M155 A partial budget for change in milking frequency and cow numbers with constrained parlor use. B. Carr[1], M. McGilliard*[1], W. White[1], G. Bethard[2], and R. Pearson[1], [1]*Virginia Polytechnic Institute and State University, Blacksburg,* [2]*G&R Dairy Consulting, Inc., Wytheville, VA.*

A computer spreadsheet was developed to determine the economic advantage of changing cow numbers and milking frequency while maintaining constant hours of parlor use. Input characteristics of the farm included number of milking stalls, employees, and hours of operation for each parlor. Cows in milk were described by number of groups of different sizes, milk yield, body weight, parlor turns per hour, and milking frequency per day. Economic parameters included prices for milk, feed, parlor labor, milking supplies, replacement cows, cull cows, dry cow care, and other marginal costs per cow. Investment costs were included for additional housing facilities and cows purchased for expansion, amortized over 5 and 3 yr (1/cull rate) respectively. A base herd situation can be entered and changes made to it, mostly in terms of number and sizes of cow groups, milking frequency, parlor throughput, and expected milk yield of each group. Scenarios were compared by expected change in net operating income, adjusted for amortized change in capital investment for cows and additional facilities. Expansion costs included cows, housing facilities (priced per cow), and a complement of dry cows. An example herd of 1200 cows in milk, grouped in 5 groups of 240 cows each, was milked twice daily with 4 turns/h in a D-20 parlor in 15 h. To evaluate the consequences of partial 3x milking, one group was reduced to 200 cows (to maintain 15 h/d parlor use) and milked three times daily (+10% milk) with 5 turns/h. Annual milk income decreased by $77,000 while operating expenses decreased by $50,000, replacement cost decreased by $20,000, and amortized cow sales increased by $32,000, for an annual increase of $25,000 in net cash income. Results were particularly sensitive to estimates of milk response and parlor turns per hour from an increase in milking frequency, and were sensitive to cow prices when herd size changed.

Key Words: Management, Milking Frequency, Parlor Throughput

Ruminant Nutrition: Beef Cattle

M156 Effects of replacing corn grain and urea with condensed corn distillers solubles in diets for finishing steers. D. Pingel* and A. Trenkle, *Iowa State University, Ames.*

Corn distillers solubles (CDS) a co-product from the dry mill corn ethanol plants is often available at a low cost. Two experiments were conducted to evaluate CDS when fed to finishing steers replacing a portion of the corn and urea. In Exp I, 96 steers (Angus and Charolais crossbred, 386 kg) were stratified by weight and randomly allotted to 16 pens. The steers were fed dry rolled corn and 5% silage and 5% hay with 0%, 4%, 8%, and 12% CDS (DM basis) for 109 d. Daily feed, gain and feed/gain were 9.1, 9.6, 9.7, and 9.4 (kg/d); 1.75, 1.78, 1.75, and 1.79 (kg/d); 5.21, 5.40, 5.51, and 5.27; for 0, 4, 8, and 12% CDS respectively, and were not statistically different (P>0.05). Carcass traits were not statically different (P>0.05). In Exp II ten beef steers were used in two simultaneous 5x5 Latin squares to evaluate replacing dry rolled corn and urea with 4 and 8% CDS, or 10 and 20% wet corn distillers grain with solubles (WDGS). The steers were placed in digestion crates for total collection of feces and urine during a 5 d period following 14 d of diet adaptation. Dry matter intake, DM digestibility, NDF digestibility, and ADF digestibility were 7.99, 8.73, 8.62 and 8.41, 7.96 (kg/d); 79, 78, 76 and 77, 76%; 53, 52, 44 and 52, 55%; 41, 44, 34, and 48, 48%; for 0, 4 and 8% CDS, and 10 and 20% WDGS, respectively. Replacing corn and urea with distillers co-products did not affect digestibility of the corn-based finishing diet (P>0.05). The results of these studies suggest that corn distillers solubles can replace a portion of the diet in finishing beef steers without affecting digestion, performance or carcass value.

Key Words: Cattle, Distiller's Co-products, Digestibility

M157 Effect of clinoptilolite zeolite on cattle performance and manure nitrogen. D. Sherwood*, G. Erickson, T. Klopfenstein, and D. Schulte, *University of Nebraska, Lincoln.*

Zeolite clay may be effective in reducing N losses from feedlots. A summer feedlot trial was conducted from May to September using 96 crossbred yearling steers (382 ± 7 kg) to evaluate effects of adding clinoptilolite zeolite at 1.2% of the diet on steer performance and N removed in manure. Steers were stratified by weight and assigned randomly to 12 pens and one of two treatments. Treatments were 1) control diet with 0% zeolite clay (CON) or 2) treatment diet with 1.2% clinoptilolite zeolite clay (CZ). Diets consisted of 62.5% dry rolled corn, 25% wet corn gluten feed, 7.5% alfalfa hay and 5% supplement. Nitrogen intake was calculated using analyzed dietary N concentration for each feedstuff and total DMI. Individual steer N retention was calculated using the NRC (1996) net protein and net energy equations. Nitrogen excretion was determined by the difference between N intake and individual steer N retention. Manure N was calculated from the weight of manure hauled and N composition. The percent N recovered was calculated by dividing manure by excreted N. Ammonia emissions were measured weekly during the last six weeks of the feeding period using wind tunnels and an acid trap for 30 minutes in each pen. There were no statistical differences in steer performance between CON and CZ. There was no difference (P=0.61) in ADG between the CON and CZ steers (1.82 vs. 1.79 kg). Gain to feed was not significant (P=0.33) with the CON and CZ steers at 0.145 and 0.138. Nitrogen in manure was not affected (P=0.62) by treatment with 18.2% recovered for CON and 17.2% recovered for CZ. Ammonia emissions were not different (P=0.58) between the CON and CZ pen treatments (53.7 and 59.3 g/hd/d). This trial indicates that feeding clinoptilolite zeolite does not have a negative effect on steer performance. However, N recovery in manure and ammonia emissions was not affected by feeding clinoptilolite zeolite.

Key Words: Cattle, Nitrogen, Emissions

M158 Variation in digestibility of undegradable intake protein among feedstuffs. J. MacDonald*, T. Klopfenstein, and G. Erickson, *University of Nebraska, Lincoln.*

Two ruminally and duodenally cannulated steers fed smooth bromegrass hay (IVDMD=58.4%) were used in a mobile bag analysis to determine undegradable intake protein (UIP), total tract indigestible protein (TTIDP) and UIP digestibility (UIPDIG) values for ingredients used in four growing trials. Three of the trials were grazing studies in which at least two ruminally cannulated heifers were used to collect diet samples of the grazed forage throughout the grazing season. Animals on these studies rotationally grazed smooth bromegrass pastures. Diet samples were collected at two times for trial 1 (T1), three times for trial 2 (T2) and eight times for trial 3 (T3). Other samples used in this analysis were: a commercially available methionine source (MET), corn cobs (COB), bloodmeal (BM), corn gluten meal (CGM), SoyPass® (SP), feathermeal (FM), two sources of dry distillers grains (DDGA and DDGB), sorghum silage (SS) and corn bran ruminally incubated for 21 or 30 hours (Bran21 and Bran30). Other samples were ruminally incubated for 16 hours except for forage samples (COB, SS, and grazed diet samples) which were ruminally incubated for 75% of their mean retention time (20 to 30 hours) as determined by their IVDMD. The UIP (% CP) content for grazed diet samples tended to be different (P=0.07) for samples collected in T1 (18.8 vs. 13.9 ± 1.00), increased quadratically (P=0.02) with time in T2 (8.10, 19.2, and 17.5 ± 1.11) and were not different across time (P=0.17) in T3 (mean=10.7 ± 0.94). The TTIDP (%CP) content of grazed diet samples were different (P=0.04) in T1 (9.05 vs. 6.02 ± 0.81) increased linearly with time (P=0.01) from 3.30 to 10.2 ± 0.94 in T2, and increased linearly with time (P<0.01) from 4.65 to 6.80 ± 0.65 in T3. The UIPDIG (%UIP) did not change with time in any of the three trials (P>0.18) and averaged 51.7 ± 1.82, 49.2 ± 5.40, and 45.1 ± 4.75 for T1, T2, and T3, respectively.

Results for other samples are in table 1. There is large variation in UIPDIG that should be considered when calculating metabolizable protein balances.

Table 1. Protein Digistibility Values for Selected Feedstuffs

Sample	CP (%DM)	UIP (%CP)	TTIDP (%CP)	UIPDIG (%UIP)
MET	47.4	101[a]	34.5[a]	65.9[a]
COB	3.78	91.1[b]	44.1[b]	51.6[b]
BM	84.7	89.5[b]	11.8[cd]	89.6[c]
CGM	70.1	69.7[c]	3.55[e]	94.9[c]
SP	49.7	65.3[d]	2.20[e]	96.6[c]
FM	85.8	60.4[e]	16.4[d]	72.9[d]
DDGA	29.7	55.7[f]	5.52[ef]	90.0[c]
DDGB	31.0	51.3[f]	5.70[ef]	88.9[c]
SS	8.89	19.9[g]	12.6[cd]	36.3[e]
Bran21	14.4	18.6[g]	12.7[cd]	31.3[e]
Bran30	14.4	16.6[g]	10.6[cf]	35.4[e]
SE	—	1.98	1.84	3.38

[abcdefg]Superscripts within column differ (P<0.05).

Key Words: Undegradable Intake Protein, Digestibility, Metabolizable Protein

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M159 Starch digestion by feedlot cattle: Predictions from analysis of feed and feces for N and starch. R. Zinn*, L. Corona, F. Owens, and R. Ware, *University of California, El Centro.*

Data from 32 metabolism trials involving 147 steers and 639 individual starch digestibility measurements were compiled to evaluate the utility of N as a digestion marker to predict total tract starch digestion. All trials were conducted at the University of California Desert Research and Extension Center. Starch digestibility was determined using chromic oxide as an indigestible marker. Animal observations consisted of 10-d for diet adjustment followed by 4-d for collection. During collection, fecal samples (approximately 200 g wet basis) were taken twice daily. Samples from each steer and within each collection period were composited for analysis. Diets contained $46.5 \pm 7.4\%$ starch and $1.85 \pm 0.20\%$ N. Dietary N concentration explained 14.5% of the variation (P < 0.0001) in apparently digestible N as a percentage of N intake (averaging 67.7%), and 72% of the variation (P < 0.0001) in apparently digestible N as a percentage of diet DM (averaging 1.26%). For calculation purposes, total tract N digestion was estimated using the equation of Holter and Reid (1959; digN, % diet DM = 0.929 diet N, % - 0.5568). Fecal starch concentration (FS, %) alone explained 94.7% of the variation (P < 0.0001) in total tract starch digestibility (TSD, %): TSD = 100.5 - 0.651 FS. Total tract starch digestion (ETSDN, %) was calculated from dietary N (DN, %), fecal N (FN, %), dietary starch (DS, %), and FS as follows: ETSDN =100*(DS - (((DN - ((0.929*DN) - .00557))/FN)*FS))/DS. These values explained 97.1% of the variation in TSD (TSD = 1.029 ETSDN - 2.59, P < 0.0001). Omitting cases where TSD was less than 95% so that data was restricted to steam flaked grain, FS explained 82.0% of the variation (P < 0.0001) in TSD (TSD = 99.9 - 0.463 FS) whereas ETSDN explained 91.8% of the variation (P < 0.0001) in TSD. Based simply on dietary and fecal concentrations of starch and N, starch digestibility was reliably determined. This procedure can markedly simplify field measurements of total tract starch digestion to assess grain quality and efficacy of processing (e.g., steam flaking; silage processing).

Key Words: Starch, Digestion, Cattle

M160 Influence of corn vitreousness and processing on site and extent of digestion by feedlot cattle. L. Corona* and R. Zinn, *University of California, El Centro.*

Eight cannulated Holstein steers (251 kg) were used in a split plot design involving two 4 x 4 Latin squares to test effects of processing method [dry rolled (DR) vs steam flaked (SF); main plot], and vitreousness (V, %; sub-plot) of yellow dent corn (V55, V61, V63 and V65) on site of digestion of diets containing 73.2% grain. No V by processing method interactions on ruminal digestion were detected, but ruminal starch digestion was less (14.4%, P < 0.01) while ADF digestion was greater (77%, P < 0.05) for DR than SF. Interactions (P < 0.10) between V and processing method on post-ruminal and total tract digestion were detected. Post-ruminal digestion of OM and starch digestion was greater for the least vitreous DR (V55) sample but no impact of V on digestion was detected with SF corn. Averaged across V, post-ruminal digestion of OM (25.7%, P < 0.05) starch (94.3%, P < 0.10) and N (10.7%, P < 0.01) were greater for SF than for DR corn. Steam flaking increased total tract digestion of OM (11%, P < 0.05), starch (16%, P < 0.01), N (8.4%, P < 0.05), and energy (13.8%, P < 0.05), but decreased total tract ADF digestion (26.7%, P < 0.01). With DR, total tract starch digestion was lower for V65 than for V55 (6.2%) and V63 (5.6%). With SF, total tract starch digestion was not affect by V. Fecal starch (FS) and total tract starch digestion were inversely related (starch digestion, % = 101 - 0.65 FS; r^2 = 0.94, P < 0.01). Ruminal pH was greater for steers fed DR than for steers fed SF (7.3%, P < 0.05). Steam flaking decreased (P < 0.01) the acetate:propionate ratio (55%), and estimated methane production (37.5%). Differences in corn vitreousness can impact site of digestion of corn components, but the impact of vitreousness was minimized or even reversed when corn was flaked.

Key Words: Corn, Vitreous, Digestion

M161 Corn or soybean hull incorporation into haylage-based backgrounding diets; effect on growth and efficiency during the backgrounding and finishing phases. M. Ko*, C. J. Mader, and K. C. Swanson, *University of Guelph, Guelph, Ontario, Canada.*

This experiment was conducted to evaluate the effects of corn or soybean hull incorporation into haylage-based diets on backgrounding calf performance and subsequent feedlot performance. Cross-bred steers (n=48, initial BW=302.5±3.4 kg) were individually fed for ad libitum intake using Calan gates. Dietary treatments included: 1) haylage (17.4% CP, DM basis; control), 2) haylage+20% (DM basis) cracked corn (CC), and 3) haylage+20% (DM basis) soybean hulls (SBH) during a 112-d backgrounding phase. Feed refusals were collected weekly and BW were recorded every 28 d throughout the experiment. During the backgrounding phase, blood samples were obtained every 28 d and analysed for plasma urea nitrogen (PUN). After the backgrounding phase, all steers were adapted to a common high moisture corn-based finishing diet. Steers were slaughtered when ultrasound estimated backfat thickness reached 7 mm. Means were compared using contrast statements (conrtol vs. CC+SBH, CC vs. SBH). During the backgrounding phase, steers fed CC or SBH had greater (P<0.01) average daily gain (ADG), dry matter intake (DMI) and gain:feed (G:F) as compared to controls (0.96, 0.91 vs. 0.55 kg/d; 7.02, 6.95 vs. 6.14 kg/d; 0.13, 0.13 vs. 0.08, respectively). Steers fed CC or SBH had lower (P<0.01) PUN concentration as compared to controls (12.8, 12.8 vs. 13.7 g/dl). ADG, DMI and G:F did not differ between steers fed CC or SBH. During the finishing phase, steers fed SBH had lower (P<0.07) ADG and finished BW than steers fed CC (1.59 vs. 1.76 kg/d; 617.9 vs. 648.7 kg). DMI (10.9 kg/d), G:F (0.16) and days required to finish (139 d) did not differ between steers fed CC or SBH. Including CC or SBH at 20% of the diet in haylage-based backgrounding diets improved growth performance suggesting that either CC or SBH could be included to improve growth and efficiency. However, when finished on a common high-concentrate diet, steers previously fed CC had greater ADG than those fed SBH suggesting that source of supplemental energy during the backgrounding phase may influence subsequent feedlot performance.

Key Words: Beef Cattle, Growth Performance, Energy Supplementation

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M162 Withdrawn.

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M163 Energy required by beef calves was more accurately predicted by effective energy than net energy calculations. J. W. Golden* and M. S. Kerley, *University of Missouri, Columbia.*

The efficiency in which cattle use nutrients for tissue accretion influences profitability in the feedlot. Individual feed intake measurements in group-fed cattle has allowed measurement of the feed conversion ratio (FCR) phenotype. Realized from this phenotypic measurement was the genetic variation among animals and the moderate heritability of this trait. This genetic variation has resulted in the development of expected progeny differences and targeting genetic markers to guide selection for this trait. Interestingly, less emphasis has been placed on targeting nutritional management strategies that impact FCR, even though optimizing rumen degradable protein (RDP) and absorbable amino acids (IAA) in the diet has been shown to improve FCR. To understand how nutritional modifications impact FCR, it is imperative that energy expenditure can be accurately calculated. The net energy system (NE) was not capable of characterizing the measured FCR in cattle (n = 14 animals per treatment) fed diets balanced for RDP and IAA. However, characterization of energy expenditures by the effective energy (EE) system agreed with measured FCR and growth data in calves. When maintenance energy expenditure was corrected for calculated vs measured values (EE_{adj}), measured FCR was in agreement with effective energy calculations of energy requirements. In this experiment EE calculations agreed with FCR and actual energy intake measurements whereas NE calculations underpredicted energy requirement for maintenance and/or growth.

Diet[1]	BMN	BMH	SBM-PF	SBM-H
NE[2]	0.63	0.75	0.82	0.83
EE[3]	0.9	1.03	1.04	1.05
EE_{adj}[4]	0.98	1.13	1.15	1.15
FCR	3.9	4.8	5.1	5.0
BWI (kg)[5]	313	317	329	328
BWF (kg)[6]	501	474	420	488
ADG (kg)	2.2	1.9	1.7	1.9

[1]Corn-based diets with bloodmeal (BM) and no hay (BMN), BM and 10% hay (BMH), soybean meal (SBM) and hay pair fed to BMN (SBM-PF), or fed ad lib (SBM-H). [2]NE consumed:NE required. [3]EE consumed: EE required. [4]Adjusted EE maintenance. [5]Initial body weight. [6] Final body weight

M164 Evaluating the prediction of dry matter intake and average daily gain in backgrounding cattle. M. S. Whetsell*[1], E. B. Rayburn[1], J. P. S. Neel[2], J. P. Fontenot[3], and W. M. Clapham[2], [1]*West Virginia University, Morgantown,* [2]*United State Department of Agriculture- Agriculture Researchg Service, Apalachian Farming System Research Center, Beaver, WV,* [3]*Virginia Tech, Blacksburg.*

On a farm, historical experience is used to develop a forage-livestock system considered the optimum for the farm by the farmer. Computer models allow extension staff and farmers to evaluate alternative farming systems or system components without investment of capital or exposure to risk. In this study we evaluated the accuracy of the 2000-update National Research Council "Nutrient Requirements of Beef Cattle" computer model for predicting calf performance during backgrounding. Seventy-two British or British cross stocker steers were used to measure performance during the fall 2001 and spring 2002 in Morgantown, West Virginia. The calves were randomly assigned to one of the three forage based wintering diets, designed to provide three distinct production levels (0.25, 0.50 and 0.75 kg per animal). The treatments were timothy hay supplemented with soybean meal or soybean meal and soybean hulls at two different levels. The National Research Council model was used to predict average daily gain (ADG) of the cattle using dry matter intake (DMI) calculated using the NRC 2000 calf DMI equation and also the observed DMI. Model DMI error was measured by calculating the model DMI residuals, the difference between predicted DMI minus observed DMI. Model error was also measured for ADG. Results showed that the predicted DMI was similar to that observed and slightly lower than that predicted by the calf DMI equation based on ration NEM ($P<0.001$). However, ADG using either equation (estimated DMI

or observed DMI) was about 0.3 kg animal[-1] day^{-1} lower than observed ADG ($P<0.001$). Results indicate that the model did not accurately predict animal performance of the cattle on feed but it did predict the increase in performance across treatments as energy content of the diet increased.

M165 Application of Lineweaver-Burk data transformation to explain animal and plant performance as a function of nutrient supply. R. P. Lana*[1,2], R. H. T. B. Goes[3], L. M. Moreira[1], A. B. Mâncio[1], and D. M. Fonseca[1], [1]*Universidade Federal de Viçosa-DZO, Viçosa, MG, Brazil,* [2]*CNPq, Brasília, DF, Brazil,* [3]*Universidade Estadual de Maringá, Umuarama, PR, Brazil.*

The efficiency of using concentrate supplements on daily weight gain of growing cattle under tropical pasture during the dry season and nitrogen fertilization on growth rate of tropical pasture (ton of dry herbage mass/hectare/110 days) and consequently stocking rate and cattle growth rate exclusively under pasture during the rainy season (kg of body weight gain/hectare/110 days) were evaluated. The animal and plant responses to the increasing amount of nutrient supply were curvilinear and were related to the saturation kinetics typical of enzymatic systems; therefore, the animal and plant growth rates follow a Michaelis-Menten relationship. The Lineweaver-Burk data transformation efficiently explained the animal and plant responses to the nutrient supply. This methodology consists in evaluating linear regressions of the reciprocal of animal and plant responses as a function of the reciprocal of nutrient supply. The half maximum plant and animal growth rate responses to the nutrient supply were verified with 5.3% nitrogen fertilization and 5.6% concentrate ration supplementation, respectively. From the curvilinear response, it can be verified that the marginal increase in animal and plant growth rate reduce as the amount of nutrient supply increase. The 1996 beef NRC, based on the Californian net energy system and the metabolizable protein system, does not consider the curvilinear relationship of animal growth rate as a function of concentrate supply, for both energy and protein. Therefore, more research needed to be done to better understand this effect, because of its economical and environmental importance.

Key Words: Cattle, Michaelis-Menten, Pasture

M166 Screening for the effects of natural plant extracts at two pH levels on in vitro rumen microbial fermentation of a high-concentrate beef cattle diet. P. W. Cardozo[1], S. Calsamiglia*[1], A. Ferret[1], and C. Kamel[2], [1]*Universidad Autonoma de Barcelona, Bellaterra, Spain,* [2]*Axiss France SAS, Bellegarde-sur-Valserine, Cedex, France.*

Six natural plant extracts and 3 secondary plant metabolites were tested at 5 doses (0, 0.3, 3, 30, and 300 mg/L) and 2 levels of pH (7.0 and 5.5) in a duplicate $9 \times 5 \times 2$ factorial arrangement of treatments to determine their effects on in vitro microbial fermentation using rumen fluid from heifers fed a high concentrate finishing diet and incubated for 24 h at 39 C. Treatments were: extracts of garlic (GAR), cinnamon (CIN), yucca (YUC), anise (ANI), oregano (ORE), and capsicum (CAP), and pure cinnamaldehyde (CDH), anethole (ATL) and eugenol (EUG). Each treatment was tested in triplicate and in two periods. Samples were collected for ammonia N and volatile fatty acid (VFA) concentrations. Differences were declared at P < 0.05. The high doses of all plant extracts decreased total VFA concentrations in both pH. When pH was 7.0, ATL, GAR, CAP and CDH reduced total VFA concentration, and ANI, ORE, CIN, CAP and CDH increased the acetate to propionate ratio. The CIN, GAR, CAP, CDH, ORE, and YUC reduced, and EUG, ANI and ATL increased ammonia N concentration. The effects of plant extracts on the fermentation profile when pH was 7.0 were not favorable for improving the efficiency of rumen microbial fermentation. In contrast, when pH was 5.5, no changes (ATL, ANI, ORE, and

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CIN) or increases (EUG, GAR, CAP, CDH and YUC) in total VFA were followed by lower acetate to propionate ratio (ORE, GAR, CAP, CDH, and YUC) which would be favorable for beef production. Ammonia N (ATL, ANI, CIN, GAR, CAP, and CDH) and BCVFA (ATL, EUG, ANI, ORE, CAP, and CDH) concentrations were also reduced, suggesting that deamination was inhibited. Results indicate that the effects of plant extracts on rumen fermentation in beef cattle diets may differ depending on rumen pH. When pH was 5.5 GAR, CAP, YUC and CDH can alter rumen microbial fermentation in favor of propionate, more efficient in terms of energy.

Key Words: Rumen pH, Fermentation, Plant Extracts

M167   Treatment of ground wheat with tannins: Effects on VFA production during in vitro ruminal incubation. T. F. Martinez[1,2], Y. Wang[1], T. Reuter*[1], and T. A. McAllister[1], [1]*Agriculture and Agri-Food Canada Research Centre*, *Lethbridge, AB, Canada*, [2]*Departamento de Biologia Aplicada, Universidad de Almeria, Almeria, Spain.*

The potential for condensed (CT) and/or hydrolyzable (HT) tannins to improve ruminant utilization of protein from starchy, high-concentrate feeds, as has been observed with forages, was studied in vitro. Ground wheat (1.0-mm sieve) was pretreated with 0 (as a control, CON) or 50 g/kg DM of commerically available Quebracho extract (as a source of CT) or tannic acid (as HT), freeze-dried, and incubated at 39°C for up to 48 h in ruminal inoculum (strained ruminal fluid + two volumes of anaerobic salts solution). Gas production and VFA accumulation in 125-mL serum vials (200 mg substrate + 20 mL inoculum, plus blanks containing inoculum only) were determined (n = 3). Tannins markedly reduced ($P = 0.033$) accumulation of VFA during the first 12 h of incubation, from 39.9 mM at 0 h to 124.3, 104.3 and 91.6 mM in CON, CT and HT, respectively. Moderate ($P = 0.61$) inhibition of VFA production by tannins was evident at 24, 36 and 48 h. From 0 to 12 h, the acetate:propionate ratio decreased from 4.5 to 2.6 in CON, compared with lesser reductions of 4.5 to 3.3 with CT ($P = 0.021$) and 4.5 to 3.8 with HT ($P = 0.001$). At 24 h, treatment effect on A:P was present but diminished (HT > CT > CON; $P < 0.05$), and at 36 and 48 h, it was no longer evident ($P = 0.781$). Initial effects on A:P (4 to 24 h) were more pronounced with HT than CT ($P < 0.05$). Tannins (CT and HT) decreased branched-chain fatty acid (BCFA) concentrations by 56.8 to 73.9% ($P = 0.009$) at all time points. The observed alterations in VFA production (18% decrease in acetate and 40% decrease in propionate, particularly during the first 12 h of incubation, and markedly decreased BCFA accumulation throughout the 48 h) suggest that CT and HT applied to ground wheat substrate suppressed protein hydrolysis in vitro, and may have value for regulating ruminal hydrolysis of readily fermentable cereal grains fed to livestock.

Key Words: Condensed Tannin, Concentrate Feed, In Vitro Fermentation

M168   Effect of mixed culture of *Lactobacillus paracasei* and *Lactobacillus lactis* and their fermentation products on ruminal fermentation of a barley grain/barley silage diet. Y. Wang*, J. Baah, L. J. Yanke, and T. A. McAllister, *Agriculture and Agri-Food Canada Research Centre*, *Lethbridge, AB, Canada*.

Two in vitro experiments were conducted to evaluate the effects on ruminal fermentation of a mixed culture of *Lactobacillus* spp. marketed as a direct-fed microbial for cattle. Ground barley grain/barley silage-based backgrounding (BKG) and finishing (FIN) diets were used in Exps. 1 and 2, respectively, both as substrates for the incubations and as feed for ruminal fluid donor cattle. Inoculum was ruminal fluid diluted with two volumes of mineral buffer. In 125-mL serum vials (15 per treatment; triplicates per time point), 40 mL inoculum were added to 300 mg of substrate, together with a liquid formulation containing *L. paracasei* and *L. lactis* cultures (4.6×10^7 cfu/mL) and their fermentation products (RE3®; Basic Environmental Systems and Technology Inc. Sherwood Park, AB). The RE3® was added at 0, 1.2, 2.4, 3.6, or 4.8 μL/vial, and autoclaved RE3® was also added at 2.4 μL/vial. One set of vials containing inoculum only was also incubated and assayed for correction of measured val-

ues. Gas production was measured periodically over 48 h, as well as apparent DM disappearance (DMD) and accumulated VFA after 0, 6, 12, 24 and 48 h of incubation at 39°C. The variables measured were all numerically greater with FIN than with BKG. With BKG, gas production and DMD were unaffected by RE3® at any level; with FIN, DMD was increased ($P < 0.01$) by RE3® at ≥2.4 μL/vial, and by autoclaved RE3® at 2.4 μL/vial. Including RE3® in the incubation increased total VFA at 6 h and 12 h (both $P < 0.001$) with BKG, and at 12 h ($P = 0.03$) with FIN. Acetate:propionate ratios at 24 h were higher with RE3® than without, both with BKG ($P < 0.001$) and with FIN ($P = 0.004$). Greater VFA concentrations at 24 h suggests that the mixed microbial product improved in vitro ruminal fermentation of barley grain/barley silage-based diets.

Key Words: Direct Fed Microbial, Volatile Fatty Acid, Cattle

M169   Effect of Lactobacilli on performance and carcass characteristics of finishing beef steers. J. Baah*, Y. Wang, D. J. Gibb, L. J. Yanke, F. H. Van Herk, and T. A. McAllister, *Agriculture and Agri-Food Canada Research Centre*, *Lethbridge, AB, Canada*.

The effects of feeding a mixed culture of *Lactobacillus paracasei* and *Lactobacillus lactis* (Basic Environmental Systems and Technology Inc., Sherwood Park, AB) to finishing cattle was assessed using 100 individually fed Hereford × Angus steers in a 140-d trial. The steers (378 ± 4.5 kg; mean BW ± SE) were balanced by weight and allocated to four dietary treatments, in which a barley-based diet (76% grain, 20% silage, 4% supplement; DM basis) was supplemented with the direct-fed microbial (DFM) at levels of 0 (T1, control), 40 (T2), 80 (T3), or 120 (T4) million cfu/kg (as-fed). The steers had ad libitum access to feed and water, and were weighed every 28 d. Data were analyzed using the MIXED models procedure, with linear and quadratic effects of DFM tested by orthogonal contrasts. Average 28-d calculations of DMI, ADG, and G:F did not differ ($P > 0.10$) among treatments, except from d 29 to 56, when ADG was greater ($P = 0.036$) for groups T2 and T4 than for the controls (1.92 and 1.91 kg, respectively, vs. 1.72 kg), and G:F was improved in group T2 (0.166 vs. 0.139; $P = 0.062$). Overall DMI averaged 10.96 kg/d and was similar ($P = 0.15$) across treatments, but ADG (d 1 to 140) was lower ($P = 0.07$) for steers in T4 (1.56 kg) than for those in T1, T2, or T3 (average of 1.66 kg). The T4 steers also had poorest ($P = 0.004$) overall G:F (0.132 vs. 0.143, averaged across T1, T2 and T3). Overall ADG and G:F were better ($P < 0.10$) in group T2 than in group T4, but neither of these differed from T1 or T3. Carcass weight and grade, dressing percentage and marbling score were unaffected ($P > 0.1$) by treatment, but saleable meat was lower ($P = 0.04$) from steers fed DFM (average 56.4%) than from controls (59.4%). Feeding the mixed *Lactobacillus* culture at the lower dose (40 million cfu/kg) improved ADG and G:F during the first 56 d of the finishing period, but there may not be any economic benefit to feeding the product for the entire 140 d.

Key Words: Direct Fed Microbial, *Lactobacillus*, Cattle

M170   Withdrawn.

M171   Evaluation of the incidence of liver abscess in feedlot cattle fed a dietary antioxidant (Agrado®). M. Vazquez-Anon*[1], F. Scott[1], B. Miller[1], and T. Peters[2], [1]*Novus International, Inc*, *St Louis, MO*, [2]*Dekalb Feeds, Rock Falls, IL.*

Liver abscesses commonly occur in feedlot cattle when fed a finishing diet and is associated with lower performance. Four studies were conducted using over 50,000 feedlot cattle to evaluate the effect of feeding the antioxidant 6-ethoxyl-1, 2, 2, 4-trimethylquinoline (Agrado® feed antioxidant) on the incidence of liver abscesses. Study 1: At OSU, 75 crossbred steers (326 kg BW) were fed a ground corn diet with 0 or 135 PPM of Agrado (DM basis) the last 28 d prior to harvest. The incidence of liver abscesses was low for all cattle, but was 34% lower (4.4% vs. 6.7%) for those fed with Agrado. Study 2: At CRF, Lamar, CO, 128 crossbred yearling steers (350 kg BW) were fed a steam-flaked corn diet

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with 0 or 150 PPM of Agrado (as-fed basis) for the last 123 d prior to harvest. The incidence of liver abscesses was 25% lower for cattle supplemented with Agrado (14.06% vs.18.75%). Study 3: At Texas Research Feedlot Inc, 1991 beef steers (566 lb BW) were fed a steam flaked corn with none, 125 IU vit E/ day or 125vit E +150 PPM Agrado during the finishing phase. Incidence of liver abscess in cattle fed 125 IU vit E was slightly reduced from 13.8 to 12.0%, but was further reduced to 10.2% when fed 125 IU vit E+150 PPM Agrado. Study 4: Liver abscess from 485 beef cattle raised in 9 feedlots fed daily with 500 IU vit E + 150 PPM Agrado during the finishing period were compared to 803 beef cattle raised in 12 feedlots fed daily with 1000 IU vit E. Incidence of liver abscess in groups of cattle fed Agrado averaged 4.9% and ranged from 0 to 7.5% and cattle not fed Agrado averaged 20.5% and ranged from 0 to 37%. Therefore, cattle with diets containing Agrado had 15.3% less liver abscesses than those fed diets not treated with Agrado. From the results of the four studies, the addition of antioxidants such as Agrado to feedlot cattle diets appears to reduce the incidence of liver abscesses.

Key Words: Antioxidants, Agrado®, Liver abscess

M172   Response by steers fed high-forage diets to oral doses of a polyclonal antibody preparation against *Streptococcus bovis* on target bacteria populations and rumen fermentation products. N. DiLorenzo*, R. K. Gill, F. Diez-Gonzalez, J. E. Larson, and A. DiCostanzo, *University of Minnesota, St. Paul.*

Five rumen cannulated steers were used in a Latin square design to test effects of an avian-derived polyclonal antibody preparation against *Streptococcus bovis* (PAPSb) on rumen counts of target bacteria and fermentation products. Steers were fed a common diet comprised (DM basis) of 96% corn silage and 4% supplement (supplied 300 mg monensin/hd/d). Diet supplied 0.91 Mcal NEg/ kg DM, 11% CP, 0.65% Ca, and 0.35% P. The PAPSb was top-dressed in increasingly concentrated doses (0, 2.5, 5.0, 7.5 or 10 ml PAPSb/hd/d) once daily at 0900 for 7 d. Samples were collected on the 7th d, and steers were permitted to consume a common diet without treatment for 10 d before initiating the next treatment period. Rumen fluid samples were collected pre-feeding, and at 0.5, 2 and 4 h post-feeding for *S. bovis* enumerations, pH and VFA measurements. There was a cubic response ($P < 0.05$) by counts of *S. bovis* to increasing doses of PAPSb. Reductions ($P < 0.05$) in rumen *S. bovis* counts were observed when feeding 2.5, 7.5 or 10 ml PAPSb/hd/d, but not when feeding 5.0 ml PAPSb/hd/ d. An interaction between PAPSb dose and sampling time was observed ($P = 0.10$) for rumen *S. bovis* counts. Feeding 7.5 ml PAPSb/hd/d reduced ($P < 0.05$) *S. bovis* counts at 2 h post-feeding; feeding 2.5 ml PAPSb reduced ($P < 0.05$) *S. bovis* counts at 0.5 and 2 h post-feeding; and feeding 10 ml PAPSb reduced ($P < 0.05$) *S. bovis* counts at all sampling times. Feeding PAPSb had no effect ($P > 0.05$) on DMI, rumen pH, VFA or lactate or their molar proportions. Rumen pH decreased ($P < 0.05$) while rumen butyrate, acetate and the acetate: propionate ratio increased ($P < 0.05$) over time ($P < 0.05$). Results indicate that an avian polyclonal preparation against *S. bovis* reduced target bacteria populations without further effects on rumen fermentation products.

Key Words: *Streptococcus bovis*, Steer, Antibodies

M173   Effect of receiving diet on early feedlot health, growth performance and subsequent carcass traits of Angus X Continental cross steer calves. P. Walker*[1], K. Earing[2], J. Ringler[2], A. Antas[3], and R. Hall[4], [1]*Illinois State University, Normal,* [2]*University of Kentucky, Lexington,* [3]*University of Illinois, Urbana,* [4]*Animal Feed and Nutrition Consulting, Richmond, IN.*

One hundred seventy-six Angus-Continental crossbred steers (mean wt. = 264±10.3kg) were assigned to 24 pens containing 6 or 10 steers per pen in a randomized complete block design (BW) consisting of a 4 x 3 factorial arrangement (4 dietary treatments in each of 3 blocks) to evaluate the influence of four receiving diets on pre-finishing performance and subsequent finishing performance, and carcass characteristics. The receiving diets consisted of mixed grass

hay (brome, orchard and blue grass) fed ad libitum and a supplement fed at 1% BW containing either wheat midds and soy hulls (D1), corn gluten feed and ground shelled corn (D2), corn gluten feed and soy hulls (D3) or corn gluten feed (D4). The receiving period (P1) was 53d. The steers were harvested following a finishing period (P2) of either 195d or 204d. All steers were fed the same shelled corn-soybean meal-corn silage based diet ad libitum during P2. Diet 1 contained 14.7% CP, 2.8% ether extract (EE), 52.8% NDF and 25.9% ADF. Diet 2 contained 15.2% CP, 4.4% EE, 32.6% NDF and 8.7% ADF. Diet 3 contained 14.1% CP, 3.4% EE, 60.8% NDF and 36.8% ADF. Diet 4 contained 24.0% CP, 4.3% EE, 35.5% NDF and 12.1% ADF. The P2 diet contained 15.6±3.2% CP, and 10.2±4.8% ADF. No differences (P>0.05) between dietary treatments were observed in number of steers treated for respiratory disease during P1 though the D1 and D3 steers had more numeric pulls for medicinal treatment than D2 and D4 steers. No significant differences were observed between dietary treatments for ADG, ADFI, DMI or G:F during P1. No differences (P>0.05) in P2 ADG, ADFI, DMI, G:F or any of the carcass traits were observed. Supplementing grass hay receiving rations with various combinations of wheat midds, soy hulls, corn gluten feed and ground shelled corn can result in similar steer performance during the receiving period with no effect on finishing performance or carcass characteristics.

Key Words: Receiving Rations, Corn Gluten Feed, Soy Hulls

M174   Efficiency of use of concentrate ration for growing animals, under tropical pastures. R. H. T. B. Goes*, R. P. Lana, A. B. Mancio, and D. D. Alves, *Universidade Federal de Viçosa-DZO, Viçosa, MG, Brazil.*

The effect of supplementation of tropical pasture (Brachiaria brizantha cv Marandu) was evaluated, considering the performance and the efficiency of the use of concentrate by growing animals. Fifty-five steers, with initial weight of 226 kg, were distributed in five paddocks of five hectares. The treatments were based on increasing supplies of supplements based on corn and soybean meal (0, 0.35, 0.70, 1.40 and 2.90 kg of supplement containing 24% CP/animal/ day). The supplement levels affected positively the average daily gain of the animals, presenting a curvilinear behavior ($y = 0.7919x^2 + 1.1906x + 0.3162$, $r^2=0.71$); but the response was only in the order of 0.10 kilo of gain per each kilo of supplement. The following linear equation of the reciprocal of daily gain (y) as a function of the reciprocal of supplement level (x) was obtained: $y = 0.2639x + 1.3268$, $r^2 = 0.97$. The lowest level of supplementation presented the best result with a conversion of 1.5:1 (kg of supplement/kg of gain). By altering the level of supply from 1.40 to 2.90 kg/animal/day the conversion became 36:1. The maximum response to the supply of nutrients for weight gain (ADGmax) was of 0.75 kg/animal/day (ADGmax = $1/a = 1/1.3268$), and the amount of supplement for the animals to respond with 50% of this gain (0.38 kg/day) was 0.20 kg/day (SUPL50%ADG = $b/a = 0.2639/1.3268$). More research is necessary to understand the effects of the increasing supplementation of nutrients for growing animals under tropical pastures.

Key Words: Cattle, Growth Rate, Tropical Weather

M175   A computing system for adjustment and simulation of growth models and estimation of nutrient requirement for grazing Brahman cattle. M. Pereda-Solís[1], S. González*[2], E. Arjona-Suárez[2], G. Bueno-Aguilar[2], and G. Mendoza-Martínez[2], [1]*Universidad Juárez del Estado de Durango, Durango, Durango, México,* [2]*Colegio de Postgraduados, Montecillo, Estado de México, México.*

Mathematical models have been used to analyze and predict growth patterns for cattle. A computing system that allows adjustment and simulation of growth models, as well as an estimation of nutrient requirement for Brahman cattle grazing in the humid tropics (Aldama municipality, State of Tamaulipas, Mexico), was developed in our study. The models used are representative of those reported in the literature and may require one to four parameters for their adjust-

ment. Our system was developed using Visual Basic 6.0 under Windows 98. Also, NRC prediction equations for cattle were applied to the growth simulation, in order to calculate intake of DM, NE for gain, Ca and P, emphasizing diet nutrient supply and cattle requirement. Data for birth season (dry or rainy), body weight changes and feeding (Stargrass pastures) for 100 female and 68 male Brahman cattle (first 365 d of age), were obtained from the Mexican Association of Zebu Breeders (Tampico, Tamaulipas). The data were used to adjust four models utilizing Richards equation (Richards, F. J. 1959. A flexible growth function for empirical use. J. Exp. Bot. 10:290-300) and a residual analysis. Calculation of nutrient requirement to obtain the estimated growth for Brahman cattle, was performed with those models. After 120 d growth curves changed according to sex and birth season, and BW gain was larger for males born in the rainy season. Pattern of nutrient requirement showed a shape similar to that of cattle BW calculated with the adjusted models. A posteriori management of estimated results makes a difference between our computing system and others. Results from this study suggest that our system might be a useful tool for analyzing factors affecting productive efficiency, as well as for sensitivity analysis of nutrients required to obtain estimated growth, for grazing cattle in tropical pastures.

Key Words: Simulation and Growth Models, Grazing Brahman, Humid Tropics

M176   Quantitative assessment of visceral energy metabolism in beef steers consuming graded levels of forage. N. Elam*, C. Taylor, S. Kitts, K. McLeod, D. Harmon, and E. Vanzant, *University of Kentucky, Lexington.*

Eight multi-catheterized Angus steers (328 ± 40 kg BW) were used to determine the relationship between forage ME supply and visceral metabolism. Experimental design consisted of a replicated 4 x 4 Latin square with four equally spaced forage intakes which provided ME ranging from 0.117 to 0.234 Mcal ME • (kg $BW^{0.75}$ • d)$^{-1}$, approximately 1 to 2 x maintenance energy requirements. Experimental periods were 28-d, and on d 27 or 28 simultaneous arterial, portal, and hepatic blood samples were obtained hourly for 6 h. Blood flows (**BF**) across the portal drained viscera (**PDV**) and hepatic (**HEP**) tissue beds were determined by continuous infusion of P-aminohippurate. Net nutrient flux and oxygen consumption were calculated as the product of BF and venous-arterial concentration differences. Heat production (**HP**) was calculated as 4.89 Kcal/L O2 consumed. Regression analyses were performed to test the effects of ME intake (**MEI**) on visceral energy metabolism. Linear, quadratic and cubic models were fitted using the maximum r^2 selection process. In all instances, quadratic and cubic functions were not significant and were subsequently removed from the model. Metabolizable energy intake accounted for 46, and 32% of the total variation in PDV, and HEP BF, respectively. Moreover, MEI accounted for 52, 39, and 56% of the total variation in PDV, HEP, and total splanchnic (**TS**) HP, respectively. Net nutrient fluxes of glucose, lactate, glutamate, and glutamine across the PDV, HEP, and TS vascular beds were not affected ($P \geq 0.28$) by MEI. These data indicate that both BF and HP by visceral tissues of beef steers fed a forage diet are a function of the level of dietary intake.

Effect of level of metabolizable energy intake on blood flow and visceral heat production

Item[a]	Regression Equation	b_0	b_1
PDV BF	162.09 + MEI(37.56)	0.105	<0.0001
HEP BF	437.72 + MEI(23.21)	0.003	0.029
PDV HP	0.375 + MEI(0.181)	0.369	<0.0001
HEP HP	0.951 + MEI(0.125)	0.101	0.013
TS HP	1.692 + MEI(0.269)	0.063	0.001

[a]PDV = Portal Drained Viscera; HEP = Hepatic; TS = Total Splanchnic; BF = Blood Flow; HP = Heat production

Key Words: Forage Intake Level, Visceral Metabolism, Heat Production

M177   Effect of alternate diets containing corn straw or corn silage as roughage on growth performance of growing bull calves. R. Barajas*[1], B. J. Cervantes[1], R. J. Virgilio[2], J. C. Barraza[1], and P. A. Castro[2], [1]*FMVZ-Universidad Autonoma de Sinaloa, Culiacan, Sinaloa, Mexico,* [2]*Tecnologia de Maxima Produccion, S.A. de C.V., Culiacan, Sinaloa, Mexico.*

To determinate the effect of alternate diets containing corn straw or corn silage as roughage on growth performance of growing bull calves, sixty bull calves (Brahman crosses; BW = 207.1 ± 2.7 kg) were used in a 97 feeding experiment. On day 1 the animals were weighed and in agreement with a complete randomized experiment design, in groups of five, were placed in 12 ground pen (6 x 12 m), and randomly designated to one of three treatments: 1) Fed growing diets containing corn straw as roughage (CTR); 2) Fed growing diets containing corn silage as roughage (SL); and 3) Fed straw-diets during the first 28 days and then switched to corn silage-diets (SS). The diets were similar in NEm and CP content. Ending weight (d 97) of SS calves was 5.8% higher (P = 0.03) than others treatments (346, 342 and 363 kg by CTR, SL and SS, respectively). ADG of complete experiment tended (P = 0.10) to be higher for SS respect to SL (1.40 vs. 1.59 kg/d). Silage diets diminished (P < 0.01) DMI respect to CTR. SS diets enhanced (P = 0.05) in 15% feed/gain ratio respect to CTR (5.65 vs. 4.91). SS had the highest NEm (P = 0.02) retained from the diet (1.73, 1.86, and 1.95 Mcal/kg by CTR, SL and SS, respectively). Usage of NEm (Observed/expected ratio) was 11% higher (P = 0.02) for SS (1.10) respect to CTR (0.99), both treatments were not different (P > 0.10) to SL (1.04). NEg of SS was higher (P = 0.02) than CTR, and similar (P > 0.10) to SL. It is concluded, that feeding corn straw-based diet by 28 days and switching to corn silage-based diets, improves the performance of growing bull calves.

Key Words: Corn Silage, Growth Performance, Bull Calves

M178   Effect of feed restriction during the growth phase on performance of Aberdeen Angus steers fed different concentrate levels during finishing. E. R. Prates*[1], J. R. P. Rosa[1], J. Restle[2], J. Lopez[1], J. O. J. Barcellos[1], and L. F. G. Menezes[1], [1]*Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil,* [2]*Universidade Federal de Santa Maria, Santa Maria, RS, Brazil.*

The objective of the work was to evaluate the effect of feed restriction during growth on the performance of Angus steers fed different concentrate levels during the finishing period. The experiment was conducted 2 phases: growth in pastures (84 days) and finishing in feedlot (84 days). Thirty-two yearling steers were used (240 kg live weight) and randomly assigned to two treatments - cultivated pasture or native pasture (growth phase) - after which the steers were designated at random to one of the four diets (25, 40, 55 and 70% of concentrate in the diet based in corn silage). The experimental design was a factorial 2 x 4 arrangment (2 feeding systems x 4 concentrate levels) with four replicates per treatment. Data were analyzed (ANOVA & Tukey) using the SAS package. During the growth phase steers in the cultivated pasture had an ADG of 0.87 kg vs. 0.09 kg for steers in native pasture. There was no interaction between feeding system and concentrate level (P>0.05), in the finishing phase. The diet with 25% of concentrate presented lower ADG (1.223 kg) as compared to diets containing 40, 55 and 70% of concentrate (1.567; 1.448 and 1.664 kg, respectively) due to the lowest concentration of energy in the ration (P<0.05). As to the feeding system there was a significant difference (P<0.01), with higher gains for the animals growing in native pasture with feed restriction as compared to those maintained in the cultivated pasture (1.586 vs. 1.365). These results agree with literature which shows that yearlings are the category that best responds in terms of compensatory gains. In intensive production systems, growth and finishing phases should be considered together, since the weight gain rates during the growth phase influences weight gain during finishing.

Key Words: Compensatory Growth, Pasture, Concentrate

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M179   Delaying daily feed delivery time: intake, water consumption, ruminal pH and stress response.   L. González*, A. Ferret, X. Manteca, J. de la Torre, and S. Calsamiglia, *Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain.*

Four rumen fistulated Holstein heifers (134 ± 1 kg initial BW) were used in a 4 x 4 Latin square design to determine the effects of delaying daily feed delivery time. Feedbunks were all cleaned at 0800 and feed offered at: 0800 (T0, no delay), 0900 (T1), 1000 (T2) and 1100 (T3). Each experimental period lasted 3 wk with 1 additional wk after each period in which all animals were fed at 0800. Intake and water consumption were recorded daily during wk 1 and 3. Concentrate (15% CP, 18% NDF) and barley straw were both offered once a day and on ad libitum basis. At d 3 and 17 of each experimental period, ruminal pH and salivary cortisol levels were measured at pre-feeding (0800, 0900, 1000 and 1100 for T0, T1, T2 and T3, respectively), and at 4, 8 and 12 h post-feeding; daily means were calculated to analyze both variables. Data were analyzed with the PROC MIXED of SAS using the SLICE option to test effects of individual or combined factors. No treatment by week interaction effects were observed. Total DMI was not affected by treatments (P>0.10), but the increase observed at wk 3 compared with wk 1 was significant for T1, T2 and T3 (P<0.05). Straw intake was not affected and resulted in a mean forage to concentrate ratio of 9 to 91. Water consumption increased at wk 3 in T0 (P<0.05). Ruminal pH was not affected by treatments, values being 6.27 ± 0.06, 5.59 ± 0.08 and 7.29 ± 0.05 for mean, lowest and highest pH, respectively. At wk 3, there was a significant decrease in mean, lowest and highest ruminal pH compared with wk 1, for T1 (P<0.05) and T3 (P<0.10), probably related to the increase in DMI. Daily mean salivary cortisol concentration did not reflect any significant change in overall stress response (2.51 ± 0.17 ng/mL) due to the delay in feed delivery time although, within T1, wk 1 was higher (P<0.05) than wk 3 (3.44 vs. 1.92 ± 0.67 ng/mL), respectively). Delaying feed delivery time has minor effects on the productive variables analyzed and on salivary cortisol concentration, and they may be compensated in three weeks.

Key Words: Heifers, Feed Delivery Time, Animal Welfare

M180   Performance, carcass traits and feed efficiency in Nellore bulls, steers and heifers.   P. V. R. Paulino*[1], S. C. Valadares Filho[1], M. I. Marcondes[1], M. A. Fonseca[1], A. M. Araújo[1], D. M. Oliveira[1], E. Detmann[1], and R. D. Sainz[2], [1]*Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil*, [2]*University of California, Davis.*

Nellore cattle comprise more than 80% of the Brazilian herd. However, little information is available regarding differences in performance, carcass traits and feed efficiency among Nellore bulls, steers and heifers. Thus, forty seven animals (16 bulls, 15 steers and 16 heifers from the same herd and 21 months of age) were used to assess that. The animals were housed and fed in individual pens for 78 days, in a complete randomized design. The diet (13% CP) consisted of corn and elephant grass silages in a 70:30 ratio (85%) and a concentrate (15%). The feed offered and orts were weighed daily and animals were weighed every 28 days. Carcass ultrasound measurements were taken by an AUP-certified technician at the end of the trial. Residual feed intake was calculated by a regression of dry matter intake on metabolic mid-test weight, average daily gain and sexual condition. A significance level of 0.05 was used to detect treatment differences. Bulls gained faster (0.82 kg/d), than heifers (0.64 kg/d) while steers were intermediate in ADG (0.70 kg/d). Therefore, bulls were heaviest at the end of the trial (340 kg) compared to the heifers (295 kg) and steers (318 kg), whose final weights were not significantly different. Bulls ate 9.5% more than the heifers and 5.3% more than the steers, whereas the steers consumed 4.7% more than the heifers. The heifers were the fattest (3.0 mm of subcutaneous fat at the 12th-13th rib) and the bulls were the leanest (2.3 mm), while steers were intermediate (2.7 mm). The fat depth over the rump though was not different among the groups (5.9 mm). Ribeye areas were greatest in bulls (67.27 cm[2]), while the steers and heifers did not differ (61.20 cm[2]). No significant difference was noted for residual feed intake. It is worth noting that the RFI difference between the most and least efficient animals was 1.26 kg/d, but within each group this difference reached 1.19 kg/d. We speculate that the

animals were quite homogeneous and that the differences in residual feed intake were barely noticeable. Sexual class seems not to explain variation in feed efficiency in Nellore cattle at young age.

Key Words: Nellore Cattle, Residual Feed Intake, Feed Efficiency

M181   Conjugated linoleic acid content in meat of crossbreed bulls grazing in tropical Mexico.   M. Montero[1], F. Juarez*[1,2], and H. Garcia[3], [1]*INIFAP, Veracruz, Ver. México*, [2]*Facultad de Medicina Veterinaria y Zootecnia, Universidad Veracruzana, Veracruz, Ver. México*, [3]*UNIDA-ITV, Veracruz, Ver. México.*

The aim was to determine the intramuscular content of conjugated linoleic acid (CLA) in crossbreed European x Zebu bulls under grazing conditions as compared with feedlot at the tropical Gulf Coast of Mexico. Fifty two bulls in a factorial arrangement 2 x 2 were classified by genetic group, defining as Indicus (I) those animals with 50% or more of Zebu, and Taurus (T) those with more than 50% of either Holstein or Brown Swiss. Half of the animals of each group was finished on Stargrass (Cynodon plectostachyus) pasture (P) and the other half in feedlots (F) fed with 60% corn grain, 10% soybean meal, 15% hay, 4% tallow, 5% molasses, 1% urea and minerals. Bulls were slaughtered at 500 kg live weight. Samples of Longissimus dorsi muscle at T12 were taken and frozen; lipids were extracted, methylated and analyzed by gas chromatography using a 100 m capillary column. Water content was 73%, crude protein 22%, fat 2.2% and minerals 1.2%. The major fatty acid (mg/g of fat) was the unsaturated C18:1 (381) followed by C16:0 (250) and C18:0 (201). The CLA content averaged 16.3 of which 6.1 corresponded to 9-cis, 11-trans C18:2. The 11-trans C18:1 content was 1.6. P vs. F comparison showed that CLA, 9-cis, 11-trans C18:2, and 11-trans C18:1 were similar (P>0.05) while C14:0 and C16:0 were higher in F and C18:0 was higher in P (P<0.01). CLA levels were 18.8a in I and 12.4b in T (P<0.05); also C14:0, C16:0 and C18:2 were higher in I (P<0.01). The interaction showed differences (P<0.05) in CLA for

FI, PI, FT and PT (20.3a, 17.4ab, 13.4b and 11.5b) respectively. The intramuscular CLA content in meat of bulls finished with pasture in the Gulf Coast of Mexico was elevated, and the genetic group associated with the diet contributed to the variation.

Key Words: CLA, Grazing, Beef Cattle

M182   Improvement of omega 3 fatty acid content of meat from young Holstein bulls receiving a high-concentrate diet.   N. Mach*[1], M. Devant[1], A. Bach[2,1], I. Diaz[3], M. Font[4], M. A. Oliver[4], and J. A. Garcia[3], [1]*Unitat de Remugants-IRTA (Institut de Recerca i Tecnologia Agroalimentàries), Barcelona, Spain*, [2]*ICREA (Institució Catalana de Recerca i Estudis Avançats), Barcelona, Spain*, [3]*Unitat de Quhímica Alimentària-IRTA, Girona, Spain*, [4]*Unitat de Qualitat de la Canal i Carn-IRTA, Girona, Spain.*

The objective of this study was to improve the content of omega 3 fatty acids (n-3) of beef meat from young Holstein bulls. Fifty four young Holstein bulls were blocked by initial BW and randomly assigned to 6 treatments following a 3x2 factorial design with three concentrate lipid levels (5, 8, and 11% of DM) and two lipid sources (whole canola seed and whole linseed). Dietary treatments were isonitrogenous and isocaloric. Animals (initial BW= 300 ± 25.5 kg) were fed barley straw and concentrate ad libitum for 76 to 128 d until reaching slaughter weight (443 ± 12.48 kg). Concentrate intake (7.1 ± 0.18 kg), ADG (1.3 ± 0.13 kg), and carcass quality were not affected by dietary treatments. The n-3 content of *Longissimus thoracis* (LT), mainly in the form of C18:3 n-3, increased linearly (P < 0.001) with concentrate lipid levels, and tripled (P < 0.001) in animals receiving linseed (1.31%) compared with those receiving canola seed (0.41%). Similarly, the n-3 content of the entire rib quadrupled (P < 0.001) in animals fed linseed (1.56%) compared with those fed canola seed (0.32%), and increased quadratically (P < 0.001) with concentrate lipid levels.

The ratio between omega 6 and omega 3 fatty acids decreased (P < 0.01) in the LT and entire rib of animals fed linseed (10 and 8, respectively) compared with those fed canola seed (26 and 25, respectively). Also, the percentage of *cis*-9, *trans*-11 CLA in the entire rib of animals fed linseed (0.39%) tended (P = 0.09) be greater than in animals receiving canola seed (0.30%). Contents of n-3 and CLA in meat in high-concentrate fed young male bulls can be enhanced by linseed supplementation without affecting animal performance and carcass quality.

Key Words: Beef, CLA, Linseed

M183 The effect of feeding sunflower oil alone or in combination with fish oil on the expression of the Δ9-desaturase gene in the liver and subcutaneous adipose tissue of heifers. F. Mulligan*[1], K. Thornton[1], T. Sweeney[1], and A. Moloney[2], [1]*Department of Animal Husbandry and Production, Belfield, Dublin, Ireland,* [2]*Teagasc, Grange Research Centre, Dunsany, Co. Meath, Ireland.*

The concentration of CLA in ruminant meat is highly dependent on the conversion of vaccenic acid to CLA by the Δ9-desaturase enzyme. The objective of this experiment was to examine dietary effects on the expression of the Δ9-desaturase gene in the liver and adipose tissue of cattle. Sixty Charolais or Limousin cross heifers were blocked on age and weight and assigned to one of five treatments: (G), unlimited access to perennial ryegrass (*Lolium Perenne*)-based pasture; (S1), restricted pasture allowance and 2.5 kg/day of concentrate containing 116 g/kg of sunflower oil; (S2), restricted pasture allowance and 2.5 kg/day of concentrate containing 166 g/kg of sunflower oil; (FS1), restricted pasture allowance and 2.5 kg/day of concentrate containing 116 g/kg of sunflower oil + 34 g/kg of fish oil; or (FS2), restricted pasture allowance and 2.5 kg/day of concentrate containing 166 g/kg of sunflower oil + 34 g/kg of fish oil. After 150 days animals were slaughtered and samples of liver and subcutaneous adipose tissue were harvested. Following extraction of total RNA and c-DNA synthesis, quantities of mRNA were determined relative to 18SrRNA by real time quantitative PCR and analysed using the DDCT method. Heifers fed diet S2 had higher (P<0.05) relative quantities of Δ9-desaturase mRNA in liver (2.87 ± 0.572) than animals fed diets G (1.54 ± 0.430), S1 (1.52 ± 0.284), and FS2 (1.57 ± 0.257) and tended to have higher (P=0.09) relative quantities of Δ9-desaturase mRNA than animals fed diet FS1 (1.95 ± 0.430). Dietary treatment did not affect the relative quantities of Δ9-desaturase mRNA in subcutaneous adipose tissue. This work demonstrates that dietary manipulations can alter the expression of the Δ9-desaturase gene in bovine liver.

Key Words: Conjugated-Linoleic Acid, Beef Cattle, Δ9-Desaturase

M184 The effects of feeding saponified fatty acids on duodenal fatty acid flow. D. O. Alkire*, M. S. Kerley, and J. H. Clark, *University of Missouri, Columbia.*

Five dually cannulated steers (430 kg) were used to determine the effects of saponified fatty acids (SFA) on duodenal fatty acid flow. Steers were used in a 5 x 5 Latin square design to evaluate five dietary treatments: 1) negative control (CON), no added fat; 2) positive control (SO), soybean oil; 3) calcium salts of soybean oil (CAS); 4) calcium salts of fish oil (CAF); and 5) magnesium salts of soybean oil (MGS). All fat supplements were fed to provide approximately 2 % EE of the total diet. Animals received a basal diet (1.3% BW, 5.7 % EE) consisting of 89 % corn, 6.6 % fish meal, and sufficient minerals to meet or exceed NRC recommendations. Steers were fed at a restricted intake of 5.5 kg/d. As expected, supplementing SFA increased EE intake compared to CON (p < 0.05). The saponified soy oil (CAS and MGS) produced a duodenal fatty acid profile similar to CON (p > 0.05) for 14:0, 16:0, 16:1, 18:0, 20:0, 21:0, 24:0, 20:5, and 24:1. The lack of differences in saturated fatty acids would suggest that saponification provided limited protection from ruminal biohydrogenation. In addition, MGS seemed to offer less protection from rumen degradation because it resulted in significantly more 18:0 in the duodenum compared to other treatments (p < 0.05). The CAF treatment produced a greater flow of 21:0,

20:5, and 24:1 to the duodenum compared to the other treatments (p < 0.05), suggesting some protection from biohydrogenation. The SO treatment depressed duodenal flow of 14:0, 16:0, 20:0, 21:0, 24:0, and 20:5 compared to all other treatments. Across all treatments, there was no difference in duodenal flow of 18:1, 18:2, 18:3, or 22:6. Also, there was no difference in total saturated, total monounsaturated, or total polyunsaturated fatty acids flowing to the duodenum (p > 0.05). We concluded that saponification of fatty acids may provide only limited protection from ruminal biohydrogenation at restricted intakes.

Key Words: Rumen-Protected Fat, Saponified Fatty Acids, Beef Cattle

M185 Effect of high oil corn on finishing cattle performance. G. J. Depetris*[1], F. J. Santini[1,2], E. L. Villarreal[1], E. E. Pavan[1], and D. H. Rearte[1], [1]*INTA EEA Balcarce, Argentina,* [2]*Fac. Cs. Agrarias. UNMdP, Argentina.*

Forty-two British cross finishing steers (360 ±25 kg BW) and 42 Angus females calves (FC; 160 ± 12 kg BW) were used in independent trials to evaluate the effect of high oil (HOC) and conventional corn grain (CC) on the growth performance of feedlot beef cattle. Within each category animals were blocked by weight (light, medium, heavy) and randomly assigned to one of two dietary treatments: T1: HOC + sunflower meal (SM) and T2: CC + SM. Whole corn grain and SM proportions in the diets were 84-16 and 75-25% for steers and FC respectively. Quality parameters evaluated were: IVDMD:79.7 and 82.9 %; CP: 9.25 and 7.6 %; starch: 60.2 and 64.5 %; lipid: 7.7 and 4.63 % to HOC and CC respectively. Total CP content of SM was 35.3 %. Diets were offered *ad libitum* once a day for 70-d. Steers dry matter intake (kg/d) was lower in T1 than in T2 (7.45 vs 8.45; P <0.01), but was similar in FC (4.9 ± 0.15; P = 0.92). No diet effect was observed in the daily gains (kg) of the steers (1.27 ± 0.05; P = 0.44), or the FC (1.177 ± 0.03; P=0.88). Feed efficiency (gain/feed) and final rib eye area (cm²) were neither affected by diets either in steers (0.161 ± 0.011; P = 0.43: 65.1 ± 1.83 cm²; P = 0.89) or in FC (0.237 ± 0.007; P = 0.47: 41.07 ± 0.85 cm²; P=0.17). Even though there was no diet effect (P > 0.25) for rate of back fat thickness (BFT) increase (mm/30d) for either category (steers, 1.541 ± 0.13; FC, 1.284 ± 0.084); steers had different initial BFT (T1, 3.56 and T2, 4.00 mm; P = 0.06) but similar final BFT (7.71 ±0.33 mm; P = 0.65), whereas FC had similar initial BFT (2.70 ± 0.09 mm; P = 0.8) and tended to have different final BFT between diets (T1, 6.10 and T2, 5.28 mm; P = 0.09). These data suggest that substituting high oil corn for conventional corn in feedlot diets did not improve gains, but tended to increase BFT in both categories evaluated.

Key Words: High Oil Corn Grain, Beef Cattle, Feedlot Performance

M186 Performance and serum glucose, insulin, IGF-1, and NEFA concentrations of calves nursing beef cows consuming high-linoleate or high-oleate safflower seed supplements. S. Lake[1], E. Scholljegerdes[1], V. Nayigihugu[1], R. Atkinson[1], G. Moss[1], E. Van Kirk[1], D. Hallford[2], D. Rule[1], and B. Hess*[1], [1]*University of Wyoming, Laramie,* [2]*New Mexico State University, Las Cruces.*

Three-year-old Angus × Gelbvieh beef cows nutritionally managed to achieve a BCS of 4 or 6 at parturition were used in a 2-yr experiment (n = 36/yr) to determine the effects of dietary lipid supplementation on suckling calf ADG and calf serum concentrations of glucose, insulin, IGF-1, and NEFA. Beginning 3 d postpartum, cows within each BCS were randomly assigned to be fed hay and a low-fat control supplement or supplements with either high-linoleate cracked safflower seeds or high-oleate cracked safflower seeds until d 60 of lactation. Rations were formulated to be isonitrogenous and isocaloric, and safflower seed diets contained 5% DMI as fat. Calf BW and blood samples were taken immediately prior to suckling and 2 h postprandial on d 30 and 60 of lactation. Maternal BCS at parturition did not influence calf ADG (*P* = 0.48), serum glucose (*P* = 0.16), insulin (*P* = 0.35), IGF-1 (*P* = 0.81), or NEFA (*P* = 0.92) concentrations. Maternal postpartum dietary treatment did not affect calf ADG (*P* = 0.81), serum insulin (*P* = 0.78), IGF-1 (*P* = 0.92), or NEFA (*P* = 0.86); however; serum glucose concentrations were greater (*P* < 0.01) in calves from lipid-supplemented cows. Day of lactation did not affect calf serum glu-

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cose ($P = 0.73$) or insulin ($P = 0.34$) concentrations; however, serum IGF-1 concentrations were greater ($P < 0.01$) at d 60 compared with d 30, whereas serum NEFA was greater ($P = 0.01$) at d 30. Calf serum NEFA ($P < 0.01$) and glucose ($P < 0.01$) concentrations were greater preprandial than postprandial; however, serum insulin was greater ($P < 0.01$) postprandial. Although calves nursing cows supplemented with lipid appeared to be less sensitive to insulin, calf ADG was not affected by altering cow diet.

Key Words: Beef Calves, Lipid Supplementation, Metabolites

M187 Mammary lipid metabolism in primiparous beef cows fed high-linoleate safflower seeds. C. Murrieta*[1], E. Scholljegerdes[1], B. Hess[1], D. Rule[1], T. Engle[2], and K Hossner[2], [1]*University of Wyoming*, *Laramie*, [2]*Colorado State University*, *Fort Collins*.

The objective of this study was to evaluate mammary gland fatty acid metabolism in lactating beef cows fed a high-linoleate supplement. Eighteen primiparous beef cows (BW = 411 ± 24.3 kg.; BCS = 5.25) were fed Foxtail millet hay at 2.13% of BW and either a low-fat control (n = 9) or a cracked high-linoleate (67%, 18:2 n-6) safflower seed supplement (n = 9). Diets were isonitrogenous and isocaloric and the high-linoleate diet contained 5% of DMI as fat. At slaughter (d 37 ± 3 postpartum) mammary and milk samples were immediately frozen in liquid N2 and stored at -80°C. Fatty acid composition of milk fat preparations was determined using GLC. Ribonuclease protection assay was used to quantify mRNA for acetyl-CoA carboxylase (ACC), fatty acid synthase (FAS), lipoprotein lipase (LPL) and stearoyl-CoA desaturase (SCD). Weight percentage of milk fatty acids indicative of de novo synthesis (10:0, $P < 0.001$; 12:0, $P < 0.001$; 14:0, $P = 0.002$; 16:0, $P = 0.02$) were less for cows fed linoleate. Desaturation products 14:1^{cis9} ($P = 0.001$), 15:1^{cis9} ($P = 0.002$), and 16:1^{cis9} ($P = 0.01$) decreased in milk fat of cows fed the linoleate diet; however, weight percentage of 18:1^{cis9} was greater ($P = 0.01$) in milk fat of linoleate cows. Biohydrogenation intermediates 18:1^{trans9} ($P = 0.03$), 18:1^{trans10} ($P = 0.03$), 18:1^{trans11} ($P = 0.01$), and 18:2^{cis9,trans11} ($P = 0.02$) were greater in milk fat of linoleate compared with control cows. Weight percentage of 18:0 was greater ($P = 0.01$) in cows fed linoleate than control cows. Dietary treatment did not affect ACC ($P = 0.21$) or FAS ($P = 0.40$) mRNA concentrations; however, relative abundance of mRNA for LPL decreased ($P = 0.03$) whereas SCD mRNA tended to increase ($P = 0.11$) in the mammary glands of cows fed linoleate. Supplementing diets of lactating beef cows with high-linoleate safflower seeds altered fatty acid composition of milk fat and may affect lipid metabolism at the genetic level of the mammary gland.

Key Words: Beef Cows, Lipid Metabolism, Mammary Gland

M188 Age, body condition, and calf sex effects on maternal conversion and circulating NEFA levels. E. Felton* and J. Warren, *West Virginia University*, *Morgantown*.

Forty-nine spring calving beef cows (avg. initial BW = 530 kg) with calf at side (avg. initial BW = 107 kg) were used in an 87-d experiment to examine the effect of cow age (2, 3 & >5 yrs old), initial cow body condition (< 4.5, 4.5-5.5 & > 5.5) and sex of calf on feed intake, gain, conversion of feed resources, and concentration of NEFA in maternal plasma over the experimental period. The "GrowSafe 4000E ™" system was used to measure individual feed intake from June 7th to September 2nd, 2004. Animals were fed ad libitum a total-mixed-ration containing 10% crude protein. For the first 45-d, the ration contained 90% fine chopped grass hay (hay; 8.53% CP) and 10% of a corn/urea based grain mix. For the remaining 42-d, the ration contained 73.5% hay and 26.5% of a corn/urea based grain mix. Plasma NEFA concentrations were analyzed by

a repeated measures ANOVA with four time points spaced across the experiment. Performance variables were analyzed by the GLM procedures of SAS. Concentration of NEFA decreased ($P < 0.05$) across time, but at differing rates ($P < 0.05$) due to age of dam, sex of calf, and body condition of the dam. There were no interactions of sex of calf or body condition within age category across time. Residual feed intake decreased ($P < 0.05$) with increasing age of dam but was unaffected by calf sex or gain, or dam body condition. Amount of offered feed consumed was greater ($P < 0.05$) in calves of 2-yr-old cows and their dams than in calves or dams of other age groups. Sex of calf or body condition of the dam had little effect on amount consumed. Efficiency of feed conversion (cow and calf weight gain/cow and calf intake of feed offered) were unaffected ($P < 0.05$) by age or body condition of dam, or sex of calf. These data demonstrate that as lactation progresses in the beef herd, first and second calf heifers and mature cows handle the demand for lactation differently. These animals do so with different efficiencies when measured as residual feed intake.

Key Words: Feed Efficiency, Cows, Lactation

M189 Effects of trace mineral source and growth implants on trace mineral status and immune response of steers. K. Dorton*, T. Engle, and R. Enns, *Colorado State University*, *Fort Collins*.

Three hundred and seventy-three steers were utilized to determine the effects of growth implants and trace mineral (TM) supplementation and source on TM status and immune response. Steers were stratified by initial body weight and were randomly assigned to one of 36 pens, which were then randomly assigned to treatments. Treatment consisted of: 1) control (no supplemental Cu, Zn, Mn, and Co), 2) inorganic (INORG) TM (CuSO$_4$, ZnSO$_4$, MnSO$_4$, and CoCO$_3$), and 3) organic (ORG) TM (iso-amounts of ORG Cu, Zn, Mn, and Co). On d 28 of the experiment, steers from 6 pens per treatment received a growth implant containing 200 mg progesterone and 20 mg estradiol benzoate, while the remaining steers within the same treatment (6 pens) did not receive a growth implant. Steers were fed a corn silage-based growing diet for 56d and were then gradually switched to a high-concentrate finishing diet. At the beginning of the finishing phase, only steers receiving growth implants during the growing phase were re-implanted with 80 mg trenbolone acetate and 16 mg estradiol. During the 140d finishing phase, all minerals excluding Zn, were fed at NRC recommended concentrations in INORG form. Treatments during the finishing phase consisted of: 1) control (no supplemental Zn), 2) INORG Zn (30 mg Zn/kg DM from ZnSO$_4$), and 3) ORG Zn (iso-amounts of ORG Zn). At the end of the growing phase, implanted steers had greater ($P < 0.01$) plasma Cu concentrations than non-implanted steers and steers receiving supplemental TM had higher liver Cu ($P < 0.01$) and plasma Zn concentrations ($P < 0.02$) than controls. Steers receiving ORG TM had greater ($P < 0.02$) total IgM concentrations than INORG-supplemented steers. On d 56 of the growing phase, implanted steers tended ($P < 0.07$) to have higher IgG antibody titer concentrations specific for pig red blood cells than non-implanted steers. In the finishing phase, steers supplemented with ORG TM had higher ($P = 0.04$) ovalbumin antibody titer concentrations than steers supplemented with INORG TM. These results indicate that TM supplementation, source, and growth implants may impact TM status and immune response in steers.

Key Words: Steer, Trace Minerals, Growth Implants

M190 Phosphorus metabolism in steers fed high grain diets. N. Meyer*, A. Trenkle, D. Pingel, and K. Barrett, *Iowa State University*, *Ames*.

Samples were analyzed from two metabolism trials to evaluate the effects of dietary phosphorus (P) intake on P excretion in beef steers fed corn-based finishing diets. In trial one, six steers were fed three diets over three time periods. Treatments consisted of three levels of protein to meet 70%, 80%, and 100% of the DIP requirements for growing steers. In experiment two, ten steers were fed five diets over five time periods. Treatments were: control, 4% or 8% distillers

solubles, and 10% or 20% wet distillers grains. For both experiments, total urine, feces, feed intake, and orts data were collected during a 5-d collection period, following 10 and 14-d dietary adaptation. Dietary P concentration (% DM) and P intake (g/d) ranged from 0.27 to 0.29 and 12.54 to 26.30 and .27 to .42 and 17.07 to 47.25 in Exp I and II, respectively. Total P excretion was significantly related to P intake, but there was considerable variation among steers in partitioning excretion of P in urine or feces. Urinary P excretion ranged from .66 to 7.03 and .20 to 12.17 g/d in Exp I and II, respectively. These studies indicate some steers fed corn-based finishing diets excrete large quantities of P in the urine. The data were analyzed using linear regression, $y = a + bx$ (y = P excretion, x = P intake).

Experiment I	y	a	b	R^2	P-value
	Urine	8.11	.1151	.242	.89
	Fecal	17.34	.2129	.618	.11
	Total	25.45	.3280	.636	.09
Experiment II	Urine	58.92	-.1509	.251	.53
	Fecal	-33.12	.6874	.475	.01
	Total	-25.81	.5366	.810	.0001

Key Words: Cattle, Phosphorus, Phosphorus Excretion

Ruminant Nutrition: Dairy I

M191   Effect of level of encapsulated vitamin C in starters fed to Holstein calves. J. Garrett*[1], D. Putnam[1], T. Hill[2], J. Aldrich[2], and R. Schlotterbeck[2], [1]*Balchem Encapsulates*, *New Hampton, NY*, [2]*Akey, Lewisburg, OH*.

The objective of this trial was to evaluate encapsulated vitamin C (EVC) (Vitashure® C; Balchem Corporation, New Hampton, NY) added to complete calf starters fed to Holstein calves. The EVC (70% ascorbic acid) is designed to be stable during feed processing and ruminal fermentation. Fifty-one calves (17 calves per treatment) were housed in individual pens bedded with straw. Calves were fed pelleted 18% CP starters that contained 59% corn, 23% soybean meal, 0.0025% decoquinate with 0, 0.05%, or 0.10% EVC. Starter and water were offered ad lib daily from 0 to 56 d. A common milk replacer powder (20% all milk protein, 20% fat, 0.005% decoquinate) was fed in two equal feedings at the rate of 454 g/d, reconstituted with water to 3.8 L liquid volume per head from 0 to 40 d. On d 41 and 42 the milk replacer was only fed in the morning (227 g of powder/d/head). Starter feed offered and refused was weighed daily. Calves (3 to 5 d old) were weighed initially and weekly thereafter. Data were analyzed as a completely randomized design in SAS® using linear and quadratic contrasts. Significance was declared at $P \le 0.05$, trends at $P \le 0.15$. Initial calf body weight did not differ. There were linear trends for calves fed starters with EVC to grow faster preweaning and be more efficient post-weaning. Cumulative starter intake from 0 to 8 weeks tended to respond quadratically to level of EVC, averaging 687, 787 and 750 g/d for calves fed 0, 0.05% and 0.10% EVC, respectively. Cumulative feed efficiency tended to respond linearly to level of EVC from 0 to 8 weeks, averaging 0.514, 0.526, and 0.540 (kg gain:kg feed) for calves fed 0, 0.05%, and 0.10% EVC, respectfully, and responded linearly through week 5. Change in hip width improved quadratically between 2 to 4 weeks and 2 to 6 weeks. Fecal scores and medical treatments did not differ. In summary, calves fed 0.05% and 0.10% EVC tended to gain 3.5 kg more body weight in 8 weeks than controls while tending to have higher intake of starter and improved feed efficiency.

Key Words: Calf, Encapsulated, Vitamin C

M192   Effect of feeding medium chain triglycerides on calf growth, insulin responsiveness and body composition. J. K. Mills*, M. E. van Amburgh, and D. A. Ross, *Cornell University*, *Ithaca, NY*.

The objective of this study was to determine the effects on the growth, body composition, and response to an insulin challenge in calves fed isocaloric, isonitrogenous diets that varied in the amount and type of fatty acid. Thirty-six calves were assigned to a randomized block design with three dietary treatments, ten calves per treatment and a baseline group of six calves. Animals were reared from birth to 88.1 kg live bodyweight (BW). Three different milk replacer-based diets were designed to deliver less than 2% of the lipid as medium chain triglycerides (MCT) (Control; diet contained no MCT), 32% MCT in the form of caprylate (MCT Oil) and 32% of fatty acids primarily in the form

of laurate from coconut oil (CO). From d 1 to 7, calves were offered 0.28 Mcal intake energy/ kg BW0.75, adjusted weekly for BW, and 0.32 Mcal intake energy/ kg BW0.75 from d 8 to slaughter. Dry matter, energy, crude protein (CP) and fat intakes were 53.7 kg, 281.8 Mcal, 14.6 kg and 13.0 kg; 56.6 kg, 297.2 Mcal, 15.8 kg and 14.2 kg; and 53.8 kg, 280.4 Mcal, 15.4 kg and 13.3 kg for the Control, MCT Oil and CO treatments, respectively. Dry matter intake (DMI), energy, protein and fat intakes did not differ among treatments (P = 0.50, 0.45, 0.29 and 0.22, respectively). Empty body gains were 0.92, 0.79 and 0.87 kg/d for Control, MCT Oil and CO diets respectively and the MCT Oil diet significantly lower than the Control. Empty body CP, ash and water were not different among treatments (P = 0.40, 0.88 and 0.45, respectively). Empty body retained energy and fat tended to be 5.6 and 8.7% greater for calves consuming the CO diet than for those fed the Control diet (P = 0.06 and 0.11, respectively). The liver weight of calves consuming the CO diet was 330 g heavier and contained 15% more fat than the liver of the Control and MCT Oil calves (P = 0.04 and 0.002, respectively). Plasma glucose was not different among treatments during an insulin challenge (P = 0.23), however, the decrease in plasma glucose concentration was significantly greater for the calves fed the MCT Oil diet compared to the Control and CO diets (P = 0.001).

Key Words: Lipid, Body Composition, Calves

M193   The effect of milk replacer protein, fat content and feeding amount on performance of Holstein heifer calves. B. Ziegler*[1], J. Linn[2], D. Ziegler[3], H. Chester-Jones[3], C. Soderholm[1], and S. Hayes[4], [1]*Hubbard Feeds, Mankato, MN*, [2]*University of Minnesota*, *St. Paul*, [3]*University of Minnesota, Waseca*, [4]*Milk Products, Chilton, WI*.

Two day-old calves from 3 commercial dairies were randomly assigned to one of 5 all-milk protein milk replacer (MR) treatments by farm source and body weight (BW). Calves were housed in 2.29 x 1.17 m individual calf pens within a frame-steel curtain side-wall naturally ventilated calf barn. Average BW across treatments at day 2 of-age was 40.7 kg ± 0.34 kg. Treatments were: 1) 20% Protein:20% Fat MR fed at 0.28 kg (as-fed) in 1.77 L water; 2) same as 1 except acidified MR; 3) 28:16 MR fed at 0.34 kg in 1.77 L water; 4) 28:16 MR fed at 0.34 kg in 2.41 L water; and 5) 28:16 MR fed up to 0.51 kg in 2.56 L water. Treatments 1, 2, 3, and 4 were fed 2X for the first 35 days and then 1X daily from day 36 to 42. Treatment 5 was fed 2X daily for the first 42 days and 1X from day 43 to 49. Calves assigned to treatments 1 and 2 were fed a calf starter (CS) containing 18% CP, and those on treatments 3, 4 and 5, a CS containing 22% CP ad libitum for 56 days. Fresh water was available daily at all times. Calves fed treatment 5 had the highest (P < 0.01) daily gain (0.81 kg) to 56 days followed by calves fed treatment 3 (0.73 kg), treatment 4 (0.68 kg), treatment 1 (0.65 kg) and treatment 2 (0.61 kg). Total DM intake (MR + CS) to 56 days was highest (P < 0.01) for calves fed treatment 5 (76.8 kg) and 3 (75.6 kg) compared to treatments 1 (69.5 kg) and 2 (67.9 kg) with treatment 4 intermediate (71.3 kg). Calves fed treatment 5 were more efficient (gain/DM intake) over 56 days