150 The correlation of razor blade shear, Allo-Kramer shear, Warner-Bratzler shear, and sensory tests to changes in tenderness of broiler breast fillets. L. C. Cavitt*[1], R. Xiong[2], J.-F. C. Meullenet[2], and C. M. Owens[1], [1]*Department of Poultry Science, University of Arkansas, Fayetteville,* [2]*Department of Food Science, University of Arkansas, Fayetteville.*

This study was conducted in order to evaluate the efficacy of the razor blade shearing method and various other instrumental shearing methods (Allo-Kramer and Warner-Bratzler) as a means for developing models for predicting tenderness in broiler breast fillets. Breast fillets were deboned at various times postmortem (0.25 to 24 h) to yield a vast assortment of tenderness levels. Breast fillets were cooked to 76 C and subjected to either shear analysis or sensory analysis (trained or consumer). A trained descriptive panel was used to evaluate samples for attributes including initial hardness and chewdown hardness and a consumer panel for evaluation of attributes including overall acceptability and intensity of tenderness. Relationships between instrumental and descriptive sensory attributes exhibited correlations of $0.53 < R^2 < 0.73$ for initial hardness and chewdown hardness while correlations between instrumental and consumer sensory attributes of acceptability of tenderness and intensity of tenderness revealed coefficient of determination values ranging from $0.71 < R^2 < 0.97$. For both descriptive and consumer sensory analysis, razor blade, Warner-Bratzler, and Allo-Kramer shear tests performed similarly for predicting the tenderness of cooked broiler breast meat. When comparing all three instrumental shearing methods, the razor blade shear test is more advantageous in predicting tenderness as compared to the other instrumental methods due to the fact that no sample cutting or weighing is required in order to execute the test, nor is it excessively destructive as only a small incision (8.9 mm in width) is made in the sample. The razor blade shear test is also advantageous over the other testing methods in that results could be obtained two times as fast as opposed to the other testing methods with very similar or greater precision for predicting tenderness of cooked broiler breast meat.

Key Words: Tenderness, Razor Blade Shear, Sensory

151 Functional analysis of turkey breast muscle. M. S. Updike*[1], M. Lilburn[2], G. Kaletunc[1], H. Zerby[1], and M. Wick[1], [1]*The Ohio State University, Columbus,* [2]*The Ohio State University, Wooster.*

Data from recent publications suggest that there is a decrease in turkey breast muscle functionality in further processing. This reduced functionality is hypothesized to be associated with changes in the salt soluble proteins extracted from the breast muscle prior to cooking. To test this hypothesis, salt soluble proteins were extracted from breast muscles obtained from three distinct turkey genotypes. These genetic lines were as follows: 1) the RBC2 line, representative of the 1960s era commercial turkeys; 2) F-line, a subline of RBC2 selected only for 16 week body weight; 3) C-line, representative of present day commercial turkeys selected for body weight and increased breast muscle yield. The rationale for using the three genotypes was to create an extremely variable genetic pool of muscle samples from which to correlate protein composition and functionality relationships. Myosin heavy chain concentrations in the salt soluble protein solutions, as determined by electrophoresis and image analysis, were not different among the genotypes ($P<0.05$). Rheological analysis was conducted on thermally induced meat gels generated from all the breast muscles sampled (n=5 per line). There was a 50-fold difference in the storage modulus (G) between the highest and lowest values obtained from the final step of a programmed temperature ramp from 40°C to 80°C. Breast muscles from the RBC2 line had the highest gel strength at 131 Pa, followed by the F-line (89 Pa), and the C-line (54 Pa; P=0.09). A reverse stepwise linear regression analysis was used to associate staining intensities of bands obtained from a 1-D proteomic fingerprint of the salt soluble proteins with the rheological variability observed in the thermally induced meat gel strengths. This analysis showed that two bands were associated with the ultimate gel strength ($R^2 = 0.87$, $P<0.01$). These findings are unique in showing that variations among the salt soluble proteins, other than myosin, affect the functionality of thermally induced meat gels. Further characterization of these bands will give further insight into the mechanisms underlying the functionality of turkey breast meat.

Key Words: Thermally Induced Meat Gel, Rheology, Proteomic Fingerprinting

Ruminant Nutrition: Beef - Energy and Nitrogen

152 Blood ketone levels of young postpartum range cows increased after supplementation ceased. R. L. Endecott*, C. M. Black, K. A. Notah, and M. K. Petersen, *New Mexico State University, Las Cruces.*

Young beef cows grazing dormant native range experience weight loss and nutrient imbalances postpartum. Due to high acetate production from ruminal fermentation and low metabolic glucose supply, ruminal acetate is cleared slowly and may be converted to β-hydroxybutyrate (βHB). As a chute-side measure of nutrient status, whole-blood βHB levels of two- and three-year-old postpartum range cows (n = 45) were measured with a handheld ketone sensor (MediSense/Abbott Laboratories, Abingdon, UK). Measurements were taken in May and July when cows were grazing dormant range. In May, cows were also receiving one of three 30% CP supplements containing increasing quantities of glucogenic precursors (57, 124, or 192 g/d glucogenic potential). For each ketone reading, βHB in the blood is oxidized to acetoacetate in the presence of hydroxybutyrate dehydrogenase with the concomitant reduction of NAD^+ to NADH. The NADH is reoxidized to NAD^+ by a redox mediator. The current generated is directly proportional to the βHB concentration. After 30 s, the βHB concentration (mmol/L) is displayed on the meter. Data were analyzed using physiological state, time of measurement and their interaction in the model. Cows had higher ($P < 0.01$) βHB in July than they did in May (0.34 vs 0.16 ± 0.02 mmol/L, respectively). Levels of βHB did not approach subclinical ketosis. However, the differences between the two measurements may suggest that the glucogenic precursors in the supplements may have improved utilization of acetate arising from ruminal fermentation. Cows were at an earlier stage of lactation (avg 53 d postpartum), presumably producing more milk, but gaining weight (0.11 ± 0.10 kg/d) in May, while in July were further along the lactation curve (avg 124 d postpartum) and producing less milk, but losing weight (-0.22 ± 0.10 kg/d). Protein supplementation may have decreased βHB produced by improving acetate clearance due to a greater supply of glucogenic precursors.

Key Words: Beta-hydroxybutyrate, Acetate, Glucose

153 Effect of step-up program during grain adaptation on ruminal pH and fermentation in feedlot cattle. D. W. Bevans*[1,2], K. S. Schwartzkopf-Genswein[1], T. A. McAllister[1], K. A. Beauchemin[1], and J. J. McKinnon[2], [1]*Agriculture and Agri-Food Canada Research Centre, Lethbridge, AB, Canada,* [2]*University of Saskatchewan, Saskatoon, SK, Canada.*

Effects on ruminal parameters of rapid vs. gradual adaptation to a high concentrate feedlot diet were compared in a completely randomized study ($n = 6$) using 12 ruminally cannulated heifers (384 ± 25 kg BW). The heifers were housed individually and feed was delivered once daily for ad libitum consumption. Dietary transition from 40 to 90% concentrate was accomplished in 3 d using one step-up diet (rapid adaptation, RA) or in 15 d with five step-up diets (gradual adaptation, GA). The initial diet comprised 35% dry-rolled barley, 45% barley silage, 15% grass hay and 5% supplement (DM basis). These ingredients were used to formulate diets containing (DM basis) 48.3, 56.7, 65.0, 73.3, 81.7, and 90% concentrate. For treatment GA, each diet was fed for 3 d; for RA, only the 65% and 90% concentrate diets were fed. Ruminal pH was monitored continuously for 20 d via indwelling electrodes, and ruminal fluid was sampled 8 h after feeding on days of diet change. On days of change to 65 or 90% concentrate, treatment effects on minimum, maximum, or mean pH, or on the area of pH × time curves falling below 5.6 or below 6.2, were not observed ($P > 0.10$). Over the 3 d following introduction of 65% concentrate diets, the area of pH <5.6 was greater ($P = 0.08$) with RA than with GA. No other effects ($P > 0.10$) of treatment on pH variables were observed during the 3 d of feeding 65% or 90% concentrate diets. Treatment did not affect ($P > 0.10$) total VFA concentrations or ruminal fluid osmolality, but in some samples, acetic

acid concentrations tended to be higher with RA than with GA. Acute acidosis (ruminal pH <5.2 for 10.1 h; 22.8 mM ruminal lactate 8 h after feeding) was observed in one RA heifer upon introduction of the 90% concentrate diet. In this study, recognized indicators of acidosis were only minimally increased by rapid step-up to a high grain diet. However, rapid adaptation to grain may cause acidosis in a small proportion of cattle.

Key Words: Acidosis, Barley, Volatile Fatty Acids

154 A comparison of whole animal energy expenditure by Angus, Holstein, and Wagyu heifers. K. A. Ross[1], C. T. Gaskins[1], J. J. Michal[1], D. H. Keisler[2], and K. A. Johnson*[1], [1]*Washington State University, Pullman,* [2]*University of Missouri, Columbia.*

Angus, Holstein and Wagyu heifers (N=8/breed; 10 mo) were used to compare and evaluate variation in maintenance energy requirements (MEm) among and within these breeds. Open-circuit, indirect respiration calorimetry chambers were used to determine heat production (HP) at 3 levels of intake balanced for 0.17 Mcal NEm/kg<.75> (HIGH), 0.13 Mcal NEm/kg<.75> (LOW), and fasting (FAST). A total collection digestion trial was used to determine the digestibility (DE) and metabolizability (ME) of the LOW diet that contained 24% rolled barley, 66% alfalfa hay, and 10% alfalfa haylage (DM-basis). Blood was collected and serum was harvested from heifers at HIGH and LOW intakes for leptin analysis. Assuming a semilog relationship between HP and ME intake (MEI), MEm was determined by iteratively solving for the point where MEI equals HP. Heifers gained 0.78 ± 0.05 and 0.56 ± 0.04 kg/d when fed HIGH and LOW diets, respectively. The LOW diet contained 68% DE and 57% ME. Methane loss at the LOW intake averaged 7.5 ± 0.2 % of gross energy intake. Angus (113.5 kcal/kg<.75>) and Wagyu (105.2 kcal/kg<.75>) had lower (P<0.01) MEm requirements than Holstein (137.1 kcal/kg<.75>). Retained energy (RE) was not different among breeds and averaged 61.4 ± 4.7 kcal/kg<.75> at HIGH and 36.7 ± 4.2 kcal/kg<.75> at LOW. Wagyu tended to have slightly higher RE (42.4 kcal/kg<.75>) at LOW intake. There was more variation in MEm between breeds (72%) than within breed (28%). Serum leptin at HIGH averaged 7.3 ± 0.47 ng/ml and was not different between breeds. Leptin concentrations in Angus and Holstein heifers did not change when switched to the LOW diet, but serum leptin of Wagyu decreased to 3.1 ± 0.47 ng/ml, which was significantly lower (P<0.01) than the other breeds. Serum leptin concentrations were not correlated to MEm or HP at any level of intake. Growing Wagyu heifers have energy requirements similar to those observed in Angus heifers of the same age.

Key Words: Wagyu, Maintenance Energy Requirements, Leptin

155 Effects of intravenous infusions of acetate, propionate, lactate, or glucose on lipogenic enzyme activity in bovine adipose tissue. J. D. Arseneau*, M. E. Spurlock, J. R. Townsend, L. A. Horstman, and R. P. Lemenager, *Purdue University, West Lafayette, IN.*

The objective of this study was to evaluate the differential effects of intravenous infusions of acetate, propionate, DL-lactate, or glucose on lipogenic enzyme activity in bovine subcutaneous (SQ) and intramuscular (IM) adipose tissue. Thirty Angus-sired intact heifers (576 ± 48 kg) were allotted to treatments by BW and ultrasound intramuscular fat percentage and intravenously infused for 48 h with either 1) 0.9% NaCl (CON), 2) acetate (ACE), 3) propionate (PROP), 4) DL-lactate (LAC), or 5) glucose (GLU). Heifers were fed a finishing diet formulated for 12% CP and 2.88 Mcal/kg ME. Heifers were fed twice daily and average daily ad libitum DMI was determined on d -5 to d -1. During infusion, CON heifers were fed at their previously determined ad libitum DMI levels. Heifers on the remaining treatments were fed at levels that provided 90% of daily ME from feed, while the remaining 10% of ME was provided by the appropriate infusion media. All heifers were infused at a rate of 150 ml/hr. Blood samples were collected prior to initiation of infusion and before each feeding. Immediately following exsanguination, SQ and IM adipose tissue were removed from the longissimus dorsi for determination of lipogenic enzyme activity. Heifers infused with GLU exhibited higher levels (P<0.05) of NADP-malate dehydrogenase (MDH) in IM compared to LAC (nmoles/minute/g adipose tissue). Activities of glucose-6-phosphate dehydrogenase (G6P), 6-phosphogluconate dehydrogenase (6PG), and acetyl-CoA carboxylase (ACC) in IM were not different (P>0.10) between treatments. Similarly, activities of MDH, G6P, 6PG and ACC in SQ adipose tissue did not differ (P>0.10) between infusion treatments. During infusions, plasma glucose concentrations were numerically higher in GLU than CON, however, the difference was not significant (P>0.10). In summary, levels of acetate, propionate, lactate and glucose infused in this study were ineffective for enhancing IM or SQ lipogenic enzyme activity in market-ready cattle consuming a high concentrate finishing diet.

Key Words: Bovine, Adipose Tissue, Enzyme Activity

156 Effects of energy supply on methionine utilization by growing steers. G. F. Schroeder*, E. C. Titgemeyer, M. S. Awawdeh, and D. P. Gnad, *Kansas State University, Manhattan.*

We evaluated the effect of energy supply on methionine (Met) utilization in growing steers. Six ruminally cannulated Holstein steers (228 kg BW) were used in a 6 x 6 Latin square, housed in metabolism crates, and fed 2.8 kg DM/d of a diet based on soybean hulls (83%), wheat straw (7.6%), and cane molasses (4.1%). Treatments were abomasal infusion of two amounts of Met (0 or 3 g/d) and supplementation with three levels of energy (0, 1.3, and 2.6 Mcal ME/d) in a 2 x 3 factorial. The 1.3 Mcal/d treatment was supplied through ruminal infusion of 90 g/d acetate, 90 g/d propionate, and 30 g/d butyrate as well as abomasal infusion of 30 g/d glucose and 30 g/d fat. The 2.6 Mcal/d treatment supplied twice these amounts. Periods were 6 d with 2 d for adaptation and 4 d for sample collections. All steers received basal infusions of 400 g/d of acetate into the rumen and a mixture (125 g/d) of all essential amino acid except Met into the abomasum. No interactions between Met and energy level were observed. Nitrogen balance was increased (P<0.05) by Met supplementation from 23.6 to 27.8 g/d indicating that Met limited protein deposition. Nitrogen retention increased linearly (P<0.05) with energy from 23.6 to 27.6 g/d. Increased energy supply also linearly reduced (P<0.05) urinary N excretion from 44.6 to 39.7 g/d and plasma urea concentrations from 2.8 to 1.5 mM. Total tract OM and NDF digestibilities were reduced linearly (P<0.05) by energy supplementation from 78.2 and 78.7% to 74.3 and 74.5%, respectively. Whole body phenylalanine flux was not affected by treatment. Energy supply linearly increased (P<0.05) serum IGF-I from 694 to 818 ng/mL and quadratically increased serum insulin level (0.38, 0.47, and 0.42 ng/mL for 0, 1.3, and 2.6 Mcal/d, respectively). In growing steers, N retention was improved by energy supplementation even when Met limited protein deposition, suggesting that energy supply affects the efficiency of amino acid utilization. (Supported by NRI Competitive Grants Program/CSREES/USDA, Award No. 2003-35206-12837).

Key Words: Methionine, Energy Supply, N Retention

157 Evaluation of soybean hulls and protein sources of varying degradability on steer performance in feedlot receiving diets. C. J. Mueller*, R. H. Pritchard, and D. L. Boggs, *South Dakota State University, Brookings.*

A 52 d feedlot receiving study was used to evaluate the use of soybean hulls (SBH) in conjunction with protein sources of various degradability on gain performance and health status. Diets based upon oat silage (40%) were formulated for 11.75% CP. The control diet contained rolled corn and soybean meal (CO), while the test diets substituted SBH for corn and were supplemented with either soybean meal (SBM), dried corn gluten feed (DCGF) or dried distillers grains plus solubles (DDGS). All diets were predicted to have a negative degradable intake protein (DIP) balance. Performance was evaluated using 200 Angus steers (BW = 268 ± 2 kg) in a randomized complete block design utilizing orthogonal contrasts for treatment comparisons. Steers were blocked by previous origin and processed within 24 h of arrival. Steers within block were stratified by BW and randomly assigned to pen (8 to 11 steers). Pens (n = 5) were then assigned to dietary treatment. Intake was greater (P < 0.05) for SBM compared to CO during the initial 28 d (6.67 vs 6.29 kg) and overall (8.01 vs 7.58 kg), while ADG (1.53 ± 0.02 kg) and gain efficiency (195 ± 4 g gain/kg feed) were similar between the two treatments (P > 0.10). No differences were detected for intake, ADG or gain efficiency between SBM and corn co-products (DCGF and DDGS; P > 0.10). Steers fed the DDGS had greater ADG compared to DCGF during the initial 28 d (1.87 vs 1.69 kg; P < 0.05), but were not different after 52 d (1.52 vs 1.58 kg; P > 0.10). Intake and gain efficiency were similar between DDGS and DCGF during the initial 28 d and overall (P > 0.10). Morbidity and mortality were similar among treatments (11.1% and 0.5%, respectively; P > 0.10). This study indicates that

soybean hulls are a viable replacement for rolled corn in 40% roughage feedlot receiving diets. The use of corn co-products as a protein source with soybean hulls does not seem to limit performance, even though DIP balance varies among sources.

Key Words: Feedlot Steers, Receiving Diets, Co-Products

158 Effect of dietary crude and degradable protein concentration on feedlot performance, estimated nutrient excretion, and carcass characteristics. T. J. Biggs*[1], M. S. Brown[1,2], L. W. Greene[2,1], E. M. Cochran[1], E. A. Lauterbach[1], and J. R. Cortese[1], [1]*West Texas A&M University, Canyon,* [2]*Texas Agricultural Experiment Station, Amarillo.*

Continued efforts are needed to refine dietary N needs to optimize feedlot cattle performance and promote environmental sustainability. Yearling steers (n = 315) were used to evaluate the effects of dietary CP and degradable protein on feedlot performance, nutrient excretion, and carcass characteristics. After adaptation to a 90% concentrate diet over 28 d, steers (375.5 ± 15.6 kg of BW) were fed one of three CP concentrations (11.5, 13. or 14.5% of DM) provided by one of three proportions of supplemental degraded intake protein (50, 75 or 100% of CP) in a 3 X 3 factorial (5 pens/treatment, 7 steers/pen) for 135 d. Urea and cottonseed meal were used in ratios of 100:0, 50:50, and 0:100, N basis. Diet CP and protein degradability did not interact ($P > 0.15$) for performance or carcass data. Steer ADG increased ($P < 0.01$) with diet CP (1.91, 2.03, and 2.23 ± 0.07 kg/d for 11.5, 13.0, and 14.5%, respectively), and gain:feed was improved as both diet CP and degradable protein increased ($P < 0.07$) from d 29 to 56 (immediately after reimplant). However, ADG tended ($P = 0.14$) to decrease as diet CP increased from d 85 to 112, and gain:feed increased as dietary CP decreased and as degradable protein increased ($P < 0.09$) from d 85 to 112. Thus, overall ADG, DMI, and gain:feed did not differ. Daily N and P retention, estimated by NRC equations, was not influenced ($P > 0.10$); steers retained 30.2 ± 0.5 g of N and 7.4 ± 0.1 g of P/d. Daily N excretion was not altered by degradability, but N excretion increased ($P < 0.01$) with dietary CP (143, 169, and 193 ± 5 g/d). Daily P excretion increased as CP increased and as degradability decreased ($P < 0.01$); P excretion ranged from 18 to 30 g/d. The number of low Choice or greater carcasses was reduced (Chi-square, $P < 0.10$) as dietary CP increased (64.1, 54.3, and 54.3), but other carcass attributes did not differ. Performance by yearling steers was not improved by a formulated CP above 11.5% or by altering the proportion of degradable protein, whereas carcass quality was enhanced by lower CP.

Key Words: Protein, Feedlot Performance, Nutrient Excretion

159 Oscillating protein concentrations of finishing beef cattle diets improves nitrogen retention by improving nitrogen digestibility. S. L. Archibeque*[1], H. C. Freetly[1], N. A. Cole[2], and C. L. Ferrell[1], [1]*USDA-ARS; U.S. Meat Animal Research Center, Clay Center, NE,* [2]*USDA-ARS; Conservation and Production Research Laboratory, Bushland, TX.*

We hypothesized that oscillating dietary CP concentrations would improve N efficiency and thus decrease overall N requirements and minimize contribution of nutrients to environmental systems. Eight Charolais-cross steers (358 kg BW) were used in a replicated 4×4 Latin Square design. The steers were allowed ad libitum access to the following finishing diets: 1) Low (Lo; 9.1% CP), 2) Med (11.8% CP), 3) High (Hi; 13.9% CP), or 4) Lo and Hi diets oscillated on a 48 h interval (Osc). Dry matter intake did not differ between treatments ($P>0.05$), but N intake varied ($P<0.01$) from 94 (Lo) to 131 (Med), 142 (Hi), and 133 g/d (Osc). Dry matter digestibility increased ($P<0.01$) from 71.8 (Lo) to 75.8 (Med), 77.7 (Hi), and 77.5 % (Osc). Nitrogen digestibility increased ($P<0.01$) from 62.2% (Lo) to 67.2 (Med), to 70.9 (Osc) and 70.1 (Hi). Nitrogen retention was greater ($P<0.01$) in the steers fed the Osc diet (55.0 g/d) than either the steers fed the Lo (34.8 g/d) or Hi (40.2 g/d) diets. However, N retention of steers fed the Med diet (49.8 g/d) differed ($P<0.02$) only from the steers fed the Lo diet. Urinary urea N was not different ($P>0.10$) between steers fed either the Med (19.5 g/d) or Osc (21.3 g/d) diet. Similarly, urinary urea as a percentage of total urinary N did not differ ($P>0.10$) between steers fed the Med (48.4) and Osc (51.5%) diets. Daily heat production tended ($P<0.09$) to be less for the steers fed the Lo (177) diet than those fed the Med (189), Hi (188), or Osc (182 kcal/$BW^{0.75}$) diets. These data indicate that oscillating dietary protein will improve the N retention of finishing steers compared to those in both excessive and deficient N states, while steers fed a similar daily concentration of dietary N in a static form only improved N retention compared to steers deficient in dietary N. Digestive mechanisms may play a greater role in this improvement in N retention than endogenous handling of nonprotein N.

Key Words: Heat Production, Oscillation, Metabolism

160 Prediction of ammonia release coupled to ammonia consumption. E. Venable*, K. Ladyman, and M. Kerley, *University of Missouri, Columbia.*

Five dual-cannulated (rumen and duodenum) cross-bred beef steers were used in a 5x5 Latin square design experiment. The hypothesis of the experiment was that ammonia uptake by ruminal microbes could be estimated and that the estimated ammonia uptake could be coupled with ammonia release in the rumen. Diets were developed to fluctuate ammonia concentration in the rumen by using the degradation rates of rumen degradable protein (RDP). The objective of this experiment was to determine if the release rate of ammonia within the rumen could be managed to maintain an optimum level of ammonia concentration (2 mM) over a 12-hour period. Diet formulations were as follows: diet 1) 87% corn; diet 2) 85.5% corn, 1.25% SBM, 0.2% urea; diet 3) 84.1% corn, 2.5% SBM, 0.4% urea; diet 4) 82.7% corn, 3.75% SBM, 0 .6% urea and diet 5) 81.3% corn, 5% SBM, 0 .8% urea. All treatments contained 10% cottonseed hulls, 0.5% lime, 1.5% fat, and 1% vitamin and mineral mix. Diets 1 and 2 should be limiting in ammonia (< 2 mM) and diets 4 and 5 should have excess ammonia (> 2 mM). Diet 3 was expected to maintain an optimum ammonia concentration (2 mM). Samples were taken and analyses performed for volatile fatty acids (VFA), and ammonia. Additional samples were taken to measure both liquid and solid passage rate, total urinary nitrogen (N), and ruminal pH. Data were analyzed using PROC GLM of SAS. Total VFA production was greatest for diet 3 ($P < 0.05$). Acetate to propionate ratio was lowest for diet 5 ($P < 0.05$). Ammonia production increased with increasing levels of SBM and urea in the diet ($P < 0.05$). Ammonia concentration was optimized (2 mM) for diet 3 ($P < 0.05$) with diets 1 and 2 having lower ($P < 0.05$) and diets 4 and 5 having greater ($P < 0.05$) ammonia concentrations. These data illustrate that it is possible to use predictive equations relating protein degradability characteristics to ammonia release and consumption in the rumen. The potential to synchronize ammonia release to uptake in the rumen, thus lowering excessive ammonia production without reducing fermentative efficacy, would reduce N content of waste.

Key Words: Ammonia, RDP

161 Evaluation of RUP amino acid levels on lean tissue growth and carcass composition of beef steers fed a roughage-free diet. A. L. Mueller*, W. H Kolath, J. W. Golden, and M. S. Kerley, *University of Missouri, Columbia.*

Feeding RDP above what is needed for optimal microbial growth and efficiency results in inefficient use of CP for lean tissue growth. Previous research conducted in our laboratory demonstrated the potential of using RUP to optimize feed efficiency. Results from feeding levels of RUP above required predictions have not been studied. Therefore, we hypothesized that feeding a diet balanced in absorbable AA composition needed for lean tissue growth would maximize energy use for growth and that additional AA availability would not improve gain or efficiency. The objective of this study was to determine the optimum RUP AA level to maximize lean tissue growth of beef steers. Four diets contained increasing amounts of RUP and were fed to crossbred Angus steers in randomized complete block design. Treatment diets contained 70 % whole shelled corn and a pelleted supplement consisting primarily of blood meal (BM) and ground corn. The diets contained 6 (6BM), 9 (9BM), 12 (12BM), and 15 (15BM) % BM. The treatments were formulated to be isocaloric and contained different levels of CP and RUP AA. There were no differences in ADG ($P > 0.05$) among RUP treatments. The feed to gain ratio was highest for the 9BM and the lowest for the 6BM and 12BM treatments ($P < 0.05$). There were no difference in back fat and rib eye area among treatments ($P > 0.05$). Calves fed a roughage-free diet, but not optimized for AA flow had poorer feed conversion ($P < 0.05$). Using the NRC (2000), individual intakes and body weights were modeled for each diet. The lack of treatment effect on growth parameters in the presence of increased RUP AA was caused by energy limiting growth in all treatments and AA being supplied at

or above requirements. Using actual intakes the Mcal of NEg required for the observed gains were calculated to be within the NRC normal limits for lean tissue accretion. The 6BM treatment had similar gains and increases in carcass composition and a lower feed to gain than the other treatments indicating it balanced the AA and energy for lean tissue growth. Supplying an AA profile that is balanced for growth relative to available energy, maximizes lean tissue growth and minimizes excess CP.

Ruminant Nutrition: Dairy - Minerals

162 Impact of minerals in water on ruminant production. J. G. Linn* and M. L. Raeth-Knight, *University of Minnesota, St. Paul*.

Water is an essential nutrient for all animals. In the consumption of water to meet this requirement, animals often consume significant amounts of various minerals. The effects of the minerals contained in water on animal performance or health are not well researched or documented with the exception of sulfates, salinity and nitrates. Most studies or reports relating water quality to animal performance and even EPA water guidelines have only considered the total mineral content of the water and not the chemical form and the availability of minerals from the water. It is well documented in the animal sciences literature that the chemical form of a mineral used in feed supplementation affects the availability of the mineral supplemented. In water, pH along with the chemical form of the mineral, affect the potential availability of the mineral from water. Magnesium for example is found as Mg^{+2} in most natural waters. When water pH is greater than 10, magnesium is usually combined with hydroxide to form MgOH. In water containing 1000 mg/L or more sulfate, significant amounts of Mg are combined with sulfate to form $MgSO_4$, whereas in waters low in sulfate, Mg complexes with bicarbonate or other anions. Routine water analysis only list total concentrations of minerals such as calcium, magnesium, chloride, sodium, sulfate, copper, iron, manganese and zinc along with pH. The chemical form or the availability of the mineral from water is not described. The objective of this presentation is to review what is known about the chemical forms of common minerals in water, the relationship between water pH and chemical form, the availability of minerals from water and ultimately relate this to requirements and potential affects on animal performance.

Key Words: Water Quality, Ruminant, Minerals

163 Quality water for dairy operations. K. Mancl*, *Ohio State University, Columbus*.

Water quality is determined from the beneficial use of the water. In dairy operations water is used both for cleaning equipment and drinking water for the animals. Each use has its own requirements. To ensure that water meets quality requirements, regular water testing in necessary. A good water test is not a waste of money. Annual water tests present a record of the water system that is critical to every dairy operation. If the water supply is damaged through human activity, evidence of a safe, adequate water supply is required to present an effective legal case.

If regular testing reveals a water quality problem, dairy operators have 4 options to solve it. 1. Improve water supply protection. 2. Find and eliminate sources of contamination. 3. Develop a new source of water. 4. Treat water to remove contaminants.

Key Words: Water Treatment, Water Testing

164 Effects of inorganic and organic (4-Plex^{R}) trace mineral supplementation on milk production and reproduction. J. D. Ferguson*[1], D. Tomlinson[2], and M. Socha[2], [1]*University of Pennsylvania, Kennett Square,* [2]*Zinpro Corporation, Eden Prairie, MN*.

A total of 138 pregnant Holstein cows were blocked by parity, production and season of calving and randomly assigned within block to one of two dietary treatments: daily supplementation with 443 mg of Zn, 444 mg of Mn, 261 mg Cu, and 25 mg of Co as inorganic sulfates (control) or a combination of inorganic salts and complexed trace minerals (treatment, 14 g of 4-Plex/day; containing 360 mg Zn from zinc methionine, 200 mg Mn from manganese methionine, 125 mg Cu from copper lysine, and 25 mg Co from cobalt glucoheptonate). Diets were fed from -60 d from projected calving date through 250 d postcalving. Liver biopsy and claw examination were performed at -60 d, 30 d, and 250 d relative to calving. Serum was collected at 30 d postcalving for analysis of NEFA, cholesterol, betahydroxy butyrate, and total protein. Milk production was measured twice daily. Insemination and health events were recorded as they occurred. Milk composition for fat, protein, SNF, MUN and SMSCC was analyzed weekly from composite of consecutive a.m. and p.m. samples. Milk production and composition were analyzed with a repeated measures model, covariately adjusted for EPA and previous milk production, where appropriate, using the PROC MIXED procedure in SAS statistical software. Reproduction was analyzed using PROC LIFEREG. Milk production, milk fat and MUN were not significantly different between supplement groups. Milk protein was significantly different between supplement groups (control, 2.91 sem .01; treatment 2.95 sem .02, $p<.04$). First service conception rate was not different between the supplement groups (33% overall), however pregnancy occurred more rapidly in the treatment cows after first insemination (hazard .194 sem .119 $p<.10$). There was no effect of treatment on any health variables or cows culled for health problems. To more closely exam reproductive effects of the organic trace mineral supplementation, a large trial across several farms would be valuable.

Key Words: Trace Minerals, Production, Reproduction

165 Effects of inorganic and organic (4-Plex^{R}) trace mineral supplementation on claw lesions. J. D. Ferguson*[1], D. Tomlinson[2], and M. Socha[2], [1]*University of Pennsylvania, Kennett Square,* [2]*Zinpro Corporation, Eden Prairie, MN*.

A total of 138 pregnant Holstein cows were blocked by parity, production and season of calving and randomly assigned to one of two dietary treatments: daily supplementation with 443 mg of Zn, 444 mg of Mn, 261 mg Cu, and 25 mg of Co as inorganic sulfates (control) or a combination of inorganic salts and complexed trace minerals (treatment, 14 g of 4-Plex/day; containing 360 mg Zn from zinc methionine, 200 mg Mn from manganese methionine, 125 mg Cu from copper lysine, and 25 mg Co from cobalt glucoheptonate). Diets were fed from -60 d from projected calving date through 250 d postcalving. Cows were housed in a free stall barn with concrete alleys. Examination of claws and surrounding soft tissues was made by a trained clinician at -60 d, 30 d, and 250 d relative to calving. Cows were confined into a restraining stall for examination. Feet were washed and hoof detritus removed with a knife blade. Lesions were classified according to Toussaint (R.E. Toussaint, 1989) based on macroscopic examination of hoof and tissues. All feet were examined by one trained veterinarian throughout the study. Keratinous lesions were classified as follows: dorsal wall ridges, erosion of the heel bulb, abaxial wall lesions, double soling, white line separation, sole abscess, sole hemorrhage, sole ulceration or sole erosion. Lesions of the surrounding soft tissue were classified as follows: digital dermatitis, pododermatitis of the digit or interdigital area, interdigital fibroma, or hairy heel wart. Lesions were mapped for location on the claw and surrounding soft tissues and graded as to severity (.5, 1, 1.5, 2, 2.5, 3, .5 being mild and 3 being the most severe). A repeated measures, multinomial model was used to examine hoof lesions using PROC GENMOD in SAS statistical software. A total of 3160 claw examinations were made. Heel erosions were the most frequent claw lesion across all treatments and time periods. Supplementation with organic trace minerals was associated with a reduction in solar lesions at 30 d postcalving. By 250 d postcalving lesions were not different.

Key Words: Trace Minerals, Hoof Quality, Dairy Cows