

**ABSTRACTS**  
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**1 Maternal biological efficiency in beef cattle.** J. D. Stevens\*<sup>1</sup>, D. D. Kress<sup>1</sup>, D. C. Anderson<sup>2</sup>, and K. C. Davis<sup>1</sup>, <sup>1</sup>Montana State University, Bozeman, <sup>2</sup>Northern Agricultural Research Center, Havre, MT.

Three different breed groups of cattle were evaluated for maternal biological efficiency under range conditions. Breed groups were Hereford (HH), Tarentaise (TT) and the F<sub>1</sub> reciprocal crosses (HT). Seventeen females of each breed group were randomly chosen from a population of pregnant animals. Fecal output (FO) and forage intake (FI) were measured on 51 cows for each of 4 yr using a constant release intraruminal bolus of chromic oxide (Cr<sub>2</sub>O<sub>3</sub>). Following a 10-d waiting period to allow Cr<sub>2</sub>O<sub>3</sub> to reach steady state equilibrium, three fecal grab samples were taken 3-d apart. Estimates were measured during five periods each year with PI in November, PII in February, PIII in May, PIV in June and PV in September. Calf weaning weight (CWW) was measured in October. Maternal biological efficiency was calculated for each cow/calf pair by dividing CWW by the sum of FI over the five periods (EFF) or by dividing CWW by the sum of FI over the five periods on a per unit body weight basis (EFF/BW). The same calculations were done for FO with very similar results. Data were analyzed by the GLM procedures of SAS. The model contained dam breed group, age of dam (2, 3, 4 and 5+ yr), sex of calf, sire breed group and year. EFF and EFF/BW differed (P<.05) by cow breed group. Least-squares means for HH, HT and TT, respectively, were 6.64, 7.45 and 7.52 kg/kg for EFF and 3.46, 3.82 and 3.64 kg·g<sup>-1</sup>·kg<sup>-1</sup> for EFF/BW. Linear contrasts for HH-TT showed the straightbreds were significantly different for EFF (P<.05) but not for EFF/BW (P>.05). The linear contrast for maternal heterosis indicated significant (P<.05) maternal heterosis for EFF/BW (7.6%) but not for EFF (5.2%). Age of dam was significant (P<.05) for EFF/BW but not for EFF. Least-squares means for 2-, 3-, 4- and 5 yr-olds were 3.02, 3.25, 3.52 and 3.82, respectively, for EFF/BW. Greater biological efficiency was exhibited by HT and TT cows than by HH cows under range conditions and maternal heterosis was positive for greater biological efficiency.

**Key Words:** Beef Cattle, Efficiency, Breed Differences

**2 Effects of season of use on beef cattle distribution patterns and subsequent vegetation use in mountain riparian areas.** C. Parsons\*<sup>1</sup>, P. Momont<sup>1</sup>, T. DelCurto<sup>2</sup>, and J. Sharp<sup>2</sup>, <sup>1</sup>University of Idaho, Caldwell, <sup>2</sup>Oregon State University, Union.

To quantify the effects of season of use on beef cattle distribution relative to the riparian area, fifty-two cow/calf pairs were randomly assigned to

two years of 3 replications of the following treatments: 1) early season (ES) grazing (mid-June to mid-July), and 2) late season (LS) grazing (mid-August to mid-September). Based on previous years DM production estimates, pastures were stocked to achieve 50 percent utilization after 28 days of grazing. Livestock observation points, livestock activities and ambient temperatures were recorded hourly during two 4-d periods in each season of use. Locations were then transcribed to a geographical information system (GIS) for the study area on Oregon State University's Hall Ranch in northeastern Oregon. Cow weight and body condition score (BCS), calf weight, ocular vegetation utilization estimates, forage quality, and fecal deposits within 1 m of the stream were recorded pre- and or post-grazing. During ES, cattle were further from the stream (P < .01) than LS cattle, averaging 161.4 and 99.4 m for ES and LS respectively. Grazing distribution also displayed a diurnal response (P < .01) with increasing ambient temperatures resulting in decreased cattle distance from the stream. Fecal deposits within 1 m of the stream tended (P = .13) to be greater following LS than ES grazing. Forage quality varied (P < .01) between seasons with ES forage having lower DM, greater CP, lower fiber, and greater IVDMD compared with LS forage. Livestock activity (grazing, ruminating or drinking) and grazing times, min/d, were not affected by season of use. However, forage utilization was influenced by season of use with ES grazing having lower riparian vegetation use and higher upland vegetation use as compared to LS grazing (P < .05). In summary, grazing season affected cattle distribution relative to the riparian area, with LS having more concentrated use of riparian vegetation.

**Key Words:** Season of Use, Beef Cattle, Distribution Patterns

**3 Profitability analysis of Holstein steers on various implant regimes.** S. L. Fowler\*<sup>1</sup>, J. Algeo<sup>2</sup>, and J. L. Beckett<sup>1</sup>, <sup>1</sup>California Polytechnic State University, San Luis Obispo, <sup>2</sup>Algeo Nutrition Consulting, Paso Robles.

The purpose of this study was to determine the profitability of feeding Holstein steers using one of five implant regimes. One hundred seventy-six Holstein steers (144 kg) randomly assigned to one of five treatment groups (n = 36) were used to determine profit margin by implant treatment protocol. Treatments are listed in Table 1. Animals were weighed at 28-d intervals and weight gain, average daily gain (ADG), and feed efficiency were calculated. All implanted groups had heavier average final live weights, increased ADG and improved feed efficiency than non-implanted controls (p < .05). Steers were harvested after 291 d on feed, at which time carcass measurements were collected. Parameters used for determining profit margin include initial animal cost, feed, medicine,

implant costs, and sales. Total animal expenses differed ( $p < .05$ ) by treatment (A=\$708<sup>a</sup>, B=\$686<sup>bc</sup>, C=\$705<sup>ab</sup>, D=\$710<sup>a</sup>, E=\$667<sup>c</sup>). Selling price reflected the price received on a quality-based grid pricing system with discounts for carcasses over 375 kg. Per animal sales differed ( $p < .05$ ) by treatments (A = (\$769<sup>a</sup>, B = (\$699<sup>bc</sup>, C = \$749<sup>ab</sup>, D = \$760<sup>ab</sup>, E = \$684<sup>c</sup>). There were no differences in profit or loss (average = -\$33 per animal). In conclusion, use of implants can impact income and expenses. However, little difference in profit was observed.

Table 1. Implant Treatments (Trade Names)

Treatment	Day 0	Day 60	Day 120	Day 180
A	Ralgro	Ralgro	Synovex-S	Revalor-S
B	Synovex-C	None	Synovex-S	Revalor-S
C	Synovex-C	None	Revalor-IS	Revalor-S
D	Revalor-G	None	Revalor-IS	Revalor-S
E	No Implant	No Implant	No Implant	No Implant

**Key Words:** Value-Based Marketing, Holstein Steers, Growth Promotants

**4 Developing replacement heifers grazing winter range: forage nutrients and responses to supplementation.** R. C. Waterman<sup>\*1</sup>, J. E. Sawyer<sup>1</sup>, G. D. Pulsipher<sup>1</sup>, K. K. Kane<sup>1</sup>, D. E. Hawkins<sup>1</sup>, J. Horton<sup>2</sup>, and M. K. Petersen<sup>1</sup>, <sup>1</sup>New Mexico State University, Las Cruces, <sup>2</sup>Kemin Industries, Inc, Des Moines, IA.

Heifers grazing winter range require dietary nutrients to compliment forage for optimal growth. A study was conducted to evaluate nutritional environment and effect of different supplementation strategies for developing heifers grazing winter range at the Corona Range and Livestock Research Center, Corona N.M. In the first experiment, eighty-four Angus-cross heifers were stratified by weaning weight, allocated to one of six replicated pastures, and randomly assigned one of three supplemental treatments: 908 g/d of a control (C) supplement consisting of 340 g  $\text{hd}^{-1} \text{d}^{-1}$  CP with 130 g UIP (n=28), 908 g/d of a by-pass supplement (BP) consisting of 340 g  $\text{hd}^{-1} \text{d}^{-1}$  CP with 170 g UIP (n=27), and 1814 g/d of an energy supplement (E) consisting of 340 g  $\text{hd}^{-1} \text{d}^{-1}$  CP with 120 g UIP + 100 g propionate salt (NutraCal<sup>®</sup>, Kemin Industries, Inc.; n=29). Initially, heifers were weighed November 23, 1998, and monthly 12h shrunk weights obtained from January to April 1999. Diet samples collected at the beginning and end of the study provided 80 and 79% NDF, 5.2 and 7.7% CP, 50.1 and 51.5% forage digestibility, respectively. Average daily gain (ADG) throughout the study was similar ( $P > .2$ ) for heifers fed C, BP, and E (.20, .15, and .24 kg/d, respectively). Weight gain was greater ( $P < .02$ ) for E fed heifers between March and April (.03, .17, and .34 kg/d for C, BP, and E, respectively). In experiment 2, eight ruminally cannulated heifers receiving BP and E were fed individually and VFA concentrations were measured over one supplemental interval. The quantity of ruminal acetate was greater ( $P < .01$ ) for heifers fed E. A supplement-by-time interaction ( $P < .04$ ) was detected for ruminal accumulation of propionate and butyrate. Diet quality estimates indicated that dormant winter range does not satisfy the nutrient requirements of developing heifers and that different supplements may alter the pattern of body weight change by altering fermentation products.

**Key Words:** Heifer Development, Supplementation

**5 Appearance of giant cotyledons in the Large Offspring Syndrome.** M. Bertolini<sup>\*</sup>, T.R. Famula, and G.B. Anderson, University of California, Davis.

The transfer of *in vitro*-produced (IVP) bovine embryos can produce unusually large calves at term, resulting in a set of symptoms collectively called the *Syndrome of Large Offspring*. This study was designed to characterize fetal and placental development in IVP embryos. *In vitro*-produced embryos were derived from standard procedures for bovine *in vitro* maturation, fertilization and culture. Selected females were superovulated to obtain *in vivo*-produced embryos. Day 7 blastocysts from both groups were transferred to synchronous recipients. Six periparturient females in each group were observed for signs of labor until delivery. After birth, calves and fetal membranes, upon their expulsion, were weighed, morphologically inspected, and linearly measured. Birth weight, gestation length, fetal membrane weight, number of cotyledons and cotyledonary surface area between the *in vivo* and *in vitro* groups were compared by a multivariate analysis of variance. Birth weight ( $32.51 \pm 5.06$  vs.  $43.24 \pm 7.45$  kg;  $P < 0.0153$ ) and cotyledonary surface

area in the fetal horn ( $3101 \pm 550$  vs.  $4124 \pm 681 \text{ cm}^2$ ;  $P < 0.0169$ ) were different between groups. A highly significant difference in the distribution of cotyledonary size in the fetal horn ( $P < 0.0001$ , Wilcoxon test) was also observed. The larger cotyledonary surface area in the fetal horn in the *in vitro* group was associated with the presence of giant cotyledons (from 15 to 21 cm in diameter) in the same horn. This event may represent a compensatory mechanism for a lack of placentation, since the *in vitro* group displayed approximately 20% fewer cotyledons than the control group ( $80.5 \pm 27.5$  vs.  $101.5 \pm 37.6$ ), for a similar total cotyledonary surface area ( $4938 \pm 923$  vs.  $4107 \pm 1006 \text{ cm}^2$ ). In conclusion, significant differences exist in the distribution of cotyledonary diameter and surface area in the fetal horn between *in vivo*- and *in vitro*-derived concepti. An association is suggested between these two traits, and this increase is allied with an increase in birth weight.

**Key Words:** Large Offspring Syndrome, Placental and Fetal Development, Cattle

**6 Fecal progestins in the early gestation ewe monitored by gas chromatography/mass spectrometry.** C.W. Miller<sup>\*</sup>, H.H. Meyer, and D.W. Holtan, Oregon State University, Corvallis.

Previous work in this laboratory revealed that hormone analysis using fecal samples may predict the number of fetuses carried by pregnant ewes at mid to late gestation. Reliable lambing number prediction is useful to the producer. Using gas chromatography/mass spectrometry the 5 $\alpha$ - and 5 $\beta$ -series of pregnanes and selected 4- and 5-pregnenes were monitored in the feces of 36 black and white face cross ewes during early gestation. Feces were collected at d 5, 21, and 32 post-mating. Endoscopy was used at d 6 to determine the number of corpora lutea and lambing number data were collected at term. The number of corpora lutea was not related ( $P > .05$ ) to hormone concentrations at any of the sampling times (ANOVA-GLM). No differences in hormone levels were detected at d 5 in response to lambing number. At d 21, 5 $\beta$ -pregnane-3,20-dione and 5 $\beta$ -pregnane-3 $\beta$ ,20 $\alpha$ -diol were higher in ewes carrying triplets than ewes carrying twins ( $P < .008$ ). At d 32, 3 $\alpha$ -hydroxy-5 $\beta$ -pregnan-20-one was higher in ewes carrying triplets than twins ( $P < .05$ ). Five progestins, including progesterone and 20 $\alpha$ -hydroxy-progesterone, were lower at d 5 in ewes that conceived (n=26) than in ewes that did not conceive (n=6) at the first mating ( $P < .05$ ). Concentrations of ten progestins were different ( $P < .05$ ) (some higher and some lower) between groups of ewes that conceived at the first mating versus those that conceived at the second mating. In ewes that conceived at the second mating, some hormones were different ( $P < .05$ ) at d 5 than at d5 of their previous non-conceptive cycle. Of the six ewes that were mated a second time two still did not conceive but hormone concentrations were not different than those that did conceive at the second mating. Although there are differences in progestin profiles in ewes carrying different numbers of fetuses, concentrations alone are not adequate predictors of prolificacy at early gestation. It is inconclusive whether detection of pregnancy is possible as early as d 5 of gestation.

**Key Words:** Fecal progestins, Ewe, Pregnancy

**7 A one-year investigation of prevalence of verotoxin-producing Escherichia coli in dairy heifers grazing an irrigated pasture.** B. H. Thran<sup>\*</sup>, H. S. Hussein, S. F. Khaiboullina, and M. R. Hall, University of Nevada, Reno.

Cattle have been recognized as reservoirs of verotoxin-producing *Escherichia coli* (VTEC) since 1982 when human illnesses were traced to consumption of improperly cooked ground beef. Culled dairy cows or heifers harboring VTEC represent a potential hazard because they enter the food chain as ground beef. In the US, most investigations have focused on the serotype O157:H7 as the VTEC responsible for the reported outbreaks whereas worldwide, human illnesses are associated with other VTEC serotypes. In investigations of O157:H7, specific characteristics (i.e., sorbitol negative and 4-methylumbelliferyl- $\beta$ -D-glucuronide [MUG] negative) were used. The objective of this study was to assess the prevalence of VTEC in dairy cattle grazing an irrigated pasture over a one-year period. A herd of 26 yearling Holstein heifers grazed grass pasture with only supplementation of alfalfa hay (*Medicago sativa*) during winter. A total of 91 fecal samples were rectally collected during four periods (spring [April], summer [July], fall [October], and winter [December] of 1999). Nineteen heifers were sampled in all periods and 7 heifers were sampled one to three times. Using microbiological methods associated

with VTEC, 2,057 initial isolates were selected. A random sample of these isolates ( $n = 362$ ) were tested for cytotoxicity using verocytotoxicity tests. Positive cytotoxicity was detected for 10 isolates from two heifers (both from the winter collection). All 10 isolates were confirmed as *E. coli* by the API identification system. The 10 isolates were sorbitol negative and MUG positive (i.e., uncharacteristic of *E. coli* O157:H7) suggesting the presence of other VTEC serotypes. VTEC were only detected in our herd during winter with a prevalence rate of 9.5%. Previous research on *E. coli* O157:H7 indicated significant fluctuations in prevalence rate with the highest rates during summer. Our data on VTEC indicate exactly the opposite and suggest that other factors (in addition to season) are responsible for VTEC presence. Our results suggest the importance of screening dairy cattle for VTEC instead of limiting the assays to O157:H7. Identification of VTEC-positive dairy cattle before slaughter is a critical step in any on-farm strategy to minimize the risk of beef contamination with such pathogens.

**Key Words:** Food safety, Dairy Cattle, *Escherichia coli*

## 8 Windrow grazing versus feeding baled meadow hay to beef cows. A. D. Schleicher\*, B. W. Hess, D. W. Koch, L. J. Held, J. W. Flake, and L. Brokaw, *University of Wyoming, Laramie.*

Our objective was to monitor forage quality of hay left in windrows or bales and determine the effects of feeding each forage type on cow performance during a winter feeding period. Two irrigated hay meadows (16.2 and 10.1 ha) were harvested August 25 to 27, 1999. Swaths were raked together to double windrow size. Meadows were divided in half; on one half, all bales were removed, while on the other half alternate windrows were baled and removed. Forage samples were collected at harvest, October 4, and November 23 to 24, 1999, and January 12 to 14, 2000. Sixty-four pregnant, rotationally-crossed (Angus x Gelbvieh) cows (3-yr old,  $n = 36$ ; 4-yr old,  $n = 28$ ) were weighed on two consecutive days and body condition-scored (BCS) before being allotted to windrowed or baled forage from December 1, 1999 to January 12, 2000 in a randomized complete block designed experiment. Cow age, expected calving date, BW, and BCS were distributed equally across forage treatments. An interim BW was obtained on December 22 and cattle were weighed on two consecutive days at the conclusion of the experiment. Windrowed forage ADF content increased ( $P = .0012$ ) from 43.8 to 45.7%, whereas baled hay ADF content averaged  $41.9 \pm .5\%$  across sampling dates. Ash, NDF, and CP were not affected ( $P \geq .11$ ) by forage treatment. Cows grazing windrowed forage had greater ADG during the first 21-d period ( $P = .02$ ) and overall ( $P = .04$ ). As a result, cows consuming windrows were heavier at the mid ( $P = .02$ ) and final ( $P = .04$ ) weigh periods. Changes in BCS were not different ( $P \geq .25$ ) until the end of the experiment, when windrow-fed cows had .2 greater ( $P = .05$ ) BCS. We interpret these results to suggest that windrow grazing is an alternative to feeding baled forage to beef cows during winter.

**Key Words:** Beef Cattle, Forages, Windrow Grazing

## 9 Effects of supplemental energy and DIP on performance, grazing behavior, forage intake and digestion of steers grazing winter range. T. N. Bodine\*, H. T. Purvis II, and D. A. Cox, *Oklahoma State University, Stillwater.*

Fifty-two steers ( $286 \pm 7$  kg initial BW) and 8 ruminally cannulated steers ( $496 \pm 14$  kg) were individually fed 1 of 4 supplements 5 d/week while grazing dormant native tallgrass prairie. Supplements were: 1) CRSBM, corn and soybean meal, balanced for total diet DIP:TDN, 2) CORN, corn and soybean hulls, equal supplemental TDN to CRSBM, 3) SBM, soybean meal, equal supplemental DIP to CRSBM, or 4) CONT, cottonseed hull-based control. Supplements were fed at a rate of 13, 13, 4, or .6 g DM/(kg BWfeeding), respectively. Grazing time was measured for 5 d by 12 steers fitted with grazing collars. Fecal output was determined by feeding chromic oxide and collecting fecal grab samples each morning for 5 d. Fecal output was adjusted for calculated chromium recovery as determined from cannulated steers fitted with fecal bags. Forage intake was determined by dividing g of fecal forage AIA by AIA concentration of masticate samples. Forage digestion was calculated as masticate AIA concentration divided by fecal forage AIA concentration. Steers fed CRSBM, CORN and SBM had increased ( $P = .01$ ) ADG (.77, .29, .48, .05 kg/d), vs CONT-fed cattle, while steers fed CRSBM had greater ( $P < .01$ ) ADG than those fed CORN or SBM. Forage OMI (12, 12, 18, 18 g/kg BW) and OMD (38, 22, 59, 60%) were reduced ( $P < .01$ ) for steers supplemented with corn (CORN, CRSBM) vs those

not fed corn (SBM, CONT) while forage OMD was greater ( $P < .01$ ) for CRSBM than CORN. Grazing time (408, 421, 490, 493 min), intensity (32, 35, 63, 54 min/bout) and harvest efficiency (.027, .025, .039, .034 g OMI/(kg BWgrazing min)) were reduced ( $P < .01$ ) by corn supplements while grazing bouts (14, 13, 8, 10) were increased ( $P < .01$ ). Supplemented steers grazing dormant native range had improved performance with the greatest response in ADG coming when grain supplements were balanced for total diet DIP:TDN. These results suggest that grain-supplemented cattle grazing dormant native range require a balance of total diet DIP:TDN to optimize animal performance.

**Key Words:** Intake, Digestion, Grazing Behavior

## 10 Supplement and forage intake by grazing ewes fed either a block or pelleted supplement. N. Taylor\*<sup>1</sup>, P. G. Hatfield<sup>1</sup>, B. F. Sowell<sup>1</sup>, J.G.P. Bowman<sup>1</sup>, J. S. Drouillard<sup>2</sup>, and D. V. Dhuyvetter<sup>3</sup>, <sup>1</sup>Montana State University, Bozeman, <sup>2</sup>Kansas State University, Manhattan, <sup>3</sup>Farmland Industries, Kansas City, KS.

Targhee ewes ( $n = 120$ ) grazing winter range were used to determine the effects of a 25% CP (as-fed) supplement provided in block (B) or pellet (P) form on supplement and forage DMI and ewe BW change. The study was conducted in two 20-d periods in which treatments were crossed over pastures (upland, U and lowland, L). Forage samples were clipped in both pastures before each period to estimate 48-h forage *in situ* DMD. The P ewes were group fed 5.45 kg pellet/d in troughs. The B ewes had ad libitum access to a molasses block. Ytterbium chloride was added to supplements at the time of manufacturing to estimate supplement DMI. Thirty ewes from each treatment were dosed with sustained release chromium boluses on d 1 of each period to estimate fecal output, from which forage DMI was determined. The statistical model included supplement type, pasture, interaction, and ewe age as a covariable. Pasture by treatment interactions were detected ( $P < 0.01$ ) for all variables. Supplement DMI for PL, PU, BL, and BU was 114 (CV = 39.6%), 94 (CV = 27.8%), 75 (CV = 82.9%), and 32 g ewe<sup>-1</sup>d<sup>-1</sup> (CV = 116%). Percentage of ewes consuming less than 20% of mean supplement DMI for PL, PU, BL, and BU was 3.3, 0, 26.7, and 43.3, respectively. Percentage of ewes consuming between 80 and 120% of mean supplement DMI for PL, PU, BL, and BU was 23.3, 51.7, 10.0, and 6.7, respectively. Forage DMI was greater ( $P < 0.01$ ) for PL and lower ( $P < 0.01$ ) for PU than other pasture/treatment combinations, and did not differ ( $P = 0.60$ ) for B between U and L. The PU lost ( $P < 0.01$ ) the most BW and PL gained ( $P < 0.01$ ) more BW than other pasture/treatment combinations. Changes in BW did not differ ( $P = 0.27$ ) for B ewes in U and L. Variation in supplement DMI was greater for ewes with ad libitum access to block supplement than ewes limit fed pelleted supplement.

**Key Words:** Supplement Form, Supplement Intake, Sheep

## 11 Improving the feed value of barley for finishing steers. T. C. Blackhurst\*, J.G.P. Bowman, L.M.M. Surber, T. K. Daniels, and T. K. Blake, *Montana State University, Bozeman.*

The objectives of this project were to evaluate feed quality of two experimental barley lines, LB6 and LB57, developed by crossing Baronesse (2-row, feed type) and Lewis (2-row, feed and malting type). Eighty crossbred steers (avg initial wt 374 kg) were allotted to 16 pens in a randomized complete block design with pen as the experimental unit. During the 159-d feeding trial steers consumed an 83% barley diet based on: 1) Baronesse; 2) Lewis; 3) LB6 or 4) LB57. All diets were balanced to contain 13% CP and 83% barley. Steers were weighed, and diet, ort, and fecal samples were collected every 28 d. Acid insoluble ash was used as an internal marker to estimate fecal output. Steers were slaughtered when 70% were visually estimated to grade Choice. Data were analyzed by the GLM procedure of SAS to detect treatment differences. Planned comparisons were made between LB6 and the mean of Baronesse and Lewis, and between LB57 and the mean of Baronesse and Lewis. No differences ( $P > 0.10$ ) were found in ADG between barley lines (avg 1.5 kg/d). No differences ( $P > 0.10$ ) were found between LB57 and the parent varieties in DMI, DMD, starch digestibility or feed efficiency (kg gain/100 kg feed). Dry matter intake was 4.7% greater ( $P = 0.004$ ) by steers fed Baronesse and Lewis than by steers fed LB6 (avg 8.9 vs 8.5 kg/d). Feed efficiency was 5.4% higher ( $P = 0.07$ ) for steers fed LB6, than steers fed the parent lines (13.6 vs 12.9, respectively). LB6 steers had greater ( $P = 0.03$ ) *in vivo* DMD than steers fed the parent lines (74.7 vs 73.2%). Acid detergent fiber intake was 17% higher ( $P = 0.01$ )

by steers fed LB57, and 4% lower ( $P = 0.01$ ) by steers fed LB6 than by steers fed Baronesse or Lewis. Steers fed LB6 had lower ( $P = 0.06$ ) marbling scores (small 40 vs small 75) than steers fed parent lines. No other differences ( $P > 0.10$ ) were found in carcass traits. Results indicate that experimental barley line LB6 had improved *in vivo* DMD and feed efficiency compared with the parent cultivars, Baronesse and Lewis.

**Key Words:** Barley, Feedlot Performance, Steers

**12 Effects of postpartum supplementation with two types of cracked safflower on production, reproduction, metabolites, and hormonal profiles of primiparous beef heifers.** J.D. Bottger<sup>\*1</sup>, D.L. Hixon<sup>1</sup>, B.W. Hess<sup>1</sup>, R.N. Funston<sup>2</sup>, D.M. Hallford<sup>3</sup>, L.F. Woodard<sup>1</sup>, and G.E. Moss<sup>1</sup>, <sup>1</sup>University of Wyoming, Laramie, <sup>2</sup>USDA-ARS, Miles City, MT, <sup>3</sup>New Mexico State University, Las Cruces.

Thirty-six Angus x Gelbvieh primiparous heifers were used to determine effects of supplementing two types of cracked safflower seeds on cow weight, body condition score, calf weight, weaning weight, reproduction, metabolites and hormonal profiles. Three supplements were fed: a corn/soybean meal control (C); high linoleate safflower seeds (L; 76% 18:2); and, high oleate safflower seeds (O; 72% 18:1). All supplements were formulated to be isocaloric and isonitrogenous and were individually fed at 0700 daily starting 72 h postpartum for 90 d. Safflower seed supplements were formulated to supply 5% of total intake as lipid. Blood samples were collected twice weekly starting at 25 d postpartum for progesterone analysis to determine the onset of cyclicity. Samples collected at d 0, 30, 60 and 90 were analyzed for IGF-I, Insulin, GH, NEFA, and glucose. Cows were milked at d 30, 60, and 90. No differences were detected in the amount of milk produced however, at d 60 milkfat was greater in the O (3.73%) than the L heifers (3.28%); at d 90 milkfat was greater in C (3.88%) than L (3.51%;  $P < 0.05$ ) heifers. By d 60 and 90, respectively, body condition scores of L (4.86, 4.85) heifers were greater ( $P < 0.05$ ) than O (4.46, 4.52) or C (4.69, 4.65) heifers. Type of supplement had no effect on length of the postpartum interval, breeding percentage, cow or calf weight change, calf weaning weight, and total or forage organic matter intake. Overall mean serum concentrations of Insulin and IGF-I were greater ( $P < 0.05$ ) than either the O or the C heifers. Neither L nor O supplementation influenced GH, glucose or NEFA concentrations. Safflower seed supplementation had no effect on the overall productivity but did influence milk composition at d60 and 90 in this group of primiparous beef heifers under the conditions of this study.

**Key Words:** Safflower Seeds, Beef Heifers, Supplementation

**13 Effects of oscillating dietary protein on ruminal fermentation and flows of N fractions to the small intestine in sheep.** T. L. Wechter<sup>\*</sup>, P. A. Ludden, B. W. Hess, J. D. Heeg, E. J. Scholljegerdes, L. Brokaw, A. D. Schleicher, J. Gould, and K. R. Bessler, University of Wyoming, Laramie.

Eight cannulated wethers (BW = 52.5 ± 5.7 kg) were used in a 4 × 4 Latin square designed experiment to evaluate the effects of oscillating dietary protein on ruminal fermentation and flows of N fractions to the small intestine in sheep. Four treatments consisted of 11, 13, or 15% CP diet fed daily, or dietary CP was oscillated between 11 and 15% on a 48-h basis (ACP). All diets consisted of 65% bromegrass hay (9.0% CP, 61% NDF, 37% ADF) plus 35% corn-based supplement, and were formulated to contain the same amount of DIP (8.5% of DM), plus additional UIP (SoyPLUS<sup>®</sup>, West Central Cooperative, Ralston, IA) to accomplish CP levels above 11%. All wethers were fed at 3.0% of initial BW (DM basis) throughout the experiment, resulting in an average OMI of 1.39 kg/d across treatments. When compared to the 13% CP daily treatment, feeding ACP had no effect ( $P > .10$ ) on ruminal or lower tract N or OM digestion in this experiment. True ruminal OM digestion responded quadratically ( $P = .08$ ) to increasing CP, reaching a maximum of 725 g/d (51.9% of OM intake) with the 13% CP treatment. Microbial efficiency did not differ ( $P > .10$ ; avg = 27.3 g of N/kg of OM truly fermented) and thus bacterial N flow at the duodenum responded quadratically ( $P < .05$ ) to increasing CP, improving to 19.6 g/d for lambs fed 13% CP. Nonbacterial ( $P < .001$ ) and total ( $P < .01$ ) N flows at the duodenum and total tract N digestibility ( $P < .05$ ) increased linearly as dietary CP increased from 11 to 15%, reflecting the increased UIP content of the diet. Because the CP content of the

diet was increased at the expense of corn, the response to increased CP observed in this experiment is mostly likely due to associative effects of starch supplementation on forage digestion. However, oscillating the CP content of the diet did not influence ruminal or post-ruminal digestibility of nutrients compared to feeding a 13% CP diet daily in this experiment.

**Key Words:** Nitrogen Flows, Oscillating Protein, Sheep

**14 Winter supplementation of primiparous heifers grazing winter range based on the Metabolizable Protein System versus the Crude Protein System.** H. H. Patterson<sup>\*</sup>, D. C. Adams, T. J. Klopfenstein, and B. Teichert, University of Nebraska, Lincoln.

Metabolizable protein (MP) requirements of spring calving heifers increase over the winter due to advancing gestation. MP content of grazed winter forage is low, which may result in an MP deficiency in the heifer. The objective of this experiment was to compare the response of supplementing pregnant yearling heifers to meet MP requirements versus conventional CP supplementation. In 1997-98 and in 1998-99, pregnant, March calving heifers (2,375 hd; 358 ± 10 kg), at two locations of a commercial ranch in the Nebraska Sandhills, were used following breeding through calving as two-year-olds. Heifers were randomly allotted to one of two suppl. treatments (approximately 300 hd/treatment) each year at each location (Locations A and B). Treatments were: 1) suppl. to meet MP requirements (MPR) or 2) suppl. to meet CP requirements (CPR). Heifers grazed fall/winter range and meadow and were offered supplements three times weekly from mid-September to mid-February. Increasing amounts of meadow hay were fed from mid-December through calving. Heifers from each treatment were managed in one group at each location from mid-February to October of each year. Body weights (BW) and body condition scores (BCS) were taken in September, February, and October. Pregnancy rate (PR) was determined by palpation in October. There were no differences in BW or BCS between treatment groups across years and locations ( $P > .10$ ), but there was a treatment X year X ranch interaction in PR ( $P = .07$ ). In 1997-98, MPR heifers had a higher PR ( $P = .01$ ; 84%) than CPR heifers (75%). The PR was 95% for both treatments at Location A in 1997-98. At location A in 1998-99, the MPR heifers had a higher PR ( $P = .01$ ; 95%) than CPR heifers (88%), and MPR heifers at location B tended to have a higher PR ( $P = .15$ , 89%) than CPR heifers (85%). Supplementing heifers over-winter to meet MP requirements improved pregnancy in one of two locations in both 1997-98 and 1998-99.

**Key Words:** Heifers, Metabolizable Protein, Pregnancy

**15 Effect of increasing undegradable intake protein (UIP) on net portal and hepatic flux of nutrients and insulin in beef heifers that consume low-quality forage.** G. D. Pulsipher<sup>\*</sup>, C. R. Krehbiel, L. A. Balstad, B. M. Capitan, M. S. Brown, and D. M. Hallford, New Mexico State University, Las Cruces.

Eight crossbred heifers (initial BW = 239.1 ± 4.8 kg) fitted with hepatic venous, hepatic portal, mesenteric venous, and abdominal aortic catheters were used in an 8 × 5 incomplete Latin square design. The objective was to evaluate the effect of increasing UIP on portal-drained visceral (PDV) and hepatic nutrient and insulin flux. Heifers were fed low-quality grass hay (5.38% CP, DM basis) ad libitum and assigned to one of five supplemental treatments. Supplements were control (no supplement; NC), 200 g/d of degradable intake protein and 100 (LUIP), 200 (MUIP), or 300 (HUIP) g/d of UIP, or soybean meal/urea (SBM) fed at equal CP to HUIP. Supplement was fed (.91 kg hd<sup>-1</sup> d<sup>-1</sup>) at 0730. Simultaneous arterial, portal, and hepatic blood samples were taken hourly from 0700 to 1600, and portal and hepatic blood flows were determined by continuous infusion of *p*-aminohippurate. Portal-drained visceral flux of ammonia and a-amino N (AAN) were greater ( $P < .01$ ) when protein was fed compared with NC. In addition, PDV flux of ammonia N increased ( $P = .02$ ) in heifers fed SBM (291.8 mmol/h) compared with heifers fed HUIP (137.65 mmol/h), whereas PDV flux of AAN increased ( $P = .02$ ) in HUIP (155.81 mmol/h) compared with SBM heifers (112.95 mmol/h). Arterial AAN concentration did not differ ( $P = .28$ ) between HUIP and SBM. Ammonia and AAN PDV flux changed (quadratic,  $P = .04$ ) with UIP; ammonia and AAN were greater and lower, respectively, for heifers fed MUIP than for heifers fed LUIP or HUIP. In general, ammonia and AAN removal by the liver increased as PDV release increased, although total splanchnic release of AAN increased linearly (L;  $P = .03$ ) as UIP increased. Net removal of urea N by the PDV was

greater ( $P < .01$ ) when protein was fed compared with NC, and decreased ( $L, P < .01$ ) as UIP increased. Portal release of insulin tended to be greater in supplemented (253.6 ng/h) vs NC (175.6 ng/h) heifers, and hepatic insulin release increased ( $L, P = .04$ ) with increasing UIP. Arterial insulin concentration did not differ ( $P > .10$ ) between SBM and HUIP. Our data suggest increased absorption of amino acid N with increasing protein. In addition, pattern of absorption of nitrogenous compounds is altered when different sources and amounts of protein are fed to ruminants that consume low-quality forage.

**Key Words:** Heifers, Undegradable Intake Protein, Net Flux

**16 Effect of ethanol and oil supplementation on site and extent of digestion in wethers fed forage-based diets.** J. Gould\*, E. Scholljegerdes, B. Hess, P. Ludden, and D. Rule, *University of Wyoming, Laramie*.

Our hypothesis was that ethanol may provide cellulolytic bacteria with an alternative energy source when dietary vegetable oil is added to forage-based diets. Eight wether lambs (initial BW  $60.9 \pm 16.8$ ) fitted with ruminal and duodenal cannulae were used in a replicated 4 x 4 Latin Square designed experiment to determine if ethanol supplementation can overcome the negative effects of dietary vegetable oil on forage digestion. Treatments were arranged in a 2 x 2 factorial, with the main factors being ethanol addition (control vs ethanol added at 2% of diet DM) and soybean oil supplementation (control vs 6% added soybean oil). Diets were formulated to be isonitrogenous and isoenergetic (TDN basis) using bromegrass hay, cracked corn, soybean meal, and corn gluten meal. Each of the four experimental periods were 14 d in length with 10 d adaptation, followed by 4 d of collection of duodenal and fecal samples at 4 hr intervals. No interactions ( $P \geq .32$ ) between ethanol and oil addition were detected in this experiment. The addition of 6% soybean oil decreased apparent ruminal ( $P = .03$ ), lower ( $P = .02$ ), and total ( $P < .01$ ) tract OM digestibility. Although ruminal NDF digestibility was not affected ( $P = .44$ ), lower ( $P = .04$ ) and total ( $P < .01$ ) tract NDF digestibility decreased with oil addition. An increase ( $P = .01$ ) in apparent ruminal OM digestibility was noted with the addition of ethanol. Ethanol tended ( $P = .19$ ) to increase ruminal NDF digestibility, which is consistent with ruminal OM digestibility. Lower tract OM digestibility was decreased ( $P = .03$ ) with ethanol, therefore apparent total tract digestibility did not change ( $P = .90$ ) for the ethanol treatment. Apparent ruminal ( $P = .04$ ) and lower tract ( $P = .04$ ) N digestibility decreased with the addition of ethanol. In this experiment, ethanol was not able to alleviate the adverse effects vegetable oil had on diet digestibility.

**Key Words:** Digestibility, Ethanol, Soybean Oil

**17 The influence of level of feed restriction on forage digestibility by beef cattle.** E. J. Scholljegerdes\*, B. W. Hess, and P. A. Ludden, *University of Wyoming, Laramie*.

Eight Angus Gelbvieh heifers (initial BW  $445 \pm 74.5$  kg) fitted with ruminal and duodenal cannulae were used in a 4 x 4 Latin square double cross-over designed experiment to assess the effect of restricted forage intake on diet digestibility and ruminal fermentation patterns. Heifers were fed chopped (2.54 cm) bromegrass hay (9.2% CP, 65% NDF) at 120, 90, 60, or 30% of maintenance intake requirements. Experimental periods were 21 d in length with 17 d adaptation followed by 4 d intensive sample collection, after which maintenance requirements and subsequent levels of intake were adjusted for BW change. Total duodenal OM and bacterial OM flow increased linearly ( $P < .01$ ) from 30 to 120% of maintenance intake. Ruminal and total tract NDF digestibility did not differ ( $P \geq .27$ ) from 30% to 120% of maintenance intake. Total OM and feed N flow increased linearly ( $P < .01$ ) but true ruminal OM and N digestibility did not differ ( $P \geq .23$ ). from 30 to 120% of maintenance intake. Microbial efficiency did not differ ( $P \geq .29$ ) but bacterial N flow increased linearly ( $P < .01$ ) from 30 to 120% of maintenance intake. Digestion of OM, N and NDF expressed as g/d increased linearly ( $P < .01$ ) from 30 to 120% of maintenance intake. Ruminal  $\text{NH}_3$  N concentration did not differ ( $P = .16$ ), whereas duodenal  $\text{NH}_3$  N flow increased linearly ( $P < .01$ ) from 30 to 120% of maintenance intake. Ruminal pH decreased linearly ( $P < .01$ ) as level of intake restriction increased. Ruminal fluid passage rate increased linearly ( $P < .01$ ) from 30 to 120% of maintenance intake. Total ruminal VFA increased linearly ( $P < .01$ ), ruminal molar proportions of acetate decreased ( $P < .01$ ), and molar proportions of propionate tended ( $P = .07$ , cubic) to increase as intake

increased from 30 to 120% of maintenance intake. Diet digestibility did not markedly improve as level of diet restriction increased. The total amount of substrate presented to the bacteria likely created an energy limitation, resulting in decreased microbial growth with a subsequent reduction in forage digestibility.

**Key Words:** Feed Restriction, Forage, Digestion

**18 Effect of inbreeding and age of dam on Hereford scrotal growth and circumference.** D. C. Anderson\*<sup>1</sup>, D. D. Kress<sup>2</sup>, D. L. Boss<sup>1</sup>, and K.C. Davis<sup>2</sup>, <sup>1</sup>*Northern Agricultural Research Center, Havre, MT*, <sup>2</sup>*Montana State University, Bozeman*.

Scrotal circumference was measured every 28-d during a 140-d feed test to 1 yr of age on Hereford bull calves to develop scrotal circumference adjustment factors for age of dam, inbreeding of calf and age of calf. Measurements (1,947) were taken on 417 calves from 1983 to 1998. All calves were produced in the linebred herd at Northern Agricultural Research Center during a selection project to maintain birth weight while increasing yearling weight utilizing a selection index. Five scrotal circumference measurements were taken during the feed period starting with an initial (S1) measurement taken 6 wk after weaning and measurements taken every 28-d to the end of the feed test (S5) when calves were approximately 1 yr of age. Average final weight ranged from 410 kg to 454 kg during the 16 yr studied. Averages for S1 and S5 were 23.3 cm and 30.8 cm, respectively. Scrotal measurements were analyzed using the general linear models procedure of SAS. The model included year, cow age (2, 3, 4, 5-10, 11+), period, age x period interaction, and the covariates calf age, cow inbreeding, and calf inbreeding. Cow inbreeding was not a significant source of variation for scrotal circumference. Calf inbreeding affected S5 ( $P = .13$ ) and reduced scrotal circumference by .042 cm/% inbreeding. Year and age of dam were important ( $P = .01$ ) on the effect of scrotal circumference. Correction factors for age of dam when scrotal circumference is taken at S5 are (0) for 5-10 yr-old, (-.15 cm) for 4 yr-old, (+.76 cm) for 3 yr-old, (+1.60 cm) for 2 yr-old, and (+.30 cm) for 11+ yr-old. Scrotal growth during the five periods was curvilinear ( $P = .05$ ). Calf age affected ( $P < .01$ ) scrotal circumference at 0.031 cm/d when taken at S5. For scrotal circumference to be used in sire selection at 1-yr of age, appropriate adjustment factors for calf age, age of dam, and inbreeding of calf need to be used.

**Key Words:** Scrotal Circumference, Inbreeding, Beef Cattle

**19 Economic values for tenderness in beef cattle.** P.L. Charteris\*<sup>1</sup>, D.L. Hoag<sup>1</sup>, S.K. Koontz<sup>1</sup>, P.R. Amer<sup>2</sup>, and B.L. Golden<sup>1</sup>, <sup>1</sup>*Colorado State University, Fort Collins*, <sup>2</sup>*Invermay Agricultural Center, Mosgiel, New Zealand*.

The aim of this study is to estimate the change in farm income resulting from a genetic change in beef tenderness. We constructed a hypothetical but realistic model of tenderness, assessed as Warner-Bratzler shear force (WBS) at a population mean from 2.0 to 7.0 kg, together with four tenderness classes representing tender, acceptable, slightly tough and tough carcasses were constructed with premiums and discounts varying between classes. Carcass value at each WBS was the product of fraction of carcasses within tenderness class together with premiums and discounts within each class. Such a pricing system would be consistent with an alliance rewarding participants for enhanced tenderness. This is not a feature of current carcass pricing. Economic value was derived as the impact of a marginal (-.1 kg) change in sire breeding value for WBS on future farm income. Economic value for WBS was worth up to \$520 in increased future farm income. Economic value for genetic change in WBS was a maximum at WBS of 2.7, 3.2 and 3.8 kg for payment systems that included premiums for tender beef, payments + discounts or discounts for tough beef, respectively. Derived economic values were non-linear over the range in WBS and sensitive to both population mean WBS and payment system. The value of selection for enhanced tenderness, as WBS, was greatest when payments included both premiums and discounts for tenderness. Inclusion of tenderness in genetic evaluation should be assessed relative to the population mean for WBS and payment system.

**Key Words:** Selection Index, Selection Criteria, Tenderness

**20 Development of economic expected progeny differences.** K. Giacomini\* and J. L. Beckett, *California Polytechnic State University, San Luis Obispo.*

The incorporation of Expected Progeny Differences (EPD) as a management tool has become an essential component for the selection of sires in commercial cow/calf operations. However, EPDs for many traits have limited economic importance, particularly for certain marketing alternatives. The development of an economic EPD model combining growth and performance traits with current marketing opportunities would enable producers to directly compare sires in terms of plus or minus dollars. To accomplish this a Microsoft Excel spreadsheet was constructed to convert current EPD values for weaning weight, yearling weight, carcass weight and grid carcass traits into dollar values based on current market conditions. Genetic data were collected from the Angus Sire Summary. Current market conditions were determined through CattleFax and USDA reports. Weaning value, yearling value and carcass value EPDs were determined by multiplying weaning weight, yearling weight and carcass weight EPDs by the respective dollar value reported for their respective weights. Grid price value was determined by combining the relative change in quality grade value and yield grade value, and adding those changes to the basis reported by the USDA. Quality grade value was estimated by multiplying the marbling EPD by the marginal value change based on the current Choice-Select spread. Yield grade value was estimated by multiplying the marginal value of Yield Grade by the change in yield grade based on backfat, ribeye area and carcass weight EPDs. The economic EPDs are to be used to estimate the increased value of offspring from different bulls for various marketing alternatives. These EPD values are to be used in the same manner as the already established EPD values, for comparison only; they are not a prediction of increased revenue to the producer. This new evaluation method may bring added value to the marketing of sires as well as to the potential purchaser.

**Key Words:** Expected Progeny Differences, Economic Traits

**21 Trace minerals for beef cattle on the web.** D. Drake\*, L. Smith, J. Maas, J. Oltjen, and A. Ahmadi, *University of California, Davis.*

Trace mineral concentrations in soil, forages and feeds vary widely throughout California. Deficiencies of selenium and copper are among the most commonly diagnosed problems in beef cattle. Widespread shipment of cattle also presents challenges for producers, nutritionists and veterinarians to provide adequate trace minerals. Historical data from Cooperative Extension advisors and the California Veterinary Diagnostic Lab samples for selenium, copper, zinc and phosphorus from blood and liver were collected, summarized, interpreted and published for each county in California on a web page (<http://animalscience.ucdavis.edu/extension/mineralproject/>) to facilitate widespread availability of statewide trace mineral data. Data was categorized into Class 1, samples collected in randomized surveys, Class 2, non-random samples from field trials or suspected problem cattle or Class 3, sick cattle of unknown history. Number, average, minimum and maximum for individuals and herds are provided on the web page. Text regarding interpretation is included. Additional information on testing and supplementing trace minerals plus a unit conversion calculator are included on the web page. The web page provides a convenient source of statewide data on trace minerals and is easily updated. It also helps identify areas for which insufficient data on the various minerals exists.

**Key Words:** Minerals, Web, Nutrition

**22 Survey of production practices of Colorado cow-calf producers.** D.E. Mount\*, J.C. Whittier, and D.L. Hoag, *Colorado State University, Fort Collins.*

This survey was conducted to obtain current information regarding demographics, ranch management, and marketing practices among Colorado ranchers and farmers. Information from the survey will be used to formulate strategies for extension and research programs that help producers improve production and marketing practices. Each operation surveyed was thoroughly described in four main categories; ranch, rancher, management practices, and issues/technology. The category of management addresses such topics as nutrition, reproduction, finances, marketing, and animal health. A stratified sample of cow-calf producers, based on herd size, was selected from 11,700 producers. The survey

was mailed to 1,600 producers of whom 396 responded, resulting in a response rate of 24.8 percent. The respondents were divided into subclasses by region, herd size, and type of operation. The results were tabulated state wide as well as within production regions by these subclasses. On a statewide basis, the average producer of those that responded owned 230 cows, and controlled 401 total cattle. The average respondent controlled 1,612 deeded hectares, 596 private leased hectares, and 2,557 public leased hectares. The average age of respondents was 55 years old with 32 years experience in the ranching business. Detailed results will be made available to Colorado extension and experiment station personnel. These personnel, at both the regional and statewide level, will determine appropriate conclusions. Results from this survey will enable research and extension programs to more accurately target the intended audience.

**Key Words:** Colorado, Cow-Calf, Survey

**23 Randomizing variables in quantitative animal science assignments.** J. L. Beckett\*, *Cal Poly State University, San Luis Obispo.*

Effective methods to teach quantitative procedures are essential for students to gain skills in accounting, least-cost analyses, what-if scenarios, etc. Many pedagogical methods, such as hands-on problem solving, are utilized to teach these principles. However, quantitative problem sets present teaching problems specific to their situations. For example, it is very difficult to ensure that number-based assignments are completed as original work by each student. To address these concerns, an assignment technique was developed and tested to determine its effectiveness in (1) learning to perform breakeven calculations and conduct sensitivity analyses, and (2) ensuring that students complete their own work. The assignment was developed as a spreadsheet in Microsoft Excel to calculate the breakeven price and profitability in a cattle feedlot situation. Variables were generated using the random number function for each individual student. The assignment was to calculate breakeven prices and profitability in the individualized feedlot scenario. After completing the project, the students utilized the Excel spreadsheet to determine the sensitivity of profit to each of the variables. Following completion of the project, students were surveyed to determine their perceptions of this teaching technique. Of the 41 students in the class, 95% answered strongly agree or agree with the statement I found the assignment to be beneficial to my understanding of the concepts of breakeven price and profitability. Although the students rated the difficulty level (range 1-7) an average of 5.6, 56% percent of the respondents preferred the personalized assignment method to teach the principles of breakeven price and profitability. Finally, 88% answered strongly agree or agree with the statement I feel that the assignment is an appropriate learning exercise for a class of this level. In summary, the use of a randomly-generated assignment decreases effort expended on grading, eliminates copying, and is perceived as a positive learning opportunity by the students.

**Key Words:** Animal Science Teaching, Spreadsheet

**24 Relationship between esophageal diet samples, clipped forage samples, and weight gain of steers.** M. Blummel\* and E. E. Grings, *USDA-ARS, Fort Keogh LARRL, Miles City, MT.*

Pasture quality and weight gain (WG) of steers were measured from May to September in 1993 and 1994 to ultimately predict animal performance by laboratory analysis. Pasture quality was assessed monthly based on esophageal diet sampling (EDS) as well as on clipped forage samples (CFS). EDS and CFS were analysed for conventional chemical parameters and 48 h *in vitro* organic matter digestibility (IVOMD); additionally, kinetics of fermentation were estimated by an *in vitro* gas production (GP) test. Kinetics of GP were described by a simple exponential model, by an exponential model including lag phase, and by a sigmoidal model. To assess the possible impact of rumen-hepatic nitrogen (N) recycling on forage utilization, CFS were incubated in N unsupplemented and N supplemented incubation medium. Monthly WG of steers from May to September were 1.50, 0.92, 0.84, 0.85, and 1.42, 0.91, 0.47, and 0.85 kg/day in 1993 and 1994, respectively. Chemical parameters and IVOMD of EDS were more closely related to WG than the respective parameters of CFS ( $P < 0.01$  vs  $P < 0.05$ ). No kinetic model of *in vitro* GP fit all periods. Exponential models provided a better fit ( $P < 0.05$ ) than the sigmoidal model in early season while the reverse was true for later season. *In vitro* GP from EDS was positively related

to WG accounting for a maximum of 79% ( $P < 0.01$ ) of the variation in WG while this relationship was only insignificant for CFS incubated in N unsupplemented medium. Supplementation with N improved this relationship and up to 70% ( $P < 0.01$ ) of the variation in gain was thus accounted for. Recycled N in the animal will contribute to available N thus increasing the fermentation of forage over that level observed in N unsupplemented CFS incubations. Best correlations with WG were obtained by a statistical combination of IVOMD and GP values of EDS and up to 87% ( $P < 0.001$ ) of the variation in WG was thus accounted for. In this model the regression coefficients were positive for IVOMD but negative for GP.

**Key Words:** Esophageal Diet Samples, Clipped Forage Samples, *In vitro* Gas Production

**25 Variation of trace minerals in forage by season and species and the effects of mineral supplementation upon beef cattle production.** J. E. Sprinkle\*, E. J. Bicknell, T. H. Noon, C. Reggiardo, D. F. Perry, and H. M. Frederick, *University of Arizona, Tucson.*

The objectives of this study were to determine: (1) how concentrations of copper, selenium, and zinc varied by season of the year or pasture among different range forage species; (2) if an oral trace mineral supplement was effective in raising blood values of copper and selenium; and (3) if trace mineral supplementation had an effect upon conception. Repeated forage samples were collected over two years from forbs, half-shrubs, cool season perennial grasses, warm season perennial grasses, and cool and warm season annual grasses at 5 different range sites on a ranch near Globe, Arizona. Sixty lactating Barzona cattle were assigned to either receive an oral trace mineral supplement or no supplement for one summer grazing season. Blood Cu and Se, body weight, body condition, and pregnancy status were determined before and after treatment. Pregnancy status was also assessed during the early part of the breeding season the following year. Concentrations in forage of both Cu and Zn were marginally deficient at  $7.0 \pm .19$  and  $20.5 \pm .53$  ppm, respectively. Selenium in forage was deficient at  $0.05 \pm .002$  ppm. There were no differences in forage Se, Cu, or Zn concentrations by year, but levels of Cu and Zn increased ( $P < .01$ ) with increased winter and summer moisture, respectively. Concentrations of Cu in forbs were greater ( $P < .001$ ) than in other forage classes. Zinc concentrations also tended ( $P < .10$ ) to be greater in forbs. There were no differences ( $P > .10$ ) in changes in cow body weight from spring to fall for treated ( $5.4 \pm 8.6$  kg) vs control ( $-7.3 \pm 10.9$  kg) cows. Prior to treatment, Cu and Se blood levels were marginally deficient in both treatment groups. After the grazing season, Se and Cu levels in both treatment groups were adequate, but treated cows had greater ( $P < .001$ ) levels of Se in the blood ( $0.18 \pm 0.007$  vs  $0.14 \pm 0.009$  ppm). Early breeding season conception (Jan. to Apr.) for lactating treated cows was 14% compared to 0% for lactating control cows during the year following treatment ( $P < .05$ ). Trace mineral supplementation to cattle deficient in Se may positively impact reproduction. Forbs appear to have greater concentrations of Cu than do other types of forage. Concentrations of Cu and Zn in forage appear to increase with greater moisture, but this does not appear to be the case for selenium.

**Key Words:** Beef Cattle, Minerals, Selenium

**26 Influence of cow age on consumption of hand-fed supplements and subsequent performance of beef cows winter grazing stockpiled forage.** N. A. Suverly\*<sup>1</sup>, T. DelCurto<sup>2</sup>, J. Jaeger<sup>2</sup>, and M.R. Keller<sup>1</sup>, <sup>1</sup>Oregon State University, Corvallis, <sup>2</sup>Eastern Oregon Agricultural Research Center, Oregon State University, Union.

Fifty mature British X Continental cows (average wt = 527.9 kg) were used to evaluate the effect of cow age on variation in intake of a hand-fed oat/biuret supplement (20% CP) during two winters of grazing stockpiled forage. Cows were allotted into five groups of ten cows representing the following cow age groups: 3, 5, 7, 9, and 11-yr cows for yr 1, and 4, 6, 8, 10, and 12-yr cows for yr 2. In yr 2, five cows from each treatment group were randomly selected and dosed with sustained release Cr<sub>2</sub>O<sub>3</sub> boluses on d 28 of the trial to estimate fecal output (FO) and forage intake. The remaining five cows of each age group were fed Cr<sub>2</sub>O<sub>3</sub> mixed within the ground oat/biuret supplement (20% CP) at a rate of 2.22 g/kg of supplement to determine supplement intake. In year 1, weight change at d 57 for 11-yr cows was greater ( $P < .10$ ) than 5-yr cows yet,

weight change did not differ ( $P > .10$ ) among ages 9-yr and younger. Weight change at d 70 and calving did not differ ( $P > .10$ ) among the age groups. In yr 2, weight change at d 56 for 4-yr cows was greater ( $P < .10$ ) than 6, 8, 10 and 12-yr cows and 12-yr cows was less ( $P < .10$ ) than 6 and 10-yr cows. Likewise, weight change at calving for 4-yr cows was greater ( $P < .10$ ) than 6, 8, and 12-yr cows. Forage intake of 10-yr cows was greater ( $P < .10$ ) than 8 and 4-yr cows yet, there was no difference ( $P > .10$ ) among 10, 12, and 6-yr cows. In contrast, supplement intake of 4-yr cows was greater ( $P < .10$ ) than 10, 12, and 8-yr cows yet, did not differ ( $P > .10$ ) when compared to 6-yr cows. There was no difference ( $P > .10$ ) in supplement intake among cows 8-yr and older. We conclude that 3 and 4-yr cows displayed the best response to hand-fed supplementation of stockpiled forages in terms of performance. Supplement intake was influenced by cow age with cows 6-yr and younger consuming the highest amounts.

**Key Words:** Beef Cattle, Hand-Fed Supplements, Intake

**27 Determination of genetic markers associated with forage quality of barley for beef cattle.** L.M.M. Surber\*, J.G.P. Bowman, T. K. Blake, V. E. Nettles, A. L. Grindeland, M. T. Stowe, R. L. Endecott, K. N. Robison, B. L. Robison, and D. R. See, *Montana State University.*

Despite the importance of forage quality to animal performance, barley forage quality has not been used as a selection criterion in barley breeding programs. Our objectives were to evaluate Steptoe/Morex doubled haploid (DH) population for forage quality, identify Quantitative Trait Loci (QTLs) for forage quality, and determine if there is a genetic basis for nitrate accumulation. The 145 lines were grown in a replicated field trial ( $r = 2$ ) under irrigated conditions in Bozeman, MT. Forage samples were collected at plant anthesis (P1). A 0.15 m clip sample of one row was cut at stubble height and dried at 60°C for 48 h. Dry matter forage yield (FY) was determined. Forage samples were ground to pass a 5-mm screen. In situ DM digestibility (ISDMD) at 48 h was determined. A sub-sample of each line was evaluated for NDF, ADF, N, and NO<sub>3</sub>-N. Data were analyzed using the GLM procedure of SAS. Genetic variation was present between lines for NDF, ADF, ISDMD, N and NO<sub>3</sub> ( $P < .04$ ). Population ISDMD ranged from 68.6 to 84.2% (CV = 3.2%), ADF ranged from 21.3 to 35.1% (CV = 6.3%), N ranged from 2.3 to 4.1% (CV = 9.3%), and NO<sub>3</sub>-N ranged from 0.2 to 1.1% (CV = 22.2%). Correlation analysis indicated that ISDMD is positively correlated ( $r = .70$ ,  $P = .0001$ ) with N and negatively correlated ( $r = -.57$ ,  $P = .0001$ ) with ADF and NDF ( $r = -.69$ ,  $P = .0001$ ). Nitrogen was positively correlated ( $r = .52$ ,  $P = .0001$ ) with NO<sub>3</sub>-N and negatively correlated ( $r = -.69$ ,  $P < .01$ ) with ADF. Forage ISDMD could be predicted from ADF, NDF and N ( $R^2 = .54$ ,  $P = .0001$ ). Major QTL markers were identified for all traits. Molecular marker associated with ISDMD, ADF and N were identified on chromosome 2, 4 and 5. Results suggest that genetic differences among Steptoe/Morex DH lines have an impact on forage digestion in the rumen. This information can be used to select improved forage-quality barley varieties.

**Key Words:** Barley, Forage quality, Genetic markers

**28 Altering the ratio and amount of undegradable intake protein in range supplements influences nutrient partitioning in young postpartum cows.** J. E. Sawyer\*, G. D. Pulsipher, R. C. Waterman, D. E. Hawkins, E. E. Parker, S. Cox, and M. K. Petersen, *New Mexico State University, Las Cruces.*

A study was conducted at the Corona Range and Livestock Research Center during two years to evaluate the effects on nutrient partitioning of increasing the ratio of undegradable intake protein (UIP) to degradable intake protein (DIP) and increasing the amount of UIP in range supplements for young postpartum cows. In both years, 2 and 3 yr old cows were assigned to one of three treatments. Treatments were fed at 908 g·hd<sup>-1</sup>·d<sup>-1</sup> and provided 340g CP, 120g UIP (LOW); 340g CP; 170g UIP (MID); or 510g CP, 340g UIP (HIGH). Treatments were applied postpartum for approximately 75 d in yr 1 and 60 d in yr 2. Year effects were observed for all responses, therefore data were evaluated as a 2X3 factorial (age and treatment) within year. In yr 1, ADG from BW nadir to end of supplementation was not influenced by treatment ( $P > 0.4$ ; 1.2, 1.4, and  $1.6 \pm .2$  kg·d<sup>-1</sup> for LOW, MID, and HIGH). All treatments resulted in negative ADG from end of supplementation until end of breeding. In yr 2, ADG of 2 yr old cows was less than 3 yr old cows ( $P < 0.05$ ; .5 vs.  $1.2 \pm .2$  kg·d<sup>-1</sup>). Cows receiving MID and HIGH had greater ADG during supplementation than those receiving LOW

( $P < 0.05$ ; 4, 1.1, and  $1.1 \pm .3 \text{ kg} \cdot \text{d}^{-1}$  for LOW, MID, and HIGH). Gains from end of supplementation until end of breeding were similar and positive. Older cows produced more milk in both years ( $P < 0.05$ ). Treatment means for milk production were similar within years, although cows receiving HIGH were numerically higher. In year 2, cows receiving MID excreted less milk fat ( $P < 0.05$ ). Excretion of milk protein, lactose, and SNF reflected milk production. Adjusted weaning weights were heavier in calves from 3 yr old cows in both years ( $P < 0.01$ ), but were not influenced by treatment in yr 1 ( $P = 0.9$ ). In yr 2, cows receiving MID or HIGH weaned heavier calves than those receiving LOW ( $P = 0.05$ ). These results imply that increasing the ratio of UIP:DIP influenced nutrient partitioning toward maternal tissues without decreasing calf growth.

**Key Words:** Protein Supplements, Nutrient Partitioning

**29 Summer grazing and fall grazing pressure effects on protein content and digestibility of fall range diets in the Nebraska Sandhills.** H. H. Patterson\*, T. J. Klopfenstein, D. C. Adams, W. H. Schacht, P. E. Reece, and A. E. Herron, *University of Nebraska, Lincoln*.

Two experiments were conducted to examine summer grazing time and fall grazing pressure effects on fall diet crude protein (CP) content and in vitro organic matter disappearance (IVOMD). In 1997 (Exp. 1) and 1998 (Exp. 2), three .30 ha pastures in each of four blocks of upland range were randomly assigned to receive one of three summer grazing treatments: 1) no summer grazing, 2) grazing in mid-June at .5 AUM/ha, and 3) grazing in mid-July at .5 AUM/ha. In Exp. 1, blocks were grazed sequentially in October and November (Fall) by 6 esophageally fistulated cows (two cows/pasture). Each pasture was grazed for 7 days. Multiple grazing pressures were created by reducing pasture size and timing of diet collections. Diets were collected in each pasture by cows grazing that pasture when the Fall stocking rate (SR) was 0, .5, 1.0, 1.5, 2.0, and 3.0 AUM/ha. In Exp. 2, each pasture was divided into three paddocks, and each paddock was grazed at 1.0, 2.0, or 3.0 AUM/ha by intact cows from October 19-24. Diets were collected before and 7 weeks following the application of grazing treatments. There were no summer treatment by SR interactions in Exp. 1 nor 2 ( $P > .15$ ). In Exp. 1, diet CP concentration (OM basis) responded cubically ( $P < .01$ ) to increasing cumulative grazing pressure (CGP), declining from 8.6% at 0 AUD/t to 6.5% at 50 AUD/t. Diet IVOMD also responded cubically ( $P = .05$ ), declining from 54% at 0 AUD/t to 50% at 50 AUD/t. In Exp. 1, June grazing tended to increase ( $P = .10$ ) the CP content of fall diets (7.5%) compared to July grazing (7.1%). In Exp. 2, there were no effects ( $P > .15$ ) of CGP on diet CP (average 8.5%) or IVOMD (54%). However, CP content (9.0%) in diets from pastures deferred from summer grazing tended to be greater ( $P = .10$ ) than in diets grazed in July (7.9%). Diet CP and IVOMD declined with increasing fall CGP in Exp. 1, and fall diet CP content tended to be lower following July grazing compared to June and deferred summer grazing in Exp. 1. and Exp. 2., respectively.

**Key Words:** Stocking Rate, Range, Diet

**30 PCR cloning and expression of chicken myostatin cDNA in *E. coli*.** Y. S. Kim<sup>\*1</sup>, K. S. Baek<sup>2</sup>, M. A. Dunn<sup>1</sup>, and D. Borthakur<sup>1</sup>, <sup>1</sup>*University of Hawaii at Manoa, Honolulu*, <sup>2</sup>*National Livestock Research Institute, Namwon, Korea*.

Myostatin, a new member of the TGF- $\beta$  superfamily of proteins, regulates skeletal muscle growth. Currently, very little is known about the molecular mechanism by which myostatin increases muscle growth. Purified myostatin protein and antibodies against myostatin will be important tools for investigating the mechanism of action of myostatin. Therefore, to produce myostatin and anti-myostatin antibody, we initiated a study to clone and express chicken myostatin cDNA fragment in *E. coli*. cDNAs were synthesized from the mRNAs that were isolated from pectoralis muscle obtained from 5 week old broiler chicken. The cDNAs were used to amplify a 369 bp C-terminal fragment of chicken myostatin using PCR. The forward (GAGGTCAGAGTTACAGACACA) and reverse (TCATGAGCACCCGCAACGATC) primers were synthesized based on a reported chicken myostatin mRNA sequence (GeneBank Accession number, AF019621). After purification, the amplified myostatin cDNA fragment was inserted into a cloning vector (pCR<sup>®</sup> T7/NT-TOPO, Invitrogen), and transformed into *E. coli* (TOP10F<sup>®</sup> One Shot<sup>®</sup>, Invitrogen). Two positive clones were identified after PCR and restriction analysis of clones isolated from 10 colonies. DNA sequence analysis of the positive

clones showed that the inserted myostatin fragment was 100% homologous to the reported chicken myostatin mRNA (AF019621). Plasmids containing the myostatin fragment were isolated, and transformed into expression competent *E. coli* (BL21(DE3)pLysS One Shot<sup>®</sup>, Invitrogen). Expression was induced by adding IPTG to the culture. The expression of the recombinant myostatin fragment (expected MW 18.5 kD) was confirmed by SDS-PAGE analysis. The expressed protein will be purified and used for monoclonal antibody production against myostatin.

**Key Words:** PCR Cloning, Myostatin, Chicken

**31 Ultimate pH affects the tenderness of longissimus muscle in callipyge lamb.** Y. B. Lee\* and S. Zhang, *University of California, Davis*.

The effects of early postmortem biochemical changes and ultimate muscle pH on myofibril degradation, structural changes and meat tenderness were investigated during 14 days of aging as an attempt to enhance the tenderness of loin chops from callipyge lambs. Twenty three callipyge lambs weighing an average of 58 kg were injected 0 (n=8) or 15-30 mg epinephrine (n=15) at 16 h before slaughter to manipulate the level of muscle glycogen. According to 24 h muscle pH of longissimus muscle, loins were sorted into low pH (5.50-5.69, n=8), intermediate pH (5.70-5.79, n=7), and high pH (5.8-6.0, n=8) group. High pH group had a lower ( $P < .05$ ) O h and 4 h postmortem glycogen, lower 4 h ATP, and lower shear values at 1d and 14 d postmortem than low pH group. After 14 days of aging high pH loin chops had an average WB shear value of 4.3 kg/1.27 cm core sample, which was close to an acceptable shear value of 4.0. Electron microscopy of muscle tissue showed that low pH muscle exhibited some random degradation of thick and thin myofibrils at 1 d and 14 postmortem, whereas high pH muscle had random degradation of thick and thin filaments with further degradation at the Z-disk -I filament junction at 14 d. It was concluded that high pH enhanced the degradation of Z-disk-I band linkages and improved callipyge lamb loin tenderness to the acceptable level.

**Key Words:** Callipyge Lamb, Tenderness, Muscle pH

**32 Marketing lamb as a branded product.** T. P. Ringkob<sup>\*1</sup>, H. A. Glimp<sup>1</sup>, D. W. Holcombe<sup>1</sup>, R. F. Butler<sup>1</sup>, and E. F. Cox<sup>2</sup>, <sup>1</sup>*School of Veterinary Medicine, University of Nevada, Reno*, <sup>2</sup>*Meat Marketing Consultant, Reno, NV*.

This project was designed to test merchandising techniques to increase supermarket retail lamb sales. The test population (n = 410) was primarily 1/2 Rambouillet x 1/2 Booroola Merino with a small proportion of Rambouillet market lambs. Lamb trait means and standard errors are as follows; live weight = 44.7  $\pm$  .17 kg, hot carcass weight = 23.0  $\pm$  .08 kg, chilled carcass weight = 22.3  $\pm$  .08 kg, quality grade = 10.1  $\pm$  .03 (Ch<sup>-</sup>), loin eye area = 11.9  $\pm$  .07 sq cm, KPH = 2.6  $\pm$  .03%, and cutability = 46.2%  $\pm$  .03. The primary strategy was to use a full page promotion in the leading newspaper in the metropolitan market area. This was used in conjunction with lowering prices to the level of beef on comparable retail cuts (lower rib chop price/lb to that of a rib steak, etc.) for the first special sale. Smaller booster ads followed. The University of Nevada Meat Plant (Est. 6004) processed the lamb carcasses 48 h postmortem into boxed vacuum wholesale cuts in carcass units to be prepared and merchandised by the supermarket chain. The product was merchandised with the brand label of WolfPack Lamb. At the start of the study the regional supermarket chain ordered and merchandised five to eight whole lamb carcasses/wk. Volume jumped from eight carcasses to 40 carcass case-ready boxed units following the first full page ad. Demand at the normal higher lamb prices varied from 26 to 57 carcass units for the next 2 mo. Store management was enthusiastic about the results and felt the program attracted a more affluent customer.

**Key Words:** Lamb, Marketing, Merchandising

**33 Prevalence of verotoxin-producing *Escherichia coli* in sheep grazing Great Basin range forages.** H. S. Hussein, S. L. Lake\*, B. H. Thran, S. F. Khaiboullina, M. R. Hall, and H. A. Glimp, *University of Nevada, Reno*.

Research in recent years has indicated that sheep harbor verotoxin-producing *Escherichia coli* (VTEC), including O157:H7 at high rates.



Although sheep have never been implicated in a VTEC associated foodborne outbreak, the risk of infection of their products (lamb and mutton) share a food safety risk similar to that of beef. Specific characteristics (i.e., sorbitol negative and 4-methylumbelliferyl- $\beta$ -D-glucuronide [MUG] negative) are usually associated with *E. coli* O157:H7 and are used for presumptive identification. However, VTEC encompass numerous serotypes of *E. coli* and are not limited to sorbitol negative; MUG negative isolates. The objective of this study was to assess the VTEC prevalence in sheep grazing Great Basin ranges over a 6-month period (summer and fall, 1999). Twenty yearling (15-mo old) ewes (7/8 Merino; 1/8 Rambouillet) were selected at random from a large flock (>1000 ewes) at Rafter 7 Ranch. The ewes grazed desert range forages (Indian ricegrass [*Oryzopsis hymenoides*] and various shrubs including white sage [*Ceratoides lanata*], fourwing saltbush [*Atriplex canescens*], and big sagebrush [*Artemisia tridentata*]). Fecal samples were rectally collected in August and November. Initial *E. coli* isolates (n = 601) were selected using microbiological methods utilizing the lack of sorbitol fermentation properties of *E. coli* in conjunction with MUG. Verocytotoxicity tests were performed to determine the toxicity status of the isolates (n = 124). Six isolates from three ewes (fall collection only) were cytotoxic. Two of the isolates matched the classical identification of O157:H7 (sorbitol negative; MUG negative) and four isolates were sorbitol negative but MUG positive. The prevalence rate of VTEC in our ewes was 15% in the fall collection while no VTEC were detected in the winter, suggesting that the infection was transient. Based on the characteristics of our isolates, different serotypes of *E. coli* (including O157:H7) may infect sheep grazing arid range lands. These results also support the importance of screening sheep for VTEC instead of limiting the tests to O157:H7.

**Key Words:** Sheep, *Escherichia coli*, Food Safety

**34 Preliminary description of swainsonine flux across ovine splanchnic tissue.** J. B. Taylor<sup>\*1</sup>, J. R. Strickland<sup>1</sup>, and C. R. Krehbiel<sup>2</sup>, <sup>1</sup>New Mexico State University, Las Cruces, <sup>2</sup>Oklahoma State University, Stillwater.

Three trials were conducted to investigate the acute effects of swainsonine (SW) administration on ovine portal and hepatic vein and hepatic artery blood flows, and on portal-drained visceral, hepatic and total splanchnic flux of SW. Sixteen wethers (BW = 60.2  $\pm$  3.2 kg) fitted with hepatic (H), portal (P) and mesenteric vein, and mesenteric artery (A) catheters were assigned to either a .2 or .8 mg/kg BW<sup>-1</sup>·d<sup>-1</sup> SW treatment (.2MG and .8MG, respectively). Treatments (TRT) were delivered by dosing with a liquid SW extract mixed with molasses. Simultaneous A, P and H blood samples were collected at 1.5 h intervals from h 0 to 12 and at 3 h intervals from h 12 to 24. Treatments were administered immediately after h 0 collection. Blood flows (BF) were estimated by continuous infusion of *p*-aminohippurate, and SW flux was calculated as the difference between venous and arterial concentrations  $\times$  BF. No TRT differences were observed for BF throughout the sampling period. Arterial, H and P BF in both TRT reached a maximal rate between h 1.5 to 4.5 and steadily declined thereafter. Arterial, P and H SW concentrations peaked by h 4.5 and 6, and subsequently plateaued for the remainder of the sampling period. Swainsonine flux was higher (P < .02) for .8MG when compared to .2MG at h 1.5 (4.091 vs. .229 mg·h<sup>-1</sup>, respectively) and 4.5 (4.072 vs. -1.938 mg·h<sup>-1</sup>, respectively) for portal drained visceral (SE = 1.031), and at h 4.5 (-1.418 vs. 5.812 mg·h<sup>-1</sup>, respectively) for hepatic (SE = 1.304). Within sampling site, SW concentrations were different between TRT from h 3 to 24 (P < .05) for A and P and from h 1.5 to 24 for H. Overall A, P and H mean SW concentrations for .2MG and .8MG TRT were .046, .064 and .052, and .158, .165 and .167 ug SW·mL<sup>-1</sup>, respectively. This data represents a preliminary descriptive analysis of SW flux across ovine splanchnic tissues. Further analysis will be conducted to quantitatively describe acute differences in SW flux of varying levels of SW consumption in sheep.

**Key Words:** Sheep, Swainsonine, Splanchnic flux

**35 Serum profiles in ewe lambs fed commercial feed with accidentally elevated copper and treated with calcium sulfate.** N. H. Wells\*, D. M. Hallford, J. A. Hernandez, J. L. Bollinger, M. K. Petersen, and U. McElyea, New Mexico State University, Las Cruces.

Debouillet ewe lambs (n = 31, 6 mo of age, avg BW = 54 kg) were exposed to elevated dietary Cu after being fed pelleted alfalfa from two

separate feed mills which contained 33 and 45 ppm Cu. After consuming about 2.5 kg/d of the diet for approximately 50 d, symptoms became apparent (hemoglobinemia, hemoglobinuria) and Cu toxicity was confirmed by a liver Cu concentration of 439  $\pm$  36 ppm in five dead animals. During the course of Cu exposure, eight of 31 ewe lambs died. The objective of this study was to determine if oral administration of calcium sulfate could reverse the symptoms of acute Cu poisoning in ewe lambs. Serum was collected from eight ewe lambs before Cu consumption and from seven ewe lambs showing extreme symptoms of Cu poisoning. Total, direct, and indirect bilirubin, gamma glutamyl transpeptidase (GGT), and creatine kinase (CK) were elevated (P < 0.05) in ewes consuming Cu. Three extremely affected ewe lambs that had stopped consuming any feed received gelatin capsules (gavage) containing 56 g of a livestock salt/gypsum (75% calcium sulfate) mixture (2:1, wt:wt) daily for 10 d. Before treatment, total bilirubin was 0.6 mg/dL in control ewes and 6.8  $\pm$  1.7 mg/dL in Cu consuming ewe lambs. After 10 d of calcium sulfate treatment, total bilirubin was 0.6 and 0.7 ( $\pm$  0.1) mg/dL, GGT was 148 and 234 ( $\pm$  47) IU/L, and CK was 325 and 1,725 ( $\pm$  666) IU/L in control ewes and those receiving calcium sulfate, respectively (P > 0.10). Neither hemoglobinemia nor hemoglobinuria were observed after 10 d. Calcium sulfate administered in gelatin capsules appears to be an effective treatment for acute copper toxicosis in sheep.

**Key Words:** Sheep, Hemolysis, Copper

**36 Influence of oral natural interferon-alpha (IFN- $\alpha$ ) on performance and rectal temperature of newly received beef steers.** N. K. Chirase\* and L. W. Greene, Texas Agricultural Experiment Station, Amarillo, West Texas A&M University, Canyon.

Although interferons are frequently used in humans to modulate the immune system, their oral use in ruminants has not been well documented. We studied the effects of low dose oral natural IFN- $\alpha$  on the health and performance of newly received steer calves. One hundred and twelve (112) crossbred steer calves (average BW 185 kg) were purchased in Tennessee and transported to the Texas A&M University/USDA-ARS beef research facility at Bushland, TX. Upon arrival, the calves were weighed, rectal temperature (RT) measured and placed in 8 pens (14 steers/pen) with feed and water. The four treatments tested were 0, 48, 300 and 500 IU of IFN- $\alpha$  which were assigned randomly and administered in a single 4-ml oral dose to each calf at arrival. Calves were observed daily at 0600 for sickness, weighed and RT measured on d 0, 1-14, 21 and 28. All performance and RT data were subjected to the analysis of variance using the GLM procedures of SAS. The results indicated that feed intake for all treatment groups were similar (P > .05) on all days measured. However, ADG was higher (P < .05) and feed to gain ratio was lower (P < .05) on d 14 for calves treated with 48 IU of IFN- $\alpha$  than the control calves. All other treatment groups were intermediate. On d 28, the feed to gain ratio for the IFN- $\alpha$  treated groups were lower (P < .05) than the controls. No differences in RT were observed when data were summarized by treatment for the entire study. However, calves that had a pre-treatment RT of  $\geq$ 40 °C (morbid calves) and treated with 300 IU of IFN- $\alpha$  gained more weight on d 14, 21 and 28 than calves treated with 48 IU of IFN- $\alpha$ . These data suggest that oral IFN- $\alpha$  improved the ADG and feed to gain ratio of newly received steer calves.

**Key Words:** Steer Calves, Interferon- $\alpha$ , Performance

**37 Effect of Bovipro<sup>TM</sup> on performance and serum metabolite concentrations of beef steers.** N. K. Chirase<sup>\*1</sup>, L. W. Greene<sup>1</sup>, F. T. McCollum<sup>2</sup>, B. W. Auvermann<sup>2</sup>, and N. A. Cole<sup>3</sup>, <sup>1</sup>Texas Agricultural Experiment Station, Amarillo, <sup>1</sup>West Texas A&M University, Canyon, <sup>2</sup>Texas Agricultural Extension Service, <sup>3</sup>USDA/ARS, Bushland, TX.

The objective of this experiment was to determine the effects of Bovipro<sup>TM</sup> (a new humate blend) on performance and serum metabolite concentrations of beef steers. Forty-eight (48) crossbred (Brangus  $\times$  Gelbvieh) steers (average BW 293 kg) were allotted randomly by initial body weight into four groups and fed diets containing 0 (control), .78, 1.56 or 3.12% Bovipro<sup>TM</sup> for 56 d. Steers were weighed on d 0, 28 and 56, and blood samples were taken on d 0 and 28. All performance and serum metabolite concentration data were subjected to analysis of variance using the GLM procedures of SAS. On d 28 of the experiment, serum Ca concentrations of steers fed 1.56% Bovipro<sup>TM</sup> were greater (P < .05) than

those of controls and steers fed .78% Bovipro<sup>TM</sup>. Serum hemoglobin and bilirubin concentrations were higher ( $P < .05$ ) for the 3.12% Bovipro<sup>TM</sup> fed steers than the controls. All other serum metabolite concentrations did not differ ( $P > .05$ ) and were within normal ranges. The results indicated that during the first 28 d, feed intake and total weight gain did not differ ( $P > .05$ ) among treatments. The rate of gain by the steers fed control, .78, 1.56 and 3.12% Bovipro<sup>TM</sup> were 1.46, 1.53, 1.52 and 1.36 kg/d, respectively. Steers fed .78% Bovipro<sup>TM</sup> required 12.1% less ( $P > .05$ ) feed per kilogram of weight gain than control steers. These results suggest that dietary Bovipro<sup>TM</sup> altered serum Ca, P, bilirubin and hemoglobin concentrations of beef steers, but the optimum level of Bovipro<sup>TM</sup> for performance needs to be determined.

**Key Words:** Beef Steers, Bovipro<sup>TM</sup>, Performance

**38 Evaluation of barley characteristics that are associated with digestible energy.** B.J. Sanford, C.W. Hunt\*, J.G. Andrae, and G.T. Pritchard, *University of Idaho, Moscow.*

The feed quality of barley is typically measured by bulk density; however, current literature indicates that bulk density does not always accurately reflect the energy value of barley. We hypothesize that chemical compositional factors of barley more accurately reflect digestible energy of barley. Forty beef steers (360 kg average initial BW) were used in completely randomized design to determine the *in vivo* digestibility of eight barley sources varying by variety, growing location and growing year. The sources were selected from 32 original sources to represent barleys from the entire spectrum of bulk density, starch and fiber content. Steers were assigned to barley source treatments and fed diets containing 78 percent rolled barley plus 22 percent chopped alfalfa hay (DM basis). Digestibility measurements were determined using chromic oxide as an external marker in two experimental periods (10 observations per barley source). Barley starch and ADF content ranged from 53 to 64.1 percent and 4.8 to 10.4 percent, respectively. Bulk density varied from 57 to 70.2 kg/hL. Diet digestibility of DM, OM, GE, NDF and ADF was affected ( $P < .05$ ) by barley source. Starch digestibility was complete (greater than 99 percent) for all diets indicating the importance of barley starch content. Calculated barley DE content and DM digestibility were positively correlated ( $P < .05$ ) with starch content ( $r = .73$  and  $.77$ , respectively) and negatively correlated ( $P < .05$ ) with ADF content ( $r = -.71$  and  $-.76$ , respectively). Bulk density was not correlated with barley DE or DM digestibility. Starch content was most predictive of barley DE content in the following equation:  $DE = 1.4862 + .0386 \text{ starch}$ . Attempts to improve the DE predictive equation with data transformations and additional variables were not successful. Results of this study indicate a large variability in barley DE content that was predictable by starch and ADF content but not by bulk density.

**Key Words:** Barley, Digestible Energy, Quality

**39 Short and long term gas production in selected California feedstuffs.** G. Getachew\* and P.H. Robinson, *University of California, Davis.*

Most feeds contain a number of carbohydrate pools, as defined by their rate of fermentation. The objective of this study was to determine short and long term *in vitro* gas production in ten feeds (Distillers dry grain, DDG; Beet pulp, BP; Cottonseed, CS; Corn silage, CSL; Alfalfa hay, ALHY; Alfalfa silage, ALSL; Wheat millrun, WMR; Almond hulls, AMDH; Wet citrus pulp, WCP; Wheat silage, WS) commonly used on commercial California dairies. Gas production was measured by incubating feeds in 100 ml calibrated glass syringes in triplicate with two runs. Data were subjected to analysis of variance with a completely randomized design. Feeds differed ( $P < 0.01$ ) in their pattern of carbohydrates fermentation and interactions between feeds and time of incubation also occurred ( $P < 0.01$ ). For instance, about 50% of the 30 h gas in cottonseed, alfalfa hay and wet citrus pulp was produced by 6 h of incubation. Feeds ranked differently when expressed as ml gas per g DM or ml gas per g carbohydrate incubated.

Wet citrus pulp, with a high non-fiber carbohydrate (NFC) contents, had the highest gas production at either 6 or 30 h. In contrast, cottonseed with a low NFC level had the lowest gas volume at 6 and 30 h. There were correlations between the NFC content of feeds and gas production per g DM incubated at both 6 h ( $r^2 = .74$ ) and 30 h ( $r^2 = .72$ ) of incubation. These relatively low  $r^2$  values indicate that gas production, at either short or long term incubation, doesn't differentiate very well between the contributions of the different carbohydrate

fractions to total gas produced. Results indicate that feeds vary greatly in simulated rumen digestion at short and long times. This should be considered in balancing rations for high producing dairy cows, relative to its impact on both short and long term digestion in the rumen.

Time (h)	Feeds										WS	LSD
	DD-G	BP	CS	CSL	ALF-HY	ALF-SL	WMR-AL	MD-H	WC-P			
	ml gas/g DM											
6	73	120	37	83	99	94	91	107	197	96	14	
30	172	302	64	239	235	160	229	222	348	214	25	
	ml gas/g carbohydrate											
6	144	153	96	98	165	137	132	130	242	127	22	
30	338	385	158	280	391	233	329	269	427	284	38	

DDG, distillers dry grain; BP, beet pulp; CS, cottonseed; CSL, corn silage; ALHP, alfalfa hay; ALSL, alfalfa silage; WMR, wheat millrun; AMDH, almond hulls; WCP, wet citrus pulp; WS, wheat silage; Carbohydrate =  $(100 - (\%CP + \%FAT + \%ASH))$ .

**Key Words:** *In Vitro* Gas Production, Carbohydrate Fermentation

**40 Nutritive value and storage characteristics of Pima cottonseed.** P.H. Robinson\*, G. Getachew, and E.J. DePeters, *Department of Animal Science, University of California, Davis.*

The objective of this study was to determine the nutritional characteristics of Pima cottonseed produced in the southwest USA during the 1999 growing season. Six varieties of Pima cottonseed (Phytogen 57, CH252, HTO, Conquistador, S6, and S7) were collected from ten locations and analyzed for chemical composition including macro and micro minerals. In addition, the effect of simulated commercial storage of cracked Pima cottonseed in 15 tonne piles on chemical composition and indices of decomposition were evaluated at four locations. Samples were collected from each pile the day after cracking and at approximately three-day intervals through day 21. Samples were analyzed for nutritional components and indices of decomposition. In addition, temperature in the pile and physical characteristics of the seed were recorded at sampling. Chemical composition data were analyzed using a completely randomized design, while data from the storage study were subjected to analysis of variance with repeated measures. Pima cottonseed varieties were found to be similar in DM and OM content ( $P > 0.05$ ). Although numerically large differences occurred among the varieties for crude protein (26.8 to 30.6%), crude fat (25.8 to 28.0%), neutral detergent fiber (44.4 to 48.4%), rumen digestible neutral detergent fiber (50% to 62%), and acid detergent fiber (29.8 to 35.6%), they were not statistically significant ( $P > 0.05$ ). Although solubility of Pima cottonseed protein was low, about 90 % of total protein was potentially digestible. The influence of storage time on chemical composition of Pima cottonseed was consistent among the piles. The temperature in all piles tended to decline as storage time increased. The free fatty acid content, an index of rancidity of fat, was not affected ( $P > 0.05$ ) by length of storage, peroxide values never reached detectable levels, and mold levels were not influenced ( $P > 0.05$ ). Results indicate that Pima cottonseed varieties are similar in nutritional composition, but somewhat variable within varieties, and that cracked Pima cottonseed can be stored under cover from weather for up to 22 days with no significant decomposition or effects on nutritional value.

**Key Words:** Cottonseed, Pima

**41 The effect of an accelerated feeding program on dairy beef steers: production, carcass characteristics and economic returns.** D. R. ZoBell\* and R. D. Wiedmeier, *Utah State University, Logan.*

The objective of this trial was to determine the effect on dairy beef steers of an accelerated feeding program addressing production, carcass characteristics and economics of production. Eight Holstein steer calves (initial wt. 198 kg) were purchased from the auction market and randomly assigned to control (C) or accelerated (A) treatments. Control steers received a growing diet which consisted of rolled barley (DMB) at levels of 28.2%, 35.3% and 78.2% for the periods 0-56d, 56-140d, and 140-308d respectively. Accelerated steers received rolled barley at 78.2% for days 0-308. The remainder of the rations consisted of corn silage, alfalfa and grass hay, and supplement. All steers were housed in individual feeding stalls for the duration of the study. One of the accelerated calves was removed early in the trial due to health. For the 0-56d period

ADG was 1.02 and 1.44 for C and A respectively ( $P < .10$ ). Dry matter intake was similar during this period ( $P > .05$ ) but FE differed ( $P < .05$ ) at 7.02 and 4.78 for C and A respectively. For the periods 56-140d, 140-308d and 0-308d, ADG, DMI and FE were similar between treatments ( $P > .05$ ). All steers were slaughtered at trial termination (308d) and carcass characteristics, such as carcass weight, carcass yield, KPH, BF, REA, cutability and yield grade, were similar ( $P > .05$ ). All steers graded choice with the exception of one in the C treatment which graded select. There was a numerical trend, suggesting improved economic returns for A over C for each of the treatment periods. This study demonstrated that Holstein beef steers can be fed successfully on diets high in concentrates from weaning to slaughter. Aggressive feeding strategies are particularly advantageous early in the feeding program.

**Key Words:** Dairy Beef, Holstein, Finishing

**42 Influence of flake thickness of roasted barley on *in situ* ruminal rate and extent of digestion of dry matter, protein, fiber, and starch in cattle.** S. J. Sorensen and D. D. Hinman\*, *University of Idaho, Caldwell.*

Barley treated in one of four ways plus corn was used in a 5x5 Latin square *in situ* trial to determine ruminal digestibility of DM, CP, ADF, ADIN and starch. Corn was dry rolled (DRC). Barley was either dry rolled (DRB), or tempered at 18% moisture for 24 h, roasted at 235°C for 5 min and rolled while hot to obtain a bulk density of 33 (RST33), 39 (RST39) or 41 (RST41) kg/hl. Treatments were sieved to remove fines and about 5 g were placed in nylon bags for ruminal incubation. Sample bags were incubated for 0, 1, 2, 4, 6, 12, 24, and 48 hours. Contents were analyzed for DM, CP, ADF, ADIN and starch. Treatments were measured to determine flake thickness. Bulk density of the barley increased as the flake thickness increased. Dry matter disappearance rate (DMDR) over 48 h was faster ( $P < .10$ ) for DRB than DRC, RST33 and RST41. Dry rolled corn and RST41 had slower ( $P < .10$ ) DMDR than DRB, RST33 and RST39 during the first six hours. Roasted barley had similar ( $P > .10$ ) DMDR for 48 h to DRC, suggesting that roasted-rolled barley did decrease the rate of ruminal digestion compared to DRB. Protein disappearance rate was faster ( $P < .10$ ) for DRB than DRC or roasted barley for both the first six hours and total 48-h incubation periods. Starch disappearance rate for RST33 was greater ( $P < .10$ ) than all other treatments for the first 6-h incubation period. In the first six hours of incubation, DRC had the slowest starch disappearance rate followed by RST41, RST39 then DRB, in increasing rates. Dry rolled corn had the slower ( $P < .10$ ) starch disappearance rate for the 48-h incubation period than RST33, RST39 and was similar ( $P > .10$ ) to RST41. Roasting barley decreases DM and starch disappearance rates to levels approaching that of DRC. Setting the roller for a thicker roasted barley flake decreased the DMDR more than thinner flake. Decreasing the disappearance rate of DM, CP and starch should help alleviate problems generally associated with feeding high levels of barley in feedlot diets.

**Key Words:** Barley, Roasting, Flake Thickness

**43 Effect of inoculants on whole-crop barley silage fermentation and dry matter degradability in the rumen.** A. N. Hristov\*<sup>1</sup>, T. A. McAllister<sup>2</sup>, and S. Graham<sup>3</sup>, <sup>1</sup>*University of Idaho, Moscow*, <sup>2</sup>*Agriculture and Agri-Food Canada, Lethbridge, Alberta*, <sup>3</sup>*Chr. Hansen Ltd., Mississauga, Ontario.*

This study was undertaken to determine the effect of 4 inoculants (A, B, D and E; Chr. Hansen Biosystems; containing combinations of *Lactobacillus plantarum* and *Pediococcus pentosaceus*) on the fermentation of whole-crop barley silage and *in situ* DM degradability. Barley forage was ensiled at 30.8% DM content in a 10 × 200 foot silage bag. Each treatment was applied in triplicate along the length of the bag. Between treatments, segments of the bag were filled with untreated (Control) silage (on average 3.7 t and 86 cm of bag length). Core samples were taken on day 55 after ensiling and water extracts were analyzed for pH, non-protein nitrogen (NPN), soluble protein (SP), ammonia (NH), reducing sugars (RS), lactic acid (LA), and lactic acid bacteria (LAB). Samples for analysis of pH and LAB were also taken on days 1, 4, 7 and 15. Ruminal degradability of silage DM was determined in nylon bags in 3 heifers fed a 60% barley silage; 40% concentrate diet *ad libitum*. As compared to Control, two of the inoculants (A and B) reduced ( $P < 0.05$ ) day-1 silage pH (4.77, 4.33 and 4.47, respectively). Day-55 pH and concentrations of NPN, SP and NH (as proportion of silage N) did not differ ( $P > 0.05$ ) among treatments. On average, inoculant-treated silages had

numerically higher ( $P > 0.05$ ) concentration of RS than the Control (52.3 vs 36.9 g/kg DM, respectively). Concentration of LA and LAB numbers did not differ ( $P > 0.05$ ) among silages after 55 d of ensiling. As compared to Control, inoculants A increased ( $P < 0.05$ ) the soluble fraction and the effective degradability (by 3%) of silage DM in the rumen. The results from this trial showed that, depending on strain, some inoculants have the potential to enhance pH decline during the initial stages of the fermentation and to increase the extent of ruminal degradability of silage DM.

**Key Words:** Inoculants, Barley Silage

**44 Effect of processing and ensiling on microbial attachment and degradability in the rumen of corn silage kernels.** A. N. Hristov\*<sup>1</sup>, T. A. McAllister<sup>2</sup>, K. Claypool<sup>2</sup>, and D. ZoBell<sup>3</sup>, <sup>1</sup>*University of Idaho, Moscow*, <sup>2</sup>*Agriculture and Agri-Food Canada, Lethbridge, Alberta*, <sup>3</sup>*Utah State University, Logan.*

This study was conducted to investigate the effect of processing and ensiling of whole-crop corn on kernel degradability and microbial attachment in the rumen. Whole-crop corn (35.4 % DM) was chopped to a theoretical length of 1 cm and ensiled in bags after harvesting with (Pr) or without (Upr) a kernel processor. Kernels from the unprocessed crop before (Fr) and after ensiling (Sl) for 300 days were manually separated into: broken (Br), mixed (Mx) and whole (Wh) kernels (Trial 1). Kernels from the processed silage were separated into: PrBrSl and UprBrSl, UprMxSl and UprWhSl kernels (Trial 2). In both trials whole and halved mature corn kernels served as controls (Mat and HvMat, respectively). Ruminal degradability parameters were determined in nylon bags incubated in 3 heifers fed an 80% corn silage diet. Ruminal microorganisms were labeled via continuous intraruminal infusion of (<sup>15</sup>NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>. On average, (Trial 1) ensiled kernels (Sl) had higher ( $P < 0.05$ ) 72-h extent and rate of ruminal DM degradation than unensiled kernels (75.5 vs 55.9% and 0.99 vs 0.75 h<sup>-1</sup>, respectively). Among treatments, the lowest ( $P < 0.001$ ) extent and rate of DM degradation was associated with Mat kernels (4.4% and 0.10 h<sup>-1</sup>, respectively) and the highest ( $P < 0.001$ ) with BrSl kernels (91.8% and 1.18 h<sup>-1</sup>). In Trial 2, PrBrSl kernels had higher ( $P < 0.001$ ) extent and rate of ruminal degradation as compared to UprBrSl (82.4 and 1.11 and 68.6% and 0.95 h<sup>-1</sup>, respectively). Microbial attachment (determined as <sup>15</sup>N-enrichment of bag residues) correlated well to the extent of DM degradation ( $r = 0.82$ ,  $P < 0.001$ ). The results from these experiments show that ensiling as well as kernel processing increases microbial colonization and the extent and rate of ruminal degradation of corn kernels.

**Key Words:** Corn Silage, Processing, Ruminal Degradability

**45 Effects of dietary vitamin E on performance and health of newly received beef steers.** J. D. Rivera\*<sup>1</sup>, G. C. Duff<sup>1</sup>, M. L. Galyean<sup>2</sup>, and D. A. Walker<sup>1</sup>, <sup>1</sup>*Clayton Livestock Research Center, New Mexico State University, Clayton*, <sup>2</sup>*Texas Tech University, Lubbock.*

One hundred twenty beef steers were used to evaluate effects of dietary vitamin E level on performance and health during the receiving period. Calves were assigned randomly at processing to one of three treatment diets formulated to supply 285, 570 or 1,140 IU/steer daily of vitamin E (assuming a DM intake of 1.5% of BW). Each treatment was replicated in four pens with 10 steers per pen. The 70% concentrate diets were fed once daily at 0830. All cattle were monitored daily for signs of bovine respiratory disease complex (BRD). Animals displaying signs were removed from their pen, and those with a rectal temperature of  $\geq 39.7^\circ\text{C}$  were treated with tilimicosin phosphate and penicillin. Cattle were weighed on d 14 and 28, and daily gain (ADG), gain:feed (G:F), and intake (DMI) were calculated for each pen. Performance data were analyzed using a linear model assuming a completely random design with pen as the experimental unit. Orthogonal polynomials were used to evaluate responses to dietary vitamin E. Supplemental vitamin E did not affect ( $P > 0.10$ ) ADG or DMI for d 0 to 14. Similarly, ADG, DMI, and G:F for d 14 to 28 and for the overall 28-d period were not affected by vitamin E level. A quadratic trend ( $P = 0.1025$ ) was noted for G:F in response to vitamin E from d 0 to 14 (0.47, 0.39, and 0.43 for 285, 570, and 1,140 IU, respectively). Percent morbidity and percent re-treatment were analyzed using a non-parametric procedure. Dietary vitamin E had no effect on percent morbidity (54, 58, and 56% for 285, 570, and 1,140 IU, respectively). A quadratic trend ( $P = 0.13$ ) was detected for percentage of cattle re-treated (15, 28, and 10% for 285, 570,

and 1,140 IU, respectively). Although no differences were observed for health and performance data, supplemental dietary vitamin E might be beneficial in recovery from bovine respiratory disease.

**Key Words:** Beef Cattle, Vitamin E, Health

**46 Effect of protein level on the activity of trypsin and chymotrypsin, and the apparent ileal amino acid digestibility in pigs fed grain sorghum-soybean meal diets.** N. Bautista<sup>1</sup>, M. Cervantes<sup>\*2</sup>, M. Cuca<sup>1</sup>, A. Pro<sup>1</sup>, C. Becerril<sup>1</sup>, and S. Rodríguez<sup>2</sup>, <sup>1</sup>*Colegio de Postgraduados, Montecillos, Edo. México*, <sup>2</sup>*ICA, Universidad Autónoma de Baja California, Mexicali*.

A digestion trial was conducted to evaluate the effect of dietary protein level on the apparent ileal digestibilities (AID) of amino acids and the activity of trypsin and chymotrypsin, of growing pigs. Four pigs (L X Y), average body weight of 22.5 kg, fitted each with two cannulae, one in proximal duodenum and the other one in terminal ileum, were used in 4 X 4 Latin Square design. Treatments consisted of four grain sorghum-soybean meal diets containing 9 (T1), 12 (T2), 15 (T3), and 18% (T4) CP. Lys, thr, and met were added to diets T1, T2, and T3, to match their contents in T4. Diet 4 was formulated to meet, at least, 110 the requirements of the essential amino acids for growing pigs. All diets contained the same amount of grain sorghum; diets 1, 2, and 3 were supplemented with corn starch. Feed was provided two times daily in equal amounts, at 0700 and 1900 h. There were four 13-d experimental periods; each consisting of an 8-d adaptation phase, followed by a 5-d digesta collection phase. Ileal digesta were collected on d 9 and 10, during 3 h followed by 3 h of no sampling. Duodenal digesta were collected for 5 min on d 11, 12, and 13 at 30, 60, 90, 120, 180, and 240 min after the morning feeding. The AID (%), in T1, T2, T3, and T4 were: arg, 69.5, 67.0, 82.4, 82.6; his, 58.4, 64.1, 70.5, 72.3; val, 50.6, 58.1, 64.7, 66.5; ile, 64.0, 66.5, 69.2, 70.7; leu, 60.0, 66.4, 63.6, 67.6; lys, 80.0, 81.3, 81.7, 79.2; met, 79.1, 74.1, 76.2, 76.00; phe, 60.0, 66.4, 69.8, 72.2; thr, 63.6, 66.7, 62.0, 62.3, respectively. There was a linear increase ( $P < .01$ ) in the AID of protein-bound amino acids as the CP level was elevated; but, no effect was observed in the AID of lys, thr, and met. Enzyme activities (U/mg protein) in T1, T2, T3, and T4, at two sampling times were: trypsin-30 min, 298, 418, 402, 292; trypsin-60 min, 277, 339, 337, 276; chymotrypsin-30 min, 20, 39, 46, 37; chymotrypsin-60 min, 23, 38, 53, 44, respectively. No significant effect ( $P > .05$ ) of dietary CP level was observed on trypsin activity, but chymotrypsin activity at 60 min was linearly increased ( $P < .05$ ) as the CP level was raised. These data show that the CP level in grain sorghum-soybean meal diets affects the apparent ileal digestibility of protein-bound amino acids.

**Key Words:** Pigs, Protein Level, Amino Acid Digestibility

**47 Effects of calcium soaps of fatty acids and bovine tallow on milk yield and composition in Native x Nubian goats.** J. L. Espinoza<sup>\*</sup>, A. Monroy, J. A. Armenta, and R. Ortega, *Universidad Autonoma de Baja California Sur, La Paz, Mexico*.

Crossbred (Native x Nubian) multiparous goats ( $40 \pm 3$  kg) were used to determine the effects of including calcium soaps of fatty acids (CSFA) or bovine tallow in isoenergetic and isonitrogenous diets on milk yield, milk composition, goats weight and kids weight. Goats and kids were assigned randomly to receive one of the following diets: 1) alfalfa hay ( $.750 \text{ kg} \cdot \text{goat}^{-1} \cdot \text{d}^{-1}$ ), ground corn ( $.700 \text{ kg} \cdot \text{goat}^{-1} \cdot \text{d}^{-1}$ ) without additional fat (C;  $n = 14$  goats with their kids); 2) alfalfa hay ( $.750 \text{ kg} \cdot \text{goat}^{-1} \cdot \text{d}^{-1}$ ), ground corn ( $.680 \text{ kg} \cdot \text{goat}^{-1} \cdot \text{d}^{-1}$ ) and CSFA (4.4%) mixed with the grain (M;  $n = 14$  goats with their kids); 3) alfalfa hay ( $.750 \text{ kg} \cdot \text{goat}^{-1} \cdot \text{d}^{-1}$ ), ground corn ( $.675 \text{ kg} \cdot \text{goat}^{-1} \cdot \text{d}^{-1}$ ) and bovine tallow (3.7%) mixed with the grain (T;  $n = 14$  goats with their kids). Diets were fed from kidding until 50 d after kidding. Milk yield measured by kid weight and suckling technique was similar ( $P > .05$ ) among treatments on 15, 30 and 45 d postpartum (C =  $1.45 \pm .12$ ,  $1.47 \pm .11$  and  $1.14 \pm .12$  kg/d; M =  $1.2 \pm .12$ ,  $1.31 \pm .11$  and  $1.2 \pm .12$  kg/d; T =  $1.28 \pm .12$ ,  $1.18 \pm .11$  and  $1.13 \pm .12$  kg/d at 15, 30 and 45 d postpartum, respectively). At 15 d postpartum, milk fat percentage was lower ( $P < .05$ ) in C (3%) than M (3.7%) and T (3.9%). At 30 d postpartum, milk fat percentage was lower ( $P < .05$ ) in C (3%) than M (3.9%) and T (4.0%). Milk protein percentage at 15 d postpartum was lower ( $P < .05$ ) in M (2.3%) than T (3.1%) and C (3%). Average daily gain of kids at 15 d of age was greater ( $P < .001$ ) in T ( $.479 \pm .04$  kg/d) than M ( $.253 \pm .04$  kg/d) and C ( $.253 \pm .04$  kg/d). Goat body weight at 50 d postpartum was not affected by treatment ( $P > .05$ ). We conclude that

feeding CSFA or bovine tallow to goats postpartum increased milk fat percentage without altering milk yield. However, CSFA reduced milk protein percentage and bovine tallow increased average daily gain in kids.

**Key Words:** Goats, Fat Intake, Milk

**48 Effect of hand-fed versus self-fed fat supplementation on performance of developing beef heifers.** L. Brokaw<sup>\*1</sup>, B. W. Hess<sup>1</sup>, and S. Bartle<sup>2</sup>, <sup>1</sup>*University of Wyoming, Laramie*, <sup>2</sup>*MoorMan's Inc., Quincy, IL*.

A growth and digestion trial were conducted to determine the efficacy of supplemental fat for developing beef heifers consuming a bromegrass hay-based diet. In Exp. 1, 88 Angus x Gelbvieh heifers ( $263.6 \pm .6$  kg) were allotted to one of three treatments in a randomized complete block designed experiment. Supplemental treatments were hand-fed corn-soybean meal based supplement (CRN), hand-fed corn-soybean meal based supplement containing 15% soybean oil (OIL), or self-fed tub supplement containing 15% soapstocks (TUB). Supplements were formulated to be isocaloric and isonitrogenous. Heifers were checked for pregnancy 112 d after the conclusion of the 90 d feeding period. For Exp. 2, in vitro digestibility and VFA were determined using the proportions of hay and supplement heifers consumed. Treatment differences for Exp. 1 and 2 were evaluated using the single degree of freedom orthogonal contrasts, CRN + OIL vs TUB and OIL vs TUB. In Exp. 1, no difference ( $P = .09$ ) existed among treatments for total intake; however, hay intake was greater ( $P = .02$ ) for TUB heifers compared to hand-fed treatments. Hand-fed heifers had greater ADG ( $P = .007$ ) and feed efficiency ( $P = .004$ ) than TUB heifers. Average daily gain and feed efficiency were also greater ( $P \leq .01$ ) for OIL heifers than TUB heifers. Number of heifers artificially inseminated was not different ( $P = .31$ ) between treatments. Of the heifers pregnant at the time of pregnancy check, there was no difference ( $P = .61$ ) in fetal ages; however, pregnancy rate was greater ( $P \leq .03$ ) for hand-fed and OIL heifers compared to TUB. In Exp. 2, IVDMD was greater ( $P = .002$ ) for hand-fed diets compared to TUB. Total VFA was not different ( $P = .34$ ) between supplemented treatments; however, acetate:propionate ratio was lower ( $P = .0001$ ) for hand-fed and OIL treatments than TUB. Decreased growth and reproductive performance of TUB-supplemented heifers may be attributed to a lower plane of nutrition compared to the hand-supplemented heifers.

**Key Words:** Fat Supplementation, Growth, Reproduction

**49 Effect of dietary protein level and the addition of a fungal protease on the performance of growing pigs.** M. Cervantes<sup>\*1</sup>, J. González<sup>1</sup>, M. Cuca<sup>2</sup>, and N. Torrentera, <sup>1</sup>*ICA, Universidad Autónoma de Baja California, Mexicali*, <sup>2</sup>*Colegio de Postgraduados, Montecillos, Edo. México*.

Two experiments were conducted to evaluate the effect of the dietary protein level and the addition of a fungal protease to grain sorghum- or wheat-soybean meal diets on the performance of growing pigs. Twenty eight pigs (LxHxD) were used in each experiment (27.5 and 24.0 kg average initial weight, experiments 1 and 2, respectively), and randomly allotted to four dietary treatments, according to a randomized complete block design, with a 2 x 2 factorial arrangement. There were 7 replicates (four males and 3 females) per treatment; each experiment lasted 28 d. Dietary treatments for both experiments were as follows: 1) low protein diet (LP: 11.0%); 2) LP plus .05% of protease (LP-P); 3) high protein diet (HP: 16.5%); 4) HP plus .05% of protease. Grain sorghum was used as energy source in Exp. 1, whereas wheat was used in Exp. 2. Crystalline lys, thr, and met were added to the LP diets to equal their levels in the HP diets. In Exp. 1, daily gain, feed intake, lys consumption and feed/gain ratio were: 618, 594, 761, 698 g/d; 1.80, 1.75, 2.07, 1.95 kg/d; 12.6, 12.2, 14.5, 13.6 g/d; 2.82, 2.96, 2.71, 2.81, respectively. Pigs fed the HP diets had a higher daily gain, feed intake and a better feed/gain ratio ( $P < .05$ ). The addition of the enzyme tended to reduce daily gain and feed conversion ( $P < .10$ ). In Exp. 2, daily gain, feed intake, lys consumption and feed/gain ratio were: 716, 738, 769, 741 g/d; 1.83, 2.07, 1.91, 1.88 kg/d; 14.9, 16.9, 15.6, 15.4 g/d; 2.57, 2.83, 2.50, 2.55. There was not any significant effect ( $P > .05$ ) of either dietary protein level nor enzyme addition on growth rate, feed intake or feed/gain ratio. This, suggest that crystalline lysine and threonine can replace 100% the soybean meal of a wheat-based diet, without affecting pig performance. Overall, the performance of pigs fed the wheat based

diets had a better performance than those fed the grain sorghum diets; one or more nutrients limit growth rate in pigs fed the LP grain sorghum diet. These data show no beneficial effect of adding a protease to grain sorghum- or wheat soybean meal diets for growing pigs.

**Key Words:** Pigs, Amino Acid Digestibility, Enzyme

**50 Performance of finishing pigs fed wheat-based diets containing low levels of inorganic phosphorus.** M. Cervantes<sup>\*1</sup>, A. Araiza<sup>1</sup>, S. Espinoza<sup>1</sup>, and M. Cuca<sup>2</sup>, <sup>1</sup>ICA, Universidad Autónoma de Baja California, Mexicali, <sup>2</sup>Colegio de Postgraduados, Montecillos, Edo. México.

An experiment was conducted to evaluate the effect of adding low levels of inorganic phosphorus to wheat-based diets, on the performance of pigs. Forty crossbred (Yorkshire-Duroc-Landrace) finishing (50.1 kg av. initial BW) pigs were used, and randomly allotted to five dietary treatments, according to a randomized complete block design. There were 4 replicates (one male and 1 female) per treatment; the experiment lasted 28 d. The dietary treatments were as follows: T1, T2, T3, T4 consisted of wheat-based diets supplemented with .05, .20, .35, and .50% of dicalcium phosphate, respectively; and T5 was the positive control, wheat-soybean meal diet, .44% total P. Treatments 1 to 4 were supplemented with crystalline lysine and threonine to equal their levels in diet 5. Diets 1 and 5 were formulated to supply 100% of the requirement of available P; also, all diets were added with vitamins and minerals to meet the requirements of the 50-100 kg pig. A linear regression analysis, involving T1 to T4, was performed. Also, four orthogonal contrasts were constructed: T1 vs T5, T1 vs T3, T1 vs T4, and T5 vs the others. Weight gain, feed intake, total P intake, available P intake, and feed/gain were: 796, 770, 796, 766, 782 g/d; 2.36, 2.61, 2.49, 2.37, 2.52 kg/d; 9.2, 10.7, 11.0, 11.1, 11.1 g/d; 4.7, 6.0, 6.2, 6.6, 5.0 g/d; 2.97, 3.39, 3.20, 3.09, 3.25, respectively. Neither, weight gain ( $P > .81$ ), feed intake ( $P > .86$ ) or feed/gain ( $P > .68$ ) were affected by the level of supplemental inorganic P in the diet. Daily gain and feed/gain ratio were similar among pigs fed the wheat-based diet containing only .05% of inorganic P and those fed the wheat-soybean meal diet. Intake of both total ( $P < .04$ ) and available P ( $P < .01$ ) linearly increased as the P content in the diet increased. These results suggest that wheat contains almost 100% the requirement of available phosphorus for maximum growth of finishing pigs. Thus, from these data it is concluded that there is no need of supplemental inorganic phosphorus in wheat-based diets for finishing pigs.

**Key Words:** Pig Performance, Wheat, Phosphorus

**51 Prediction of barley feed quality from laboratory analyses.** L.M.M. Surber<sup>\*1</sup>, J.G.P. Bowman<sup>1</sup>, T. K. Blake<sup>1</sup>, D. D. Hinman<sup>2</sup>, D. L. Boss<sup>1</sup>, and T. C. Blackhurst<sup>1</sup>, <sup>1</sup>Montana State University, Bozeman, <sup>2</sup>University of Idaho, Caldwell.

The objectives of this research were to determine if feedlot performance by cattle fed barley-based diets was related to, and could be predicted from barley feed quality characteristics as measured by laboratory procedures. Fifty-six observations (each observation was a diet mean in a feedlot study) of animal performance used for these analyses were from 18 feedlot trials conducted in Montana and Idaho, during 1993 through 2000. Dry rolled barley diets fed were based on 21 different barley genotypes, including 14 cultivars and 7 experimental lines. Dry rolled barley samples from each of the diets fed were evaluated for starch, ADF, 3 h in situ DMD (ISDMD), and particle size as measured by dry sieving. Barley  $NE_m$  and  $NE_g$  (Mcal/kg) contents were calculated using NRC equations, and DMI, average BW, and ADG. Correlations and regressions were made using SAS. There was a negative correlation between ADG and ISDMD ( $r = -0.36$ ,  $P = 0.007$ ), and positive correlations between ADG and  $NE_m$  and  $NE_g$  ( $r = 0.32$ ,  $P = 0.03$ ). Negative correlations were found between DMI and starch ( $r = -0.29$ ,  $P = 0.04$ ), DMI and particle size ( $r = -0.31$ ,  $P = 0.04$ ), and DMI and  $NE_m$  and  $NE_g$  ( $r = -0.71$ ,  $P < 0.001$ ). In vivo DMD was positively correlated with ISDMD ( $r = 0.52$ ,  $P = 0.002$ ), and negatively correlated with particle size ( $r = -0.68$ ,  $P < 0.001$ ). Feed efficiency (gain/feed) was negatively correlated with ISDMD ( $r = -0.37$ ,  $P = 0.007$ ), and positively correlated with starch ( $r = 0.33$ ,  $P = 0.02$ ) and particle size ( $r = 0.35$ ,  $P = 0.02$ ). Barley  $NE_m$  could be predicted from starch and ISDMD ( $R^2 = 0.42$ ,  $P < 0.001$ ). ADG could be predicted from  $NE_m$ , ADF, starch and particle size ( $R^2 = 0.75$ ,  $P < 0.001$ ). Feed efficiency could be predicted from  $NE_m$ , starch and ISDMD ( $R^2 = 0.66$ ,  $P < 0.001$ ). Laboratory analysis

of barley starch, ADF, ISDMD and particle size could be used to select new barley varieties with improved feed quality.

**Key Words:** Barley, Feed Quality, Feedlot Performance

**52 Interaction of maceration and fibrolytic enzyme supplementation on digestion of rice straw in Holstein cows.** M. A. Lopez-Soto<sup>\*1</sup>, A. Plascencia<sup>1</sup>, and R. A. Zinn<sup>2</sup>, <sup>1</sup>Universidad Autonoma, Baja California, Mexico, <sup>2</sup>University of California, Davis.

Five Holstein cows (633 kg) with cannulas in the rumen and proximal duodenum were used to evaluate the interaction of maceration and fibrolytic enzyme supplementation on digestion of rice straw. Treatments consisted of a steam-flaked corn-based diet supplemented with 40% forage as: 1) ground sudangrass hay; 2) ground rice straw, 3) macerated rice straw; 4) ground straw plus Fibrozyme (15 g/d), and 5) macerated straw plus Fibrozyme. Enzyme supplementation increased ruminal digestion of OM (5%;  $P < .01$ ) and NDF (21.8%;  $P < .01$ ), but did not affect ( $P > .10$ ) total tract digestion of OM, NDF, or N. Maceration decreased ruminal digestion of NDF (14%,  $P < .10$ ), but increased (10%,  $P < .05$ ) total tract NDF digestion. There were no treatment effects ( $P > .10$ ) on ruminal microbial efficiency. Maceration decreased both ruminal (16%,  $P < .05$ ) and total tract (4%,  $P < .01$ ) N digestion. Maceration increased ( $P < .01$ ) the Kd and Kp of NDF by 52% and 26%, respectively. Accordingly, maceration decreased ruminal solids and NDF content (13, and 28%, respectively;  $P < .10$ ). Enzyme supplementation increased the Kd of NDF (43%,  $P < .01$ ). The increase in Kd of NDF digestion with enzyme supplementation was greater (interaction,  $P < .05$ ) with macerated than with nonmacerated straw (64 vs 19%, respectively). Enzyme supplementation did not affect ( $P > .10$ ) ruminal solids and NDF content, or Kp of NDF. Total tract digestion of OM, NDF, and GE were greater (3, 19, and 4%, respectively;  $P < .05$ ) for sudangrass- than for rice straw-based diets. There were no treatment effects on ruminal pH, VFA and estimated methane production. We conclude that enzyme supplementation works synergistically with maceration to enhance the feeding value of low quality forages.

**Key Words:** Maceration, Fiber, Digestion

**53 Metabolizable amino acid requirement of feedlot calves.** M. N. Machado<sup>\*</sup>, M. F. Montano, and R. A. Zinn, University of California, Davis.

One hundred ninety-two crossbred steers (229 kg) were used evaluate the influence of metabolizable amino acid intake on growth performance and health during the initial 42-d receiving period. Treatments consisted of four levels of metabolizable lysine (23, 24, 25 and 26 g/kg diet DM). No steers died during the study. Morbidity averaged 36%, and was not affected ( $P > .20$ ) by treatments. Increasing the metabolizable lysine supply did not affect ( $P > .20$ ) DMI, but increased (linear effect,  $P < .01$ ) ADG, gain efficiency, and dietary NE. Metabolizable amino acid supply of the basal diet, determined using 6 steers (214 kg) with cannulas in the rumen and proximal duodenum, was in very close agreement with expected ( $R^2 = .99$ ;  $P < .0001$ ) based on NRC (1996) level 1 model. The metabolizable amino acid supplies for treatments in Trial 1 were estimated by adding tabular metabolizable amino acid values for the supplemental proteins to the observed metabolizable amino acid supply of the basal diet. Treatment effects on metabolizable lysine supply explained 99% of the variation ( $P < .01$ ) in ADG, and 91% of the variation in observed versus expected dietary NE. The biological value of intestinal chyme was determined based on the chemical score ratio technique, using bovine tissue as the reference protein. Accordingly, methionine and lysine were closely co-limiting amino acids having ratios of 77 and 79%, respectively. We conclude that current NRC standards reliably predict both requirements and supplies of metabolizable amino acids for feedlot calves. Diet formulations that do not meet the metabolizable amino acid requirements may depress both ADG and the partial efficiency of utilization of metabolizable energy for maintenance and gain.

**Key Words:** Amino Acid, Cattle, Metabolism

**54 Comparative feeding value of elephant grass in growing diets for feedlot cattle.** E. G. Alvarez<sup>\*1</sup>, M. F. Montano<sup>1</sup>, and R. A. Zinn<sup>2</sup>, <sup>1</sup>Universidad Autonoma, Baja California, Mexico, <sup>2</sup>University of California, Davis.

One hundred twelve crossbred yearling heifers (357 kg) were used in a 56-d trial. Dietary treatments consisted of an 80% concentrate diet supplemented with 20% forage as alfalfa hay, sudangrass hay, or first or second cutting elephant grass (*Pennisetum purpureum*, designated "Promor A"). Replacing grass hay with alfalfa depressed DMI (14.5%,  $P < .01$ ) and ADG (12.4%,  $P < .05$ ). Replacing sudangrass with elephant grass hay increased (4.7%,  $P < .05$ ) DMI and tended to increase ( $P = .27$ ) ADG. Dietary NE values were similar ( $P > .10$ ) for sudangrass and elephant grass diets. Replacing grass hay with alfalfa increased dietary NE ( $P < .10$ ). Elephant grass cutting date did not affect ( $P > .20$ ) growth-performance. Given that the NEm value of sudangrass hay is 1.14 Mcal/kg, the NEm and NEg values for elephant grass are 1.19 and .64 Mcal/kg, respectively. The corresponding values for alfalfa hay are 1.69 and 1.07 Mcal/kg, respectively. Based on their nutrient composition, the NE values of alfalfa hay are 8% greater than expected (1.69 vs 1.56 Mcal/kg), and the NE values of elephant grass are 10% lower than expected (1.19 vs 1.32 Mcal/kg). Four Holstein steers (153 kg) with cannulas in the rumen and proximal duodenum were used evaluate treatment effect on digestion. Forage type did not affect ( $P > .20$ ) ruminal digestion of OM, NDF, and N. Microbial efficiency was 11% greater ( $P < .05$ ) for alfalfa than for grass hay diets, and 19% greater ( $P < .01$ ) for elephant grass than for sudangrass diets. Total tract digestion of OM was 5% greater ( $P < .05$ ) for alfalfa than for grass hay diets, and 4% greater ( $P < .10$ ) for elephant grass than for sudangrass diets. Total tract digestion of NDF was 20% greater ( $P < .10$ ) for elephant grass than for sudangrass diets. Cutting date did not affect ( $P > .20$ ) digestion of elephant grass. We conclude that the NE value of the elephant grass and sudangrass hay are similar. However, the palatability or acceptability of elephant grass is superior to that of sudangrass and alfalfa hay in growing-finishing diets for feedlot cattle.

**Key Words:** Elephant Grass, Cattle, Metabolism

**55 Effect of degree of corn processing on visceral organ mass and chemical composition of gastrointestinal tract fill of beef heifers.** M. S. Brown<sup>\*</sup>, C. R. Krehbiel, L. A. Balstad, R. Lopez-Ordaz, and G. D. Pulsipher, *New Mexico State University, Las Cruces.*

Nine crossbred heifers (298 +/- 7 kg BW) were used to determine the effect of degree of corn processing on visceral organ mass and gastrointestinal fill. Heifers were fed a 90% concentrate diet based on corn steam flaked to a bulk density of .36 (n = 5) or .26 kg/L (n = 4; 28 [SF28] or 20 [SF20] pounds/bushel, respectively) for a period of 19 d before slaughter. Degrees of processing were selected to generate final products with 50 or 75% enzymatically available starch. At slaughter, visceral organ digesta was removed, weighed, sampled, and pH determined; wet weight of the washed organ was recorded. Intake (g) of OM, starch, CP, NDF, and ADF was 6511, 4186, 909, 1368, and 707 for heifers fed SF28 and 6488, 4309, 844, 1198, and 667 for heifers fed SF20, respectively. Nutrient intake was used as a covariate for analyzing digesta data. Ruminal OM fill tended ( $P = .12$ ) to be increased, whereas ruminal starch fill was increased ( $P = .09$ ) for heifers fed SF28 compared with heifers fed SF20. Cecal OM, CP, and ADF fill were decreased ( $P < .10$ ) for heifers fed SF28. The pH of digesta was increased ( $P < .04$ ) in the proximal small intestine and distal large intestine for heifers fed SF20. Absolute mass of the rumen (8,072 vs 7,590 +/- 163 g) and kidneys (817 vs 715 +/- 29 g) was increased ( $P < .06$ ) for heifers fed SF20, whereas absolute mass of the cecum (348 vs 253 +/- 37 g) tended ( $P = .12$ ) to be increased for heifers fed SF20. When expressed as g of tissue/kg of EBW, fractional mass of the rumen, cecum, and kidneys was increased ( $P < .07$ ) for heifers fed SF20. Fractional mass of the omasum, abomasum, proximal small intestine, distal small intestine, distal large intestine, liver, pancreas, and spleen did not differ ( $P > .23$ ) among treatments. Results suggest that an increased degree of corn processing is accompanied by decreased ruminal starch fill, increased cecal fiber fill, and increased mass of the rumen, cecum, and kidneys.

**Key Words:** Visceral Organ Mass, Digesta, Grain Processing

**56 Influence of tempering on the steaming requirements of flaked corn for feedlot cattle.** R. A. Ware, J. Salinas<sup>\*</sup>, and R. A. Zinn, *University of California, Davis.*

Four Holsteins steers (238 kg) with cannulas in the rumen and proximal duodenum were used to evaluate the influence of tempering on steaming requirements of flaked corn. Treatments were: 1) dry rolled corn, no steam (DRC); 2) tempered rolled corn, no steam (TRC), 3) tempered flaked corn, 5-min steaming time (T-5min-SFC), and 4) flaked corn, 25 min steaming time (25min-SFC). Tempering consisted of the following: water (.075 L/kg corn) plus the .15 mL/kg tempering agent (SarTemp) were sprayed on corn as it was augered into a holding bin located directly above the steam chest. Retention time of corn in the holding bin was approximately 30 min. The various processing treatments were allowed to air-dry (2 d) before use in diet preparation. There were no treatment effects ( $P > .10$ ) on ruminal digestion of OM, DIP and ruminal microbial efficiency. There was a tendency ( $P = .19$ ) for ruminal NDF digestion to be lower for 25min-SFC than for T-5min-SFC. Ruminal digestion of starch was greater ( $P < .05$ ) for steam-flaked corn treatments than for rolled corn treatments. Ruminal N efficiency tended to be greater ( $P = .13$ ) for steam flaked corn treatments than for rolled corn treatments. Post ruminal and total tract digestion of OM, starch, and N were greater ( $P < .05$ ) for steam- flaked corn treatments than for rolled corn treatments. Ruminal pH was lower ( $P < .05$ ) for steam-flaked corn treatments than for rolled corn treatments. Ruminal acetate:propionate molar ratios and estimated methane production were also lower for steam-flaked corn treatments than for rolled corn treatments. The similarities between T-5min-SFC and 25min-SFC with respect to site and extent of starch digestion and VFA molar proportions are promising evidence that pretempering corn prior to steam flaking will reduce the minimal steam requirements to obtain optimal utilization of corn.

**Key Words:** Flaked Corn, Cattle, Digestion

**57 Comparative feeding value of corn seed byproduct pellets in growing-finishing diets for feedlot cattle.** R. A. Ware, H. Perez, F. Sanchez<sup>\*</sup>, B. R. Tonroy, and R. A. Zinn, *University of California, Davis.*

One thousand two hundred forty-five crossbred bulls with an average initial weight of 316 kg were used in a 42-d trial to evaluate the comparative feeding value of corn seed byproduct pellets (CSBP). The CSBP consist primarily of broken seed kernels and corn steep liquor. Nutrient composition (DM basis) of CSBP was as follows: DM, 92%; CP, 15.5%; Fat, 4.3%; crude fiber, 1.7%; ash, 2.7%; Ca, .02% and P, .49%. Bulls were blocked by weight and randomly assigned within weight groups to 18 pens (approximately 69 bulls per pen). The trial was conducted at Ganaderia Integral Vizur, located in Culiacan, Sinaloa, Mexico. The cattle had been on feed for approximately two months prior to beginning the experiment. The CSBP replaced steam-flaked white corn and protein supplement in the control diet so that diets provided similar amounts (8%) of metabolizable protein. The steam-flaked corn had a flake density of .39 kg/L. Daily weight gain was greater (7.2%,  $P < .05$ ) for bulls consuming CSBP. This improvement in weight gain was primarily a reflection of increased DMI (7.3%,  $P = .18$ ). There were no treatment effects on gain efficiency and estimated NE value of the diet. However, the ratio of observed to expected NEm and NEg were lower (5 and 7%, respectively,  $P < .05$ ) for CSBP then for steam-flaked corn diets. Using the replacement technique, the estimated NEm and NEg values for CSBP were 2.20 and 1.52 Mcal/kg, respectively. We conclude that CSBP are a highly palatable protein-rich concentrate with a NE value comparable to that of ground corn. The pellets may be including at levels of up to 40% of diet DM without having detrimental effects on growth performance.

**Key Words:** Corn, Byproduct, Cattle

**58 Influence of maceration on the feeding value of rice straw in growing-finishing diets for feedlot cattle.** N. Torrentera<sup>\*</sup>, E. G. Alvarez, and R. A. Zinn, *University of California, Davis.*

One hundred eight yearling crossbred steers were used in a 107-d trial to evaluate the influence of maceration on the feeding value of rice straw. Treatments consisted of a steam-flaked corn-based diet containing 20% forage (DM basis) as sudangrass, rice straw or macerated rice straw.

All forages were ground to pass through a 2.6 cm screen prior to incorporation into complete mixed diets. There were no treatment effects ( $P > .10$ ) on ADG. Growth performance was similar ( $P > .10$ ) for diets containing sudangrass or macerated rice straw. Maceration lowered (12%,  $P < .05$ ) DMI and increased (9 and 10%, respectively;  $P < .05$ ) feed efficiency and NE of rice straw diets. Six steers with cannulas in the rumen and proximal duodenum were used to evaluate treatment effects on digestion. Ruminal digestion of OM, NDF and feed N were not different ( $P > .10$ ) for rice straw than for macerated rice straw. However, maceration increased (12%,  $P < .05$ ) total tract NDF digestion. One hundred twenty crossbred steer were used in a 54-d feeding trial to evaluate macerated rice straw in high-forage growing diets. Treatments consisted of a steam-flaked corn-based diet containing 40% forage as sudangrass, alfalfa, rice straw and macerated rice straw. Weight gain, DMI, and feed efficiency were greater ( $P < .05$ ) for sudangrass and alfalfa than for rice straw diets. Maceration of rice straw enhanced ( $P < .10$ ) ADG, DMI, and feed efficiency, increasing the NE value of rice straw for maintenance and gain by 15 and 32%, respectively. We conclude that maceration increases the feeding value of rice straw.

**Key Words:** Rice Straw, Processing, Cattle

**59 Health and growth-performance merits of feeding shipping-stressed calves on a chopped forage blend prior to feeding a 70% concentrate receiving diet.** S. A. Rodriguez\* and R. A. Zinn, *University of California, Davis.*

Two trials were conducted to evaluate the health and growth-performance merits of feeding shipping-stressed calves on a chopped forage blend (46.5% alfalfa hay, 46.5% sudangrass hay, and 7% cane molasses) before starting them on a 70% concentrate receiving diet. In both trials the calves originated from central Texas and were in transit roughly 30 h. Trial 1 involved 96 crossbred calves (195 kg) during a 42-d receiving period. Treatments consisted of feeding the chopped forage blend for 0 versus 7 d before feeding a 70% concentrate receiving diet. There were no treatment effects ( $P > .20$ ) on growth performance. However, feeding the chopped forage blend for 7 d tended ( $P = .12$ ) to reduce the percentage of calves pulled as sick, and reduced ( $P < .05$ ) the average treatment days/calf pulled as sick. Trial 2, involved 173 crossbred calves (174 kg) during a 28-d receiving period. Treatments consisted of feeding the chopped forage blend for 2 versus 8 d before feeding the 70% concentrate receiving diet. Feeding the chopped forage blend for 8 d tended to depress weight gain 6.5% ( $P = .15$ ) and increased (10%,  $P < .05$ ) feed/gain. Percentage calves pulled as sick and average sick days were reduced ( $P < .05$ ) by 65 and 34%, respectively. We conclude that feeding a chopped forage blend during the early receiving period will promote health of shipping-stressed calves. This practice may result in slight depressions in live weight gain and feed conversion. Long-term effects on feedlot growth-performance are expected to be minimal.

**Key Words:** Shipping Stress, Cattle, Feeding

**60 The interaction of flake density and tempering on the comparative feeding value of steam-flaked corn for feedlot cattle.** R. A. Zinn, E. G. Alvarez, M. F. Montano, S. A. Rodriguez, and R. A. Ware\*, *University of California, Davis.*

A feedlot growth-performance trial was conducted to evaluate the relative response to tempering when flake density of corn is increased from .31 kg/L (24 lb/bushel) to .39 kg/L (30 lb/bushel). Four dietary treatments were compared: 1) non-tempered, flake density = .31 kg/L; 2) non-tempered, flake density = .39 kg/L; 3) tempered, flake density = .31 kg/L and 4) tempered, flake density = .39 kg/L. The basal diet contained (DM basis) 8% alfalfa hay, 4% sudan grass hay, 77.3% corn, 2.5% fat, 4% molasses and 4.2% vitamin-mineral supplement. Tempering prior to flaking increased ( $P < .01$ ) the moisture content of corn as it exited the rolls by 3.7 percentage units over steam-flaking alone. Decreasing the tension on the rolls to increase flake density increased (32%,  $P < .01$ ) flake thickness and decreased (30%,  $P < .01$ ) enzymatic starch reactivity. At equal flake density, tempered corn tended to be thicker (5.9%,  $P < .10$ ) and had slower (13%,  $P < .05$ ) enzymatic starch reactivity. There were no treatment interactions ( $P > .10$ ). Increasing flake density from .31 to .39 kg/L did not affect ( $P > .20$ ) ADG, but increased dietary NE (2.7%,  $P < .05$ ). Given that NEm and NEg values of corn flaked to a density of .31 kg/L are 2.38 and 1.68 Mcal/kg, respectively, then the corresponding NE values for corn flaked to a density of .39 kg/L are 2.30 and 1.61 Mcal/kg, respectively. We conclude that

tempering does not increase the NE value, per se, of flaked corn. The difference in feeding value of corn flaked to densities of .31 and .39 kg/L is appreciable.

**Key Words:** Flaked Corn, Cattle, Density

**61 Efficacy of feeding a probiotic to yearling replacement beef heifers in a wintering backgrounding program.** J.R. Jaeger\* and T. DelCurto, *Eastern Oregon Agricultural Research Center, Oregon State University, Union.*

BioCycle Plus<sup>®</sup>, a probiotic product, has been shown to improve the digestive efficiency of dairy cows. There is limited information regarding use of this product in growing beef cattle. Ninety-six weaned heifers (average wt = 252 kg; average body condition score = 4.49, 1 to 9 scale) were stratified by weight and age, and within stratum assigned randomly to 3 replicates of a 2 x 2 factorial. Treatments were: 1) control, 1.36 kg/head/d of ground oats (CON); 2) ground oats with DTX (I-form bacteria, saccharides, selected organic acids and vitamins, DTX); 3) ground oats with BioCycle (yeast culture and mold inhibitor, BC); and, 4) ground oats with BioCycle Plus (combination of treatments 2 and 3, BC+). All heifers received basal diets of alfalfa/orchard grass hay *ad libitum*. Heifers were adapted to bunk fed supplements from d 0 to 13, with treatment supplements fed from d 14 to 84. Weights and body condition scores were obtained after a 16 h shrink on d 0, 28, 56 and 84. Blood samples were collected from all heifers on d 74 and 84. The resulting serum was analyzed for progesterone to determine puberty status before estrous synchronization. All heifers received SyncroMate B on d 84 and were artificially inseminated 11 d later. Heifers were then exposed to a bull from d 14 to 30 after synchronization. Over the 84 d, heifers gained between 0.52 and 0.64 kg/head/d. Heifers receiving DTX or BC+ had greater ( $P < 0.10$ ) weight change than CON heifers. However, only BC heifers displayed a greater ( $P = 0.03$ ) increase in body condition score than CON heifers (0.35 vs. 0.15, respectively) over the 84 d. Proportion of DTX heifers pubertal was reduced compared to CON heifers (12.5 vs. 37.5%, respectively,  $P < 0.05$ ). First service conception rate to artificial insemination and final pregnancy rate did not differ ( $P > 0.10$ ) among groups averaging 47.92 and 67.71%, respectively. Although BC+ treated heifers weighed more at the end of the study, they did not display improved reproductive performance.

**Key Words:** Probiotic, Beef Heifers, Development

**62 Use of microtracers as a reliable and inexpensive tool for rapid assessment of microingredient distribution in diets for feedlot cattle: molasses- and forage-level effects.** J. F. Calderon\*<sup>1</sup>, J. Melendrez<sup>1</sup>, M. Machado<sup>2</sup>, M. Ambrozio<sup>2</sup>, A. Pereira<sup>2</sup>, and R. A. Zinn<sup>2</sup>, <sup>1</sup>*Universidad Autonoma, Baja California, Mexico*, <sup>2</sup>*University of California, Davis.*

We have developed a new technique for the application of microtracer technology to the assessment of microingredient uniformity in diets for feedlot cattle. The influence of dietary forage (12 vs 24%) and molasses levels (6, 12, 18, and 24%) on the efficiency of recovery of microtracer (33 g/1000 kg) using this new technique was compared with that of chromic oxide (87.4 g/1000 kg) and laidlomycin propionate (101.5 g/1000 kg). The order of ingredient addition to the batch mixer was as follows: grain, mineral supplement, forage, fat, and molasses. Markers were premixed with 10 kg of mineral supplement in a small cement mixer before being added to the batch mixer. The grain and mineral supplements were mixed together for 1 min before addition of the remaining ingredients. After all ingredients were added to the mixer, the batch was mixed for an additional 5 min. An 8-kg sample was taken from each feed batch (341 kg) as it exited the mixer. Eight separate batches (replications) of each dietary treatment were produced. Marker recovery averaged 103.5, 78.3, and 97.2% for microtracer, chromic oxide, and laidlomycin, respectively. The corresponding CV for marker recovery averaged 8.1, 7.2, and 13.0%, respectively. There were no treatment effects ( $P > .20$ ) on recovery of microtracer and laidlomycin. With chromic oxide, recovery increased (linear effect,  $P < .05$ ) with increasing molasses level, and tended to decrease ( $P < .10$ ) with increased forage level. The CV for microtracer recovery also tended (linear effect,  $P < .10$ ) to decrease with increasing molasses level. Recovery of microtracer and laidlomycin were not different ( $P > .20$ ) and both were greater ( $P < .01$ ) than chromic oxide. The CV for marker recovery were not different ( $P > .20$ ) for microtracer and chromic oxide, and both were less than that of laidlomycin. We concluded that the microtracer technique that we have developed is a

reliable and inexpensive tool for rapid assessment of microingredient distribution in complete mixed diets for feedlot cattle. Very wide ranges in forage and liquid supplement content of the diet do not appear to pose an appreciable limitation to the reliability of microtracers.

**Key Words:** Feed Mixing, Marker, Molasses

**63 A comparison of bite-count derived botanical composition of diet and clipping vs. rumen evacuation as techniques to estimate diet quality with grazing beef cattle.** D. Damiran<sup>1</sup>, S. Findhold<sup>2</sup>, T. DelCurto<sup>1</sup>, and B.K. Johnson<sup>2</sup>, <sup>1</sup>Eastern Oregon Agricultural Research Center, Oregon State University, Union, <sup>2</sup>Oregon Department of Fish and Wildlife, La Grande.

A study was conducted comparing the bite-count method (BC) of estimating forage intake, diet composition, and synthesized diet quality to direct estimates of diet quality using rumen evacuation (RE) techniques. Four sites, in secondary successional grand fir (*Abies grandis*) zones, were chosen as experimental pastures. Each pasture, in turn, contained two 0.25 ha enclosures that were either: 1) ungrazed (avg 890 to 1332 kg/ha) or 2) grazed by cattle in mid-June and mid-July to remove no more than 40% of total forage yield (avg 833 to 970 kg/ha). Four ruminally-cannulated steers were used to evaluate both techniques to determine diet quality obtained during the first three weeks of August. Diet collections and bite-count data were obtained in concurrent sampling regimes consisting of four 20 min grazing bouts per location and pasture. Degree of utilization (DU) in grazed enclosures was 32.85 ± 4.63%. Average RE OM intake (RE-OMI) was 357 ± 35.6 and 260.8 ± 35.4 g/20 min in grazed and ungrazed enclosures, respectively. In contrast, BC OM intake (BC-OMI) was 174.8 ± 16.9 and 373 ± 44.2 g/20 min in grazed and ungrazed enclosures, respectively, suggesting some problems in estimating bite size in previously grazed pastures. The RE-OMI estimate was 2-fold greater than the BC-OMI estimate ( $P < .05$ ) in previously grazed pastures. Crude protein in RE samples averaged 10.2 ± 0.4%, whereas, CP for the BC method was lower averaging 7.5 ± 0.3% across pastures ( $P < .05$ ). RE ADF and NDF were higher ( $P < .01$ ) than BC ADF and NDF. However, RE and BC *in vitro* OM digestibility did not differ ( $P > .10$ ) averaging 65.4 and 66.3% for RE and BC methods, respectively. In summary, BC methods tended to underestimate CP, and fibrous constituents presumably due to our inability to estimate bite size and composition accurately.

**Key Words:** Beef Cattle, Diet Quality, Forage Intake

**64 Interaction of dietary calcium and fat on digestive function in cattle fed high-forage diets.** H. L. Castro<sup>1</sup>, J. F. Sanchez<sup>1</sup>, M. S. Vasquez<sup>1</sup>, E. G. Alvarez<sup>2</sup>, and R. A. Zinn<sup>1</sup>, <sup>1</sup>Universidad Juarez, Durango, Mexico, <sup>2</sup>University of California, Davis.

Four bull calves (260 kg) with cannulas in the rumen and proximal duodenum were used in a 4 x 4 Latin square experiment to evaluate the interaction of dietary calcium level (.6 versus 1.1%, DM basis) and supplemental fat (0 versus 4% tallow) digestive function. The basal diet contained 65% ryegrass hay (DM basis). There were no treatment effects ( $P > .20$ ) on ruminal OM digestion. Increasing dietary Ca increased (5.4%,  $P < .05$ ) ruminal NDF digestion. However, dietary Ca did not otherwise affect ( $P > .20$ ) ruminal and total tract digestion of OM starch, or N. Fat supplementation actually increased (11.6%,  $P < .01$ ) ruminal NDF digestion and ruminal microbial efficiency (8%,  $P < .05$ ). Fat supplementation did not affect ( $P > .20$ ) total tract digestion of OM, NDF, starch, or N. Supplemental fat increased (6.4%,  $P < .01$ ) dietary DE. Given that the DE of the ground sorghum that fat replaced in the diet was 3.70 Mcal/kg, then the DE value of the supplemental tallow was 8.45 Mcal/kg. Supplemental fat decreased (5%,  $P < .05$ ) ruminal pH. Neither dietary Ca nor fat levels affected ( $P > .20$ ) ruminal soluble Ca concentration. However, supplemental fat increased the pH adjusted soluble Mg concentrations. Fat supplementation did not affect ( $P > .20$ ) apparent ruminal Ca digestion. However, there was a Ca by fat level interaction on apparent total tract Ca digestion. With .6% dietary Ca supplemental fat did not affect Ca digestion. In contrast, with 1.1% dietary Ca, supplemental fat increased (18%) apparent Ca digestion. We conclude that supplemental fat will not have a detrimental effects on characteristics of ruminal and total tract digestion of OM, NDF, and N, nor will it increase dietary Ca requirements in cattle fed high-forage diets.

**Key Words:** Calcium, Fat, Cattle

**65 Influence of dietary forage level on growth performance and digestive function in cattle fed steam-flaked corn-based growing-finishing diets.** R. A. Zinn, E. G. Alvarez\*, W. Chai, M. F. Montano, J. E. Ramirez, and J. Salinas, University of California, Davis.

Ninety six medium-framed yearling crossbred steers were used in a feedlot growth-performance trial to evaluate the influence of forage level (5, 10, 15 and 20% sudangrass hay, DM basis) on utilization of a steam-flaked corn-based finishing diet. There was a quadratic effect ( $P < .01$ ) of forage level ADG, with ADG being maximal at the 15% forage level. Daily weight gain increased by 1.9% per unit increase in forage level within the range of 5 to 15% forage, but declined 8% as forage level increased from 15 to 20%. This occurred because DMI did not increase (quadratic effect,  $P < .10$ ). The ratio of observed:expected dietary NE was not affected ( $P > .10$ ) by dietary treatments, averaging 1.0. There were no treatment effects ( $P > .10$ ) on dressing percentage, longissimus area, fat thickness, KPH, and marbling score. Four Holstein steers (189 kg) were used in a 4 x 4 Latin square experiment to evaluate treatment effects on characteristics of ruminal and total tract digestion. Forage level did not affect ( $P > .10$ ) ruminal digestion of OM and starch, but increased ruminal digestion of ADF (linear effect,  $P < .05$ ), feed N (linear effect,  $P < .05$ ) and ruminal microbial efficiency (cubic effect,  $P < .05$ ). Ruminal pH increased (linear effect,  $P < .01$ ) with increasing forage level. Changes in ruminal digestion of ADF and feed N were closely associated with changes in ruminal pH. Increasing forage level decreased total tract digestion of OM (linear effect,  $P < .01$ ) and starch (linear effect,  $P < .05$ ). Post-ruminal ADF digestion nearly compensated (linear effect,  $P < .01$ ) for differences in ruminal ADF digestion, although ADF digestion tended to be higher (cubic effect,  $P < .10$ ) with increasing forage level. Increasing forage level did not influence ( $P > .10$ ) ruminal VFA molar proportions. We concluded that when sudangrass hay is the principal forage source in steam-flaked corn-based finishing diets, growth-performance is optimized when the forage level is 15%. Increasing dietary forage level beyond 15% may depress energy intake, and ADG.

**Key Words:** Forage Level, Cattle, Sudangrass

**66 Influence of day-to-day fluctuations in feed intake on growth-performance and digestive function of feedlot cattle.** M. F. Montano, E. G. Alvarez, A. Pereira\*, and R. A. Zinn, University of California, Davis.

A growth-performance trial and a metabolism trial were conducted to evaluate the influence of a 20% fluctuation in daily DM intake on performance and digestive function in Holstein steers. Feed intake was adjusted at weekly increments according to projected changes in live weight. The experimental diet contained (DM basis): 8.00% sudangrass hay, 77.45% steam-flaked corn, 3.00% yellow grease, 8.00% cane molasses, 1.78% limestone, 1.27% urea, and .5% trace mineralized salt. Steers were fed twice daily. Two treatments were compared: constant daily feed intake versus variable daily feed intake. With the variable feeding group steers were fed in a cycle of 10% more followed by 10% less than that of the constant feeding group. That is, the first day they received 10% more than the constant feeding group, the second day they received 10% less than the constant feeding group, the third day they received 10% more than the constant feeding group, etc., until the end of the trial. Thus, the change in feed intake from day to day was 20%. Steers were programmed to gain 1.1 kg/d. Daily fluctuation in feed intake did not influence ( $P > .20$ ) ADG, DM intake, feed efficiency, dietary NE, or carcass characteristics. Furthermore, fluctuating intake did not influence ( $P > .20$ ) ruminal or total tract digestion of OM, ADF, starch, and N, ruminal pH, or ruminal VFA molar proportions. We conclude that fluctuating day-to-day DM intake by as much as 20% (1.5 kg/d) will not adversely affect growth-performance or digestive function in calf-fed Holstein steers during the late finishing phase.

**Key Words:** Intake, Cattle, Digestion



**67 Influence of level of supplementation of the feeding value of cane molasses in growing-finishing diets for feedlot cattle.** M. F. Montano<sup>1</sup>, K. Preciado<sup>\*1</sup>, and R. A. Zinn<sup>2</sup>, <sup>1</sup>Universidad Autonoma, Baja California, Mexico, <sup>2</sup>University of California, Davis.

A growth-performance trial and a metabolism trial were conducted to evaluate the influence of level of supplementation (6, 12, 18, and 24%, DM basis) on the feeding value of cane molasses in a steam-flaked corn-based finishing diet. Four Holstein steers (317 kg) with cannulas in the rumen and proximal duodenum were used to evaluate treatment effects on digestive function. There were no treatment effects ( $P > .20$ ) on ruminal digestion of OM, NDF, and feed-N. Ruminal microbial efficiency tended (linear effect,  $P < .10$ ) to decrease with increasing molasses level. Increasing molasses level did not affect ( $P > .20$ ) total tract OM digestion, but decreased total tract digestion of starch (linear effect,  $P < .01$ ) and N (linear effect,  $P < .05$ ). Sixty four medium-frame crossbred heifers (447 kg) were used in a 61-d feedlot trial to evaluate treatment effects on growth performance. Molasses decreased (linear effect,  $P < .05$ ) ADG, and DMI, and increase (linear effect,  $P < .01$ ) feed cost of gain. Diet NE for maintenance and gain decreased linearly ( $P < .01$ ) with increasing molasses level. Given that the Nem and Neg value of steam-flaked corn are 2.38 and 1.68 Mcal/kg, respectively, then the corresponding values for cane molasses are 1.30 and .73 Mcal/kg, respectively. These NE values for cane molasses are considerably less (76 and 68%, respectively) than expected based on tabular values. We concluded that feeding more than 6% cane molasses in finishing diets for feedlot cattle may have marked detrimental effects on ADG and gain efficiency. Furthermore, the NE value of molasses at these higher-than-normal levels of inclusion are considerably lower than currently tabulated. Low NE value observed in this study may be due, in part, to detrimental effects of increasing dietary molasses levels on protein efficiency.

**Key Words:** Molasses, Cattle, Performance

**68 Influence of close-up starting programs on performance of feedlot steers during the early receiving period.** M. Machado\* and R. A. Zinn, University of California, Davis.

Considerable research has been conducted to evaluate different dietary protein levels for feedlot cattle, but very little research has been conducted to evaluate the most appropriate intervals for which the diets should be formulated. For example, diets formulated to meet the average metabolizable amino acid requirements of feedlot calves during a 28-d receiving period may be grossly inadequate in meeting requirements during the first 7 to 14 d when DMI is typically very low. The objective of this study was to evaluate the influence of three close-up feeding strategies on performance of steers. Dietary treatments were formulated to meet the average metabolizable amino acid requirements (NRC, 1996) of calves during 1) the initial 7 d; 2) the initial 14 d and 3) the initial 21d following arrival into the feedlot, assuming average interval DMI of 2.8, 3.0, and 3.6 kg/d, respectively. After pens received the respective close-up treatment they were switched to diet 3 for the remainder of the 56-d trial. Daily weight gain (linear effect,  $P < .10$ ), gain efficiency (linear effect,  $P < .10$ ), and dietary NE (linear effect,  $P = .12$ ) decreased as the close-up interval increased. Morbidity was low (18%) and not affected ( $P > .20$ ) by dietary treatments. We conclude that the addition of a close-up diet formulated to meet the metabolizable amino acid requirements of shipping stressed calves during the initial 7 d in the feedlot, when feed intakes are normally comparatively low, will have long-term beneficial effect on cattle growth performance.

**Key Words:** Amino Acid, Cattle, Receiving

**69 Comparative digestion of steam flaked corn, barley, wheat and oats in finishing diets for feedlot cattle.** S. A. Rodriguez\*, M. F. Montano, and R. A. Zinn, University of California, Davis.

Four Holstein steers (455 kg) with cannulas in the rumen and proximal duodenum were used to compare characteristics of digestion of steam-flaked corn, barley, wheat, and oats. Grains were flaked to a density of .31 kg/L (24 lb/bushel). The basal diet contained (DM basis) 74% grain, 5% alfalfa hay, 5% sudangrass hay, 4% yellow grease, 8% molasses, 1.75% limestone, .8% urea, .4% trace mineralized salt, .75% sodium bicarbonate, and .3% chromic oxide. Ruminal OM digestibility was lower ( $P < .05$ ) for oats than for corn, barley, and wheat (63 vs 69, 71 and

70% respectively). Ruminal digestibility of ADF was greater ( $P < .05$ ) for corn than for barley, wheat and oats. Ruminal digestion of Feed N was greater ( $P < .05$ ) for barley (71%) and wheat (71%), than for corn (62%) and oats (62%). Ruminal starch digestibility was lower ( $P < .05$ ) for corn (89%) than for barley (92%), wheat (90%) and oats (93%). Microbial efficiency values was greater ( $P < .05$ ) for wheat (21) and oats (23) than for corn (17) and barley (18). Ruminal pH was lower ( $P < .05$ ) for wheat diet (5.6) than for corn (6.0), barley (5.8) and oats (6.0). Source of grain did not influence ( $P > .10$ ) ruminal VFA molar proportion. Postruminal digestibility of OM and starch were greater ( $P < .05$ ) for corn (68 and 100% respectively) and wheat (66 and 97% respectively) than barley (58 and 93% respectively) and oats (54 and 85% respectively). Postruminal digestibility N was slightly greater ( $P < .05$ ) for wheat (77%) and oats (77%) than corn (75%) and barley (75%). Total tract digestion of DM, OM, and ADF were greater ( $P < .05$ ) for corn (85, 87 and 53% respectively) than for barley (80, 82 and 42% respectively), wheat (83, 85 and 39% respectively) and oats (75, 77 and 38% respectively). Total tract digestibility of starch for all grain was greater than 99%. Dietary DE (Mcal/kg) was greater ( $P < .05$ ) for corn (3.89) than for barley (3.69) wheat (3.80) and oats (3.61). Given that the DE of steam flaked corn is 4.19 Mcal/kg, then the corresponding replacement DE values for steam-flaked barley, wheat and oats are 3.92, 4.07, and 3.81 Mcal/kg, respectively.

**Key Words:** Grain, Cattle, Digestion

**70 Replacement value of radish hay for alfalfa hay in diets of newly-weaned beef calves.** J. Gould\*, E. J. Scholljegerdes, B. W. Hess, D. W. Koch, J. W. Flake, and L. J. Held, University of Wyoming, Laramie.

The objective of this research was to determine the replacement value of radish hay for alfalfa hay in diets of newly-weaned beef calves. One week after weaning, 105 Angus Gelbvieh steers ( $248 \pm 2.2$  kg) were blocked by BW and allotted to one of 15 pens resulting in 7 steers per pen with five replications within treatment. Steers were fed one of three forage-based diets at 0600 daily for 35 days. Forage treatments were 100% alfalfa hay (ALF), 50% radish top hay 50% alfalfa hay (MIX), and 100% radish top hay (RAD). Diets were formulated to be isonitrogenous using a grain-based supplement. Body weights were taken on two consecutive days at the beginning and final two days of the feeding trial. An interim BW was obtained on d 17. Feed efficiency was calculated using ADG and DMI. Diets were analyzed for DM, CP, NDF, and in vitro organic matter digestibility (IVOMD). Data were analyzed as a randomized complete block design, and experimental treatment differences were evaluated using orthogonal polynomial contrasts. A linear trend ( $P = .11$ ) favoring RAD was noted for IVOMD. In vitro OM digestibility of hay alone increased linearly ( $P = .02$ ) because of greater IVOMD for the mixture of forage sources. From d-0 to 17, RAD steers out gained ( $P = .02$ , linear) ALF and MIX. From d-0 to d-17 DMI was greatest for RAD followed by ALF, which was greater than MIX (quadratic,  $P = .01$ ). From d-18 to 35, ADG and feed efficiency increased ( $P \leq .05$ , quadratic) for MIX compared to RAD and ALF. The 35 d ADG showed a quadratic ( $P = .01$ ) response with MIX having numerically greater ADG than RAD and ALF. Quadratic effects ( $P < .06$ ) were noted for 35 d DMI and feed efficiency with ALF being greater than MIX and RAD. Results of this experiment indicate that radish top hay can be used as a replacement for alfalfa hay if supplemented correctly. Notwithstanding, mixing radish top hay with an equal proportion of alfalfa hay appears to elicit complementary nutritional effects in newly-weaned calves.

**Key Words:** Radish Hay, Alfalfa Hay, Gain

**71 Fatty acids profiles in the adipose tissue of underfed goats.** M. Gómez-Pastén\*<sup>1</sup>, O. Mora<sup>1</sup>, H. R. Vera -Avila<sup>2</sup>, R. M. Meléndez-Soto<sup>1</sup>, and A. Shimada<sup>1</sup>, <sup>1</sup>FES- Cuautitlán-UNAM, México, <sup>2</sup>CNIFYMA-INIFAP, México.

Twenty-one adult female non-lactating and non-pregnant Nubian crossbred goats were used to determine the influence of long term feed restriction on the bodyweight, body composition, dissectable adipose tissue and fatty acid composition of subcutaneous and visceral adipose tissue. All goats were fed at maintenance levels for 9 weeks to allow the animals to reach and maintain their liveweight and body condition. Animals were then feed-restricted for 36 weeks and divided into three groups receiving either 100, 80 or 60% of the levels of DMI previously observed (RL100, RL80 and RL60, respectively). After this treatment,

the animals were slaughtered and the weights of their dissectable kidney (KAT) and subcutaneous adipose tissue (SCAT) were registered and samples of fat were used to quantify their proportion of fatty acids by HPLC using an online derivatization. Body weights were affected by the restriction (4.79 and 10.84 kg). The proportion of C6, C8, C10, C12, C14, C16, C18, C18:1, C18:2, C18:3, C20, total saturated fatty acids and total unsaturated fatty acids in KAT were not affected by the restriction level. Only C16:1 was affected by the RL (0.41, 0.49 and 0.87% for RL100, RL80 and RL60, respectively,  $P < 0.08$ ). However in SCAT, C16:1 was in major proportion in the most restricted animals (0.3, 0.4 and 0.8 %, respectively,  $P < 0.05$ ) and the same was observed for C18:2 (1.39, 1.35 and 1.90% for RL100, RL80 and RL60, respectively,  $P < 0.09$ ). Saturated fatty acids were in lower proportion and unsaturated fatty acids were in higher proportion in RL60 animals ( $P < 0.08$ ). The RL affected body weight, the proportion dissectable adipose tissue and the profiles of fatty acids. The SCAT was the most affected.

**Key Words:** Fatty Acids, Undernutrition, Goats

**72 Influence of variation in supplement inclusion rate and laidlomycin propionate on growth performance of feedlot cattle.** R. A. Zinn<sup>1</sup>, A. Plascencia<sup>\*2</sup>, M. F. Montano<sup>2</sup>, and A. Pereira<sup>1</sup>, <sup>1</sup>University of California, Davis, <sup>2</sup>Universidad Autonoma, Baja California, Mexicali, Mexico.

For many types of feed formulations a CV of 5% has become a standard for uniformity of feed mixing, permitting that an animal receives at least 90% of its formulated dietary allowances 95% of the time. However, with diets intended for feedlot cattle, the diversity of physical form and density of individual feed ingredients complicates the preparation of uniform feed mixes. Risks to cattle health and growth performance when uniformity in spacial distribution of critical ingredients is reduced has not been investigated. In this study, 112 yearling steers (364 kg) were used in a 123-d trial to evaluate the interaction of variation in supplement inclusion rate (0 vs 20% CV) and laidlomycin propionate (0 vs 10 mg/kg) on growth performance and carcass characteristics. The basal diet contained 71.8% steam-flaked corn, 3.0% cottonseed meal, 10.0% sudangrass hay, 3.5% yellow grease, 8.0% molasses, and 3.7% supplement. Weekly variation was produced by altering the inclusion rate of the supplement portion of the diet, as follows: on d 1, and d 5 of each week the diet contained 125% of the specified amount of supplement; of d 2, d 4, and d 6 the diet contained 100% of the specified amount of supplement; on d 3 and d 7 the diet contained 75% of the specified amount of supplement. Accordingly, the CV in weekly supplement concentration of the complete mixed diet was 20%. There were no treatment interactions ( $P > .20$ ). Variation in supplement inclusion rate decreased ADG (8%;  $P < .05$ ), gain efficiency (5%;  $P < .01$ ), dietary NEm (2.3 %,  $P < .01$ ), and dietary NEg (3.3%,  $P < .01$ ). Supplemental laidlomycin tended to increase ADG (6%,  $P = .19$ ), but did not affect ( $P > .20$ ) gain efficiency of dietary NE. There were no treatment effects ( $P > .20$ ) on carcass characteristics. We conclude that variation in supplement inclusion rate can have a marked effect on growth performance of feedlot cattle.

**Key Words:** Feed Mixing, Variation, Cattle

**73 Integration of early weaning and sexed semen into a single-calf heifer system to increase the value of non-replacement heifers.** B.A. Ereth\*, J.C. Whittier, P.D. Burns, D.N. Schutz, D.W. Couch, and G.E. Seidel, Jr, Colorado State University, Fort Collins.

Integrating early weaning and sexed semen into a single-calf heifer system may be an alternative to traditional marketing of non-replacement heifers. This integrated system (IS) has potential for heifers to produce a calf by 20 mo of age and a carcass by 24 mo of age. Phase I of the IS included early weaning, estrous synchronization, and AI. Sexed semen was utilized to yield female progeny, decrease calving difficulty risk and create a second generation to perpetuate the IS. The IS group was composed of 46 Red Angus X Hereford heifers rejected for replacement status and early weaned at 110 ± 15.0 d. The control group was 40 traditional weaned (TW) heifers from the same herd, managed in a traditional replacement system (TRS). The early weaned (EW) heifers were placed on self-feeders and adjusted to a finishing ration. They were fed to 65% of mature weight to induce early puberty by 9 mo of age. At time of TW, age of EW heifers was less than TW heifers (202 ± 15.0 d and 229 ± 2.8 d respectively,  $P < .0001$ ). There was no difference

between groups in weight at TW, yet EW heifers had greater weight per day of age (WDA) than TW heifers, 1.2 ± .10 kg and 1.1 ± .11 kg ( $P < .0001$ ). Dams of EW heifers had greater body condition score (BCS), 6.6 ± .80 than TW dams, 5.8 ± .78 ( $P < .0001$ ) by TW. At AI of EW heifers, weight was greater for EW than TW heifers, 313 ± 28.0 kg and 293 ± 31.4 kg respectively ( $P < .0031$ ) and WDA of EW and TW heifers were 1.2 ± .10 kg/d and 1.0 ± .10 kg/d ( $P < .0001$ ). One month prior to MGA/PGF protocol synchronization, 20% EW and 8% TW were exhibiting estrous cycles as determined by progesterone assay. At fixed-time mating, age of EW heifers was 293 ± 15.0 d with 85% cyclic. Ultrasonography at 35-d post AI revealed first service conception rates of 27%. Phase I of the IS increased BCS of dams, enabled greater gains and weights of heifers, induced early puberty and resulted in 9 mo old heifers pregnant to sexed semen.

**Key Words:** Early Weaning, Single-Calf Heifer System, Sexed Semen

**74 Seasonal mineral status of beef cattle on twenty-two ranches across western Colorado evaluated using liver and serum concentrations.** B. Ereth, J. Whittier\*, B. Toombs, R. Baird-LeValley, C. Mucklow, and M. King, Colorado State University, Fort Collins.

Twenty-two beef cattle herds across western Colorado were evaluated for trace mineral status. Serum and liver samples were taken twice yearly for two consecutive years to establish baseline levels of Cu, Fe, Mn, Mg, Mo, K, N. Estimated feed and water intake for each herd gave approximate total intake of each mineral. Cattle categorized as Cu deficient according to liver biopsy ( $< 40$  ppm) was 70.84%, however, according to serum ( $< .6$  ppm), only 25.58% were reported as deficient. Pearson<sup>®</sup> correlation coefficient between total serum copper and liver copper in year one was .339 ( $P < .0001$ ). These results indicate that serum was not an accurate measurement of copper reserves in beef cows. Both years exhibited similar trends and results comparing serum/liver viability. Mineral status changed from fall 93 to spring 94 (year 1) and from fall 94 to spring 95 (year 2) for all trace minerals reported except Mo. Liver concentration of Fe and Mn decreased from fall to spring in both years ( $P < .0002$  and  $P < .0007$  respectively year 1,  $P < .0001$  and  $P < .0299$  year 2 respectively). Liver concentration of Zn increased from fall to spring in both years 1 and 2 ( $P < .0001$  and  $P < .0027$ ). Liver Cu concentration decreased from fall to spring in year 1 ( $P < .0155$ ) but increased in year 2 ( $P < .0001$ ). County of herd origin had an effect on liver concentration of all trace minerals for years 1 and 2. Mineral status of western Colorado varies between counties and from spring to fall with the most accurate measurement being liver concentration taken via liver biopsy.

**Key Words:** Beef Cows, Trace Minerals

**75 Effect of hay source and level on tissue trace mineral concentrations in growing steers.** E. E. Grings\*<sup>1</sup> and W. W. Poland<sup>2</sup>, <sup>1</sup>USDA-ARS, Miles City, MT, <sup>2</sup>Dickinson Research Extension Center, North Dakota State University, Dickinson.

Twenty-four steers (avg 410 kg) were fed alfalfa or western wheatgrass hay at either 1.90 or 2.35% of BW for 91 d to evaluate the effects of hay type and feeding level on tissue trace mineral concentrations. At the end of the feeding period, steers were slaughtered at a commercial abattoir. Tissue weights and samples were collected; samples were oven dried and analyzed for Cu, Zn, Mn, and Fe by atomic absorption spectrophotometry. Data were analyzed with a model including hay source and intake level, their interactions, and BW as a covariate. Alfalfa hay contained 7 ppm Cu, 17 ppm Zn, 30 ppm Mn, 426 ppm Fe, and 3.6 ppm Mo. Grass hay contained 2 ppm Cu, 20 ppm Zn, 29 ppm Mn, 143 ppm Fe, and 1.3 ppm Mo. Increasing hay intake by 124% increased ( $P < .01$ ) intake of minerals but had little effect on tissue mineral concentrations. Heart Cu concentrations were greater ( $P < .10$ ) in steers on the high than low intake level. Kidney Zn concentrations were affected ( $P < .10$ ) by the hay source by level interaction. Liver weights averaged 1,466 g DM for alfalfa-fed and 1,276 g DM for grass-fed steers ( $P < .01$ ). On a dry tissue basis, total liver Cu, Zn, and Mn were affected by hay source, being greater in alfalfa-fed than grass-fed steers (55.7 vs 31.0 mg Cu, 162.3 vs 139.5 mg Zn, 16.0 vs 13.2 mg Mn for alfalfa- and grass-fed steers, respectively). For Zn and Mn this was due to increased liver weight but for Cu it was related to both increased concentration ( $P < .01$ ) and liver weight in alfalfa-fed steers. Heart Zn concentrations ( $P < .10$ ) and total heart Zn ( $P < .05$ ) were greater for grass-fed (80.3 ppm and 25.7 mg)

than alfalfa-fed steers (76.4 ppm and 23.0 mg). Kidney, heart ( $P < .05$ ), and muscle ( $P < .10$ ) Mn concentrations were greater for alfalfa-fed (4.8, 1.7, and .30 ppm) than grass-fed (4.4, 1.4, and .19 ppm) steers even though Mn intake were similar ( $P > .10$ ). Differences in tissue mineral concentrations among steers fed different hays are related to more than mineral intake.

**Key Words:** Minerals, Alfalfa Hay, Grass Hay

**76 Effects of a slow-release urea product on performance and carcass characteristics of feedlot cattle.** G. C. Duff<sup>1</sup>, D. A. Walker<sup>1</sup>, K. J. Malcolm-Callis<sup>1</sup>, M. W. Wiseman<sup>1</sup>, J. D. Rivera<sup>1</sup>, and M. L. Galyean<sup>2</sup>, <sup>1</sup>Clayton Livestock Research Center, New Mexico State University, Clayton, <sup>2</sup>Texas Tech University, Lubbock.

Two studies were conducted to evaluate the effects of a slow-release urea product (RumaPro) on performance (Exp. 1 and 2) and carcass characteristics (Exp. 1) of beef steers. In Exp. 1, 180 crossbred steers (Continental x British; initial BW = 400 kg) were used to evaluate a 90% concentrate diet with RumaPro as the supplemental CP source vs a 90% concentrate diet (Control) with soybean meal (SBM) plus urea (1.21%; DM basis) as the supplemental CP sources. Steers were stratified by BW into three blocks (six pens per block) with nine pens (10 steers/pen) per treatment. No differences ( $P > 0.10$ ) were noted for ADG for the overall feeding period. Although not significant ( $P < 0.11$ ), steers fed RumaPro consumed 3% less feed than Control steers. For the overall feeding period, gain:feed was improved ( $P < 0.01$ ) for steers fed RumaPro vs Control. No differences ( $P > 0.10$ ) between treatments were noted for hot carcass wt, marbling score, fat thickness, yield grade, or internal fat. Control steers had a greater ( $P < 0.10$ ) dressing percent and larger longissimus muscle area ( $P < 0.03$ ) than RumaPro steers. In Exp. 2, 226 crossbred steers (Continental x British; initial BW = 398 kg) were used to evaluate the effects of graded levels of RumaPro in a 90% concentrate diet on performance. Steers were stratified by BW and assigned to five weight blocks (four pens/weight block). Treatments (five pens/ treatment) included SBM as the supplemental CP source (0), and 33, 66, or 100% RumaPro. No differences ( $P > 0.10$ ) were noted among treatments for ADG or daily DMI for the overall feeding period, but gain:feed was improved (linear;  $P < 0.05$ ) with RumaPro diets (0.165, 0.166, 0.164, and 0.171 for 0, 33, 66, and 100% RumaPro, respectively). Results suggest that a slow-release urea product might improve gain efficiency by finishing beef steers compared with soybean meal and soybean meal plus urea.

**Key Words:** Beef Cattle, Slow-Release Urea, Performance

**77 Influence of betaine on pasture, finishing and carcass performance, and backfat and marbling deposition in steers.** B.J. Bock<sup>1</sup>, J.R. Brethour<sup>2</sup>, K.R. Harmony<sup>2</sup>, and S.R. Goodall<sup>3</sup>, <sup>1</sup>Fort Hays State University, Hays, KS, <sup>2</sup>Agricultural Research Center, Kansas State University, Hays, <sup>3</sup>Gladwin A. Read Co., Elgin, IL.

Two experiments were conducted to investigate the effects of supplemental betaine on steer performance, backfat and marbling deposition. Live backfat measurements were taken using ultra-sound. In Exp. 1, eight pastures were used to study pasture gain using 80 steers (317 kg), with 10 steers per pasture. Steers were grazed from July to October (90 d). Steers were fed either 1.0 kg of a control (CON) supplement, which was formulated to contain 30% CP, or 1.0 kg of the control supplement plus 20 g betaine (BET) per head per day. Dominant pasture grasses and forbs were blue grama, western wheatgrass, buffalo grass, and western ragweed. Betaine supplementation had no effect on overall gain or backfat deposition. There was a tendency ( $P = .07$ ) for betaine to increase daily gain in the second period of the trial (.64 vs. .72 kg, CON vs. BET, respectively). There was no effect of BET on backfat thickness at the end of the grazing phase. In Exp. 2, eight pens were used to study steer performance using the same 80 steers used in Exp. 1, with animals allotted by pasture to pen. Steers were fed from October to February (141 d) either a control diet (CON) or control diet plus 20 g betaine (BET) per head per day. Steers which were fed BET supplement on pasture tended ( $P = .08$ ) to gain more in the feedlot (221.4 vs. 228.7 kg; CON vs. BET, respectively). There was no overall effect of BET on finishing gain ( $P = .53$ ), however, this response was variable by period. There was a tendency for BET to increase carcass backfat ( $P < .08$ ) in the finishing phase. There were no significant effects on marbling or REA. Feeding betaine on pasture may improve gain during

the finishing phase; however feeding betaine on a high concentrate diet appears to increase backfat deposition.

**Key Words:** Betaine, Beef Cattle, Backfat

**78 The effect of feeding pressed sugar beet pulp in beef cattle feedlot-finishing diets.** J.L. Park\*, I.G. Rush, C.T. Milton, and B.A. Weichenthal, University of Nebraska, Lincoln.

Two trials were conducted to determine the effect of feeding pressed beet pulp as the roughage source in a finishing beef cattle diet. In trial 1 (n=118, average initial body weight: 468 kg) and trial 2 (n=90, average initial body weight: 391 kg) a complete randomized design was utilized, and performance and carcass parameters were measured. British crossbred yearling steers were randomly assigned to one of three diet treatments. The diets consisted of dry rolled corn, protein supplement, and either corn silage or beet pulp as the roughage source. Treatments were (DM basis); 8.5% corn silage (CON), 8.5% beet pulp (8.5BP), or 12.5% beet pulp (12.5BP). The diets were formulated to be isonitrogenous at 13% CP. In both trials there were no differences in feed efficiency between treatments. **Trial 1:** Dry matter intake (DMI) and average daily gain (ADG) were higher for CON ( $P < .01$ ) compared with 8.5BP and 12.5BP. Marbling scores ( $P < .02$ ) and backfat ( $P < .05$ ) were greater for the CON treatment compared with the beet pulp treatments. **Trial 2:** There were no differences in DMI or ADG. Carcass measurements were not different between treatments. The different responses observed for DMI as beet pulp was included in the diet between trials 1 and 2 may be due to the storage of the beet pulp. In trial 1, the pulp was ensiled prior to feeding, whereas the pulp was fed fresh in trial 2. Reduced DMI in trial 1 would explain the differences observed in marbling and backfat. Beet pulp can serve as a substitute for corn silage and even though dry matter intake may be slightly affected, feed efficiency will be equal.

	CON	8.5BP	12.5BP
Trial 1			
ADG, kg/d	1.54 <sup>a</sup>	1.32 <sup>b</sup>	1.35 <sup>b</sup>
DMI, kg/d	11.92 <sup>a</sup>	10.65 <sup>b</sup>	10.74 <sup>b</sup>
Feed/gain	7.79	8.09	7.97
Trial 2			
ADG, kg/d	1.60	1.57	1.55
DMI, kg/d	10.42	10.59	10.17
Feed/gain	6.56	6.73	6.56

<sup>a,b</sup>Means on same row with different superscripts are different ( $P < .05$ ).

**Key Words:** Beet Pulp, Corn Silage, Fiber

**79 Effects of Profi peas, *Pisum arvense*, on growth performance and carcass characteristics of feedlot cattle.** W.R. Flatt\* and T.L. Stanton, Colorado State University, Fort Collins.

The objective of this study was to evaluate the effects of Profi peas (PP) on cattle growth, efficiency, and carcass characteristics. Approximately 300 British cross cattle (n=157 heifers, 161 steers; avg. initial BW 275 ± 31.5 kg) were used in a randomized experimental design. Calves were stratified by live weight, randomized by breed, and assigned to treatments consisting of 0, 5, 10, and 20% PP (DM basis) in the diet. Feed intake decreased linearly ( $P < 0.05$ ) as the level of PP increased in the diet. Over the 167 d trial period the feed intakes averaged 9.39, 8.83, 8.58, and 8.40 kg DM (± 0.29 kg) for the 0, 5, 10, and 20% dietary levels of PP, respectively. Average daily gain was not ( $P > 0.05$ ) affected by dietary level of PP averaging 1.44, 1.43, 1.39, and 1.42 kg per day (± 0.05 kg). Feed efficiency improved linearly ( $P < 0.05$ ) for the calves fed an increasing level of PP during the 167 d feeding trial. The feed efficiency (DM intake/ADG) of the differing level of PP averaged 2.98, 2.82, 2.81, and 2.70 (± 0.08) for the 0, 5, 10, and 20% dietary levels of PP, respectively. Dressing percent, hot carcass weight, marbling score, percent grading choice, and yield grade scores were not improved between those cattle on the 0% PP to those on the 5, 10, and 20% pea diets. Morbidity was also not improved ( $P > 0.05$ ) by adding PP to the diet. The calves on the 0% PP had a higher incidence of mortality (6.7% vs. 0%) than those on the pea supplemented diets ( $P < 0.05$ ). Profi peas fed in a finishing diet enhanced feed efficiency and could offer potential as a protein supplement.

**Key Words:** Profi Peas, Beef Cattle, Growth Performance

**80 Development of a low-cost, easy-to-assemble, and durable ruminal cannula for cattle.** E. G. Alvarez\*<sup>1</sup> and R. A. Zinn<sup>2</sup>, <sup>1</sup>Universidad Autonoma, Baja California, Mexicali, Mexico, <sup>2</sup>University of California, Davis.

Conventional silicon-based ruminal cannulas harden with time, becoming stiff and difficult to manipulate. This hardening of the cannula also promotes greater leakage. In an effort to overcome some of these limitations, we have developed a low-cost, durable, and easy-to-assemble alternative. The new cannula is comprised of two rubber toilet bowl plungers fused together using marine rubber adhesive, and has an internal diameter of 80 mm. We have tested this new cannula over a three-year period in a total of 20 steers, and 5 Holstein cows. Throughout this time period the cannulas did not lose their flexibility. Hence, they were easy to manipulate, and because of their excellent tissue compatibility, with minimal body protrusion, they were not prone to leakage. The internal diameter of the cannula is smaller (22%) than that of conventional silicone-based cannulas that are commercially available. However, due to the light weight and highly pliable nature of the cannula material, facility of sampling ruminal contents was similar. We conclude that this new cannula preparation is a practical alternative to conventional silicone-based ruminal cannulas for cattle.

**Key Words:** Rumen, Cannula, Cattle

**81 Effects of fructooligosaccharides on fecal characteristics, digestibility of nutrients, and concentration of fecal odor components in dogs.** H. S. Hussein\*<sup>1</sup> and G. D. Sunvold<sup>2</sup>, <sup>1</sup>University of Nevada, Reno, <sup>2</sup>The Iams Company, Lewisburg, OH.

Odor components (ammonia, aliphatic amines, branched-chain volatile fatty acids [BCVFA], indoles, phenols, and volatile sulfur-containing compounds) in feces from companion animals, humans, or other animals are end-products of hindgut fermentation. They are produced by bacterial degradation of endogenous and undigested food proteins. These odor components not only produce unpleasant smell but also impose negative effects on animals' health. Fructooligosaccharides (FOS) are nondigestible carbohydrates that shift the microbial ecology in the colon by supporting desirable bacterial species and inhibiting undesirable species that produce fecal odor. To evaluate the efficacy of FOS, 18 adult dogs were used for 63 d (21 d for adaptation to a high-protein [32% CP] diet [control] and 42 d for dietary FOS [.25 or .5%] inclusion) in a randomized complete block [dog breed] design experiment. On d 22, two dog groups (6 each) were switched to the FOS-containing diets while the third group (6 dogs) was maintained on the control diet. No interactions ( $P > .05$ ) between FOS treatments and time (21 or 42 d of FOS inclusion) were detected for any of the measurements evaluated. Inclusion of FOS had no effects ( $P > .05$ ) on fecal characteristics (wet weight, DM, or consistency), apparent digestibility of DM or OM, and fecal concentrations of ammonia, BCVFA, phenols, or indoles. In comparison to the control diet, however, there were non-significant ( $P = .21$ ) numerical reductions in concentrations ( $\mu\text{g/g DM}$ ) of amines (i.e., putrescine [803 vs 468], cadaverine [518 vs 287], tyramine [22 vs 8], and total amines [2,505 vs 2,011]) when FOS was included at the highest level. These values correspond to 42, 45, 64, and 20% reductions, respectively. These positive changes suggest a potential role of FOS in reducing production of fecal odor.

**Key Words:** Dogs, Fecal Odor, Fructooligosaccharides

**82 Effects of fructooligosaccharides on fecal characteristics, digestibility of nutrients, and concentration of fecal odor components in cats.** H. S. Hussein\*<sup>1</sup> and G. D. Sunvold<sup>2</sup>, <sup>1</sup>University of Nevada, Reno, <sup>2</sup>The Iams Company, Lewisburg, OH.

The colonic bacterial species in companion animals or other non-ruminants not only contribute to the normal physiological functions but also participate significantly in the causation or prevention of various diseases. Degradation of undigested or endogenous amino acids in the colon results in a wide range of fecal odor components (ammonia, aliphatic amines, branched-chain volatile fatty acids [BCVFA], indoles, phenols, and volatile sulfur-containing compounds). In addition to their unpleasant smell, recent research has documented their role as a health hazard. Fructooligosaccharides (FOS) are nondigestible carbohydrates that shift the microbial ecology in the colon by supporting desirable bacterial species and inhibiting undesirable species that produce fecal

odor. To evaluate the efficacy of FOS, 27 adult cats were used for 74 d (30 d for adaptation to a high-protein [32% CP] diet [control] and 44 d for dietary FOS [.25 or .50%] inclusion) in a completely randomized design experiment. On d 31, two groups (9 cats each) were switched to the FOS-containing diets while the third group (9 cats) was maintained on the control diet. No interactions ( $P > .05$ ) between FOS treatments and time (22 or 44 d of FOS inclusion) were detected for any of the measurements evaluated. Inclusion of FOS had no effects ( $P > .05$ ) on fecal characteristics (wet weight, DM, or consistency), apparent digestibility of DM or OM, and fecal concentrations of ammonia or BCVFA. In comparison to the control diet, however, there were numerical reductions ( $P > .05$ ) in concentrations ( $\mu\text{g/g DM}$ ) of cadaverine (1,148 vs 898), tyramine (322 vs 176), and total amines (2,750 vs 2,253) when FOS was included at the highest level. These values correspond to 22, 45, and 18% reductions, respectively. There were trends for linear reductions in key fecal odor components due to FOS inclusion. The corresponding fecal concentrations ( $\text{g/g DM}$ ) were 602, 474, and 460 ( $P = .13$ ) for p-cresol, 347, 289, and 230 ( $P = .37$ ) for 4-ethylphenol, 232, 191, and 184 ( $P = .20$ ) for indole, and 1,180, 956, and 875 ( $P = .06$ ) for total indoles and phenols. These positive changes suggest a potential role of FOS in reducing production of fecal odor.

**Key Words:** Cats, Fecal Odor, Fructooligosaccharides

**83 Conservative and moderate stocking effects on Chihuahuan desert forage production.** J. L. Holechek\*, M. Thomas, D. Galt, and F. Molinar, New Mexico State University, Las Cruces.

Our primary objective was to evaluate perennial grass production on 2 conservative and 2 moderate stocked pastures arranged in a split-plot repeated measure design on the Chihuahuan Desert Rangeland Research Center in south-central New Mexico in the 1993 through 1999 period. Forage utilization levels were targeted on conservative stocked pastures to be 30% (i.e., averaged 35%; 1993-1999) and 40% on moderate stocked pasture (i.e., averaged 47%; 1993-1999). Autumn standing crop of perennial grasses was higher ( $305 \pm 54$  vs  $216 \pm 27$  kg/ha;  $P < 0.10$ ) on conservative than moderate stocked pastures across all years of study. A stocking rate x year interaction indicated that this effect ( $P < .1$ ) was most evident in 1993 and 1994 with significance being approached ( $P < .2$ ) in years 1996-1999. Current year growth (production) of perennial grasses was also higher ( $155 \pm 33$  vs  $126 \pm 26$  kg/ha;  $P < 0.09$ ) on conservative than moderate stocked pastures across years. However, this effect was less consistent across years than for total perennial grass standing crop. During the dry years (1995, 1998), conservative stocked pastures averaged nearly 50% higher in current year growth of perennial grasses than those moderate stocked (stocking rate x year;  $P < .10$ ). During the seven-year study period, conservatively stocked pastures supported nearly the same number of animal units per year (AUY) as moderate stocked pastures even though a main effect of stocking rate was observed ( $136.2 \pm 17$  vs  $153.6 \pm 32$  AUY;  $P < .01$ ). This was most likely due to the 24% higher average forage production and less need for destocking in dry years. Several studies from other range types and the Chihuahuan Desert support these findings that conservative stocking is a viable approach to increase forage production and residual matter on degraded rangelands. Higher livestock productivity and increased multiple use benefits are other reported advantages of conservative stocking.

**Key Words:** Rangeland, Grazing Capacity, Cattle

**84 Conservative and moderate stocking effects on cow-herd performance in the Chihuahuan Desert.** M. G. Thomas\*, C. C. Bailey, and J. L. Holechek, New Mexico State University, Las Cruces.

Proper stocking level is an important decision for desert rangeland management. The objective herein was to compare cow-herd performance between two conservative and two moderate stocked pastures (1095  $\pm$  86 ha) in the Chihuahuan Desert in 1997-1999. Stocking rates were determined by measurement of current yr growth of perennial grasses and targeting forage utilization to be 30% on conservative stocked pastures and 40% on moderate stocked pasture. In the spring of 1997, primiparous cows, primarily Brangus, were randomly assorted by age ( $5.1 \pm .2$  yrs) and body condition score (BCS; scale 1 to 9;  $4.7 \pm .1$ ) to each pasture and maintained in single-sire-mated herds. Each autumn and spring, forage utilization levels were estimated and animal units (AU) were adjusted to maintain targeted levels. Cow weight (CW) and BCS

were determined each January, May, and October. Reproductive performance of each herd and adjusted calf weaning weights (ADJWWT) were determined each October. There was no main effect of stocking level ( $P > .1$ ) nor stocking level  $\times$  yr interactions ( $P > .10$ ) detected within these data. Means for conservative versus (vs) moderate stocking for herd performance in 1997-1999 were: AU =  $15.3 \pm 4$  vs  $13.3 \pm 5$ ; fall CW =  $556 \pm 14$  vs  $526 \pm 20$  kg; fall BCS =  $5.3 \pm .3$  vs  $5.0 \pm .2$ ; ADJWWT  $225.2 \pm 46$  vs  $173.9 \pm 56$  kg; kg of calf weaned per ha =  $3.17 \pm .8$  vs  $3.55 \pm 1.2$ ; calf crop % =  $78 \pm 16$  vs  $64.4 \pm 20$ . Concomitantly, herd performance differed ( $P < .05$ ) across yrs. These effects became most important in January of 1999 as cow weights were greater ( $P < .02$ ) in conservative ( $541 \pm 4$  kg) than moderate ( $506.5 \pm 2.2$  kg) stocked pastures. Due to drought at this time, stocking levels were reduced in all pastures with destocking occurring in the moderate stocked pastures and one of the conservative stocked pastures in the spring of 1999. These management procedures yielded  $10 \pm 10$  AU in conservative stocked pastures and 0 AU in moderate stocked pastures. These data suggest that cow-herd performance can be similar between conservative and moderate stocking levels in the Chihuahuan desert with conservative stocking offering advantages for partial herd sustainability during drought.

**Key Words:** Beef Cattle Performance, Stocking Level, Desert

**85** *In-vitro* digestibility of grazed mixed native range forage using inoculum from alternative sources. N. Butler<sup>\*1</sup>, G.A. Younglove<sup>1</sup>, J.W. Waggoner<sup>2</sup>, and R.H. Hart<sup>3</sup>, <sup>1</sup>Chadron State College, Chadron, NE, <sup>2</sup>University of Wyoming, Laramie, <sup>3</sup>ARS-USDA, High Plains Grassland Research Station, Cheyenne, WY.

*In-vitro* digestion utilizing rumen fluid as the inoculum source is a readily accepted procedure. However, maintaining rumen cannulated animals as a source of rumen fluid under free ranging conditions is both costly and time consuming. Consequently, researchers have suggested using fecal fluid as an alternative inoculum source as it is easier to collect and does not require the capital and labor associated with maintaining rumen cannulated donor animals. This study was conducted to evaluate the value of fecal fluid as an inoculum source in determining the digestibility of mixed native range forage. Forage samples were collected from June of 1996 through August of 1997 using esophageal fistulated steers. Samples were freeze dried and an *in-vitro* dry matter digestibility determination using the modified Tilley and Terry technique was conducted using either cattle rumen fluid (RF) or cattle fecal fluid (FF) as the inoculum source. As expected *in-vitro* digestibility decreased as plants matured regardless of inoculum source. In addition, the effect of inoculum source on forage digestibility was not significant ( $P \geq .05$ ). Fecal fluid digestibilities ranged from a high of 62.41% to a low of 46.00%, while RF digestibilities ranged from a high of 65.04% to a low of 47.48% for spring and winter grazed forage respectively. On average the FF estimates of forage digestibility were approximately 2.10% lower overall than those obtained using RF inoculum. These data suggest liquid fractions from cattle feces can be utilized as an alternative inoculum source to estimate *in-vitro* digestibility of mixed native range forage. Thus, FF may provide a useful inexpensive tool for evaluating the digestibility of forages consumed by free ranging domestic ungulates.

**Key Words:** In-vitro Digestibility, Mixed Native Range Forage

**86** Effects of season of calving and weaning age on cow and calf production through weaning. E. E. Grings, R. E. Short<sup>\*</sup>, and R. K. Heitschmidt, Ft. Keogh LARRL, USDA-ARS, Miles City, MT.

Crossbred cows and heifers were bred by natural service during 32-d breeding seasons that included estrous synchronization to calve ( $n = 575$ ) in February (F), April (A), or June (J) to determine effects of season of calving (SOC) on cow and calf performance. Cows and replacement heifers were rebred ( $n = 781$ ) so as to have the same SOC the next year. Calves were weaned (early and late) at 6 or 8 mo for February and April calves and at 4 or 6 mo for June calves. Data were collected from all calves and cows within each SOC at both weanings. There were small but significant ( $P < .05$ ) effects of SOC on birth weight of calves (36.7, 35.6, and 37.8 kg for F, A, and J, respectively), and there were no significant effects ( $P > .05$ ) on rebreeding pregnancy rates (86.3, 85.2, and 87.1% for F, A, and J, respectively). Calf weight at a standard age (190 d) was decreased ( $P < .05$ ) as SOC became later (226, 214, and 191 kg for F, A, and J, respectively), and for June calves at 190 d, late weaned calves were heavier ( $P < .05$ ) than early weaned (196 vs 186

kg). Calf gains from 1st to 2nd weaning decreased ( $P < .05$ ) as SOC became later (45, 41, and 30 kg for F, A, and J, respectively). June calves that were late weaned gained more ( $P < .05$ ) than early weaned (33 vs 26 kg). Cow weight change from 1st to 2nd weaning decreased ( $P < .05$ ) as SOC became later and with late weaning (early weaned; 38.7, 14.7, and 9.9 kg vs late weaned; 10.7, -5.5, and -15.7 kg; both F, A, and J, respectively). Change in cow body condition score from 1st to 2nd weaning was mainly affected by weaning age of the calf with late weaned cows having a greater ( $P < .05$ ) loss in condition than early weaned cows for each SOC (early weaned; -.04, -.03, and -.30 vs late weaned; -.54, -.51, and -.64; both F, A, and J, respectively). Conclusions are that SOC does not affect rebreeding, but it does have dramatic effects on age constant weight and weight gains of calves. Age of calf at weaning has effects on weight and condition score changes of cows but little effect on calves.

**Key Words:** Beef Cattle, Season of Calving, Production Traits

**87** The influence of season on distribution patterns relative to water and resource use by cattle grazing mixed forested rangelands. T. DelCurto<sup>\*1</sup>, B.K. Johnson<sup>2</sup>, M. Vavra<sup>1</sup>, P.K. Coe<sup>2</sup>, and A.A. Ager<sup>3</sup>, <sup>1</sup>Eastern Oregon Agricultural Research Center, Oregon State University, Union, <sup>2</sup>Oregon Department of Fish and Wildlife, La Grande, <sup>3</sup>USDA Forest Service, Pacific Northwest Research Station, La Grande, OR.

Sustainable watersheds and resource use may be key factors determining the future of public land grazing in the western US. At the Starkey Experimental Forest and Range (SEFR), deer, elk, and cattle interactions are being studied in a free-ranging environment within a 78 km<sup>2</sup> study area enclosed by a 2.4 m high fence. Cattle are moved through pastures on a deferred-rotation schedule. Pastures grazed early in one year will be grazed late the following year. We evaluated distribution relative to water and vegetation resource use by cattle in two pastures that, depending on rotation, were grazed either early or late. We linked cattle locations ( $n = 52,536$ ) determined with an automated telemetry system from 1991 to 1996 to a geographic information system (GIS) of the SEFR. Between and within seasons, cattle displayed strong patterns of spatial distributions and selection of resources on an hourly basis. Feeding sites for cattle were significantly different ( $P < 0.05$ ) between seasons relative to distance to water, structure of the vegetation, and canopy cover. In late summer, cattle were closer to water and grazed in stands with higher canopy cover. In early summer, as resources were consumed and vegetation dried, cattle shifted distributions to more concave slopes, closer to water, sites with higher forage production, and more northerly aspects ( $P < 0.05$ ). In late summer, patterns were reversed. In the first half, cattle selected for areas closer to water, higher forage production areas, and northerly aspects but as resources were removed, cattle used areas far from water, more concave sites, and areas with deeper soils ( $P < 0.05$ ). Scheduling and timing of grazing will have substantial effects on forage utilization and distributions relative to use of riparian areas.

**Key Words:** Beef Cattle, Grazing Distribution, Riparian Areas

**88** Influence of a grazing system, season of use, and aspect on the nutritional quality of forages, and subsequent performance and distribution of beef cattle grazing forested rangelands. K. Walburger<sup>\*1</sup>, T. DelCurto<sup>1</sup>, M. Vavra<sup>1</sup>, L. Bryant<sup>2</sup>, and J.G. Kie<sup>2</sup>, <sup>1</sup>Eastern Oregon Agricultural Research Center, Oregon State University, Union, <sup>2</sup>USDA Forest Service, Pacific Northwest Research Station, La Grande, OR.

A study was designed to determine if grazing treatment and pasture aspect has an affect on forage quality, ADG and cattle distribution and to determine if forage quality drives pasture preference within a mountain riparian pasture. Fifty-two, crossbred yearling heifers were assigned randomly to two treatments: 1) free choice season-long access to both a grassland (south-slope aspect) pasture and a forest (north-slope aspect) pasture, riparian zone excluded; and 2) a predefined grazing system between the grassland and forest pastures, also with the riparian zone excluded. The grazing schedule for the managed system was mid-June to mid-July in the grassland pasture, mid-July to mid-September in the forest pasture, and returning to the grassland pasture mid-September to mid-October. Individual heifer weights were obtained every 28 d. Differences in animal performance between grazing systems were most pronounced during the final grazing period. In four of five years, total weight gain of managed heifers tended to be greater than the weight

gain of free choice heifers. However, this difference was only significant ( $P < .05$ ) in two of five years, averaging 9.1 kg. As the grazing season progressed, forage CP and IVDMD decreased ( $P < .05$ ). As a result, weight gains decreased in the later periods as compared to gains early in the summer season ( $P < .05$ ). Forage quality was also influenced by aspect ( $P < .10$ ). Specifically, Idaho fescue (*Festuca idahoensis*) CP and IVDMD were greater for north vs south facing aspects. Bluebunch wheatgrass (*Agropyron spicatum*) CP was higher ( $P < .05$ ) for north aspects in one of the two years only. In this study, beef cattle performance and diet quality declined over time. Distribution patterns favored north aspects later in the grazing season.

**Key Words:** Beef Cattle, Grazing Management, Forage Quality

### 89 Critical control points affecting profitability in beef cow production: using SPA data. T. Baird and N. Dalsted\*, Colorado State University, Fort Collins.

Recent efforts by the NCBA's IRM committee have been focused on determining what are the key factors affecting the profitability of beef cow production. Initially, the key factors to be evaluated included weaning weight, cost per cow, total feed cost per cow, purchased feed cost per cow, total income per cow, and average steer weight sold. The study has focused on 53 cow-calf operations in Colorado. The database consisted of a total of 16,821 cows with corresponding SPA data for the years of 1995 to 1999.

A regression model and a stochastic frontier model uses cross-sectional data to identify the critical control points and the efficiency differences between the cow/calf operations. The regression model utilizes net income before taxes as the dependent variable. The primary independent variables include: average selling price of heifers, average selling price of steers, cull cow price, total operating cost per cow, actual weaning weight of heifers, actual weaning weight of steers, and female replacement rate, and adjusted exposed females.

Initial regression results suggest that total operating cost per cow, actual weaning weight of heifers, average selling price of heifers, and adjusted exposed females are key factors that affect the level of net income (profitability) of the 53 operations evaluated. Analytical results addressing efficiency measures (stochastic frontier model) as well as factors affecting profitability will be presented.

**Key Words:** Profitability, Production, Costs

### 90 Manure production characteristics from lactating Holsteins. D. Meyer, V. Erikson\*, E. Tooman, and T. James, University of California, Davis.

Regulatory agencies are devoting greater attention to animal feeding operations. In California, this focus has targeted dairy animals. Estimates of total manure produced as well as nutrient content of manure are used by various agencies to determine if sufficient manure storage capacity and land available to receive manure nutrients exist for each dairy operation. Additionally, the volatilization of ammonia and potential subsequent formation of particulate nitrate has been identified as an environmental concern. Twelve lactating Holsteins (three groups of four) were used. Animals were fed individually during an adaptation period (10 d). Animals were relocated for total collections. Daily DMI, water intake, orts, feces, and urine were measured. Indwelling urinary catheters were inserted 2 d prior to the collection period (5 d). Some urine samples were acidified to reduce loss of N. Other samples were unacidified for use in ammonia volatilization experiments. All samples were collected on a 24-hr basis. Average (standard deviation) values were DMI 21.3 (3.3) kg/d and water intake 99.3 (15.2) l/d. Dietary N, P, and K concentrations were 2.64, .38, and 1.77 % of diet DM. Daily excretions were 40.5 (7.5) kg feces at 17.7 % DM and 26.7 (4.8) kg urine at 5.0 % DM. Fecal N, P, and K were 2.8 (.2), .8 (.1), and .4 (.2) % DM and urinary values were .9 (.2), .0 (.0), 1.0 (.2) % urine mass. Urinary urea N was 7091 (1915) mg/l. Average manure production per 454 kg body weight was 48.2 kg/d with concentrations of N, P, and K at 5.0, .7, and 3.5 % DM. Corresponding values from the Engineering Standard Table D384.1 (dairy manure column) are 39.1 kg/d and 3.8, .8, and 2.4 % DM.

**Key Words:** Dairy manure, Excretion, Environment

### 91 Evaluation of the melengesterol acetate/prostaglandin (MGA/PGF) and MGA/Select Synchronizing protocols in beef heifers. R. N. Funston\*<sup>1</sup>, R. P. Ansotegui<sup>1</sup>, B. D. Thompson<sup>2</sup>, J. J. Lipsey<sup>3</sup>, M. D. Ropp<sup>3</sup>, and T. W. Geary<sup>4</sup>, <sup>1</sup>Montana State University, Bozeman, <sup>2</sup>Miles City Veterinary Clinic, Miles City, MT, <sup>3</sup>American Simmental Assoc., Bozeman, <sup>4</sup>USDA-ARS, Miles City.

The objective of this study was to evaluate synchronization, conception and pregnancy rates of beef heifers synchronized with either the Select Synchronizing protocol preceded by 7 d of MGA (MGA/Select Synchronizing) or the traditional MGA/PGF protocol. Crossbred beef heifers from one location ( $n=796$ ) were randomly assigned to treatment and AI sire. Heifers in the MGA/Select Synchronizing group ( $n=402$ ) were fed MGA (.5 mg/hd/d) for 7 d, received an injection of GnRH (100 mcg) the day following the last MGA feeding and an injection of PGF (25 mg) 7 d after GnRH. Heifers in the MGA/PGF group ( $n=394$ ) received MGA (.5 mg/hd/d) for 14 d followed 17 d later by an injection of PGF (25 mg). Heifers were observed for estrus continuously during daylight hours beginning 1 d before through 5 d after PGF treatment. Heifers received AI according to the AM/PM rule. Pregnancy status was determined by ultrasound approximately 42 d after AI. Mean body condition scores and weights at time of breeding for the MGA/Select Synchronizing and MGA/PGF heifers were 6.3 and 6.4, and 374 and 380 kg, respectively. Synchronization rates were not different ( $P > .1$ ) between the MGA/Select Synchronizing (85%) and MGA/PGF (83%) treated heifers. Conception and pregnancy rates to AI were also similar ( $P > .1$ ), 58 and 48% for the MGA/Select Synchronizing heifers and 59 and 49% for the MGA/PGF heifers, respectively. Five percent of the MGA/Select Synchronizing and 4% of the MGA/PGF heifers were detected in estrus the day before PGF. By 56 h following PGF, 70% of the MGA/Select Synchronizing and 59% of the MGA/PGF heifers had been observed in estrus. Approximately 90% of synchronized heifers were in estrus by 80 h following PGF in both treatments. In summary, short-term (7 d) MGA feeding preceding the Select Synchronizing protocol produced similar synchronization, conception and pregnancy rates as the traditional MGA/PGF protocol.

**Key Words:** Estrus Synchronization, GnRH, Melengesterol Acetate

### 92 Effects of fishmeal supplementation on first service pregnancy rates in primiparous lactating beef cows. T. R. Bonnette\*, D. B. Abbey, J. C. Whittier, and P.D. Burns, Colorado State University, Fort Collins.

The objective of this study was to determine if supplementing primiparous lactating beef cow with fishmeal (FM) increases first service conception rates. Forty lactating, first-calf, crossbred cows were stratified by body conditions score, body weight, and calving date; and allotted to one of eight pens ( $n=5$  cows/pen). Cows were fed a corn silage based diet and supplemented with a protein supplement containing either corn gluten meal (CGM) or FM. Supplementation began 25-days prior to the start of and continued throughout the 90-day breeding season. Diets were formulated to be isonitrogenous and isocaloric. Fishmeal was supplemented at 5% and CGM at 8.7% DM intake. Body weight and condition scores were taken every two weeks to monitor change in body weight and condition. Cows were bred artificially 12 hr after being detected in estrus. Jugular blood samples were taken on days 3 or 4, 9 or 10, and 15 or 16 post-estrus following first service AI breeding and analyzed for concentrations of progesterone. Pregnancy was determined by ultrasonography 25 to 30 days post-breeding in cows that did not return to estrus. Average daily gain and body condition scores did not differ between treatment groups ( $P > .10$ ). First service conception rates were 20% higher for the cows receiving fishmeal supplementation (73 vs 53% for cows supplemented with fishmeal or corn gluten meal, respectively;  $P = .22$ ). Overall pregnancy rates at the end of the breeding season did not differ between the treatment groups ( $P > .10$ ). Serum concentrations of progesterone did not differ between the treatment groups during the estrous cycle following first service ( $P > .10$ ). Preliminary data indicate that fishmeal supplementation may increase fertility in primiparous lactating beef cows. Fishmeal may increase fertility by suppressing uterine prostaglandin release rather than increasing progesterone synthesis by the corpus luteum.

**Key Words:** Cows, Fishmeal, Pregnancy Rates

**93 Evaluation of fixed-time AI with GnRH on pregnancy rate of beef heifers synchronized with the MGA/PGF<sub>2</sub> $\alpha$  protocol.** B.W.P. Sasongko\*<sup>1</sup>, J.C. Whittier<sup>1</sup>, P.D. Burns<sup>1</sup>, T.W. Geary<sup>2</sup>, and R.G. Mortimer<sup>1</sup>, <sup>1</sup>Colorado State University, Fort Collins, <sup>2</sup>Fort Keogh Livestock and Range Research Station, Miles City, MT.

The objective of this study was to evaluate pregnancy rate to timed-insemination with 100  $\mu$ g of GnRH at 60 h post PGF in beef heifers synchronized with the 14-d MGA/ 19-d PGF system. The comparison treatment was 14-d MGA/19-d PGF with heat detection and AI up to 72 h, then non-responding heifers were all mated at 72 h. The study was conducted on virgin heifers at two locations (L1, n = 78; L2, n = 169) in the spring of 1999. In both locations, animals were fed .5 mg MGA/head/d for 14 d. There was a 19-d interval between the end of MGA feeding and the 25 mg injection of PGF. Animals were randomly assigned either to timed AI at 72 h (72) or to 60 h plus 100  $\mu$ g GnRH injection (60) post prostaglandin injection. Estrous detection began at the same time of PGF injection through 72 h at L2. At L1, estrus was observed starting one day before PGF injection through 72 h for animals in treatment 72, but it was from the time of PGF injection to 60 hour for 60-treated animals. Animals in treatment 72 in both locations that exhibited estrus were bred according to am-pm rule, except for those observed at 72 hour and non-responders. All heifers in treatment 60 were bred at 60 hour in L1. Animals in treatment 60 that exhibited estrus in L2 were bred according to am/pm rule except for those exhibiting estrus at 36, 60, 72 hour and non-responders. There was no interaction between treatments and locations on AI pregnancy rates ( $P > 0.1$ ) and thus data were pooled to either 72 or 60 treatment. Chi-square analysis showed similar AI pregnancy rates between treatments (72 = 60.5%, 60 = 60.3%). These data indicate that the duration of estrous detection was reduced and similar pregnancy rates were achieved by mating at 60 h with 100  $\mu$ g GnRH compared to waiting until 72 h post PGF following a 14-d MGA/19-d PGF synchronization system.

**Key Words:** Beef Heifers, Fixed-Time AI, Estrous Synchronization

**94 Reproductive, hormonal, and milk characteristics of ewes treated with propylthiouracil and melatonin during late gestation.** J. L. Bollinger, D. M. Hallford, J. A. Hernandez, and K. L. Shirley, *New Mexico State University, Las Cruces.*

Twenty-four, pregnant Debouillet ewes (avg. BW = 80.5 kg) were used to examine the effects of 6-N-propyl-2-thiouracil (PTU) alone or in combination with melatonin on serum thyroxine (T<sub>4</sub>), BW, milk traits, serum LH and ovarian activity. Ewes received a gelatin capsule daily by gavage for a 20-d treatment period beginning on February 1 (d 0 of prepartum period, approximately d100 of gestation). All ewes also received an i.m. injection containing 2 mL of safflower oil at 1600 daily for the last 15 d of the 20-d treatment period. In the control treatment (n = 8), gelatin capsules were blank and injections contained only safflower oil. In the second group of 8 ewes, capsules contained 12 mg of PTU/kg BW/d for 5 d and 10 mg PTU/kg BW/d for the last 15d while injections contained only oil (PTU). The third group of 8 ewes received PTU capsules as described for the PTU group but all injections contained 5 mg of melatonin (PTU+MEL). On d 8, serum T<sub>4</sub> was less in PTU-treated groups than in controls ( $P < 0.01$ ). This decrease in serum T<sub>4</sub> resulting from PTU treatment was consistent during the remainder of the treatment period. After terminating PTU treatment (d 20), serum T<sub>4</sub> values were similar ( $P > 0.30$ ) in all groups by d 21. Ewe BW did not differ ( $P > 0.30$ ) among treatments. In addition, ewe milk production and lamb BW were similar ( $P > 0.30$ ) among the three maternal treatment groups. Serum LH concentrations were similar among treatments ( $P > 0.70$ ) on both d 7 and 14 postpartum. No differences ( $P > 0.40$ ) were observed in area under the LH curve (AUC) or pulse numbers among treatments on either d 7 of 14. None of the ewes exhibited ovarian cyclicity during the 30-d postpartum sampling period as indicated by no serum progesterone values greater than 1 ng/mL. Results suggest that PTU and PTU+MEL effectively lowered serum T<sub>4</sub> without adverse effects on the ewe or lamb but did not prevent the decline in LH pulsatility.

**Key Words:** Sheep, Reproduction, Thyroxine

**95 Flow cytometric identification of subclinical mastitis in ewes.** M. McFarland\*, D. W. Holcombe, D. Redelman, D. L. Garner, J. R. Allen, M. E. Surian, and D.J. King, *University of Nevada, Reno.*

A study was conducted using repeated sampling to determine the incidence of subclinical mastitis (SM) and the organism associated with the inflammation in ewes over a lactation period. Somatic cell counts (SCC) of 56 Rambouillet-cross multiparous ewes examined at 20 d postpartum ranged from .009 to  $97 \times 10^6$ . Fourteen ewes were selected and categorized as having low (control;  $< 0.6 \times 10^6$ ) or high (SM;  $> 1 \times 10^6$ ) SCC. Udder halves, rather than individual ewes, were reclassified as control or SM based on SCC values for each sampling period. Milk samples (5 ml) were collected at 30, 60 and  $90 \pm 1.6$  d (mean  $\pm$  SD) postpartum. At 0700 (h=0) a sample was collected from each side, the udder was milked out and sampling continued at 2 h intervals through h 6. At 90 d, additional samples were collected at 12, 18, and 24 h. Samples were examined using differential fluorescent staining (SYBR Green I<sup>TM</sup> and propidium iodide nuclear stains) and flow cytometry to quantify the total SCC. At 30 and 60 d, SM udder halves (n=4 and 8) had higher ( $P < .0001$ ) total SCC ( $14$  and  $3.1 \times 10^6$ , respectively) than control udder halves (n=24 and 20;  $0.17$  and  $.006 \times 10^6$ , respectively). Sampling did not differ ( $P > .10$ ) across treatments for the 6-h sampling period. At 90 d, SM udder halves (n=8) had greater ( $P < .0001$ ) total SCC than control udder halves (n=20) for all sampling times. Sampling time had no affect ( $P > .10$ ) on SCC from SM halves, however, control udder halves had elevated ( $P < .05$ ) total SCC counts at h 24. This rise was attributed to four udder halves with elevated SCC at h 18 and 24. *Staphylococcus* species were cultured from 5/28 samples tested at each collection time. However, only 2/5, 3/5 and 4/5 samples tested were from SM udder halves for 30, 60 and 90 d, respectively. These data suggest that it is difficult to identify all ewes with subclinical mastitis using repeated sampling measures over the lactation period because disease status varies.

**Key Words:** Ewes, Milk, Mastitis

**96 Effects of the polyamine putrescine on serum progesterone and steady state levels of mRNA encoding steroid enzymes in the bovine corpus luteum.** D. J. Denniston\*, K. K. Kane, C. N. Roybal, M. L. Vogt, and D. E. Hawkins, *New Mexico State University, Las Cruces.*

The objectives of this research were to investigate the effects of the polyamine putrescine (PUT) on serum progesterone and steady-state levels of mRNA encoding steroid enzymes in the bovine corpus luteum. Fourteen days post ovulation, cows with mid luteal CL (n=21) were randomly assigned to one of three treatments: phosphate buffered saline (PBS), 2.5 mg prostaglandin F<sub>2</sub> $\alpha$  (PGF<sub>2</sub> $\alpha$ ), or 1.0 mM PUT. PUT was infused in vivo into the mid- luteal CL via needle-guided transvaginal ultrasonography. Blood was collected via caudal venapuncture at the time of infusion and every 60 minutes for 360 minutes following infusion to quantify serum progesterone (P<sub>4</sub>) secretion. As expected, serum P<sub>4</sub> concentration decreased over time in CL treated with PGF<sub>2</sub> $\alpha$  confirming efficacy of treatment delivery. Differences in concentration of serum P<sub>4</sub> over time were apparent from 180 minutes through 360 minutes ( $P < 0.05$ ). Mean serum progesterone during this period was elevated in PUT treated CL (7.7 ng / mL) when compared to CL treated with PGF<sub>2</sub> $\alpha$  (4.8 ng / mL) or PBS (5.3 ng / mL). At 360 minutes post infusion, the ovary containing the infused CL was removed via paralumbar laparotomy. Total RNA from the CL was extracted and mRNA encoding steady state levels of cytochrome P450 side-chain cleavage (SCC) and  $3\beta$ -hydroxysteroid dehydrogenase/ $\Delta^5$ - $\Delta^4$  isomerase (3 $\beta$ HSD) were measured. To verify mRNA integrity and to ensure that equal amounts of mRNA were assayed, duplicate samples were hybridized to a random primer labeled cDNA for tubulin. Amount of mRNA for SCC and tubulin did not differ among treatments ( $P > 0.05$ ). However, steady state levels of mRNA for 3 $\beta$ HSD were significantly lower (40%) in the PGF<sub>2</sub> $\alpha$  treated CL than either the PBS or PUT groups ( $P < 0.05$ ). In conclusion, PUT treated CL secreted higher concentrations of serum P<sub>4</sub> during the last 180 minutes post infusion without altering steady state levels of mRNA for SCC or 3 $\beta$ HSD. CL treated with PGF<sub>2</sub> $\alpha$  had decreased serum P<sub>4</sub> and mRNA for 3 $\beta$ HSD without affecting levels of SCC.

**Key Words:** Polyamines, Putrescine, Progesterone

**97 Dose-response of rumen and plasma glucose and lactate to intraruminally administered wheat flour in sheep.** V. Kuncharapu\*, N. S. Sundar, and M.L. Bruss, *University of California, Davis*.

The objective was to develop dose-response models for maximal increases in rumen and plasma glucose and D- and L-lactate in ruminants ingesting excessive amounts of starch. Using a slurry of whole wheat flour given via rumen fistulas, six ewes were given doses of 20 to 70 g/kg in increments of 10 with each sheep receiving one dose. Water and alfalfa pellets were available ad lib. Blood and rumen samples were taken at 0, 4, 8, 12, 24, 36 and 48 hours. The dose-response of maximal increase in rumen glucose concentration could be described approximately by either a linear or sigmoid (Hill) equation ( $r=0.71$ ,  $P=0.12$  for either case). Except for the lowest dose where there was no change, maximal increases in plasma glucose concentration were relatively constant (1.55 mmol/L/0.23 SE,  $P=0.003$ ) with dose. The dose-responses of maximal increases in rumen D- and L-lactates were similar, each having a sigmoidal increase in concentration with dose with the inflection between 40 and 50 g/kg. Hill equations were fitted ( $r=0.87$ ,  $P=0.02$  for both isomers) and predicted maximal increases in concentration of 55 and 67 mmol/L for D- and L- lactate, respectively, were similar to the greatest observed increases. The dose-response of maximal increase in plasma D-lactate was approximately sigmoid ( $r=0.65$ ,  $P=0.16$ ) with the inflection between 40 and 50 g/kg and a predicted maximum of 10 mmol/L, which was less than greatest observed increase. However, the dose-response of maximal increase in plasma L-lactate did not fit well to a linear or sigmoid equation, but  $r=0.77$  and  $P=0.07$  for rank correlation. It is concluded that in starch overload, the Hill equation is a good model for maximal increases in rumen D- and L-lactate concentrations, but less useful for maximal increases in concentration of plasma D- and L-lactate or plasma or rumen glucose.

**Key Words:** Glucose, Lactate, Starch Overload

**98 Oral treatment of aromatase inhibitor (Letrozole): Effects on hormone and sperm production in the stallion.** T.A. Stein\*, J.F. Roser, B.A. Ball, and A.J. Conley, *University of California, Davis*.

The aromatase inhibitor, Letrozole [4-4'-(1H-1,2,4-triazol-1-yl-methylene)-bis-benzonitrile; Novartis Pharmaceuticals], has been reported to significantly inhibit estrogen (rat, primate, human, dog) and sperm (primate) production. In stallions, which have unusually high levels of testicular estrogen, the long term effects of Letrozole treatment on hormone and sperm production were determined by giving Letrozole (0.55mg/kg BW,  $n=7$ ) or vehicle ( $n=3$ ) orally every other day for 60 days during the breeding season. Jugular blood samples were collected three times a week throughout the study. Plasma was stored at  $-20^{\circ}\text{C}$  until analyzed by radioimmunoassay for luteinizing hormone (LH), follicle stimulating hormone (FSH), testosterone (T), estradiol (E2), and inhibin. Biopsy samples obtained from the right testis of each stallion, prior to and after treatment, were used to determine aromatase enzyme activity of the membrane fraction. Semen was collected from all stallions twice one hour apart every other week to determine changes in the total number of progressively motile sperm per ejaculate. During treatment, plasma levels of T in treated stallions was elevated ( $2.33\text{ng/ml} \pm 0.1$  SEM) compared to control stallions ( $1.00\text{ng/ml} \pm .06$  SEM;  $p \leq .05$ ). A simultaneous suppression in plasma E2 concentrations ( $31.23\text{pg/ml} \pm 1.42$ ;  $42.38\text{pg/ml} \pm .84$  SEM), inhibin ( $1.41\text{ng/ml} \pm .07$ ;  $2.80 \pm .06$  SEM) and LH ( $1.94\text{ng/ml} \pm .24$ ;  $6.73 \pm .27$  SEM) was observed in treatment versus control stallions, respectively ( $p \leq .05$ ). Plasma FSH levels did not differ between treatment and control stallions. The aromatase activity of treated stallions was significantly suppressed ( $963 \pm 154$  to  $326 \pm 173$  pmol/mg/2hr  $\pm$  SEM) as compared to control stallions ( $1141 \pm 10$  to  $897 \pm 116$  pmol/mg/2hr  $\pm$  SEM) during treatment ( $p \leq .05$ ). Total progressively motile sperm per ejaculate did not differ between groups. Letrozole treatment significantly changed the T:E2 ratio without affecting sperm production. There was a decrease in inhibin production without a change in plasma FSH levels, suggesting that T or E2 may modulate inhibin production locally.

**Key Words:** Letrozole, Aromatase

**99 Linoleic acid supplementation improves fertility in oMt1a-oGH transgenic mice.** A. Thomas\*, J. D. Murray, and A. M. Oberbauer, *University of California, Davis*.

Mice carrying a regulatable growth hormone (GH) transgene (oMt1a-oGH) are subfertile when the transgene is actively expressed. Pregnancy can be rescued by provision of a high energy diet. The current study was designed to test if overall dietary energy was sufficient to maintain pregnancy in activated oMt1a-oGH females or if a specific fat component was necessary. At weaning, 60 transgenic (TG) and 47 wild-type (WT) females were fed Diet B (5.39% fat, 1.06% linoleic acid, 3123.2 kcal/g ME) and the drinking water was supplemented with 25 mM  $\text{ZnSO}_4$  to activate the transgene. At 8 wks of age, females were allocated to one of six treatment groups: Group 1 - TG continuing to be fed Diet B, Group 2 - TG fed Diet L (5.39% fat, 2.25% linoleic acid, 3123 kcal/g ME), Group 3 - TG fed Diet E (15.86% fat, 1.06% linoleic acid, 3737.6 kcal/g ME), Group 4 - WT continuing to be fed Diet B, Group 5 - WT fed Diet L, and Group 6 - WT fed Diet E. At 10 wks of age, females were mated and at Day 17 of pregnancy, the number of corpora lutea, live fetuses, and resorption sites were counted. Pregnancy rate was not different ( $p > .2$ ) across TG groups, although that of Group 1 females (50.0%) was lower ( $p < .05$ ) than that of WT (92%). Ovulation rate was not different ( $p > .2$ ) among TG groups, although Group 3 had less ( $p < .05$ ) ovulations ( $10.67 \pm 0.73$ ) than WT fed the same diet ( $14.00 \pm 0.76$ ). There was no difference ( $p > .3$ ) among TG groups for litter size, however Group 2 had significantly ( $p < .05$ ) more fetuses at Day 17 ( $10.83 \pm 0.58$ ) than pooled WT ( $8.89 \pm 0.34$ ), and Group 2 had a higher ( $p < .05$ ) pre-implantation embryonic survival (PRE) (94.0%) compared with WT (77.5%). Group 1 ( $1.75 \pm 0.31$ ) and Group 2 ( $1.25 \pm 0.25$ ) exhibited significantly ( $p < .05$ ) more resorption sites than did WT ( $0.53 \pm 0.15$ ). Finally, Group 1 had a lower ( $p < .05$ ) post-implantation embryonic survival (POST) (84.7%) versus WT (94.5%). These data suggest that high circulating GH affects reproduction adversely at the level of POST, while dietary supplementation of linoleic acid to TG females enhances PRE.

**Key Words:** Mice, Linoleic Acid, ME

**100 Genetic parameter estimates for mature weight, weaning weight and post weaning gain in Red Angus cattle.** J. L. Evans\*<sup>1</sup>, B. L. Golden<sup>1</sup>, R. M. Bourdon<sup>1</sup>, and R. L. Hough<sup>2</sup>, <sup>1</sup>Colorado State University, Fort Collins, <sup>2</sup>Red Angus Association of America, Denton, TX.

Our objective was to determine if a genetic relationship exists between mature weight (MW), weaning weight (WW) and post weaning gain (PW) in Red Angus cattle. We received data from the Red Angus Assoc. of America on 111,460 MW, 546,780 WW and 215,132 PW records. Mature weight contemporary groups were formed using weaning contemporary group of the calf and percentage Red Angus of the dam. Weaning contemporary group included birth contemporary group, weaning workgroup, weigh date, calf sex, and feed treatment and management code. Post weaning gain contemporary group included yearling workgroup, weigh date, calf sex, breeder management code and weaning contemporary group. We selected three herds for our analysis and removed records of animals with incomplete contemporary group information and less than 50% Red Angus, reducing the data to 25,143 MW, 22,651 WW and 19,180 PW records. We estimated variance components with Method R procedures and multivariate animal models. Analyses included WW with MW at ages 2, 3 and 4 to 9 yr, and PW with MW of 2 to 9 yr. For MW fixed effects included contemporary group and an interaction of age of cow by age of dam; random effects included additive direct genetic effects of animal, permanent environment and residual. Fixed effects for WW included contemporary group, a sex by age of dam interaction, a covariate of weaning age; random effects were additive direct(maternal) genetic effects of animal and residual. Post weaning gain fixed effects were contemporary group, a sex by age of dam interaction, and random additive direct genetic effects of animal and residual. Median genetic correlation estimates between WW and MW at 2, 3 and 4 to 9 yr were .61, .43, and .81. The median genetic correlation estimate between PW and MW was .68. Results show that an additive genetic relationship is present among MW, WW and PW. Inclusion of WW or PW records in a multivariate analysis with MW may serve to increase accuracy of MW predictions.

**Key Words:** Beef Cattle, Genetic Parameters, Maturity



**101 Feedlot performance and hepatic trace mineral status of beef heifers previously consuming dietary copper antagonists.** J.D. Bailey<sup>1</sup>, R.P. Ansotegui\*<sup>1</sup>, J.A. Paterson<sup>1</sup>, and C.K. Swenson<sup>2</sup>, <sup>1</sup>Montana State University, Bozeman, <sup>2</sup>Zinpro Corporation.

An experiment was conducted to determine if a combination of inorganic and organic Cu and Zn affected ADG, cell-mediated immunity (CMI), DMI, gain/feed (G/F), carcass characteristics, or hepatic trace mineral status in feedlot heifers previously consuming Cu antagonists Mo, S and Fe. Sixty yearling, Angus x Hereford heifers (avg 372 kg BW) were stratified by BW, initial hepatic Cu, and previous treatment across 12 pens. Heifers were individually fed supplements that contained 1) basal supplement with no additional Cu or Zn (CON); 2) 250 mg Cu and 500 mg Zn; 50% organic complex, 50% sulfate (2W); 3) same levels of Cu and Zn; 100% sulfate (SU) while the remainder of the diet was pen fed. Phytohemagglutinin (PHA) was injected intradermally at two sites on the neck. Response to PHA was measured at 0, 3, 6, 9, 12 and 24 h post-injection on study d 50. Liver biopsies were taken on d 0, 25, 50, and 75. The ADG, DMI, and G/F were analyzed using pen as the experimental unit. The ADG, DMI, G/F did not differ ( $P > .10$ ) among treatments. Carcass weight, REA, FT, QG, and YG were similar ( $P > .10$ ) among treatments. Swelling response to PHA did not differ ( $P > .10$ ) among treatments. Hepatic repletion of Cu was similar ( $P > .10$ ) among treatments until d 50. From d 50 through d 75, heifers consuming the CON treatment accumulated less ( $P < .05$ ) hepatic Cu than heifers consuming either the 2W or SU supplements. Heifers consuming the 2W or SU supplements accumulated similar amounts of ( $P < .05$ ) hepatic Cu. Liver Zn differed ( $P < .05$ ) over time but was similar ( $P > .10$ ) among treatments. Hepatic Mo differed ( $P < .05$ ) over time but was similar ( $P > .10$ ) among treatments until d 75. At d 75, 2W heifers had less ( $P < .05$ ) hepatic Mo than CON heifers and tended ( $P = .08$ ) to have less hepatic Mo than SU heifers. A combination of organic/inorganic trace minerals may be advantageous in reducing hepatic Mo retention, which may limit further systemic effects of Cu antagonists.

**Key Words:** Copper, Zinc, Antagonists

**102 Effects of feeding soybean oil pre-breeding as a supplement to flush mature Suffolk ewes on body weight change, conception rate, and lamb birth weight.** M. W. Salisbury, T. T. Ross\*, L. L. Melton, and S. Langley, *New Mexico State University, Las Cruces.*

A trial was conducted to determine the effect of soybean oil (SBO) and length of flushing on body condition score (BCS), BW change, first cycle conception, lambing rate, and lamb birth weight. Treatments consisted of control (alfalfa hay only, 17.2% CP), oil (alfalfa hay plus 294 g/d of a SBO based supplement, 9.4 g of N/d and 341 g of TDN/d), or no oil (alfalfa hay plus 371 g/d of a cornstarch (CS) based supplement, 9.5 g of N/d and 352 g of TDN/d). Supplements were fed so that they were equal in energy and protein. Ewes were fed from d -21 to 17 (d 0 = ram introduction) or d -21 to 54 (d 54 = 20 d after ram removal) in a 3 X 2 factorial arrangement. Thus, treatments were control (alfalfa only), short oil (SBO supplement d -21 to d 17), long oil (SBO supplement d -21 to d 54), short no oil (CS supplement d -21 to d 17) and long no oil (CS supplement d -21 to d 54). Ewes were 5 ewes/pen and fed long stem alfalfa hay (3.2% of BW) daily plus their treatments until breeding began. At breeding, ewes receiving like treatments were grouped. Breeding dates were obtained. Ewe BW and BCS were recorded at the initiation and end of the feeding period. At lambing, lamb birth date and birth weights were recorded. For all analyses, individual ewe was the experimental unit. Initial ewe BW and BCS were similar ( $P = .46$  and  $P = .98$ , respectively) among treatments. Body weight and BCS change during the experiment were also similar ( $P = .47$  and  $P = .59$ ) among treatments. All of the short oil ewes bred during the first cycle with 80% of the other supplementation treatments breeding during the first cycle and only 50% of the control ewes breeding in the first cycle. However, no differences were noted for number of lambs born ( $P = .90$ ), number of ewes conceiving ( $P = .30$ ) or lamb BW ( $P = .90$ ). Results from this experiment suggest no advantage to using SBO as a flushing supplement except that fed supplemented ewes, regardless of supplement type, tended to have higher first cycle conception rates.

**Key Words:** Sheep, Flushing, Nutrition

**103 Effects of snakeweed toxicity and supplementation on gonadotropin-releasing hormone (GnRH), feed and weight change, and liver function.** D. J. Padilla, J. Smith, T. T. Ross, M. W. Salisbury, J. R. Strickland, and L. L. Melton, *New Mexico State University, Las Cruces.*

Twenty ewe-lambs were used to determine if energy and protein supplementation would improve tolerance to snakeweed toxicosis. Ewe-lambs were randomly assigned to one of four dietary supplements: Control (no supplement; CONT), corn (189g), undegradable intake protein (227g; UIP), or degradable intake protein (227g; DIP). Supplements were isocaloric. During Phase 1 (38 d) all ewes were fed 94% hachita blue grama hay, 6% alfalfa hay (DMI basis) and supplement. Phase 2 (25 d) all ewes were fed 80% hachita blue grama hay, 20% snakeweed (DMI basis), and assigned supplement. Diets were isonitrogenous and isocaloric between the two phases. Weights were taken before Phase 1, after Phase 1, and after Phase 2. Feed intake was measured by weighing refusals daily. Ewes were estrually synchronized at the end of each phase using Lutalyse. A GnRH challenge was conducted at the end of both phases by administering 10mg GnRH iv at days 9 to 11 after the Lutalyse injection. Blood samples were taken every 15 minutes for 240 minutes. Bromosulfothalein (BSP) clearance was also measured at the end of each phase to measure liver function and the liver's ability to conjugate and eliminate compounds. BSP was administered by single bolus injection iv (4mg/kg). Blood samples were taken 0 to 60 minutes at 5 minute intervals. After Phase 1, ewes had a mean BW loss ( $P = .0002$ ) of 1.56 kg. In Phase 2, ewes gained of 0.2 kg BW. Across both phases, supplements altered weight gain ( $P < .0002$ ). Controls lost the most weight, UIP gained the most weight, with the other two diets being intermediate. Ewes consuming snakeweed had a lower ( $P = .002$ ) area under the curve (AUC) for LH than ewes not consuming SW. Area under the LH curve was ( $P > .05$ ) influenced by supplements. Ewes receiving DIP had higher ( $P < 0.05$ ) AUC than UIP and Corn, but were similar ( $P > .10$ ) to CONT. Results from BSP clearance indicate distribution slopes between the two phases are different ( $P = .01$ ), and elimination slopes were similar ( $P > .60$ ).

**Key Words:** Snakeweed, Toxic Plants, LH

**104 Serum thyroid profiles in lambs fed swainsonine.** J. A. Hernandez\*, M. L. Vogt, J. R. Strickland, J. B. Taylor, and D. M. Hallford, *New Mexico State University, Las Cruces.*

Ten wethers (BW =  $48 \pm 9$  kg) were used to investigate acute and sub-acute exposure effects of locoweed consumption on serum swainsonine, alkaline phosphatase and thyroid hormone concentrations. Animals were individually fed (1.8% BW) isocaloric and isonitrogenous diets consisting of blue grama and alfalfa hay along with either 0.2, 0.4 or 0.8 mg/kg BW of swainsonine provided by locoweed (*Oxytropis sericea*, 614  $\mu$ g swainsonine/g of DM) for 20 d. Serum was collected before and at 6-h intervals for 24 h after receiving locoweed on d 0 (first day of treatment). Additional samples were collected before feeding on d 7, 14 and 21. Serum swainsonine was elevated 12 h after feeding on d 0 ( $P < 0.05$ ) and remained increased during the 20-d treatment period. Serum alkaline phosphatase (AP) tended to increase by 24 h after feeding on d 0. Serum thyroxine ( $T_4$ ) and triiodothyronine ( $T_3$ ) did not differ ( $P > 0.05$ ) among dietary swainsonine treatment groups (swainsonine x time,  $P > 0.20$ ). At 0, 6, 12, 18, and 24 h after consumption of swainsonine on d 0, serum  $T_4$  values were 81, 76, 78, and 68 ( $\pm 3.2$ ) ng/mL, respectively (linear,  $P < 0.05$ ); and serum  $T_3$  values were 3.7, 4.2, 3.7, 3.2 and 3.2 ( $\pm 0.2$ ) ng/mL, respectively (linear,  $P < 0.05$ ). Both serum  $T_4$  (81, 50, 41, 34  $\pm 3.1$  ng/mL, respectively) and  $T_3$  (3.7, 1.4, 1.2, 1.1  $\pm 0.3$  ng/mL, respectively) decreased (quadratic,  $P < 0.01$ ) in samples collected on d 0, 7, 14, and 21. The increase in serum AP and rapid decline in serum  $T_4$  and  $T_3$  may be useful indicators of acute swainsonine toxicosis.

**Key Words:** Locoweed, Toxicology, Thyroid

**105 Effect of ionophore supplementation on selected serum constituents of sheep consuming locoweed.** K. M. Whittet\*<sup>1</sup>, H. B. Encinas<sup>2</sup>, J. R. Strickland<sup>1</sup>, and J. B. Taylor<sup>1</sup>, <sup>1</sup>New Mexico State University, Las Cruces, <sup>2</sup>North Dakota State University, Fargo.

The effects of ionophore supplementation on selected serum constituents of sheep consuming locoweed were investigated. Sixteen sheep (BW =  $50.3 \pm 1.0$  kg) were allotted by weight to a 2x2 factorial arrangement

of four treatments: 1) no locoweed, no lasalocid, 2) no locoweed, .75 mg lasalocid / kg BW, 3) .5 mg swainsonine / kg BW, no lasalocid, 4) .5 mg swainsonine / kg BW, .75 mg lasalocid / kg BW. Swainsonine (SW) was provided by locoweed (*Oxytropis sericea*), and sheep were fed a blue grama based diet at 2.5% BW for a 35 d treatment period. Diets were formulated to be isocaloric and isonitrogenous. Blood samples were collected on d 1, 7, 14, 21, 31, and 35 to determine serum SW concentration, total iron (FE) concentration, and alkaline phosphatase (AP) activity. There was no lasalocid by locoweed interaction ( $p > .4$ ) for any of the response variables measured. Average daily gains ( $p = .4$ ) and orts ( $p = .7$ ) were not affected by the treatments. No lasalocid treatment ( $p = .67$ ) or day ( $p = .1$ ) effect of serum SW was observed. A locoweed by day interaction ( $p < .0001$ ) of serum AP was detected. Alkaline phosphatase levels were elevated ( $p < .01$ ) for the locoweed treated animals at 24 h following initial exposure and remained elevated throughout the trial. In addition, total FE was suppressed ( $p < .08$ ) in locoweed fed sheep. A day effect ( $p < .02$ ) was observed for serum FE. However, there were no linear, quadratic, or cubic effects of day noted ( $p > .17$ ). Lasalocid treatment had no effect on serum AP or FE. These data indicate that the use of lasalocid in grazing animals should not increase the likelihood of locoweed intoxication.

**Key Words:** Ionophore, Lasalocid, Locoweed

**106 Effects of hexane and ether fractions of snakeweed (*Gutierrezia spp*) on selected serum constituents of male Sprague-Dawley rats.** D. S. Al-Ajmi, J. R. Strickland\*, T. T. Ross, D. J. Padilla, and R. L. Ashley, *New Mexico State University, Las Cruces.*

A trial was conducted to determine the effect of hexane and ether fractions of snakeweed (SW) on selected serum constituents in male Sprague-Dawley rats. Treatments were positive control (CON, n=8, maintenance intake + 10% DM), hexane fraction (HF, n=8), ether fraction (EF, n=7) and pair-fed control for hexane (HPC, n=8) and ether (EPC, n=7). All rats were fed a commercial rat chow daily as the basal diet. Chemical fractions were delivered by top dressing the diet using soybean oil as the carrier. The fractions were delivered to represent SW at a rate equal to 40% of the diet as DM. Pair-fed controls received the carrier in the amounts equal to the total of the extract plus soybean oil. Serum samples were collected at the end of the trial (day 30). Body weights were recorded weekly. Triglycerides were lower in rats fed HF ( $p < .05$ ) and EF ( $p = 0.06$ ) compared to their respective pair-fed controls. In addition, blood urea nitrogen was depressed in HF ( $p < .05$ ) and EF ( $p = 0.06$ ) compared to their respective pair-fed controls. Total bilirubin was also elevated in both HF and EF ( $p < .05$ ) in relation to their respective pair-fed controls. Average daily gains (g) tended to be lower for HF ( $p < .10$ ) and EF ( $p = 0.13$ ) compared to their respective pair-fed controls. In general, these data indicate that the HF and EF may contain potential toxicants as reflected by alteration of serum constituents. These changes were noted between the extracts and pair fed controls. Thus, the effects may be potentially attributed to the chemical contents of both extracts and not due to the nutrient content of the diet.

**Key Words:** Rat, Chemical Fractionation, Bioassay

**107 Influence of shade and time of feeding on feedlot performance of crossbred steers during periods of high ambient temperature.** W. Chai, N. Torrentera\*, and R. A. Zinn, *University of California, Davis.*

The objective of this research was to determine the influence of shade and feeding time on the feedlot performance of crossbred steers during periods of high ambient temperature. In Trial 1, 70 crossbred steers (295 kg) were used to evaluate the influence of shade (0 versus 3.3 m<sup>2</sup>/steer) on growth performance. Maximum daily air temperature and relative humidity averaged 41°C and 67%, respectively. Shade enhanced DMI (6%,  $P < .05$ ) and ADG (9%,  $P < .10$ ). There were no treatment effects on dietary NE. In Trials 2 and 3, the interaction of shade (0 versus 3.7 m<sup>2</sup>/steer) and feeding management (provide 70% of daily feed allowance at 0600 versus 1800 h) were evaluated. Maximum daily air temperature and relative humidity was similar for both studies, averaged 41°C and 43%, respectively. Trial 2 involved 112 crossbred steers (436 kg). Shade increased ( $P < .05$ ) DMI and water intake (5.1 and 30.3%, respectively). There was an interaction ( $P < .05$ ) between shade and feeding program on ADG, feed efficiency, and dietary NE. In the

absence of shade, providing 70% of the daily feed allowance in the afternoon increased ADG (22%), feed efficiency (14%), and dietary NE (6%). However, in the presence of shade, feeding management did not affect growth performance. Trial 3, involved 96 crossbred steers (244 kg). Shade increased ADG (14,  $P < .10$ ), feed efficiency (10%,  $P < .05$ ) and NE for maintenance and gain by 5.5 and 7.0% ( $P < .05$ ). Providing 70% of the daily feed allowance in the afternoon did not affect ( $P > .20$ ) ADG, but increased ( $P < .10$ ) the NE value of the diet for maintenance and gain by 3.7 and 5.0%, respectively. Feeding management affected ( $P < .01$ ) the eating habits of the cattle. Cattle provided with 70% of their daily feed allowance in the afternoon consumed 31% of their daily DMI between 0600 and 1800 h, while cattle that were provided 70% of their daily feed allowance in the morning consumed 57% of their daily DMI between 0600 and 1800 h. We concluded that feeding strategies that will induce cattle to consume a majority of the daily feed allowance during the evening will enhance their growth performance and energetic efficiency during periods of high ambient temperatures.

**Key Words:** Shade, Cattle, Performance

**108 Montana ranch production practices: 1999 survey.** M.C. King\*, J.A. Paterson, R.N. Funston, L.P. Anderson, and MT Coop. Ext. Agents, *Montana State University, Bozeman.*

A ranch survey was conducted throughout Montana to determine management practices that influenced marketability of weaned calves. Ranches were selected to represent a cross section of ranch cow inventory, management practices and marketing strategies. The ten-page questionnaire was given by county agents during September through December of 1999. Sixty seven ranches representing 20,840 mature cows were included in this survey. The ranches were characterized as raising only registered cattle (3%), only commercial cattle (79%) or a combination of both (21%). Seventy nine percent of the respondents used a record keeping system, of which 43% used a computer. Calving season averaged 62 d (range 40-100 d). The method of castration revealed that 52% utilized a blade, 42% utilized an elastrator and 6% used some other method of castration. The number of times that calves were vaccinated for respiratory diseases before sale averaged one vaccination (range 0-3). The preference for type of vaccine showed that 55% of the producers used a killed vaccine, while 39% preferred modified live vaccines. Sixty one percent of the producers implanted steer calves and 24% implanted heifer calves. With regard to nutrition, 76% of ranchers balanced rations using either published or analyzed values, yet 91% of respondents purchased a supplement. When marketing cattle, the average days held after weaning prior to shipment was 34 d (range 0-330 d) with 80% of the calves sold within 45 d of weaning. Sixty six percent of the time respondents marketed their cattle to the same buyer (range 0-100%). Seventy five percent of the ranchers provided the buyers calf vaccination history and 64% provided implant history to buyers. Twenty eight percent of the ranches participated in a marketing alliance. Forty two percent of the respondents received feedlot data and 45% received carcass data back on their calves. This survey provides baseline data for understanding producer management practices that will provide guidance in developing educational and research programming.

**Key Words:** Survey, Ranch, Cattle

**109 Development of a multi-institutional, web-based, graduate animal breeding course.** A. D. Herring\*<sup>1</sup>, M. G. Thomas<sup>2</sup>, and R. M. Enns<sup>3</sup>, <sup>1</sup>Dept. Animal Science & Food Tech., Texas Tech University, <sup>2</sup>Dept. Animal & Range Science, New Mexico State University, <sup>3</sup>Dept. Animal Sciences, University of Arizona.

A graduate level, introductory course in animal breeding and genetics was developed and collaboratively taught as a web-based, distance education class for the Spring 1999 semester. A total of 15 students from the University of Arizona (n = 4), New Mexico State University (n = 5) and Texas Tech University (n = 6) enrolled in the course. The class was divided into 13 modules that were completed weekly in conjunction with discussion sessions involving students and instructors at respective locations. Course materials were delivered through internet-based software. A joint meeting was held during the middle of the semester. Students from different institutions were required to write collaborative research grant proposals. Survey of students at the course completion revealed that they enjoyed interactions with students and professors at other institutions and that the arrangement of course material into modules was both acceptable and useful. They also found weekly discussion sessions

useful. Most students felt that the largest challenge in the course was the collaborative research proposal. This course format should be useful for teaching other animal science graduate courses through distance education, and will be cheaper than many other distance education formats.

**Key Words:** Animal Breeding, Distance Education, Internet

**110 An animal behavior modifier (ABM<sup>TM</sup>), tail stimulation, affects performance and serum metabolite concentrations of beef steers.** N. K. Chirase\* and L. W. Greene, *Texas Agricultural Experiment Station, Amarillo, West Texas A&M University, Canyon.*

During this millennium, many issues of beef production must be confronted with solutions that demand new and innovative approaches. Tail stimulation to induce feed consumption has been demonstrated in satiated rats but not in ruminants. Two experiments were conducted to determine the effects of an animal behavior modifier (ABM<sup>TM</sup>), tail stimulation, on performance and serum metabolite concentrations of beef steers. Experiment 1 consisted of 6 treatments derived by varying the tail stimulation level (pounds per square inches, PSI) settings on the ABM<sup>TM</sup> device mounted on the tail of each steer and controlled by a radio transmitter. Each device delivered 16 stimulations per day at 90 min intervals. Treatments (Control or 0, 20-30, 30-40, 40-50, 50-60 and 60-70 PSI) were assigned randomly to a pen equipped with an individual feed monitoring device such that one half of the steers received no ABM<sup>TM</sup> treatment (control). After 14 d of treatment application, all stimulations above 30-40 were dropped. Cattle were weighed every 7 d for 28 d. Experiment 2 was exactly like Exp 1, except that steers were fed and watered in pens similar to those of commercial feedyards. All performance and serum metabolite concentration data were subjected to the analysis of variance using the GLM procedures of SAS. The results from Exp 1 indicated that the steers receiving 30-40 PSI stimulation had a higher ( $P < .05$ ) feed intake (9.0 vs. 7.5 kg/d), ADG (1.38 vs. .87 kg/d) and lower ( $P < .05$ ) feed to gain ratio (6.5 vs. 8.6) than the controls. The results of Exp 2 indicated that the steers treated with 30-40 PSI had a higher ( $P < .05$ ) ADG (1.47 vs 1.15 kg/d), lower ( $P < .05$ ) feed to gain ratio, and higher serum concentrations of Ca, glucose, total protein and hemoglobin than the control steers. These data suggest that the ABM<sup>TM</sup> stimulation could be a new and exogenous or noninvasive approach for improving performance of beef steers.

**Key Words:** Steers, Animal Behavior Modifier, Performance

**111 The effects of phytohemagglutinin and pokeweed mitogen on bovine oocyte maturation *in vitro*.** S. Wang<sup>1</sup>, K.E. Panter<sup>2</sup>, J.N. Stellflug<sup>3</sup>, R.C. Evans<sup>1</sup>, and T.D. Bunch\*, <sup>1</sup>ADVS Department, Utah State University, Logan, <sup>2</sup>USDA-ARS, Poisonous Research Laboratory, Logan, <sup>3</sup>USDA-ARS, U.S. Sheep Experiment Station, Dubois, ID.

Phytohemagglutinin (PHA) and pokeweed mitogen (PWM), the extracts from *Phaseolus vulgaris* and *Phytolacca americana*, respectively, are two mitogenic agents causing blastoid reaction to produce a short-lived burst of mitosis involving small lymphocytes. This study investigated the effects of PHA and PWM on bovine oocyte maturation as indicated by the subsequent preimplantation embryo development *in vitro* using a randomized complete block (5 replications) design with three treatments (TRT). Bovine oocytes ( $n = 736$ ) were aspirated from abattoir ovaries and *in vitro* matured (IVM) in the media containing PWM (Gibco, Cat. No. 15360-019) 10  $\mu$ l/ml (TRT1), PHA (Gibco, Cat. No. 10576-015) 10  $\mu$ l/ml (TRT2) or none of them (Control), respectively. The IVM culture lasted for 24 h in a humidified 5% CO<sub>2</sub> atmosphere at 39 °C. The IVM oocytes were fertilized *in vitro* (IVF) and the IVM/IVF derived zygotes were then *in vitro* cultured (IVC) in modified CR2 medium. Embryo development was evaluated at d 2, d 6, and d 8 (IVF = d 0). Percentage data were angularly transformed and analyzed by ANOVA. The cleavage rates were 83.5%, 90.0% and 88.9%. The percentage of morulae at d 6 was 26.6, 53.9 and 54.4; and the percentage of blastocysts at d 8 was 1.4, 12.7 and 12.9 for TRT1, 2 and 3, respectively. The cleavage rate and the numbers of embryos developed to morulae and blastocyst stages in PWM medium were significantly lower than those in PHA and Control ( $P < 0.05$ ), indicating that PWM adversely influence bovine oocyte maturation and the effects are extended to subsequent embryo development. However, there was no difference ( $P > 0.05$ ) between PHA and Control. In conclusion, bovine oocyte *in vitro*

maturation may be adversely affected by mitogenic agents, depending on their sources, as shown by the subsequent development of preimplantation embryos *in vitro*.

**Key Words:** *In vitro* Maturation, Phytohemagglutinin, Pokeweed Mitogen

**112 Effects of transforming growth factor- $\beta$ 1 (TGF- $\beta$ 1) on isolated growth plate chondrocytes.** J.E. Haut and A.M. Oberbauer\*, *University of California, Davis.*

Large frame size, a function of bone growth, is correlated with improved carcass quality. Chondrocytes within the growth plate undergo developmental changes to cause bone growth. TGF- $\beta$ 1 is abundant in the growth plate. This study was designed to determine if TGF- $\beta$ 1 enhances the proliferation and differentiation of growth plate chondrocytes. Cell number, distribution of TGF- $\beta$ 1 mRNA and the differentiation markers collagen type I (Col) and alkaline phosphatase (ALP) mRNAs, and number of apoptotic cells were evaluated in growth plate zones as a consequence of TGF- $\beta$ 1 treatment. Costochondral growth plates from 4 wk old rats ( $n=6$ ) were fractionated into relatively pure fractions representing the developmental phenotypes of the growth plate: mature hypertrophic, immature hypertrophic, proliferative, early proliferative, and resting cells. Experiments were replicated three times with mRNA assayed by slot blot and apoptosis determined by annexin V labeling. Cells were plated in 10% fetal bovine serum (FBS) until 50% confluent, serum deprived in 1% FBS for 18 h, then treated for 48 h with 0, 0.1, 1.0, 10.0, and 20.0 ng/ml TGF- $\beta$ 1 with four wells per treatment. 1 ng/ml TGF- $\beta$ 1 was sufficient to increase cell numbers relative to the 0 ng/ml control cultures across all chondrocyte fractions ( $21 \pm 4\%$ ,  $p < .05$ ). Though the level of inherent apoptosis in cultured growth plate chondrocytes increased as the cells transitioned from resting to immature hypertrophic cells ( $2 \pm 6\%$  to  $8.8 \pm 6\%$ , respectively,  $p < .01$ ), TGF- $\beta$ 1 increased the number of apoptotic cells by 50% relative to controls ( $p < .01$ ). The expression profiles for TGF- $\beta$ 1, Col, and ALP mRNA in freshly fractionated chondrocytes showed that hypertrophic cells had the highest steady-state levels of these mRNAs when expressed on a per cell basis ( $p < .01$ ). TGF- $\beta$ 1 treatment doubled the level of TGF- $\beta$ 1 mRNA in the resting cells relative to control cultures ( $p < .05$ ), but did not change Col mRNA levels ( $p > .2$ ). TGF- $\beta$ 1 also markedly depressed ALP mRNA in all fractions ( $p < .05$ ), with the resting zone being affected the most with a 70% reduction. These results suggest that TGF- $\beta$ 1 plays a role in regulating chondrocyte proliferation, differentiation, and death within the growth plate, processes that influence endochondral bone elongation.

**Key Words:** TGF- $\beta$ 1, Growth Plate, Apoptosis

**113 Effect of chromium picolinate on growth and carcass traits of growing-finishing pigs in commercial conditions.** J. L. Espinoza\*<sup>1</sup>, R. Ortega<sup>1</sup>, R. Barroso<sup>1</sup>, J. A. Guevara<sup>1</sup>, R. Gonzalez<sup>1</sup>, A. Palacios<sup>1</sup>, and O. Ruiz<sup>2</sup>, <sup>1</sup>Universidad Autonoma de Baja California Sur, La Paz, Mexico, <sup>2</sup>Universidad Autonoma de Chihuahua, Chihuahua, Mexico.

An experiment was conducted to evaluate chromium picolinate (CrP) on growth performance and carcass traits of growing-finishing pigs. At approximately 90 d postweaning ( $35 \pm 1.6$  kg) male and female pigs were assigned randomly and fed diets supplemented with 0 (CON;  $n = 120$ ) or 200 ppb chromium as CrP (CrP-fed;  $n = 122$ ) during a 60 -d period. The basal diet was modified according to the animal's requirements until finishing. Weight gain at finishing was similar ( $P > .05$ ) for CON ( $67 \pm 2.7$  kg) and CrP-fed pigs ( $62.6 \pm 2.5$  kg). Backfat thickness, measured by backfat probe at the tenth rib, 24 h after slaughter, decreased ( $P < .05$ ) in CrP-fed females ( $2.2 \pm .2$  and  $3.3 \pm .3$  cm in CrP-fed and CON, respectively) but not in males ( $P > .05$ ;  $2.2 \pm .3$  and  $2.8 \pm .3$  cm in CrP-fed and CON, respectively). A treatment x sex interaction was observed ( $P < .05$ ) in ribeye area. Longissimus muscle area was greater ( $P < .05$ ) in CrP-fed ( $29.6 \pm 4$  cm<sup>2</sup>) than CON females ( $11.2 \pm 5$  cm<sup>2</sup>). Longissimus muscle area was similar ( $P > .05$ ) in CON ( $29.2 \pm 2$  cm<sup>2</sup>) and CrP-fed males ( $23.8 \pm 2$  cm<sup>2</sup>). Carcass length, width and depth were similar between CrP-fed and CON groups ( $P > .05$ ). Carcass weight was reduced by CrP ( $P < .05$ ) in females ( $77.1 \pm .5$  and  $75.5 \pm .5$  kg in CON and CrP-fed, respectively). The results of this investigation indicate that 200 ppb of CrP supplementation had no

effect on pig growth performance, but decreased backfat thickness, increased longissimus muscle area and reduced carcass weight in females, with no differences observed between males.

**Key Words:** Pigs, Chromium Picolinate, Carcass

**114 Survival of *Listeria monocytogenes* B4 in soil.** C. L. Melendrez, R. G. Espinosa, T. May, and J. D. Thomas\*, *New Mexico State University, Las Cruces.*

*Listeria monocytogenes* is of major concern to the food industry, especially the ready-to-eat processed meat industry. This is because *Listeria monocytogenes* is pathogenic and has the ability to thrive at cold temperatures. This study was conducted to determine the ability of *Listeria monocytogenes* B4 to survive in soil stored at various temperatures. A sandy-loam soil mixture was placed in a drying oven at 100°C for 60 h. No bacteria could be recovered from the soil after drying. A pure culture of *Listeria monocytogenes* B4 was grown in Modified Listeria Enrichment Broth. Several broth samples were plated to determine sample purity. No foreign colonies were detected. The bacteria were separated from the broth by centrifugation and washing with sterile water. The bacteria were then resuspended in sterile water. Ten milliliters of bacterial suspension were added to 90 g of soil in moisture proof plastic bags. Controls consisted of 10 ml of sterile water added to 90 g of soil in place of the bacterial suspension. Bags were placed in 4°C, 25°C or 37°C incubators. Each temperature treatment and control was done in duplicate. The bags were left open to prevent an anaerobic atmosphere from forming. The bags were weighed daily and appropriate amounts of sterile water were added to maintain an approximate 10% to 12% moisture content. Samples from each bag were taken at 0, 3, 7, 14, 21 and 28 d. Samples were diluted, plated in triplicate on Listeria Enrichment Agar and incubated at 37°C for 48 h. Initial concentration for all treatments was approximately 10<sup>7</sup> bacteria/g of soil. After 28 d the bacteria in the soil stored at 4°C and 25°C had decreased only slightly to 10<sup>6</sup> bacteria/g. The bacteria in the soil stored at 37°C had decreased to 10<sup>3</sup> bacteria/g. This research clearly shows that *Listeria monocytogenes* B4 has the ability to remain viable in soil stored over a wide temperature range for at least 28 d.

**Key Words:** *Listeria monocytogenes*, Pathogenic

**115 Carcass characteristics and shear force values of Dorper, Suffolk, and Western White-Face sired wethers harvested at similar fat depth.** W.J. Means, B.W. Hess\*, K.A. Staab, S.R. Pohlman, M.M. Schwoppe, and J.E. Nel, *University of Wyoming, Laramie.*

Carcasses and shear force values of Dorper (DPR), Suffolk (SFK), and Western White-Face (WWF) sired wethers were compared. Lambs were stratified by BW and allotted to one of 15 pens, resulting in 4 lambs per pen. Initially, wethers consumed alfalfa hay ad libitum. A commercial concentrate was self-fed as hay was gradually reduced. Lambs were harvested at a commercial plant in two groups after reaching a constant backfat, as determined by palpation. All carcass measurements were collected according to USDA guidelines by the same trained technician. Double loins were fabricated, vacuum packaged, and transported to the UW Meat Lab. Loins were wet aged 14 d, frozen, cut into double loin chops, and repackaged. Two double chops from the anterior portion of the loin were thawed and roasted to a medium degree of doneness. Chilled chops were cored (1.27 cm diameter) and sheared using a Warner-Bratzler Shear (WBS) device. Data were analyzed using a one-way MANOVA and means were separated using a protected LSD. Fat depth measured at the 12th rib averaged 2.5 mm and did not differ ( $P = .62$ ) among sire groups. Although SFK sired wethers had heavier ( $P = .0002$ ) hot carcass weights than DPR or WWF sired wethers (27.8 vs. 24.9, 26.1 kg, respectively), *longissimus* muscle areas were similar ( $P = .77$ ) among the three sire groups and averaged 16.1 cm<sup>2</sup>. Leg scores for DPR (11.85, 11=avg. choice) were higher ( $P = .0001$ ) than SFK or WWF (11.25 and 10.90, respectively). Carcass maturity, body wall thickness, and USDA quality grades were similar ( $P > .05$ ); however, SFK had greater ( $P = .0017$ ) flank streaking scores than DPR or WWF. Warner-Bratzler Shear values for DPR were 3.44 kg, which was greater than ( $P = .02$ ) WBS values for SFK (2.94 kg) and WWF (2.94 kg). Dorper sired wethers did not produce more tender meat when harvested at similar 12th rib fat depth.

**Key Words:** Dorper, Shear Force, Carcass Characteristics

**116 Effects of timing and frequency of grazing on quality and yield of stockpiled forages in western Oregon.** N. A. Sverly\*, T. DelCurto, S. Paxton, M. R. Keller, and D. W. Weber, *Oregon State University, Corvallis.*

Six paddocks (15 ha each), consisting of cool season grasses, were used to evaluate the use of a spring, rotational grazing system for the purpose of stockpiling and conditioning forage for late summer use by beef cattle. A variable number of mature, lactating cows and their nursing calves were used to graze each paddock for three rotations. A "put and take" stocking rate was used to graze each paddock to the same end point of 1136 kg/ha in four day grazing bouts. Treatments consisted of: 1) non-grazed, control; 2) grazed twice (2X); and 3) grazed three times (3X). Utilization cages and .25m<sup>2</sup> forage samples were used to determine forage yield and quality in late summer as well as in the spring prior to each grazing rotation. Crude protein of paddock forage grazed 3X was 17.8% greater ( $P < .10$ ) than non-grazed forage yet, did not differ ( $P > .10$ ) when compared to paddock forage grazed 2X. No differences ( $P > .10$ ) were found among non-grazed paddock forage and paddock forage grazed 2X. The NDF for paddock forage grazed 2X and 3X tended to be lower ( $P = .13$  and  $.16$ , respectively) than non-grazed paddock forage. Yield of non-grazed paddock forage was 3651.30 and 4463.4 kg/ha greater ( $P < .10$ ) than paddock forage grazed 2X and 3X, respectively. No difference ( $P > .10$ ) was observed in yield among paddock forage grazed 2X and 3X. We concluded that although abstinence from grazing spring forage displays the best response in terms of stockpiled yield, producers are likely to be dependent upon grazing the spring forage growth. Grazing does not consistently influence the quality of stockpiled forage to a great magnitude yet, the influence can be important when utilizing low-quality forages. Parameters, such as temperature and accumulated precipitation, can be used to gauge the termination of spring grazing.

**Key Words:** Stockpiled Forage, Forage Quality, Rotational Grazing

**117 Influence of grass-legume pastures on forage availability and growth performance of Holstein heifers.** R. Lopez\*, C. R. Krehbiel<sup>2</sup>, K. Duncan<sup>1</sup>, E. Hanson<sup>1</sup>, M. G. Thomas<sup>1</sup>, M. Looper<sup>1</sup>, E. Castellanos<sup>1</sup>, G. Donart<sup>1</sup>, R. Flynn<sup>1</sup>, and C. Barnes<sup>1</sup>, <sup>1</sup>New Mexico State University, Las Cruces, <sup>2</sup>Oklahoma State University, Stillwater.

Forage availability and quality are improved when alfalfa is grazed in combination with temperate or tropical grass. Perennial grass grazed in combination with alfalfa might be used to produce dairy heifer replacements by 24 months of age. Ninety-four Holstein heifers (initial BW = 177 ± 25 kg) were stratified by BW and randomly assigned to one of four replicated pastures: 1) Jose tall wheatgrass (JTW; grazed Mar. 11 through Oct.14, 1999); 2) 50% JTW + 50% alfalfa; (JTWA; grazed Mar.11 through Oct.14, 1999); 3) Kleingrass (K; grazed Apr. 8 through Oct. 14, 1999), and 4) 50% K + 50% alfalfa (KA; grazed Apr. 8 through Oct.14, 1999). Each of the four pastures had 1.28 ha and contained four .32 ha paddocks. Heifers were rotated through paddocks at 7-d intervals. Body weights were taken every 28 d. A core group of six heifers/pasture were randomly selected to estimate gain. Stocking rate across the grazing season averaged 3.7, 3.8, 4.1, and 5.0 head/ha for JTW, JTWA, K, and KA, respectively. Across the grazing season, available DM was greater ( $P < .01$ ) for JTW than for K, KA, and JTWA (2105 ± 89 > 1160 ± 89, 660 ± 89, 635 ± 89 kg/ha). Similarly, DM availability expressed as kg of DM/ha/kg of BW was greater ( $P < .01$ ) in JTW pastures relative to K, JTWA or KA ( $9 \pm .4 > 5 \pm .5$ ,  $2.9 \pm .4$ ,  $2.5 \pm .5$  kg per the core group of 6 animals). Body weight gain was greater ( $P = .05$ ) in heifers consuming JTWA compared with JTW, KA, or K ( $231 \pm 1 > 228 \pm 1$ ,  $225 \pm 1$ ,  $222 \pm 1$  kg), and a treatment x time interaction ( $P < .01$ ) occurred for ADG. Heifers grazing K and KA had greater ADG during May and June whereas ADG was greater for heifers grazing JTW in August. Gain per ha was greater ( $P < .05$ ) for heifers grazing KA (112 ± 7 kg/ha), K (109 ± 7 kg/ha), and JTWA (97 ± 7 kg/ha) than for heifers grazing JTW (86 ± 7 kg/ha). Our data suggest that alfalfa grazed in combination with JTW improved gain/ha compared with grazing JTW alone, whereas no advantage of grazing alfalfa with K was observed. Moderate growth rates (.70 kg/d) can be obtained for Holstein heifers grazing JTWA, K, or KA.

**Key Words:** Dry Matter Availability, Growth Performance, Holstein Heifers

**118 Evaluation of supplemental high oil corn for heifers grazing summer pasture.** L. Brokaw\*, B. W. Hess, A. D. Schleicher, E. J. Scholljegerdes, L. M. Yun, J. D. Heeg, and J. Bratka, *University of Wyoming, Laramie.*

Nine Angus × Gelbvieh rotationally crossed heifers (539 ± 62 kg initial BW) with ruminal and duodenal cannulae were used in a split-plot designed experiment to determine the effects of supplemental normal corn or high oil corn on intake and OM and NDF digestibility. Beginning June 28, 1999, heifers continually grazed a 6.5 ha pasture predominated by bromegrass (*Bromus* spp.) and received one of three supplemental treatments: no supplementation (CON); daily supplementation of normal corn at .5% BW (CRN); and daily supplementation of high oil corn at .5% BW (HOC). Three 26 d periods consisted of 17 d of adaptation followed by 9 d of sample collections. Treatment and sampling period effects were evaluated using orthogonal single-degree of freedom and polynomial contrasts, respectively. Supplementation did not affect ( $P \geq .33$ ) ADF, NDF, ether extract, or N of masticate collected via ruminal evacuation. Forage in vitro OM digestibility (IVOMD) was lower ( $P = .04$ ) for HOC than CRN heifers. Masticate ADF increased quadratically ( $P = .001$ ), and IVOMD and N decreased linearly ( $P = .02$  and  $P = .0005$ , respectively) with advancing season. Forage OM intake was not influenced ( $P = .56$ ) by supplementation; however, total OM intake was greater ( $P = .004$ ) for supplemented heifers. Forage and total OM intakes decreased linearly ( $P \leq .002$ ) as the grazing season progressed. Apparent total tract OM and NDF digestibility ( $P \leq .001$ ) increased with supplementation, and was lower ( $P \leq .05$ ) for HOC compared to CRN heifers. Apparent total tract OM and NDF digestibilities declined linearly ( $P = .009$  and  $P = .003$ , respectively) with advancing forage maturity. Supplementing corn in this experiment had no detrimental effects on forage intake and enhanced total tract OM and NDF digestion in heifers grazing a summer pasture of predominately bromegrass forage. Compared to normal corn supplementation, high oil corn supplementation lowered digestive abilities of heifers grazing bromegrass forage.

**Key Words:** Supplementation, Digestion, High Oil Corn

**119 Influence of supplemental protein degradability on energy utilization and methane emission by beef cows on dormant, cool-season forages.** M.D. Palmer\* and K.C. Olson, *Utah State University, Logan.*

Multiparous crossbred beef cows (n=25, BW=611kg) were assigned to 5 treatment groups of 5 cows each using a completely randomized design to evaluate supplemental DIP:UIP effects on energy utilization and methane emissions. The cows were group fed tall fescue straw (NDF 73%, CP 5.9%) ad libitum and individually supplemented daily with blends of 2 soybean meal sources varying in ruminal degradability. The treatment supplements contained 28%, 34%, 40%, 45%, and 51% UIP. Two sampling periods were conducted: late gestation and early lactation. Gross energy (GE), digestible energy (DE), and metabolizable energy (ME) expressed as Mcal/d displayed physiological stage by treatment interactions ( $P < 0.02$ ). Gross Energy, DE and ME decreased with increasing UIP % during both gestation and lactation with the exception of 28% UIP in gestation and 51% UIP in lactation (cubic,  $P \leq 0.10$ ). Methane production in g/kg of total DM intake, g/kg forage DM intake, g/Mcal GE intake and g/d did not respond to treatments with LSM ± SE 27.13 ± 0.95, 33.0 ± 3.0, 6.76 ± 0.56, and 232 ± 14 respectively. Polynomial contrasts of methane production in g/kg of total DM intake, g/kg forage DM intake and g/Mcal GE intake varied cubically across supplement treatments in response to UIP% ( $P < 0.10$ ). Digestible energy, fecal energy loss, ME, urine energy loss, and methane energy loss expressed as a percentage of GE intake did not respond to treatments. Digestible energy, fecal energy, ME, urine energy, and methane energy loss LSM ± SE were 45.69 ± 0.88, 54.31 ± 0.88, 29.9 ± 1.0, 6.83 ± 0.42 and 8.92 ± 0.74, respectively. Methane energy loss varied cubically ( $P = 0.08$ ) to UIP % with 51 % UIP appearing to have the lowest methane energy loss. Increasing UIP % in the supplement decreased energy intake and had no observable effect on cow energy efficiency.

**Key Words:** Beef Cattle, Protein Degradability, Low Quality Forage

**120 Influence of type of supplemental carbohydrate on ruminal responses and methane output from ruminants consuming low-quality forage.** R.J. Lira, A.A. Davis\*, and K.C. Olson, *Utah State University, Logan.*

To evaluate the influence of type of carbohydrate in an energy supplement on nutrient utilization by gestating and lactating beef cows and ewes, 3 energy supplements (control, barley grain, and sugar beet pulp) and 2 species (cows and ewe, n = 3 for each supplement × species group) were evaluated during 2 experimental periods (gestation and lactation) in a completely randomized design with a factorial arrangement. The basal diet was tall wheatgrass (*Agropyron elongatum*) straw (5.5% CP). Forage and total dry matter intake (FDMI and TDMI, respectively) interacted ( $P = 0.04$ ) with species, supplements, and physiological stages. An interaction of physiological stage and sampling time occurred for rumen fluid pH. Supplement and sampling time interacted for butyric acid proportion and total VFA concentration. Diet digestibility displayed an interaction between species and physiological stage. Digestibility was lower during lactation than gestation for cows, but similar for ewes. Ruminal retention time interacted for species, supplement, and physiological stage. Fill of the gastrointestinal tract responded to physiological stage, with values of 0.80 and 1.36% BW for gestation and lactation, respectively. Methane output displayed an interaction between species and physiological stage when data were analyzed as g CH<sub>4</sub>/d/kg BW. The highest and more variable values in methane losses were from ewes. From gestation to lactation, both species increased methane production. Energy lost in feces responded to physiological stage ( $P = 0.0008$ ). Across species and supplements, 48 and 60% of the gross energy intake were lost as feces during gestation and lactation, respectively. The use of energetic supplements in ewes depressed FDMI in late gestation, but stimulated it during lactation. For cows, the use of energetic supplements did not affect FDMI during late gestation or lactation. The source of energy did not affect any variables, and thus the choice of supplement will depend on relative cost. Intake was more strongly affected in ewes than cows when low-quality forage was used. However, dry matter intake was strongly depressed for both species in late gestation.

**Key Words:** Ruminants, Energy Supplements, Low Quality Forage

**121 Influence of magnesium supplementation on performance of cattle grazing ryegrass pasture.** H. Castro<sup>1</sup>, M. S. Vasquez\*<sup>1</sup>, F. Sanchez<sup>1</sup>, R. Rosales<sup>1</sup>, C. Casas<sup>1</sup>, E. G. Alvarez<sup>2</sup>, and R. A. Zinn<sup>2</sup>, <sup>1</sup>Universidad Juarez, Durango, Mexico, <sup>2</sup>University of California, Davis.

Thirty-six crossbred bulls (193 kg) were used in a 56-d grazing trial to evaluate the influence of supplemental Mg (.22 versus .38% of supplement, DM basis) on ADG. Bulls were balanced by weight and divided into two groups of 18 bulls each. A ryegrass pasture (3.7 ha) was divided into 8 uniform sections. Treatment groups were allotted to sections within a 7-d rotational grazing scheme. Bulls were group-fed 2.25 kg/hd/d (DM basis) of a supplement containing: 80% cracked corn, 11.5% SBM, 7.2% cane molasses, .85% TM salt, and 0 or .8% magnesium oxide. Forage intake was estimated based on a pasture exclusion technique. Pasture samples contained .22% Mg (DM basis). Dry matter intake averaged 104 g / kg BW<sup>.75</sup>. Addition of Mg increased (13%;  $P = .12$ ) ADG and final BW (3.3%;  $P < .10$ ). We concluded that Mg supplementation of cattle on ryegrass pastures will enhance growth performance.

**Key Words:** Magnesium, Ryegrass, Cattle

**122 A potential simple and inexpensive method for estimating crude protein and forage intake of grazing cattle.** S. L. Kronberg\* and A.V. Grove, *South Dakota State University, Brookings.*

We evaluated a potential simple and relatively inexpensive technique for estimating daily CP intake (CPI; kg/d, DMB) and daily DMI (kg/d) for yearling crossbred beef heifers. We hypothesized that if we could estimate daily CPI accurately, we could either combine this estimate with one for dietary CP content (%CP) from NIRS analysis of feces to estimate DMI or perhaps we could estimate DMI directly with an equation based on levels of specific jugular blood variables. Five hays were fed to 10 heifers (483 + 10 kg) sequentially from highest to lowest CP level. CP contents of the hays were 17.2, 16.3, 10.2, 8.2 and 7.4 % and each hay was fed for 5 d at ca. 2.2 % of BW. Blood and

feces was collected from each heifer in the afternoon of d 5. Actual CPI and DMI were determined from analysis of feed and orts for the 24 h prior to blood collection. Equal amounts of serum were pooled from 5 heifers per hay creating 2 samples per hay type. The pooled samples were assayed for levels of amino acids and insulin-like growth factor binding proteins (IGFBP). Serum urea N (SUN), insulin-like growth factor I (IGF-I) and non-esterified fatty acid (NEFA) levels were determined for each heifer and hay type then averaged within the same groups of heifers described above. Serum urea N level was the best predictor of CPI ( $CPI = .432904 + .050885 * SUN$ ;  $R^2 = .94$ ;  $P = .0001$ ). NEFA, valine and IGFBP-2 were the best predictors of DMI ( $DMI = 7.121516 + 8.409785 * NEFA + .986833 * Valine + .000001663 * IGFBP-2$ ;  $R^2 = .96$ ,  $P = .0001$ ). This equation should be viewed with caution given that the range of hay intake was only 9.3 to 10.1 kg/d. Estimates of dietary CP content (%CP) using NIRS analysis of feces ( $NIRS\%CP$ ) were not sufficiently accurate ( $\%CP = -1.0073 + 1.4088 * NIRS\%CP$ ;  $R^2 = .81$ ,  $P = .0004$ ) to allow for accurate predictions of DMI. We expect that our ability to predict %CP will improve considerably as we develop a NIRS-based prediction equation specific to our hay and pasture forages. We expect that this approach to predicting CPI and DMI will require development of prediction equations that are specific to the area and animals of interest, but may be simpler and less expensive than alternative methods available.

**Key Words:** Cattle, Forage, Intake

**123 Interaction of forage level and fibrolytic enzymes on digestive function in cattle.** M. Murillo\*<sup>1</sup>, H. L. Castro<sup>1</sup>, J. F. Sanchez<sup>1</sup>, M. S. Vasquez<sup>1</sup>, J. Cruz<sup>1</sup>, E. G. Alvarez<sup>2</sup>, and R. A. Zinn<sup>2</sup>, <sup>1</sup>Universidad Juarez, Durango, Mexico, <sup>2</sup>University of California, Davis.

Four Simmental bulls (550 kg) with cannulas in the rumen and duodenum were used in a 4 x 4 Latin square design to evaluate the interaction of forage level (66 vs 33 %) and fibrolytic enzymes (0 vs 15 g/d Fibrozyme) on characteristics of digestion. Chromic oxide (0.19 %; DM basis) was added as a digesta marker. Fibrozyme (7.5 g/feeding) was incorporated into the diet at the time of feeding. Feed intake was restricted to 2.2 % of BW. Increasing forage level increased (6%,  $P < .01$ ) ruminal pH. There were forage level by enzyme interactions on ruminal digestion of the OM ( $P < .05$ ), NDF ( $P < .05$ ), ADF ( $P < .01$ ), and starch ( $P < .10$ ). With diets containing 33% forage enzyme supplementation increased the ruminal NDF and ADF digestion (10 and 43%, respectively). Whereas, with the diet containing 66% forage, enzyme supplementation did not affect fiber digestion. Increasing forage level decreased ruminal microbial efficiency (11%,  $P < .01$ ), and postruminal digestion of OM (13%;  $P < .01$ ), NDF (36%;  $P < .01$ ), ADF (39%;  $P < .05$ ), and starch (3%;  $P < .05$ ). There were interactions ( $P < .01$ ) between supplemental enzymes and forage level on total tract ADF digestion. As with ruminal digestion, enzyme supplementation also increased (8%) total tract ADF digestion in bulls fed the 33% forage diet, but it did not affect ADF digestion in bulls fed the 66% forage diet. Increasing forage level decreased (3%,  $P < .01$ ) total tract OM digestion and increased (8%,  $P < .01$ ) total tract NDF digestion. We conclude that the responses to supplemental fibrolytic enzymes are augmented under conditions of lower ruminal pH.

**Key Words:** Xylanase, Cattle, Digestion

**124 Suckling beef calf performance response to creep feeding with a soft, concentrated separator byproduct creep block.** C.A. Stonecipher\*, B.R. Bowman, C.E. Foley, and K.C. Olson, Utah State University, Logan.

The effect of a creep block on suckling beef calf performance was studied over 2 years. The study was conducted at 2 locations in Utah. Crossbred cow-calf pairs were used at Logan ( $n = 133$  in 1997;  $n = 130$  in 1998). The crosses consisted of Hereford, Tarentaise, Angus and Gelbvieh. Cattle were blocked into two groups based on phenotype at Logan. Purebred Tarentaise cows with crossbred calves were used in Panguitch ( $n = 37$  in 1997;  $n = 39$  in 1998). Within each block (2 phenotype blocks in Logan, 1 block in Panguitch), cattle were stratified into two similar groups based on age, weight, body condition score (BCS), and calf age and weight. One of 2 treatments (control, receiving no supplement; and creep-fed, receiving ad-libitum access to supplement) was randomly assigned to each group within a block. Blocks were weighed weekly to

estimate creep consumption. Cows were weighed and BCS at initiation and end of the study. Calves were weighed on a monthly interval. Forage was clipped monthly to determine availability and crude protein content. Data were analyzed as a randomized complete block design. Cow weight and BCS did not respond ( $P > 0.28$ ) to calf supplementation in either year. Weight of calves did not respond to creep feeding ( $P > 0.19$ ) in either year. Calf ADG did not respond to creep feeding ( $P > 0.26$ ) in 1997, but tended to be higher for creep-fed calves in 1998 ( $P = 0.09$ ; 1.10 vs. 1.15 kg/d). Forage availability did not vary among creep treatments in either year ( $P > 0.50$ ). Availability did not change during the season in 1997 ( $P = 0.26$ ), but decreased as the season progressed in 1998 ( $P < 0.01$ ). Crude protein content of pasture forage did not vary among creep treatments in either year ( $P > 0.35$ ), but decreased as the season progressed ( $P = 0.02$ ) in both years. Mean disappearance of creep feed from blocks was low in both years (0.12 and 0.13 kg per calf per day in 1997 and 1998, respectively). Because intake of the creep feed was extremely low, calf performance was essentially unaffected in both years.

**Key Words:** Beef Cattle, Creep Feeding, Energy Supplementation

**125 Comparative feeding value of high-pressure flaked sudangrass in growing diets for cattle.** M. Ambrozio\*, E. G. Alvarez, and R. A. Zinn, University of California, Davis.

Eight Holstein steers (436 kg) with cannulas in the rumen and proximal duodenum, were used in a crossover design to evaluate the influence of high-pressure flaking of sudangrass hay on characteristics of digestion. Sudangrass hay (89% DM) was ground in a hammer mill to pass through a 2.54 cm screen. The high-pressure flaked sudangrass hay treatment was produced by passing ground hay through a 107 cm Flakemaster roller mill set to zero tolerance at a pressure of 3447 kPa (500 PSI). Diets contained (DM basis) 43.9% steam flaked corn, 2% fishmeal, 1.1% limestone, 1% urea, .5% salt, 3% yellow grease, 8% cane molasses, .15% magnesium oxide, .40% chromic oxide (digesta marker), and 40% of either ground or high-pressure flaked sudangrass hay. Daily DM intake was restricted to 7.7 kg. There were no treatment effects ( $P > .20$ ) on ruminal or total tract digestion of OM, NDF, and feed N. High pressure flaking decreased ruminal N efficiency ( $P < .05$ ). We conclude that, high-pressure flaking of sudangrass hay will not enhance its feeding value in growing diets for feedlot cattle.

**Key Words:** Sudangrass, Digestion, Cattle

**126 In vitro digestibility of soybean hulls varying in their soluble and insoluble fiber by using fecal inoculum from horses.** H. S. Hussein, H. Han, and J. P. Tanner\*, University of Nevada, Reno.

It is estimated that 2.4 million tons of soybean hulls are produced annually in the US. Therefore, their use as a dietary fiber source in animal diets is of high potential. Because data on utilization of this by-product by the horse is limited, the objective of this study was to determine the in vitro digestibility of soybean hulls from different sources. Soybean hull samples were obtained from 8 sources across the US and were analyzed for nutrient content. Compositional data revealed variation in both the amount of total dietary fiber (ranging from 71.7 to 81.9%) in the soybean hulls and the ratio of insoluble:soluble fiber. The CP content also varied widely among sources, ranging from 10.9 to 15.2%. Three horses (replications) were maintained on a diet containing oat-alfalfa cubes (i.e., 70% alfalfa hay and 30% oat hay) and were used as donors of fecal inocula for the in vitro fermentation. In a completely randomized design experiment, the treatments were arranged as an 8 x 3 factorial. The main factors were 8 sources of soybean hulls (the insoluble:soluble fiber ratios were 14.6, 12.3, 8.4, 7.9, 7.9, 7.5, 7.1, and 7.0:1) and 3 incubation times (i.e., 6, 12, and 24 h). No interactions ( $P > .05$ ) between soybean hull source and incubation time were detected for DM or OM digestibilities. However, the effects of the main factors were significant ( $P < .05$ ) for DM and OM digestibilities. In vitro digestibilities (across soybean hull sources) of DM (19.2, 20.5, and 28.7%, respectively) and OM (22.6, 24.0, and 31.3%, respectively) increased with extending incubation time (i.e., 6, 12, and 24 h). In vitro OM digestibilities (across incubation times) were 29.4, 25.6, 21.1, 24.3, 27.1, 29.0, 22.9, 28.5%, respectively. In vitro DM digestibilities (across incubation times) were 26.6, 22.3, 18.1, 21.1, 24.3, 25.5, 19.8, and 24.9, respectively. Because the highest ( $P < .05$ ) digestibility values were detected for soybean hulls with insoluble:soluble fiber ratios ranging from

7.0 to 14.6, our results suggest that fermentation of soybean hulls by horses is not influenced by the insoluble or soluble fractions of dietary fiber.

**Key Words:** In vitro Fermentation, Soybean Hulls, Horse

**127 The effects of bovine follicular fluids supplemented to maturation medium on subsequent embryo development *in vitro*.** S. Wang<sup>\*1</sup>, Y. Liu<sup>1</sup>, K.E. Panter<sup>2</sup>, J.N. Stellflug<sup>3</sup>, R.C. Evans<sup>1</sup>, and T.D. Bunch<sup>1</sup>, <sup>1</sup>Utah State University, Logan, <sup>2</sup>USDA-ARS Poisonous Research Laboratory, Logan, <sup>3</sup>USDA-ARS Sheep Experiment Station, Dubois, ID.

This study investigated the effects of bovine follicular fluids (bFF) collected from various sizes of follicles on bovine embryo development *in vitro* using a randomized complete block (8 replications) design with five *in vitro* maturation (IVM) treatments (TRT). Follicular fluids were aspirated from follicles of abattoir ovaries. Oocytes (n = 3904) were aspirated from 5 to 7 mm follicles, washed in hepes-TALP five times and moved into IVM medium supplemented with 20% (v/v) bFF from follicles < 2 mm (TRT1), 3-7mm (TRT2), 8-15 mm (TRT3), and >15 mm (TRT4) in diameter. The IVM medium without bFF served as control (TRT5). The IVM culture lasted for 24 h in a humidified 5% CO<sub>2</sub> atmosphere at 39 °C. The IVM cultured oocytes were then subjected to *in vitro* fertilization (IVF) and *in vitro* culture (IVC). Cleavage rates were determined at 45 h after IVF. Embryo development was evaluated at d 6 and d 8 (IVF = d 0). Percentage data were angularly transformed and analyzed by the ANOVA. The cleavage rates were 82.1%, 81.9%, 83.5%, 81.4% and 82.8%; the percentage of morulae at d 6 was 41.2, 41.6, 41.1, 48.9 and 49.5; and the percentage of blastocysts at d 8 was 25.4, 25.0, 26.7, 29.3 and 29.6, for TRT1, TRT2, TRT3, TRT4 and control, respectively. There was no significant (P>0.05) difference with respect to oocyte cleavage. However, there were significantly (P<0.05) fewer embryos that developed to morula and blastocyst stages after matured in the medium supplemented with bFF from small follicles (<2mm and 3-8 mm) than those supplemented with bFF from large follicles (>15 mm), indicating that bFF from small size follicles (<15 mm) adversely influence *in vitro* development of bovine oocytes to the morulae and blastocyst stages. There was no significant difference in embryo development between TRT4 and control. These results suggest that bovine embryo development was affected when bFF from certain size follicles is added to IVM medium.

**Key Words:** Bovine, Follicular Fluid, *In vitro* Maturation

**128 Effects of fat intake on hormone secretion and lipid metabolites in cycling Pelibuey ewes.** J. L. Espinoza<sup>\*1</sup>, S. Soto-Simental<sup>2</sup>, J. A. Ramirez<sup>3</sup>, A. Palacios<sup>1</sup>, and R. Ortega<sup>1</sup>, <sup>1</sup>Universidad Autonoma de Baja California Sur, La Paz, Mexico, <sup>2</sup>Universidad Autonoma del Estado de Hidalgo, Pachuca, Mexico, <sup>3</sup>Universidad Autonoma de Chihuahua, Chihuahua, Mexico.

Multiparous cycling, non-lactating Pelibuey ewes were used to determine the influence of calcium soaps of fatty acids (CSFA) or bovine tallow in diets on serum concentrations of hormones and lipid metabolites. Eighteen ewes (n = 6 ewes per group) received 1 kg/ewe<sup>-1</sup>/d<sup>-1</sup> of isoenergetic and isonitrogenous diets containing 1.5% of CSFA (M), 1.2% of bovine tallow (T), or no CSFA and no tallow (C). Serum insulin was greater (P < .01) in ewes fed fat (M = 1.9 ± .11, T = 2.5 ± .11 ng/mL) than non fat-fed ewes (C = 1.7 ± .11 ng/mL) and was higher in T than M (P < .001). Serum growth hormone was lower (P < .06) in ewes fed fat (M = 2.6 ± .15, T = 2.2 ± .15 ng/mL) than C-fed ewes (2.8 ± .15 ng/mL) and was lower in T than M (P = .05). On day 9 of the estrous cycle, serum progesterone, total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, and triglycerides were similar (P > .05) among treatments. In this trial, bovine tallow fed to Pelibuey ewes at 1.2% of the diet increased insulin and reduced growth hormone mean serum concentrations compared with control or CSFA, but no effects were observed on progesterone and lipid metabolites.

**Key Words:** Pelibuey Ewes, Fat Intake, Hormones

**129 Effect of fishmeal supplementation on bovine endometrial concentrations of omega-3 fatty acids.** P.D. Burns, D.B. Abbey<sup>\*</sup>, T.R. Bonnette, M.A. Harris, and J.C. Whittier, Colorado State University, Fort Collins.

Fishmeal contains a high percentage of omega-3 fatty acids. These fatty acids have been shown to decrease prostaglandin synthesis in a number of tissues. In ruminants, these fatty acids are unique in that they escape rumen biohydrogenation and become incorporated into muscle and adipose tissue. Therefore, omega-3 fatty acids may get incorporated into uterine endometrium and suppress prostaglandin synthesis, resulting in increased fertility. The objective of this experiment was to determine if fishmeal supplementation alters fatty acid profiles in bovine endometrium. Seven non-lactating Angus cows were randomly allotted to receive one of two protein supplements. Cows were fed a corn silage base diet and supplemented with either fishmeal (n = 3) or corn gluten meal (n = 4). Diets were formulated to be isonitrogenous and isocaloric. Fishmeal was supplemented at 5% and corn gluten meal at 8.7% DM intake. After 25-days of supplementation, cows were given 25 mg of PGF<sub>2</sub>α at 14 day intervals to synchronize estrous cycles. On day 18 post-estrus of the second estrous cycle, uteri were collected at slaughter and caruncular endometrium was dissected. Endometrium was freeze-dried and fatty acids were methylated using a direct methylation procedure. Following methylation, individual fatty acids were separated using GLC. Total weight percentage of saturated (C14:0, C16:0, C18:0, C20:0, and C24:0) and unsaturated (C14:1, C16:1, C18:1, C18:2, C18:3, C20:1, C20:2, C20:3, C20:4, C22:1, and C22:6) fatty acids did not differ between treatment groups (P > .10). Likewise, the total weight percentage of omega 5 (C14:1), 6 (C18:2, C20:1, C20:2, C20:4), 7 (C16:1), and 9 (C18:1, C22:1) fatty acids did not differ between treatment groups (P > .10). However, weight percentage of omega-3 (C18:3, C20:3, C20:5, and C22:6) fatty acids were higher (P < .01) in endometrium collected from fishmeal supplemented cows. The predominate omega-3 fatty acid was C20:5. In conclusion, endometrium collected from fishmeal supplemented cows contained more omega-3 fatty acids. Omega-3 fatty acids may compete with arachidonic acid for binding sites on the cyclooxygenase enzyme and decrease uterine prostaglandin synthesis, resulting in increased fertility.

**Key Words:** Fishmeal, Cows, Omega-3 Fatty Acids

**130 Cellular mechanisms by which oxytocin mediates uterine prostaglandin (PG) F<sub>2</sub>α synthesis: Does G<sub>i</sub> proteins and extracellular signal-regulated protein kinase (ERK) play a role.** J.O.B. Mendes, Jr.<sup>\*</sup>, P.D. Burns, T.R. Bonnette, R.S. Yemm, S.E. Nelson, and C.M. Clay, Colorado State University, Fort Collins.

In non-pregnant ewes, oxytocin appears to stimulate uterine PGF<sub>2</sub>α synthesis. The cellular mechanisms by which oxytocin stimulates uterine PGF<sub>2</sub>α synthesis is unknown. The objective of experiment 1 was to determine if G<sub>i</sub> proteins play a role in mediating oxytocin-induced PGF<sub>2</sub>α release in ovine endometrium *in vitro*. Uteri were collected from ovary-intact ewes (n = 4) 14-days post-estrus. Caruncular endometrial explants (40-50 mg) were dissected and subjected to *in vitro* incubation. Explants were incubated for 90 min in the media alone. Explants then were pre-treated for 65 min in media containing 0, .01, .1 or 1 μg/ml pertussis toxin, an inhibitor of G<sub>i</sub> proteins (n = 8 explants/dose of pertussis toxin). Four explants from each pre-treatment were then incubated for an additional 30 min in media alone or oxytocin (10<sup>-7</sup> M). Incubations were terminated and media assayed for PGF<sub>2</sub>α by RIA. Oxytocin stimulated release of PGF<sub>2</sub>α in the absence of pertussis toxin (P < .05). Pertussis toxin had no effect on the ability of oxytocin to stimulate PGF<sub>2</sub>α release (P > .10). The objective of experiment 2 was to determine if ERK, one class mitogen-activated protein kinase, plays a role in mediating oxytocin-induced PGF<sub>2</sub>α release in ovine endometrium. Tissue was collected and incubated as described above. Explants were pre-treated in media containing 0, .2, 2, or 20 μM PD98059, an ERK inhibitor. Oxytocin stimulated PGF<sub>2</sub>α release in the absence of PD98059 (P < .05). PD98059 blocked oxytocin-induced PGF<sub>2</sub>α release in a dose dependent manner (P < .01). In conclusion, data from the present study indicate that ERK mediates oxytocin-induced PGF<sub>2</sub>α release in ovine endometrium. The oxytocin receptor does not appear to be coupled to G<sub>i</sub> proteins in this tissue.

**Key Words:** Ewes, Prostaglandin, Oxytocin

**131 Estrogen concentrations in milk and plasma in relation to estrus and ovulation in dairy cows.** H. Lopez\*<sup>1</sup>, T.D. Bunch<sup>1</sup>, K.E. Panter<sup>1</sup>, and M.P. Shipka<sup>2</sup>, <sup>1</sup>Utah State University, Logan, <sup>2</sup>University of Alaska, Fairbanks.

The objective of this study was to determine the efficacy of using milk estradiol-17β(E2) as an indicator of estrus in dairy cows. Primiparous Holstein cows (n = 23) received radiotelemetric transmitters on d 16 of the estrous cycle (day 0 = estrus) for continuous monitoring of behavioral estrus. Cows also underwent twice daily visual estrous detection. Milk and blood samples were collected every 12 h at each milking, from d 18 until the fourth milking after estrus, for radioimmunoassay of E2. Ultrasound examination of ovaries was conducted daily in a subset of cows from d 18 until ovulation was confirmed. Statistical analysis consisted of the application of correlation, F test for equal variance and t test procedures. Plasma and milk E2 concentrations were not highly correlated (r = 0.47; P > 0.10). Intervals from peak plasma and peak milk E2 until onset of estrous standing behavior (t = 3.18; P < 0.05) and until ovulation (t = 2.38; P < 0.05) were different. Peak milk E2 concentrations were related to estrous standing behavior such that peak milk E2 was observed one milking before first estrous behavior in 38.8%, two milkings before first estrous behavior in 22.2%, three milkings before first estrous behavior in 22.2%, four milkings before first estrous behavior in 5.6%, five milkings before first estrous behavior in 5.6%, and two milkings after first estrous behavior in 5.6% of cows. Mean duration from peak milk E2 until onset of estrous standing behavior was 21.0 ± 3.7 h and until ovulation was 46.7 ± 5.3 h. Mean duration from onset of estrous standing behavior until ovulation was 26.4 ± 4.2 h. Interval from peak milk E2 until ovulation was different than the interval from the onset of estrous standing behavior until ovulation (t = 4.86; P < 0.001). These two intervals were correlated (r = 0.71; P < 0.01) and had equal variance (F = 1.92; P > 0.10), indicating that knowledge of milk E2 concentration may be a useful tool for dairy cow insemination management if on-farm tests for milk E2 were developed.

**Key Words:** Estradiol-17β, Milk, Estrus

**132 Predicting growth performance from pituitary responsiveness to growth hormone releasing hormone in bulls selected for semi-arid environments.** M. G. Thomas<sup>1</sup>, R. M. Enns\*<sup>2</sup>, H.M. Zhang<sup>2</sup>, C. C. Rasor<sup>1</sup>, D. M. Hallford<sup>1</sup>, and J. D. Thomas<sup>1</sup>, <sup>1</sup>New Mexico State University, Las Cruces, <sup>2</sup>University of Arizona, Tucson.

Pituitary secretion of GH in response to GHRH has been associated with growth in developing Angus bulls. We evaluated this relationship with Angus and Brangus bulls selected for production in a semi-arid environment. After weaning, Angus (n = 26) and Brangus (n = 64) bulls of 9 sires and 248.3 ± 2 d of age received an i.v. injection of hGHRH (.2 μg/kg BW) to stimulate pituitary secretion of GH. Blood was collected from each bull prior to GHRH injection and thereafter at 30 and 60 min. Growth traits were subsequently evaluated during a 112-d performance test. Concentrations of GH at 0, 30, and 60 min were 18.0 ± 17, 56.8 ± 26, 28.9 ± 14 ng/mL with the area under the GH curve (AUC-GH) estimated to be 2,423 ± 107. Initial (IWT) and final performance test (FWT) weights were 281 ± 36 and 450 ± 42 kg with a weight gain (WG) of 170 ± 24 kg. Back-fat thickness (BF) at the end of the test was 0.44 ± 0.31 cm. Pituitary responsiveness to GHRH was evaluated for use in predicting growth performance using generalized least-squares procedures. In the model, yr, breed, sire(breed), age, basal testosterone, and age of dam were used to predict growth performance traits with AUC-GH as a covariate. The r<sup>2</sup> for these analyses ranged from 0.47 to 0.92. Year, breed, and sire(breed) were significant (P < 0.05) sources, or tended to be significant (P < 0.10) sources, of variation for IWT, FWT, WG, and BF. In analyses predicting IWT and FWT, age was also a significant (P < 0.01) source of variation but the endocrine factors basal testosterone and AUC-GH were not (P > 0.2). However, in analyses predicting WG, AUC-GH was a significant (P = .04) source of variation. The correlation between AUC and WG across breeds was 0.27 (P = 0.01). This correlation was not detectable in Angus, but was found to be 0.29 (P = 0.03) in Brangus. In a similar prediction analyses of AUC-GH, yr and breed approached significance (P < 0.12) with the probability value for sire(breed) being 0.18 (r<sup>2</sup> = 0.19). These data support previous finding which suggest that GH responsiveness to GHRH

may be useful in predicting growth performance in bulls and provides new evidence to suggest that this response may differ across breeds and sires in cattle selected for semi-arid environments.

**Key Words:** Bulls, Growth, GHRH

**133 Influence of individual rams on ewe prolificacy.** A. L. Carr\*, W. C. Russell, R. H. Stobart, F. S. Hruby, P. Bulgin, and G.E. Moss, University of Wyoming, Laramie.

In spontaneous ovulating species such as sheep, prolificacy is generally accepted as an inherent characteristic of the ewe with little influence of the male. Empirical reports, however, challenge this generalization. The objective of this experiment was to determine the influence of individual rams on ewe prolificacy by analyzing data collected over an eight-year interval. During this interval, western white face ewes (n = 1346) from a single flock were randomly selected, pen mated to single sires, and shed lambed. Number of lambs born from individual ewes mated to individual sires (n = 42) were recorded and analyzed by GLM procedures to determine the influence of year, ewe age, and sire on ewe prolificacy. Number of lambs born per ewe differed by year (P < .0001) and age of ewe (P < .0001). Ram effects (P < .0007) on ewe prolificacy ranged from 1.3 to 2.2 ± .1 lambs per ewe. Among all rams, 6 (14%) sired < 1.5, 13 (30%) sired 1.6 to 1.79, 16 (37%) sired 1.8 to 1.99, 6 (14%) sired 2.0 to 2.19, and 2 (5%) sired ≥ 2.2 lambs per ewe. It is concluded that individual rams differ in their ability to sire multiple offspring and that the magnitude of the extremes observed among rams may be of importance to overall flock productivity. Although mechanisms through which such effects may be mediated remain an enigma, it appears most likely that individual rams differentially affect ovulation rate, conception rate or embryonic survival.

**Key Words:** Ram, Ewe, Prolificacy

**134 A comparison of the effects of equine chorionic gonadotropin (eCG) and equine luteinizing hormone (eLH) on cultured adult equine Leydig cells.** M.F. Hess\* and J.F. Roser, University of California, Davis.

Equine chorionic gonadotropin (eCG), a glycoprotein hormone secreted by specialized trophoblast cells, evokes responses typical of both follicle stimulating hormone (FSH) and luteinizing hormone (LH) in many species. In contrast, eCG does not bind to FSH receptors in the equine ovary or testis and only binds to LH receptors in equine testes at one-tenth the affinity of equine LH; however, the cellular responsiveness to eCG has not been determined in the horse. The objective of this study was to compare the effects of eCG and eLH upon cultured equine Leydig cells by evaluating estradiol (E2) and testosterone (T) production. Testes from five adult stallions (aged 3 to 8 years) were collected at the time of castration, dissected, enzymatically dispersed, washed, and a Leydig cell enriched preparation was cultured for 24 hours in the presence of either eCG or eLH in a dose-dependent manner (0.0015 μM - 36 μM). Media was collected and analyzed for E2 and T by validated RIA. E2 and T production were evaluated at 0.15 μM (equivalent to the stallion's normal physiological concentration of 5 ng/ml eLH) and 1.5 μM (equivalent to 50 ng/ml eLH) and were expressed as % baseline response ± SEM (see Table 1). In this equine Leydig cell preparation, eCG and eLH stimulated E2 and T production. eCG and eLH elicited similar steroidogenic responses at doses equivalent to concentrations equaling and exceeding the physiological normal concentration of eLH in the stallion.

Table 1. Effect of eLH and eCG on cultured equine Leydig cell testosterone and estradiol production

Dose	Response (% of baseline ± SEM)			
	Testosterone		Estradiol	
	eLH	eCG	eLH	eCG
0.15 μM	91.97 ± 60.82	18.94 ± 35.47	12.88 ± 3.50	8.64 ± 7.50
1.5 μM	227.05 ± 128.70	119.86 ± 75.09	25.15 ± 6.85	14.71 ± 7.67

**Key Words:** Equine, Testicular, Culture