, or to consume basal diet only (CON). Treatment with RPC was obtained by the addition of 50 g RPC top dressed product (Sta-Chol<sup>®</sup>, Ascor Chimici, Italy, with 50% choline as choline chloride) per cow, just after once daily TMR distribution. Body condition score (BCS) was measured weekly from -21 to +70 DIM. Milk production was automatically recorded at each milking, within an automatic milking system, whereas milk composition was determined every 2 weeks. Statistical analysis was performed by a randomized block design, with supplementation (RPC vs. CON), and time as main

factors, with cow repeated in time; BCS variation was analyzed as a simple one-way ANOVA. Milk production (34.8 vs. 29.9 kg/d;  $P<0.001$ ), ECM (34.9 vs. 31.1 kg/d;  $P<0.01$ ), fat yield (1.26 vs. 1.11 kg/d;  $P<0.05$ ), and protein yield (1.10 vs. 1.00 kg/d;  $P<0.05$ ) were higher for the RPC group, whereas no significant differences between treatments were evidenced in fat and protein content. Prepartum BCS was lower in the RPC group (3.27 vs. 3.49;  $P<0.01$ ); however, BCS variation throughout the treatment period (-21 to 35 d relative to calving date) had a trend to be higher in the RPC group (0.83 vs. 0.61;  $P=0.14$ ). The differences in BCS variation suggest a better management of body fat reserves in the transition phase of RPC cows. From the results obtained in the present trial, on a small number of cows, peripartum supplementation of RPC at the considered level seems to improve productive performance in an extent which encourages further studies on a larger number of cows.

**Key Words:** Choline, Dairy Cow, Milk Yield

**T354 Effects of feeding rumen-protected choline (RPC) on health and reproduction of dairy cows.** F. S. Lima<sup>\*1</sup>, M. F. Sa Filho<sup>1</sup>, J. E. Garrett<sup>2</sup>, and J. E. P. Santos<sup>1</sup>, <sup>1</sup>*Veterinary Medicine Teaching and Research Center, University of California Davis, Tulare*, <sup>2</sup>*Balchem Corporation, Animal Health & Nutrition, New Hampton, NY*.

Objectives were to determine the effects of feeding RPC on health and reproduction in dairy cows. In Experiment 1 (E1), 369 cows were fed 15 g/d of RPC (Reashure, Balchem Encapsulates) from 25 d before calving to 80 d in milk (DIM). In E2, 578 primigravid cows were fed 15 g/d of RPC in the 21 d before calving. Health of cows was monitored daily in the first 80 DIM by the research team in E1 and by farm personnel in E2, both following the same disease case definitions. Cows were presynchronized with 2 injections of PGF2a given 14 d apart and then subjected to a timed AI using the CoSynch protocol (d 0, GnRH, d 7, PGF2a, d 10 GnRH and timed AI) initiated either 10 or 14 d after the second PGF2a for E1 and E2, respectively. Data were analyzed using the Logistic procedure of SAS (2001). In E1, feeding RPC reduced ( $P<0.05$ ) the incidence of ketonuria (10.7 vs 28.8%), clinical ketosis (4.0 vs 11.3%), and relapse of clinical ketosis (2.3 vs 6.8%). Incidence of retained placenta, postpartum fever, puerperal metritis, metritis and displacement of abomasum did not differ ( $P>0.10$ ) between treatments, but mastitis was reduced ( $P=0.06$ ) in cows fed RPC compared with controls (14.8 vs 22.5%), and cows fed RPC experienced fewer ( $P=0.04$ ) cases of mastitis (0.19 vs 0.33/cow). Cyclicity prior to the CoSynch protocol was similar ( $P=0.67$ ) between treatments and averaged 81.7%. Conception rates at first (48.2 vs 41.2%;  $P=0.20$ ) and second postpartum AI (23.7 vs 19.8%;  $P=0.47$ ) did not differ between RPC and control. In E2, RPC did not affect ( $P=0.41$ ) incidence of clinical ketosis (7.0 vs 3.7%), reduced ( $P=0.02$ ) the incidence of retained placenta (2.1 vs 6.7%), but more ( $P<0.02$ ) RPC cows experienced postpartum fever (17.2 vs 11.4%) and metritis (35.4 vs 21.8%) than controls. Conception rates at first (50.6 vs 50.8%;  $P=0.83$ ) and second AI (38.8 vs 46.4%;  $P=0.49$ ) were similar between RPC and control. Feeding RPC prior to and after calving improved postpartum health, but did not significantly influence uterine health or reproductive performance of dairy cows. When fed only prepartum to primigravid cows, RPC had mixed effects on health, but did not influence reproduction.

**Key Words:** Choline, Dairy Cow, Reproduction

**T355 Interrelationships of dietary supplies of choline and methionine on productive performance of Holstein dairy cows.** B. J. Thering<sup>\*1</sup>, J. M. Ramos-Nieves<sup>1</sup>, J. L. Lukas<sup>1</sup>, D. E. Putnam<sup>2</sup>, and T. R. Overton<sup>1</sup>, <sup>1</sup>Cornell University, Ithaca, NY, <sup>2</sup>Balchem Encapsulates, New Hampton, NY.

Holstein dairy cows (n=60) in early lactation were used to investigate the interrelationships between dietary supplies of choline and methionine (Met) on productive performance. During wk 11 of lactation, cows (n=10 multiparous and n=5 primiparous) were assigned to one of four dietary treatments in a completely randomized design with a 2 x 2 factorial arrangement of treatments. Main effects were supplementation with 0 or 15 g/d of rumen-protected choline (Reashure™, Balchem Encapsulates, New Hampton, NY) and 0 or 14 g/d of rumen-protected Met (Mepron M85, Degussa Corporation, Kennesaw, GA). Treatments were administered by daily topdress from wk 11 through 18 of lactation. Cows were fed a diet formulated to supply Met and Lys at 1.94 and 6.79% of metabolizable protein, respectively. Covariate data collected during wk 10 of lactation was used during statistical analysis of all variables. Dry matter intake (25.4, 25.0, 25.4, and 25.4 kg/d for control, choline, Met, and choline+Met, respectively) and milk yield (43.7, 44.1, 44.5, 44.1 kg/d) were not affected (P > 0.60) by treatment. Supplementation with Met tended (P < 0.09) to decrease milk fat percentage (3.68 vs. 3.55%) and supplementation with choline tended (P < 0.06) to decrease milk true protein percentage (2.86 vs. 2.82%). Percentages of lactose and total solids in milk were not affected (P > 0.13) by treatment. Yields of milk components were not affected (P > 0.24) by treatment. Supplementation with choline tended (P < 0.10) to increase concentrations of milk urea N (13.1 vs. 13.6 mg/dL). Body weight and body condition score were not affected (P > 0.19) by treatment. Interactions of parity with either the main effects or the interaction of the main effects were not significant (P > 0.10) for any variable. Overall, supplementation with either choline or methionine resulted in only minor effects on productive performance; interactions of choline and methionine were not evident for any of the variables studied in this experiment.

**Key Words:** Dairy Cow, Choline, Methionine

**T356 Effects of feeding protected choline on arrival or during Optaflexx feeding on performance or carcass characteristics of feedlot cattle.** R. K. Gill<sup>\*1</sup>, C. R. Dahlen<sup>2</sup>, N. DiLorenzo<sup>1</sup>, and A. DiCostanzo<sup>1</sup>, <sup>1</sup>University of Minnesota, St. Paul, <sup>2</sup>University of Minnesota Northwest Research & Outreach Center, Crookston.

One hundred eighty seven crossbred yearling steers (average initial BW = 306 kg) were allocated to 16 pens (9 to 14 steers/pen) to evaluate the effects of feeding ruminally protected choline (RPC) on arrival or during Optaflexx feeding on performance and carcass characteristics. Steers were fed a finishing diet based on corn silage (13.0 %), high moisture corn (63.5 %), dry rolled corn (18.0 %), and mineral supplement (5.5 %) on a DM basis. Pens were randomly assigned to one of four dietary treatments: 1) no RPC added in the protein supplement (**Control**), 2) feeding 20 g RPC/hd/d in the protein supplement from d 1 to d 42 (**Initial 42**), 3) feeding 20 g RPC/hd/d during the last 28 to 42 d on feed (**Final 42**), or 4) or feeding 20 g RPC during both the initial 42 d and final 28 to 42 d on feed (**Both**). All dietary treatments received the β-agonist Optaflexx during the final 28 to 42 d on feed. Dry matter intake (9.81 ± 0.26 kg/d), ADG (1.87 ± 0.03 kg/d), and G:F (0.19 ± 0.07 kg) were unaffected by dietary

treatment (P > 0.05). Hot carcass weight, dressing percentage, KPH, fat thickness, and rib eye area were also unaffected by dietary treatment (P > 0.05). Carcasses from steers of all treatments were, on average, low choice quality grade with average yield grade 2.0. Previous research has demonstrated that optimum performance with RPC occurs with 20 g of RPC supplementation daily. Further research is warranted to test duration of RPC supplementation during the finishing period alone or in combination with β-agonists.

**Key Words:** Choline, Feedlot Cattle, Performance

**T357 Field studies adding dl-methionine hydroxy analogue calcium to lactation cow rations.** D. Nuzback<sup>\*1</sup>, G. Bowen<sup>1</sup>, R. Anderson<sup>1</sup>, M. Vazquez-Anon<sup>1</sup>, and M. Hutjens<sup>2</sup>, <sup>1</sup>Novus International, St. Louis, MO, <sup>2</sup>University of Illinois, Urbana.

Four commercial high producing herds (Dairy A, a MN herd; Dairy B, a WI herd; Dairies C and D, IL herds) were supplemented with 25 grams per cow per day of the calcium salt of 2-hydroxy-4- methylthio butanoic acid (84 % HMTBa; MFP ^TM^, Novus International, Inc.), a source of methionine. The experimental design included a pre-treatment period, a treatment period (treat) of 90 days, and a post-treatment period. Milk production data were collected using PC DART or Dairy Comp 305 record systems with the pre- and post-treatment data averaged for the control period. A total of 1,938 cows met the experimental criteria (milk production data from Oct., 2005 to June, 2006). SAS statistical software was used to evaluate the treatment differences. Cows in the four herds receiving HMTBa produced 1.96 kg more milk per cow (P = 0.01), averaging 41.8 kg (treat) while control cows averaged 39.9 kg. Milk protein yield was increased by 52 grams per day in the supplemented cows compared to the controls (P < 0.01). Control cows averaged 1,185 grams of protein compared to supplemented cows yielding 1,237 grams of milk protein. Milk fat yield increased, but was not significantly different. Table 1 summarizes individual farm milk production responses. The economic benefit was a 5:1 benefit to cost ratio based on \$12 per 45 kg of milk and a 10 cent investment for HMTBa.

**Table 1. Milk production yield response by herd**

Dairy	Herd Size (total)	Cows (included)	Control (kg/cow)	Treat (kg/cow)	SE (+/-)
A	1400	1005	41.9	43.9	0.19
B	1250	782	39.9	41.0	0.18
C	150	119	39.1	41.1	0.48
D	70	32	38.4	41.1	1.03

**Key Words:** Amino Acid, Milk Yield, Milk Protein

**T358 Influence of dietary protein on growth, fluoride kinetics and radiology of long bones of crossbred calves exposed to high fluoride diets.** J. D. Lohakare<sup>\*2,1</sup>, A. K. Pattanaik<sup>2</sup>, and S. A. Khan<sup>2</sup>, <sup>1</sup>University of Bonn, Bonn, Germany, <sup>2</sup>Indian Veterinary Research Institute, Izatnagar, India.

Effects of dietary protein levels on the performance of crossbred calves exposed to high fluoride diets were investigated. Accordingly, 30

crossbred calves (6-8 months) were distributed randomly into a 2×3 factorial arrangement involving two levels of dietary fluorine (F; 0 and 200 mg/kg), and three levels of dietary protein (CP; 100, 75 and 125 % of Kearn recommendation). All the calves were fed on a standard diet consisting of concentrate mixture and ad libitum wheat straw. There was daily recording of dry matter intake as well as fortnightly monitoring of live weight changes. A metabolism trial was conducted towards the end of the 210 days of experimental feeding to assess the fluoride kinetics. The results revealed that average daily gain of the calves was significantly ( $P < 0.05$ ) influenced by both dietary CP as well as F levels, being lower on low protein ( $319 \pm 50.4$  vs.  $400 \pm 27.0$  and  $407 \pm 34.5$ g) and high F ( $289 \pm 27.9$  vs.  $462 \pm 17.1$ g), respectively. Similar was the case in terms of feed conversion efficiency; it was lower ( $P < 0.05$ ) upon low CP and high F feeding. Moreover, a significant interaction between F and CP indicated a lower ( $P < 0.05$ ) feed efficiency when F was added to low CP diet. The mean daily intake, excretion and retention of F were higher ( $P < 0.01$ ) in the F supplemented calves. No effect of dietary protein levels was apparent on fecal fluoride excretion. A significant ( $P < 0.01$ ) interaction between protein and F levels was evident in the urinary excretion of F; calves on low protein diet exhibiting lower urinary excretion. Consequently, the bioavailability of F tended to be higher on low than normal or high protein diets. Lateral radiographs of metacarpal and metatarsal bones taken at 90 and 210 days of the study revealed significant effects of high fluoride diet on bone width, cortical thickness and medullary cavity but without any influence of dietary protein levels. Overall, it is concluded that while feeding of high CP did not exert appreciable protective effects, provision of low CP diet aggravated the performance-reducing effects of high fluoride diet.

**Key Words:** Fluorine, Protein, Calves

**T359 Organic selenium (Sel-Plex<sup>®</sup>) improves selenium content in milk and cheese of dairy goats.** G. Caja<sup>\*1</sup>, C. Flores<sup>1</sup>, A. A. K. Salama<sup>1</sup>, J. Saldo<sup>1</sup>, and G. Bertin<sup>2</sup>, <sup>1</sup>Universitat Autònoma de Barcelona, Bellaterra, Spain, <sup>2</sup>Alltech France, Levallois-Perret, France.

Thirty Murciano-Granadina dairy goats were used to study the lactational effects of inorganic Se (SS, selenium selenite,  $\text{Na}_2\text{SeO}_3$ ) and organic Se from selenized *Saccharomyces cerevisiae* CNCM I-3060 (SP, Sel-Plex<sup>®</sup>, Alltech) in a source and dose response experiment. Goats were allocated to 4 balanced groups to which dietary treatments were randomly assigned: control (without Se supplement, C), inorganic (0.3 mg Se as  $\text{Na}_2\text{SeO}_3$ , SS-0.3), and 2 doses of organic selenium (0.3 mg and 0.45 mg Se as Sel-Plex<sup>®</sup>; SP-0.3 and SP-0.45, respectively). Concentrate mixture (0.8 kg/d), in which Se source was included, was fed individually. Forage diet (65% chopped tall fescue hay and 35% alfalfa hay pellets) was offered ad libitum for each group. The experiment lasted for 30 wk (wk 6 to 35 of lactation) and included a covariate period (P1, wk 1 to 2) on C diet, supplementation period (P2, wk 3 to 18), and washing out period (P3, wk 19 to 30) again on C diet. Milk yield was recorded weekly, and samples for milk composition analysis and technological dairy traits evaluation were taken biweekly. Milk was bulked for each group at wk 18 for cheese making. Milk (Se content) and blood (haematological and biochemical analysis) sampling was done at wk 2, 3, 4, 8, 12, 16, 18, 24, and 30. No differences in DM intake, milk yield or milk quality traits were detected between treatments. Concentrations of Se in milk varied ( $P < 0.001$ ) between treatments during p2 and were 8.8, 13.8, 19.5, and 39.7  $\mu\text{g/l}$  for c,

ss-0.3, sp-0.3, and sp-0.45, respectively. During p1 and p3, there were no differences between treatments in milk Se (4.9 and 7.8  $\mu\text{g/L}$ , respectively). During P2, Se and glutathione peroxidase (GPX) concentrations in blood increased ( $P < 0.01$ ) by Se supplementation with no difference between SS-0.3 and SP-0.3 and SP-0.45 values being the highest ( $P < 0.01$ ). Concentrations of Se in fresh cheese were 61, 99, 160, and 368  $\mu\text{g/kg}$  in C, SS-0.3, SP-0.3, and SP-0.45, respectively. In conclusion, organic Se was more effective than inorganic Se in increasing the concentration of Se in milk and cheese in dairy goats, indicating an improved bioavailability of Se from selenized *Saccharomyces cerevisiae* CNCM I-3060.

**Key Words:** Organic Selenium, Dairy Goats, Mineral Nutrition

**T360 Utilization of TRC Nutritional Laboratories trace mineral compost for growing and finishing beef cattle.** D. R. ZoBell<sup>\*</sup>, J. O. Hall, R. D. Wiedmeier, and C. K. Chapman, Utah State University, Logan.

The objectives of this study were to determine the effect of TRC Trace Mineral Compost Material (TMCM) on production characteristics and whole body mineral status of growing and finishing beef cattle. A total of 45 British-based crossbred steer calves (initial wt. 293 kg) were used during the growing and finishing phases of this study. There were 9 pens with 3 pens per treatment and 5 steers per pen. All calves in the growing (84d) and finishing (140d) studies received a standard barley-based growing (34% barley DMB) or finishing diet (77.3% barley DMB). Treatment consisted of a Control (C), Treatment 1 (T1) and Treatment 2 (T2). All calves received .045 kg of limestone per day during the finishing phase and 50,000 IU Vit A for the growing and finishing periods. The C calves received .045 kg d-1 of a standard TM salt; T1 calves .022 kg d-1 of salt (99%) and .07 kg d-1 of TMCM; T2 calves received .022 kg d-1 of salt and .14 kg d-1 of TMCM. True cut liver biopsy samples were collected from all calves at the beginning of the growing and finishing studies and at trial termination to monitor levels of Ca, Co, Cu, Fe, Mg, Mn, P, K, Se, Na and Zn. There were no differences between treatments for DMI, ADG, FE or carcass characteristics during growing or finishing ( $P > 0.05$ ). Generally, the treatments resulted in an increase in liver mineral levels as the study progressed through growing and finishing ( $P < 0.05$ ). However, Se and Co were low initially and remained so through finishing for T1 and T2 calves ( $P < 0.05$ ). The results indicated that feeding TMCM did not adversely affect production through all phases of production.

**Key Words:** Minerals, Beef Cattle, Liver

**T361 Influence of chromium supplementation during growing period on performance of Brahman cross bull calves.** R. Barajas<sup>\*1</sup>, E. A. Velazquez<sup>1</sup>, B. J. Cervantes<sup>2,1</sup>, F. Juarez<sup>1</sup>, and J. A. Romo<sup>1</sup>, <sup>1</sup>FMVZ-Universidad Autonoma de Sinaloa, Culiacan, Sinaloa, Mexico, <sup>2</sup>Ganadera Los Migueles SA de CV, Culiacan, Sinaloa, Mexico.

Sixty Brahman cross bull calves (BW =  $244 \pm 2.2$ kg) were used in a 91 d feedlot experiment to determine the influence of chromium supplementation during the growing period on performance of Brahman cross bull calves. Bull calves were received in a big pen (35 × 45 m) and fed a corn silage-based diet and rested 10 d, after that the animals

receive an implant containing estradiol and trenbolone (Component TES with Tylan; Elanco Animal Health de Mexico). Bull calves were sorted by weight into groups of five, allotted to pens (6 x 12 m) in a randomized block design. Treatments consisted of: 1) corn silage-based starting-diet during the first 28 d and the next 63 d fed a ground corn soybean meal-based growing-diet without supplementary chromium (Control); 2) control diet and 2.2 mg of supplementary Cr/head daily during the first 28 d in the feedlot; or 3) control diet and 2.2 mg of supplementary Cr/head during 91 d of entire experiment. Chromium was supplied as chromium methionine (MiCrOPLEX; Zinpro Co) mixed in 1 kg of ground corn and top dressed in the feed bunk. During the 28 d of receiving period Cr supplementation had no effect ( $P > 0.25$ ) on average daily gain ( $1.39 \pm .08$  kg/d), DMI ( $6.53 \pm .22$  kg/d) and feed/gain ratio ( $4.77 \pm .26$  kg/kg). From d 29 to d 91, cattle performance was not affected ( $P > 0.6$ ) by treatments. Over the complete 91 d experiment, bull ending weight ( $384.7 \pm 6.66$  kg) was similar ( $P = 0.72$ ) for all treatments. Average daily gain ( $1.542 \pm .07$  kg/d) was not affected ( $P = 0.85$ ) by Cr supplementation. The addition of chromium in the diet did not modify ( $P > 0.50$ ) DMI ( $7.197 \pm .27$  kg/d) or feed/gain ratio ( $4.68 \pm .18$  kg/kg). Observed/expected net energy of maintenance was 26% higher than expected from dietary composition and was not altered ( $P = 0.8$ ) by chromium supplementation. These results suggest that organic chromium supplementation may not be necessary for rested bull calves fed corn silage based-diets.

**Key Words:** Bull-Calves, Chromium, Growth-Performance

**T362 Effects of potassium, alcoholic diet and vitamin E to minimize transport stress in Korean steers.** J. S. Shin<sup>\*1</sup>, B. Y. Choi<sup>1</sup>, H. Kim<sup>1</sup>, C. S. Ra<sup>1</sup>, B. J. Hong<sup>1</sup>, J. S. Oh<sup>1</sup>, and B. K. Park<sup>2</sup>, <sup>1</sup>*College of Animal Life Sciences, Kangwon National University, Chuncheon, Korea*, <sup>2</sup>*National Livestock Research Institute, Rural Development Administration, Pyeongchang, Korea*.

This study was conducted to compare and evaluate effects of potassium, alcoholic diet, and vitamin E on transport shrinkage, blood metabolites, and meat color from transport stress in Hanwoo steers. Experiments were divided into four treatment groups; control (general feeding system), alcoholic diet (1.58kg/animal/day), potassium (1.45% of total dry matter intake), and vitamin E (500IU/animal/day). And each treatment had ten steers. Transport shrinkage was higher in control than in alcoholic diet, potassium or vitamin E ( $p < 0.05$ ). Concentrations of serum creatinine, glucose, total protein, and insulin of control were increased after transport compared with before transport ( $p < 0.05$ ). But those of alcoholic diet, potassium, and vitamin E were decreased after transport compared with before transport ( $p < 0.05$ ). Concentrations of serum calcium and cortisol were increased after transport compared with before transport regardless of treatments ( $p < 0.05$ ). But concentrations of serum inorganic phosphorus and triglyceride were decreased after transport compared with before transport regardless of treatments ( $p < 0.05$ ). Meat color were lower in alcoholic diet and vitamin E than in control ( $p < 0.05$ ). Fat color, marbling score, back fat thickness, and meat production index were similar between treatments ( $p < 0.05$ ). Lightness among surface colors of longissimus muscle was higher in vitamin E than in control ( $p < 0.05$ ), and chroma value was lower in control than in alcoholic diet, potassium or vitamin E ( $p < 0.05$ ). Therefore, results suggest that transport stress was decreased by alcoholic diet, potassium, or vitamin E. Also, potassium and alcoholic diet are more favorable in terms of transport shrinkage and blood

metabolite. And vitamin E has positive effects on meat color and surface colors of longissimus muscle in Korean steers.

**Key Words:** Transport Shrinkage, Meat Color, Korean Steers

**T363 The effects of maternal natural source vitamin E supplementation on suckling calf immune function.** M. Richardson<sup>\*1</sup>, S. Lake<sup>1</sup>, P. Gunn<sup>1</sup>, S. Eicher<sup>2</sup>, R. Lemenager<sup>1</sup>, and N. Pyatt<sup>3</sup>, <sup>1</sup>*Purdue University, West Lafayette, IN*, <sup>2</sup>*USDA-ARS, West Lafayette, IN*, <sup>3</sup>*ADM-Animal Nutrition Research, Decatur, IN*.

The objective of this study was to determine the effects of maternal supplementation of natural-source vitamin E (NSVE) and a commercially available mixture containing NSVE on suckling calf immune response. Eighty Angus beef cows (initial BW = 608 kg; initial BCS = 5.9) were randomly assigned to one of three isocaloric dietary treatments: 1) corn-based supplement with no added vitamins or minerals (CON), 2) corn-based supplement containing 1000 IU NSVE/d (VITE), and 3) corn-based supplement containing a commercially available mixture formulated to contain 1000 IU of NSVE/d (VITE+). Supplementation began 3 wks prepartum and continued through wk 8 of lactation. Blood was collected from calves at 24 h for analysis of IgG concentration as an indicator of passive transfer. At 19 d of age, blood was collected from calves to determine the presence of CD14 and CD18 receptors on leukocytes. At 25 and 40 d of age, calves were injected with hen egg albumin (OVA) and bled weekly until d 60 of age to determine total antibodies produced to OVA. Maternal NSVE supplementation did not influence ( $P > 0.05$ ) calf ADG or 24 h IgG concentrations. Calves suckling VITE and VITE+ dams tended to have greater ( $P = 0.19$ ) CD14 levels than CON calves while CD18 tended to be greater ( $P = 0.18$ ) in VITE+ than VITE and CON calves. A treatment  $\times$  day interaction ( $P < 0.001$ ) was detected for total antibodies produced to OVA. Total antibodies produced at d 14 tended to be greater ( $P = 0.06$ ) in VITE+ than CON calves, indicating an accelerated response time to the OVA challenge; however, VITE calves had greater ( $P = 0.05$ ) antibody production to OVA at d 28 than CON calves. In conclusion, maternal NSVE supplementation appeared to improve immune function in suckling calves with an increase in antibodies produced at d 14 and 28 and tended to increase CD14 and 18 receptors; however, calf performance was not affected.

**Key Words:** Beef Calves, Immune Response, Vitamin E

**T364 Effects of a humate product on growth performance, carcass merit, and tissue and serum mineral composition of individually-fed steers.** M. S. Brown<sup>1</sup>, T. E. Lawrence<sup>1</sup>, C. H. Ponce<sup>\*1</sup>, R. Pulikanti<sup>1</sup>, C. S. Smith, Sr.<sup>1</sup>, D. L. Mitchell<sup>1</sup>, B. Sumerford<sup>2</sup>, and J. D. Davenport<sup>2</sup>, <sup>1</sup>*West Texas A&M University, Canyon, TX*, <sup>2</sup>*Entex Energy, Amarillo, TX*.

Humate is composed of salts of humic and fulvic acids, Fe, and Al, and has reduced in vitro ammonia emissions from cattle waste at high rates of application. The objective of the present study was to evaluate the influence of a humate product (HA4, Entex Energy, Amarillo, TX) on performance, carcass merit, and tissue and serum mineral composition of beef steers. Twenty-seven crossbred steers (479 kg initial shrunk weight) were fed a 90% concentrate diet based on

steam-flaked corn containing 0, 0.5, or 1.0% of diet DM as HA4. Steers were housed in individual pens and fed treatments for 94 days before slaughter. Dietary HA4 did not affect ( $P > 0.10$ ) overall DMI (8.41, 8.51, and  $8.65 \pm 0.3$  kg/d), ADG (1.31, 1.37, and  $1.36 \pm 0.06$  kg/d), or feed efficiency (6.45, 6.33, and  $6.41 \pm 0.28$ ) for steers receiving 0, 0.5, and 1.0% HA4, respectively. Carcass marbling score, external fat thickness, LM area, and yield grade were not influenced by treatment ( $P > 0.10$ ). After slaughter, bone and soft tissue samples were collected from the wholesale foreshank (IMPS 117) for mineral analysis. Sodium concentration in soft tissue was 8% greater when 1.0% HA4 was fed ( $P < 0.05$ , quadratic), whereas sulfur and zinc concentrations were increased by feeding 0.5% HA4 and returned to control values when 1.0% HA4 was fed ( $P < 0.05$ , quadratic). Bone Ca, Mg, and Na concentrations were reduced ( $P < 0.05$ , quadratic) by 0.5% HA4, but concentrations of these minerals were similar between 0 and 1.0% HA4. Aluminum was not detected in soft tissue samples, and bone Al was above the assay limit of detection (5 ppm) in only 1 or 2 animals/treatment. Serum Fe concentration on d 94 was increased by feeding 0.5% HA4 ( $P = 0.08$ ; quadratic), and serum iron binding capacity on d 94 was increased by feeding either 0.5 or 1.0% HA4 ( $P = 0.03$ , quadratic; 408, 515, and  $483 \pm 24$  ug/dL). Data suggest that HA4 may be fed up to 1% of diet dry matter for less than 100 days without an adverse impact on animal performance, carcass merit, or tissue composition.

**Key Words:** Humic Acid, Iron, Mineral Composition

**T365 Impact of dietary K:Na:Mg ratios on the mineral utilization and rumen activity in fistulated non-lactating cows fed diets containing untreated corn silage and Silo-King® treated alfalfa haylage.** G. A. Ayangbile\*, D. Jones, and J. Horst, *Agri-King, Inc., Fulton, IL*.

The dietary K:Na:Mg ratios influence the systemic acid base balance in dairy cows. The impact of this ratio on the rumen activity and nutrient utilization were evaluated. In a  $4 \times 4$  latin square experimental design, non-lactating cows were fed a TMR containing a) 80% untreated corn silage:20% Silo-King® treated alfalfa haylage (80:20, CS/Hlg), b) 60:40, CS/Hlg, c) 40:60, CS/Hlg, and d) 20:80, CS/Hlg. The K concentration decreased with increased haylage, Na concentration was constant, and Cl and Mg increased as haylage increased. Cows were adapted to the diets for 16 d, followed by 5 d collection. Total DM fecal output was collected, and spot urine samples were collected at random before feeding (0 h) and after feeding (4 h). Blood and rumen fluid were obtained at 0 h and 4 h after feeding. These samples were processed, stored and later analyzed for minerals and VFA. Electrolytes and Mg digestibilities were higher ( $P < .05$ ) for the diet with the lowest K. Similar significant increases were observed for other minerals except copper. Absorption and retention of Ca, P and Mg were higher ( $P < .05$ ) in diets with less K. The rumen ultracentrifuged soluble Na and P were higher for all cows at 0 h (net secretion), but lower after feeding. There was a linear decrease ( $P < .05$ ) in soluble K, P, Mg, Mn, and Fe at 4 h after feeding. The total daily urine output was lower ( $P < .05$ ) for cows with less dietary K. Results indicate a lower K:Na ratio and Mg adjustment in a high soluble protein type diet may help improve the mineral utilization and stabilize the mineral balance in the rumen.

**Key Words:** K:Na:Mg Ratios, Rumen Minerals, Treated Forage

**T366 Effect of growth-rate on fat-soluble vitamin, copper and zinc concentrations in the circulation of neonatal calves.** B. J. Nonnecke\*<sup>1</sup>, M. R. Foote<sup>2</sup>, R. L. Horst<sup>1</sup>, W. R. Waters<sup>1</sup>, B. L. Miller<sup>3</sup>, T. E. Johnson<sup>3</sup>, and M. Fowler<sup>3</sup>, <sup>1</sup>National Animal Disease Center, Ames, IA, <sup>2</sup>Iowa State University, Ames, <sup>3</sup>Land O'Lakes Research Farm, Webster City, IA.

Effects of three, targeted growth-rates on plasma concentrations of fat-soluble vitamins and mineral in preruminant calves were evaluated. Calves ( $9 \pm 2$  d of age) were assigned randomly to treatments designed to achieve three targeted rates of gain [No-Growth (NG) = 0.0 kg/d, Low-Growth (LG) = 0.55 kg/d, or High-Growth (HG) = 1.2 kg/d] over an 8 wk period. Milk replacer intakes needed to achieve specified growth-rates were estimated using the NRC Nutrient Requirements of Dairy Cattle calf model computer program. All calves were fed a 30% CP, 20% fat, MR reconstituted to 14% DM. Diets were formulated to ensure that protein was not limiting. Because vitamin concentrations in the MR were based on DM intake of HG calves, NG and LG calves were supplemented with additional vitamins once weekly to compensate for reduced MR consumption. Growth rates for NG (0.11 kg/d), LG (0.58 kg/d), and HG (1.16 kg/d) calves differed throughout the study. Although vitamin A and D, and zinc concentrations were unaffected ( $P > .05$ ) by growth rate, vitamin D concentrations increased ( $P \leq 0.05$ ) and zinc concentrations decreased ( $P \leq 0.05$ ) with time. Throughout the study these concentrations remained within normal ranges for the preruminant calf. Vitamin E and copper were affected by growth rate. At wk8, HG calves had lower ( $P \leq 0.05$ ) vitamin E concentrations than LG and NG calves. Copper concentrations were greater ( $P \leq 0.05$ ) for HG calves than LG and NG calves from wk4 to wk7. Vitamin E was unaffected by age ( $P = 0.12$ ); whereas, copper decreased ( $P \leq 0.05$ ) with age. Concentration ranges for both variables were within ranges considered normal for neonatal calves. Results suggest that growth rate during the neonatal period may influence vitamin E and Cu availability, with vitamin E playing a pivotal role as lipid-phase antioxidant and the latter as a trace element intimately associated with a number proteins, including essential enzymes.

**Key Words:** Preruminant Calf, Neonatal Growth, Calf Nutrition

**T367 Please see abstract # 285.**

**T368 Short term response of lactating cows to the supplementation of high citrus pulp content diets with corn and organic trace minerals.** S. C. Salvador, M. N. Pereira\*, J. F. Santos, L. Q. Melo, and M. L. Chaves, *Universidade Federal de Lavras, Brazil*.

Substitution of corn by citrus pulp may reduce the cost of dairy diets. However, differences in ruminal fermentation of these substrates may affect animal performance and the economic efficiency of dairy production. This experiment evaluated the response of lactating cows to the inclusion of finely ground mature flint corn to pelleted citrus pulp diets. Treatments with corn contained 10% corn and 24% citrus pulp while citrus diets contained only 33% citrus pulp as the energy concentrate. The complete substitution of inorganic sources of Cu, Mn, Se, Zn and Cr by organic sources was simultaneously evaluated. Four corn silage based diets were generated by a factorial arrangement of the two factors. Sixteen cows received the treatments in a  $4 \times 4$  Latin



squares with 21 d periods. The effect of substituting inorganic by organic mineral sources was not conclusive. Daily dry matter intake was 19.4 kg for citrus diets and 20.5 kg with corn ( $P=0.03$ ). Intake of digestible organic matter was increased by corn supplementation ( $P<0.01$ ). There was a trend for a decreased fractional rate of *in situ* ruminal degradation of corn silage dry matter ( $P=0.11$ ) and for increased size of the indigestible fraction ( $P=0.15$ ) for diets with corn, suggesting that forages degradation did not determine intake. Milk production was 27.5 kg for citrus and 28.4 kg with corn ( $P=0.04$ ). Corn supplementation increased milk protein production and content ( $P=0.03$ ) and had no effect on fat secretion ( $P>0.24$ ). The concentration of purine derivatives in urine was numerically greater for the diets in which corn partially substituted citrus pulp. Diets formulated exclusively with citrus pulp may function when milk payment is based on volume, but some corn starch inclusion seems to be desirable when milk solids is valued.

Funded by Tortuga

**Key Words:** Starch, Pectin, Digestibility

**T369 Effects of trace mineral sources on bioavailability and function in dairy cattle.** B. J. Thering\*<sup>1</sup>, R. M. Ehrhardt<sup>1</sup>, M. Vazquez-Anon<sup>2</sup>, J. D. Richards<sup>2</sup>, and T. R. Overton<sup>1</sup>, <sup>1</sup>Cornell University, Ithaca, NY, <sup>2</sup>Novus International, St. Louis, MO.

Multiparous Holstein cows (n=30) were used to determine effects of trace mineral source on bioavailability, functional proteins, and performance. All cows were fed a basal diet formulated to meet NRC (2001) requirements for Zn (47 ppm), Cu (11 ppm), Mn (43 ppm; excess) and Se (0.27 ppm) from feedstuffs and inorganic sources beginning 3 wk prior to the experiment. Following covariate data collection, cows were assigned to one of three treatments and diets were top-dressed with either a rice hull carrier (NRC) or one of two organic trace mineral plus biotin mixtures providing 322 mg Zn, 150 mg Cu, 130 mg Mn, 3.78 mg Se, and 20 mg of biotin per day for 4 wk. One mixture was MINTREX<sup>®</sup> organic trace minerals (Mintrex) and the other (AA-complex) was Met and Lys complexes of trace minerals, Se-yeast, and biotin. Liver Cu concentrations tended to be increased for cows fed Mintrex and AA-complex compared to NRC following 4 wk (481, 539, 562 ppm;  $P<0.10$ ) and overall liver Se concentrations tended to be increased by Mintrex and AA-complex compared to NRC (1.49, 1.89, 2.09 ppm;  $P<0.10$ ), but overall liver Mn and Zn were not affected by treatment. Metallothionein mRNA in liver was increased at wk 1 for cows fed Mintrex ( $P<0.05$ ) and unchanged in cows fed AA-complex or NRC. Cows fed Mintrex had higher milk Mn during wk 4 compared to NRC (17.6, 24.0, 20.1  $\mu\text{g}/\text{kg}$ ;  $P<0.04$ ). Whole-blood Se was increased in cows fed Mintrex compared to NRC (19.9, 21.4, 21.1  $\mu\text{g}/\text{dL}$   $P<0.05$ ). Treatment did not affect plasma and liver superoxide dismutase and glutathione peroxidase. Milk yield and DMI were not affected by treatment, but cows fed Mintrex had increased ( $P<0.05$ ) milk fat (3.48, 3.81, 3.51%), true protein (3.12, 3.20, 3.14%), and total solids (12.1, 12.5, 12.2%). Overall, supplementation with both forms of organic trace minerals resulted in increased bioavailability, but Mintrex supplementation further increased liver MT expression and milk component content compared to either the control or AA-complex treatments.

**Key Words:** Trace Mineral, Bioavailability, Dairy Cow

**T370 Milk yield and reproductive performance in Holstein cows supplemented with Chromium in early lactation.** B. Lavín-Garza<sup>1</sup>, A. Garza<sup>2</sup>, M. Daccarett<sup>3</sup>, F. R. Valdez<sup>4</sup>, C. A. Meza-Herrera<sup>5</sup>, and R. Rodríguez-Martínez\*<sup>6</sup>, <sup>1</sup>Beta Santa Mónica, San Pedro, Coahuila, México, <sup>2</sup>Beta San Gabriel, Francisco I. Madero, Coahuila, México, <sup>3</sup>Private Consultor, Madera, CA, <sup>4</sup>Kemin Agri. Food Norteamérica Inc., Des Moines, IA, <sup>5</sup>Unidad Regional Universitaria de Zonas Áridas-Universidad Autónoma Chapingo, Bermejillo, Dgo., México, <sup>6</sup>Universidad Autónoma Agraria Antonio Narro Unidad Laguna, Torreón, Coah., México.

Chromium is an essential mineral in diets for humans and laboratory animals because it is an active component of the Glucose Tolerance Factor and its effect on milk yield and reproductive performance in cows has been reported, both in multiparous as well as on primiparous cows. However, reports regarding its function are contradictories denoting a better milk yield and reproductive performance in primiparous than multiparous cows. The aim of this study was to evaluate Cr supplementation upon milk yield and reproductive performance during early lactation in dairy cows. The study was carried out in Northern Mexico (25° NL, 102° WL, 1,100 m). A total of 147 cows were assigned to four groups: 1) PCr, (n=36, primiparous cows) and 2) MCr (n=39, multiparous cows), both supplemented with 10 mg Chromium essential base (KemTRACE Cr 0.04% Kemin Industries, Des Moines, Iowa, USA) mixed in the total mixed ration, and 3) PnCr, (n=38) and 4) MnCr, (n=34), primiparous and multiparous cows, respectively, both without Cr supplementation. Response variables considered total milk yield per cow per day (TMY), peak milk yield (PMY), days to peak milk yield (DPMY), days at first IA (DIA), and number of services per conception (SPC). Variables were recorded and analyzed by the Proc GLM of SAS. No Differences ( $P>0.05$ ) in PMY between PCr AND PnCr occurred (41.0 vs 40.3 l), but MCr-cows had higher ( $P<0.01$ ) PMY than MnCr (62.9 d vs 57.6 d). A decreased ( $P<0.01$ ) DPMY was observed in PCr-cows with respect to PnCr-cows (70.6 d vs 100.7 d), but were similar ( $P>0.05$ ) in both primiparous groups. TMY and DIA were similar ( $P>0.05$ ) in both supplemented and non-supplemented primiparous and multiparous cows. SPC was lower ( $P<0.01$ ) in PCr with respect to PnCr (1.6 vs 2.4), while differences between MCr and MnCr groups did not occurred. These results support the importance of Cr supplementation in dairy cows, upon milk yield and reproductive performance, especially in primiparous cows managed under intensive conditions.

**Key Words:** Chromium, Milk Yield, Reproductive Performance

**T371 Blood mineral, hormone, and osteocalcin responses of multiparous Jersey cows to an oral dose of 25-hydroxyvitamin D<sub>3</sub> prior to parturition.** M. S. Taylor\*, K. F. Knowlton, M. L. McGilliard, and J. H. Herbein, Virginia Polytechnic Institute and State University, Blacksburg.

Increasing blood calcium (Ca) prior to parturition could attenuate the severity of periparturient hypocalcemia. Jersey cows tend to be susceptible to periparturient hypocalcemia, therefore our objective was to evaluate the effects of a prepartum oral dose of vitamin D<sub>3</sub> (D<sub>3</sub>) or 25-hydroxyvitamin D<sub>3</sub> (25-OH) on factors associated with peripartum blood Ca regulation in Jersey cows. Twenty-seven multiparous Jersey cows were randomly assigned to receive an oral bolus containing corn starch (control) or corn starch plus 15 mg of 25-OH or 15 mg of D<sub>3</sub> at 6 d prior to expected parturition. Cows were maintained in individual

box stalls from 20 d prior to parturition and fed a common diet. Jugular blood samples were collected at -14, -13, -5, -4, -3, -2, -1, calving, 1, 3, 5, 7, 9, 11, 13, 28, 56, and 84 d. After calving cows were housed in a free-stall barn and consumed a common diet. Colorimetric assays were used to analyze Ca, P, and Mg concentrations in serum. Osteocalcin (OC), an indicator of bone formation, was determined using a competitive immunoassay. Serum 25-hydroxyvitamin D<sub>3</sub> and parathyroid hormone (PTH) were determined only in samples obtained from -5 through 13 d. Blood Ca, P, and Mg decreased around the time of calving and then increased over time. Serum OC was higher in second lactation cows compared with cows entering their third or fourth lactation. Serum 25-hydroxyvitamin D<sub>3</sub> was higher for cows dosed with 25-OH (119.0 pg/ml) compared with those dosed with D<sub>3</sub> (77.5 pg/ml) or control (69.3 pg/ml). Cows dosed with 25-OH tended to have lower serum PTH concentration, but treatments did not affect serum Ca, P, or Mg. Although results indicated a 60% increase in serum 25-hydroxyvitamin D<sub>3</sub> due to a single oral dose of 25-OH prior to calving, the amount administered in this study apparently was not sufficient for initiation of any improvement in Ca homeostasis at parturition.

**Key Words:** Calcium, Osteocalcin, Cow

**T372 Changes in phosphorus metabolism of ruminants fed with different cation anion balances and proportions of roughage and concentrate.** M. S. V. Salles<sup>1</sup>, M. A. Zanetti<sup>2</sup>, T. M. Ribeiro<sup>2</sup>, and S. F. M. Bonilha\*<sup>1</sup>, <sup>1</sup>Agência Paulista de Tecnologia dos Agronegócios, Assis, São Paulo, Brazil, <sup>2</sup>Faculdade de Zootecnia e Engenharia de Alimentos - USP, Pirassununga, São Paulo, Brazil.

There is an increasing environmental concern about P excretion from feedlot cattle to the environment. As dietary cation anion balance (DCAB) may change mineral retention, research leading to appropriate DCAB can help minimize such impact. Thus, two experiments were carried out in the FZEA/USP (Brazil) aiming to assess DCAB effect in diets with different proportions of roughage and concentrate on the phosphorus metabolism of young ruminants. On each experiment, 24 Holstein calves (91.43 ± 12.44 Kg of average BW for the first and 117.62 ± 20.88 for the second experiment) were randomly allotted to individual cages and fed during 35 days the following treatments: DCAB of -123, +218 and +341 mEq/kg of DM, in a diet of 60% of roughage (corn silage) and 40% of concentrate (60R40C) in the first experiment and DCAB of -127, +207 e +397 mEq/kg of DM in a diet of 40% of roughage and 60% of concentrate (40R60C) in the second experiment. Ionic coefficients were achieved through addition of ammonium sulphate or sodium bicarbonate. Balance of P was determined by total feces and urine collection during five days. All P determinations were carried out through a colorimetric method (725 nm reading). Data were analyzed in a completely randomized design using PROC GLM of SAS. Orthogonal polynomial contrasts were used to partition treatment effects, and adopted the significance level of P<0.10. Results are presented on table 1. The higher P retention occurred in DCAB +341 with diet 60R40C and in DCAB +207 in diet with 40R60C; however, the diet that excreted less P was with DCAB +341 with diet 60R40C (5.68 g/day).

**Table 1. Phosphorus balance in calves**

Item	60R40C				Linear	Probability Quadratic
	-123	+218	+341	SEM		
P intake (g/day)	7.97*	9.99	11.97	0.48	0.0003	0.6268
P retention (g/day)	3.64	4.31	6.87	0.38	0.0001	0.0282
P retention/ P intake (%)	45.42	43.39	56.79	1.82	0.0071	0.0062
Item	40R60C				Linear	Quadratic
	-127	+207	+397	SEM		
P intake (g/day)	12.92	21.26	20.37	1.22	0.0017	0.0758
P retention (g/day)	7.49	13.64	12.75	0.91	0.0037	0.0714
P retention/ P intake (%)	52.67	63.88	62.26	2.46	0.0769	0.2952

\*mean values

**Key Words:** DCAB, Mineral, Retention

**T373 Please see abstract # 284.**

**T374 Cobalt/vitamin B<sub>12</sub> status of embryo donor ewes, but not recipients, affects neonatal lamb behavior.** C. M. Dwyer\*, C. J. Ashworth, J. J. Robinson, J. A. Rooke, T. G. McEvoy, and L. M. Mitchell, SAC, Edinburgh, UK.

Earlier reports indicate that lambs born to ewes sub-clinically deficient in cobalt/vitamin B<sub>12</sub> during pregnancy are slow to stand and suck and have increased morbidity and mortality. These problems are not prevented by cobalt supplementation during mid to late pregnancy, suggesting that they originate during early development. The aim of this study was to distinguish between the effects of cobalt/vitamin B<sub>12</sub> status of ova and of the recipient ewe on lamb behavior using reciprocal embryo transfer. Ewes from cobalt-deficient farms were either untreated (-Co, n=82) or were given an intra-ruminal cobalt-containing bolus 30 days before embryo transfer (+Co, n=82). Day 6 embryos were recovered from 33 superovulated -Co or +Co ewes and transferred singly to -Co or +Co recipient ewes. Lamb behavior (n=48 lambs) was recorded by focal observation at birth and during the first 3 days of life by scan sampling at 2-hourly intervals. Data were analysed by linear mixed models using natural log transformations of behavior data that were not normally distributed. Circulating concentrations of vitamin B<sub>12</sub> on the day of ovum recovery were higher in +Co than -Co donors (P<0.001). Concentrations of vitamin B<sub>12</sub> were lower in -Co compared to +Co ewes during pregnancy (P<0.001) and in lambs born to -Co compared to +Co ewes at birth (-Co=543 pmol/l, +Co=1805 pmol/l s.e.d.=92.1, P<0.001). There was no effect of donor or recipient cobalt/vitamin B<sub>12</sub> status on lamb birth weight, on lamb behavior immediately after birth, on mean ewe-lamb distance during the first 3 days of life, or on any aspect of ewe behavior. However, lambs from +Co donors were more active than lambs from -Co donors; they stood more frequently (% observations active: +Co donor=29.6, -Co donor=22.0, s.e.d.=2.4, P<0.01), were more frequently observed interacting with their mother (% observations: +Co donor=6.3, -Co donor=3.1, s.e.d.=1.2, P<0.01) and spent more time exploring their

environment (% observations: +Co donor=16.6, -Co donor=6.9, s.e.d.=2.3,  $P < 0.001$ ). These data indicate that nutrient status prior to mating and during the early cleavage stages of embryo development affects lamb behavior.

**Key Words:** Sheep, Behavior, Vitamin B<sub>12</sub>

**T375 Effects of maternal nutrition and selenium supply on visceral organ mass of pregnant ewe lambs.** J. J. Reed\*<sup>1</sup>, T. L. Neville<sup>1</sup>, K. A. Vonnahme<sup>1</sup>, P. P. Borowicz<sup>1</sup>, J. B. Taylor<sup>2</sup>, D. A. Redmer<sup>1</sup>, J. S. Luther<sup>1</sup>, C. J. Hammer<sup>1</sup>, L. P. Reynolds<sup>1</sup>, and J. S. Caton<sup>1</sup>, <sup>1</sup>*Center for Nutrition and Pregnancy, Animal and Range Science Department, North Dakota State University, Fargo,* <sup>2</sup>*USDA-ARS, U. S. Sheep Experiment Station, Dubois, ID.*

To examine effects of maternal nutrient restriction or excess and dietary Se on maternal visceral organ mass, 82 pregnant Rambouillet ewe lambs ( $52.2 \pm 0.8$  kg) were allotted randomly to one of 6 treatments in a 3 x 2 factorial design. Groups included plane of nutrition (60% [RES], 100% [CON], and 140% [HIGH] of requirements) and dietary

levels of Se (adequate Se [7.4 µg/kg BW] vs. high Se [85 µg/kg BW]; from Se enriched yeast). Selenium treatments were initiated at breeding and nutritional treatments on d 40 of gestation. All diets were fed once daily in a complete pelleted form (36.5% beet pulp, 22.3% alfalfa meal, 16.2% corn, 18% soybean hulls, and 7.0% soybean meal; 14.4 % CP, 2.63 Mcal ME/kg; DM basis). Within 24 h after parturition, ewes were necropsied and tissues harvested. Empty maternal BW was least ( $P < 0.01$ ) in RES, intermediate in CON, and greatest in HIGH. Selenium supplementation did not alter empty maternal BW. Mass (g) of the rumen, reticulum, omasum, abomasum, liver, pancreas, spleen, omental fat, kidney, and perirenal fat were least ( $P < 0.01$ ) in RES, intermediate in CON, and greatest in HIGH ewes. When expressed as g/kg of empty BW, the responses to treatment differed; for example, for abomasum, jejunum, and large intestine, RES had greatest ( $P < 0.01$ ), CON intermediate, and HIGH the least. Supplemental Se increased ( $P < 0.10$ ) ruminal, abomasal, and small intestinal mass (g/kg empty BW) compared with adequate Se. No other differences in visceral organ mass were observed in response to Se supplementation. These data indicate that maternal nutrition has large impacts on visceral organ mass and that Se supplementation at supranutritional levels alters the mass of some gastrointestinal organs in pregnant ewe lambs.

**Key Words:** Maternal Nutrition, Selenium, Visceral Organ Mass