

of treatments with four concentrations of cobalt glucoheptonate and two diet types (dry and lactating dairy cow diets). Differences ( $P < 0.05$ ) between dry and lactating dairy cow diets, respectively, were observed for pH (6.40 vs 6.12), true OM digestion (42.8 vs 59.3 %), ADF digestion (42.3 vs 50.7 %) and total VFA concentration (75.1 vs 103.8 mM). Neutral detergent fiber digestion (35.0 vs 40.0 %) and total nonstructural carbohydrate digestion (80.9 vs 83.4 %) were similar ( $P > 0.05$ ) between dry and lactating dairy cow diets. Crude protein digestion (22.8 vs 33.7 %) and N flow (2.18 vs 2.88 g/d) were lower ( $P < 0.05$ ) for the dry cow diets compared with the lactating dairy cow diets. Efficiency of bacterial synthesis (20.2 vs 21.6 g of N/kg of OM truly digested) was similar ( $P > 0.05$ ) between diets. There were no effects ( $P > 0.05$ ) of cobalt supplementation on nutrient digestion and microbial fermentation nor were there any interactions ( $P > 0.05$ ) with type of diet. Results indicate that supplementation with cobalt at various concentrations in either a dry or lactating dairy cow diet with monensin did not have any impact on fermentation by ruminal microbes.

**Key Words:** Cobalt, Continuous culture, Monensin

**424 Prediction of urine volume and urinary output of nitrogen and minerals in lactating dairy cows.** T. D. Nennich<sup>1</sup>, J. H. Harrison<sup>1</sup>, L. Johnson<sup>1</sup>, D. Meyer<sup>2</sup>, W. Weiss<sup>3</sup>, N. St-Pierre<sup>3</sup>, R. L. Kincaid<sup>4</sup>, M. Wattiaux<sup>5</sup>, and D. L. Davidson<sup>1</sup>, <sup>1</sup>Washington State University, Puyallup, <sup>2</sup>University of California, Davis, <sup>3</sup>The Ohio State University, <sup>4</sup>Washington State University, Pullman, <sup>5</sup>University of Wisconsin.

The objective of this study was to develop prediction equations for estimating urinary volume, nitrogen, and mineral excretion of lactating

dairy cows. A data set was assembled from total urine collection studies ( $n = 25$ ) that used multiparous Holstein cows. The studies were conducted by Washington State University, University of California-Davis, The Ohio State University, and the University of Wisconsin. Metabolizable protein (MP) supply was estimated for each individual cow using the 2001 Dairy NRC Model. Based upon their estimated MP intake, cows were assigned into treatments of LOWMP that included cows with MP supply at 110% or less of their calculated MP requirements, and HIGHMP that included cows with MP supply greater than 110% of MP requirements. Milk production for cows in LOWMP ranged from 9.8 to 86.1 kg/d and 1.4 to 52.6 kg/d for HIGHMP. Dietary crude protein (CP) concentration was  $17.1 \pm 5.9\%$  and  $18.2 \pm 5.8\%$  for LOWMP and HIGHMP, respectively. Urinary nitrogen ranged from 63 to 499 g/d for LOWMP and 90 to 436 g/d for HIGHMP. Regression analysis performed using the PROC MIXED procedure of SAS included study as a random variable. The regression equations predict urine volume, urinary nitrogen, and urinary excretion of P, K, Na, Ca, Mg, Cu, and Zn. Predictors used in the equations include days in milk (DIM), body weight (BW), dry matter intake (DMI), dietary CP concentration, milk CP content, and milk urea nitrogen (MUN). The best equation for the prediction of urinary nitrogen (g/d) using the LOWMP data set was:  $0.12 \cdot \text{DIM} + 0.18 \cdot \text{BW} + 4.29 \cdot \text{DMI} + 14.47 \cdot \text{diet CP\%} + 4.35 \cdot \text{MUN} \# 321$  ( $n = 230$ ) compared to:  $0.28 \cdot \text{BW} + 4.85 \cdot \text{DMI} + 7.95 \cdot \text{diet CP\%} + 4.62 \cdot \text{MUN} + 20.77 \cdot \text{milk CP\%} - 334$  ( $n = 154$ ) for the HIGHMP data set. Prediction equations can be used to more accurately estimate urinary nitrogen and mineral excretion of lactating dairy cows than current tabular values.

**Key Words:** Urine, Nitrogen, Dairy cows

## Ruminant Nutrition: Feedlot

**425 Effect of wintering system and feedlot sorting on performance and economics of yearling steer production systems.** J. D. Folmer<sup>1</sup>, C. N. Macken<sup>1</sup>, M. P. Blackford<sup>1</sup>, G. E. Erickson<sup>1</sup>, and T. J. Klopfenstein<sup>1</sup>, <sup>1</sup>University of Nebraska, Lincoln, NE.

An experiment was conducted to evaluate the effects of different winter management and feedlot sorting on the performance and economics of a yearling steer production system. Two hundred steers (239 kg) were stratified by weight and assigned randomly ( $n = 100$ ) to one of two winter management strategy treatments. Intensive (INT) or normal (NOR) management strategies consisted of 91 d of winter corn residue grazing (CRG) and 52 d of dry-lot hay feeding with wet corn gluten feed (WCGF) supplementation. NOR steers received 2.27 kg of WCGF DM daily while INT steers received 2.72 kg. INT steers also received Bovatec (170 mg/d) with the WCGF, and were implanted with Ralgro on d 1, and with Synovex S on d 91. All Steers received a Revelor G implant on d 143 and began the summer grazing period. INT steers were placed on feed at d 220 and NOR steers on d 264. At initiation of feedlot finishing, steers were implanted with Revelor S, and stratified by weight and assigned randomly ( $n = 50$ ) to one of two additional treatments in two replications, sorted (S) or unsorted (U). S steers were divided into three weight groups, the heavy 25%, the middle 50%, and the light 25%, and marketed at a common fat thickness target of 1.14 cm fat thickness. Heavy steers were marketed 14 d prior, middle 7 d after, and light 21 d after the unsorted control group. Results from the experiment indicate that INT managed steers had greater wintering phase ADG than the NOR managed steers 0.83 vs. 0.68 kg/d, respectively. Feedlot initial weights were 446 kg for INT steers on d 220, and 456 kg for NOR steers on d 264. NOR ( $P < .01$ ), and S ( $P < .05$ ) steers had significantly greater ADG, DMI, hot carcass weight (HCW), final weight (FW), and lower feed conversion than INT and U steers. NOR steers had fewer days on feed, while S had additional days on feed. INT steers performed better resulting in heavier, more profitable steers after the wintering phase. NOR steers were heavier and more profitable after the summer grazing and feedlot finishing phases. Sorting steers into marketing groups when they enter the feedlot resulted in heavier, more profitable steers versus unsorted controls.

**Key Words:** Steers, Systems, Sorting

**426 Effects of live cultures of *Lactobacillus acidophilus* (Strains 45 and 747) *Propionibacterium freudenreichii* on performance, carcass and intestinal characteristics, and *Escherichia coli* O157:H7 shedding of finishing beef steers.** N. A. Elam<sup>\*</sup>, J. F. Gleghorn, J. D. Rivera, M. L. Galyean, M. M. Brashears, and S. M. Younts-Dahl, Texas Tech University.

Two hundred forty beef steers (British and Continental; initial BW =  $332.8 \pm 23.1$  kg) were used to determine the effects of live cultures of *Lactobacillus acidophilus* (LA) and *Propionibacterium freudenreichii* (PF) on performance, carcass and intestinal characteristics, and prevalence of *Escherichia coli* O157:H7 (EC) shedding during the finishing phase. Cattle were fed a steam-flaked corn-based 92% concentrate diet for an average of 170 d. The four treatments included: 1) control (CON) lactose carrier only; 2)  $1 \times 10^9$  cfu of LA Strain 747 plus  $1 \times 10^6$  cfu of LA Strain 45 plus  $1 \times 10^9$  cfu of PF-24 per animal daily (G); 3)  $1 \times 10^9$  cfu of LA Strain 747 plus  $1 \times 10^9$  cfu of PF-24 per animal daily (Y); and 4)  $1 \times 10^6$  cfu of LA Strain 747 plus  $1 \times 10^6$  cfu of LA Strain 45 plus  $1 \times 10^9$  cfu of PF-24 per animal daily (B). A randomized complete block design was used with pen as the experimental unit (12 pens/treatment). No differences ( $P > 0.10$ ) among treatments were detected for final BW, DMI, ADG, gain:feed, and hot carcass weight. In addition, dressing percent, longissimus muscle area, fat thickness at the 12<sup>th</sup> rib, percentage of internal fat, and yield grade did not differ ( $P > 0.10$ ) among treatments. A trend ( $P = 0.08$ ) was detected for treatment differences in ileal lamina propria (LP) thickness. The average LP thickness for Y and G steers was less ( $P < 0.05$ ) than the average for CON and B steers (0.38 vs 0.45 mm). Moreover, Y and G steers had a lower ( $P < 0.10$ ) incidence of EC shedding than CON and B steers. Under the conditions of this study, live cultures of LA plus PF did not greatly affect feedlot performance and carcass characteristics. Some of the cultures used in this study decreased fecal EC shedding, which might be related to the results for ileal LP thickness.

**Key Words:** Beef Cattle, Direct-fed Microbials, Lamina Propria

**427 Influence of sire breed on residual feed intake as an indicator of efficiency in steers.** C. L. Ferrell<sup>\*</sup>, T. G. Jenkins, and H. C. Freedly, USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE.

The objective was to evaluate residual feed intake (RFI) as an indicator of efficiency. Steers (107) sired by Angus (A), Hereford (H), Belgian

Blue (B), Piedmontese (P), Boran (Bo), Brahman (Br), and Tuli (T) and from A, H, or MARC III dams were used. Eight additional steers of each sire breed were used as initial slaughter animals. Steers were individually fed (half near maintenance and half at ad libitum) a high-concentrate diet (83.8% corn) in pens of eight for 140 d. Steers were weighed at 14 d intervals, and feed allotments were adjusted at those times. Steers were slaughtered at the MARC abattoir and retained energy (RE) was determined by comparative slaughter procedures. Initial weight (IWT), final weight (FWT) and ADG were calculated from regressions of weight on time for each steer. Similarly, DMI and MEI was calculated from regressions of cumulative feed consumed on time for each steer. Residual feed intake (RFI) was determined as the residual from within feed level regressions of MEI (kcal/kg<sup>0.75</sup>/d) on retained energy (kcal/kg<sup>0.75</sup>/d), and residual retained energy (RRE) was determined as the residual from the regression of RE (kcal/kg<sup>0.75</sup>/d) on MEI (kcal/kg<sup>0.75</sup>/d). Increased feed level increased intake and retained energy ( $P < 0.01$ ), RRE ( $P = 0.06$ ), but not RFI ( $P = 0.99$ ). Sire breed influenced all traits ( $P < 0.01$ ), but feed level  $\times$  sire breed did not influence RRE ( $P = 0.25$ ) or RFI ( $P = 0.35$ ). Mean RRE and RFI for A, B, H, Bo, P, Br, and T sire breeds were: 2.17, 0.52; -10.04, 7.3; 3.28, 6.25; 3.65, -16.34; -8.68, 24.95; 4.83, -10.74; and 3.34, -11.77, respectively. The five of 107 steers identified as most efficient based on RFI were from the ad libitum group and averaged 4.95 kg DMI/d and 5.02 Mcal RE/d (means for ad libitum were 7.11 kg/d and 5.67 Mcal/d) suggesting potential negative consequences of over emphasizing RFI as a means to improve efficiency. These results suggest important differences exist among sire breeds in efficiency as measured by RRE or RFI.

**Key Words:** Breed, Efficiency, Feed level

**428 Ruminal biohydrogenation and conjugated linoleic acid formation in beef cattle fed finishing diets containing crude fish oil and/or different oil sources.** S. K. Duckett<sup>\*1</sup>, B. Jacob, M. H. Gillis, C. E. Realini, K. R. Smith, A. Parks, and R. Eggleston, <sup>1</sup>*The University of Georgia*.

Four Hereford steers (550 kg) cannulated in the proximal duodenum were used to assess the effect of dietary oil source with or without the addition of fish oil on ruminal biohydrogenation (BH) and flow of long chain fatty acids to the duodenum. The steers were fed one of four diets in a 2 by 2 factorial arrangement of treatments (oil source: canola vs. corn oil; fish oil level: 0 or 1%) in a 4 x 4 Latin Square design. The dietary treatments included: 1) 4% corn oil (CO), 2) 4% canola oil (CA), 3) 3% corn oil plus 1% fish oil (COFISH), and 4) 3% canola oil plus 1% fish oil (CAFISH) added to a high concentrate diet (12% grass hay, 84% concentrate). All four diets were designed to be isonitrogenous and isolipid. Chromic oxide was added to the diets as an external marker for the determination of duodenal output. Experimental periods lasted 14 d with 10 d for diet adaptation and 4 d for sample collection. Data were analyzed with animal, period, oil source, fish oil and oil source by fish oil interaction in the model. Addition of canola oil increased ( $P < 0.05$ ) BH of oleic and linolenic acids compared to corn oil addition. Fish oil addition increased ( $P < 0.05$ ) linoleic acid BH in canola oil but did not alter BH of linoleic acid in corn oil diets. Overall BH of unsaturated 18C fatty acids was lower ( $P < 0.05$ ) for CA and COFISH than CAFISH with CO being intermediate. Oil source did not alter ( $P > 0.05$ ) flow of stearic, trans-octadecenoic, and oleic acids to the duodenum. Linoleic acid flow to the duodenum was greater ( $P < 0.05$ ) for corn than canola oil; whereas, linolenic acid flow was greater ( $P < 0.05$ ) for canola than corn oil. Addition of fish oil reduced ( $P < 0.05$ ) the flow of stearic and linoleic acids to the duodenum, and increased ( $P < 0.05$ ) flow of trans-11 vaccenic acid by 1.5 fold. Flow of conjugated linoleic acid (CLA) and omega-3 fatty acids was greater ( $P < 0.05$ ) for diets containing fish oil regardless of oil source. Addition of fish oil increased flow of trans-11 vaccenic, CLA, and omega-3 fatty acids to the duodenum regardless of oil source.

**Key Words:** Beef, Conjugated linoleic acid, Fish oil

**429 Effect of source of energy, and rate of growth in the growing phase on performance and carcass characteristics of steers.** J. P. Schoonmaker<sup>\*1</sup>, M. J. Cecava<sup>2</sup>, F. L. Fluharty<sup>1</sup>, H. N. Zerby<sup>1</sup>, and S. C. Loerch<sup>1</sup>, <sup>1</sup>*The Ohio State University, Wooster, OH*, <sup>2</sup>*ADM Alliance, Decatur, IN*.

One hundred and eighty four steers (init. BW 161.7  $\pm$  3.4 kg) were used to determine the effect of source and amount of energy in the growing phase on performance and carcass characteristics. Steers were allotted to one of four growing phase regimens. For three regimens, steers were weaned at 119 d of age and 1) fed a high grain diet ad libitum (ALC), 2) limit-fed a high grain diet to achieve a gain of 0.8 kg/d from 119 to 192 d of age, and 1.2 kg/d from 193 to 259 d of age (LFC), or 3) fed a high forage diet ad libitum from 119 to 192 d of age, and an intermediate level forage diet ad libitum from 193 to 259 d of age (ALF). For the fourth regimen, steers were weaned at 204 d of age and fed a high grain diet from 205 to 259 d of age (NW). From 260 d of age to slaughter all steers consumed a common diet. LFC and ALF spent the most, and NW the least amount of time ( $P < 0.01$ ) in the feedlot to achieve a target fat depth of 1.25 cm. ALC steers were the youngest, and NW the oldest at slaughter ( $P < 0.01$ ). Overall ADG was greatest for ALC, and lowest for NW steers ( $P < 0.01$ ). ALF steers consumed the most DM ( $P < 0.01$ ). While in the feedlot, LFC and ALC steers were more efficient in converting feed to BW gain ( $P < 0.01$ ), than ALF and NW steers. NW had the lowest and ALC the greatest ( $P < 0.01$ ) fat depth at 260 d of age. Consequently, NW steers produced the heaviest, and ALC the lightest ( $P < 0.01$ ) carcasses at slaughter. Fat depth at slaughter did not differ among treatments ( $P > 0.56$ ). NW steers had the largest, and ALC and LFC steers had the smallest longissimus muscle area ( $P < 0.06$ ). Growing phase dietary treatments did not affect ( $P > 0.20$ ) yield grade. Marbling score did not differ ( $P > 0.35$ ), but laboratory analysis revealed that ALC steers had the lowest percent fat ( $P < 0.02$ ) in the longissimus muscle. Shear force was greatest ( $P < 0.08$ ) for steaks from ALC and LFC steers, and lowest for steaks from ALF and NW steers. Feeding steers an ad libitum forage diet from 119 to 260 d of age, as well as normal-weaning extended the growth curve, improved intramuscular fat content, and increased muscle tenderness. Limit feeding a high concentrate diet did not extend the growth curve or increase muscle tenderness, but did improve intramuscular fat content, indicating that source and amount of energy affected partitioning of fat deposition.

**Key Words:** Beef cattle, Early-weaned, Limit-feeding

**430 Effect of source of energy, and rate of growth in the growing phase on adipocyte cellularity, and lipogenic enzyme activity in the intramuscular and subcutaneous fat depots of Holstein steers.** J. P. Schoonmaker, F. L. Fluharty, and S. C. Loerch, *The Ohio State University, Wooster, OH*.

Seventy-three Holstein steers (init. BW 138.5  $\pm$  4.3 kg), approximately three mo. of age, were allotted by BW to one of three growing phase treatments to determine the effect of source and amount of energy on feedlot performance, and characteristics of subcutaneous (SC) and intramuscular (IM) adipose tissue. Treatments were: 1) high concentrate diet fed ad libitum (ALC), 2) high forage diet fed ad libitum for 55 d, then a mid-level forage diet fed ad libitum for 98 d (ALF) or 3) limit-fed a high concentrate diet to achieve a gain of 0.8 kg/d for 55 d, then 1.2 kg/d for 98 d (LFC). All steers were fed the ALC diet from d 154 to slaughter. Eight steers per treatment were selected after an average of 145 and 334 d on feed for determination of adipocyte cellularity and lipogenic enzyme activity. Remaining steers were slaughtered after an average of 334 d on feed. At initial slaughter, ALC steers had approximately twice as much ( $P < 0.01$ ) SC and IM fat. At final slaughter, LFC steers had the greatest ( $P < 0.09$ ) fat depth, and greatest ( $P < 0.08$ ) longissimus muscle ether extract. Increased fat depth for ALC steers at initial slaughter was a result of a greater ( $P < 0.01$ ) mean adipocyte diameter in the SC depot. Mean IM adipocyte diameter followed the same trend ( $P = 0.16$ ). The number of adipocytes/g of SC fat was lowest for ALC and greatest for ALF ( $P < 0.09$ ) at initial slaughter. Mean diameter and number of adipocytes/g of IM and SC fat did not differ ( $P > 0.52$ ) among treatments at final slaughter (after 174 d on a common finishing diet). Amount of energy (ALC) increased activities of ATP-citrate lyase, fatty acid synthetase, 6-phosphogluconate dehydrogenase, glucose-6-phosphate dehydrogenase, and malate dehydrogenase in the SC depot ( $P < 0.02$ ), and increased activities of ATP-citrate lyase and glucose-6-phosphate dehydrogenase in the IM depot ( $P < 0.10$ ) at initial

slaughter. Lipogenic enzyme activity in the SC depot at final slaughter, did not differ ( $P > 0.33$ ) among treatments. Glucose-6-phosphate dehydrogenase activity in the IM depot at final slaughter was decreased ( $P < 0.08$ ) in ALF. Hypertrophy made a greater contribution to fat tissue growth than hyperplasia. Hypertrophy was affected by amount, whereas hyperplasia was affected by source of energy. Differences diminished when cattle were placed on the common finishing diet.

**Key Words:** Early-weaning, Limit-feeding, Adipocyte characteristics

**431 Ground flaxseed as a component of finishing cattle diets.** E. J. Good\*, J. S. Drouillard, T. J. Kessen, E. R. Loe, M. J. Sulpizio, M. A. Greenquist, S. P. Montgomery, J. J. Sindt, J. N. Pike, and K. A. Hachmeister, *Kansas State University, Manhattan, KS.*

Ground flaxseed fed to feeder cattle at approximately 10% of the diet has been shown to increase plasma and longissimus muscle concentrations of alpha linolenic acid and eicosapentanoic acid, and to increase quality grades, while decreasing retail display life of the product. An experiment was conducted to determine the effects of combinations of ground flaxseed and vitamin E on feedlot performance, carcass quality, retail display life, and fatty acid composition. Steers ( $n=79$ ; 338 kg BW) were individually fed diets containing ground flaxseed at 0, 5, 10, or 15% of the diet, with and without the addition of 220 IU vitamin E/kg DM. All diets were fed throughout a 120-d finishing period. After completion of the finishing period, carcass data, including hot carcass weight, yield grade, marbling score, subcutaneous fat thickness, ribeye area, and percentage of kidney, pelvic and heart fat, were determined for each animal. Also, retail display life, 2-Thiobarbituric Acid Reactive Substances (TBARS), fatty acid composition, and sensory attributes of longissimus dorsi muscles were evaluated. Cattle fed flax had a linear tendency ( $P=0.08$ ) for increased average daily gain, DMI was increased ( $P < 0.05$ ), but gain:feed was not affected. There was a quadratic effect ( $P < 0.05$ ) of flax level on KPH, and the amount of fat over the 12th rib ( $P < 0.05$ ). Additionally, there was a linear increase in dressing percent as level of flax was increased ( $P < 0.05$ ). Feeding flaxseed tended ( $P=0.08$ ) to increase the percentage of carcasses grading USDA Choice, with 5% flax as the optimum level. There were no differences in TBARS or Warner Bratzler shear force among any of the treatments. A trained taste panel evaluated myofibrillar tenderness, juiciness, flavor intensity, connective tissue amount, overall tenderness, and off-flavor intensity on the steaks, but observed no differences among treatments. Retail display life display was improved ( $P < 0.05$ ) by feeding any level of flax with vitamin E. Vitamin E did not improve retail shelf life in the absence of flax. Dietary treatments combining vitamin E and ground flaxseed produced no negative effects on meat quality. Flax is an acceptable source of energy and may enhance growth and carcass quality attributes of cattle.

**Key Words:** Flaxseed, Vitamin E, Carcass quality

**432 Comparison of concentrated separator byproduct with cane molasses and the relationship of blood glucose concentration at arrival to finishing performance and carcass characteristics of heifers.** E. R. Loe\*, J. S. Drouillard, T. J. Kessen, S. P. Montgomery, J. N. Pike, J. J. Sindt, and M. J. Sulpizio, *Kansas State University.*

To determine the effect of diet and arrival blood glucose concentration on finishing performance and carcass characteristics, 394 crossbred heifers (298 2 kg initial BW) in 24 pens were used in a completely randomized design with a  $2 \times 2$  factorial arrangement of treatments. Factors were cane molasses or concentrated separator byproduct (CSB) and high or low initial blood glucose. Blood samples were taken at arrival and 9 d prior to slaughter. Heifers were sorted into two groups based on blood glucose concentrations at arrival (low glucose = heifers  $< 66$  mg/dL; high glucose = heifers  $> 66$  mg/dL). Mean initial glucose in whole blood was 57 and 78 2 mg/dL and in plasma was 96 and 117 3 mg/dL for low- and high-glucose groups, respectively. Diets contained (DM basis) 77% steam-flaked corn, 8% alfalfa hay, 5% cane molasses or CSB, 3% tallow, and 10% supplement which contained vitamins, minerals, and feed additives. Heifers were fed a common receiving diet for 26 d and the cane molasses or CSB diet for 148 d. No interactions between diet and arrival glucose were detected ( $P > 0.42$ ). Diet did not affect feedlot performance ( $P > 0.23$ ), final glucose concentrations ( $P > 0.49$ ), apparent dietary  $NE_g$  ( $P > 0.21$ ), or carcass characteristics ( $P > 0.10$ ).

Low-glucose heifers had lower final plasma glucose ( $P = 0.009$ ; 114 vs 139 mg/dL); consumed more feed ( $P = 0.02$ ); had heavier final live BW ( $P = 0.02$ ); and greater fat thickness ( $P < 0.05$ ). Glucose concentration did not affect feed efficiency or morbidity ( $P > 0.65$ ). Apparent  $NE_g$  for cane molasses and CSB were not different ( $P = 0.20$ ). Concentrated separator byproduct is a suitable replacement for cane molasses. Cattle that had low glucose at arrival had improved finishing performance and fatter carcasses compared to heifers with high blood glucose at arrival.

**Key Words:** Concentrated separator byproduct, Cane molasses, Blood glucose

**433 Effects of dietary crude protein level and carcass characteristics of growing-finishing beef steers.** J. F. Gleghorn\*<sup>1</sup>, N. A. Elam<sup>1</sup>, M. L. Galyean<sup>1</sup>, G. C. Duff<sup>2</sup>, and N. A. Cole<sup>3</sup>, <sup>1</sup>Texas Tech University, Lubbock, TX, <sup>2</sup>University of Arizona, Tuscon, AZ, <sup>3</sup>USDA-ARS-CPRL, Bushland, TX.

Two experiments were conducted at two locations to determine the effects of dietary CP level and source on performance and carcass characteristics of beef steers. British x Continental steers were blocked by BW ( $357 \pm 28$  and  $305 \pm 25$  kg initial BW;  $n=360$  and  $225$ ; four and five pens/treatment in Exp. 1 and 2, respectively). Steam-flaked corn-based diets were arranged in a  $3 \times 3$  factorial with three CP levels (11.5, 13, 14.5% of DM) and three sources of supplemental CP (N basis): 100% urea (U), 50:50 blend of urea and cottonseed meal (B), or 100% cottonseed meal (C). Steers in both experiments were initially implanted with Ralgro and reimplanted with Revalor-S on d 56. Performance and carcass data were pooled over location and analyzed with mixed model procedures using pen as the experimental unit. Crude protein level quadratically affected ADG ( $P < 0.05$ ) and carcass-adjusted (to a common dress) ADG ( $P < 0.10$ ). Increasing the level of supplemental urea linearly increased carcass-adjusted ADG and gain:feed ( $P < 0.05$ ) and carcass-adjusted gain:feed ( $P < 0.001$ ). Dry matter intake was not affected by CP level or source ( $P > 0.10$ ). Dry matter intake was not affected by CP level or source ( $P > 0.10$ ). Hot carcass weight (HCW), longissimus muscle area (LMA), and dressing percent tended to increase linearly with increasing urea level ( $P < 0.06$ ), whereas increasing CP level quadratically affected HCW ( $P < 0.05$ ), with a maximum value at 13% CP. Differences in back fat thickness and yield grade were negligible across treatments. Neither marbling score nor percentage of carcasses grading Choice was affected by CP level or source. Results indicate that increasing CP levels from 11.5 to 13% slightly increased ADG and carcass-adjusted ADG, whereas increasing the proportion of supplemental urea increased carcass-adjusted ADG, gain:feed, carcass-adjusted gain:feed, HCW, LMA, and dressing percent. A CP level above 13% seemed to be detrimental to ADG and HCW.

**Key Words:** Beef cattle, Crude protein, Urea

**434 Processing Methods that Influence Characteristics of Steam-Flaked Corn.** J. J. Sindt\*, J. S. Drouillard, S. P. Montgomery, and E. R. Loe, *Kansas State University, Manhattan.*

We evaluated surfactant (SRF) concentration, tempering (TMP) moisture concentration, duration of steam (STM) conditioning, and flake density (DEN) as variables that potentially influence characteristics of steam-flaked corn. Samples of whole corn ( $n=12$ ; 89% DM; 2 kg/sample) were weighed and placed into individual glass jars (3.785 L). Samples were then tempered in water (6, 10, or 14% added water to achieve 17, 21, and 25% moisture after TMP) containing 0 or 0.67 g/L of SRF and rotated continuously for 2 h at 20° C. Samples were then subjected to STM for either 20 or 40 min in a 12-chamber STM conditioner. After STM conditioning, samples were flaked to a common DEN. This procedure was replicated three times daily using three flake DEN (360, 335, and 310 g/L) and repeated for three consecutive days to complete a  $2 \times 3 \times 2 \times 3$  factorial arrangement of treatments. Samples of corn were collected following TMP, STM, and flaking. As expected, TMP increased (linear,  $P < 0.0001$ ) flaked-corn moisture content, however, moisture content was not altered by SRF ( $P=0.38$ ), STM ( $P=0.17$ ) or DEN ( $P=0.86$ ). Adding the SRF during TMP reduced ( $P < 0.05$ ) the amount of moisture lost from corn between steaming and flaking. In vitro gas production was not affected by TMP ( $P=0.62$ ), SRF ( $P=0.31$ ), or STM ( $P=0.33$ ), however, decreasing DEN increased (linear,  $P < 0.01$ ) the volume of gas produced. Flake durability was tested by tumbling the flakes for 10 min in a commercial durability tester and measuring the amount of flakes

retained on a 9.5 mm screen. Increasing STM duration while increasing TMP moisture concentration increased the proportion of grain retained on a 9.5 mm screen ( $P < 0.05$ ; STM duration  $\times$  TMP moisture interaction). Additionally, decreasing DEN improved (linear,  $P < 0.05$ ) flake durability. Fermentation characteristics are most influenced by DEN, and flake integrity can be improved by increasing TMP moisture and STM duration, or by reducing DEN.

**Key Words:** Steam-flaked corn, Grain processing, Tempering

**435 Effect of full-fat corn germ and vitamin E on performance and carcass characteristics of beef cattle fed finishing diets containing dried-rolled or steam-flaked corn.** S. P. Montgomery\*, J. S. Drouillard, J. J. Sindt, M. A. Greenquist, B. E. Deppenbusch, E. J. Good, E. R. Loe, M. J. Sulpizio, and T. J. Kessen, *Kansas State University*.

Two experiments were conducted to evaluate full-fat corn germ (FFCG) as a fat source in finishing diets. In Exp. 1, crossbred beef steers ( $n = 358$ ; BW = 319 kg) were blocked by previous treatment and assigned randomly to each of four dietary treatments providing six pens per treatment. Treatments consisted of diets containing dry-rolled corn and 35% wet corn gluten feed (DM basis) and 0, 5, 10, or 15% FFCG. Diets were offered once daily for the entire 155-d finishing period. Increasing FFCG decreased ADG (quadratic,  $P < 0.02$ ) (1.29, 1.36, 1.39, and 1.33 kg) and DMI (linear,  $P < 0.02$ ) of steers but increased gain efficiency (linear,  $P < 0.01$ ). Addition of FFCG increased (linear,  $P < 0.04$ ) kidney, pelvic, and heart fat, and USDA Yield Grade. In Exp2, crossbred beef heifers ( $n = 888$ ; BW = 380 kg) were allotted randomly to pens and pens were blocked by date of implanting. Pens were assigned randomly to each of 8 dietary treatments arranged in a  $4 \times 2$  factorial providing six pens per treatment. Treatments consisted of diets formulated to provide no added fat (Control), 4% tallow, (Tallow), or 10% or 15% FFCG on a DM basis with or without 2000 IU of additional vitamin E. Diets were offered once daily for the entire 105-d finishing period. No fat  $\times$  vitamin E interaction was detected ( $P > 0.20$ ). Fat addition decreased ( $P < 0.01$ ) DMI, marbling score and the number of carcasses grading USDA Choice. Effects of Tallow and 10% FFCG were not different ( $P > 0.06$ ). Increasing FFCG decreased (quadratic,  $P < 0.03$ ) ADG (1.29, 1.31, 1.20 kg) and gain efficiency (0.146, 0.154, 0.147 kg gain/kg DMI). Increasing FFCG decreased (linear,  $P < 0.05$ ) DMI, marbling score, and the percentage of carcasses grading USDA Choice. No affect of vitamin E was detected. These data suggest that full-fat corn germ can serve as a supplemental fat source in cattle finishing diets.

**Key Words:** Full-fat corn germ, Fat source, Finishing cattle

**436 Influence of dietary crude protein on potential ammonia emissions from beef cattle manure.** N. A. Cole\*<sup>1</sup>, R. N. Clark<sup>1</sup>, R. W. Todd<sup>1</sup>, C. R. Richardson<sup>2</sup>, A. Gueye<sup>2</sup>, L. W. Greene<sup>3</sup>, and K. McBride<sup>3</sup>, <sup>1</sup>USDA-Agricultural Research Service, Bushland, TX, <sup>2</sup>Texas Tech University, Lubbock, TX, <sup>3</sup>Texas Agricultural Experiment Station, Amarillo, TX.

Atmospheric emissions of ammonia are a growing concern of livestock producers, the general public, and regulators. The concentration and form (rapidly degradable vs. undegradable in the rumen) of CP in beef cattle diets may affect urinary and fecal excretion of nitrogen and thus may affect ammonia emissions from beef cattle feedyards. To determine the effects of dietary CP concentration and degradability on potential ammonia emissions, 54 steers were randomly assigned to nine dietary treatments in a  $3 \times 3$  factorial arrangement. Treatments consisted of three dietary CP concentrations (11.5, 13, and 14.5 percent, DM basis) and three supplemental urea:cottonseed meal ratios (100:0, 50:50, and 0:100 of supplemental N). On three occasions during the feeding period (approximately 35, 75, and 115 d) steers were confined to tie stalls and feces and urine excreted were collected for five d and frozen. One percent of thawed daily urine and feces excretion were mixed and added to polyethylene chambers containing 1,550 g of soil. Chambers were sealed and ambient air was drawn through the chambers at a rate of 1.5 L/min using a vacuum pump. Ammonia in the outgoing air was trapped in a 0.9 M sulfuric acid solution for seven days. Ammonia emissions were highly correlated to urinary N excretion and application [ammonia emissions = 0.723(urine N) - 10.29;  $r = 0.78$ ;  $P < 0.01$ ; ammonia emissions and urine N in mg]. As the CP concentration in the diet increased from 11.5 to 13 percent, potential daily ammonia emissions increased 60 to 225 percent (d 30 and 115, respectively). Ammonia losses for steers fed

the 13 and 14.5 percent CP diets were not significantly different, probably because urinary N excretions were not different. As days on feed increased, in vitro ammonia emissions also increased due to increased urinary N excretion ( $P < 0.01$ ). On days 75 and 115 urinary N excretion and ammonia emissions increased ( $P < 0.10$ ) as the proportion of urea in the supplement increased. This study indicates that dietary CP concentration and degradability may affect daily emissions of ammonia from beef cattle feedlots. However, daily ammonia emissions must be balanced with possible effects on animal performance to determine optimal CP concentrations and forms in finishing diets.

**Key Words:** Beef cattle, Protein, Ammonia

**437 Finishing diets with elevated levels of  $\alpha$ -linolenic acid increase adipose tissue  $\alpha$ -linolenic acid, but do not alter stearoyl Co-A desaturase activity.** S. L. Archibeque\*<sup>1</sup>, D. K. Lunt<sup>1</sup>, R. K. Tume<sup>2</sup>, and S. B. Smith<sup>1</sup>, <sup>1</sup>Texas A&M University, College Station, TX, <sup>2</sup>Food Science Australia, Tin-galpa D. C. Queensland, Australia.

Forty-five Angus steers (358 kg BW) were used in a  $3 \times 3$  factorial, completely randomized block design evaluate the hypothesis that dietary  $\alpha$ -linolenic acid (from corn, corn with flaxseed, or milo) and whole cottonseed (WCS) inclusion (0, 5, or 15% DM) would interact to alter fatty acid metabolism and deposition of conjugated linoleic acid (CLA) in subcutaneous (s.c.) and interfascicular (i.f.) adipose tissues. Lipogenesis from acetate in s.c. adipose tissue was greater ( $P < 0.01$ ) in steers fed flaxseed ( $5.42 \text{ nmol}\cdot\text{h}^{-1}\cdot 10^5 \text{ cells}^{-1}$ ) than in the corn ( $3.10 \text{ nmol}\cdot\text{h}^{-1}\cdot 10^5 \text{ cells}^{-1}$ ) or milo ( $1.92 \text{ nmol}\cdot\text{h}^{-1}\cdot 10^5 \text{ cells}^{-1}$ ) groups. Stearoyl-CoA desaturase activity (SCD) in s.c. adipose tissue decreased ( $P < 0.04$ ) from  $53 \text{ nmol}\cdot\text{mg protein}^{-1}\cdot 7 \text{ min}^{-1}$  in the 0% WCS group to  $20 \text{ nmol}\cdot\text{mg protein}^{-1}\cdot 7 \text{ min}^{-1}$  in the 15% WCS group. The i.f. saturated fatty acid percentages increased ( $P < 0.01$ ) with increasing levels of WCS, and there was a tendency ( $P < 0.09$ ) for a similar effect in subcutaneous adipose. The i.f. cis-9, trans-11 CLA percentage increased with increasing WCS in the steers fed the corn diet, whereas it remained unchanged or even decreased slightly in the steers fed the flaxseed or milo-based diets (interaction,  $P < 0.02$ ). Steers fed flaxseed had a greater ( $P < 0.01$ ) s.c. adipose concentration of vaccenic acid (18:1trans-11) than the steers fed milo and tended ( $P < 0.07$ ) to have greater amount of vaccenic acid than steers fed corn alone. Steers fed flaxseed also had greater ( $P < 0.01$ ) s.c. and i.f. percentages of the  $\alpha$ -linolenic acid (18:3n-3) than steers fed either of the other grain sources, and this effect accompanied a similar increase ( $P < 0.01$ ) in total polyunsaturated fatty acid percentages. Steers fed flaxseed had a larger mean adipocyte volume in i.f. adipose tissue ( $P < 0.01$ ), which tended to be larger in s.c. adipose tissue ( $P < 0.06$ ). The increases in saturated fatty acids in s.c. adipose tissue appear to be a result of the decreased SCD activity in s.c. adipose tissue with increased inclusion of WCS. Increased dietary  $\alpha$ -linolenic acid from flaxseed may have increased s.c. adipocyte volume by stimulating lipogenesis.

**Key Words:** Steers, Adipose metabolism, Linolenic acid

**438 Conjugated Linoleic Acid in tissues from beef cattle fed different lipid supplements.** S. F. Porter\*<sup>1</sup>, T. R. Dhiman<sup>1</sup>, D. P. Cornforth<sup>1</sup>, R. D. Wiedmeier<sup>1</sup>, K. C. Olson<sup>1</sup>, B. R. Bowman<sup>1</sup>, and N. D. Luchini<sup>2</sup>, <sup>1</sup>Utah State University, Logan, UT, <sup>2</sup>BioProducts Inc., Fairlawn, OH.

The objective was to utilize fat supplements mixed with a high-grain ration to increase Conjugated Linoleic Acid (CLA) levels in beef cattle tissue and provide beef that is desirable to the consumer. Sixteen steers and 8 heifers were blocked according to body weight and assigned to 1 of 4 treatments. Animals were fed a TMR consisting of ground barley (78%), alfalfa hay, and corn silage plus 300 g/hd/d of either Megalac<sup>®</sup> (ML) as control, fish oil (FO), partially rumen-protected trans fat (TF), or linseed oil (LO) as a fat supplement mixed into the TMR. Animals were fed for an average of 148 d and then slaughtered between 450 and 590 kg live body weight. At slaughter, muscle and adipose tissue samples were collected from the loin and round and analyzed for fatty acid profile. There was no tissue-by-treatment or site-by-treatment interaction ( $P < 0.05$ ), so all samples were pooled and the overall treatment means were reported. Tissues from TF and LO cattle had higher average cis-9 trans-11 CLA levels than FO and ML treatments ( $P < 0.05$ ). Cis-9 trans-11 CLA levels for ML, FO, TF, and LO were 0.24<sup>b</sup>, 0.26<sup>b</sup>, 0.45<sup>a</sup>, and 0.41<sup>a</sup>, % of total fatty acids, respectively. Trans-10 cis-12 CLA levels

were not different between treatments ( $P < 0.05$ ) and averaged 0.016% of total fatty acids. Color stability tests were performed tri-weekly on top loin steaks for 21 d. By day 7, FO steaks had a higher hue angle (indicating brownness), which continued until day 20 ( $P < 0.05$ ). Neck muscle vitamin E levels in FO were lower than in LO and TF, but not different from ML ( $P < 0.05$ ). Vitamin E values for ML, FO, TF, and LO were 2.35<sup>ab</sup>, 1.58<sup>b</sup>, 3.29<sup>a</sup>, and 2.99<sup>a</sup>, g/kg of neck muscle, respectively. Off-flavor was stronger in FO ( $P < 0.05$ ) according to a trained

taste panel. In the present study, supplementing trans fat and linseed oil increased cis-9 trans-11 CLA levels in beef tissue by 88% and 71% compared to control, respectively. The TF and LO treatments had 108% and 89% higher tissue vitamin E levels than FO, respectively. Feeding fish oil decreased color stability and introduced an off-flavor to the beef.

**Key Words:** Beef, Fat, Conjugated linoleic acid

## Dairy Foods Symposium: Dairy foods research success stories

**439 Dairy foods research success stories.** W. Sandine<sup>1</sup>, C. White<sup>2</sup>, D. Hettinga<sup>3</sup>, J. Hotchkiss<sup>4</sup>, R. Thunell<sup>5</sup>, M. Mangino<sup>6</sup>, and D. Willrett<sup>5</sup>, <sup>1</sup>Oregon State University, <sup>2</sup>Mississippi State University, <sup>3</sup>Land O' Lakes, Inc., <sup>4</sup>Cornell University, <sup>5</sup>DSM, <sup>6</sup>Ohio State University.

This symposium results from the need to remind federal granting agencies and legislators of the economic and social benefits from agricultural research. While research funding from NSF and NIH has increased dramatically since 1990, that for agriculture has decreased, especially for agricultural experiment stations. Examples will be given. Research success stories benefiting this nation will be presented: A brief history of dairy foods research and its contribution to the American way of life; the

dramatic impact of increased market milk shelf life for consumers and industry profits; the value of cheese starter culture media developments to industry and consumers; the defined strain starter culture program for Cheddar cheese plants; carbon dioxide and shelf life extension in cottage cheese for an expanded market; and successful whey research yields new products and eliminates an environmental pollutant. From these and other success stories the 38 member societies of CAST along with N-CFAR and other agencies are developing Fact Sheets to distribute to members of the U.S. congress and administrators to heighten their awareness of needed funding increases for agricultural research.

**Key Words:** Research, Funding, CAST

## Beef Species: Beef cattle performance

**440 Influence of breed on performance and dry matter intake by feedlot bull calves in Brazil.** R. Almeida<sup>1,2</sup> and D.P.D. Lanna<sup>2</sup>, <sup>1</sup>UFPR and PUCPR, PR, Brazil, <sup>2</sup>LNCA-ESALQ/USP, SP, Brazil.

Performance and daily feed intake records from the largest bull test in Brazil were analyzed to determine differences attributable to breed. Postweaning performance of purebred calves was evaluated from seventeen pens, which held 145 Angus, 342 Brangus and 911 Nellore, for a total of 1,398 bulls tested in 2000, 2001 and 2002. Bulls calves arrived at 8 months of age and initial weight of 218 kg, and were fed for 28 days of adaptation and 112 days of test. A high forage diet (50% of DM as concentrate; 14% CP and 67% TDN) typical of Brazilian feedlots was used and monensin included at 27 ppm. Data were analyzed using GLM procedure of SAS. The first data set (performance data) included 1,398 individual records and the second set used 17 pens monitored daily for dry matter intake. Breed type affected weights at 8, 9 ( $P < .01$ ) and 11 ( $P < .05$ ) months, but not ( $P > .05$ ) at 13 months of age (end of feedlot period). Nellore bulls started on test with heavier weights but had the same final weight (13 months) as Angus and Brangus. Breed type also affected ( $P < .01$ ) average daily gain. Brangus and Angus had higher gains ( $1.34 \pm 0.04$  and  $1.27 \pm 0.03$  kg/d) than Nellore bulls ( $1.19 \pm 0.02$  kg/d). Angus and Brangus consumed more feed ( $P < .01$ ) than Nellore calves. During the 112 day-evaluation period intakes for Angus, Brangus and Nellore calves were:  $7.23 \pm 0.12$ ,  $7.19 \pm 0.10$  and  $6.71 \pm 0.06$  kg/day, and  $2.55 \pm 0.05$ ,  $2.49 \pm 0.04$  and  $2.20 \pm 0.02$  of BW, respectively. There were no differences ( $P > 0.05$ ) in feed efficiency among breeds. NRC (1984 and 1996) equations were used to predict DMI. The biases were -0.3, +0.6 and +10.0% for the NRC (1984) and -3.0, -2.1 and +7.2% for the NRC (1996), and for Angus, Brangus and Nellore, respectively. NRC equations overpredicted DMI for *Bos indicus* breeds. New DMI prediction equations for high roughage and purebred Zebu cattle need to be developed and validated.

**Key Words:** Beef cattle, Feed intake, Nellore

**441 Evaluation of yearling bull sale prices at six regional locations.** D. Dean\* and A. Herring, Texas A&M University, College Station.

During the spring of 2001, a seedstock marketing cooperative conducted six sales in CO, IA, ID, MO, and SD. Breeders delivered bulls to locations approximately 150 d prior to sale date; bulls were fed to gain approximately 1.4 kd/d. The purpose of this study was to evaluate specific areas of selection used by commercial producers and their effect on sale prices of yearling purebred bulls. Data on Gelbvieh (GV, n = 675), Angus (AN, n = 65) and Red Angus (RA, n = 50) bulls were analyzed.

Specific traits available included sale price, age-adjusted ultrasound rib-eye area (ADJREAU), age-adjusted ultrasound intramuscular fat percentage (ADJUIMF), age-adjusted ultrasound 12th and 13th rib back-fat thickness (ADJUBFT), actual birth weight (BWT), actual weaning weight (WWT), average daily gain (ADG), ADG ratio, adjusted yearling weight (ADJYW), Frame score (FRAME), scrotal circumference (SC), birth weight EPD (BWTEPD), weaning weight EPD (WWTEPD), yearling weight EPD (YWEPEPD), milk production EPD (MILKEPD), total maternal EPD (TMEPD). AN and RA bulls were combined into one group and analyzed separately from GV bulls. RA EPDs were adjusted to the AN base according to 2001 across breed EPD adjustments. Sale price was analyzed by GLM procedures of SAS with independent variables of sire, with regressions on ADJREAU, ADJUIMF, ADJUBFT, BWT, WWT, ADG, ADG ratio, ADJYW, FRAME, SC, BWTEPD, WWTEPD, YWEPEPD, MILKEPD, and TMEPD. EPDs did not account for differences in sale price for GV bulls. Sire ( $P = 0.0005$ ), BWT ( $P = 0.0288$ ), WWT ( $P = 0.055$ ), ADG ( $P = 0.0386$ ), ADGRATIO ( $P = 0.0159$ ), SCROTAL ( $P = 0.0006$ ) and ADJREA ( $P = 0.0001$ ) affected prices paid by customers buying GV bulls with a slight trend for ADJBACKFAT ( $P = 0.0628$ ). Among GV bulls, sale price difference per unit change of the independent variables BWT, WWT, ADG, ADG ratio, SC, ADJREAU, and BACKFAT were -\$7.79, \$1.09kg, -\$256.88, \$9.95, \$41.71, \$82.66, and \$116.87, respectively. Among ANRA bulls, only ADJYWEPEPD affected ( $P = 0.05$ ) sale prices, with a price per unit change of \$34.24. EPDs were not influential in sale prices of these yearling bulls that had actual performance data reported in sale catalogs.

**Key Words:** Sale prices, Yearling bulls, Performance data

**442 Evaluation of forage sources for finishing diets containing wet corn gluten feed.** C. R. Dahlen<sup>1</sup>, A. DiCostanzo<sup>2</sup>, R. T. Ethington<sup>3</sup>, T. L. Durham<sup>4</sup>, J. E. Larson<sup>2</sup>, and G. C. Lamb<sup>5</sup>, <sup>1</sup>Northwest Research and Outreach Center, University of Minnesota, <sup>2</sup>Department of Animal Science, University of Minnesota, <sup>3</sup>Kansas Feeds, Inc, <sup>4</sup>ADM Corn Processing, <sup>5</sup>North Central Research and Outreach Center, University of Minnesota.

Two hundred twenty-three Angus crossbred steers (308 kg) were used to evaluate effects of various forage sources in diets containing wet corn gluten feed. Steers were assigned by weight and origin to one of sixteen pens (14 or 15 steers/pen). Pens were randomly assigned to one of five dietary treatments. Dietary treatments consisted of diets balanced (1.39 Mcal NE<sub>g</sub>/kg DM; 12.5% CP) using high moisture and dry rolled corn (50:50 DM basis) with one of the following forage sources: corn silage (n = 3), wet corn gluten feed (n = 3), or wet corn gluten feed in combination with corn silage (n = 3), grass-legume hay (n = 3), or both (n = 4). Effects of forage source on performance and carcass characteristics were determined using non-orthogonal contrasts. Steers fed diets containing