

## Ruminant Nutrition

### Byproducts, Growing Cattle, and Protein

**920 Composition of DDGS from dry grind ethanol plants.** R. Belyea\*<sup>1</sup>, K. Rausch<sup>2</sup>, A. Mueller<sup>1</sup>, and M. Tumbleson<sup>2</sup>, <sup>1</sup>University of Missouri, <sup>2</sup>University of Illinois at Urbana-Champaign.

Increased demand for ethanol has resulted in growth in the number and size of dry grind (DG) ethanol plants. In DG processing, corn is ground, and the entire ground kernel is fermented; components, such as germ and fiber, are not fractionated and there is one major coproduct (distillers grains with solubles, DDGS). DG plants require less equipment and capital and generate small volumes of ethanol, compared to traditional wet mill plants. Most DG plants are owned by producers and contribute significantly to local economies. Much of the operational cost of DG processing is cost of corn. Income from marketing of DDGS is critical in offsetting the input cost of corn and is a major factor in the economic feasibility of DG plants. Increased number and size of DG plants has increased the volume and market competition for DDGS. DG processing differs from wet milling; the composition of DDGS from DG plants could be considerably different from that from other sources. However, there are few published analytical data. Also, variation in composition can affect market value of DDGS. The objective was to obtain DDGS characterization data and to identify potential sources of variation. Samples were taken from processing streams from dry grind plants located in the upper Midwest. They were analyzed for dry matter, total N (protein), fiber, ash, fat, minerals and amino acids using AOAC methods. DDGS from DG processing had higher fiber, fat and protein than DDGS from traditional sources. Sample to sample variation for most nutrients was similar to that reported in the literature. Variation in the composition of corn was minimal and did not contribute markedly to the variation in DDGS. There was considerable variation in the composition of and proportion of streams from which DDGS were produced. High content of certain minerals, such as P, will present marketing challenges. Improving the quality and marketability of DDGS will require better control of parent process streams.

**Key Words:** coproducts, ethanol, nutritional quality

**921 Nonenzymatically browned sunflower seeds as a source of ruminal undegraded lipid in combination with a wet corn milling feed for lactating dairy cows.** S.B. Al-Suwaigh\* and R.J. Grant, *University of Nebraska, Lincoln.*

The objective was to determine the effect of supplementing nonenzymatically browned sunflower seeds (chipped, dehulled, 5% sulfite liquor; NEBS) to a diet containing 40% wet corn milling feed (WCMF) on efficiency of 4% FCM production and composition of milk fat. Three diets contained 1) WCMF with no added lipid, 2) WCMF + tallow to supply 3% added lipid, and 3) WCMF + NEBS to supply 3% added lipid. All diets contained 18.5% CP, 31% NDF and were fed as TMR. Diet 1 contained 53% forage and 3% lipid. Thirty Holstein cows (9 primiparous) were assigned to these three diets at 130 DIM for 6 wk. Dry matter intake, 4% FCM, body weight, and body weight change during the 6-wk trial were not affected by diet. Production of 4% FCM and efficiency of FCM production averaged 33.3 kg/d and 1.12 kg/kg, respectively. Diet 3 resulted in the lowest ( $P < 0.05$ ) content of C14:0 and C16:0 fatty acids in milk. The content of C18:2, C18:1(t11), and C18:2(c9,t11) was increased ( $P < 0.05$ ) by diet 3. These results indicate that there was no improvement in efficiency of FCM production by addition of lipid to a diet containing 40% WCMF. In addition, the NEBS improved the fatty acid profile of the milk fat with no reduction in total milk fat production.

**Key Words:** Nonenzymatic browning, Sunflower seeds, Dairy cattle

**922 Ruminal behavior of protein and starch free organic matter of Vicia Faba in dairy cows.** P. Yu\*<sup>1</sup>, B.J. Leury<sup>2</sup>, and A.R. Egan<sup>2</sup>, <sup>1</sup>Department of Animal and Poultry Science, University of Saskatchewan, <sup>2</sup>School of Agriculture and Food Systems, University of Melbourne.

Faba beans (*vicia faba*) (FB) were dry roasted at different temperatures (110, 130, 150°C) for 15, 30 or 45 min to determine effect of dry roasting on rumen degradation of crude protein and starch free organic matter ( $P^{SFO}$ ). Rumen degradation characteristics of  $P^{SFO}$  were determined by the nylon bag incubation technique in dairy cows fed

60% hay and 40% concentrate. Measured characteristics of  $P^{SFO}$  were undegradable fraction (U), degradable fraction (D), lag time (T<sub>0</sub>), and the rate of degradation (K<sub>d</sub>) of D. Based on measured characteristics, rumen availability (RA $P^{SFO}$ ) and bypass  $P^{SFO}$  (B $P^{SFO}$ ) were calculated. Dry roasting did not significantly affect rumen degradation characteristics of  $P^{SFO}$  ( $P > 0.05$ ). The D varied from 70.3% in RFB to 69.4, 71.9, 85.6%; U from 29.7% in RFB to 30.6, 28.2 and 14.4%; K<sub>d</sub> from 22.4%/h in RFB to 24.4, 21.1 and 7.9%/h; RA $P^{SFO}$  from 63.2 in RFB to 63.0, 64.1 and 57.5% and B $P^{SFO}$  varied from 36.8% in RFB to 37.1, 36.0 and 42.5% at 110, 130 and 150°C, respectively. Dry roasting slightly decreased RA $P^{SFO}$  from 140.2 (RFB) to 136.3 (110°C), 143.8 (130°C) and 131.1 (150°C) g/kg DM, respectively. The above results plus previous published results indicated dry roasting had the differently affected patterns on different compositions in FB. It strongly increased bypass crude protein (BCP) and moderately increased starch (BST) with increasing temperatures and times but least affected  $P^{SFO}$ . Such desirable degradation patterns in dry roasted FB might be beneficial to the high yielding cows which could use more dry roasted  $P^{SFO}$  as an energy source for microbial protein synthesized in the rumen and absorb more amino acids and glucose in the small intestine.

**Key Words:** Bypass protein and starch free organic matter, Ruminal Behavior, Legume seeds

**923 Effect of substitution of a soybean meal-sorghum grain blend for cull chickpeas on growth performance and carcass traits in sheep.** J.F. Obregon\*<sup>1</sup> and R. Barajas<sup>1</sup>, <sup>1</sup>FMVZ-Universidad Autonoma de Sinaloa (Mexico).

With the objective of determine the effect of substitution of a soybean meal-sorghum grain blend for cull chickpeas on growth performance and carcass traits in sheep, thirty two Pelibuey sheep (males; BW = 24.8 ± 0.97 kg) were used in a complete randomized block experiment design. The animals were weighed and blocked by weight, in groups of four were placed in eight ground flour pens (2 × 3 m), and assigned to consume one of two diets in that consisted the treatments: 1) Diet with 15.7% CP and 3.4 Mcal of DE/kg, containing sudan grass hay 18%, soybean meal 15.5%, ground sorghum 55%, sugarcane molasses 8.8%, urea 0.5%, and mineral premix 2.2% (control); and 2) Diet similar to control, but containing 40% of cull chickpeas (variety Blanco Sinaloa) substituting all soybean meal and 24.5% of sorghum equivalent to a 39:61 SBM-Sorghum blend (CHP treatment). Animals were weighed in day 1 and 35 days after when finished the trial, feed was offered twice a day under free access condition. Once finished experiment, they were killed in a slaughterhouse, carcass trait were recorded, carcass were dissected and main cuts were measured. Treatments not affected ( $P = 0.80$ ) ended weight (31.03 vs. 31.05 kg), average daily gain (0.178 vs. 0.175 kg/day), feed intake (1.036 vs. 1.032 kg/day) or feed/gain (5.84 vs 5.97). NEM and NEg of cull chickpeas were estimates to be close to 2.12 and 1.45 Mcal/kg. Cold carcass weight, carcass long and wide, carcass yield, rib eye area, back fat, and KPH fat were similar ( $P = 0.22$ ) in both treatments. Long loin, short loin, rib, leg, shoulder and neck cuts were not affected ( $P = 0.18$ ) by treatments. It is concluded, that cull chickpeas can be included in finishing diets for finishing sheep, substituting usual feed stuff as soybean meal and sorghum without affect growth-performance, carcass trait or carcass cutability.

**Key Words:** Chickpeas, Soybean meal, Sorghum, Growth-Performance, Sheep

**924 Effect of substitution of a soybean meal-sorghum grain blend for cull chickpeas on apparent digestibility of finishing diets for sheep.** J.F. Obregon\*<sup>1</sup> and R. Barajas<sup>1</sup>, <sup>1</sup>FMVZ-Universidad Autonoma de Sinaloa (Mexico).

With the objective to determine the effect of substitution of a soybean meal-sorghum grain blend for cull chickpeas on apparent digestibility of finishing diets for sheep, a total fecal collection experiment was conducted. Four Pelibuey sheep (males; BW = 31.75 kg) were used in a Crossover design experiment, the sheep were assigned to consume one of two diets in that consisted the treatments: 1) Diet with 15.7% CP and 3.4 Mcal of DE/kg, containing sudan grass hay 18%, soybean meal

15.5%, ground sorghum 55%, sugarcane molasses 8.8%, urea 0.5%, and mineral premix 2.2% (control); and 2) Diet similar to control, but containing 40% of cull chickpeas (variety Blanco Sinaloa) substituting all soybean meal and 24.5% of sorghum equivalent to a 39:61 SBM-Sorghum blend (CHP treatment). Sheep were placed individually in metabolic crates (0.6 x 1.2 m). Experimental periods consists in 10 days adaptation period and four days of samples collection. From each diet treatment and period one kg of diet was taken as sample and the total fecal production was collected. DM excreted in feces (206 vs. 216 g/day) was not affected by treatments ( $P = 0.32$ ). Crude protein in feces was similar ( $P = 0.97$ ) in both treatments (42.0 vs. 41.9 g/day). Apparent digestibility of DM was equal ( $P = 0.51$ ) across treatments (78.5 vs. 77.9%). Apparent digestibility of crude protein was not altered ( $P = 0.78$ ) by CHP inclusion (74.6 vs. 74.1%). The DE of diets was similar ( $P = 0.51$ ) with values of 3.59 and 3.33 Mcal/kg for control and CHP, respectively. The observed DE/expected DE ratio of diets was not different ( $P = 0.67$ ) shown values of 0.97 and 0.98 for control and CHP treatments. True digestibility of CP of chickpeas was calculated to be 84% and its DE content 3.82 Mcal/kg. It is concluded, that cull chickpeas contain 3.8 Mcal of DE/kg and 84% of its protein is truly digestible, and can be included in finishing diets for sheep substituting usual feed stuff such as soybean meal and sorghum without affect digestibility or energy content.

**Key Words:** Chickpeas, Soybean meal, Sorghum, Digestibility, Sheep

**925 Effect of substitution of whole cotton seed by naturally heat-humidity damaged cotton seed on apparent digestibility of finishing diets for sheep.** A. Estrada\*<sup>1</sup> and R. Barajas<sup>1</sup>, <sup>1</sup>FMVZ-Universidad Autonoma de Sinaloa (Mexico).

With the objective to determinate the feed substitution of whole cotton seed by naturally heat-humidity damaged cotton seed on apparent digestibility of finishing diets for sheep a total fecal collection experiment was conducted. Four Pelibuey sheep (males; BW = 23.5 kg) were used in a Crossover design experiment, the sheep were assigned to consume one of two diets in that consisted the treatments: 1) Diet with 16.8% CP and 3.54 Mcal of DE/kg, containing Sudan grass hay 12%, whole cotton seed (WCS) 20%, ground sorghum grain 47%, canola meal 10%, sugarcane molasses 8%, urea 0.9%, and mineral premix 2.1% (control); and 2) Diet similar to control, but containing 20% of naturally heat-humidity damaged cotton seed substituting WCS (HDC treatment). Sheep were placed individually in metabolic crates (0.6 X 1.2 m). Experimental periods consisted in 10 days adaptation period and four days of samples collection. From each diet treatment and period one kg of diet was taken as sample and the total fecal production was collected. DM and CP was assayed. Mean daily intake of dry matter and crude protein were 602 g and 114 g, respectively. Dry matter in feces (169.4 vs. 168.5 g/day) and CP excreted in feces (32.1 vs. 31.8 g/day) were not affected by treatments ( $P=0.88$ ). The inclusion of heat-humidity damaged cotton seed did not affect ( $P=0.90$ ) apparent digestibility of dry matter (72.0 vs. 71.8%) and apparent digestibility of crude protein (71.3 vs. 72.6). DE of diet was not altered ( $P=0.78$ ) by treatments (3.070 vs. 3.065 Mcal/kg). This data suggest, that cotton seed that becomes damaged by rain and further sun exposed, can be used as feedstuff in finishing diet for sheep attributing it, the same nutritional value as whole cotton seed.

**Key Words:** Cotton seed, Heat damage, Protein, Digestibility, Sheep

**926 Evaluation of feeding value of the corn steep liquor as an energy and protein source for finishing cattle diets.** C. C. Ribeiro-Filho\* and A. Trenkle, Iowa State University.

Two finishing trials and one digestion trial were conducted to evaluate the feeding value of corn steep liquor, a liquid byproduct from the corn wet milling industry, as an energy and supplemental nitrogen source for finishing cattle diets. In trial 1, thirty-six yearling steers weighing 381 kg, were fed for 145 days diets containing 0 or 10% of dry matter as steep liquor. Steep liquor replaced a portion of the corn, soybean meal and urea, and all the molasses. Average daily gain, feed intake and feed efficiency were not significantly ( $P>.10$ ) different between treatments. There were no significant differences ( $P>.10$ ) in carcass characteristics except that steers fed steep liquor had lower ( $P<.05$ ) marbling scores and KPH fat %. In trial 2, seventy-two crossbred steers weighing 442 kg were fed for 84 days diets containing steep liquor at 0, 6 or 12% of dry matter replacing a portion of the corn and urea, and all the molasses in the diet. There were no significant ( $P>.10$ ) differences in performance

and carcass characteristics among treatments. For the digestion trial, nine steers with average weight of 430 kg were placed in metabolism crates for total collection. The steers were fed diets containing 0, 6, or 12% of dry matter as corn steep liquor. The experimental design was Latin Rectangle with 3x3 design repeated three times. Each experimental period was 21 days, with the first 17 days for diet adaptation and the last 4 days for collection. The average DM digestibility was 80.89, 82.35, and 82.93% for 0%, 6%, and 12% corn steep liquor, respectively. There was no significant difference in DM digestibility ( $P>.10$ ) between 0 and 6%, but there was significant difference ( $P<.10$ ) between 0 and 12% steep liquor. Feeding steep liquor tended to linearly increase digestibility. The results of this study indicated that corn steep liquor did not affect performance and carcass characteristics when fed up to 12% of dietary dry matter. It can be effectively used as energy and supplemental protein source in finishing cattle diets.

**Key Words:** Corn Steep Liquor, Byproducts, Cattle

**927 Evaluation of white corn in finishing diets fed to beef cattle.** C. L. Warrick\* and A. Trenkle, Iowa State University.

Two trials were conducted to determine the effects of feeding white and yellow corns to finishing beef cattle. The first trial compared feedlot performance, carcass characteristics and carcass fat color of 120 Angus steers with beginning average weight of 273 kg when fed diets containing white corn (WC) or yellow corn (YC). Steers were sorted based on frame score and were randomly allotted into pens of six with 8 pens (4 large and 4 small frame) fed WC diets and 12 pens (6 large and 6 small frame) fed YC. The two diets were identical with corn type as the only variable (dry rolled corn 78.7%; corn silage 10%; ground hay 5%; molasses .75%; and supplement 5.55%). DM feed intake, ADG, feed/gain and final weights after 180 days were 8.32, 8.05 kg/d ( $P < .05$ ); 1.52, 1.52 kg/d ( $P > .1$ ); 5.49, 5.28 ( $P < .05$ ); and 549.6, 548.8 kg ( $P > .1$ ) for WC and YC, respectively. Corn type had no effects ( $P > .1$ ) on carcass weight, dressing percent, thickness of backfat, REA, KPH, marbling or quality and yield grades which were 336.9, 336.7 kg; 61.3, 61.4%; 1.13, 1.10 cm; 83.2, 80.6 cm<sup>2</sup>; 1.70, 1.74%; 554, 544 (500 = small<sup>0</sup>, 400 = slight<sup>0</sup>); 75.8, 83.3% choice; and 2.66, 2.71 for WC and YC respectively. Color of subcutaneous fat over the ribs was whiter for cattle fed WC ( $P < .01$ ). In the second trial dry matter digestibility was determined by collecting feces of 10 345 kg steers individually confined in metabolism crates with periods consisting of 9 days adaptation and 5 days collection. Diets containing WC or YC were fed twice daily as whole or dry rolled corn. DM digestibility was not different for corn type ( $P = .71$ ). Dry rolling increased the digestibility of both corn types from 76.42% to 80.30% for YC and 77.60% to 79.98% for WC ( $P < .01$ ). The results indicate that WC can be fed to finishing beef steers without a loss in performance or carcass quality and yield grades. Advantages of whiter fat in carcasses of cattle fed WC may have implications for export beef markets.

**Key Words:** White Corn, Finishing Cattle, Digestibility

**928 Effects of steam-flaking on the nutritive value of yellow, high available phosphorus, high-oil, and white corn varieties.** K. F. Wilson<sup>1</sup>, T. C. Bramble\*<sup>2</sup>, G. V. Pollard<sup>3</sup>, and C. R. Richardson<sup>2</sup>, <sup>1</sup>Loveland Ind., Greeley, CO, <sup>2</sup>Texas Tech Univ., Lubbock, <sup>3</sup>Southwest Texas State Univ., San Marcos.

The objective of this study was to determine the effects of steam-flaking on yellow (YC), high available phosphorus (HAP), high-oil (HO), and white corn (WC). Each variety was steam-flaked to .37 kg/L for analyses. Variables measured for nutritive value of the varieties before and after steam-flaking were DM, ash, CP, ether extract (EE), starch availability (SA), free moles of sulfhydryls (FMS), and dry matter disappearance (DMD). Each variety was steam-flaked utilizing a laboratory steam-flaker. Samples were collected immediately after steam-flaking and frozen for subsequent analyses. Variety x treatment interactions ( $P < 0.05$ ) were observed for DM, SA, and 6, 12, 18, and 24 h DMD. Increases ( $P < 0.05$ ) in SA and FMS are more than likely attributed to the disruption of the starch-protein matrix via the thermal and mechanical insult of steam-flaking. Also, DMD was increased ( $P < 0.05$ ) by steam-flaking the four measured times. These effects may be attributed to the exposure of the starch by steam-flaking. Of the four varieties tested, HO was greater ( $P < 0.05$ ) in CP and EE before and after steam-flaking. The HAP variety contained ( $P < 0.05$ ) less CP and EE regardless of processing. Following steam-flaking, YC, HO, and

WC yielded a greater percentage of starch when compared to HAP. Free moles of sulfhydryls, were lowest ( $P < 0.05$ ) for HAP as compared to all other varieties. Results for SA and FMS were an indication of the treatment effect on DMD. Initially, HAP appeared to digest very well, but subsequent time measurements showed HAP did not digest as well as the other varieties. These results indicate that more severe processing might be needed for HAP as compared to the other varieties.

**Key Words:** steam-flaking, nutritive value, corn varieties

**929 Impact of the chemical and physical properties of yellow, high available phosphorus, high-oil, and white corn varieties on steam-flaking.** K.F. Wilson<sup>1</sup>, G.V. Pollard\*<sup>2</sup>, C.R. Richardson<sup>3</sup>, and T.C. Bramble<sup>3</sup>, <sup>1</sup>Loveland Ind., Greeley, CO, <sup>2</sup>Southwest Texas State Univ., San Marcos, <sup>3</sup>Texas Tech Univ., Lubbock.

The objective of this study was to determine if the chemical and physical properties of yellow (YC), high-oil (HO), high available phosphorus (HAP), and white corn (WC) varieties affected steam-flaking (SF) properties. Measurements included DM (%), ash (%), CP (%), total starch (TS, %), ether extract (EE, %), surface area (SA, cm<sup>2</sup>), kernel mass (M, g), kernel volume (V, cm<sup>3</sup>), kernel density (K, g/cm<sup>3</sup>), true density (T, g/cm<sup>3</sup>), kernel tensile strength (KT, kg), moisture uptake (MU, sec), energy (EC, kWh), processing time (PT, min), flake durability (FD, %), and fines (F, %). Differences ( $P < 0.05$ ) between YC and WC versus HO and HAP were observed for the components of DM, ash, CP, and EE. High-oil corn had higher ( $P < 0.05$ ) levels of CP and EE as compared to YC, HAP, and WC. However, HAP was lower ( $P < 0.05$ ) in CP and EE compared YC, HO, and WC. Differences ( $P < 0.05$ ) between YC and WC versus HO and HAP exist for SA, M, V, K, T, KT, and MU. High-oil and HAP had more ( $P < 0.05$ ) M and SA than YC and WC. Yellow corn and WC were greater ( $P < 0.05$ ) in K and T as compared to HAP and HO, while WC required more force ( $P < 0.05$ ) to crush with respect to TS (hard seed coat) as compared to YC, HAP, and HO. High-oil corn was more nutrient dense (CP and EE) while WC had greater ( $P < 0.05$ ) T than the other varieties. Results of the chemical and physical analyses suggest YC requires less ( $P < 0.05$ ) PT and EC as compared to the other varieties. However, YC had a greater ( $P < 0.05$ ) FD with the least amount of F. In conclusion, HAP would not be optimal for steam-flaking because of FD and F issues. Therefore, HO would be advised because of the relative ease of steam-flaking and the density of nutrients. As for YC and WC, they are considered above average for nutrient density, but do to the KT, more wear to machinery might be observed.

**Key Words:** corn varieties, chemical-physical properties, steam-flaking

**930 Methane production of lactating dairy cows fed grass silage and beet pulp based concentrates.** F.P. O'Mara\*, J.F. Connolly, and D.K. Lovett, *University College Dublin.*

The objective of this experiment was to measure the effect of replacing digestible fibre with sugars on the dry matter intake (DMI), milk production and methane production of dairy cows. This was achieved by replacing 4 kg per day of unmolassed beet pulp with 4 kg of molassed beet pulp. In addition, each cow was fed 2 kg of concentrates (including 1 kg of soyabean meal), 100 g of mineral/vitamin mixture, and grass silage ad libitum. The experiment involved 8 cows, who were fed both diets in a cross-over design with 4 week periods. Three weeks were allowed for adaptation, with measurements taken in the final week. Methane output was measured using the sulfur hexafluoride (SF<sub>6</sub>) technique. Boluses containing SF<sub>6</sub> with a pre-determined release rate were inserted into the cows' rumen 3 weeks before the first sampling period. Their breath was sampled for five 24 hour periods and methane and SF<sub>6</sub> were determined by gas chromatography. Daily methane output was calculated from the release rate of SF<sub>6</sub> from the bolus and the concentrations of methane and SF<sub>6</sub> in the sample. Dry matter digestibility (DMD) was estimated by twice daily dosing of chromic oxide over five days and faecal grab sampling over the final two days at 07:00, 10:00, 13:00, 16:00, 17:00 and 20:00. There were no significant differences between the treatments in daily silage or total DMI or milk yield (silage DMI, 11.1 and 11.3 kg, SED 0.15; total DMI, 16.5 and 16.7 kg, SED 0.15; milk yield, 17.7 and 18.1 kg, SED 0.65, for the unmolassed and molassed beet pulp treatments, respectively). Methane production averaged 585 l per day and was not significantly affected by treatment (580 and 590 l, SED 26.4, for the unmolassed and molassed beet pulp treatments,

respectively). The energy content of this methane was 0.075 of gross energy intake. The DMD was 0.73 (SED 0.0079) on both treatments. In conclusion, any change in methane production as a result of replacing 4 kg unmolassed beet pulp with 4 kg molassed beet pulp (equivalent to replacing 1 kg of fibre with 1 kg of sugars) was not large enough to be detected.

**Key Words:** Methane, Dairy Cows, Beet Pulp

**931 Effect of iron sulfate supplementation of the diet on plasma gossypol concentration and productivity of lactating Holstein cows fed cracked Pima cottonseed.** K. McCaughey\*, E. DePeters, P.H. Robinson, J. Santos, J. Pareias, and S. Taylor, *University of California, Davis, CA.*

Lactating Holstein cows were fed one of four diets containing whole Upland cottonseed (WCS) or cracked Pima cottonseed (CrP) with increasing levels of iron sulfate to evaluate the effect of supplemental iron on milk yield and composition as well as DMI in cows fed diets with relatively high levels of gossypol. All diets contained 49% concentrate, 10% cottonseed and 41% chopped alfalfa hay (DM basis). The cottonseed portion of the Control diet contained only WCS. The remaining three diets contained 6.7% CrP and 3.3% WCS. Diets containing CrP were supplemented with 0, 250, or 500 ppm iron as iron sulfate. Eight cows (4 primiparous and 4 multiparous) were used in a replicated 4x4 Latin square design. Periods were 28 d in length with the last 14 d for data collection. Milk yield (kg/d) and DMI (kg/d) decreased linearly with increasing iron sulfate in the diet ( $P=0.099$  and  $P=0.007$ , respectively). Milk fat (%) was not affected by iron sulfate supplementation. For primiparous cows, milk yield, milk fat, and DMI were 39.2, 3.3, 26.4; 40.3, 3.6, 27.6; 38.0, 3.5, 27.0; and 36.8, 3.8, 25.4 for the Control, 0 ppm Fe, 250 ppm Fe, and 500 ppm Fe diets, respectively. Similar data for multiparous cows were 49.7, 3.1, 31.8; 51.2, 3.2, 32.8; 49.9, 3.3, 32.5; and 47.7, 2.8, 29.7, respectively. WCS, whole Pima, and CrP contained (% of meats DM) 0.65%, 0.99%, and 0.96% free gossypol and 0.27%, 0.52%, and 0.52% minus (-) isomer of gossypol, respectively. Total plasma gossypol ( $\mu\text{g/ml}$ ) increased ( $P<0.001$ ) with substitution of CrP for WCS and decreased at an increasing rate ( $P<0.001$ ) with the inclusion of supplemental Fe to the diet. Total plasma gossypol of the primiparous and multiparous cows were 5.3, 4.9; 9.1, 9.8; 7.4, 7.0; and 7.1, 6.8 for the Control, 0 ppm Fe, 250 ppm Fe, and 500 ppm Fe diets, respectively. Substitution of CrP for WCS increased milk yield and DMI. Although dietary iron sulfate addition reduced plasma gossypol concentration, production of milk and DMI decreased.

**Key Words:** Cottonseed, Gossypol, Dairy cows

**932 Relationship between bulk tank milk urea nitrogen and individual cow milk urea nitrogen values.** P. Arunvipas\*, J. VanLeeuwen, I. Dohoo, E. Leger, and G. Keefe, *Atlantic Veterinary College, UPEI, Charlottetown PE Canada.*

The objective of this study was to determine if bulk tank milk urea nitrogen (BTMUN) are similar to the whole herd average of individual cow MUN levels in pastured dairy herds in Prince Edward Island (PEI), and whether this relationship is affected by other factors such as herd size, type of DHI recording that is used on the farm, and season of the year. In 199 herds in PEI, bulk milk samples were tested for MUN every two weeks between July, 1999 and June, 2000. During this year, all herds had all cows tested for MUN once a month. The weighted (for milk production) herd average MUN levels (WHMUN) were calculated for each month and compared to the BTMUN closest to it in time. There were 1,772 complete observations in the final dataset. These data were stratified by pasture season (yes/no), five herd size groups based on the number of milking cows in the herd (<40, 41-60, 61-80, 81-100, >100 cows/herd), and one of four different individual cow milk sampling protocols employed on the farm (owner versus technician sampling, morning and/or evening sampling). WHMUN and BTMUN had a moderate concordance correlation ( $P_c = 0.81$ ) and a low mean difference of 0.06 mg/dl, indicating that BTMUN values provided a moderately reliable indicator to the urea status of the whole herd. This moderate reliability extended to both the pasture ( $P_c = 0.79$ ) and non-pasture seasons ( $P_c = 0.82$ ), and various milk sampling protocols ( $P_c = 0.79-0.83$ ). Correlations were numerically but not statistically higher in small and medium sized herds ( $P_c = 0.83$  and 0.81, respectively) than in large herds ( $P_c$

= 0.71-0.77) seen in Atlantic Canada. The reasons why BTMUN and WHMUN are not more highly correlated remain unknown.

**Key Words:** Bulk tank milk urea nitrogen, Milk urea nitrogen

**933 Effects of an emulsifier on the steam-flaking properties and nutrient characteristics of yellow, high available phosphorus, high-oil, and white corn varieties with regards to retrogradation.** K.F. Wilson\*<sup>1</sup>, L.D. Thompson<sup>2</sup>, G.V. Pollard<sup>3</sup>, C.R. Richardson<sup>2</sup>, D. Hughes<sup>4</sup>, and T.C. Bramble<sup>2</sup>, <sup>1</sup>Loveland Ind., Greeley, CO, <sup>2</sup>Texas Tech Univ., Lubbock, <sup>3</sup>Southwest Texas State Univ., San Marcos, <sup>4</sup>Ultimate Resource, Dallas, TX.

Yellow (YC), high-oil (HO), high available phosphorus (HAP), and white corn (WC) were subjected to steam-flaking to determine if the inclusion of an emulsifier during conditioning affects processing time, energy consumption, flaked grain quality and nutritive value among the varieties. Each corn variety was steam-flaked (.37 kg/L) with and without an emulsifier. Data collected included the effects of steam-flaking (energy consumption [kWh], processing time [min], flake durability [%], and fines [%]) and nutritive value (starch availability [%] and free moles of sulfhydryls [%]) of the retrograded and non-retrograded steam-flaked corn samples. After steam-flaking, a sample was collected immediately and evaluated for flake durability and fines and a second sample was taken and frozen for analyses. Additionally, samples were placed in ambient air to dry for 8, 16, 24, and 48 h to evaluate the effects of the emulsifier on retrogradation. Interactions ( $P < 0.05$ ) were observed for processing time, energy consumed, flake durability, and percent fines. Addition of the emulsifier increased ( $P < 0.05$ ) processing times and energy consumption. Additionally, the emulsifier inclusion improved ( $P < 0.05$ ) flake durability and decreased ( $P < 0.05$ ) the percent fines for HAP. Other differences ( $P < 0.05$ ) observed were for starch availability and free moles of sulfhydryls, which consisted of drying-time x emulsifier and corn variety x emulsifier interactions. Results implied that the emulsifier retarded ( $P < 0.05$ ) the retrogradation process with respect to starch availability and free moles of sulfhydryls. In conclusion, this study showed that by utilizing an emulsifier, the effects of retrogradation might be slowed, and processing improved.

**Key Words:** emulsifier, retrogradation, steam-flaking

**934 Optimal level of supplemental distillers dried grains plus solubles (DDGS) for heifers grazing tall fescue pastures.** J. B. Corners\*, K. J. Barnhart, M. Ellersieck, and J. E. Williams, University of Missouri-Columbia, Columbia, MO.

Forty-eight heifers ( $258.1 \pm 18.1$  kg) were randomly assigned to a 4 X 2 factorial arrangement, with endophyte level (HE and LE) in tall fescue and DDGS supplementation as main effects. Twelve heifers were assigned to one of four 0.8 ha paddocks (two HE vs two LE; three animals per treatment within paddock). The four treatments were: 0.11 kg soyhull control, 0.45 kg DDGS, 0.91 kg DDGS and 1.36 kg DDGS. During the 70-day trial, supplemental intake was based on mean animal weight within each treatment. At 0700 hr, heifers were placed in individual feeding stanchions for 30 minutes and fed supplements, then returned to pasture. The twelve paddocks used during the study were clipped for removal of seed heads 10 days prior to turnout. Cattle were rotated every 21 days. Total forage availability was measured in each paddock by clipping forage 2.0 cm above the ground inside ten randomly placed 0.1 m<sup>2</sup> quadrants prior to rotation onto and after rotation off paddocks. The mean NDF and CP contents of the forage were  $60.6 \pm 0.04\%$  and  $9.1 \pm 1.14\%$ , respectively. Mean forage availability was  $5,340 \pm 1,568$  kg/ha during the grazing season. Forage intake was determined by feeding 0.45 kg pelleted alfalfa meal, containing 10g Cr<sub>2</sub>O<sub>3</sub>/hd daily, for 17 days. Fecal samples were collected at 0600 and 1800 hr on d 11-17. Since pasture effect ( $P > 0.05$ ) and pasture x treatment interaction ( $P > 0.05$ ) were not significant, only treatment effects were discussed. The addition of DDGS in increasing quantity resulted in increasing DM ( $P < 0.0001$ ) and CP ( $P < 0.0001$ ) intakes from the supplement. Increasing levels of DDGS supplementation resulted in a linear increase in ADG ( $P < 0.02$ ). No difference ( $P > 0.13$ ) was observed in the protein:gain ratio of the treatment groups. Based on findings, DDGS supplementation increased ADG regardless of endophyte level in tall fescue pasture. Forage intake data will be presented at the meeting.

**Key Words:** Tall Fescue, Distillers Dried Grains plus Solubles, Intake

**935 Effect of substitution of whole cotton seed by naturally heat-humidity damaged cotton seed on growth performance and carcass traits in sheep.** A. Estrada\*<sup>1</sup> and R. Barajas<sup>1</sup>, <sup>1</sup>FMVZ-Universidad Autonoma de Sinaloa (Mexico).

With the objective to determinate the effect of substitution of whole cotton seed by naturally heat-humidity damaged cotton seed on growth performance and carcass traits in sheep. Thirty-two Pelibuey sheep (males; BW =  $21.6 \pm 1.57$  kg) were used in a complete randomized block experiment design. The animals were weighed and blocked by weight, in groups of four were placed in eight ground flour pens (2 x 3 m), and assigned to consume one of two diets in that consisted the treatments: 1) Diet with 16.8% CP and 3.54 Mcal of DE/kg, containing Sudan grass hay 12%, whole cotton seed (WCS) 20%, ground sorghum grain 47%, canola meal 10%, sugarcane molasses 8%, urea 0.9%, and mineral premix 2.1% (control); and 2) Diet similar to control, but containing 20% of naturally heat-humidity damaged cotton seed substituting WCS (HDC treatment). Animals were weighed in days 1, 28 and 56, feed was offered twice a day under free access condition. At the end of the experiment (d 56), they were killed in a slaughterhouse, carcass traits were recorded, carcass were dissected and main cuts were measured. Treatments did not affect ( $P = 0.58$ ) end weights (33.69 vs. 32.5 kg), average daily gain (0.214 vs. 0.190 kg/day), daily feed intake (1.239 vs. 1.171 kg/day), and feed/gain (5.87 vs. 6.22). NEM and NEg of heat-humidity damaged cotton seed were estimates to be close to 2.37 and 1.52 Mcal/kg. Cold carcass weight, carcass long and wide, carcass yield, rib eye area, back fat, and KPH fat were similar ( $P = 0.18$ ) in both treatments. Long loin, short loin, rib, leg, shoulder and neck cuts were not affected ( $P = 0.24$ ) by treatments. It is concluded, that cottonseed that becomes damaged by rain and further sun exposed, can be included in finishing diets for finishing sheep, substituting usual whole cotton seed without affect growth-performance, carcass trait or carcass cutability.

**Key Words:** Cotton seed, Heat damage, Growth-Performance, Sheep

**936 Ensiling wet corn distillers grains alone or in combination with soyhulls.** K. F. Kalscheur\*, A. D. Garcia, A. R. Hippen, and D. J. Schingoethe, South Dakota State University, Brookings, SD.

With the development of ethanol plants wet distillers grains have become increasingly available as a feedstuff for cattle. Improvements in the storage of wet distillers grains (WDG) can result in a reduction of spoilage and greater utilization. The objective of this study was to evaluate the fermentation and preservation characteristics of ensiling wet corn distillers grains alone or mixed with soyhulls (SH). Treatments were ensiled in laboratory silos as follows: 1) 100% WDG; 2) 85% WDG + 15% SH; and 3) 70% WDG + 30% SH. Samples of each treatment were collected for analyses prior to ensiling. The silos were opened at d 3, 7, and 21 and samples were collected to evaluate the fermentation characteristics. Packing density was kept constant across all treatments at 190 kg/m<sup>3</sup> (DM basis). Dry matter and CP of the ensiled feeds were 35, 43, and 49% and 30.8, 24.8, and 21.1% for 100% WDG, 85% WDG, and 70% WDG, respectively. The pH of the 100% WDG was the lowest at 3.2 and increased ( $P < 0.05$ ) with decreasing levels of WDG (4.0 and 4.3 for 85% and 70% WDG, respectively). Lactic acid (% of DM) was highest for 100% WDG (4.4%) and tended to decline as SH were included in the treatments. Acetic acid, propionic acid, and ammonia-N did not differ across treatments. There was no change in DM, CP, pH, lactic acid, propionic acid, or ammonia-N in the ensiled treatments over time ( $P > 0.05$ ). Acetic acid increased ( $P < 0.05$ ) from less than 0.01% of DM for d 0 and 3 to 0.89 and 0.97% for the 85% and 70% WDG treatments on d 21, respectively. There was no ethanol detected prior to ensiling, however it increased ( $P < 0.05$ ) with ensiling time for all treatments. Ethanol concentration was the highest (2.24% of DM) for 85% WDG on d 21. The low initial pH of the WDG probably explains why there were no significant pH differences within treatments over time. Differences in pH between treatments can be explained by the dilution effect of the addition of SH. These results suggest that WDG can be effectively preserved by ensiling, either alone or with the addition of SH.

**Key Words:** Wet corn distillers grains, Soyhulls, Ensiling

**937 Effects of Flaxseed Supplementation on Nutrient Utilization, Milk Production and Composition by Lactating Dairy Cows.** H.W. Soita<sup>\*1</sup>, J.A. Meier<sup>1</sup>, M. Fehr<sup>1</sup>, D.A. Christensen<sup>1</sup>, J.J. Mckinnon<sup>1</sup>, and A.F. Mustafa<sup>2</sup>, <sup>1</sup>University of Saskatchewan, Saskatoon SK. CANADA, <sup>2</sup>University of McGill, QC. CANADA.

Twelve multiparous Holstein cows at 72+16 DIM were used in a 3x3 Latin square with 21-d periods to determine the effect of replacing barley grain with raw (RFS) or micronized (MFS) flaxseed in a total mixed ration (TMR) on nutrient digestibility, milk yield and milk composition. The 3 dietary treatments (DM basis) included: 1. control ration (50% barley silage, 50% barley grain and canola meal based-concentrate); 2. control ration with 1 kg barley replaced by 1 kg raw RFS; 3. control ration with 1 kg barley replaced by 1 kg MFS. Nutrient digestibility was determined using acid insoluble ash as an indigestible marker. Neutral detergent fiber, ADF and CP digestibility were not affected by supplementation, however, calcium digestibility was reduced ( $P < 0.05$ ) by 62 and 46% when RFS and MFS were fed, respectively. Milk yield (38.3, 39.6, and 38.4 kg/d for the control, RFS and MFS diets, respectively) was similar across treatments. Milk fat (3.50, 3.48, and 3.52 %) and protein (3.31, 3.34, and 3.31%) for the control, RFS and MFS diets, respectively, were not affected by treatment. The concentration of c9, t11-conjugated linoleic acid in milk increased ( $P < 0.05$ ) by 49% for the MFS diets relative to the control diet (CLA; 0.51, 0.57 and 0.76 g/100g fatty acids for the control, RFS and MFS diets, respectively). The MFS diets also increased ( $P < 0.05$ ) the C18:1, C18:2 and C18:3 concentrations in milk while reducing that of C18:0, C16:0, C14:0 and C12:0. There was no effect of raw flaxseed on milk or milk fatty acid composition. Replacing 1 kg of barley grain with 1kg of MFS in the diet of lactating cows increased the unsaturated fatty acid and the CLA content of milk without depressing nutrient digestibility or daily milk production. (Key words: Raw and Micronized flaxseed, conjugated linoleic acid, milk composition)

**Key Words:** Micronized or raw flaxseed, Milk composition, Conjugated linoleic acid

**938 In situ rate and extent of ruminal DM and N degradation of byproduct feeds in steers fed a high-concentrate diet.** S.S. Swanek<sup>\*1</sup>, C.R. Krehbiel<sup>1</sup>, D.R. Gill<sup>1</sup>, and B.A. Gardner<sup>2</sup>, <sup>1</sup>Oklahoma State University, Stillwater, OK, <sup>2</sup>Steve Armbruster Consulting, Inc., Stillwater, OK.

In situ rate and extent of ruminal DM and N degradation of 15 byproduct feeds was determined in steers consuming a high-concentrate diet. Byproducts were classified as high protein (HP; >40% CP; soybean meal [SBM; 48% CP], cotton seed meal [CSM], guar meal [GM], peanut meal [PM], extruded soybean meal [EXSBM], and feather meal [FM]); medium protein (MP; 20-40% CP; dried distillers grain [DDG], corn germ [CG], crambe meal [CRM], sunflower meal [SFM], and wet distillers grain without solubles [WDG]); or low protein (LP; <20% CP; wheat middlings [WM], dehydrated alfalfa meal [DEHY; 17% CP], soybean hulls [SH], and corn gluten feed [CGF]). Feeds were randomly assigned to two of four steers (8 byproducts/steer) and duplicate bags were incubated in the rumen for 0, 2, 4, 8, 12, 18, 24, and 48 h. Ruminal degradation was calculated as  $A + B[Kd / (Kd + Kp)]$ , where A is the assumed instantly soluble fraction and B and is the potentially degradable protein. A constant rate of passage (Kp) was used ( $0.05 \text{ h}^{-1}$ ). Of the HP byproducts, PM had the greatest (95.8%;  $P < .01$ ) rumen-degradable protein (RDP), A fraction (80.1%) and ruminal DM degradability (90.6%). Feather meal had the lowest RDP (21.0%;  $P < .01$ ) and the greatest C (rumen-undegradable) fraction (68.4%;  $P < .01$ ). For MP, SFM had greater ( $P < .05$ ) RDP (83.3%) than all MP byproducts except WDG (79.3%;  $P = .28$ ). Corn Germ had the lowest ( $P < .01$ ) A fraction (31.5%) and the greatest ( $P < .02$ ) rate of DM disappearance (1.81%/h). Wet distillers grain without solubles had the greatest (87.3%;  $P < .05$ ) DM disappearance and CRM had the lowest (43.3%). Wheat middlings and CGF had the highest ( $P < .01$ ) RDP (89.5 and 91.7%), A fraction ( $P = .01$ ; 73.7 and 78.9%) and DM degradability ( $P < .01$ ; 68.5 and 68.7%), and the lowest ( $P < .05$ ) rates of B fraction (0.39 and 0.28%/h) and DM disappearance (0.27 and 0.25%/h) of the LP feeds. Soybean hulls had the lowest ( $P < .01$ ) RDP (59.2%) and DM degradability (27.4%), and the highest ( $P < .01$ ) C fraction (20.9%). Rate and extent of N degradation varied considerably among byproduct feeds. Our data suggests a potential for feeding combinations of byproducts to optimize RDP and

microbial efficiency, and maintain a balanced amino acid profile to the small intestine.

**Key Words:** In Situ Ruminal Degradation, Protein, Byproduct

**939 Cheese whey silage for growing holstein heifers and beef finishing steers.** D.R. ZoBell<sup>\*1</sup>, K.C. Olson<sup>1</sup>, and R.D. Wiedmeier<sup>1</sup>, Utah State University.

Cheese whey silage (WS) was produced at two separate locations to determine the effect of feeding WS on production characteristics of growing holstein heifers (HH) and finishing beef steers (BS). For the HH study, WS was produced by combining liquid cheese whey (45% DM) (W), wheatgrass straw (WGS) and wheat middlings (WM) at proportions of 51.5, 38.3 and 10.2% (DMB) respectively and ensiling. The WS had a DM nutrient analysis of 46.4% DM, 13.8% CP, 17.3% ADF, 27.4% NDF, .59% Ca, .56% P, and pH of 3.9. Forty-eight HH (258 kg) were assigned to treatments of Control (C) or Treated (T) with 8 head per pen and 3 pens per treatment for this 56d study. The C heifers received a growing ration with DM proportions of 16.6% alfalfa hay (AH), 40.4% corn silage (CS), 41.0% WM and 2.0% supplement (S). Treated HH received the WS and supplement. Control and T rations were isocaloric and isonitrogenous. In the BS study, WS was produced by combining W (45% DM), wheat straw and WM at DM proportions of 63.1, 28.9 and 8.0% respectively. The WS had a DM nutrient analysis of 43.5% DM, 13.3% CP, 19.9% ADF, 28.4% NDF, .64% Ca, .67% P, and pH of 4.3. Forty steers (438 kg) were assigned to treatments of C or T with 5 head per pen and 4 pens per treatment in this 84d study. Control steers received a diet consisting of 85.6% dry-rolled barley (B), 8.1% CS, 1.5% SBM and 4.8% S (DMB). Treated steers received 84.1% B, 12.2% WS and 3.8% S (DMB). The C and T rations were isocaloric and isonitrogenous. Carcass data was obtained at time of slaughter. Statistical analysis of data for both studies were performed using the MIXED procedure of SAS. Results from the HH study indicated ADG (kg/hd/day), DMI (kg/hd/day) and FE values for C and T of 1.09 and 1.06 ( $P = .79$ ); 8.0 and 6.55 ( $P = .11$ ); and 7.38 and 6.52 ( $P = .32$ ) respectively. Finishing steer results for C and T respectively were 1.11 and 1.20 ( $P = .15$ ) for ADG (kg/hd/day); 9.05 and 9.73 ( $P = .006$ ) for DMI (kg/hd/day); and 8.26 and 8.22 ( $P = .93$ ) for FE and carcass traits did not differ ( $P > .05$ ). Although production variables were not different, cost of gain was decreased by 35.3% and 5.7% respectively for the HH and BS studies, due to the lower cost of the T rations. These studies suggest there may be an economic basis for including whey silage in growing and finishing diets.

**Key Words:** whey silage, growing, finishing

**940 Accelerated growth of dairy calves fed various levels of whole milk or milk replacer.** G. D. Marx<sup>\*1</sup> and M. C. Jacobson, <sup>1</sup>University of Minnesota, Crookston.

Performance of 64 newborn Holstein dairy calves equally divided by sex and size were evaluated during a 35 d period utilizing two levels each of whole milk (WM) or milk replacer (MR). In both WM and MR fed calves, the high level was 50% higher than the control level. WM was fed at 3.64 kg or 5.46 kg/d and MR fed at 0.64 kg in 3.0 kg water or 0.96 kg in 4.7 kg water divided between two feedings/d/calves. Preweaned calves were also fed an 18% CP grain starter to appetite. Maternal colostrum was fed the first 3 d of life at 3.64 kg/d/calves. All 64 calves were weaned at 35 d and continued on a grain starter and haylage ration fed free choice for another 35 d to determine any residual effects when fed 50% additional WM or MR as baby calves. Calves were housed inside an insulated and ventilated warm calf facility. All preweaned calves were fed in individual steel pens 1.2 m x 1.5 m and weaned calves were fed in group pens 3.7 m x 3.7 m. Water was available free choice with automatic fountains in each pen. Feed intakes, refusals, feed samples, body weights and health data were collected. Data were analyzed by GLM procedure of SAS. The calves fed the high level WM and MR gained 0.46 and 0.52 kg/d and were significantly higher ( $P < 0.05$ ) than the control calves that gained 0.38 and 0.40 kg/d. Grain starter intake by the control calves fed WM or MR was higher at 0.25 and 0.26 kg/d, but not statistically different ( $P > 0.05$ ) than calves fed the high level that consumed 0.22 and 0.23 kg/d. Weaned calves that were fed the high levels of WM and MR as baby calves gained 0.76 and 0.78 kg/d and controls gained 0.67 and 0.73 kg/d. Grain starter intakes of the weaned calves that had been fed the high levels of WM and MR were 1.51 and 1.53 kg/d and the controls consumed 1.43 and 1.38 kg/d. No differences ( $P > 0.05$ ) were noted in weight gains and starter intake of weaned calves.

Forage intakes and feed/gain ratios of weaned calves were similar for all groups. Scour days/calf were low and similar for all treatments and no other unusual health problems were observed. Use of higher levels of both WM or MR improves growth rate of dairy calves.

**Key Words:** Dairy calves, Accelerated growth, Calf nutrition

**941 Skeletal muscle growth and hepatic urea kinetics in lambs offered different dietary supplies of sodium propionate or metabolizable protein.** A.P. Moloney\*<sup>1</sup> and G. E. Lobley<sup>2</sup>, <sup>1</sup>Teagasc, Grange Research Centre, Dunsany, Co. Meath, Ireland, <sup>2</sup>Rowett Research Institute, Bucksburn, Aberdeen AB21 9SB, UK.

Increased supply of glucogenic precursors from the rumen could spare amino acids from hepatic gluconeogenesis thereby enhancing protein accretion in the growing ruminant. The objective was to determine the effects on body composition and hepatic urea production in lambs offered different dietary supplies of propionate and metabolizable protein (MP). Sixty wether lambs (Bodyweight (BW) = 44.0 kg sd 3.38) were offered one of 6 rations (22g/kg BW + 100g hay) in a 3 (0, 40 or 100 g sodium propionate (SP) /kg) by 2 (0.9 MP requirement or 1.35 MP requirement) randomized block experiment. Carcass composition was determined after an 83-day growth period by dissection and tissue accretion calculated by reference to a representative lambs slaughtered at the beginning of the experiment. In parallel, 6 wether lambs were used in a 6 (rations) by 6 (periods) Latin Square experiment to measure urea kinetics by intravenous injection with [<sup>15</sup>N, <sup>15</sup>N]urea followed by total urine and feces collection for 72h and measurement of enrichment of [<sup>15</sup>N, <sup>15</sup>N]urea and [<sup>14</sup>N, <sup>15</sup>N]urea in urine and <sup>15</sup>N concentration in feces. There were no interactions between SP and MP supply. Increased MP supply increased (p=0.05) carcass weight (29.5 v. 30.3 kg), did not affect carcass composition or the weight of internal fat depots, increased (p< 0.05) urea-N production (26.3 v. 32.9 g/day) and decreased (p<0.05) the fractional transfer of urea-N to the gastrointestinal tract (0.638 v. 0.544). Increased SP supply did not affect hepatic urea kinetics, increased (linear p<0.05) carcass weight (29.1, 30.3 and 30.2 kg), skeletal muscle mass (16.4, 17.4 and 17.7 kg) and growth (30.1, 42.3 and 46.1 g/d for 0, 40 and 100 g SP/kg, respectively). It is concluded that an increase in SP supply increased muscle growth independent of MP supply.

**Key Words:** Propionate, Urea, Muscle

**942 Kid preference for supplement.** T.W. White\*<sup>1</sup>, H.G. Bateman<sup>1</sup>, C.C. Williams<sup>1</sup>, and S. Alford<sup>1</sup>, <sup>1</sup>Louisiana State University Agricultural Center, Baton Rouge, LA 70803.

Eight Boer x Spanish wether kids (mean BW = 17.7 ± 0.82 kg) were used in two preference experiments. Kids were fed Coastal bermudagrass hay and offered 100 g supplement DM from corn (C); corn and soybean meal (CS); corn, soybean meal, and fish meal (CSF) as meal (M); or pellet (P) or urea-fish meal molasses liquid (L). In Exp.1, each kid was offered two supplements simultaneously in every combination at 0800 on 2 consecutive days. Supplements were removed when one was completely consumed, and the percentage of DMI calculated for each. Pellets were preferred (P < 0.01) over M and both over (P < 0.01) L. Intake was equal for CP and CSP and higher (P < 0.03) than for CSFP that was higher (P < 0.01) than for CSFM that was higher (P < 0.02) than for L. In Exp.2, supplements were offered individually and consumption timed and statistically analyzed. Pelleted CS and CP were consumed more quickly (P < 0.05) than CSFP, CSM and CM that were consumed more quickly (P < 0.01) than CSFM and L. Kids prefer supplements that contain corn or soybean meal over those that contain fish meal, and they prefer pellets over meal or liquid although they will consume each fed individually.

**Key Words:** Goats, Supplement preference

**943 Effect of Aminophylline on Metabolic and Thermoregulatory Responses During Hypothermia Associated with Cold Exposure in Lambs.** B. Zimmermann\*<sup>1</sup>, G. Diebold<sup>1</sup>, J. Galbraith<sup>2</sup>, W. Whitmore<sup>2</sup>, G. Murdoch<sup>2</sup>, R. Mosenthin<sup>1</sup>, and R.J. Christopherson<sup>2</sup>, <sup>1</sup>Hohenheim University, Institute of Animal Nutrition (450), 70593 Stuttgart, Germany, <sup>2</sup>Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, T6G2P5 Ca.

The objective of the study was to test in two experiments the hypothesis that treatment with the phosphodiesterase inhibitor aminophylline would enhance metabolic rate and delay the development of hypothermia in lambs. In experiment 1, six lambs were allocated to aminophylline treatments on a randomized schedule such that each lamb received each of four dose levels as a single injection (0, 8, 16 or 32 mg/kg i.p.) once over a period of two weeks. Dose rates between 16 and 32 mg/kg, i.p., increased (P < 0.05) metabolic rate of lambs calculated from oxygen consumption, recorded with an open circuit respiratory system. In the second experiment, 11 male and 10 female lambs were allocated to each of two treatments. Controls received 0.9% saline injections and aminophylline-treated animals received injections of aminophylline (24 mg/kg, i.p.) before exposure to an air temperature of -15C to determine whether treatment would delay hypothermia. Mean heat production of the lambs at -15C ranged from 13 W/kg to 15 W/kg and was increased (P < 0.01) by aminophylline, but was not significantly affected by gender of the lambs. Aminophylline did not shorten the time for re-warming in experiment 2 even though metabolic rate was increased. Aminophylline, therefore, has some potential as a treatment for hypothermia or to improve recovery from hypothermia in lambs by increasing metabolic rate during cold stress.

**Key Words:** lamb, metabolic rate, aminophylline

**944 Effects of ruminal and post-ruminal infusion of starch hydrolysate or glucose on the microbial ecology of the gastrointestinal tract in growing steers.** J. S. Van Kessel\*<sup>1</sup>, P. C. Nedoluha, A. Williams-Campbell<sup>1</sup>, R. L. Baldwin, VI<sup>1</sup>, and K. R. McLeod<sup>2</sup>, <sup>1</sup>USDA-ARS, Beltsville, MD, <sup>2</sup>University of Kentucky, Lexington, KY.

Forty steers fitted with ruminal and abomasal infusion catheters were used to determine the effects of site of carbohydrate supply on gastrointestinal tract bacteria. Steers were assigned randomly to one of 8 groups in a complete randomized block design with a 36 d experimental period. Treatments included: 1.) a pelleted basal ration fed at 0.163 Mcal ME (kg BW<sup>0.75</sup>)<sup>-1</sup> d<sup>-1</sup> (LE), 2.) the basal ration fed at 0.215 Mcal ME (kg BW<sup>0.75</sup>)<sup>-1</sup> d<sup>-1</sup> (HE), 3.) the basal ration fed at 0.163 Mcal ME (kg BW<sup>0.75</sup>)<sup>-1</sup> d<sup>-1</sup> plus ruminal infusion of starch hydrolysate (SH) (RSH), 4.) the basal ration fed at 0.163 Mcal ME (kg BW<sup>0.75</sup>)<sup>-1</sup> d<sup>-1</sup> plus abomasal infusion of SH (ASH), and 5.) the basal ration fed at 0.163 Mcal ME (kg BW<sup>0.75</sup>)<sup>-1</sup> d<sup>-1</sup> plus abomasal infusion of glucose (AG). Glucose and SH were infused at 14.35 and 12.64 g/kg BW<sup>0.75</sup>/d, respectively. Ruminal, intestinal, and fecal samples were obtained on d 36. Ruminal pH was low (5.79) in LE steers and unaffected (P > 0.10) by increased energy intake or carbohydrate infusions. Intestinal and fecal pHs were 6.93 and 7.00, respectively for LE steers. Energy intake (P < 0.10) and carbohydrate infusions (P < 0.01) decreased intestinal and fecal pH compared with LE. Ruminal counts of anaerobic bacteria in LE steers were 8.99 Log<sub>10</sub> cells/g. ASH and AG steers had approximately 1.5 Log<sub>10</sub> cells/g higher (P < 0.01) intestinal and fecal anaerobic populations. There were 40, 22, and 23%, respectively, fewer aerobic than anaerobic ruminal, intestinal, and fecal bacteria. Less than 1% of the anaerobic bacteria enumerated in the rumen, intestines and feces were coliforms, and 97% of the coliforms were *Escherichia coli*. Carbohydrate infusions resulted in only numerical increases in fecal coliform and *E. coli* concentrations (P > 0.10). Fecal *E. coli* were highly acid-sensitive in all steers with less than 1% surviving a 1 h exposure to low pH (2.0). This suggests that intestinal or fecal pH is not a good indicator of acid-resistance and supports the concept that there are other factors that may induce acid resistance.

**Key Words:** Bacteria, *Escherichia coli*, Cattle

**945 Replacing corn silage with sorghum silage to supplement growing steers grazing high quality pastures: effects on productive performance.** L. O. Abdelhadi\*<sup>1,2,3</sup>, F. J. Santini<sup>1,2</sup>, and E. L. Villarreal<sup>2</sup>, <sup>1</sup>Fac. Cs. Agrarias-UNMDP, <sup>2</sup>INTA EEA Balcarce, <sup>3</sup>CONICET - Argentina.

Sorghum is better adapted to lower rainfall and unfavourable soil conditions than corn, but its lower grain digestibility could affect animal responses. This study was conducted to evaluate the effect of replacing corn silage (CS) by grain sorghum silage (SS), on liveweight gain (LWG) and fat deposition rate (FDR) of grazing steers. Forty-two British steers (9 months age and 187±26 kg LW) were assigned to one of three treatments in a randomized design: TP, fresh pasture ad libitum; TCS or TSS, with pasture plus CS ('Novartis Suco' hybrid) or SS ('Dekalb DA38' hybrid), both fine chop and rolled at dough grain stage, representing 40% of the total diet (on a DM basis), respectively. Two paddocks (reps) per treatment and 7 animals per rep were used. All steers grazed in a one-day strips throughout 115 days from June to October, mixed pastures (70% grass and 30% legumes) with 2975 kg DM/ha availability (estimated weekly), 16.0% DM, 22.3% CP, 35.8% NDF and 74.6% IVDMD. Supplements contained 6.1 and 6.7% CP, 50.9 and 42.9% NDF, 13.7 and 22.9% starch, 64.7 and 51.5% IVDMD and were consumed at a rate of 2.78 and 2.89 kg DM/animal/d, 1.2% of LW for CS and SS, respectively. FDR was estimated measuring subcutaneous fat depth (FD) between 11-12<sup>th</sup> rib using an ultrasonic ecograph and steers were weighted every 21 days until the end of the experiment. Silage supplementation, led us to increase stocking rates from 2.45 in TP up to 4.66 (TCS and TSS) steers/ha, and beef production from 266 in TP up to 483 (TCS) and 488 (TSS) kg/ha. We conclude that partial replacement of high quality pastures by SS, would result in similar performance that once obtained with CS, but would affect FDR of the animals.

Item	TP	TCS	TSS
DMI, kg/d	6.81	6.96	7.21
Initial LW, kg	192.6	181.1	187.4
Final LW, kg	298.8	281.8	291.1
LWG, kg/d	0.948	0.913	0.923
Initial FD, mm	2.32	2.38	2.46
Final FD, mm	3.58	3.28	3.10
FDR, mm/30d	0.327 <sup>a</sup>	0.228 <sup>ab</sup>	0.148 <sup>b</sup>

<sup>abc</sup> Means within a row with unlike superscripts differ ( $P < .05$ )

**Key Words:** Supplementation, Corn Silage, Sorghum Silage

**946 Effects of ruminal infusion of electrolyte solutions on calf performance parameters.** S. I. Wawrzyniak\*<sup>1</sup>, H. D. Tyler<sup>1</sup>, and J. D. Quigley, III<sup>2</sup>, <sup>1</sup>Iowa State University, Ames, <sup>2</sup>American Protein Corporation, Ames, IA.

To treat dehydration, diarrheic calves are often ruminally drenched with electrolyte solutions. To determine the effects of these solutions on feed intake and average daily gain, dairy bull calves (n=28) were ruminally infused with either a commercial electrolyte solution or a 9% saline solution at the rate of 10% of body weight per day for three consecutive days. Control calves (n=15) were sham-infused by inserting the esophageal feeder without infusing any fluids. Calf starter and water were offered ad libitum and starter intake was recorded daily. Body weights were determined at day -1 (pre-infusion) and day 8 (post-infusion). Feed intake was lower for calves infused with fluids than for control calves ( $P < 0.01$ ). Average daily gain was lower in calves infused with fluids than in control calves ( $P < 0.01$ ). Feed intake ( $P < 0.05$ ) and average daily gain ( $P < 0.01$ ) were decreased for calves infused with electrolytes as compared to calves infused with saline solution or control calves. Overall, infusion of either electrolytes or saline solution into the rumen was detrimental to calf performance.

**Key Words:** Rumens, Electrolytes, Feed intake

**947 Effect of nitrogen intake on total nitrogen excretion and its partition between urine and feces in Holstein heifers.** JC Marini\* and ME Van Amburgh, Cornell University.

Nitrogen (N) losses affect ground and surface water quality; in addition ammonia and nitrous oxide emissions affect air quality and the latter has been implicated as a significant contributor to global warming. Reducing N emissions, while maintaining adequate animal performance is

a challenge that animal nutritionists face today. In order to investigate the effect of dietary protein level on N excretion and its partition in urine and feces, four Holstein heifers (267±3.6 kg) were used in a Youden square design. Isocaloric diets (2.66 Mcal ME/kg DM) with a N content of 1.4, 1.9, 2.5, 3.0 and 3.4% were fed at approximately 1.8 x maintenance. Increasing the N content of the diet increased urinary N excretion (20.4, 37.8, 66.4, 93.3 and 118.8±1.05 g N/d;  $P < 0.0001$ ) and N balance (19.7, 24.8, 29.6, 32.3 and 32.4±3.99 g N/d;  $P < 0.01$ ), but did not affect the fecal N excretion (49.5±1.22 g N/d;  $P = 0.21$ ). Urea accounted for 97% of the increase in urinary N excretion and urea excretion increased 25-fold between the lowest and highest level of N fed. Increasing N intake reduced the efficiency of N utilization (21.5, 21.9, 20.6, 18.1 and 16.0±2.63 %;  $P = 0.07$ ) and increased the amount of N excreted per unit of N retained (3.82, 3.87, 4.05, 4.45, 6.37±0.92 g N excreted/g N retained;  $P < 0.05$ ). The proportion of N excreted in the urine increased (1.1, 1.7, 2.4, 2.8 and 4.5±0.65 g urinary N/g N retained;  $P < 0.001$ ), while the proportion of fecal N excretion decreased (2.72, 2.14, 1.66, 1.60 and 1.83±0.31 g fecal N/g N retained;  $P < 0.05$ ) with increasing N intake. Reducing dietary N concentration not only decreased the total N excretion, but also reduced the N that is readily volatilized as ammonia (i.e. urea and urinary and fecal ammonia) and increased the carbon:N ratio of the manure, which is related to a decrease in N losses, both as ammonia and nitrous oxide. Feeding reduced amounts of protein, coupled with a high digestible diet, could be a useful tool to reduce the amount of N excreted in the environment, but at the same time maintain adequate growth rates and N retention.

**Key Words:** Nitrogen, Manure, Ammonia

**948 The response of growing dairy calves to additional dietary chromium on growth and humoral characteristics.** J.A. Jackson, S.T. Franklin, L.J. Driedger\*, and C.H. Hamilton, University of Kentucky, Lexington, KY.

The objective of this study was to examine the effects of dietary addition of chromium picolinate on intake, body weight gain and liver and serum triglyceride concentrations in growing dairy calves. Twenty four Holstein bull calves were assigned to dietary treatments of 1) basal diet, 2) basal diet with 0.2 mg/kg supplemental chromium (Cr), 3) basal diet with 0.4 mg/kg supplemental Cr, and 4) basal diet with 0.8 mg/kg supplemental Cr. Calves were assigned to treatment diets at 56 to 70 days of age and fed a control diet for 1 wk. The treatment diets were fed for 9 wk. Body weights were recorded and jugular blood samples were collected on wk 0, 3, 6, and 9. Liver samples were collected via biopsy on wk 0, 6, and 9. Mean as fed intakes were 4.2, 4.5, 4.2 and 4.4 kg/d (NS) for the 0, 0.2, 0.4, and 0.8 mg/kg dietary treatments. Average body weight gains were 1.27, 1.30, 1.24, and 1.34 kg/d (NS) for calves fed the 0, 0.2, 0.4, and 0.8 mg/kg dietary treatments. Liver triglyceride concentrations averaged 0.478, 0.318, 0.255, and 0.244% wet weight ( $P < .01$ ) and serum triglyceride concentrations averaged 36.4, 32.4, 31.6, and 31.8 mg/dl (NS) for calves fed the 0, 0.2, 0.4, and 0.8 mg/kg dietary treatments. Results would suggest that dietary Cr supplementation may alter lipid metabolism.

**Key Words:** Triglyceride, Chromium, Calves

**949 Effects of ruminal infusion of electrolyte solutions on calf performance parameters.** S. I. Wawrzyniak\*<sup>1</sup>, H. D. Tyler<sup>1</sup>, and J. D. Quigley, III<sup>2</sup>, <sup>1</sup>Iowa State University, Ames, <sup>2</sup>American Protein Corporation, Ames, IA.

To treat dehydration, diarrheic calves are often ruminally drenched with electrolyte solutions. To determine the effects of these solutions on feed intake and average daily gain, dairy bull calves (n=28) were ruminally infused with either a commercial electrolyte solution or a 9% saline solution at the rate of 10% of body weight per day for three consecutive days. Control calves (n=15) were sham-infused by inserting the esophageal feeder without infusing any fluids. Calf starter and water were offered ad libitum and starter intake was recorded daily. Body weights were determined at day -1 (pre-infusion) and day 8 (post-infusion). Feed intake was lower for calves infused with fluids than for control calves ( $P < 0.01$ ). Average daily gain was lower in calves infused with fluids than in control calves ( $P < 0.01$ ). Feed intake ( $P < 0.05$ ) and average daily gain ( $P < 0.01$ ) were decreased for calves infused with electrolytes as

compared to calves infused with saline solution or control calves. Overall, infusion of either electrolytes or saline solution into the rumen was detrimental to calf performance.

**Key Words:** Rumen, Electrolyte, Feed intake

**950 Corn processing and soybean meal treatment on performance of growing beef steers fed grass silage-based diet.** D. R. Ouellet\*<sup>1</sup>, M. D'Amours<sup>2</sup>, R. Berthiaume<sup>1</sup>, L. Faucitano<sup>1</sup>, and D. Pellerin<sup>2</sup>, <sup>1</sup>*Dairy and Swine R&D Centre, AAFC, Lennoxville (QC), Canada*, <sup>2</sup>*Animal Science Dept., Laval University, Quebec (QC), Canada*.

This experiment was designed to synchronize nitrogen and energy supply into the rumen and also to provide additional nitrogen at the duodenum from a treated soybean meal source. Forty medium-framed crossbred steers (260 ± 2 kg BW) were used in a 140-d study with a 2 x 2 factorial arrangement of treatments to determine the effect of corn particle size (cracked or ground) and soybean meal processing (solvent extracted 48% CP soybean meal or lignosulfonate treated soybean meal; Soypass<sup>TM</sup>) on feed intake, weight gain and feed-to-gain ratio. Grass silage (23.5, 15.1, 30.7, 42.7% of DM, CP, ADF and NDF, respectively) was offered for ad libitum consumption, while corn and soybean meal were fed at 3.5 and 0.45 kg d<sup>-1</sup>, respectively. Animals were fed individually twice a day and half of the supplement was added on the top of the silage and mixed by hand. Dry matter offered andorts were recorded daily. Animals were treated against internal parasites (Ivermectin) and received an ionophore (Bovatec), and growth stimulant (Revalor<sup>TM</sup>). Steers were weighed on three consecutive days at the beginning and at the end of the experiment. A single weight was also recorded every 14 d. Dry matter intake was not affected (P > 0.10) by treatment and averaged 8.6 ± 0.3 kg d<sup>-1</sup>. Average daily gain was higher (P < 0.02) for animals receiving the ground corn than those fed cracked corn (1.47 vs 1.36 ± 0.05 kg d<sup>-1</sup>). Feed-to-gain ratio was not affected by treatment and averaged 6.1 ± 0.2 kg DMI kg gain<sup>-1</sup>. No effect of soybean meal treatment and its interaction with corn processing was observed. In conclusion, although DMI was not affected by treatment, weight gains of growing steers fed a grass silage-based diet were improved by the reduction of corn particle size. This suggests that increasing energy availability in the rumen, by reducing corn particle size, was more beneficial than increasing the supply of amino acids at the duodenum through soybean meal processing.

**Key Words:** Corn processing, Soybean meal, Steer performance

**951 The effect of dietary roughage and processed corn on rumen development and growth in dairy calves.** D.L.J. Benschop\*<sup>1</sup>, J.P. Cant<sup>1</sup>, and R. Spratt<sup>2</sup>, <sup>1</sup>*University of Guelph, Animal and Poultry Science*, <sup>2</sup>*Agribands Purina Canada Inc.*

The ingestion of highly processed cereal starters by dairy calves may reduce ruminal pH to the point that dry matter intake and growth are compromised. To test the effect of dietary roughage and less processed corn on rumen pH, development and overall growth of calves, 48 male Holstein calves were stratified by liveweight at one week of age and randomly assigned to one of four dietary treatments (n=12) for a period of eight weeks. Treatments included a steam-flaked corn (SFC)/ rolled barley (RB) multi-particle calf starter as a control (CON) and three diets in which the SFC/RB was partially replaced by 10% coarse alfalfa meal (AM), 20% AM or completely replaced by cracked corn (CC). The AM was directly incorporated into the protein pellet within the starter ration. The diets were formulated to contain 20% CP, 3.5% crude fat, 1% calcium and 0.5% phosphorous. Starter and water were available ad libitum, and two litres of calf milk replacer were fed twice daily until weaning at week five. Starter intake was measured daily, bodyweight was measured weekly, rumen fluid samples were taken on a bi-weekly basis, and half of the calves were slaughtered on week eight. The largest differences in intake and growth became most apparent post-weaning as presented in the table below. No significant differences in weights of various digestive organs between treatments were detected. A 20% inclusion of roughage in the diet of these calves increased rumen pH, total dry matter intake, average daily gain and total amount of digesta within the digestive tract. Cracked corn as a substitute for SFC/RB had no effect.

Variables	Diet				SEm
	CON	10% AM	20% AM	CC	
Initial Bodyweight (kg)	43.9	44.7	44.1	44.4	5.58
Final Bodyweight (kg)	70.3 <sup>ab</sup>	76.4 <sup>ab</sup>	77.8 <sup>a</sup>	69.6 <sup>b</sup>	9.51
Daily DMI (g)					
d29-d42	906 <sup>a</sup>	1134 <sup>ab</sup>	1191 <sup>b</sup>	974 <sup>ab</sup>	323
d43-d56	1840 <sup>ab</sup>	2015 <sup>ab</sup>	2124 <sup>a</sup>	1731 <sup>b</sup>	373
ADG (g)					
d29-d42	560 <sup>b</sup>	709 <sup>ab</sup>	836 <sup>a</sup>	593 <sup>b</sup>	282
d43-d56	925	937	936	745	283
Rumen pH (d56)	5.39 <sup>a</sup>	5.51 <sup>ab</sup>	5.67 <sup>b</sup>	5.54 <sup>ab</sup>	0.19

<sup>a,b</sup> unlike superscripts are different (P < 0.05)

**Key Words:** Roughage, Rumen, Growth

**952 Influence of ruminal and postruminal carbohydrate infusion on visceral organ mass and adipose tissue accretion in growing beef steers.** K.R. McLeod\*<sup>1</sup>, R.L. Baldwin<sup>1</sup>, M.B. Solomon<sup>1</sup>, A.V. Capuco<sup>1</sup>, and D.L. Harmon<sup>2</sup>, <sup>1</sup>*USDA, ARS, Beltsville MD 20705*, <sup>2</sup>*Univ. of Kentucky, Lexington, 40546*.

Forty beef steers (243 ± 2 kg BW) with ruminal and abomasal infusion catheters were used to determine the effects of site of carbohydrate (CHO) digestion on visceral organ mass and adipose accretion. Treatments included a pelleted basal diet (89% orchard grass hay, 5% Soypass<sup>®</sup>, and 5% corn gluten meal) fed at 0.162 (LE) or 0.215 Mcal ME/kg BW.75/d, LE plus ruminal (RSH) or abomasal (ASH) infusion of partially hydrolyzed maize starch, and abomasal infusion of glucose (AGLU). Starch and glucose were infused at rates of 12.6 and 14.4g/kg BW.75/d, respectively, approximating 20% of MEI. Volume (5 kg/site/d) of infusate was equalized across treatment and site with water. After 35 d of infusion, steers were slaughtered and visceral organ and adipose (mesenteric and omental) mass were determined and subcutaneous adipose thickness over the 5th and 12th rib was measured. Total intake energy (IE) was greater (P < 0.001) for HE vs LE. Dietary IE was similar (P > 0.10) between LE and CHO infusion treatments, however total IE increased (P < 0.001) with CHO infusion. Total IE was similar (P > 0.10) among CHO infusion treatments, however infused IE was greater (P < 0.001) for AGLU vs ASH (54 vs 51 kcal/kg BW.75/d). As a percentage of empty body weight (EBW), rumen, omasum, total stomach-complex, and pancreas weights were greater (P < 0.05) for HE vs LE. RSH increased (P < 0.05) rumen and pancreas weights as a percentage of EBW compared with either LE or ASH. Dietary IE did not effect (P > 0.10) adipose accretion on an EBW basis, however AGLU increased (P > 0.05) omental and total visceral adipose weights compared with either LE or ASH. There was a trend for increased adiposity, in both visceral and carcass depots, with CHO infusion compared with LE (AGLU > ASH > RSH). Increasing CHO supply ruminally appears to stimulate ruminal tissue proliferation, while increasing supply abomasally does not alter intestinal mass. Moreover, AGLU stimulated adiposity to a greater extent than ASH.

**Key Words:** carbohydrate, viscera, adipose

**953 Effects of Alimet<sup>®</sup> on performance of growing cattle fed forage diets and molasses based liquid supplements.** E. R. Rodriguez\*<sup>1</sup>, W. E. Kunkle<sup>1</sup>, and M. Vazquez-Añon<sup>2</sup>, <sup>1</sup>*University of Florida, Gainesville, FL*, <sup>2</sup>*Novus International, Inc., St. Charles, MO*.

Previous research has shown that adding undegradable intake protein (UIP) to molasses-based supplements improved gains of forage-fed growing cattle. This research evaluated adding corn gluten meal (CGM) or a methionine hydroxy analog (MHA, Alimet<sup>®</sup>, Novus International, Inc.) to diets for growing beef cattle fed hay supplemented with molasses based supplements. Supplement treatments were formulated to supply 0, 2, 4, and 6 g/d of total sulfur amino acids (TSAA) in UIP from either CGM (63.8% CP, 86% TDN) or Alimet<sup>®</sup> (40% rumen bypass methionine assumed) and were compared to a molasses-corn (control) supplement. Both UIP sources were fed in a liquid supplement slurry containing 82% fortified molasses (13% crude protein, minerals, vitamins) and 18% ground corn (8.5% CP, 88.5% TDN). Twenty-eight pens (4 head/pen) of Angus-Brahman crossbred cattle (9-12 months of age) were assigned randomly within sex and breed type. At the start of the trial, calves averaged 277 kg and were in excellent body condition (BCS,



5.8). Bermudagrass hay was offered ad libitum in hay rings outside (no shelter) and molasses slurries limit fed at 2.1 kg DM/d during the 112-day trial (December thru April). Animal data were averaged for each pen, which was the experimental unit. During the 112 day trial, cattle fed CGM at 2, 4, or 6 g/d of bypass TSAA had similar ( $P > .05$ ) performances (.64 to .68 kg/d shrunk wt gain) and gains were 104 to 145 g/d above ( $P < .05$ ) cattle fed the control supplement. Feeding MHA at 2, 4, or 6 g/d of bypass TSAA resulted in 59 to 118 g/d higher ( $P < .05$ ) gain than cattle fed the control supplement. Treatment differences on height or body condition score changes were not found. Feeding 6 g/d bypass TSAA gave the highest gains that were similar ( $P > .05$ ) for both sources and supplement cost of added gain was 65 cents/kg gain for CGM but only 43 cents/kg gain for MHA. MHA had a 22 cent/kg added gain supplement cost advantage compared to CGM and adding 17 g/d of MHA (6 g/d of bypass TSAA) to the supplement cost under 6 cents and produced over 20 cents in increased gain. Supplementing cattle with Alimet<sup>®</sup> or CGM resulted in similar ( $P > .05$ ) improvements in gains of growing cattle, however Alimet<sup>®</sup> supplemented cattle had a lower supplement cost of added gain compared to CGM.

**Key Words:** Supplement, Methionine, Molasses

**954 Intake, digestibility and plasma urea nitrogen in heifers fed supplements with different ruminal undegradable protein levels.** R. Lopes Oliveira<sup>\*1</sup>, J. Carlos Pereira<sup>2</sup>, D. Nascimento Junior<sup>2</sup>, R. A. M. Vieira<sup>3</sup>, and M. Dias Ribeiro<sup>2</sup>, <sup>1</sup>Faculdades UPIS, Brasília, DF, Brazil, <sup>2</sup>Universidade Federal de Vicosa-MG, Brazil, <sup>3</sup>Instituto Melon de Estudos e Pesquisas, Silvânia-GO, Brazil.

The effects of supplements with different levels (high - 60% of crude protein, medium - 40% of crude protein, low - 20% of crude protein) of ruminal undegradable protein (RUP) by Brown-Swiss heifers grazing *Brachiaria brizantha* cv. Marandu on the intake, digestibility and plasma N-urea concentrations were studied. The experiment lasted 90 days, divided in three periods of 30 days, corresponding to May, June and July 2000. Fifteen purebred Brown Swiss heifers (five by treatment), averaging 19.7 months and 394 kg live weight (LW), were used. The pasture availability was monitored to maintain offer of 6% LW, in green dry matter (GDM). The dry matter (DM) availability, GDM and leaf:colm ratio were evaluated. The heifers were fed 2.5 kg/head/day of concentrate supplement, offered twice a day (8 a.m. and 4 p.m.). Ex-trusa was collected in animals fistulated in the esophagus. Feces were collected twice a week; the animals received 10 g chromium oxide/day. Indigestible neutral detergent fiber (NDF) in the feeds and feces were used to determine the intake and digestibility. There were no effects of supplements on the pasture, however there were differences among periods, because, as dry season progressed, the forage availability decreased and leaf:colm ratio and senescent material proportion increased. There was no effect of treatments on forage intake or forage plus supplement. DM, organic matter (OM) and CP digestibility, and total digestible nutrients (TDN) content were lower for the diets with high RUP content. It was observed interaction of period:treatment for the fiber digestibility, where in the treatments with high and medium RUP, the digestibility decreased as the dry season progressed and, in the treatment with low RUP, the digestibility increased. The animals fed supplement with high RUP content showed average plasma N-urea concentrations lower than those fed supplement with average RUP contents, followed by those fed diets with low RUP.

**Key Words:** *Brachiaria brizantha*, Escape protein, Supplementation

**955 Use of soybean hulls as a replacement for rolled corn in receiving calf diets.** C.J. Mueller<sup>\*</sup>, H.M. Blalock, and R.H. Pritchard, *South Dakota State University*.

Feedlot receiving studies conducted during consecutive years were used to evaluate the use of soybean hulls (SBH) as a replacement for rolled corn (RC) in receiving calf diets. Angus steers used during year 1 (Y1; n = 155) and 2 (Y2; n = 116) were purchased from the same source. Each year populations were blocked by calves that were weaned approximately 30 d prior to shipment (EW; offspring of dams < 4 yr) and those weaned the day of shipment (NW; offspring of dams > 4 yr). Incoming BW for calves in Y1 were 264 ± 2.4 kg for NW and 265 ± 2.9 kg for EW, while Y2 calves averaged 273 ± 2.3 kg for NW and 251 ± 3.9 kg for EW. Diets fed once daily consisted of oat silage (Y1 = 45%, Y2 = 39%) and either RC (Y1 = 45%, Y2 = 50%) or SBH (Y1 = 45%, Y2 = 56%).

The balance of the diets consisted of pelleted supplements meeting key nutrient requirements (NRC). Tabular (NRC) energy values for RC and SBH diets were: Y1 1.13 and 1.04 Mcal of NEg/kg; Y2 1.14 and 1.05 Mcal of NEg/kg, respectively. Calf performance was determined using non-shrunk BW. Calves fed SBH diets had similar ( $P > 0.10$ ) ADG (1.39 vs 1.44 kg; RC vs SBH) and gain efficiency (0.18 vs 0.17; RC vs SBH). A year x diet interaction occurred for DMI ( $P = 0.07$ ). During Y1, calves fed SBH had higher DMI (7.77 vs 8.49 kg;  $P < 0.001$ ) than calves fed RC. During Y2, DMI was similar ( $P > 0.10$ ) between diets (7.92 vs 8.22 kg; RC vs SBH). The interaction may be a result of below average temperatures during Y1. Moderate cold stress causes increased passage rate, which may have adversely affected digestion of SBH in Y1. The EW calves had higher DMI than NW calves (7.85 vs 8.43 kg;  $P < 0.001$ ). Higher DMI resulted in a trend toward greater ADG for EW calves compared to NW calves (1.38 vs 1.45 kg;  $P = 0.062$ ). Gain efficiency was not affected ( $P > 0.10$ ) by weaning management. Both studies indicate that soybean hulls are a potential substitute for rolled corn in receiving calf diets.

**Key Words:** Soybean hulls, Receiving diets, Feedlot cattle

**956 Effect of source and level of supplemental bypass total sulfur amino acids (tsaa) on performance of growing cattle fed bermudagrass hay diets supplemented with molasses based supplements.** B. R. Austin<sup>\*1</sup>, L. B. Davis<sup>1</sup>, P. A. Davis<sup>1</sup>, B. A. Reiling<sup>1</sup>, and W. E. Kunkle<sup>1</sup>, <sup>1</sup>University of Florida, Gainesville, FL, US.

Performance responses to protein supplements were evaluated to determine if responses could be explained by total sulfur amino acids (TSAA) in bypass (UIP) protein. Supplements were formulated to provide 3 or 6 g/d of bypass TSAA from either corn gluten meal (CGM) fed at 0.24 or 0.47 kg/d, or from rumen protected methionine sources. The UIP sources used were Mepron M 85 (MEP) fed at 4.15 or 8.31 g/d, Smartamine M (SMT) fed at 4.76 or 9.53 g/d, and Alimet (ALI) fed at 8.53 g/d. These were compared to a sugarcane molasses and ground corn (control) supplement. Supplements contained 84% fortified molasses (urea, minerals, vitamins) and 18% ground corn. CGM replaced corn in supplements containing CGM. Cattle were assigned to 32 pastures (1.6 ha) with two heifers and two steers in each pasture. Calves averaged 281 kg with a body condition score of 5.56 at the start of the trial (December 15, 1999). Bermuda grass hay was offered ad libitum and molasses slurries were limit fed at 2 kg DM/day. Animal data were averaged for each pen. Supplementation of bypass TSAA tended to ( $P = 0.06$ ) increase cattle gains over control (0.52 vs. 0.57 kg/d). Cattle supplemented with 3 or 6 g/d of bypass TSAA had similar ( $P = 0.93$ ) gains (0.571 vs. 0.572 kg/d). Cattle gain increased ( $P < 0.05$ ) when supplemented with 6 g/d of bypass TSAA from CGM (0.61 kg/d,  $P = 0.01$ ) or 3 g/d of bypass TSAA from ALI (0.60 kg/d,  $P = 0.02$ ). Cattle supplemented with 3 or 6 g/d of bypass TSAA from MEP had similar ( $P > 0.20$ ) gains (0.50, 0.56 vs. 0.52 kg/d) to controls. Cattle supplemented with 3 g/d of bypass TSAA from SMT tended ( $P = 0.056$ ) to have higher gains (0.59 kg/d) than the control treatment, but cattle supplemented with 6 g/d of bypass TSAA from SMT had gains (0.54 kg/d) similar ( $P = 0.56$ ) to the control treatment. Cattle supplemented with 6 g/d bypass TSAA from CGM grew more ( $P < 0.05$ ) in height than cattle supplemented with 3 g/d bypass TSAA from MEP or control cattle. Supplemental sources of bypass TSAA did not significantly affect body condition scores.

**Key Words:** Supplementation, Methionine, Molasses

**957 Using non-pasteurized fermented whey in calf feeding.** F.I. Juarez<sup>\*1</sup>, M. Montero<sup>1</sup>, and H.S. Garcia<sup>2</sup>, <sup>1</sup>CIRGOC-INIFAP, <sup>2</sup>UNIDA-Instituto Tecnológico de Veracruz.

Whey from non-pasteurized fresh cheese making was inoculated with a probiotic lactobacilli (*L. Acidophilus* B-4495) and allowed to ferment for up to 48 h. Twenty-four newborn calves (Holstein x Zebu or Brown Swiss x Zebu) were housed individually and fed artificially. Three males and three females were randomly assigned to each of 4 treatments: control calves (T1) were fed 4 L fresh milk; a second group (T2) was given 4 L fresh milk and 2 L fresh whey; a third group (T3) was fed with 4 L fresh milk and 2 L fermented whey, and a fourth group consumed 3 L fresh milk and 3 L fermented whey. Milk was offered until the animals were weaned (third month of age). Whey was included in the diets after the first month in increments of 1 L/month until the sixth month and a commercial feed was offered for free consumption and at 1 kg/d

after weaned. Hay from Stargrass (*Cynodon plectostachyus*) was offered during the experiment. Response variables were daily concentrate consumption (CC), biweekly body weight (BW) and daily weight gain (DWG), for treatments, sex and interactions. A randomized model was used for ANOVA data analysis and BW at birth was employed as covariable. Means were compared using Tukey's test at a  $p < 0.05$ . Results indicated that whey consumption produced savings in CC; the means for treatments T1-T4 were 80.1, 47.0, 51.0 and 75.5 kg, respectively (MSE=4.49). Treatment T4 had a CC greater than treatments T2 and T3 suggesting compensation by substitution of milk by whey. However this value was no greater than that for T1. BW (kg) was not affected for T4 at weaning (91.4, 85.0, 81.5, 93.9) or after 6 months (137.6, 145.3, 130.9, 144.7). Similarly, DWG values were not affected by the treatments (564, 611, 537, 604 g). It is concluded that including fermented whey saved CC by 40% and could replace milk by 25% in calf feeding.

**Key Words:** milk replacer, probiotic, fermented

**958 Effects of 2-hydroxy-4-(methylthio) butanoic acid (HMB) and dl-methionine on microbial growth, VFA production and nutrient digestion in continuous culture.** S. Noftsker\*, J. Firkins, and N. St-Pierre, *The Ohio State University, Columbus OH.*

2-Hydroxy-4-(methylthio) butanoic acid (HMB) has effects on milk composition and yield, potentially through ruminal actions. Four continuous culture fermenters were used to determine the optimal level of HMB for digestibility of nutrients and synthesis of microbial crude protein, and to compare the highest level of HMB to an equal concentration of methionine supplied as dl-Met. A highly degradable hay and grain mix was fermented at three levels of HMB (0 %, 0.055 %, and 0.110 % of DM) and one level of dl-Met (0.097 %) according to a 4 X 4 Latin square design. Fermenters were fed 100 g DM daily. Digesta samples were collected during the last three days of each of the four 10 day experimental periods. Digestibilities of ADF, NDF and DM were largely insensitive to supplementation of Met, although there was an increase in ADF digestibility when Met was supplied as HMB over the same level of Met supplied as dl-Met. Microbial efficiency (g microbial N/kg OM truly digested) was not different among treatments. Total production of volatile fatty acids were influenced by HMB supplementation, with isovalerate and isobutyrate increasing linearly with increasing HMB supplementation. Propionate production peaked and butyrate dipped to a low point at 0.055 % HMB. Met provided as dl-Met produced lower amounts of butyrate and isobutyrate than Met supplied in HMB. dl-Met had numerically similar production of BCVFA (isovalerate, isobutyrate and valerate) as the control. The proportion of bacterial N produced from ammonia N showed a linear decrease with HMB, and also a trend ( $p = 0.1$ ) for bacteria receiving dl-Met to use more ammonia N than those receiving HMB. These data suggest that supplementation of Met as HMB may have a sparing effect on BCVFA, since the BCVFA are not needed to provide carbon for synthesis of valine, isoleucine and leucine with ammonia. Methionine supplied as dl-Met does not appear to act in the same way as that provided by HMB.

**Key Words:** methionine, continuous culture, 2-hydroxy-4-methylthiobutanoic acid

**959 Milk protein synthesis as a function of amino acid supply.** L. Doepelel\*<sup>1</sup>, M.D. Hanigan<sup>2</sup>, J.J. Kennelly<sup>1</sup>, and H. Lapierre<sup>3</sup>, <sup>1</sup>University of Alberta, Edmonton, Canada, <sup>2</sup>Purina Mills LLC, St. Louis, Mo, <sup>3</sup>Dairy and Swine R & D Centre, Lennoxville, Canada.

To evaluate the relationship between milk protein yield and amino acid supply, a total of 59 trials and 213 different treatments involving post-ruminal infusions of casein or free amino acids were analyzed. Digestible duodenal flow of essential (E) amino acids (AA) was predicted from NRC (2001). Intestinal digestibility of the infusates was considered to be 100%. Total amino acid supply was the sum of dietary and infusate supply. The relationship between milk protein yield and individual EAA total supply was quadratic ( $P < 0.05$ ,  $R^2 > 0.55$ ) for all EAA. Therefore, for each AA, a breakpoint was iteratively determined using a least squares fitting method. Below the breakpoint, milk protein yield increased linearly with AA supply, while above, protein yield did not respond incrementally to increased AA supply. The AA supply at each breakpoint was summed to give total EAA supply, which was converted into MP supply using a factor of 0.48 (NRC, 2001). From this, the

requirement for each AA as a percentage of MP is proposed. The requirements for lysine and methionine are in line with present recommendations (NRC, 2001). In addition, the efficiency of use for lactation for each EAA was calculated as the total amount of the AA in milk/(total AA supply - AA used for maintenance). The maintenance requirement of each AA was calculated as the maintenance requirement for MP, as predicted by NRC (2001), multiplied by the AA composition of the whole empty body of cattle. Efficiency of use for each AA decreased substantially above the breakpoint with lysine, methionine, and histidine being the most efficiently used AA. These results suggest that the EAA efficiency factors for lactation used in prediction schemes should not be a constant but should be decreasing with increasing AA supply.

AA	Requirement % of MP	Efficiency below breakpoint	Efficiency above breakpoint
Arg	4.8	0.81	0.37
His	2.3	0.98	0.56
Ile	5.3	0.65	0.44
Leu	9.6	0.70	0.43
Lys	7.3	0.87	0.55
Met	2.2	0.99	0.64
Phe	5.4	0.57	0.38
Thr	5.0	0.54	0.37
Val	6.1	0.68	0.46

**Key Words:** Milk protein synthesis, Amino acid, Efficiency of lactation

**960 Influence of 2-hydroxy-4 (methyl thio) butanoic acid isopropyl ester (HMBi) on the digestibility of organic matter and energy value of corn silage measured in vitro.** J.C. Robert, N. Ballet, C. Richard, and B. Bouza, *Aventis Animal Nutrition, Antony, France.*

HMBi is a novel source of methionine for ruminants. 50% is absorbed through the rumen wall to provide metabolizable methionine. The remaining 50% is hydrolysed in the rumen to HMB and isopropanol. The objective of this experiment was to evaluate the ruminal effect of HMBi using the rumen simulation technique (HFT gas test; Menke et al., 1988) using corn silage as the substrate. Dried and ground substrate (200 mg) was incubated with 10 mL of rumen juice + 20 mL of buffer in syringes gently agitated at 39°C. HMBi was tested at the dose of 15.6 mg (12 mg methionine equivalent) vs a control (no HMBi supplementation). Gas production (Vg- ml/200 mg DM) was measured at incubation times of 1, 2, 3, 4, 6, 8, 24, 30, and 48 h. The corrected gas production at 24 h and chemical composition of corn silage were used to calculate organic matter digestibility OMD (%) and energy values (UFL/kg DM) using the prediction equations proposed by Menke et al. (1988). The results indicate a significant stimulation of rumen fermentation with HMBi supply from the 8 h incubation time onwards. HMBi supply improved, respectively, corn silage OMD and energy values ( $P < 0.05$ ) from 68.1 to 71.2 (+4.6%) and 0.82 to 0.87 (+6.0%).

Vg (mL per 200 mg DM)	8	24	36	48
Incubation time (h)	8	24	36	48
Control	23.1b	50.7b	55.2b	63.1b
HMBi	24.0a	54.3a	59.9a	70.1a
SED	0.13	0.23	0.36	0.69

a, b : means in the same column with different superscripts are significantly different ( $P < 0.05$ )

**Key Words:** Ruminants, Dairy cows, Rumen, Fermentation, Methionine chemical derivative

**961 Ruminal metabolism of 2-hydroxy-4 (methyl thio) butanoic acid isopropyl ester (HMBi).** J.C. Robert, N. Ballet, C. Richard, and B. Bouza, *Aventis Animal Nutrition, Antony, France.*

The metabolism of HMBi was studied in the rumen in vitro by the HFT gas technique (Menke et al, 1988). 200 mg of dried and ground corn silage was incubated with 10ml of rumen juice + 20ml of buffer in syringes gently agitated at 39°C. HMBi was tested at the dose of 15.6mg (12mg methionine equivalent) vs a control (no HMBi supply). In vitro, fermentation was pursued during 48 hours and the supernatant of the rumen content mixture was collected in syringes at different incubation times (h) : 1,2,3,4,6, 8,24,30,48 and treated 1/

by NaCl 1% before analysis for HMBi, HMB, methionine and ammonia and 2/ by HgCl<sub>2</sub> 1% before analysis for isopropanol, acetone and volatile fatty acids. HMBi concentrations (mg/ml) decreased regularly all along the fermentation, respectively at fermentation times (h) 2,8,24 and 48 : .42, .40, .08, .008 [The following modelisation could be fitted :  $Y = 112.06 e^{-0.09x}$  ( $R^2 = 0.99$ ) with  $Y =$  concentrations and  $x =$  time]. In parallel, HMB concentrations (mg/ml) increased rapidly up to a maximum at 8h incubation time and decreased thereafter : respectively at the same incubation times : .13, .29, .25, .05. Iso-propanol and acetone concentrations increased up to 8 and 24 h respectively and plateaued after. Significant differences were observed for acetate, isovalerate, total VFA and butyrate but no significant differences for propionate. Effectively, HMBi was hydrolysed to HMB and isopropanol with modification of individual VFA concentrations. Mean Isop. Acetone, VFA Concentrations (mg/ml) Treatments effects

	Iso-prop.	Aceto	Aceta	Pro-pio.	I Butyr.	I soval.	Tot. VFA
Control	.01b	.05b	2.18b	.73a	.47a	.059b	3.50b
HMBi	.06a	.08a	2.26a	.75a	.45b	.065a	3.59a
SED	.0001	.0002	.0035	.011	.0002	.00003	.006

**Key Words:** Ruminants, Dairy cows, Rumen, Metabolism, Methionine chemical derivative

### 962 Effect of crude protein levels and forage source on nitrogen balance of dairy cows. K.L. Karg\* and M.A. Wattiaux, University of Wisconsin-Madison.

Forty eight multiparous Holstein cows were used to evaluate the effects of primary forage source (alfalfa silage (AS) or corn silage (CS)) and CP level (16.5% (LP) or 17.9% (HP)) on N balance to test the hypothesis that urinary N excretion may be reduced with no loss in milk N. Cows were blocked by calving date and assigned to dietary treatments in a 2x2 factorial at wk 3 of lactation. N balance was performed on wk 13 and 14 postpartum. Diets were fed as TMRs including 55% forage (DM basis; 14% CS and 41% AS or 14% AS and 41% CS). According to NRC 2001, the ME and MP allowable milk was at least 45 kg/d for all diets. Predicted MP balance was 14, 229, 47 and 256 g/d for ASLP, ASHP, CSLP, and CSHP diets respectively. The RDP and RUP balance averaged -11,17; 127, 280; -2, 55; and 137, 299 g/d on ASLP, ASHP, CSLP, and CSHP diets respectively. Ytterbium was used as a marker and on wk 13, fecal samples were collected over a 4 d period. On wk 14, cows were fitted with catheters for a 72 h total urine collection. Data were analyzed with the MIXED procedure of SAS and differences among dietary treatments were tested with orthogonal contrasts. N intake was confounded by numerical differences in DMI, and as a result, was highest in ASHP and lowest in CSHP diets. Fecal N was lowest in CS compared to AS diets (161 vs 206 g/d) but was not affected by CP level. Urine N was lowest in LP compared to HP diets (206 vs 245 g/d) but was not affected by primary forage source. Daily milk N excretion (based on true protein) was not affected by dietary treatments. This trial demonstrated that reduction in manure N excretion may be substantial with no loss in milk N production. The impact of diet CP on urine N excretion and forage source on fecal N excretion were additive, and of similar magnitude.

Item	Treatments					p-value		
	ASLP	ASHP	CSLP	CSHP	SEM	forage	protein	FxP
N intake (g/d)	637	720	621	603	26	.01	.22	.06
N feces (g/d)	205	207	170	151	11	<.01	.41	.35
N urine (g/d)	209	251	203	238	10	.30	<.01	.72
N milk (g/d)	180	176	194	180	7	.18	.20	.43
N retained	43	86	55	35	17	.25	.51	.07

**Key Words:** Alfalfa silage, Corn silage, Environment

### 963 Effects of moist heat treatment on ruminal nutrient degradability of sunflower seed. Arif Mustafa\*<sup>1</sup>, Yvan Chouinard<sup>2</sup>, and Daniel Ouellet<sup>3</sup>, <sup>1</sup>McGill University, <sup>2</sup>Université Laval, <sup>3</sup>Agriculture and Agri-Food Canada.

A study was conducted to determine the effects of moist heat treatment (autoclaving at 127 C with a steam pressure of 117 kPa for 10, 20, and 30 min) of sunflower seed on CP fractions, ruminal DM and CP degradabilities, and ruminal disappearance of amino and fatty acids. Two ruminally fistulated cows were used in a randomized complete block design. Heating of sunflower seed decreased soluble protein and increased neutral detergent insoluble protein with little effect on acid detergent insoluble protein. Results of the in situ study showed that moist heat treatment decreased (cubic effect,  $P < 0.05$ ) ruminal degradability of DM and CP of sunflower seed. Ruminal undegraded CP of raw sunflower was low (84 g/kg of CP) and increased (cubic effect,  $P < 0.05$ ) by 139, 143, and 164%, respectively as heating time increased from 0 to 10, 20 and 30 min, respectively. Ruminal disappearance of all amino acids (following 12 h of incubation) was lower ( $P < 0.05$ ) for raw than heated sunflower seed. Similar results were also observed for ruminal disappearance of fatty acids. It was concluded that moist heat treatment decreased ruminal nutrient degradabilities of sunflower seed and thus increased the concentrations of amino acids and polyunsaturated fatty acids available for digestion in the small intestine.

**Key Words:** Sunflower seed, Ruminal nutrient degradability, Moist heat treatment

### 964 Antagonistic amino acids to the inhibitory amino acids on growth of mixed ruminal bacteria. H. Kajikawa\*, M. Mitsumori, K. Tajima, and M. Kurihara, National Institute of Livestock and Grassland Science, Tsukuba, Ibaraki, Japan.

Inhibitory effects of some amino acids on the bacterial growth have been known, but little information on this subject is available for the ruminal bacteria. These inhibitions are supposed to be caused mainly by feedback inhibition of a common enzyme in a multi-branched pathway for syntheses of several amino acids. This study was conducted to confirm the presence of antagonistic amino acids to the inhibitory amino acids. Ruminal bacterial were harvested from a ruminally fistulated cow, washed with a buffer, and incubated with glucose, xylose and cellobiose. Growth of the mixed ruminal bacteria was inhibited ( $P < 0.01$ ) when each (1 mM) of 5 amino acids, Ile, Phe, Thr, Leu or Cys was added to a control treatment, in which ammonium salt was included as a sole N source. Addition of Leu, Val, or both of them reduced the inhibitory effect of Ile, and addition of both Ile and Val also reduced the inhibition by Leu. These inhibitions by the branched amino acids would be due to an inhibition of a common enzyme, probably  $\alpha$ -acetoxy acid synthase, for syntheses of the branched amino acids. The inhibition by Phe was mitigated by adding Trp or Tyr, and the growth was almost recovered by addition of both Trp and Tyr, which suggesting that the inhibition could be attributed to the suppression of a common enzyme, probably 3-deoxy- D-arabino-heptulosonate 7-phosphate synthase, for syntheses of the aromatic amino acids. The inhibitory effect of Thr, on the other hand, was not affected by adding Lys and Met, which are both synthesized from Asp along with Thr, but was mitigated ( $P < 0.01$ ) by addition of Ala, Gln, Glu, Ser or Val. No amino acid reduced the inhibitory effect of Cys. These findings suggest that bacterial growth would be inhibited by some mechanisms other than feedback inhibition when supplemented with Thr and Cys.

**Key Words:** Inhibitory amino acid, Antagonistic amino acid, Rumen bacteria

### 965 Effects of the level of rumen undegradable protein on microbial fermentation and amino acid flow from a continuous culture system. S. Gargallo, S. Calsamiglia\*, and A. Ferret, Universitat Autònoma de Barcelona.

Eight dual flow continuous culture fermenters were used in three replicated periods to study the effects of diets formulated to contain different amounts of heat treated soybean meal (HSBM) or corn gluten meal (CGM) on rumen microbial fermentation and amino acid (AA) flow. Fermenters were fed an isonitrogenous 60 to 40 forage to concentrate diet, composed of basal ingredients (72% of DM) and a protein supplement (28% of DM). Treatments consisted of a non-protein N supplement (50% urea and 50% tryptone) or true protein (HSBM or CGM) in the following proportions: 0% HSBM, 33% HSBM, 66% HSBM, 99% HSBM, 0%

CGM, 33% CGM, 66% CGM, and 99% CGM. True digestion of DM and OM was higher for HSBM diets than for CGM ( $P < 0.05$ ), and decreased as the level of rumen undegradable protein (RUP) increased ( $P < 0.01$ ). Fibre digestion was not affected by protein source or level. Ammonia N concentration decreased as the level of HSBM or CGM increased ( $P < 0.01$ ). Non-ammonia and dietary N flow were similar between protein sources but increased as the level of true protein increased ( $P < 0.01$ ). Bacterial N flow was not affected by treatment. Efficiency of microbial protein synthesis was similar between protein sources, but increased as the level of HSBM increased ( $P < 0.01$ ). Protein degradation was highest for 0% HSBM and 0% CGM and decreased as the level of RUP increased ( $P < 0.01$ ). Total volatile fatty acid (VFA) concentration and molar proportions of acetate and propionate were not affected by protein source or level, but the concentration of branched-chain VFA was higher for CGM diets ( $P < 0.05$ ) compared to HSBM, and decreased as the level of true protein increased ( $P < 0.01$ ). Diets containing CGM resulted in the largest ( $P < 0.01$ ) flow of total and essential AA. The largest amount of lysine was provided by 99% HSBM ( $P < 0.01$ ), and 99% CGM provided the largest amount of methionine ( $P < 0.05$ ). Supplementation of diets with sources of RUP increased non-ammonia N, dietary N, total and essential AA flow, and modified the AA profile of effluent.

**Key Words:** Undegradable protein, Microbial fermentation, Amino acid flow

**966** A dietary protein to metabolizable energy ratio: Altering soluble and potentially rumen degradable protein fractions on rumen ammonia, volatile fatty acid production, and nitrogen balance of prepubertal Holstein heifers. M.T. Gabler\* and A.J. Heinrichs, *The Pennsylvania State University*.

Four prepubertal Holstein heifers, between 148 kg and 191 kg BW, fitted with rumen cannulae were used to evaluate the effects a dietary crude protein to metabolizable energy ratio (CP:ME), with altered soluble and potentially rumen degradable protein fractions, on rumen ammonia, VFA production, and nitrogen balance in a 4#4 Latin square design with a 2#2 factorial arrangement of treatments. Treatment rations were fed at 2.0% BW as DMI containing a CP:ME ratio of 62.10.8 g of dietary CP per Mcal of ME with altered soluble (AB1) (33.6 or 40.6% AB1 as a % of CP) and potentially rumen degradable (B2B3) (20.9 or 28.2% B2B3 as a % of CP) protein fractions. Treatment rations contained corn silage and grass hay as forage sources with soybean meal, SoyPlus, and urea as protein sources. Increased intakes of AB1 increased rumen ammonia ( $P=0.01$ ) but decreased ( $P=0.01$ ) total VFA concentrations. Molar proportions of isovalerate and isobutyrate were decreased ( $P<0.02$ ) with increased intakes of AB1. Increased intakes of B2B3 tended to increase ( $P=0.11$ ) total VFA concentrations while increasing ( $P<0.04$ ) molar proportions of propionate and isobutyrate. Increased molar proportions of propionate decreased ( $P=0.02$ ) the acetate to propionate ratio with increased intakes of B2B3. Nitrogen utilization was not affected by increased intakes of AB1 or B2B3. Although, increased intakes of AB1 tended ( $P=0.14$ ) to increase urine urea excretion. Increasing solubility (40.6 versus 33.6% AB1 as a % of CP) of the dietary CP in a 62.10.8 CP:ME ratio did not produce benefits in total VFA concentrations, individual VFAs, and N utilization. Feeding a CP:ME ratio of 62.10.8 with increased potentially rumen degradable protein (28.2 versus 20.9% B2B3 as a % of CP) at 2.0% BW as DMI resulted in trends toward increased total VFA concentrations with increases in molar proportions of propionate and isobutyrate.

**Key Words:** Heifers, Soluble Protein, Potentially Rumen Degradable Protein

**967** The degradability and fermentation characteristics of diets containing extruded soybean meal. A.L. Mueller\*, L.M. Lake, M.S. Kerley, M.R. Ellersiek, and R.L. Belyea, *University of Missouri-Columbia, Columbia, MO*.

The objective of this study was to determine the degradability of extruded soybean meal (ESBM). Soybean meal (SBM) was left unextruded (UNEX) and extruded at exit temperatures of 116 (116E), 138 (138E), and 160°C (160E). The SBM treatments were formulated into a diet containing 43% ground corn (GC) and 43% soybean hulls (SH). In Experiment 1, the in situ rumen degradability was determined for SBM

treatments alone. In Experiment 2 and 3, the in situ and in vitro degradability and fermentation characteristics were determined for GC, SH, and diets containing UNEX (UNEX Diet), 116E (116 Diet), 138E (138 Diet), or 160E (160 Diet). In Experiment 1, the percent dry matter remaining (DMR) and nitrogen remaining (NR) after incubation increased ( $P < .05$ ) in the ESBM treatments compared to the unextruded SBM. The 160E had more ( $P < .05$ ) DMR and NR the later hours of digestion than the other treatments. The ESBM treatments had slower ( $P < .01$ ) dry matter degradation (DMD) and nitrogen degradation (ND) rates than the unextruded SBM; 160E had the slowest ( $P < .01$ ) DMD and ND rates. In Experiment 2, replacing SBM with ESBM in the diets increased ( $P < .05$ ) the percent NR after incubation without affecting DMD ( $P > .05$ ). The 160 Diet had more ( $P < .05$ ) NR the later hours of digestion than the other treatments. The ESBM diet treatments had slower ( $P < .01$ ) ND rates than UNEX Diet; treatment 160 Diet had the slowest ( $P < .01$ ) ND rate. In Experiment 3, the percent DMR was unaffected ( $P > .05$ ) by treatment. Diets containing ESBM had more ( $P < .05$ ) NR than UNEX Diet; the 160 Diet had more ( $P < .05$ ) NR than the other ESBM diets. Including ESBM in diets did not affect ( $P > .05$ ) total volatile fatty acid (VFA), acetate, propionate, butyrate, branched chain VFA, or ammonia production. These data suggested that replacing SBM with ESBM in a dairy diet might improve the amount of rumen undegradable protein (RUP) reaching the small intestine without affecting the degradability or fermentation characteristics of the diet.

**Key Words:** Extruded, soybean meal, protein degradation

**968** Effect of level of rumen-degraded protein on milk production, ruminal metabolism and N utilization in lactating dairy cows. S M Reynal\*<sup>1</sup> and G A Broderick<sup>2</sup>, <sup>1</sup>University of Wisconsin-Madison, <sup>2</sup>U. S. Dairy Forage Research Center, Madison, WI.

Twenty-eight (8 ruminally cannulated) lactating Holstein cows were blocked by DIM, and randomly assigned to seven 4 x 4 Latin squares (2 squares of cannulated cows) to determine the effect of different levels of dietary RDP on milk production, ruminal metabolism and urinary and fecal N excretion. Diets were formulated from corn silage, alfalfa silage, high moisture corn, solvent soybean meal, SoyPass<sup>®</sup>, urea, vitamins and minerals to provide similar levels of CP coming from ingredients other than urea. Solvent soybean meal, SoyPass and urea in the diets were adjusted to achieve RDP levels of 11.6, 10, 8.3, and 6.6% of diet DM for diets A, B, C, and D, respectively. DMI, milk and fat production averaged 25.5, 42.8 and 1.3 kg/d across diets and were not different. Milk protein content was higher ( $P<0.01$ ) for diet B than for diets C and D (3.09 vs. 3.00 and 2.97%) and intermediate for diet A (3.07%). Milk protein yield was higher ( $P<0.05$ ) for diets A and B than for diet D (1.31 and 1.34 vs. 1.24 kg/d) and intermediate for diet C (1.29 kg/d). Milk urea N was higher ( $P<0.01$ ) for diets A and B than for diets C and D (13.0 and 13.2 vs. 11.4 and 11.3 mg/dl). There was no effect of diet on ruminal pH. However, ruminal ammonia was higher ( $P<0.01$ ) on diets A and B than on diet C (9.2 and 8.3 vs. 6.5 mM), and higher ( $P<0.01$ ) on diet C than on diet D (4.0 mM). Cows fed diet A had the highest ( $P<0.01$ ) urinary N and urine volume when compared to diets B, C and D (319 vs. 270, 255 and 224 g/d; and 28.0 vs. 19.7, 21.5 and 20.3 l/d, respectively). Cows fed diet D had the lowest ( $P<0.01$ ) urinary N excretion (224 g/d) when compared to other diets. Decreasing dietary RDP levels from 11.6 to 8.3% reduced urinary N excretion by 64 g/d without affecting milk and protein yield, but diet D with 6.6% RDP decreased N excretion but also depressed milk production.

**Key Words:** Rumen degradable protein, Milk production, Nitrogen utilization

**969** Comparison of in situ and TCA methods for fractioning amino acids in tropical forages. L. F. Miranda\*<sup>1</sup>, N. M. Rodriguez<sup>1</sup>, R. D. Sainz<sup>2</sup>, E. S. Pereira<sup>3</sup>, E. O. S. Saliba<sup>1</sup>, and M. M. Gontijo Neto<sup>4</sup>, <sup>1</sup>Universidade Federal de Minas Gerais, Brazil, <sup>2</sup>University of California, Davis, USA, <sup>3</sup>Universidade Estadual Oeste Paraná, Brazil, <sup>4</sup>EMBRAPA Gado de Corte, Brazil.

Rumen in situ and methods were used to fractionate essential and non essential amino acids (AA) in N fractions in foliage from leucaena (*Leucaena leucocephala*), manioc (*Manihot esculenta*), perennial soybean (*Neonotonia wightii*), ramie (*Boehmeria nivea*) and gunduru (*Cajanus cajan*). Dry matter, crude protein and acid detergent fiber were determined in all forages. Fraction A (NPN) was determined as the difference

between total N and N insoluble in trichloroacetic acid (TCA), fraction C was determined as the N insoluble in acid detergent (ADIN), and fraction B was calculated by difference. Forages were also incubated in situ for 6, 18 or 48 h to derive alternative estimates of fractions A, B and C. AA profiles of the original feeds and the residues from TCA, acid detergent, and in situ incubations were determined by HPLC after acid hydrolysis or peroxidation followed by acid hydrolysis. The in vitro and in situ methods gave similar ( $P > 0.05$ ) estimates of AA concentrations in fractions A and B of guandu, ramie and perennial soybean. The essential AA profiles of guandu residues were similar for both procedures however, for leucaena and manioc the in situ procedure gave lower results for essential AA of fraction A and higher for fraction B ( $P < 0.05$ ). Differences among forages preclude any definitive conclusions regarding the best method to determine AA profiles of N fractions.

**Key Words:** fractionate amino acids, tropical forage

**970 Milk from forage as affected by rumen degradable protein and corn grinding with corn silage-based rations.** E. Charbonneau<sup>\*1</sup>, P.Y. Chouinard<sup>1</sup>, G. Allard<sup>1</sup>, H. Lapierre<sup>2</sup>, and D. Pellerin<sup>1</sup>, <sup>1</sup>Universite Laval, QC, Canada, <sup>2</sup>AAC, Lennoxville, QC, Canada.

To optimize the production of milk from forage (MF), previous studies pointed to a better adequacy between the type of concentrate and the forage served. When corn silage is used, increasing the RDP content in the diet should allow a better utilization of forages. To evaluate this concept, eight multiparous Holstein cows in early lactation were used in a replicated 4x4 Latin square design with 3-wk periods. Diets were fed as TMR and were formulated to provide similar levels of NEL and CP but differed in RDP. Corn and alfalfa silages were used. Treatments were: 1) cracked corn and treated soybean meal (low RDP) 2) cracked corn and soybean meal (medium RDP), 3) cracked corn, soybean meal and urea (high RDP), 4) ground corn, soybean meal and urea (high RDP). The first three treatments were compared on the basis of their level of RDP. Increasing the level of RDP in diets had no effect on BW or DMI, but decreased milk production from 32.8 to 30.7 kg/d ( $P < 0.01$ ). Milk fat content (3.99%) was not affected. Milk protein content was higher with the medium RDP (3.43%) treatment than with the low or high RDP (3.32%;  $P < 0.001$ ). MF calculated on a protein basis decreased ( $P < 0.05$ ) as RDP increased. Milk urea increased from 13.3 to 16.6 mg/dl ( $P < 0.001$ ) as RDP increased. This suggests that the lowest concentration of RDP was sufficient in the rumen. The last two treatments had high RDP while ground corn was compared to cracked corn. No changes were observed in BW, but DMI ( $P < 0.01$ ) increased with ground corn. Milk production was higher (33.4 vs 30.7 kg/d;  $P < 0.01$ ), fat content lower (3.44 vs 4.02%;  $P < 0.01$ ) and protein content higher (3.41 vs 3.31%;  $P < 0.01$ ) with ground corn. MF calculated on a protein basis was higher with ground corn ( $P < 0.05$ ). Ground corn decreased ( $P < 0.001$ ) urea in milk. Even when corn silage is used in TMR, if combined with alfalfa silage, corn grinding had beneficial effects on milk production.

**Key Words:** Milk from Forage, Corn Grinding, Rumen Degradable Protein

**971 Effect of protein source on microbial protein synthesis in beef cattle fed barley grain-based diets.** K. M. Koenig<sup>\*1</sup>, K. A. Beauchemin<sup>1</sup>, and L. M. Rode<sup>2</sup>, <sup>1</sup>Agriculture and Agri-Food Canada, Research Centre, Lethbridge, AB, Canada, <sup>2</sup>Rosebud Technology, Ltd., Lethbridge, AB, Canada.

Four British cross heifers fitted with ruminal and duodenal cannulas were used in a 4 x 4 Latin square to evaluate the effects of protein source on ruminal fermentation, microbial protein synthesis, and nutrient digestibility. The basal diet was 90% barley grain concentrate and 10% barley silage (DM basis) with either no protein supplementation (13.6% CP), or an additional 1% CP (% of DM) in the form of urea, canola meal (CM) or blood meal (BM). Ruminal ammonia N concentration was highest for the urea supplemented diet (111 ± 15 mg N/L) but no differences were observed for the control, CM, and BM diets (59 to 78 mg N/L). Ruminal VFA concentration was highest for the BM supplemented diet, but it did not differ among the control urea, and CM diets. Canola meal and BM tended ( $P < 0.15$ ) to increase microbial N flow by 30 and 23 g N/d or 33 and 25%, respectively, above the control diet. The response of microbial N flow to urea supplementation was intermediate between the control and true protein sources. True ruminal OM

digestion tended ( $P < 0.15$ ) to be higher for the urea supplemented diet, however, post-ruminal OM digestion tended to be lower, and therefore, there was no effect of protein source on total tract OM digestion (80.3 ± 1.1%). Microbial efficiency did not differ ( $P > 0.15$ ) between the protein sources and averaged 21.2 ± 3.0 g N/kg OM truly fermented, although numerically, microbial efficiency was 28 and 23% higher with CM and BM supplementation, respectively. There was no effect of protein source on total tract NDF (46.2 ± 4.3%) and ADF (34.0 ± 3.1%) digestibility. In conclusion, high concentrate, barley grain-based finishing diets required supplementation with rumen degradable protein to maximize microbial protein synthesis. True protein sources such as CM and BM that provide peptides and amino acids in addition to ammonia N had the greatest effect on stimulating microbial protein synthesis.

**Key Words:** Protein sources, Microbial protein synthesis, Barley, Beef cattle

**972 Effect of protein intake on synthesis of albumin and plasma total protein in lactating dairy cows.** G. Raggio<sup>\*1</sup>, G.E. Lobley<sup>2</sup>, D. Pellerin<sup>1</sup>, G. Allard<sup>1</sup>, R. Berthiaume<sup>3</sup>, P. Dubreuil<sup>4</sup>, M. Babkine<sup>4</sup>, and H. Lappiere<sup>3</sup>, <sup>1</sup>Universite Laval, QC, Canada, <sup>2</sup>Rowett Research Institute, Aberdeen, UK, <sup>3</sup>AAC, Lennoxville, QC, Canada, <sup>4</sup>Coll. Vet. Med., U. Montreal, QC, Canada.

A better understanding of N transfer from dietary protein to milk protein by dairy cows would improve the efficiency of N utilization while decreasing the N rejected in the environment. The effect of protein intake on synthesis of plasma albumin and total protein was determined for six multicatherized cows in a double 3x3 Latin Square design. Three isoenergetic mixed silage-based diets (1.82 Mcal/kg DM), formulated to supply incremental amounts of RUP by inclusion of an undegradable protein supplement (Pro-lak<sup>®</sup>): Lo-P (13.0% CP), Med-P (15.0% CP) and Hi-P (17.0% CP), were fed every 2 h. Cows on Lo-P and Hi-P were continuously infused with <sup>2</sup>H<sub>5</sub> phenylalanine (d5-Phe) into the jugular vein for 9 h (1.4 mmol/h) on d 21. Blood samples were collected hourly from the arterial, portal and hepatic vessels between 3-9 h. Concentrations and isotopic enrichment of d5-Phe were measured for free plasma Phe, plasma albumin and total protein. Results are given for the Lo-P vs Hi-P. Milk production increased ( $P = 0.05$ ; 33.5 vs 35.8 kg/d) with the Hi-P diet. Plasma albumin also increased ( $P = 0.001$ ; 32.9 vs 34.3 g/L) but total protein remained unchanged ( $P > 0.20$ ; 76.2 vs 78.4 g/L). Daily incorporation of d5-Phe into both total protein and albumin was linear ( $R^2 > 0.98$ ). Neither fractional nor absolute synthesis rates of albumin (3.3 vs 3.3 %/d; 35 vs 36 g/d) and total protein (6.4 vs 6.4 %/d; 158 vs 157 g/d) were affected ( $P > 0.20$ ) by intake of RUP. Whole body irreversible loss rate of Phe increased ( $P = 0.04$ ) at Hi-P (158 vs 184 g/d) as did portal absorption ( $P = 0.06$ ; 89 vs 122 g/d) and hepatic net removal ( $P = 0.20$ ; -48 vs -81 g/d). A greater proportion of hepatic Phe removal was used for total export protein synthesis ( $P = 0.20$ ; 16.9 vs 11.9 %) at Lo-P. These results suggest that hepatic synthesis of albumin and other export proteins is maintained in lactating dairy cows even when protein nutrition is reduced.

**Key Words:** Liver, Albumin, Protein intake

**973 Hepatic propionate metabolism in postparturient dairy cows as affected by prepartum carbohydrate source, chromium supplementation, and insulin addition in vitro.** L. C. Ruzzi<sup>\*1</sup>, M. S. Piepenbrink<sup>1</sup>, K. L. Smith<sup>1</sup>, T. R. Overton<sup>1</sup>, J. K. Drackley<sup>2</sup>, and M. T. Socha<sup>3</sup>, <sup>1</sup>Cornell University, Ithaca, NY, <sup>2</sup>University of Illinois, Urbana, <sup>3</sup>Zinpro Corporation, Eden Prairie, MN.

Our objective was to determine whether hepatic capacities for oxidation and gluconeogenesis from propionate are affected by prepartum dietary carbohydrate source, chromium-L-methionine (CrMet) supplementation, and insulin addition in vitro. Liver was biopsied on d 1 postpartum from 24 Holstein cows fed a prepartum diet containing a starch-based concentrate (NFC; 1.63 Mcal/kg NE<sub>L</sub>, 14.5% CP, 41.3% NFC) or a diet containing a nonforage fiber source-based concentrate (NFFS; 1.59 Mcal/kg NE<sub>L</sub>, 14.3% CP, 34.5% NFC) from 21 d before expected parturition until parturition and supplemented with CrMet once daily via gelatin capsule at dosages of 0, 0.03, or 0.06 mg/kg BW<sup>0.75</sup> in a 2 (carbohydrate source) x 3 (CrMet) arrangement of treatments. Liver slices were incubated with [1-<sup>14</sup>C]propionate (10 mM) for 2 h with addition of either 0 or 10 nM of bovine insulin and capacities for conversion of [1-<sup>14</sup>C]propionate to CO<sub>2</sub> and glucose were measured. The

interaction of prepartum carbohydrate source and CrMet supplementation was significant ( $P < 0.01$ ) because conversion of [ $1-^{14}C$ ]propionate to both  $CO_2$  (4.66, 4.49, 5.38  $\mu\text{mol/h} \times \text{g wet wt.}$ ) and glucose (2.24, 2.54, 3.14  $\mu\text{mol/h} \times \text{g wet wt.}$ ) was increased when CrMet was supplemented to cows fed the NFFS diet but conversion of [ $1-^{14}C$ ]propionate to both  $CO_2$  (6.36, 6.27, 3.36  $\mu\text{mol/h} \times \text{g wet wt.}$ ) and glucose (4.15, 3.31, 1.43  $\mu\text{mol/h} \times \text{g wet wt.}$ ) was decreased when CrMet was supplemented to cows fed the NFC diet. Effects of insulin addition in vitro and its interactions with in vivo treatments on conversion of [ $1-^{14}C$ ]propionate to  $CO_2$  and glucose were not significant ( $P > 0.15$ ). Overall, data indicate that effects of CrMet supplementation on hepatic propionate metabolism are diet dependent. Furthermore, hepatic capacity for propionate metabolism on d 1 postpartum is refractory to insulin addition in vitro.

**Key Words:** Periparturient Cow, Hepatic Gluconeogenesis, Insulin

**974 Effect of substitution of soybean meal for sesame meal on apparent digestibility of dry matter and crude protein in diets for sheep.** R. Barajas\*<sup>1</sup>, J.F. Obregon<sup>1</sup>, E. Romero<sup>1</sup>, and A. Estrada<sup>1</sup>, <sup>1</sup>FMVZ-Universidad Autonoma de Sinaloa (Mexico).

With the objective of determinate the effect of substitution of soybean meal for sesame meal on apparent digestibility of dry matter and crude protein in diet for sheep, a total fecal collection experiment was conducted. Four Pelibuey sheep (males; BW=22.19 kg) were used in a crossover design experiment, the sheep were assigned to consume one of two diets in that consisted the treatments: 1)Diet with 22.63% CP and 3.4 Mcal of DE/kg, containing Sudan grass hay 20%, soybean meal 30%, ground corn 38%, sugarcane molasses 9%, urea 0.6%, and mineral premix 2.4%(control); and 2)Diet similar to control, but containing 30% of sesame meal substituting soybean meal (SM). Sheep were placed individually in metabolic crates(0.6x1.2 m). Experimental periods consists in 10 days adaptation period and four days for samples collection. From each diet treatment and period one kg of diet was take as sample and the the total fecal production was collected. DM and CP was assayed. DM intake was similar ( $P=0.80$ ) across tratments (675 vs. 679 g/day). Sesame meal in diet increased ( $P < 0.01$ ) DM excreted in feces (136 vs. 205 g/day), and aumented ( $P < 0.05$ ) fecal excretion of crude protein (23.33 vs. 29.97 g/day). Apparent DM digestibility was reduce( $P < 0.01$ ) by sesame meal (79.9 vs. 69.8%), and diminished ( $P=0.02$ ) digestibility of dietary crude protein from 84.8 to 76.2%. Digestible energy content of diets was decreased ( $P < 0.01$ ) by SM tratment (3.42 vs. 2.98 Mcal/kg). Taken as reference, the value of 95% as true digestibility of soybean meal crude protein and DE=3.88 Mcal/kg, the true digestibility of protein from sesame meal was calculate in 85% its DE content was estimate to be 2.4 Mcal/kg of DM. It is concluded, that substituting soybean meal by sesame meal decrease the digestibility of dry matter and crude protein, and reduce energy content of diet for sheep, and that true digestibility of crude protein from sesame meal is nearly to 85%, and its DE content is close to 2.4 Mcal/kg of DM.

**Key Words:** Sesame meal, Soybean meal, Digestibility

**975 Effect of dietary protein content and alfalfa:corn silage ratios on nitrogen excretion and milk production of late lactation cows.** H.H.B. Santos\*<sup>2</sup>, S. Lardoux<sup>1</sup>, V.R. Moreira<sup>2</sup>, and L.D. Satter<sup>1,2</sup>, <sup>1</sup>U.S. Dairy Forage Research Center USDA-ARS,, <sup>2</sup>Dairy Science Department, University of Wisconsin, Madison.

The objective of this study was to evaluate the effect of different dietary protein concentrations and alfalfa silage:corn silage proportions in the diet on nitrogen distribution between milk, feces, and urine of late lactation cows. Twenty-four cows (12 multiparous and 12 primiparous) were randomly assigned to a 6x6 Latin square design with 14-d periods. Treatments were arranged in a factorial design with two alfalfa silage:corn silage ratios (70:30 and 30:70) and three levels of crude protein (~15, ~16.5, and ~18%). Roasted soybeans replaced high moisture corn to increase dietary protein content. Feed intake was measured daily and analyzed for DM, CP, NDF, ADF, and marker (ytterbium) concentration. Milk yield was recorded daily and sampled at the end of each period. Urine samples were obtained at 4hr-intervals during the last day of each period and 12 rectal fecal samples were obtained during the last 3 days from each cow on every even hour of the 24-hr period. Fecal

marker and urinary creatinine concentrations were used to calculate N excretion in feces and urine.

Forage ratio	AS:CS (70:30)		AS:CS (30:70)		P ≤						
	AS	CS	AS	CS	AS vs CS	15 vs 16.5	15 vs 18	16.5 vs 18			
Dietary protein, %	14.9	16.5	18.1	15.4	16.9	18.5	SEM				
DMI, kg/d	19.3	19.5	20.4	18.9	19.9	19.7	0.44	0.31	0.03	0.01	0.21
Milk, kg/d	26.5	27.9	28.4	27.7	28.2	28.0	0.62	0.21	0.01	0.01	0.72
Milk fat, %	3.72	3.84	3.84	3.88	3.83	3.78	0.09	0.29	0.35	0.76	0.52
Milk CP, %	3.09	3.05	2.98	2.99	3.03	3.00	0.04	0.01	0.93	0.01	0.01
N Intake, g/d	460	516	592	465	537	582	11.7	0.38	0.01	0.01	0.01
Milk N, g/d	131	136	136	132	138	136	3.47	0.45	0.01	0.01	0.62
Fecal N, g/d	188	186	212	176	198	204	9.08	0.48	0.03	0.01	0.01
Urine N, g/d	167	193	210	145	184	221	6.33	0.13	0.01	0.01	0.01
Milk N, % NI	28.5	26.4	23.0	28.4	25.7	23.4	0.52	0.64	0.01	0.01	0.01
Re-covered N, % NI	106.0	100.1	94.9	98.2	97.1	96.6					

**Key Words:** Nitrogen excretion, Alfalfa silage, Corn silage

**976 Effect of substitution of soybean meal for Chop-suey beans (Vigna radiata) on apparent digestibility of dry matter and crude protein in diets for sheep.** A. Estrada\*<sup>1</sup>, J.F. Obregon<sup>1</sup>, O. Tovar<sup>1</sup>, and R. Barajas<sup>1</sup>, <sup>1</sup>FMVZ-Universidad Autonoma de Sinaloa (Mexico).

With the objective to determinate the effect of substitution of soybean meal for Chop-suey beans (Vigna radiata) on apparent digestibility of dry matter and crude protein in diets for sheep, a total fecal collection experiment was conducted. Four Pelibuey sheep (males; BW = 21.25 kg) were used in a Crossover design experiment, the sheep were assigned to consume one of two diets in that consisted the treatments: 1) Diet with 22.63% CP and 3.4 Mcal of DE/kg, containing Sudan grass hay 20%, soybean meal 30%, ground corn 38%, sugarcane molasses 9%, urea 0.6%, and mineral premix 2.4% (control); and 2) Diet similar to control, but containing 30% of raw ground chop-suey beans substituting soybean meal (CSB). Sheep were placed individually in metabolic crates (0.6 x 1.2 m). Experimental periods consisted in 10 days adaptation period and four days of samples collection. From each diet treatment and period one kg of diet was taken as sample and the total fecal production was collected. DM and CP was assayed. Treatments have no effect ( $P = 0.52$ ) on DMI (635 vs. 640 g/day), DM excreted in feces (130 vs. 127 g/day), and DE of diet (3.4 vs. 3.43 Mcal/kg). Observed/expected DE was similar ( $P = 0.52$ ) across treatments (1.00 vs. 1.04). CSB decreased ( $P < 0.01$ ) nitrogen intake (142 vs. 107 g/day), without affect ( $P = 0.58$ ) fecal excretion of crude protein (21.6 vs. 20.7 g/day). Apparent digestibility of CP was diminished ( $P = 0.07$ ) by inclusion of chop-suey beans (84.7 vs. 80.5 %). The true digestibility of CP of chop-suey beans was calculated to be 93% and its value of DE 3.88 Mcal/kg of DM. This data suggest, that raw ground chop-suey beans could be used as feedstuff in finishing diet for sheep.

**Key Words:** Chop-suey beans, Soybean meal, protein, Digestibility, Sheep

**977 Dietary inclusion of silymarin in peripartum dairy cows: Effects on milk productivity, plasma metabolite and liver tissue.** D. Tedesco\*<sup>1</sup>, A. Tava<sup>2</sup>, C. Domeneghini<sup>1</sup>, A. Costa<sup>1</sup>, D. Sciannimanico<sup>1</sup>, and M. Tameni<sup>1</sup>, <sup>1</sup>Dipart. di Scienze e Tecnologie Veterinarie per la Sicurezza Alimentare, University of Milano, Italy, <sup>2</sup>Ist. Sper. Colt. Foragg., Lodi, Italy.

During the peripartum period the dairy cows animal can be subject to metabolic disorders such as ketosis and fatty liver diseases. Silymarin, a natural extract from *Silybum marianum* seeds (SM), is recognized as being a potent hepatoprotector in human disease. A total of 30 dairy cows, selected from a herd according to their previous milk production, health status, parity ( $\geq 2$ ) and BCS, has divided into two groups. Fifteen were administered 10 g/day of SM extract as an oral drench from 7 d before expected calving to 15 d after calving. Milk production was

recorded daily for each animal for 305 d of lactation. The BCS was evaluated 15 d before the expected calving and at blood sampling days. Blood samples were collected 7 d before the expected calving and after 7, 14, 21, and 30 d. Liver biopsy samples were collected at d 7 and 30 post calving. Health status was evaluated daily in the first 30 d of lactation. Treatment with SM increased milk production. The a, b, and c parameters from Wood equation of both lactation curves showed significant differences during all the first 70 d of lactation ( $P < 0.05$ ). These differences were on average from 2 to 5 kg/d for each animal. The body condition loss after calving was less evident for treated animals, statistically significant at 30 d postpartum ( $P < 0.05$ ), when BCS values were 2.5 and 2.8 for the control and the treated group, respectively. The results for blood NEFA, BHBA, total cholesterol, HDL, LDL, TG, total bilirubin, glycemia, BUN,  $\gamma$ GT, were not affected by treatment. Changes were only related to the sampling days ( $P < 0.05$ ) according to the peripartum period. Histological evaluation on liver biopsies evidenced intracytoplasmatic fatty drops of different dimensions in both samples. These drops in the treated animals were located in proximity of the centrolobular vessels, suggesting their rapid mobilization. The data demonstrate a positive effect of silymarin inclusion in the diet of periparturient dairy cows. No changes were evident in the metabolic parameters considered. A better health status was observed in the treated animals. Silymarin was kindly granted by I.D.B. Holding Indena S.p.a.

**Key Words:** Natural hepatoprotector, Dairy cow, Peripartum

### 978 Influence of soybean meal processing techniques on milk yield response of dairy cows. T. R. Dhiman<sup>\*1</sup>, <sup>1</sup>Utah State University.

Twenty-four dairy cows were used in a 3 x 3 Latin square design experiment to quantify the yield response to feeding soybean meal processed using different techniques. Each period was 4 wk. The first 2 wk in each period were considered as adaptation time to the diets and measurements were made during the last 2 wk. Cows were fed a basal diet containing 47% forage and 53% grain. The dietary protein supplement in the three treatment diets was solvent extracted soybean meal (SBM), extruded-expelled soybean meal (ESBM), or full-fat extruded soybean meal (FFSB). Protein supplement was added at 11.3% of dietary DM. All three diets had same energy, crude protein, fat, fiber, and minerals and were fed as a total mixed ration. Cows produced 34.2, 33.8, and 33.7 kg energy corrected milk (ECM) per day in SBM, ESBM and FFSB treatments, respectively. Cows in SBM, ESBM or FFSB had similar feed intake, milk yield, ECM yield, ECM/feed intake, milk fat content, milk fat yield, milk protein yield and milk urea content. Milk protein content and yield were 2.84<sup>a</sup>, 2.78<sup>b</sup> and 2.80<sup>b</sup> % and 1.03, 1.01 and 1.03 kg/day in SBM, ESBM and FFSB, respectively. Conjugated linoleic acid content of milk was 0.54<sup>b</sup>, 0.64<sup>a</sup> and 0.77<sup>a</sup> g/100 g of fat in SBM, ESBM and FFSB, respectively. Due to higher fat content of extruded-expelled soybean meal (9.1% fat) and full-fat extruded soybeans (20% fat) the diets containing these protein supplements (ESBM and FFSB) had 0.4 and 0.8% less supplemental fat compared with SBM treatment diet. Using the value of supplemental fat at a rate of 77 cents per kg, the value of fat provided by extruded-expelled soybean meal and full-fat extruded soybean was 7.7 and 15.4 cents per cow per day, respectively. Suggesting that the value of extruded-expelled soybean meal and full-fat extruded soybeans was 25 and 50 dollar per ton higher than solvent extracted soybean meal, respectively. Results suggest that cows fed solvent extracted soybean meal, extruded-expelled soybean meal, or full-fat extruded soybeans as a protein supplement had similar milk yield response when diets were balanced for net energy of lactation content. It is recommended that the price of protein supplement should be based not only on protein quality but also on fat content.

**Key Words:** Soybean, Milk, Fat

### 979 Rumen undegradable protein from forage grass. Pierre Groenenboom<sup>\*1</sup>, James Shelford<sup>1</sup>, and Shabtai Bittman<sup>2</sup>, <sup>1</sup>UBC Education and Research Centre, <sup>2</sup>Pacific Agri-Food Research Centre.

Rations for lactating dairy cattle should supply adequate amounts of rumen undegradable protein (RUP) without oversupplying rumen degradable protein (RDP). Although most proteins from forage grasses are RDPs, we examined whether altering nitrogen (N) fertilizer regimes and harvest schedules can increase the percentage of RUP in forage grass.

Plots of orchardgrass were given 0, 50, or 100 kg/ha/harvest of N fertilizer. The plots were harvested three or four times a year for three years. To examine the effects of harvest schedule, harvest was delayed in some plots so that plots were cut in one of three periods within each harvest period. Harvested grass was analyzed for dry matter yield, crude protein (CP), true protein (TP), and neutral detergent fibre (NDF). Grass samples were incubated in the rumens of ruminally cannulated cows to examine dry matter and protein degradations. Decreased N fertilization and delayed harvest increased the proportion of true protein (TP) in harvested grass. Consequently, non-protein nitrogen (NPN) was reduced. NPN is very rapidly degraded in the rumen. TP consists of a range of proteins, some of which are rapidly degraded, while others may escape ruminal degradation. The increase in TP suggests an increase in RUP. Altering N availability and utilization provides opportunities to increase production efficiency and reduce environmental pollution.

**Key Words:** Rumen undegradable protein, Forage grass, True protein

### 980 Effect of nitrogen intake on nitrogen recycling and urea transporter expression in lambs. JC Marini<sup>\*1</sup>, JD Klein<sup>2</sup>, JM Sands<sup>2</sup>, and ME Van Amburgh<sup>1</sup>, <sup>1</sup>Cornell University, <sup>2</sup>Emory University.

Urea recycling in ruminants has been studied extensively in the past but the mechanisms regulating the amount of urea recycled or excreted remain obscure. In order to elucidate the role of urea transporters (UT) on nitrogen (N) recycling, nine Dorset-Finn ewe lambs (20.8±0.8 kg) were fed diets containing 1.6, 2.9, or 4.0 g N/kg DM for 21 d. Nitrogen (N) balance and urea kinetics were carried out the last 3 days of the period. Animals were then slaughtered and mucosa samples from the rumen, duodenum, ileum and cecum, as well as kidney medulla and liver were collected. Increasing N intake, linearly increased N balance (1.5, 5.1 and 5.4±0.86 g N/d,  $P < 0.01$ ), urinary N excretion (2.4, 10 and 16.5±0.86 g N/d,  $P < 0.01$ ) and plasma urea concentration (4.3, 20.3, 28.4±2.62 mg urea-N/dl,  $P < 0.01$ ), but did not affect fecal N excretion (5.0±0.5 g N/d;  $P = 0.93$ ). Urea production (3.6, 14.0 and 20.5±2.50 g N/d;  $P < 0.01$ ), urinary urea excretion (0.7, 7.0 and 13.4±0.73 g N/d;  $P < 0.001$ ) and urea recycled (2.9, 7.1 and 7.1±1.12 g N/d;  $P < 0.01$ ) increased linearly with N intake. No changes due to protein intake were observed on creatinine excretion (518±82.4 mg/d;  $P = 0.66$ ) and clearance (46±10.7 ml/min;  $P = 0.56$ ). Urea clearance by the kidney increased linearly with N intake (14.9, 24.4 and 34.9±5.9 ml/min;  $P < 0.04$ ) while urea clearance into the GI tract decreased (39.4, 23.6 and 19.0±4.5 ml/min;  $P < 0.01$ ). Urea transporter B was present in all the tissues analyzed but UT-A only in kidney medulla, liver and duodenum. Among animals on the three diets, no differences ( $P > 0.10$ ) in UT expression, quantified by densitometry, were found. Rumen wall urease activity decreased linearly ( $P < 0.02$ ) with increasing level of N intake. Urease activity in duodenal, ileal and cecal mucosa was lower than in the rumen for all the animals in the three diets and not different from zero ( $P > 0.10$ ) in animals on the high protein diet. Although urease activity in the tissues of lambs fed the low and medium protein diet were different than zero ( $P < 0.05$ ), there were only 14 and 7 % of the ruminal urease activity. Urea transporter abundance in the kidney medulla and the GI tract do not reflect the increase in urea reabsorption by the kidney and transferred to the GI tract.

**Key Words:** Urea Recycling, 15N, Urea Transporter