211 Evaluating residual feed intake on performance of growing and finishing steers. C. O. Trejo*, L. L. Berger, D. B. Faulkner, J. M. Dahlquist, and T. G. Nash, *University of Illinois*, *Urbana*.

Improving feed efficiency in the beef cattle industry has become increasingly important as feed costs continue to rise. Residual feed intake (RFI) has been proposed as an efficiency trait that appears to be independent of most other performance traits. The objective of this trial was to evaluate RFI on performance of growing and finishing steers. Residual feed intake was calculated as the difference between the actual dry matter intake (DMI) and a predicted DMI. The predicted DMI was defined as a linear regression of DMI, average daily gain (ADG), and metabolic body weight ($BW^{0.75}$). Two groups were classified for the growing and finishing phase: Low RFI (<0.5 SD) and High RFI (≥0.5 SD). One hundred and sixty Angus, Simmental, and Angus-Simmental cross bred early weaned steers were fed during 112 days either of two diets: high concentrate (65% cracked corn, CC) or high fiber (38% soy hulls). Steers were fed with a common finishing diet (50% CC and 25% dry distillers grains with solubles) for approximately 152 more days. There was no significant interaction (P>0.05) between the two diets and the RFI classification groups during the growing phase in performance. No differences were found for ADG (P=0.28) and DMI (P=0.13). Steers with low RFI were heavier (P=0.037) at the end of the growing phase and had higher (P=0.003) feed efficiency than the low RFI steers. There was a significant difference (P<0.001) between the individual RFI values of each group. For the finishing phase, there were no differences for final BW and ADG between each of the RFI groups. However, steers in the low RFI group ate 1.24 kg/d less (P=0.0001) and had higher (P<0.001) gain:feed ratio than the high RFI group. There was 1.54 kg/d difference on RFI between the two groups. Identifying steers with low RFI potential can help improve feed efficiency and profitability during the growing and finishing phase.

Key Words: Residual Feed Intake, Early Weaned Steers

212 Relationships between residual feed intake and carcass-quality traits in Santa Gertrudis steers. F. R. B. Ribeiro*[1], R. K. Miller[1], E. G. Brown[2], P. A. Lancaster[1], L. O. Tedeschi[1], S. Moore[3], D. DeLaney[3], and G. E. Carstens[1], [1]*Texas A&M University*, *College Station*, [2]*Stephen F. Austin State University*, *Nacogdoches, TX*, [3]*King Ranch*, *Kingsville, TX*.

Our objective was to examine the phenotypic associations between residual feed intake measured during the growing (**GRFI**) and finishing (**FRFI**) phases, and carcass traits and tenderness in Santa Gertrudis steers (N = 113). Individual intakes were measured while steers were fed high-roughage (ME = 2.26 Mcal/kg) and high-grain (ME = 3.0 Mcal/kg) diets for 77 and 88 d during the growing and finishing phases. For each phase, RFI was calculated as the residual value from linear regression of DMI on mid-test $BW^{0.75}$ and ADG For each phase, steers were categorized into low, medium and high RFI groups based on +/- 0.50 SD from the mean of 0.0 +/- 0.84 and 0.0 +/- 0.98 for GRFI and FRFI, respectively. Steers were harvested at about one cm 12th rib fat thickness (**BF**). After 24 h, a LD sample was removed for calpastatin activity (**CAP**). At 48 h, carcass traits (hot carcass weight (**HCW**), LD muscle area (**LMA**), kidney, pelvic and heart fat (**KPH**), BF and marbling score (**MS**)) were measured, and yield grade (**YG**) calculated. Two 12th rib steaks were aged 1- (**WSF1**) or 14-d (**WSF14**) for Warner-Bratzler shear force. RFI during the growing phase was weakly correlated (0.19; P < 0.05) with WSF14, but not (P > 0.05) with HCW, LMA, BF, KPH, YG, MS, WSF0 or CAP. Steaks from low and medium GRFI steers had lower (P < 0.05) WSF14 (2.2 and 2.1 vs 2.4, respectively) than steaks from high GRFI steers. FRFI was correlated (P < 0.05) with BF (0.27) and CAP (0.19), but not with other carcass traits. Carcasses from low-FRFI steers had less (P < 0.01) BF (0.97 vs 1.24 cm), lower (P < 0.05) YG (2.7 vs 3.2), but similar LDA (78 vs 75 cm2) and MS (475 vs 481) than carcasses from high-FRFI steers. Steaks from medium-FRFI steers had lower (P < 0.05) WSF14 than steaks from high FRFI steers. The low-FRFI steers had lower (P < 0.05) CALP (2.57 vs 2.81) than high-FRFI steers. Carcasses from low FRFI steers (more efficient) were leaner, but had similar marbling scores as carcasses from high RFI steers. Results suggest that selection for improved RFI will not have a negative impact on marbling and beef tenderness.

Key Words: Carcass Traits, Tenderness, Residual Feed Intake

213 Predicting water intake by yearling steers during the summer. J. L. Lacey*, J. J. Wagner, and T. E. Engle, *Colorado State University*, *Fort Collins*.

Four hundred and thirty-two crossbred yearling steers (339 kg ± 4.8) housed in 48 pens were used to study relationships between water intake (WI), dry matter intake (DMI), various measures describing the weather, and water quality. Because every two pens shared a common water fountain, 24 observations were available for this analysis. Water sources included: reverse osmosis water (RO) versus high sulfate well water. Average sulfate concentrations for the RO water treatment was 253.14±101.12 mg per L versus 637.4±36.81 mg per L for well water. Mean daily temperature (TEMP), humidity (HUM), dew point (DP), wind speed (WIND), and precipitation (RAIN) data were obtained from the weather station located at Lamar Municipal Airport located approximately 2 km from the Southeast Colorado Research Center. Equations predicting WI were developed using mixed model procedures. Water intake increased 1.25±0.17 L per kg increase in DMI (P < 0.0001), 0.82±0.07 L per degree C increase in TEMP (P < 0.0001), 0.68±0.07 L per degree C increase in DP (P < 0.0001), and 2.12±1.25 L per head if RO water was used as compared with well water (P < 0.11). Water intake declined 0.19±0.04 L per % unit increase in HUM (P < 0.0001) and was reduced by 0.05±0.02 L for each km/h increase in WIND (P < 0.04). There was no significant difference in water intake due to precipitation (P > 0.95). Predicted WI from the current study was reasonably close to WI predicted by equations listed in NRC (2000).

Key Words: Steer, Feedlot, Water Intake

214 Combinations of steam-flaked corn, dry-rolled corn, and dried corn distiller's grains with solubles for feedlot heifers. P. L. Black*[1], G. L. Parsons[1], M. K. Shelor[1], K. K. Karges[2], M. L. Gibson[2], and J. S. Drouillard[1], [1]*Kansas State University*, *Manhattan*, [2]*Dakota Gold Research Association*, *Sioux Falls, SD*.

Crossbred heifers (n=689, 302 ± 65 kg initial BW) were used to evaluate finishing performance of cattle fed combinations of steam-flaked corn

(SFC), dry-rolled corn (DRC), and dried corn distiller's grains with solubles (DDG). The study was conducted as a randomized complete block using a 2 × 2 factorial arrangement of treatments. All diets contained SFC, and factors consisted of the levels of DDG (0 or 25%) and DRC (0 or 25%). Heifers were individually weighed and blocked into heavy and light groups. Within block, heifers were assigned randomly to pens containing 25 animals each, with 7 pens per treatment. Heifers were fed once daily *ad libitum* for 137 to 157d. ADG, DMI, and feed conversion efficiency were not different among treatment groups ($P < 0.05$). Heifers fed DRC had greater dressing percentages than their counterparts fed diets without DRC ($P < 0.05$). Feeding DDG also increased dressing percentage ($P < 0.05$). There were no differences among treatments with respect to HCW, quality grade, yield grade, 12th rib fat thickness, KPH, longissimus muscle area, incidence of liver abscess, or total carcass value. Partial substitution of SFC with DRC or DDG yielded comparable feedlot performance and carcass value with lower input cost.

Table 1. Performance and carcass traits of cattle fed SFC finishing diets with 0 or 25% DDG and 0 or 25% DRC.

	SFC		SFC/DRC		
	0% DDG	25% DDG	0% DDG	25% DDG	SEM
Carcass adjusted ADG, kg	1.40	1.41	1.44	1.46	0.03
Gain:feed	0.174	0.165	0.166	0.160	0.0029
Dressed yield, %[a]	62.58	63.65	63.76	64.62	0.46
HCW, kg	328	326	330	330	4.3
USDA Choice or higher, %	43.5	42.1	49.3	39.3	4.6
USDA yield grade	2.69	2.78	2.76	2.66	0.10
Total carcass value, $	934	931	948	935	14.0

[a] Main effects of DDG and DRC, $P < 0.05$

Key Words: Distiller's Grain, Cattle, Finishing

215 Cow live weight is negatively related to feed efficiency of cow/calf pairs from birth to weaning[1]. T. Z. Albertini*[2], S. R. de Medeiros[3], R. A. de A. Torres Júnior[3], and D. P. D. Lanna[2], [1]*Fapesp, Embrapa*, [2]*ESALQ-USP*, *Piracicaba, SP, Brazil*, [3]*Embrapa Beef Cattle*, *Campo Grande, MS, Brazil*.

Feed efficiency of beef cows and their calves from birth to weaning was determined. Cow/calf pairs were individually fed from 26±12 d (mean±standart deviation) of life to weaning at 210 d. Forty adult non-pregnant cows were evaluated: 20 1/2 Caracu x Nelore, 10 1/2 Angus x Nelore and 10 Nelore. The 1/2 Caracu x Nelore and Nelore cows were bred to Red Angus bulls and the 1/2 Angus x Nelore were bred to Canchim (5/8 Charolais) bulls. The diet (2.3±0.1 Mcal ME/kg and 11.2±2.3% CP) was fed in variable amounts and adjusted every 28 days to keep the weight and body scores of the cows unchanged. The same diet was offered *ad libitum* to the calves (beginning at 2 months *postpartum*). Milk production was determined by milking each cow, at a minimum of 8 points in lactation. Correlations among efficiency indexes were evaluated using MANOVA option of Proc GLM in SAS. Regression analysis was used to compare the efficiency of cow/calf pairs and live weight of cows. The model included the effects: start of feeding period, genetic group, sex and age of calf at beginning of the experiment. Efficiency of cow/calf pairs was 33.9±3.6 g LWG_{210d}/Mcal metabolizable energy. Efficiency of calves was 89.1±8.2 g LWG_{210d}/Mcal of total MEI (milk+solid diet). The live weight of cows was 450±55 kg. Phenotypical correlations showed a strong negative correlation between the live weight (LW) of cows and the efficiency of cow/calf pairs ($r=-0.65$; $P<0.001$). The linear regression of efficiency of cow/calf and cow′s LW was: $y = -0.0397x + 52.61$ ($R^2 = 0.43$). There was a positive, although less dramatic, correlation between cows LW and the efficiency of progeny efficiency (g $gain_{210d}$/Mcal of calves MEI; $r=0.35$; $P<0.05$). In conclusion, heavier cows were associated with lower cow/calf pair efficiencies. However the progenies of heavier cows are more efficient in pre-weaning.

Key Words: Growth, Bioenergetics, Milk

216 Effects of using wheat gluten and rice protein concentrate in calf milk replacers. T. M. Hill*, H. G. Bateman, II, J. M. Aldrich, and R. L. Schlotterbeck, *Akey*, *Lewisburg, OH*.

There is limited information in the literature on feeding milk replacers (MR) containing either hydrolyzed wheat gluten (HWG; 80% CP) or rice protein concentrate (RPC; 80% CP) to calves under 2 months of age. These protein sources appear to have little or no antinutritional properties unlike several other plant proteins and they are widely used in MR. Trial 1 compared feeding 26% CP, 17% fat MR that contained A) 0, B) 6, or C) 12% HWG replacing whey CP. The MR were fed at 0.681 kg/d (reconstituted to 4.6 L) halved into AM and PM feedings for 39 d, followed by 0.341 kg/d for d 40 to 42 (AM feeding only). Holstein calves (43 kg BW and 5.0 mg serum protein/dL initially) 2 to 3 d old from one source were used. Trial 2 compared feeding 26% CP, 17% fat MR that contained A) 0, B) 8, or C) 16% RPC replacing whey CP. The MR were fed at 0.681 kg/d (reconstituted to 4.6 L) halved into AM and PM feedings for 25 d, followed by 0.341 kg/d for d 26 to 28 (AM feeding only). Holstein calves (42 kg BW and 4.8 mg serum protein/dL initially) 2 to 3 d old from one source were used. Within trial, the MR were formulated to have equal concentrations of CP, fat, Lys, Met, Ca, P, and added trace minerals, vitamins, and decoquinate. All MR were adequate in essential amino acids. Each trial was analyzed as a completely randomized design using the MIXED procedure of SAS. Means were separated using linear and quadratic contrast statements. In Trial 1, pre-weaning ADG (0.640, 0.561, and 0.505 kg/d), starter intake, and hip width change decreased linearly ($P < 0.05$) with increasing concentration of HWG in the MR. In Trial 2, ADG (0.389, 0.340, and 0.178 kg/d) and feed efficiency declined linearly ($P < 0.05$) as RPC increased in the MR. Post-weaning performance did not differ among MR treatments in Trials 1 and 2. In these trials, pre-weaning ADG of calves less than 2 mo old was reduced when either HWG or RPC replaced whey protein in a MR.

Key Words: Wheat Gluten, Rice Protein Concentrate, Milk Replacer

217 The effects of controlled feeding a high concentrate or high forage diet at four nitrogen intakes on nitrogen utilization in dairy heifers. G. I. Zanton* and A. J. Heinrichs, *The Pennsylvania State University*, *University Park*.

The hypothesis of this experiment is that N provided in a high concentrate (**HC**) ration will be utilized with a greater efficiency than a high forage ration (**HF**) by postpubertal dairy heifers and that the response will be affected by level of N intake (**NI**). To test this hypothesis, 8 Holstein heifers (beginning at 362 ± 7 kg and 12.3 ± 0.4 mo) were fed eight rations according to a split-plot, 4 × 4 Latin square design. Treatments were formulated to contain 75% or 25% forage (corn silage and chopped wheat straw) and 4 levels of NI (0.94, 1.62, 2.30, 2.96 g N/kg $BW^{0.75}$ per d) and were fed to equal ME intake (182 kcal/kg $BW^{0.75}$). Blood samples were collected over d 19-20 and feces and urine were collected the final 8 d/28 d period. Concentration of BUN was significantly higher for HC and with increasing NI. Urea-N excretion was not different between forage levels, but increased significantly and linearly with NI. Urea clearance rate (L/h) did not differ between forage levels and increased, but at a decreasing rate, as NI increased. A significant interaction resulted from urea clearance increasing at a greater rate and obtaining higher values for HF, whereas clearance of urea for heifers fed HC obtained significantly lower maximal values. Like urea-N excretion, daily urinary N excretion was affected only by NI. Retained N responded linearly to increased levels of NI. As a result of a significant interaction between forage level and NI on fecal N excretion and numerical differences in urine N, retained N at maximum NI was greater for HC than HF. In spite of this observation, gross N efficiency (**GNE**) only tended to be affected by an interaction and was not significantly affected by forage level. Linear and quadratic responses in GNE to increases in NI occurred such that the statistical maximum GNE was achieved when N intake was 1.62 g N/kg $BW^{0.75}$. To conclude, differences in N utilization between HC and HF in this trial were small and were not evident until NI increased to impractical levels.

Key Words: Dairy Heifer, Forage:Concentrate, N Intake

218 Effects of ractopamine HCL on growth performance and carcass characteristics of feedlot heifers. J. W. Homm*[1], W. J. Platter[1], M. J. Corbin[1], J. J. Wagner[2], N. E. Davis[2], J. S. Drouillard[3], and C. E. Walker[3], [1]*Elanco Animal Health*, *Greenfield, IN*, [2]*Colorado State University*, *Ft. Collins*, [3]*Kansas State University*, *Manhattan*.

Two studies were pooled to evaluate the effects of ractopamine hydrochloride (RAC) on growth performance and carcass characteristics in beef heifers. The studies consisted of 2 treatments (0 and 200 mg $hd^{-1}•d^{-1}$ RAC), 16 replications per treatment and 1016 heifers (491.3 kg; 8 to 9 head/pen). Days on feed averaged 172 (CO site) and 186 (KS site), with the RAC diets fed the last 14, 28, and 42 d prior to harvest. Steam flaked corn-based rations met or exceeded National Research Council nutrient requirements and Rumensin®, Tylan®, and MGA® were fed at label dosages. One way ANOVA was used to estimate treatment effects on live animal performance and carcass characteristics. The statistical model included treatment as a fixed effect with random effects of replicate nested in study site, treatment and replicate nested in study site, study site and the study site by treatment interaction. Repeated measures analysis was used to evaluate live weight response over time. Treatments were pooled into control and RAC, the statistical model included treatment, time, and the treatment by time interaction. The response in live weight gain to feeding RAC was quadratic over the 42 d period with RAC treated heifers having a live weight gain of 5.9, 9.6, and 11.2 kg over controls at 14, 28, and 42 d, respectively. Hot carcass weight tended ($P = 0.12$; 5.5 kg) to increase after 28 d on RAC and was heavier ($P < 0.05$; 8.3 kg) after 42 d. After 42 d ribeye area was larger ($P < 0.05$) for RAC treated heifers. Dressing percentage, marbling score, yield grade, and dark cutters were similar among treatment groups. USDA quality and yield grade distributions were similar between treatment groups. These data indicate that performance on a live and hot carcass weight basis continues to increase with RAC supplementation throughout a 42 d feeding duration.

Key Words: Ractopamine HCL, Heifers, Growth and Carcass

219 Interaction of growing and finishing production system and sorting by weight. D. R. Adams*, T. J. Klopfenstein, G. E. Erickson, M. K. Luebbe, and J. R. Benton, *University of Nebraska*, *Lincoln*.

Cattle are commonly sorted at weaning into different production systems. Our objective was to determine if sorting cattle by BW decreases variation in HCW and decreases overweight carcasses (431 kg). Steers (n=288) were purchased from a sale barn in the fall. All the cattle were assigned randomly into sorted or unsorted groups (n=144). The unsorted group was then assigned randomly to one of three feeding times: calf-fed, summer yearling or fall yearling. The calf-feds were fed from November to May. The summer and fall yearlings grazed cornstalks together through the winter until spring and then grazed cool season grass until May. The summer yearlings entered the feedlot in May and were fed until October. The fall yearlings grazed pasture until September when they entered the feedlot and were fed until January. In the sorted group, the heaviest 1/3 were fed as calf-feds. When the cattle were brought off of grass in May, the heaviest 1/2 of the remaining sorted group were fed as summer yearlings, while the lightest 1/2 went to pasture and then were fed until January. When entering the feedlot, the cattle were assigned randomly to six pens per group per feeding time and pen was experimental unit. Design was a 2 X 3 factorial. There were interactions ($P<0.05$) for initial feedlot BW and HCW (by design), and for G:F and percent of carcasses > 431 kg. Sorted cattle had heavier initial feedlot BW and HCW as calf-feds but lighter as fall yearlings compared to controls. Sorted cattle had fewer overweight carcasses as fall yearlings (2.8% vs. 10.5%), but there were few overweight carcasses among either sorted or control cattle fed as calf-feds or summer yearlings. Unsorted calf-feds had higher G:F than sorted with no differences due to sorting within summer or fall yearlings. Sorting decreased variation of HCW (SD=27 vs. 39 Kg) and number of overweight carcasses without effecting fat thickness or quality grade.

Key Words: Carcass Characteristics, Feedlot Cattle, Sorting

220 Effect of the addition of plant extracts (Queen of Calves) to milk and differing levels of milk on gastro intestinal tract development of calves. J. K. Margerison*, G. W. Reynolds, and R. Laven, *Massey University*, *Palmerson North, New Zealand*.

This research assessed the effect of plant extracts added to milk on the development of the gasto intestinal tract. Using a randomised block design, 18 (Male) dairy calves were randomly selected and allocated (48 h) according to; birth date, breed and live weight to one of three treatments; 4 l/h/d of whole milk (M); 4 l/h/d whole milk 4 l, plus 200 g plant extracts (MP); 2 l/h/d whole milk, plus 200 g plant extracts (0.5MP) and 3 calves per treatment diet were euthanized at 7 and 14 weeks of age to assess the physical and histological development of the gastro intestinal tract. Histological examination of the reticulum: pole and cranial, ventral

and dorsal rumen showed that calves offered plant extracts, at 7 weeks, had greater dorsal rumen papillae thickness (M:0.202 [b]; MP: 0.295 [a]; 0.5MP: 0.346[a] (0.0294, P<0.05) and height (M: 0.336 [b]; MP: 0.378 [b]; 0.5MP; 0.716 [a] (sem 0.0710 P<0.001) and at 14 weeks (M: 0.334 [ab]; MP: 0.293 [b]; 0.5MP:0.388 [a], sem 0.0710 P<0.05) dorsal rumen (M: 1.02 [ab]; MP: 1.08 [a]; 0.5MP: 0.810 [b], sem 0.0396 P< 0.05) and ventral rumen wall thickness (M: 0.631[b]; MP:0.791 [a]; 0.815 [a], sem 0.0421 P<0.05), greater full stomach weights (14 weeks: M: 16.6 [b]; MP: 21.6[a]; 0.5MP: 16.9 [b], sem 1.09 P<0.05), at 7 weeks had greater small intestine villi height height (M: 0.556 [b]; MP: 0.763 [a]; 0.5MP: 0.541 [b] sem 0.0381, P<0.001) and lower caecum mucularis (M: 0.756 [a]; MP: 0.586[b]; 0.5MP: 0.449 [b], sem 0.0541 P<0.001) (μm) compared with calves offered milk. Rumen fluid pH, VFA concentrations of acetic, propionic, isobutyric, butyric, valerate were not significantly different. The addition of plant extracts to milk increased rumen and small intestine development, but did not affect rumen volatile fatty acid concentrations.

Key Words: Gastro Intestinal Tract, Plant Extracts, Calves

221 Determination of the optimal amino acid concentration in milk replacers for calves less than five weeks of age. T. M. Hill*[1], H. G. Bateman, II[1], J. M. Aldrich[1], R. L. Schlotterbeck[1], and K. G. Tanan[2], [1]*Akey*, *Lewisburg, OH*, [2]*Provimi*, *Brussels, Belgium*.

The amino acid requirements of herd replacement calves less than 5 wk old and fed milk replacers (MR) are not clearly defined. The objective of these four studies was to investigate the effect of supplementing MR containing 24 to 28% CP (from milk sources) and 17% fat with Lys, Met, and Thr in order to estimate their optimal concentrations for calves less than 5 wk of age. Holstein bull calves (initially 3 and 4 d old, 43 &PLUSMN; 1 kg BW) were fed an 18% CP (as-fed) starter ad libitum and weaned at 31 to 32 d of age (28 d studies). Calves were housed in an unheated, curtain-sided nursery. In Study 1, six MR treatments were fed based on the combination of three CP concentrations (24, 26, and 28% CP) each with or without added Lys and Met. In Studies 2 and 3, 26% CP and 2.34% Lys MR treatments were fed to test the concentration of Met (0.64, 0.68, and 0.72% Met in Study 2, and 0.64, 0.72, and 0.80% Met in Study 3). In Study 4, 26% CP, 2.34% Lys, and 0.72% Met MR treatments were fed to test the concentration of Thr (1.06, 1.43, and 1.80%). There was a 17% improvement ($P < 0.05$) in ADG in Study 1 from adding Lys and Met that was maximized with 2.34% Lys. The ADG response to added Met in Studies 2 (linear, $P < 0.05$) and 3 (quadratic, $P < 0.05$) were 13 and 7%, respectively, with a plateau at 0.72% Met. There was no ADG or efficiency response to added Thr in Study 4. Formulating 17% fat, whey-based MR fed at 0.68 kg/d to 26% CP, 2.34% Lys, and 0.72% Met appeared optimum based on responses of ADG, feed efficiency, and serum concentrations of urea nitrogen. Feeding calves more CP and essential amino acids did not improved ADG and efficiency. Amino acid requirements of calves less than 5 wk old, averaging 48 kg BW, consuming 204 g CP/d, and gaining 0.46 kg BW/d, appeared to be met with 17 g Lys, 0.31 Met to Lys ratio, 0.54 Met+Cys to Lys ratio, and a Thr to Lys ratio less than 0.60.

Key Words: Calf, Amino Acid, Milk Replacer