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**BREEDING AND GENETICS**

**1 Evaluation of F1 crosses from Angus, Charolais, Salers, Piedmontese, Tarentaise and Hereford sires. I. Calf performance and heifer development.** D. L. Boss<sup>\*1</sup>, D. D. Kress<sup>2</sup>, D. C. Anderson<sup>1</sup>, D. W. Bailey<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*.

Calf performance ( $n=625$ ) from Hereford, Tarentaise, and Hereford-Tarentaise cross dams that were bred to either Angus (AN), Charolais (CH), Salers (SA), Piedmontese (PD), Tarentaise or Hereford (TH) bulls was evaluated. Cows began calving about March 14 each year. Calf data were analyzed using a model including birth date, year, age of dam, calf sex, dam breed, sire breed, and sire within sire breed. Sire within sire breed was the error term for sire breed. Birth weights of the AN, SA sired calves and TH reciprocal crosses (37.3, 38.3 and 39.2 kg, respectively) were lower ( $P=0.003$ ) than the CH and the PD sired calves (42.0 and 40.4 kg, respectively). Sire breed had no effect on calving difficulty ( $P=0.9$ ). Sire breed affected early June weight of the calves ( $P=0.04$ ) in which AN, SA and TH sires had lower weights (91, 89 and 91 kg; respectively) than the CH and PD (94 and 95 kg). Weaning weights were similar for all breeds ( $P=0.13$ ). Calves from CH, PD and SA sires had higher ( $P=0.06$ ) hip heights at weaning (115, 114 and 114 cm respectively) when compared to AN and TH bred calves (112 cm). Heifer calves from this study were placed in a heifer development program and were evaluated until they were yearlings ( $n=270$ ). Post weaning heifer data were analyzed using a model that included year, sire breed and sire within sire breed. Sire within sire breed was used as the error term for sire breed. Yearling weight and hip height were greatest ( $P<0.06$ ) for CH sired heifers (358 kg and 123 cm) with the remaining sires being slightly lower (ave 339 kg and 120 cm). Pelvic areas were largest ( $P=0.04$ ) for CH sired heifers ( $169 \text{ cm}^2$ ) with AN and PD being the smallest (160 and  $162 \text{ cm}^2$ , respectively) and the SA and TH being intermediate (167 and  $166 \text{ cm}^2$ ). In this study the PD sired progeny were more similar to CH at birth and during early growth and more similar to AN for heifer growth and development.

**Key Words:** Beef Cattle, Crossbred Dams, Calf Performance

**2 Evaluation of F1 crosses from Angus, Charolais, Salers, Piedmontese, Tarentaise and Hereford sires. II: Feedlot and carcass traits.** D.C. Anderson<sup>\*1</sup>, D.D. Kress<sup>2</sup>, D.W. Bailey<sup>1</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*.

For 4 yr, feedlot and carcass traits were evaluated from 291 crossbred steers out of Tarentaise, Hereford and Tarentaise-Hereford cross dams mated to Angus (AN), Charolais (CH), Salers (SA), Piedmontese (PD) and Tarentaise-Hereford (TH) sires. The objective of the study was to compare feedlot and carcasses characteristics among F1 sire groups. Calves were weaned Oct. 1 and placed on feed Nov. 15. Steers were serial slaughtered by time on feed with 1/2 each sire breed group fed 176–215 d and 1/2 fed 215–254 d. Average time on feed was 220 d. Finishing rations included barley, corn silage, chopped hay and protein supplement. Main effects were year, age of dam (AOD), sire breed (SB), sire/sire breed, and dam breed (DB). Steer birth date (BD) was used as a covariate. Sire/sire breed was used as error term for SB. Feedlot growth traits were initial weight on feed (IW), final weight (FW) and ADG. Carcass traits were hot carcass wt (HCW), marbling score (MARB), % KPH, yield grade (YG), ribeye area (RIB) and 12th rib fat thickness (FAT). AOD affected ( $P<0.01$ ) growth traits but not carcass traits. DB influenced IW, ADG, YG and FAT ( $P<0.05$ ). SB affected IW ( $P=0.04$ ), ADG ( $P=0.09$ ), FW ( $P=0.09$ ), HCW ( $P=0.44$ ), MARB ( $P=0.01$ ), KPH ( $P<0.01$ ), YG ( $P<0.01$ ), FAT ( $P<0.01$ ). PD sired steers had lowest ADG ( $P<0.05$ ), least MARB ( $P<0.05$ ), least FAT ( $P<0.05$ ), lowest YG ( $P<0.01$ ) and largest RIB ( $P<0.01$ ) when compared to other breeds. CH sires had heaviest FW ( $P<0.05$ ). CH and SA were similar in all traits studied and ranked intermediate for MARB, RIB, YG and FAT ( $P<0.05$ ). Greater than 50% of steers from all SB except PD graded YG 2 USDA choice after being fed an average 220 d.

**Key Words:** Beef Cattle, Crossbred, Feedlot and Carass Traits

**3 Evaluation of F1 crosses from Angus, Charolais, Salers, Piedmontese, Tarentaise and Hereford sires. III. Cow traits of young dams.** K. C. Davis<sup>\*1</sup>, D. D. Kress<sup>1</sup>, D. C. Anderson<sup>2</sup>, D. L. Boss<sup>2</sup>, and D. W. Bailey<sup>2</sup>, <sup>1</sup>*Montana State University, Bozeman*, <sup>2</sup>*Northern Agricultural Research Center, Havre, MT*.

Weight (WT40) and milk production (MILK40) at 40 d post-calving, weight (WT120) and milk production (MILK120) at 120 d post-calving,

and weight (WTWEAN), body condition (WEANCS), and hip height (HIPHT) at weaning (195 d post-calving) were measured over three years on a group of young dams at the Northern Agricultural Research Center in Havre, MT ( $n=285$ ). The objective was to compare cow traits of F<sub>1</sub> dams from different sire breeds. Dams were from Angus, Charolais, Salers, Piedmontese, or Tarentaise or Hereford bulls bred to cows of Tarentaise, Hereford, or Tarentaise-Hereford breeding. The model included year, age of dam, and sire breed group, with sire within sire breed group as the error term for sire breed. WT40, WT120, and WTWEAN were affected by year, dam age, and sire breed ( $P<0.01$ ). Charolais cross dams and Salers cross dams were heavier throughout the year while Piedmontese cross dams were lightest and different from other breed groups. Year, dam age, and sire breed were significant sources of variation for WEANCS ( $P<0.01$ ). Three-yr-old dams had less body condition than 2 and 4-yr-olds. Charolais cross dams had the highest condition scores (5.2), but were not different from Angus, Salers, or Tarentaise or Hereford cross dams (4.9). Piedmontese cross dams carried the least condition (4.5) but were different only from Charolais cross dams. Charolais and Salers cross dams, at 137 cm, were taller ( $P<0.01$ ) than the other breed groups with no difference between the remaining groups (132 cm). Sire breed did not affect MILK40 ( $P=0.08$ ) or MILK120 ( $P=0.48$ ). MILK40 increased with dam age but there was no difference between 2 and 3-yr-olds for MILK120.

**Key Words:** Beef Cattle, Crossbred Dams, Cow Traits

**4 Evaluation of F<sub>1</sub> crosses from Angus, Charolais, Salers, Piedmontese, Tarentaise or Hereford sires. IV. Calf traits from 2-yr-old and 3 and 4-yr-old dams.** K. C. Davis<sup>1</sup>, D. D. Kress<sup>1</sup>, D. C. Anderson<sup>2</sup>, D. L. Boss<sup>2</sup>, and D. L. Bailey<sup>2</sup>, <sup>1</sup>*Montana State University, Bozeman*, <sup>2</sup>*Northern Agricultural Experiment Station, Havre, MT*.

Calf traits, including birth weight (BWT), calving ease score (CE), 40 d (WT40) and 120 d (WT120) milk test weights, and weaning weight (WWT), weaning condition score (WCS) and hip height (HHT) were evaluated on 141 calves from 2-yr-old dams and 140 calves from 3 and 4-yr-old dams. Calves averaged 195 d at weaning. Dam breeding was Angus, Charolais, Salers, Piedmontese, Tarentaise, or Hereford bulls bred to cows of Tarentaise, Hereford, or Tarentaise-Hereford breeding. The resulting F<sub>1</sub> cross females were bred to South Devon, Angus, or Simmental bulls as 2-yr-olds and to Simmental bulls as 3 and 4-yr-olds. Model effects included year, sex, cow age, dam breed, and calf sire breed. Calves from 2-yr-old dams had an average BWT of 35 kg and an average CE score of 1.5. Calves from 3 and 4-yr-old dams averaged 44 kg of BWT with CE scores of 1.4. None of the main effects were significant for these traits within the two age groups ( $P>.1$ ). This was also true for WT40 for 2-yr-old dams ( $P>.1$ ), which averaged 64 kg. Calf age, sex, sire breed, and dam breed were significant ( $P<.05$ ) for WT120, WWT, and HHT, with no dam breed effect ( $P=.72$ ) for WCS for the 2-yr-old group. Salers and Charolais cross dams had heavier and taller calves with the remaining dam groups intermediate. Weights measured at milk test for calves from 3 and 4-yr-old dams were affected by calf age, year, and cowage ( $P<.05$ ). Calf age, cow age, and dam breed group affected traits measured at weaning ( $P<.05$ ). Salers cross dams (250 kg) differed from Piedmontese cross dams (228 kg) in weight weaned, with the remaining dam breed groups intermediate and not different. Salers and Angus cross dams weaned calves with more body condition (5.6) and Salers and Tarentaise-Hereford cross dams had taller calves at weaning (116 cm) than other dam breed groups.

**Key Words:** Beef Cattle, Crossbred Dams, Calf Traits

**5 Evaluation of F<sub>1</sub> crosses from Angus, Charolais, Salers, Piedmontese, Tarentaise and Hereford sires V: Grazing distribution patterns.** D. W. Bailey<sup>\*1</sup>, D. D. Kress<sup>2</sup>, D. C. Anderson<sup>1</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*.

Grazing patterns of cows ( $n=199$ ) sired by Angus, Charolais, Salers, and Piedmontese bulls were compared on seven foothill pastures during the summers of 1998 to 2000. These F<sub>1</sub> cows (ages 2 to 4 yr) were from dams with Hereford and Tarentaise breeding. Grazing locations were recorded 2 to 3 times per week by horseback observers during the early morning grazing period. Dependent variables were calculated from these observations and included mean slope use and the mean horizontal and vertical distances traveled from water in each pasture. Cows were observed in an

average of 4.9 pastures. Statistical model included year, pasture, lactation status, cow age, sire breed, dam breed, sire\*dam breed interaction and cow. Cow was used as the error term for sire breed, dam breed and the sire\*dam breed interaction. Grazing patterns differed ( $P<0.001$ ) among years and pastures. Non-lactating cows used steeper slopes and traveled further from water (horizontally and vertically) than lactating cows ( $P<0.01$ ). Cows that were 3-yr-old used steeper slopes and traveled further from water (horizontally) than cows that were 2 and 4 yr of age ( $P<0.01$ ). Cows sired by Piedmontese bulls traveled further vertically from water ( $P<0.03$ ) than did cows sired by Angus bulls. Slope use and the horizontal distance traveled to water was similar ( $P>0.1$ ) among sire breeds. Dam breed and the sire\*dam breed interaction did not affect ( $P>0.1$ ) grazing patterns. Repeatability of slope use and vertical distance traveled to water among pastures was low, 0.03 and 0.07 respectively. Repeatability of horizontal distance traveled to water was 0.21. Ongoing research indicates that at least some aspects of cattle grazing patterns may differ among breeds.

**Key Words:** Cattle, Grazing, Distribution

**6 Estimating genetic parameters of a linear type scoring method for beef cattle .** D. P. Kirschten\*, D. D. Kress, M. W. Tess, and K. C. Davis, *Montana State University, Bozeman*.

Scores provided by ABS Global were evaluated to estimate genetic parameters of linear type traits ( $N=10$ ) for Simmental females. Scores were collected by 40 evaluators over a period of twelve years from 1988 to 2000. Females ranged from 1 yr to 15 yr of age. Number of calvings ranged from zero to fourteen. Up to seven contemporary groups were represented in 185 herds. Scores were assigned based on a 50 point linear scale. Body traits evaluated were stature (ST), muscle (MU), capacity (CA), body length (BL), femininity (FE), rear leg set (RL, side view) and foot and pastern angle (FP). The number of scores evaluated for body traits ranged from 13,739 to 13,746. Mean scores and ranges for body traits were: ST, 30.6, 10 to 50; MU, 28.6, 2 to 50; CA, 29.4, 3 to 50; BL, 30.5, 2 to 50; FE, 26.6, 2 to 50; RL, 25.1, 2 to 45; and FP, 26.1, 0 to 50. Udder traits evaluated were udder attachment (UA), udder depth (UD) and teat size (TS). The number of scores evaluated for udder traits was 7,452. Mean scores and ranges for udder traits were: UA, 25.8, 1 to 50; UD, 26.7, 2 to 50; and TS, 26.2, 2 to 50. Body traits and udder traits were analyzed using an animal model and MTDFREML procedures to estimate genetic parameters. The statistical model for the traits included the additive direct genetic (animal) effect and the fixed effects of herd, year of evaluation, contemporary group, age of cow, number of calvings, and evaluator. Heritability estimates were: ST, 0.57; MU, 0.41; CA, 0.42; BL, 0.45; FE, 0.34; RL, 0.20; FP, 0.21; UA, 0.23; UD, 0.33; and TS, 0.38. Genetic and phenotypic correlations differed in magnitude and sign among traits. In general, parameter estimates were within the range of those previously reported in the literature. Results from this study established that with selection it is possible to readily change ST, MU, CA, and BL in Simmental cattle. Desirable change can be made in FE, RL, FP, UA, UD, and TS, but at a slower rate of progress.

**Key Words:** Beef Cattle, Genetic Parameters, Linear Type Traits

**7 Heritability and repeatability of sexual performance.** G. D. Snowder<sup>\*1</sup>, J. N. Stellflug<sup>1</sup>, and L. D. Van Vleck<sup>2</sup>, <sup>1</sup>*USDA, ARS, U. S. Sheep Experiment Station, Dubois, ID*, <sup>2</sup>*USDA, ARS, MARC, Lincoln, NE*.

Sexual performance has been subjectively measured in a libido test for screening rams prior to public sale and breeding at the U.S. Sheep Experiment Station from 1990 to 2000. The objective of this study was to determine if sexual performance was genetically influenced. Sexual performance scores ranged from 1 to 6 with scores increasing from sexually inactive to highly sexually active in the presence of estrus ewes. Overall average sexual performance score was  $3.5 \pm 0.02$ . Records from four breeds (Columbia, 807; Polypay, 1,668; Rambouillet, 1,208; and Targhee, 1,002) were combined into multiple breed analyses because breeds had similar phenotypic variances. Total numbers of records were 4,685 and included a second sexual performance test on 1,212 rams in the subsequent year. Variance component estimation was accomplished using REML analyses. Fixed effects were breed of ram, genetic selection line within breed, year by breed, and season born by breed. A permanent environmental effect for ram was included to account for repeated measures. Age and weight of the rams at time of the libido test were

considered as linear covariates and were breed specific. The additive genetic variance was estimated as 0.54. The variance due to repeated measures was 1.19; and the residual variance was estimated as 0.67. The heritability estimate was moderate ( $0.22 \pm 0.04$ ). The repeatability of the score was high (0.72). The residual variance accounted for only 28% of the total phenotypic variance. These results imply that the sexual performance test is reliably measured and also that response to selection for ram serving capacity will be favorable.

**Key Words:** Behavior, Heritability, Sexual performance

### 8 Survival, growth and carcass composition of lambs sired by Dorper and Suffolk sires. H.H. Meyer\*, J.M. Thompson, and T.M. Spezzano, Oregon State University, Corvallis.

Lambs were produced from Suffolk (S) and Dorper (D) rams to compare the two breeds as terminal sires. Whiteface and blackface crossbred ewes were randomized by genotype and age for either group mating to S rams or single sire mating to two unrelated D rams. Following mating, all ewes were managed as a single group through weaning of their lambs. A total of 329 lambs were born and 89% survived to weaning; sire breed had no effect on lamb survival. Lambs from S sires were heavier at birth (.5 kg;  $P < .05$ ) and weaning (2 kg;  $P < .05$ ). Twelve lambs of each sire genotype were finished on a concentrate diet and slaughtered at a mean shrunk liveweight of 52 kg. Sire breed had no effect on growth rate but D lambs had a higher dressing % (56% vs 53%;  $P < .05$ ) and produced carcasses with greater fat depth over the loin (76 vs 56 mm;  $P < .05$ ). Sire breeds did not differ in progeny ribeye area. Lambs from the two Dorper rams were very similar in all traits measured.

**Key Words:** Lambs, Dorper, Growth

### 9 The effect of the callipyge mutation on genes in the distal end of ovine chromosome 18. T. L. Shay<sup>1</sup>, C. A. Bidwell<sup>2</sup>, C. Charlier<sup>3</sup>, K. Segers<sup>3</sup>, S. Berghmans<sup>3</sup>, M. Georges<sup>3</sup>, and N. E. Cockett<sup>1</sup>, <sup>1</sup>Utah State University, Logan, <sup>2</sup>Purdue University, West Lafayette, IN, <sup>3</sup>University of Liege, Liege, Belgium.

*Callipyge* (*CLPG*) is a major gene responsible for a pronounced muscle hypertrophy in sheep. Genetic characterization of the locus has demonstrated a unique model of inheritance termed "polar overdominance", where only heterozygous offspring inheriting the mutation from their sire express the phenotype. We recently constructed bovine-and ovine-specific contigs that span the callipyge region on ovine chromosome 18. Comparative analysis of ovine sequence from this region and the corresponding region on human HSA14q allowed identification of six genes. Two of the six genes, *DLK1* and *GTL2*, have been characterized in humans, mice, and cattle. The remaining four genes, *DAT* (*DLK1-associated transcript*), *PEG11* (*paternally expressed gene 11*), *antiPEG11*, and *MEG8* (*maternally expressed gene 8*), are novel. *DLK1* and *PEG11* code for protein products while the other four genes apparently act via non-coding RNA products. Use of single nucleotide polymorphisms (SNPs) identified in the region demonstrated that *DLK1*, *DAT*, and *PEG11* are paternally expressed while *GTL2*, *antiPEG11*, and *MEG8* are maternally expressed. Northern blot analysis showed altered expression of *GTL2*, *DLK1*, and *PEG11* in a genotype-, age-, and muscle-specific manner. In homozygous normal lambs, *GTL2* and *DLK1* were expressed prenatally in longissimus dorsi but mRNA levels declined after birth. The callipyge mutation resulted in overexpression of *GTL2* and *DLK1* through 8 wk of age. Expression of *PEG11* was very low in prenatal normal and callipyge lambs, but was elevated postnatally in callipyge lambs at 2 wk and 8 wk of age. There was no difference in expression of these three genes between callipyge and normal animals in the supraspinatus, tongue, and heart, which are tissues that are not affected by the mutation. Therefore, the callipyge mutation has altered postnatal expression of at least three genes from this imprinted gene cluster.

**Key Words:** Sheep, Muscle Hypertrophy, Gene Expression

### 10 Calf weight/cow weight ratio at weaning as a predictor of beef cow efficiency. D. D. Kress<sup>\*1</sup>, D. C. Anderson<sup>1</sup>, J. D. Stevens<sup>1</sup>, E. T. Miller<sup>1</sup>, T. S. Hirch<sup>1</sup>, J. E. Sprinkle<sup>1</sup>, D. L. Boss<sup>2</sup>, D. W. Bailey<sup>2</sup>, R. P. Ansoteg<sup>1</sup>, and M. W. Tess<sup>1</sup>, <sup>1</sup>Montana State University, Bozeman, <sup>2</sup>Northern Agricultural Research Center, Havre, MT.

Hereford (HH), Tarentaise (TT), and F<sub>1</sub> reciprocal cross (HT) cows were evaluated for biological efficiency under range conditions. The objective was to evaluate ratio of calf weight to cow weight (RATIO) as a predictor of cow efficiency. Fecal output (FO) was measured and forage intake (FI) calculated for 51 cows using a constant release intraruminal bolus of chromic oxide during 5 periods of each of 4 yr. Pregnant cows (n=17) of each breed group were selected at random previous to the first period in November. Calf weight (CALFWT) and cow weight (COWWT) were measured at weaning in early October. Cow/calf unit efficiency values were calculated as CALFWT divided by the sum of cow FI over the five periods (EFF) and as CALFWT divided by the sum of cow FI over the five periods on a per unit of cow weight basis (EFF/BW). The same calculations were made using FO and all results were very similar to those using FI. RATIO was calculated as CALFWT/COWWT. Number of cow-calf pairs was 147. The model included dam breed group, dam sire within dam breed group, age of dam, sex of calf, calf sire breed group, year, and various covariates. Dam breed group was important ( $P < .01$ ) for EFF, EFF/BW, and RATIO. Least-squares means for HH, HT, and TT, respectively, were 6.63, 7.50, and 7.74 kg/kg for EFF, 3.45, 3.93, and 4.00 kg·g<sup>-1</sup>·kg<sup>-1</sup> for EFF/BW, and 0.38, 0.44, and 0.47 kg/kg for RATIO. With RATIO as a covariate, dam breed group was not important ( $P > 0.57$ ) for EFF or EFF/BW and suggested RATIO was a good proxy for the genetic effect of dam breed group. Partial regressions of EFF and EFF/BW on RATIO were 13.35 and 7.35, respectively. Standard partial regressions of EFF and EFF/BW on RATIO were 0.94 and 1.03, respectively, indicating that RATIO accounted for a large percentage of variation in efficiency. RATIO was an accurate predictor of cow/calf biological efficiency.

**Key Words:** Beef Cattle, Efficiency, Ratio of Calf/Cow Weight

### 11 Effects of genotypes of casein and serum proteins on milk production in Holsteins. A. Barreras\*, O. Robinson, F. Monge, O. Vizcarra, and L. Navarro, Universidad Autonoma de Baja California, Mexicali, B.C. Mexico.

The objective was to determine the genotypic and allele frequencies of alpha-s1-casein (As1-CN), kappa-casein (K-CN), alpha-lactalbumin (A-LA) and beta-lactoglobulin (B-LG), and to study the relationships of milk protein on milk production. Blood samples were collected from 250 Holstein first lactation cows located in Tijuana, B.C. Genotyping of As1-CN, K-CN, A-LA and B-LG was made by DNA analysis using the polymerase chain reaction (PCR) method. The digested PCR products were analyzed by agarose or polyacrylamide gel electrophoresis. Calculation of genotype frequencies was conducted by the direct count method. The effects of milk protein variants on first lactation performance were estimated separately for each genetic marker using a classification model by least squares procedures. A linear model included herd, calving year, month calving, length of lactation as covariate, and milk protein genotypes as fixed effects and sire as a random effect. The frequencies of BB genotype for As1-CN, K-CN, and B-LG were .636, .017 and .288 respectively. Allelic frequencies were: B-LG A .47, B-LG B .53, A-LA A .335, A-LA B .665, K-CN A .9045, K-CN B .0955, As1-CN A frequency was not observed in this study. Least squares analysis of variance showed that herd, calving year, and length of lactation had significant effects on total milk production. No significant additive effects were found by K-CN, A-LA and B-LG on total milk production. However, genotypes of As1-CN have significant effect on total milk production (BC>BB).

**Key Words:** genetic polymorphisms, milk protein, milk production

### 12 Estimates of genetic and phenotypic parameters for calf birth weight and calving difficulty in Limousin cattle. A.P. Marquez<sup>\*1</sup>, J.F. Ponce<sup>1</sup>, J. Rodriguez<sup>1</sup>, F. Bueno<sup>1</sup>, H. Gonzalez<sup>1</sup>, A. Correa<sup>1</sup>, J. Guerrero<sup>2</sup>, and J.F. Castillo<sup>3</sup>, <sup>1</sup>Instituto de Ciencias Agricolas, <sup>2</sup>University of California, Holtville, <sup>3</sup>Universidad Autonoma de Ciudad Juarez.

Genetic parameters for birth weight and calving difficulty were evaluated in a herd, located in Samalayuca, a representative rangeland system in the desertic region at north of Mexico. Progeny (n=18, and n=69) from

41 dams: heifers and mature cows of a total of 50 dams involving inheritance of Limousin (L) mated naturally to sires Limousin were used. The objective was to estimate heritabilities direct for birth weight (BW) and calving difficulty (CD). Separate analyses for each trait used least squares mixed model, SAS (1989). The analytical model included: year of birth, age of dam, sex of the calf, with date of birth as a covariate to adjust a common age as fixed effects; sire and residual as random components. Mean birth weight was 39.97 kg. Birth weight ranged from 36 to 37.94 kg in heifers 29 month-old at parturition. Birth weight ranged from 38.5 to 43.70 kg in mature cows that produced calves at 57 month-old. Calving difficulty was subjectively evaluated categorically using descriptive scores (i.e., 1=no difficulty, 2= little difficulty by hand, 3 = little difficulty with jack, 4= slight difficulty with a calf jack, 5= moderate difficulty with calf jack, 6= major difficulty with jack, and 7= Caesarean birth presentation). Calving difficulty was greater ( $P < .05$ ) in heifers (29.8%) than mature cows (11.45%). The sex of the calf was the major source ( $P < .05$ ) of variation in levels of calving difficulty for both heifers and mature cows. The estimated heritability values direct for birth weight and calving difficulty were ( $h^2 = .29 .07$ ), and ( $h^2 = .05 .04$ ), respectively. Breeders must consider birth weight and calving difficulty as important traits in their breeding programs.

**Key Words:** Birth weight, Calving difficulty, Heritability

**13 Estimates of genetic parameters for weaning weight in Limousin cattle in a desertic region at north of Mexico.** A.P. Marquez<sup>\*1</sup>, J.F. Ponce<sup>1</sup>, J. Rodriguez<sup>1</sup>, F. Bueno<sup>1</sup>, H. Gonzalez<sup>1</sup>, A. Correa<sup>1</sup>, J. Guerrero<sup>2</sup>, and J.F. Castillo<sup>3</sup>, <sup>1</sup>Instituto de Ciencias Agricolas, <sup>2</sup>University of California, Holtville, <sup>3</sup>Universidad Autonoma de Ciudad Juarez.

Genetic parameters for weaning weight (WW) were evaluated in a herd, located in Samalayuca, a representative rangeland system in the desertic region at north of Mexico. Progeny (n=15, and n=58) weaned calves of 41 dams: heifers and mature cows respectively of a total of 50 dams involving inheritance of Limousin (L) mated naturally to sires Limousin (L) were used. The objective was to characterize the performance of Limousin cattle into desertic region of Mexico, and to estimate heritabilities direct and maternal for weaning weight (WW). Analysis of data used a least squares mixed model. The analytical model included: year of birth, age of dam, sex of the calf, with date of birth as a covariate to adjust a common age as fixed effects; sire and residual as random components. Mean weaning weight of progeny adjusted to 200 d was 204.31 kg. Weaning weight ranged from 169.58 kg in calves of heifers to 207.79 kg in calves of mature cows. Female calves were lighter (5%)

compared to male calves for both heifer and mature cows. The estimated heritability value in this study for weaning weight direct were ( $h^2 = .23 .06$ ). This can be accomplished by selecting cows on the basis of weaning weights of their calves; cows that wean calves heavier than the herd average in one year are more apt to produce calves heavier than average succeeding years.

**Key Words:** Weaning weight, Heritability, Limousin

**14 Estimates of genetic and phenotypic parameters of 368-day weight, total feed consumption, daily gain, and feed conversion in Limousin cattle in Samalayuca, Mexico.** A.P. Marquez<sup>\*1</sup>, J. Guerrero<sup>2</sup>, J.F. Castillo<sup>3</sup>, and J.H. Herrera<sup>4</sup>, <sup>1</sup>Instituto de Ciencias Agricolas, <sup>2</sup>University of California, Holtville, <sup>3</sup>Universidad Autonoma de Ciudad Juarez, <sup>4</sup>Colegio de Posgrados, Montecillos.

Data came from a herd of Limousin (L) cattle under a rangeland system in a desertic region representative of the north of Mexico. Progeny (n=8, and n=29) male calves from heifers and mature cows, respectively of 41 of a total of 51 dams involving inheritance of Limousin (L) mated to Limousin (L) sires were used. The objective was to estimate heritability direct, and phenotypic parameters for weight at 368 d, total feed consumption, daily gain, and feed conversion, during 112 d test. Separate analysis for each trait used a least squares mixed model. The analytical model included: year of birth, age of dam, sex of the calf, with date of birth as a covariate to adjust a common age as fixed effects; sire and residual as random components. Mean weight at 368 d was 364.76 kg. Weight at 368 d ranged from 268 to 430 kg. Mean weight to initiate the 112 d performance test was 232.14 kg. Weight to initiate the performance test ranged from 166 to 334 kg. Mean value of total feed consumption per animal during 112 d test was 841.56 kg. Mean value of total feed consumption per animal during 112 d test ranged from 716.78 to 1097 kg. Mean weight of gain per animal at the end of 112 d test was 159.13 kg. Mean weight gain at the end of 112 d test ranged from 122.08 to 183.04 kg. The average daily gain per animal during 112 d test was 1.351 kg. The average daily gain during 112 d test ranged from 1.09 to 1.642 kg. Mean values of feed per unit of gain was 7.514 kg. Mean values of feed per unit of gain ranged from 6.4 to 8.8 kg. The estimated heritability values of weight at 368 d, total feed consumption, average daily gain and feed efficiency were ( $h^2 = .33 .04$ ,  $h^2 = .59 .05$ ,  $h^2 = .44 .06$ , and  $h^2 = .37 .04$ ) respectively.

**Key Words:** Heritability, Weight at 368 d, Feed conversion

## ENVIRONMENT & LIVESTOCK MANAGEMENT

**15 Development of Holstein heifers grazing irrigated grass-legume pastures.** R. Flores<sup>\*1</sup>, R. Lopez<sup>1</sup>, M. Looper<sup>1</sup>, C. Krehbiel<sup>1</sup>, E. Hanson<sup>2</sup>, K. Duncan<sup>2</sup>, M. Murray<sup>2</sup>, M. Thomas<sup>1</sup>, G. Donart<sup>1</sup>, and R. Flynn<sup>2</sup>, <sup>1</sup>New Mexico State University, Las Cruces, <sup>2</sup>NMSU Agricultural Science Center, Artesia, New Mexico.

Sixty-four Holstein heifers were utilized to evaluate the effects of grazing irrigated grass-legume pastures on average daily gain (ADG), skeletal growth, and onset of puberty. Eight heifers were randomly assigned to one of four replicated pastures: 1) Jose tall wheatgrass (JTW); 2) Jose tall wheatgrass + ~ 5% alfalfa (JTWA); 3) Kleingrass (K); and 4) Kleingrass + ~ 5% alfalfa (KA). Each pasture had 1.28 hectares (ha) and contained four .32 ha paddocks. Forage samples were collected for analyses every 28 d. Heifers grazed forages from April to November. Heifers were rotated through paddocks at 7 d intervals; therefore, each paddock had a 21 d rest between grazing periods. Heifers were provided ad libitum access to fresh water, salt, mineral and bloat guard. Body weight (BW) and hip height (HH) were collected every 28 d following a 16 h shrink. Blood samples were collected every 28 d from May through June and every 7 d from July to October, and concentrations of progesterone were quantified. Plasma concentrations of insulin-like growth factor-I (IGF-I) were quantified ( $n = 16$ ) in pubertal and non-pubertal heifers. Across the grazing season, the main effect of treatment on ADG was similar ( $P > 0.10$ ) for heifers grazing JTW, JTWA, K, and KA (0.79 ± 0.06, 0.76 ± 0.05, 0.71 ± 0.07, and 0.70 ± 0.05 kg). There was a treatment x period interaction ( $P < 0.0001$ ) on ADG. Heifers grazing JTW had increased ADG during October and November. Overall body weight gain across the grazing season tended ( $P = 0.12$ ) to be greater

for JTW ( $153.0 \pm 4.8$  kg) than JTWA, K, and KA ( $145.2 \pm 4.8$ ,  $134.4 \pm 4.8$ , and  $134.3 \pm 4.8$  kg). Hip heights were influenced ( $P < 0.0001$ ) by treatment. Final HH were  $123.2 \pm 1.3$ ,  $121.8 \pm 1.2$ ,  $123.9 \pm 1.2$ , and  $123.6 \pm 1.2$  cm for heifers grazing JTW, JTWA, K, and KA respectively. Puberty was not influenced ( $P > 0.10$ ) by treatment; 60% of all heifers reached puberty by 1 yr of age. Mean concentrations of IGF-I were  $130.8 \pm 17.1$  ng/mL for pubertal heifers and  $123.3 \pm 17.1$  ng/mL for non-pubertal heifers ( $P > 0.10$ ). Data suggest that perennial grasses grazed with or without alfalfa provide adequate gain (0.70 to 0.79 kg/d) to develop replacement dairy heifers.

**Key Words:** Holstein Heifer, ADG, Hip Height

**16 Orientation of beef cattle grazing foothill winter range in Montana.** B.E. Olson\* and R.T. Wallander, Montana State University, Bozeman.

Cattle may graze foothill winter range in northern areas as an alternative to feeding hay, although this exposes them to potential thermal stress. Consequently, cattle may orient to maximize heat gain or to minimize heat loss depending on ambient weather. Our objective was to determine how mature cattle orient while grazing winter range. During two winters (Winter 1 1996-1997; Winter 2 1997-1998), we recorded orientation of mature cattle ( $n = 32$ ) at 30 minute intervals dawn to dusk three days each week for approximately 7 weeks. Circular statistics, including mean vector (body orientation relative to direction) and

vector length (variation around mean vector), were used to characterize orientation. Stepwise multiple linear regression was used with mean vector and vector length as response variables, and solar radiation, net radiation, temperature, relative humidity, wind velocity, and wind direction as predictor variables. Mean vector was approximately east-west (Winter 1, 80°; Winter 2, 100°; body perpendicular to the sun low in the winter sky), although coefficients of determination were low, especially in the second winter (Winter 1,  $R^2 = 0.14$ ; Winter 2,  $R^2 = 0.03$ ). Vector lengths increased with increasing solar radiation, especially at cold temperatures (Winter 1,  $R^2 = 0.24$ ; Winter 2  $R^2 = 0.17$ ), indicating more cattle were assuming the same orientation under these conditions. Cattle oriented perpendicular to the sun's rays intercept about 80% more direct radiation than cattle facing the sun. When oriented perpendicular to the sun, intercepted radiant heat can be as much as 4x basal metabolic heat production. A simple energy balance model, including solar radiation, net radiation, cattle surface temperature, latent and sensible heat loss, conduction, storage, and metabolic heat, indicates that orientation, which determines surface area exposed to solar radiation and wind, greatly affects thermal energy gains and losses under different weather conditions.

**Key Words:** Surface temperature, Thermal balance, Radiation

**17 Sheep and cattle response when grazed together on sagebrush-grass rangeland.** B.C. Glidewell<sup>1</sup>, J.C. Mosley<sup>\*2</sup>, and J.W. Walker<sup>3</sup>, <sup>1</sup>USDA-ARS Grazing Lands Research Lab, El Reno, OK, <sup>2</sup>Montana State University, Bozeman, <sup>3</sup>Texas Agricultural Experiment Station, San Angelo.

Grazing sheep and cattle together (i.e., common use or multispecies grazing) may increase livestock production on sagebrush-grass rangeland. This study compared the dietary botanical composition, dietary nutritive quality, and weight gain of sheep and cattle grazed separately versus sheep and cattle grazed together. The grazing trials were conducted during two summers at the U.S. Sheep Experiment Station near Dubois, Idaho. The same moderate stocking rate was used both summers and for all four treatments: cattle alone, sheep alone, 75% cattle/25% sheep, and 50% cattle/50% sheep. The percentages of cattle and sheep describe the relative total live weight of each species at the beginning of the grazing trials. Each treatment had three replicates. Sheep and cattle ate grass-dominated diets in all treatments, and dietary overlap was high (> 80%) when sheep and cattle grazed together. Nutritive quality (CP and NDF) of sheep diets did not differ among treatments ( $P > 0.10$ ), whereas cattle diets had less NDF ( $P = 0.09$ ) when cattle grazed with sheep rather than alone. Cattle ADG did not differ among treatments ( $P > 0.10$ ) but trended higher when cattle grazed with sheep. Sheep ADG also trended higher when sheep grazed with cattle. The amount of growing season precipitation influenced which treatment maximized total gain/ha. In a wet year, multispecies grazing produced more gain/ha than cattle alone ( $P < 0.01$ ). In a dry year, multispecies grazing produced as much gain/ha as cattle alone ( $P > 0.10$ ). Therefore, over the long-term gain/ha should increase by grazing cattle and sheep together.

**Key Words:** Beef Cattle, Sheep, Multispecies Grazing

**18 The influence of cattle grazing on elk forage conditions and habitat selection.** K.K. Crane<sup>\*1</sup>, J.C. Mosley<sup>2</sup>, T.K. Brewer<sup>2</sup>, W.L. Torstenson<sup>2</sup>, and M.W. Tess<sup>2</sup>, <sup>1</sup>University of Wyoming, Laramie, <sup>2</sup>Montana State University, Bozeman.

Contemporary research indicates that prescribed livestock grazing may improve forage conditions for elk. However, cattle grazing treatments to improve elk forage conditions have not been evaluated at a landscape scale and little evidence has been presented which demonstrates that forage conditioning treatments actually affect elk habitat selection. We hypothesize that selection of foraging sites by elk is influenced by differences in forage quantity and quality created by dispersed cattle grazing in rangeland landscapes. To evaluate this hypothesis we compared elk habitat selection patterns during critical periods (fall, winter, and spring) with delineated "forage condition zones" resulting from different intensities of summer cattle grazing: heavy, moderate, light, and none. Habitat use by elk was monitored with monthly surveys from a fixed-wing aircraft, and more than 7,150 independent elk locations were used in the analysis. Selection ratios and Bonferroni Z-confidence intervals were used to assess whether elk exhibited preferential selection for forage conditions attributable to cattle grazing intensity. Results from

1999-2000 indicated that elk in fall, winter and spring avoided areas where cattle had not grazed during the preceding summer ( $P < 0.05$ ). In fall and winter, elk preferred to forage where cattle had lightly ( $P < 0.05$ ) or moderately ( $P < 0.05$ ) grazed the preceding summer, while in spring, elk strongly preferred to graze where cattle had grazed moderately during the preceding summer ( $P < 0.05$ ). Our results indicate that prescriptive cattle grazing can encourage or discourage where elk graze in rangeland landscapes.

**Key Words:** Cattle, Elk, Habitat

**19 Late spring calving lowers cow wintering costs with minimal impact to calf performance.** M. A. Smith<sup>\*1</sup>, J. W. Waggoner, Jr.<sup>1</sup>, D. M. Perry<sup>1</sup>, and R. H. Hart<sup>2</sup>, <sup>1</sup>University of Wyoming, Laramie, <sup>2</sup>USDA-ARS-High Plains Grassland Research Station, Cheyenne, Wyoming.

Comparable groups of late winter (n = 34) and late spring (n = 31) calving date Hereford cows have been maintained on short grass summer range for 5 years near Cheyenne, Wyoming. The objectives of this work were to determine the differences in calf and cow performance and to assess the minimum winter nutritional needs during the feeding period. During the winter feeding portion of the study in complete random design, cows were fed according to NRC requirements for beef cattle with the body condition of cows allowed to drop as low as 4, 3 months or more before parturition and body condition of 5 to be reached by parturition. Analysis of variance and Chi-square statistical methods were used to analyze data. Early calving cow weights were higher year round ( $P < 0.05$ ) than late calving cows. Late calving cows gained less weight in summer ( $P < 0.05$ ) due to lactation requirements than early calving cows. Time of calving did not ( $X^2 = 2.0626$ ) affect rebreeding efficiency. Late born calves were heavier at birth ( $P < 0.05$ ) and survival to weaning was greater than early born calves (by 4%). Weaning weights were lower ( $P < 0.05$ ) for late born calves than early born calves. Late calving cows required less winter nutrients and year-round nutrient requirements more closely match the seasonally available nutrients from range forages. Producers will need to determine if the reduction in feed, labor, and personal costs and enhanced opportunities for effectively managing forage resources overcome the reduction in weaning weights. Late season calving is a keystone in sustainable cattle production strategies. Year round grazing of rangeland or irrigated forage will be closer to realization and purchases of products off ranch will be limited. Risks of adverse climatic condition effects on production will be reduced. Risks of untimely fluctuations in production costs or market will be reduced. Alternative marketing tactics and retained ownership will be useful in mitigating the low weaning weights.

**Key Words:** Late season calving, Lower production cost, Sustainable production

**20 Effect of protein sources differing in rumen degradability and calcium propionate content on *in-vitro* gas production.** R. C. Waterman, L. A. Stalker<sup>\*</sup>, L. A. Balstad, and M. K. Petersen, New Mexico State University, Las Cruces.

Recent woducted by researchers at New Mexico State University indicates that additions of calcium propionate to the rumen can decrease acetate:propionate ratios, indicative of increased rate of forage fermentation. An experiment was conducted to determine whether supplements with varying amounts of undegradable intake protein (UIP) and calcium propionate alter total and rate of gas production *in-vitro*. Five range supplements were formulated to contain 37% CP, 38% UIP (Trad); 37% CP, 50% UIP (LUIP); 37%CP, 60% UIP (HUIP); 19% CP, 35% UIP plus 5% calcium propionate (LCP+Pr, NutroCal<sup>TM</sup>, Kemin Industries, Inc.); and 37% CP, 60% UIP plus 11% NutroCal (HUIP+Pr). One hundred fifty mL of ruminal inoculum, 150mL McDougal's buffer, 5 g rumen extrusa (6.8% CP, 80.9 % NDF, 17% Ash) were combined with either 1 g Trad, LUIP, HUIP, HUIP+Pr or 2 g LCP+Pr and added to the appropriate 250 mL Erlenmeyer *in-vitro* flask (n=20). Flasks were capped with a rubber stopper and connected to an inverted 200 mL buret by plastic tubing. Treatments were randomly assigned to flasks and incubated at 39° C. Every 4 h water displacements were recorded until gas production ceased for all flasks (44 h). Results were analyzed using ANOVA with flask as the experimental unit. Total gas production ( $P < 0.07$ ) was 458, 513, 547, 564 and  $539 \pm 31$  mL of gas, for Trad, LUIP, HUIP, LCP+Pr, HUIP+Pr treatments, respectively. Rate of gas production ( $P < 0.05$ ) was 3.5, 4.7, 5.0, 3.5 and  $4.5 \pm 0.31$  mL  $4^{-1}$  h for

Trad, LUIP, HUIP, LCP+Pr, HUIP+Pr treatments, respectively. Results from this experiment indicate that UIP but not calcium propionate content of range supplements can alter amount and rate of *in-vitro* gas production.

**Key Words:** Protein source, *In-vitro*, Gas production

**21 Feedlot performance and carcass characteristics of Texas Rambouillet feeder lambs implanted with Zeranol implants.** J. R. Stultz, B. J. May\*, G. R. Engdahl, M. A. Carr, C. B. Scott, and R. L. Reed, *Angelo State University, TX*.

One hundred fifty Texas Rambouillet feeder lambs with an average initial weight of 33.17 kg were used to compare the effects of hormone implants versus a control on feedlot performance and carcass characteristics. Lambs were randomly divided into two groups and assigned to treatments as follows: no implant (control) and implant (Zeranol). On d 0, lambs were weighed, dewormed, vaccinated for overeating, ear tagged, and implanted according to treatment. Lambs were fed ad libitum through a self feeder. Weights were recorded on subsequent d 28, 56, 84, and 105 and when end weights (approximately 54.43 kg) were reached, lambs were slaughtered. Backfat thickness, ribeye area, yield and quality grade measurements were recorded. Analysis showed higher ( $P < .05$ ) average daily gain in lambs implanted with Zeranol when compared to the control group on d 28, 56, and 84. In addition, final weights were higher ( $P < 0.05$ ) for implanted lambs. Feed to gain ratio (kg feed:kg gain) was reduced ( $P < 0.05$ ) in lambs implanted with Zeranol. Although no differences in carcass yield grade, quality grade, or backfat thickness were observed, implanted lambs possessed a larger ribeye area and heavier carcass weights ( $P < 0.05$ ). Data from this study indicate that Texas Rambouillet feeder lamb feedlot performance and carcass characteristics can be improved with Zeranol implants.

**Key Words:** Lambs, Feedlot, Zeranol

**22 Preliminary characterization of swainsonine absorption and elimination in sheep following acute exposure.** A. K. Clayshulte\*, J. R. Strickland<sup>1</sup>, J. B. Taylor<sup>2</sup>, R. L. Ashley<sup>1</sup>, and M. A. Siepel<sup>1</sup>, <sup>1</sup>New Mexico State University, Las Cruces, <sup>2</sup>North Dakota State University, Fargo.

Swainsonine (SW) absorption and elimination in sheep was investigated. This experiment was conducted as a part of a companion study exploring the effects of subacute SW exposure on its toxicokinetics and subclinical markers of intoxication. Fifteen wethers (BW = 74.7 kg + 7.6) were stratified by BW and assigned to three treatments: 1.6 mg SW/kg BW (HI), .4 mg SW/kg BW (LO), and no SW. Swainsonine was administered orally as a crude locoweed (*Oxytropis sericea*) extract mixed with corn syrup. Blood was collected via jugular venapuncture at 1 h intervals from 0 to 12 h, 3 h intervals from 15 to 24 h, 6 h intervals from 30 to 48 h, and 12 h intervals from 60 to 168 h. Treatments were delivered immediately after 0 h collection. Serum SW was determined via  $\alpha$ -mannosidase inhibition assay (detection limit = 25 ng/mL; CV = 11.9%). Serum SW peaked at 6 h for HI (289.6 ng/mL), and at 10 h for LO (68.6 ng/mL). At 3 h, HI serum SW concentrations were higher ( $P < .05$ ) than LO values, and remained higher through 30 h. For the HI treatment, absorption (0-6 h) occurred at a rate of  $0.514 \text{ h}^{-1}$  ( $t_{1/2} = 1.4 \text{ h}$ ), distribution (7-48 h) at a rate of  $.056 \text{ h}^{-1}$  ( $t_{1/2} = 12.6 \text{ h}$ ), and elimination (60-132 h) at a rate of  $.004 \text{ h}^{-1}$  ( $t_{1/2} = 184.2 \text{ h}$ ). For the LO treatment, absorption (0-10 h) occurred at a rate of  $.228 \text{ h}^{-1}$  ( $t_{1/2} = 3.0 \text{ h}$ ), distribution (11-42 h) at a rate of  $.113 \text{ h}^{-1}$  ( $t_{1/2} = 6.2 \text{ h}$ ), and elimination (48-120 h) at a rate of  $.002 \text{ h}^{-1}$  ( $t_{1/2} = 289.4 \text{ h}$ ). At 144 h for HI treatment, SW values rose unexpectedly to 64.3 ng/mL (SE = 29.6). No SW was detected after 144 h for HI, or 120 h for LO. These preliminary data represent initial efforts at defining the absorption kinetics of SW. Understanding the rate, mechanism and extent of SW absorption from locoweed will facilitate development of management protocols to improve animal tolerance of locoweed.

**Key Words:** Sheep, Locoweed, Swainsonine

**23 Serum GH, insulin and thyroxine and body weight, and mammary changes of ewes in response to weaning methods.** J.A. Hernandez\*<sup>1</sup>, N.H. Wells<sup>1</sup>, D.W. Holcombe<sup>2</sup>, and D.M. Hallford<sup>1</sup>, <sup>1</sup>New Mexico State University, Las Cruces, <sup>2</sup>University of Nevada, Reno.

At weaning (d 0, approximately 60 d after lambing), 15 mature, lactating Rambouillet ewes were divided into three groups to determine if restricting feed and water for 24 h after weaning would hasten the dry-off period. Treatments consisted of a control group in which the ewes remained with their lambs and continued to lactate, ewes with lambs weaned and no feed or water restriction, and ewes with lambs weaned as well as removal from feed and water for 24 h after weaning. Ewes with lambs weaned were maintained in a single pen following the 24-h feed and water restriction and received 1.6 kg alfalfa hay daily, while lactating ewes remained in a separate pen and received 2.7 kg of alfalfa and 0.3 kg of corn daily. Serum samples were taken daily for the 14-d observation period. Body weight and mammary area changes were recorded on d 0, 7 and 14 of the trial. Ewe BW ( $77 \pm 3.6 \text{ kg}$ ) were similar ( $P = 0.12$ ) at the initiation of the trial and remained similar for 14 d ( $P = 0.09$ ). Over the 14-d period (treatment x day,  $P = 0.34$ ), serum GH in lactating ewes averaged  $5.2 \pm 1.0 \text{ ng/mL}$  compared with  $5.4$  and  $3.0 (\pm 1.0) \text{ ng/mL}$  in weaned non-restricted and restricted ewes, respectively. Likewise, serum thyroxine was similar ( $P = 0.29$ ) and averaged  $78$ ,  $75$ , and  $71 (\pm 3) \text{ ng/mL}$  in the same three respective groups. Serum insulin did not differ ( $P = 0.18$ ) among groups on d 0 and 1 after which, ewes that continued to lactate had less insulin ( $P < 0.05$ ) than did either of the weaned groups from d 2 through d 6 ( $0.7$ ,  $1.8$ ,  $1.4 \pm 0.3 \text{ ng/mL}$  on d 6 in the three respective groups). From d 8 to 14, serum insulin was again similar among groups ( $P > 0.10$ ). During the 14-d period, mammary area increased ( $P < 0.01$ ) by 5% in lactating ewes and decreased by 41% and 30% in non-restricted and restricted ewes, respectively ( $P < 0.01$ ). A 24-h feed and water restriction at weaning did not hasten mammary involution but the process of weaning resulted in increased serum insulin concentrations.

**Key Words:** Sheep, Weaning, Hormones

**24 Growth of dairy calves fed with two different milk replacers in Mexicali, Mexico.** J.S. Saucedo-Quintero\*, L. Avendao-Reyes, and F.D. Alvarez-Valenzuela, *University of Baja California, Calexico*.

The objective was to compare some growth characteristics and costs in dairy calves fed with two different milk replacers during their first 60 d of age. Calves were fed 4 L of colostrum within 12 h of birth, and then they received 4 L of whole milk until 20 d of age. After that, calves were fed the following diets: 4 L of whole milk (CG, n=14 and average birth weight of 30.4 kg); 4 L of a commercial milk replacer 1 (MR1, n=13 and average birth weight of 33.1 kg); and 4 L of a commercial milk replacer 2 (MR2, n=13 and average birth weight of 32.3 kg). Calf starter and alfalfa hay were offered to all calves from the first week of age. Calves were maintained in the same pen during the trial. Response variables were weight at 20, 30, 40, 50 and 60 d of age, as well as daily weight gain from birth to 60 d of age and from 20 to 60 d of age. Statistical models were performed using the statistical software SAS. Body weight at 60 d of age was similar ( $P > .05$ ) for CG (58.8 0.8 kg) and MR2 (57.4 0.7 kg), and CG was higher ( $P < .05$ ) than MR1 (56.7 0.8 kg). Daily weight gain from birth to 60 d was higher ( $P < .05$ ) in CG (0.50 0.03 kg) than in MR1 (0.333 0.03 kg) and MR2 (0.394 0.03 kg), while daily weight gain from d 20 to d 60 was higher ( $P < .05$ ) in CG (0.55 0.03 kg) than in treatments MR1 (0.283 0.03 kg) and MR2 (0.383 0.03 kg). The cost of feeding during the 40 d of trial was 47.7, 32.5, and 44.2 dollars for treatments CG, MR1 and MR2 respectively. The results indicate that even though the use of milk replacers represents an economical alternative for raising replacements in the Mexicali valley, Mexico, growth performance of calves after weaning should be monitored in order to recommend a milk replacer.

**Key Words:** dairy calves, milk replacer, daily weight gain

**25 Influence of body temperature and metabolic disorders on milk production and reproduction in postpartum dairy cattle.** A.C. Fitzgerald<sup>\*1</sup>, J.C. Hilliard<sup>2</sup>, C.A. Rogers<sup>1</sup>, and M.L. Looper<sup>1</sup>, <sup>1</sup>New Mexico State University, Las Cruces, New Mexico, <sup>2</sup>BZJ Dairy, Mesquite, New Mexico.

Body temperature (BT) was monitored rectally in 42 primiparous cows and 93 multiparous cows for 7 d postpartum (PP). Relationships between BT and metabolic disorders (MD) on reproductive performance and subsequent milk production (Nov to Feb) in PP cows were determined. Body temperatures were considered increased for primiparous cows if > 39°C and > 39.5°C for multiparous cows. Daily BT was measured at 0730. Primiparous and multiparous cows with increased BT were orally administered four aspirin boluses and one probiotic supplement. This treatment regime was continued for two consecutive days. Seventy-six percent of primiparous cows and 28% of multiparous cows had increased BT during the first 7 d PP. Mean increased BT was 39.5 and 39.1°C for primiparous and multiparous cows, respectively. Increased BT at any time during the first 7 d PP did not affect ( $P > 0.10$ ) subsequent milk production. Primiparous and multiparous cows with MD had decreased ( $P = 0.07$ ) Feb milk production (31.5 kg) compared to cattle without MD (35.9 kg). Pregnancy rates were affected ( $P = 0.09$ ) by a parity x metabolic disorder interaction. Pregnancy rates at 90 d PP were 0 and 36% for primiparous cows with and without MD, respectively. Twelve percent of multiparous cows with or without MD were pregnant at 90 d postpartum. Primiparous cows with increased BT on d 1 or 2 PP had recurring increased BT at least once during the next 5 d PP ( $P = 0.06$ ). Increased BT did not recur ( $P > 0.10$ ) in multiparous cows that had increased BT on d 1 or 2 PP. Increased BT during the first 7 d PP was correlated ( $P < 0.05$ ) with MD for primiparous cows ( $r = 0.31$ ) and multiparous cows ( $r = 0.45$ ). More primiparous cows had increased BT during the first 7 d PP than multiparous cows. Increased BT was associated with MD, and MD decreased milk production and pregnancy rate in primiparous dairy cows.

**Key Words:** Postpartum cow, Body temperature, Metabolic disorder

**26 Semen collection from rams: Artificial vagina versus a vaginal collection vial.** M. C. Wulster-Radcliffe, M. A. Williams, J. N. Stellflug, and G. S. Lewis\*, USDA-ARS Sheep Experiment Station, DuBois, ID.

The time required to train rams to an artificial vagina (AV) makes collecting semen from large numbers of rams difficult. To manage this problem, we developed a glass, round bottomed, 1.75 cm i.d.  $\times$  8.9 cm long vaginal collection vial (VCV). Two experiments were conducted to determine whether the VCV affected 1) semen volume per collection and 2) percentage of motile spermatozoa and 3) forward progressive motility score before and after extension and after freezing and thawing. A soft rubber cap with a hole in the center was used to cover the VCV. A VCV was inserted into the vagina of an estrus ewe, and a monofilament line attached to the VCV was clipped to the wool near the vagina. Rams were joined with unrestrained ewes in a pen until they ejaculated into the VCV. In Exp. 1, five rams were used in a switchback design with four collection periods. During each period (1 d), semen was collected with an AV and a VCV. Immediately after collection, semen volume and motility were quantified. Semen was extended with an aloe vera-based diluent at a 1:4 dilution rate, motility was quantified again, and semen was frozen. At 1 h after freezing, semen was thawed and motility was quantified. Treatments did not affect ( $P > 0.05$ ) ejaculate volume (mean = 0.68 mL) or any measure of motility at any time after collection (i.e., before extension, after extension, or after freezing and thawing). In Exp. 2, 10 rams were used in a switchback design with five collection periods (period = 3 d). On d 1 and 3 of each period, either an AV or a VCV was used to collect semen. Immediately after collection, ejaculate volume and motility were quantified. Treatments did not affect ( $P > 0.05$ ) ejaculate volume (mean = 0.9 mL), percentage of motile cells, or forward progressive motility score. We conclude from these data that a VCV can be used to collect semen from rams that are not trained for semen collection, without decreasing ejaculate volume or sperm motility.

**Key Words:** Ram, Semen, Artificial vagina

**27 Influence of beef breeds (Brangus, Charolais, or Hereford) on locoweed consumption.** G. C. Duff<sup>\*1</sup>, M. H. Ralphs<sup>2</sup>, D. A. Walker<sup>1</sup>, J. D. Graham<sup>1</sup>, J. D. Rivera<sup>1</sup>, and L. F. James<sup>2</sup>, <sup>1</sup>Clayton Livestock Research Center, New Mexico State University, Clayton, <sup>2</sup>USDA-ARS Poisonous Plant Research Laboratory, Logan, UT.

A study was conducted over two years to evaluate the influence of beef breeds (Brangus, Charolais, and Hereford) on locoweed consumption. Steers for both years were purchased from Hope, AR and had never been exposed to locoweed. In year 1, 21 steers (seven/breed group) were used initially in the study on pastures located near Sofia, NM. Twenty-one steers (seven/breed group) were used in year 2 and pastures were located near Des Moines, NM. Steers were placed in separate pastures for each breed (3 pastures/year) and were rotated through pastures on a weekly basis. Locoweed intake was estimated by bite counts. Steers were observed for 5 min each starting at 0600 and at 1700, and the number of bites taken of cool and warm season grasses, forbs, and locoweed were recorded. Blood samples were collected on d 0, 7, 21, and 28. A breed x year interaction was observed for locoweed consumption. During year 1, Brangus cattle consumed more locoweed during the first week of the study than Charolais or Herefords (12, 2, and 3% of bites recorded for Brangus, Charolais, and Herefords, respectively); whereas, Charolais and Hereford cattle started consuming locoweed during wk 2 and 3 and did not differ from Brangus cattle during wk 2 and 3. During year 2, Brangus cattle consumed more ( $P < 0.10$ ) locoweed during wk 1 (15, 2, and 0%), wk 2 (6, 1, and 1%), and wk 3 (9, 4, and 0% for Brangus, Charolais, and Hereford, respectively) of the experiment compared with Charolais and Hereford cattle. No differences ( $P > 0.10$ ) for bite counts were noted between Charolais and Herefords during year 2. No differences were noted among breeds for serum alkaline phosphatase (AP) concentrations during year 1. Serum AP was increased ( $P < 0.01$ ) for Brangus vs Charolais and Hereford on d 7 and 14 during year 2. Results suggest that differences among breeds exist for locoweed consumption.

**Key Words:** Locoweed, Beef Breeds, Bite Counts

**28 Acute oral exposure of lactating ruminants to swainsonine and subsequent appearance in the serum, elimination in milk and subclinical toxicity in the mothers and nursing young.** J. B. Taylor<sup>\*1</sup> and J. R. Strickland<sup>2</sup>, <sup>1</sup>North Dakota State University, Fargo, <sup>2</sup>New Mexico State University, Las Cruces.

A series of experiments were conducted to investigate the elimination of swainsonine (SW) in the milk of lactating ruminants acutely exposed to SW and to assess subsequent subclinical effects on the mothers and their nursing young. In experiments 1 (ewes) and 2 (cows), lactating ruminants were exposed to locoweed providing .8 mg SW·kg<sup>-1</sup> BW for ewes (gavage; n = 4; BW = 75.8 ± 3.6 kg; lactation = 45d) and up to 2.0 mg SW·kg<sup>-1</sup> BW for cows (free choice; n = 16; BW = 389.6 ± 20.9 kg; lactation = 90 d). Serum and milk were collected at h 0 (before treatment), 3, 6, 12 and 24 for ewes and h 0 (before treatment), 6, 12, 18 and 24 for cows. Swainsonine was highest ( $P < .05$ ) by h 6 in the serum and milk of ewes. Consumption of at least .68 mg SW·kg<sup>-1</sup> BW induced ( $P < .05$ ) consistent ( $> .025 \mu\text{g} \cdot \text{mL}^{-1}$ ) appearance of SW in cow serum and milk with maximal concentrations occurring by h 12 ( $P < .05$ ). In experiment 3, lactating ewes (n = 13; BW = 74.8 ± 6.4 kg; lactation = 30 d) and cows (n = 13; BW = 460.8 ± 51.9 kg; lactation = 90 d) were exposed (gavage) to either 0, .2 or .8 mg SW·kg<sup>-1</sup> BW and individually penned with their nursing young. Serum and milk from the mothers and serum from the nursing young were collected at h 0 (before treatment), 3, 6, 9, 12 and 24. Ewe and cow serum and milk SW was higher ( $P < .05$ ) in the .8 mg treated group and maximal concentrations for both SW treatments occurred from h 6 to 12 h ( $P < .05$ ). Rises in alkaline phosphatase activity indicated subclinical toxicity in the treated ewes ( $P < .05$ ). Acute oral exposure of lactating ruminants to .2 and .8 mg·kg<sup>-1</sup> BW induces elimination of SW in both ovine and bovine milk and subclinical toxicity in lactating ewes; however, neither subclinical toxicity nor SW was detected in the serum of the nursing calves and lambs.

**Key Words:** Swainsonine, Ruminant, Milk

**29 A model for determining risk of pine needle abortion in cattle calving at different times of the year.** R. E. Short\*, M. D. MacNeil, and E. E. Grings, *USDA-ARS, Fort Keogh LARRL, Miles City, MT.*

Abortions in cattle caused by consumption of needles from Ponderosa pine trees (PN) are a significant risk for producers in the Western United States. This risk is determined by a combination of the risks of consumption of PN and of an effect once PN are consumed. Risk of abortions once PN have been consumed is affected by amount consumed and stage of pregnancy. Risk of cattle consuming PN is affected by many variables, the relative effects of which have not been determined, and include low temperature, wind speed, snow, storms, stress, age-of-cow, and nutrient intake and balance. We assumed that low temperature is one of the primary risk factors affecting consumption. Previous data on risks associated with stage of pregnancy were used to determine the regression of day of gestation when PN are eaten on the probability of abortions (PA). This regression was: PA = -88 + .74 d with PA being 0 from 0 to 120 d of gestation and then increasing to 1 from 255 d through calving. A 107-year data set (1893 to 2000) for Miles City, MT, was used to determine the probability of temperatures being  $\leq -10^{\circ}\text{C}$  (PT). Daily PT were averaged for bimonthly (1st and 15th) intervals and were 0 from April 15 through Oct. 15 and then were .05, .19, .33, .45, .55, .56, .59, .49, .39, .19, and .07 from Nov. 1 through April 1. Cows were simulated to calve at 24 bimonthly intervals (1st and 15th). Daily PT were multiplied by the PA curve of an abortion and summed across days to obtain a cumulated relative risk (CRR) by calving date. CRR was 1 for cows calving Nov. 1 and 4, 9, 15, 23, 31, 39, 42, 45, 43, 39, 33, 27, 20, 15, 10, 6, 4, 2, 1, 0, 0, 0, and 0 for each of the 23 subsequent bimonthly periods. CRR was high for cows calving from Jan. 15 through May 1 with maximal risk on March 1. We conclude that date of calving may be used as a tool to decrease risk of PN induced abortions in cattle with minimal risk occurring for cows calving from June 1 through Dec. 15. Risks will vary by location because of differences in PT.

**Key Words:** Pine Needle Abortion, Risk, Calving Date

**30 Inhibitory effect of nitrocompounds on ruminal methane production in vitro.** R. C. Anderson<sup>\*1</sup>, T. R. Callaway<sup>1</sup>, J. S. Van Kessel<sup>2</sup>, and D. J. Nisbett<sup>1</sup>, <sup>1</sup>USDA/ARS, Food and Feed Safety Research Unit, College Station, TX, <sup>2</sup>USDA/ARS, Animal Waste Pathogen Laboratory, Beltsville, MD.

Ruminal methane ( $\text{CH}_4$ ) production is an inefficient process that results in losses of 2 to 12% of gross energy intake. Presently, we tested the effect of three potential inhibitors of ruminal  $\text{CH}_4$  production in vitro. Ruminal fluid collected from a cow maintained on an alfalfa:flaked corn diet (1:1) was incubated ( $39^{\circ}\text{C}$ ) for 24 h under 100%  $\text{CO}_2$  in closed tubes (10 ml/tube) supplemented with 72 mM sodium formate and 12 mM 2-nitropropanol, nitroethane or nitroethanol. Control cultures contained no added nitrocompound. Presented values are the mean  $\pm$  SE from  $n = 3$  and tests for significance were accomplished using an analysis of variance. Methane production was reduced ( $P < 0.05$ ) from control incubations ( $27.6 \pm 2.1 \mu\text{mol}/\text{ml}$ ) by more than 10-fold by all nitrocompounds ( $2.6 \pm 0.4$ ,  $1.5 \pm 0.4$  and  $1.4 \pm 0.1 \mu\text{mol}/\text{ml}$  for 2-nitropropanol, nitroethanol and nitroethane, respectively). By comparison,  $\text{CH}_4$  production is typically reduced by about 33% when cattle are fed the widely used ionophore, monensin. Contrary to expectations, concentrations of acetate, propionate and butyrate produced by nitrocompound supplemented cultures were not significantly different than those produced by control cultures ( $62.1 \pm 5.1$ ,  $15.8 \pm 1.1$  and  $11.0 \pm 1.91 \mu\text{mol}/\text{ml}$ , respectively) indicating that reductant was not redirected toward the production of more reduced fermentation acids. However,  $\text{H}_2$  did accumulate in cultures supplemented with the nitrocompounds ( $2.8 \pm 0.2$ ,  $2.1 \pm 0.6$  and  $1.9 \pm 0.2 \mu\text{mol}/\text{ml}$  for 2-nitropropanol, nitroethanol and nitroethane, respectively). These results indicate that energetic efficiencies associated with microbial interspecies  $\text{H}_2$  transfer were diminished and suggests a possible role for using nonmethanogenic  $\text{H}_2$  oxidizing bacteria as a way to maintain an electron sink typically beneficial to the fermentations. Future research in this area may lead to the development of strategies that reduce economic losses associated with ruminal  $\text{CH}_4$  production.

**Key Words:** Methane, Rumen, Nitrocompound

**31 Responses to supplements differing glucogenic potential fed to young postpartum range beef cows.** R.C. Waterman\*, L. Canales, R.L. Ashley, J.E. Sawyer, J.B. Taylor, G.D. Pulsipher, N.H. Wells, C.P. Mathis, D.E. Hawkins, G.B. Donart, E.E. Parker, S.H. Cox, J.A. Hartung, J. Horton<sup>1</sup>, and M.K. Petersen,  
<sup>1</sup>Kemin Industries, Inc. Des Moines, IA.

Cattle grazing winter range forage may be limited by precursors for gluconeogenesis. The major precursors are protein and propionate. A study conducted at the Corona Range and Livestock Research Center evaluated supplements differing in source and quantity of glucogenic precursors, using supplements varying in undegradable intake protein (UIP) content, with or without addition of propionate salt, to young postpartum beef cows ( $n = 51$ ). Supplements were fed at  $908 \text{ ghd}^{-1}\text{d}^{-1}$  and provided 327 g CP, 118 g UIP (loglu); 360 g CP, 175 g UIP (midglu); 360 g CP, 180 g UIP + 100 g propionate salt (highlu; NutroCal<sup>TM</sup>, Kemin Industries, Inc.). Supplements were formulated to be isoenergetic and approximately isoruminally degradable. Supplements were individually fed for 90 d postpartum  $2 \times \text{wk}^{-1}$ . Results were analyzed by ANOVA and treatment effects were computed using contrasts loglu vs midglu + highlu and midglu vs highlu. No midglu vs highlu comparisons were significant so only loglu vs midglu + highlu are reported. Days to lowest BW post-partum were similar ( $P > 0.05$ ) among supplemented cows (43 vs 45 and 48 3.7 d for loglu vs midglu + highlu). Average daily gains were higher ( $P < 0.1$ ) for midglu and highlu supplemented cows from BW nadir to the end of breeding (0.30 vs 0.36 and 0.33 0.05  $\text{kgd}^{-1}$  for loglu vs midglu + highlu, respectively). Milk yield ( $\text{gd}^{-1}$ ) were greater ( $P = .107$ ) for midglu and highlu supplemented cows (4879 vs 6261 and 5578 531  $\text{g}^{-1}$  for loglu vs midglu + highlu, respectively). These results suggest young cows receiving supplements higher in UIP with or without propionate salt can recover sooner from BW nadir while producing more milk.

**Key Words:** Protein Supplements, Propionate, Glucogenic Precursors

**32 Influence of fat-supplementation on beef cow reproduction and calf performance.** B. M. Alexander, D. L. Hixon, B. W. Hess, B. L. Garrett, J. D. Bottger\*, and G. E. Moss, *University of Wyoming, Laramie.*

Effects of fat supplementation on cow reproduction and calf performance were evaluated using Angus x Gelbvieh cows. High Fat Range Supplement (HFRS) and HFRS-SPH (same product as HFRS except differing fat source; Consolidated Nutrition, Omaha, NE) were compared to an isocaloric, isonitrogenous corn-soybean (CON) supplement. In Exp. 1, primiparous cows were individually fed (CON,  $n = 12$ ; HFRS,  $n = 12$ ; HFS  $n = 10$ ) for approximately 56 d prepartum. Heifer body condition score (BCS; 1 = emaciated, 9 = obese) did not differ ( $P = 0.78$ ) among groups and averaged 5.3 .02 and 4.7 .05 pre- and postpartum, respectively. Milk production and samples for analysis of fat, protein, somatic cells and milk solids were collected at d 30, 60 and 90 postpartum. Milk production was greater ( $P < 0.01$ ) in HFRS than CON supplemented cows, while somatic cell counts were greater ( $P < 0.01$ ) in CON than HFRS or HFRS-SPH supplemented primiparous cows. However, calf body temperature, vigor at birth, birth weight, and weight gain did not differ ( $P > 0.1$ ). Serum concentrations of IGF-I before and during the postpartum interval were not ( $P = 0.32$ ) influenced by diet. Neither number of cows cycling by 90 d postpartum ( $P = 0.15$ ) or length of the postpartum interval differed ( $P = 0.25$ ) among groups. In Exp. 2, multiparous cows were randomly assigned to one of four isocaloric, isonitrogenous supplements: CON ( $n = 49$ ), fed 56 d pre- to 56 d postpartum; HFRS fed 56 d pre- and CON fed 56 d postpartum ( $n = 47$ ); HFRS-SPH fed 56 d pre- and CON fed postpartum ( $n = 49$ ); or CON fed pre- and HFRS-SPH fed 56 d postpartum ( $n = 49$ ). At parturition, cows fed the CON supplement were in better BCS (5.8 .1;  $P < 0.001$ ) than cows fed either commercial supplement (5.4 .1). Calf performance, first service and overall conception rates, however, did not differ among treatments ( $P > 0.1$ ). Although fat supplementation may have beneficial effects, in the current study these effects were not beyond those garnered by supplements providing equal protein and energy in heifers and cows in moderate body condition.

**Key Words:** Fat Supplementation, Reproduction, Beef Cows

**33 Effects of feed mixing time on performance, in vitro dry matter disappearance, and carcass characteristics in finishing cattle.** K. J. Malcolm-Callis\*, G. C. Duff, D. A. Walker, and M. W. Wiseman, *Clayton Livestock Research Center, New Mexico State University, Clayton*.

Sixty-six beef steers (Angus or Beefmaster crosses; 365 9.9 kg) were used to evaluate two mixing times (30s or 8 min) of concentrate diets on performance, carcass characteristics, and in vitro digestion. Eight pens (4 pens /treatment) were used. Steers were finished with concentrate diets containing 9.84% sudangrass hay, 9.76% whole corn, 66.06% steam-flaked corn, 4.63% molasses, 2.42% fat, 3.68% soybean meal, 2.64% major minerals and 0.97% premix added in the respective order. Treatments were constructed by mixing diets for 30s or 8 min immediately following addition of the final ingredient (average 4.24 min for addition of all ingredients). Average daily gain was greater ( $P < 0.05$ ) for steers fed the 8 min mixed diet from d 28 to 56, d 84 to 112, and ( $P < 0.10$ ) for d 0 to 112 (1.90, 1.31, and 1.85 kg/d respectively). However, ADG was greater ( $P < 0.05$ ) among steers offered the diet mixed for 30 s during d 56 to 84 (1.43 kg/d). Time of mixing did not affect ( $P > 0.10$ ) daily DMI. No differences ( $P > 0.10$ ) were observed in gain:feed for d 0 to 28; however, gain:feed was improved ( $P < 0.05$ ) for d 28 to 56 and d 84 to 112 among steers receiving the diet mixed for 8 min. In contrast, gain:feed was improved ( $P < 0.01$ ) in steers receiving the diet mixed 30 s for d 56 to 84. Mixing time had no effect ( $P > 0.10$ ) on IVDMD at 6, 12 or 24 h. At 48 h, IVDMD was greater ( $P < 0.10$ ) for the diet mixed 8 min vs 30s. No differences ( $P > 0.10$ ) in carcass characteristics were observed between diet mixing times. Results from this study suggest that mixing time may influence performance of finishing beef cattle. Mixing time did not influence in vitro digestibility or carcass quality in this study. More research needs to be conducted evaluating mixing times on ruminal fermentation patterns and possible effects on subacute acidosis.

**Key Words:** Feed mixing, Beef cattle, Performance

**34 Comparison of Maximum Stabilized Enzyme of Russelville, Arkansas and monensin/tylosin as feed additives for feedlot steers.** D. W. Bailey<sup>1</sup>, D. C. Anderson<sup>1</sup>, D. L. Boss<sup>1</sup>, G. R. Welling<sup>\*1</sup>, and D. D. Kress<sup>2</sup>, <sup>1</sup>*Northern Agricultural Research Center, Havre, MT*, <sup>2</sup>*Montana State University, Bozeman*.

A study was conducted to compare feedlot performance and carcass characteristics of steers fed Maximum Stabilized Enzyme of Russellville, Arkansas (MSE) or monensin / tylosin (M/T) as feed additives. Steers (n=81) were stratified by sire breed (Angus, Charolais, Piedmontese, Salers, Tarentaise and Hereford) and randomly allocated to the MSE and M/T treatments. The barley, corn silage, hay and protein supplement ration was identical for each treatment except for the feed additives. For the MSE treatment, MSE was added to the ration at a daily rate of 1 kg MSE per 40000 kg of steer body weight (average intake was 12 g MSE d<sup>-1</sup>). Steers in the M/T treatment received 300 mg of monensin per day and 90 mg of tylosin phosphate per day. During the first three 28-day periods, average daily gain of MSE steers ( $1.53 \pm 0.03$  kg d<sup>-1</sup>) was greater ( $P=0.06$ ) than steers in the M/T treatment ( $1.45 \pm 0.04$  kg d<sup>-1</sup>). During the last period, gains were similar ( $P=0.3$ ) for both treatments. Hot carcass weight ( $P=0.01$ ), fat thickness ( $P=0.01$ ), % KPH ( $P=0.06$ ) and rib-eye area ( $P=0.04$ ) of the MSE steers were greater than MSE steers. Marbling ( $P=0.2$ ), quality grade ( $P=0.4$ ) and yield grade ( $P=0.6$ ) were similar for both treatments. Almost no indications of illness were observed in either treatment. No steers were treated for bloat, and there were no condemned livers. In this study, steers fed MSE had heavier carcasses, greater fat thickness, more KPH and larger rib eye areas than steers fed M/T, however quality and yield grades were similar between treatments.

**Key Words:** Maximum Stabilized Enzyme, Monensin, Carcass

**35 Night Feeding of Growing Cattle in Hot Summer Relieved Heat Load and Tended to Increase Growth Efficiency.** Arieh Brosh\*, Yoav Aharoni, Pavel Korilov, and Ala Orlov, *Animal Science, ARO Neve-Yaar, Ramat Yishay, Israel*.

Under heat-load conditions eating and digestion may cause an increased heat load if they coincide with the hottest part of the day. The studies were designed to assess the effect of time of feeding on the heat production (HP) pattern during the day and on performance and efficiency. The presented data are derived from three summer studies, of about 90 days each year, located at two feedlots. One lot was unshaded; in the other shade was provided by a 3- to 4-m-high roof, covering about one-third of the yard. Holstein and beef-breed fattening calves, and growing beef heifers were used. In each feedlot each year animals were separated by breed, gender and age, and into two treatments, day and night fed. The day-fed animals received most of the feed during the day; the night-fed animals, during the night. Intake and efficiency were measured on group basis. During the years we used 417 animals, separated into 11 groups in each treatment. Heart rate (HR) and skin temperature were recorded throughout the day by data loggers harnessed to the chest behind the forelegs. In one year, HP throughout the day was calculated by multiplying HR by the measured HP per heartbeat. The night-fed cattle manifested the lowest HP during the hottest hours of the day, but the full-day HP was reduced only a little by night feeding. Overall, the 3-year study showed that time of feeding did not affect growth rates: 1.259 and 1.266 kg/day for the day- and night-fed, respectively (SED 0.048,  $P<0.89$ ). Night feeding significantly reduced DM intake, from 7.325 to 6.693 kg/day (SED 0.246,  $P<0.021$ ), and tended to increase feed efficiency (gain per unit intake), from 177 to 194 (g gain per kg DM intake; SED 8.9,  $P<0.083$ ).

**Key Words:** Time of feeding, Heat load, Heat production

**36 Evaluation of market impacts on growth path management strategy.** B.J. Renquist\* and J.W. Oltjen, *University of California, Davis*.

Economic conditions demand that beef producers consider market impacts on growth path management strategy. Our objective was to develop a model of beef cattle growing-finishing patterns that would allow economic evaluation for different market conditions. In this study, patterns are defined as the amount of time post-weaning on three nutritional regimes—irrigated pasture, range, and feedlot. Different market conditions include variable land rent, feed costs, and carcass grid prices. Our previous dynamic growth and intake models allow for this evaluation with the addition of an economic submodel. The economic routine compiles data from the intake and growth submodels and evaluates each daily for profit or loss. This model is deterministic and data compiled applies to the average weaned steer calf within a group with initial body condition score of five and weight of 182 kilograms. Because the model predicts body composition, animals were slaughtered at 33.5% body fat. Initial results suggest that expenses are direct indicators of profit. Comparison of pasture, range, and feedlot costs determined their relative effect upon total expenses. Profit disturbances associated with pasture rent costs are minimal in this model application. Varying rental costs from \$5/AUM to \$32/AUM decreased profit associated with pasture by \$56, but had little effect upon relative value of growing-finishing patterns. Range cost alterations had a more significant effect upon relative profits. An increase in rent from \$5/AUM to \$25/AUM decreased profits in the rangegrown animals by \$180. Unexpectedly, feed costs had little effect upon the comparison of these three growth patterns. The increased daily intake by animals that spent time on pasture or range decreased the variability of total intake. The results of this investigation indicated that feedlot costs are stable throughout the growing-finishing patterns. Therefore, profit adjustments, under these conditions, varied with range and pasture rent. This model can be modified for various locations and feeding conditions for more extensive application.

**Key Words:** Growth, Composition, Mathematical Modeling

## EXTENSION

### 37 Meeting carcass quality specifications and carcass characteristics of Northern California cattle in alliance, futurity and youth programs. D.J. Drake\* and L.C. Forero, University of California-Davis, Cooperative Extension.

Carcass data from three sources were used to demonstrate data processing appropriate for Extension educational programs and to provide benchmark values. Means, histograms and percent meeting multiple carcass quality specification were used to describe carcass characteristics. Overall means (SD) (n=2516) were: carcass weight 335 kg (36), YG 2.96 (.70), ribeye area 83.9 cm<sup>2</sup> (9.0), backfat thickness 1.22 cm (.41), and quality grade of Select +. Differences in means were significant ( $P<0.05$ ), but small between sources of cattle. Histograms and normal curve distributions showed wide variation particularly for carcass weight and marbling. Projections based on normal distributions provided quantitative values for carcasses not meeting specifications, further describing variation. Alliance cattle meeting 5 carcass specifications ranged from 8 to 58 percent across ranches. More ( $P=0.02$ ) heifers (41 percent) satisfied specifications than steers (21 percent) when pooled among ranches. Differences between alliance, futurity and youth sources were small and suggest youth and futurity programs provide examples of potential alliance carcass characteristics. These data suggest Extension programs emphasize individual performance and include management as well as genetics in value-based production.

**Key Words:** Cattle, Carcass, Alliance

### 38 Selenium supplementation of beef cattle via fertilizer amendment. R. L. Hathaway\*, J. E. Oldfield, S. G. Paxton, and G. J. Pirelli, Oregon State University, Corvallis.

Selenium was recognized as an essential nutrient in the 1950's. A deficiency of the trace mineral is associated with several diseases, which include abnormal growth or mortality. There are several methods by which Se can be provided to animals in areas where deficient. The most popular methods are the use of injectables and/or trace mineral supplementation. Lesser is known about providing Se as a fertilizer amendment. Therefore, this trial was conducted for to compare supplementing Se to beef cattle via forage fertilization with a traditional oral salt-mineral Se supplementation. Pregnant mature cows were assigned at random to two groups: Se supplementation via salt-mineral supplement with 52 ppm Se (mineral), or a conserved forage that was previously fertilized with 10 grams of Se per hectare (forage). All cows consumed diets deficient in Se from June to December. In December 1999 all cows were assigned to conserved forage diets that reflected the above Se supplementation strategies. Conserved forage was analyzed for Se levels and blood samples were analyzed for whole blood Se. Conserved forage Se levels were 0.033 for the non-Se fertilizer forage and 0.225 ppm for the Se-fertilized forage. Blood samples collected from the cows in December were similar ( $P > 0.05$ ) 0.097 and 0.091 ppm Se

for mineral and forage, respectively, below the normal range. January 2000 blood levels were higher ( $P < 0.01$ ) for the cows fed forage from Se fertilized fields, 0.170 and 0.469 ppm Se for mineral and forage, respectively. Blood samples collected from newborn calves within 24 h of birth (taken in February and March 2000) were also higher ( $P < 0.01$ ) for cows fed Se fertilized forage compared to cows provided traditional Se trace mineral salt, 0.225 and 0.509 ppm for mineral and forage, respectively. Our data suggest Se fertilizer is an effective way to improve Se status of forage and a means of providing supplemental Se when used as wintering forage for late gestation beef cows and their calves.

**Key Words:** Beef Cattle, Selenium Supplementation, Fertilization

### 39 A systems approach for reducing morbidity of feeder calves. D.J. Fennewald\*, J.A. Paterson, R.J. Lipsey, P.J. Burfening, R.N. Funston, J. Peterson, and L.P. Anderson, Montana State University, Bozeman.

**ABSTRACT:** Two thousand, eight hundred and ninety-eight calves from 12 ranches in MT were individually identified with electronic ear tags to determine if a standardized weaning protocol could reduce morbidity from weaning to harvest. Freshly weaned calves were allocated to 1) CONTROL (defined as present weaning practices which may or may not provide pre-weaning vaccinations and do not retain calves for 45 d after weaning) or 2) TREATMENT (calves fed 1.82 kg/d of a wheat mids based-pellet for 28 d containing additional levels of Cu, Zn, Mn, Se, CP, vitamins A and E and a coccidiostat (Decox#) and were backgrounded for 45 d before shipment). All ranches vaccinated calves with both viral and clostridial vaccines (MLV or killed). Calves were fed in six states. Seven of the ranches divided calves into control and treatment groups (826 and 855, respectfully) while three ranches had only treatment ( $n = 835$ ) and two ranches had only control ( $n = 382$ ). Results suggested calf morbidity from weaning until harvest was reduced ( $P < 0.05$ ) for calves backgrounded for 45-d or longer compared to calves backgrounded less than 45 d (6 vs. 21%). Death loss was lower ( $P < 0.001$ ) for 45-d backgrounded calves (0.3%) compared to calves backgrounded less than 45-d (2.4%). Although not significant ( $P=0.17$ ) calves fed the weaning pellet for 28 d following weaning numerically had lower morbidities from weaning until harvest (6.3%) compared to control calves (19.5%). Range in morbidities was 0-100% for CONTROL vs. 0.5-20.9% for TREATMENT. Boosting vaccinations 14-28 d after initial vaccinations appeared to reduce ( $P=0.18$ ) morbidity in the feedlot (7.4% for calves that received boosters vs. 21% for calves that received a single vaccination). Results from this first year's study suggest that morbidity and death loss of weaned calves may be reduced when a systematic approach includes attention to nutrition, proper vaccination and 45-d backgrounding. Future work will emphasize the effect that morbidity has on feedlot performance and carcass value.

**Key Words:** Beef cattle, Weaning, Morbidity

## GRADUATE STUDENT COMPETITION

### 40 Supplementation of undegradable intake protein to yearling heifers grazing flood-meadow pastures. C.A. Stonecipher\*, D.R. ZoBell, K.C. Olson, and B.R. Bowman, Utah State University, Logan.

The effect of an undegradable intake protein (UIP) source on performance, diet digestibility, and forage intake of yearling heifers grazing flood-meadow pastures was studied over 2 consecutive summers (1999 and 2000) at Logan, Utah. Crossbred yearling beef heifers composed of varying proportions of Angus, Hereford, Tarentaise, and Gelbvieh ( $n=48$  in 1999;  $n=47$  in 2000) were blocked according to weight, age, and breed into one of two treatments (control, receiving no supplement; and supplement, receiving a mixture of 0.906 kg per d of ground corn and 0.453 kg per d of Soybest®). Heifers were weighed at 28 d intervals. The rumen evacuation technique was used to collect diet samples. Diet digestibility was estimated using indigestible acid detergent fiber as an internal marker. In 1999, fecal output was estimated using chromic oxide from sustained release boluses as an external marker. Forage intake was calculated from fecal output and diet digestibility. Diet and fecal sampling were conducted in 2 periods (early July and September). Data were analyzed in a completely randomized design.

Total organic matter intake expressed as kg per d did not differ among treatments ( $P>0.15$ ), but was higher in the control group on a percentage of body weight basis ( $P=0.03$ ). Supplementation did not affect organic matter digestibility (OMD) in July 1999, but increased OMD in July 2000. Supplementation increased OMD in September 1999, but decreased OMD in September 2000. Supplementation did not affect NDF digestibility in July 1999, but increased NDF digestibility in September 1999 ( $P<0.01$ ). Weights increased as the season progressed ( $P<0.01$ ) but did not differ among treatments ( $P=0.10$ ). However, supplementation increased ADG ( $P<0.01$ ), particularly during the latter part of the grazing season. Weights ( $P<0.01$ ) and ADG ( $P=0.06$ ) were higher in 2000. Undegradable protein supplementation may be beneficial to heifers that need to increase ADG during the grazing season but may not be warranted for heifers that are adequate in weight.

**Key Words:** Beef heifers, Protein supplementation, Meadow pastures

**41 Does troponin-T degradation, collagen percentage or collagen crosslinking explain differences in tenderness between Wagyu and Limousin cattle?** P.S. Kuber<sup>\*1</sup>, J.R. Busboom<sup>1</sup>, E. Huff-Lonergan<sup>2</sup>, S.K. Duckett<sup>3</sup>, P.S. Mir<sup>4</sup>, Z. Mir<sup>4</sup>, R.J. McCormick<sup>5</sup>, M.V. Dodson<sup>1</sup>, C.T. Gaskins<sup>1</sup>, and D.J. Marks<sup>1</sup>, <sup>1</sup>Washington State University, Pullman, <sup>2</sup>Iowa State University, Ames, <sup>3</sup>University of Idaho, Moscow, <sup>4</sup>Agriculture and Agri-Food Canada, Lethbridge, AB, <sup>5</sup>University of Wyoming, Laramie.

*Longissimus* muscle (**LM**) from 12 Wagyu (**W**), 12 Wagyu x Limousin (**WxL**) and 12 Limousin (**L**) steers fed two dietary treatments (0 or 6 % sunflower oil) were evaluated for Troponin-T (**TN-T**) proteolytic degradation, % collagen (**OH-Pro**) and collagen crosslinking (**HP**). A barley-based diet was fed during both the backgrounding (100 d) and finishing phase (159 d), with or without supplemental oil. Cattle were humanely slaughtered and at 24 h postmortem (**PM**), steaks (2.54 cm) were removed, packaged, aged (2°C for 1, 3, 7, 14, 28, and 56 d PM) and frozen (-40°C). Dietary treatment did not affect ( $P > 0.05$ ) any tenderness attributes. Across all aging times, Warner-Bratzler shear force (**WBS**) values of LM steaks were lower ( $P < 0.05$ ) in W than L. At d 1, W required slightly more force ( $P > 0.05$ ) to shear than WxL or L (0.3 and 0.11 kg respectively), however by d 14 WBS values were lower ( $P < 0.05$ ) for W than L (0.767 kg). Wagyu steaks received higher ( $P < 0.05$ ) sensory panel sustained tenderness (**SusT**) scores than L at d 14. Western Blot analysis, measuring TN-T degradation, indicated that the appearance of the TN-T 30kda degradation fragment increased during aging ( $P < 0.0001$ ) over all breeds. Rate of TN-T fragment appearance was slower ( $P < 0.05$ ) in L than W over all aging times. Breed did not affect ( $P > 0.1$ ) OH-Pro or HP in d1 steaks (1.25 cm). More tender steaks typically have a rapid appearance of TN-T degradation product; in this study W were more tender than L, paralleling a more rapid rate of proteolytic degradation. Furthermore, tenderness differences were not explained by OH-Pro or HP therefore proteolysis maybe responsible for differences in tenderness between W and L steaks.

**Key Words:** Troponin-T, Collagen, Wagyu and Limousin

**42 Effect of an endothelin-1 receptor antagonist on serum progesterone levels in the mid-luteal bovine corpus luteum.** D. J. Denniston\*, K. K. Kane, W. D. Bryant, L. Canales, and D. E. Hawkins, New Mexico State University, Las Cruces.

Endothelin-1 (ET-1) is an endothelial cell-derived protein, expressed at greatest levels at luteolysis. The increase in ET-1 at luteolysis has recently been implicated to play a role in demise of the CL. The current hypothesis tested whether blocking of the ET-1 receptor would prevent luteolysis of the mid-luteal bovine CL after treatment with prostaglandin F<sub>2α</sub> (PGF<sub>2α</sub>). Objectives were to investigate effects of the ET-1 receptor antagonist, BQ-123, infused *in vivo* into the mid-luteal bovine CL, via needle-guided transvaginal ultrasonography. Ten to 12 d post ovulation, heifers with mid-luteal CL ( $n = 32$ ) were randomly assigned to one of three treatments: phosphate buffered saline (PBS),  $10^{-5}$ M BQ-123 (high), or  $10^{-7}$ M BQ-123 (low). Heifers in each treatment group were further randomly assigned to receive 5 mg (i.m.) PGF<sub>2α</sub> at either 2 or 4 h post infusion. All heifers were treated with PGF<sub>2α</sub> at one of the two time periods to determine if PGF<sub>2α</sub> in the absence of ET-1 binding would effectively cause luteolysis. To quantify serum progesterone (P<sub>4</sub>) secretion, blood was collected via caudal venipuncture at the time of infusion and every 60 min until treated with PGF<sub>2α</sub>. Following PGF<sub>2α</sub> injection, blood was further collected every 60 min for 360 min and at 12, 24 and 36 h post infusion. Mean serum P<sub>4</sub> concentrations were not different among the control, high, or low treatment groups (7.0 ng /mL, 7.1 ng /mL, 6.3 ng /mL  $\pm$  0.3;  $P > 0.05$ ). Additionally, no differences in mean serum P<sub>4</sub> concentrations were detected between those animals receiving PGF<sub>2α</sub> at 2 h compared to 4 h post infusion ( $P > 0.05$ ). In conclusion, mid-luteal bovine CL treated *in vivo* with BQ-123 did not maintain higher P<sub>4</sub> concentrations. Further, those heifers treated with PGF<sub>2α</sub> 4 h post infusion did not maintain higher concentrations of serum P<sub>4</sub> than their counterparts receiving PGF<sub>2α</sub> 2 h after treatment with BQ-123.

**Key Words:** Bovine Corpus Luteum, Endothelin, Progesterone

**43 Effect of ammoniation on digestibility of bluegrass seed straw in beef cattle.** J. I. Szasz<sup>\*1</sup>, C. W. Hunt<sup>1</sup>, L. R. Kennington<sup>1</sup>, G. T. Pritchard<sup>1</sup>, A. V. Grove<sup>1</sup>, K. A. Johnson<sup>2</sup>, and S. M. Parish<sup>2</sup>, <sup>1</sup>University of Idaho, Moscow, <sup>2</sup>Washington State University, Pullman.

Environmental regulations restrict burning of grass seed residue which has created interest in improving the nutritional value of these residues for livestock. Eighteen bales of bluegrass seed straw (average 227 kg) were obtained to evaluate the effect of 0 (**A0**), 3 (**A3**) and 5 (**A5**) percent ammoniation on nutrient composition and ruminal degradability. Ammoniation increased ( $P < 0.05$ ) CP content of bluegrass straw (3.6, 11.6 and 13.9% for A0, A3, and A5, respectively); however, NDF content was not affected by treatment. In situ DM degradability at 24 h was the same for A0 and A3 straw, but was greater ( $P < 0.05$ ) for A5 straw (40.6, 41.8, and 46.1%, respectively). In situ NDF degradability at 24 h was greater ( $P < 0.05$ ) for A3 and A5 straws compared to A0 straw (36.3, 41.1 and 31%, respectively). Four ruminally cannulated mature beef steers were used in a 4 x 4 Latin square design to determine the effects of ammoniation or added DIP (urea) on digestion of bluegrass straw. Dietary treatments were A0, A3, A5, and A0 plus supplemental DIP. In situ DM and NDF degradabilities were greater ( $P < 0.05$ ) for A5 than other treatments ( $P < 0.10$ ) at 24, 36, 48, and 96 h of ruminal incubation. Similarly, total tract DM, OM, NDF, and ADF digestibilities were greater ( $P < 0.05$ ) for A5 compared to all other dietary treatments. Differences in DM and OM digestibility were not observed between the other treatments. Averaged across sampling times, acetate:propionate ( $P < 0.10$ ) was greater when steers were fed A5 compared to the other treatments. Ammoniation of grass seed straw at the 5% level enhanced digestibility more than the 3% level. Supplemental DIP increased ruminal ammonia but was not effective in increasing digestibility.

**Key Words:** Crop residue, Chemical treatment, Beef cattle

**44 Dietary safflower seeds influence 18:1<sup>trans-11</sup> and conjugated linoleic acids (CLA) of lamb carcasses.** M. R. Bolte\*, B. W. Hess, W. J. Means, G. E. Moss, and D. C. Rule, University of Wyoming, Laramie.

Our objective was to determine effects of dietary high-oleate (OLE; 76% oleate) or high-linoleate (LIN; 78% linoleate) safflower seeds on fatty acids (FA) in muscle and adipose tissue of feedlot lambs. White-faced ewe lambs ( $n = 36$ ) were fed a basal diet (82.2% beet pulp pellets, 9.5% oat hay, 6.0% molasses, 1.5% soybean meal, and 0.8% mineralized salt; CON), blocked by BW, and allotted randomly to dietary treatments (CON, OLE, or LIN). Safflower seeds were used in isocaloric and isonitrogenous replacement of beet pulp, oat hay, and soybean meal so that OLE and LIN diets contained 7.1% crude fat. Tissue FA were determined in *M. Semitendinosus* (St), *M. Longissimus dorsi* (Ld), and adipose tissue from the tail head (Th), adjacent to the 12<sup>th</sup> rib (SQLd), and kidney and pelvic fat (Kp) depots. Tissue FA data were analyzed as a split-block design. Single degree of freedom orthogonal contrasts were used to compare effects of OLE and LIN vs. CON and OLE vs. LIN. Average daily gain, feed efficiency, and carcass characteristics did not differ ( $P \geq 0.16$ ) across dietary treatments. Dietary treatment  $\times$  tissue type interactions were detected ( $P \leq 0.05$ ) for most individual FA. When pooled across tissue type, saturated FA tended to be greater ( $P = 0.08$ ) for CON, but monounsaturated FA were not affected ( $P \geq 0.11$ ) by diet. However, 18:1<sup>trans-11</sup> was greater ( $P < 0.0001$ ) in tissues of lambs fed safflower seeds and in LIN than OLE. Safflower-supplemented lambs had greater ( $P < 0.0001$ ) PUFA, but PUFA did not differ ( $P = 0.13$ ) between OLE and LIN. Total CLA (*cis*-9, *trans*-11 and *cis*-10, *trans*-12) were greater ( $P < 0.0001$ ) in tissues of lambs fed safflower seeds and in LIN than OLE. Weight percentages of 18:1<sup>trans-11</sup> ranked Th > Kp > SQLd > St > Ld, whereas CLA ranked Th > SQLd > St > Kp > Ld. Feeding poly- and mono- unsaturated FA increased tissue 18:1<sup>trans-11</sup> and CLA, which is a favorable change in regard to current human dietary guidelines.

**Key Words:** Fat Supplementation, Transvaccenic Acid, Conjugated Linoleic Acid

**45 Characterization of ruminal protein degradation in potential forages for irrigated pastures in the Intermountain West.** A.A. Davis<sup>1</sup>, K.C. Olson<sup>1</sup>, D.B. Vagnoni<sup>2</sup>, and G.A. Broderick<sup>3</sup>, <sup>1</sup>Utah State University, Logan, <sup>2</sup>Cargill Animal Nutrition Center, Elk River, MN, <sup>3</sup>U.S. Dairy Forage Research Center, Madison, WI.

Three protein degradation techniques were performed on 6 cool-season forages that are commonly grown in the Intermountain West. The objectives were to (1) compare *in situ*, commercial protease, and inhibitor *in vitro* techniques for degradable intake protein (DIP) values, (2) determine if either *in vitro* technique could be a viable commercial lab technique for similar forages, and (3) build a database containing protein characteristics for cool-season grasses grown in the Intermountain West. Forage samples were composited by species, year (1997 and 1998), and stage of maturity (vegetative vs. reproductive). *In situ* samples were incubated in 4 ruminally cannulated beef cows. A first-order disappearance model was used to determine fractions A, B, and C, lag, DIP, and rate of degradation of fraction B. A commercial protease, *Streptomyces griseus*, was evaluated at 0.066 activity units/ml for 48 hours. Species and stage of maturity interacted ( $P < 0.01$ ) for fraction A in both years; fractions B and C, rate of degradation, and DIP in 1998; and lag in 1997. Species, stage of maturity, and microbial correction method interacted ( $P < 0.01$ ) in 1997 for fractions B and C, and DIP. Stage of maturity and microbial correction method interacted ( $P < 0.03$ ) in 1998 for fractions B and C, and DIP. Species and microbial correction method interacted ( $P < 0.05$ ) in 1998 for fraction C. All main effects were significant ( $P < 0.01$ ) for lag in 1998 and lag interacted ( $P < 0.01$ ) with microbial correction method in 1997. Most interactions occurred because ranking of species changed across maturities or microbial correction methods. Technique interacted with species ( $P = 0.04$ ) and stage of maturity ( $P < 0.01$ ) when DIP techniques were compared. All techniques were significantly different from each other. Due to differences between techniques, neither of the *in vitro* procedures can be considered a viable commercial lab technique. The database included all species and stages of maturity because species-by-maturity interactions were common.

**Key Words:** Ruminants, Forage Quality, Protein degradability

**46 Oviductal characteristics and protein concentrations in prepubertal ewe lambs, and mature ewes after natural or progestin-synchronized estrus.** A. S. Jacobs\*, J. G. Berardinelli, P. S. Joshi, and R. Adair, *Montana State University, Bozeman*.

The objectives of this experiment were to determine if gross morphological characteristics and protein concentrations of the ampulla (AMP) and isthmus (IST) differed among pubertal ewe lambs or mature ewes after natural or progestin-synchronized estrus. Prepubertal ewe lambs (PP; n=5), mature ewes that exhibited natural estrus (MNE; n=4), and mature ewes synchronized with progestin-impregnated sponges (MSE; n=5) were observed for estrus with the aid of mature rams. Salpingectomies were preformed aseptically via mid-ventral laparotomy under halothane anesthesia 24 h following estrus for MNE and MSE ewes, and 18 h following feed and water removal for PP ewe lambs. Immediately before oviduct removal, ligatures were placed at utero-tubal, isthmic-ampullary, and ampullary-infundibular junctions of each oviduct to prevent migration of substances between oviductal areas. Each oviduct was excised, trimmed of connective tissue, measured for length, and weighed. Ampullary and isthmic portions of each oviduct were flushed with 3 mL and 1.5 mL, respectively, of Delbecco's PBS (pH = 7.2). Data for AMP and IST weight, length, weight to length ratio, protein content, and protein concentrations were analyzed by ANOVA for a completely random design. Protein content (ug), or concentrations, expressed as either ug/g or ug/cm for the AMP and IST did not differ ( $P > 0.10$ ) among the groups. However, weights, lengths, and weight to length ratios of the AMP and IST were greater ( $P < 0.09$ ) in MNE and MSE ewes than in PP ewe lambs. Progestin synchronization of mature ewes does not appear to affect gross oviductal characteristics or protein secretion. Although oviducts of PP ewe lambs are shorter and weigh less than mature ewes, they contain equivalent quantities of proteins. The physiological role of the protein in PP ewes is not known.

**Key Words:** Sheep, Oviduct, Protein

**47 Effects of snakeweed (*Gutierrezia spp.*) ingestion on reproduction and liver function in sheep.** D.J. Padilla\*, T.T. Ross, D.M. Hallford, M.W. Salisbury<sup>1</sup>, and J.L. Bollinger, <sup>1</sup>University of Tennessee, Knoxville.

Two trials were conducted to determine effects of snakeweed (SW) on liver function and reproduction. Sheep fed SW were assigned a pair-fed control. Body weights were recorded, and diets were adjusted weekly. In Trial 1 (35 d), six wethers received 20% SW and 80% hachita blue grama hay (DMI basis). Six control wethers received 17.1% alfalfa and 82.9% hachita blue grama hay (DMI basis). Blood samples were collected weekly for serum constituents and hematocrit. At the end of Trial 1, a single injection of bromosulfothalein (BSP; 4 mg/kg) and caffeine (2 mg/kg) was administered i.v. to measure liver function. In Trial 2 (34 d), five ewes were fed 25% SW and 75% sorghum hay (DMI basis). Five control ewes were fed 9.6% alfalfa and 90.4% sorghum hay (DMI basis). Blood samples were taken on d 0, 22 and 33 for hematocrit, sorbitol dehydrogenase (SDH), and serum constituents. Blood samples were collected bi-weekly to measure progesterone (P<sub>4</sub>). A GnRH challenge was conducted during the mid-luteal phase by administering 10 µg GnRH (i.v.). After administering GnRH, blood samples were collected every 15 min for 240 min. Rams were placed with the ewes during their second estrous cycle, and pregnancy rates were determined 59 d later. In Trials 1 and 2, BW did not change ( $P > 0.05$ ). In Trial 1, SW treated wethers had increased hematocrits, cholesterol concentrations, and serum potassium ( $P < 0.05$ ). Rate of BSP serum clearance was lower in wethers fed SW ( $P < 0.05$ ). Caffeine distribution and elimination rates did not differ ( $P > 0.05$ ). In Trial 2, SW ingestion did not affect hematocrits, SDH, P<sub>4</sub> and pregnancy rates ( $P > 0.05$ ). Baseline LH was elevated in those ewes consuming SW ( $P < 0.05$ ). Area under the curve for LH was not different ( $P > 0.05$ ). Snakeweed may have an effect on the liver's ability to clear biological compounds, but reproduction may not be compromised.

**Key Words:** Snakeweed, Liver, Reproduction

**48 Evaluation of calving seasons and marketing strategies in Northern Great Plains cow-calf enterprises.** V. L. Reisenauer\*, M. W. Tess, D. A. Griffith, and J. P. Paterson, *Montana State University, Bozeman*.

Two bio-economic computer models were used to evaluate alternate calving seasons in combination with different calf marketing strategies for their effects on profitability. The Montana State University model of beef cattle production was used to simulate performance of a cow-calf enterprise under range conditions representative of the Northern Great Plains. The model developed at the U.S. Meat Animal Research Center was used to simulate post-weaning performance. The simulated ranch utilized a rotational breeding system based on Hereford and Angus, and had a fixed forage base (4,500 AUM native range, 520 t grass hay, 185 t alfalfa hay). Calving seasons studied were spring (SP, beginning March 15), summer (SU, May 15), and fall (FA, August 15). Weaning dates were October 31, December 15, and February 1, for SP, SU, and FA. Herd size for the fixed resource was 540, 541, 635 cows for SP, SU and FA. Heifer calves not retained as replacements were sold at weaning. Marketing strategies for steers included: a) sale at weaning, b) sale after backgrounding at 1.13 kg/d to 363 kg in a custom lot, and c) sale after backgrounding to 363 kg, then fed at 1.45 kg/d to 544 kg in a custom lot. Input prices were from 1996. Quarterly cattle prices were representative of the peak of the 1990s cattle cycle adjusted for inflation (1996 basis). Profit was measured as ranch gross margin (RGM, gross ranch returns minus variable costs). When steers were sold at weaning RGM was \$181,079, \$168,105, and \$143,948 for SP, SU, FA. Cumulative gross margin (CGM, RGM plus profit or loss from retained ownership) was used to compare alternate marketing scenarios. After backgrounding, CGM was \$188,997, \$181,996, and \$173,645; while after finishing CGM was \$207,275, \$185,616, and \$184,887, for SP, SU, and FA, respectively. System rankings reflect differences in herd size, cow feed costs, calf weaning weight, and seasonal market prices.

**Key Words:** Beef Cattle, Calving Season, Marketing

**49 Feedlot performance of Bulls actively immunized against luteinizing hormone releasing hormone fusion proteins. D Aissat\*, J.M Sosa, D. M deAvila, K. P Bertrand, and J. J Reeves, Washington State University, Pullman.**

This study was conducted to evaluate the effectiveness of an LHRH fusion protein vaccine on endocrine changes, feedlot performance, and carcass quality of bulls. Crossbred bulls ( $n=30$ , average weight 179.4 kg averaging 130.2 days of age) were randomly assigned to three treatment groups. 1) Castrated (C) ( $n=10$ ); 2) Castrated-Implanted with trenbolone acetate (CI) ( $n=10$ ); 3) Immunized (IM) against a cocktail of recombinant fusion protein ovalbumin-LHRH-7 and thioredoxin-LHRH-7 ( $n=10$ ). Blood was collected every 2 wk to evaluate antibody and hormone concentrations. Significant serum anti-LHRH antibodies ( $P<0.001$ ) were detected in animals of the immunized group, which had reduced serum LH ( $P<0.001$ ) and reduced serum FSH ( $P<0.001$ ) concentration when compared to C or CI animals. Serum testosterone concentration in the IM bulls was not different from the two castrated group ( $P>0.05$ ) by day 60 after primary immunization. Initial scrotal circumference in the IM bulls was 18.0.6 cm on day 0 and grow to only 22.6 1.3 cm by day 310. For the last 200 days of the study, scrotal circumference did not change ( $p>0.05$ ). Average daily gain was evaluated and showed no significant difference between the treatment groups during both backrounding ( $P>0.05$ ) and finishing ( $P>0.05$ ). The evaluation of the carcass traits (yield grade and quality grade) showed no difference ( $p>0.05$ ) between the three treatment groups. Vaccinating bulls against an LHRH fusion protein cocktail suppressed LH and FSH resulting in reduced testicular development and reduced circulating testosterone resulting in growth and carcass characteristic similar to the steers.

**Key Words:** LHRH, Immunization, Bulls

**50 Biohydrogenation, flow and disappearance of fatty acids in beef cattle fed supplemental high-linoleate or high-oleate safflower seeds. E. J. Scholljegerdes\*, B. W. Hess, K. R. Hightower, G. E. Moss, D. L. Hixon, and D. C. Rule, University of Wyoming, Laramie.**

Our objective was to evaluate ruminal biohydrogenation, duodenal fatty acid (FA) flow, and FA disappearance in cattle fed supplemental safflower seeds. Nine Angus  $\times$  Gelbvieh heifers (643 kg) fitted with ruminal and duodenal cannulae were used in a triplicated  $3 \times 3$  Latin square, and fed 10.6 kg of bromegrass hay and isocaloric and isonitrogenous supplements: 2.1 kg of corn and 0.24 kg of soybean meal (CON), 0.15 kg SBM and 1.7 kg high-linoleate (67.2% 18:2) safflower seeds (LIN), or 1.6 kg high-oleate (72.7% 18:1) safflower seeds (OLE). Safflower seed supplements were formulated to provide 5% added dietary fat. Single degree of freedom orthogonal contrasts (CON vs. LIN and OLE; LIN vs. OLE) were used to evaluate treatment effects. Ruminal biohydrogenation of dietary 18:2 was greatest (OLE vs. LIN,  $P = 0.0006$ ) for LIN, whereas biohydrogenation of dietary 18:1 was greatest (OLE vs. LIN,  $P < 0.0001$ ) for OLE. Duodenal flow of 18:0 was greater ( $P < 0.0001$ ) for CON, but did not differ ( $P = 0.92$ ) between OLE and LIN. Total flow of unsaturated FA to the duodenum was greatest ( $P < 0.0001$ ) in cattle fed safflower seeds, and LIN was greater ( $P < 0.0001$ ) than OLE. Duodenal flow of 18:1 and 18:2 increased ( $P < 0.0001$ ) in OLE and LIN, respectively. Duodenal flow of 18:1<sup>trans-11</sup> was greater ( $P < 0.0001$ ) in cattle fed safflower seeds and in LIN than OLE. Postruminal disappearance of saturated FA was greatest ( $P < 0.0003$ ) for the CON; however, postruminal disappearance of total unsaturated FA was greatest ( $P \leq 0.002$ ) for LIN. Therefore, postruminal disappearance of total FA was greatest ( $P = 0.05$ ) for LIN. Supplemental high-linoleate or high-oleate safflower seeds to cattle fed forage-based diets increased quantity of unsaturated fatty acids reaching the duodenum. Postruminal disappearance of unsaturated fatty acids was observed in cattle fed high-linoleate safflower seeds, indicating fatty acids apparently available for metabolism are affected by dietary fat source.

**Key Words:** Cattle, Safflower Seeds, Supplementation

**51 Effect of the progesterone receptor antagonist, mifepristone, on progesterone secretion from the early and mid cycle bovine corpus luteum. L. Canales\*, D. J. Denniston, K. K. Kane, W. D. Bryant, R. Kelling, and D. E. Hawkins, New Mexico State University, Las Cruces.**

To investigate the effects of mifepristone (RU486), a progesterone receptor antagonist, on luteal progesterone secretion, transvaginal infusions were performed in vivo into the early (d 5-6) and mid (d 10-12) estrous cycle bovine corpus luteum (CL). Crossbred cows were synchronized with one injection of 25 mg (i.m.) PGF2 $\alpha$  (Lutalyse<sup>®</sup>) and behavioral estrus detected. Five to 6 and 10 to 12 d post estrus, cows with early ( $n = 20$ ) and mid ( $n = 14$ ) estrous cycle CL, respectively, were randomly assigned to one of three treatments: 1) control (300  $\mu$ L phosphate buffered saline), 2) high RU486 (300  $\mu$ L 0.05mM RU486) and 3) low RU486 (300  $\mu$ L 0.05 $\mu$ M RU486). Infusions were administered directly into the CL via needle-guided transvaginal ultrasonography. Blood samples were collected via caudal venipuncture prior to infusion (time 0) and 1, 3, 6, 9, 12, 24, 36, and 48 hr following infusion to measure serum progesterone levels. Serum was analyzed by radioimmunoassay. Data are presented as percentage of time 0 values (pre-infusion). Following infusion of the early CL (d 5-6), mean serum P4 was greater in the low RU486 treatment group when compared with control and high RU486 groups (144.9, 104.4 and 98.0  $\pm$  14.6% of time 0, for low RU486, control and high RU486, respectively;  $P = 0.05$ ). Control and high RU486 treatment groups had similar progesterone ( $P > 0.05$ ). However, no differences in mean serum progesterone were observed among treatments in the mid luteal CL (d 10-12; 146.0, 128.7, and 109.5  $\pm$  18.8% of time 0, for low RU486, control and high RU486, respectively;  $P > 0.05$ ). Therefore, mid luteal CL were not affected by RU486 at either treatment level. The inhibition of progesterone receptors in the early estrous cycle CL with RU486 (0.05 $\mu$ M) increased progesterone secretion.

**Key Words:** Corpus Luteum, Mifepristone, Progesterone

**52 Use of bovine somatotropin in conjunction with CO-Synch and Select Synch protocols for synchronizing estrus and ovulation in beef cows. H. Foster<sup>1</sup>, J.C. Whittier<sup>1</sup>, P.D. Burns<sup>1</sup>, J. Breummer<sup>1</sup>, D. Baker, T. Engle<sup>1</sup>, T. Field<sup>1</sup>, W.R. Wailes<sup>1</sup>, T.W. Geary<sup>2</sup>, D.C. Anderson<sup>3</sup>, and D.L. Boss<sup>3</sup>, <sup>1</sup>Colorado State University, Ft. Collins, <sup>2</sup>USDA-ARS, Miles City, MT, <sup>3</sup>Northern Montana Ag. Exp. Sta., Havre, MT.**

Objectives were to examine effects of exogenous bovine somatotropin (bST) on pregnancy rates in conjunction with two separate estrus synchronization protocols: CO-Synch and Select Synch. In the CO-Synch trial, lactating beef cows ( $n=690$ ) from 3 locations were administered 100 g of GnRH, followed 7 d later by 25 mg of PGF2a and on d 9 another 100 g of GnRH and were also inseminated. Cows were assigned to the following treatments: 500 mg of bST administered at the first GnRH injection (Trt 1), bST with PGF2a (Trt 2), bST with the second GnRH injection (Trt 3) and no bST (Control). Cows were examined for pregnancy at approx. 60 d post-AI. Pregnancy rates for treatments 1, 2, 3 and Control were 30.0%, 26.9%, 33.1%, and 27.1%, respectively, and did not differ ( $P>0.05$ ). Thus, bST had no effect on pregnancy results in the CO-Synch estrous synchronization protocol. In the second trial, lactating beef cows ( $n=581$ ) were synchronized using the Select Synch protocol. On d 0, cows were administered 100 g of GnRH, followed 7 d later by 25 mg of PGF2a, combined with heat detection and AI on d 6-11. Cows were assigned to the following treatments: 500 mg of bST injected at the time of GnRH administration (Trt 1), bST with PGF2a (Trt 2) and no bST administration (Control). Estrus response rates were higher for Trt 1 (69.84 +/- 4.9;  $P < 0.05$ ), but there were no differences for estrous response rates between Trt 2 (58.4 +/- 4.9) and 3 (58.9 +/- 4.9;  $P > 0.05$ ). Conception rates were higher for cows injected with bST at the time of the GnRH (64.1%) than for the animals administered bST in conjunction with PGF2a (35.5%),  $P < 0.05$ ). However, conception rates for the GnRH/bST group were not higher than Control (60.2%,  $P > 0.05$ ). Based on this trial, bST does not have a beneficial effect on conception rates, but does have a deleterious effect when administered at the time of PGF2a.

**Key Words:** Estrus synchronization, Beef cows, Bovine somatotropin

**53 Transplantation of Bovine Germinal Cells into Mouse Testes.** J. M. Oatley\*, D. M. de Avila, M. D. Griswold, and J. J. Reeves, *Washington State University, Pullman*.

To develop techniques for spermatogonial transplantation in bulls it is essential to have an effective bioassay to evaluate transplantation efficiency of spermatogonial stem cell collection, purification, and culture techniques. The objective of the present study is to develop a mouse bioassay model to evaluate transplantation efficiency of fresh and cultured bovine germ cells. Bull calves of three different ages (1, 2, and 3 mo) were used as a source of donor testis cells. Two calves were used for each age point, one calf was experimentally made cryptorchid at one week of age and the other left normal. A STO (mouse fibroblast) feeder cell line was used to culture bovine testis cells for 2 wks prior to transfer into recipient testes. Immunodeficient nude mice (*nu/nu*) in which endogenous spermatogenesis had been abolished by busulfan treatment served as recipient animals for transplantation. Donor bovine germ cells were microinjected into mouse seminiferous tubules. Mouse testes were analyzed 2 wks after transplant by bovine-specific whole mount immunohistochemistry for the presence of bovine donor germ cells. Bovine testis cells were present in nearly all-recipient mouse testes analyzed. Fresh bovine testes cells were observed as colonies of round cells within mouse seminiferous tubules, indicating spermatogonial expansion and colonization; however, cultured bovine testis cells appeared as fibrous tissue and not spermatogenic colonies. The average number of colonies resulting from cryptorchid testes was not different ( $P > 0.05$ ) than from non-cryptorchid,  $51.9 \pm 4.5$  and  $56.6 \pm 11.4$ , respectively. Fresh donor cells from calves older than 1-month gave rise to a greater average number of colonies within recipient testes ( $P < 0.05$ ) (1mo,  $33 \pm 3.8$ ; 2mo,  $69.5 \pm 7.7$ ; 3mo,  $63.2 \pm 5.6$ ). Fresh bovine germ cells are capable of colonization in the busulfan treated nude mouse testes, making it a suitable model for evaluation and development of spermatogonial transplant techniques in bulls.

**Key Words:** Bovine, Spermatogonia, Transplantation

**54 Effect of fishmeal supplementation on fertility in primiparous, lactating beef cows.** T.R. Bonnette\*, J.C. Whittier, T.E. Engle, and P.D. Burns, *Colorado State University, Fort Collins*.

Over a two-year study, 82 lactating, primiparous beef cows were used to study the effect of fishmeal supplementation on first-service conception rates. Cows were fed a corn silage based diet supplemented with fishmeal (5% DM) or corn gluten meal (8.7% DM), beginning 25 days prior to the start of and continuing through the 90-d breeding season. Throughout the breeding season, cows were visually observed for estrous behavior for a minimum of 30 min at dusk and dawn. Cows were artificially bred with bulls of proven fertility 12 h after being detected in estrus. Pregnancy status was determined by transrectal ultrasonography at 25-30 days post-breeding in cows not returning to estrus. During the second year of the study, blood samples were collected from 4 cows in each treatment group immediately before supplementation began (wk 0) and at wk 1-5 of supplementation. Plasma samples were analyzed for omega-3 fatty acids; eicosapentaenoate (EPA) and docosahexaenoate (DHA). Serum samples were also collected from all cows on d 3 or 4, 9 or 10, and 15 or 16 following first insemination and analyzed for progesterone. Plasma EPA and DHA increased during the first 5 wk of supplementation ( $P < .05$ ) in cows supplemented with fishmeal. Serum progesterone concentrations did not differ between treatment groups following the first insemination ( $P > .10$ ). However, first-service conception rates tended ( $P = .14$ ) to be higher in cows supplemented with fishmeal when compared to cows supplemented with corn gluten meal (75.6 vs 61.5%, respectively). Overall pregnancy rates did not differ between the two treatment groups ( $P > .10$ ). This study indicates that fishmeal supplementation may improve first service conception rates in lactating, primiparous beef cows. The apparent increase in fertility was not due to an increase in progesterone synthesis by the corpus luteum.

**Key Words:** Fertility, Fishmeal, Beef cow

**55 A mutation at the *agouti* locus is associated with recessive black coat color in sheep.** M. A. Smit\*, T. L. Shay, and N. E. Cockett, *Utah State University, Logan*.

The presence of the recessive black coat color gene in sheep flocks is of considerable economic importance. Producers receive low prices for

black wool sold commercially because the textile industry requires unpigmented wool that can absorb dyes. It is difficult to eliminate the production of colored sheep because the gene for black coat color is recessive, and carriers are phenotypically indistinguishable from homozygous white animals. The objective of this project is to identify the gene responsible for recessive black pigmentation. To determine which gene may be responsible for the expression of pigmented fleece, samples from a pedigree of Suffolk sheep in which the recessive black gene was segregating were collected. Genotypes of these animals were generated for microsatellite markers flanking the loci of three genes involved in coat color production. This analysis revealed that the *agouti* locus is a candidate for recessive black pigmentation; markers mapped to ovine chromosome 13 at the presumed location of *agouti* segregated with the coat color genotype. Further analysis of the *agouti* gene showed that the causative mutation may lie in exon 2. Polymerase chain reaction (PCR) using primers for *agouti* exon 2 and subsequent electrophoresis of these PCR products revealed different banding patterns in homozygous black versus white animals, suggesting that the mutation might be associated with this region of the gene. Further efforts will be directed towards characterizing this difference.

**Key Words:** Ovine, Coat Color, Agouti

**56 Performance and metabolic characteristics of multiparous Angus and Brahman cows grazing in the Chihuahuan desert.** B.S. Obeidat\*, M.G. Thomas<sup>1</sup>, C.C. Bailey<sup>1</sup>, D.M. Halford<sup>1</sup>, D.H. Keisler<sup>2</sup>, M.L. Petersen<sup>1</sup>, W.D. Bryant<sup>1</sup>, J.A. Hernandez<sup>1</sup>, M.D. Garcia<sup>1</sup>, and R. Lopez<sup>1</sup>, <sup>1</sup>New Mexico State University, Las Cruces, <sup>2</sup>University of Missouri, Columbia.

Understanding metabolic differences between breeds of cattle is important when selecting for production in semi-arid environments. Spring-calving Angus and Brahman cows ( $n = 8/\text{breed}$ ) grazing in the Chihuahuan Desert were used to evaluate metabolic hormone status and reproductive performance in the Winter, Spring and Fall, 2000. Grazable forage CP was 5.6, 6.4, and 10.9% in the respective seasons. Angus were heavier than Brahman across seasons ( $P < 0.01$ ). Body condition scores (BCS) were similar ( $P > 0.10$ ) across breeds and were 4.4, 3.6 and 4.6 in the Winter, Spring and Fall. No differences ( $P > 0.05$ ) were observed in serum concentrations of the adipose derived hormone leptin in Brahman across seasons. However, serum leptin was greater ( $P < 0.01$ ) in Winter than Spring and Fall in Angus. Brahman had more serum leptin than Angus in the Fall ( $1.8 > 0.70 - 0.09 \text{ ng/mL}$ ;  $P < 0.01$ ). Partial correlation analyses with the effect of breed and season removed indicated that serum leptin was correlated with BCS ( $r = 0.31$ ,  $P < 0.05$ ). A main effect of breed suggested that Brahman had greater fecal output per kg BW than Angus ( $1.1 > 0.99 - 0.04$ ,  $P < 0.01$ ); however, no relationship ( $P > 0.10$ ) was detected between serum leptin and fecal output or estimated intake. Serum insulin was higher ( $P < 0.01$ ) in Brahman than Angus and was higher ( $P < 0.01$ ) in Brahman in Fall and in Spring than in Winter. Brahman had greater ( $P < 0.01$ ) serum IGF-I during the Winter than Angus and serum glucose was greater ( $P < 0.01$ ) in Brahman than in Angus in the Spring and Winter. Mean concentrations of glucose for Angus and Brahman throughout the study were 35.4 and 46.6 mg/dL. Serum concentrations of triiodothyronine ( $T_3$ ), which regulates metabolic rate, were greatest ( $P < 0.01$ ) during the Fall and lowest during the Spring for Angus and Brahman. Serum concentrations of  $T_3$  were greater ( $P < 0.01$ ) in Brahman than in Angus in Winter and Spring. Pregnancy rate after a 90-d breeding season was 75% in the Angus and 57% in Brahman ( $\chi^2$ ;  $P = 0.46$ ). Results suggest that Brahman cows tend to have greater concentrations of metabolic hormones relative to Angus cows and these concentrations may be sensitive to seasonal dynamics of forage quality in the Chihuahuan Desert.

**Key Words:** Breed, Metabolic hormones, Desert

**57 Feeding strategies affect conjugated linoleic acid content and quality of beef.** C. S. Poulsom\*, T. R. Dhiman, D. Cornforth, and K. C. Olson, *Utah State University, Logan*.

Conjugated linoleic acid (CLA) has been shown to have health benefits in animal models. Increasing the CLA in beef would enhance its nutritive value. Twenty Angus crossbred steers (235 - 18.8 kg BW) were used to study the effect of diet on the CLA content of beef and the quality of the resultant product. Steers were assigned to one of four treatments and were followed from weaning to slaughter. There were two feeding periods (backgrounding and finishing). During backgrounding: Trt 1,

2 and 3 received a diet consisting of a 60:40 forage to grain ratio. Trt 4 received alfalfa hay only. During finishing: Trt 1 and 2 received a diet consisting of a 15:85 forage to grain ratio. In addition to the basal diet Trt 2 received 84 g per head/d of a synthetic mixture of rumen protected CLA isomers. Trt 3 and 4 were finished on pasture containing predominantly Kentucky bluegrass and orchardgrass. Average live BW at slaughter was between 500 to 600 kg. Muscle tissue samples were collected at slaughter from the loin and round of each carcass and analyzed for fatty acid profile. Total CLA as a percent of total fatty acids in lean muscle of the loin and round was 0.21<sup>a</sup>, 0.43<sup>c</sup>, 0.82<sup>b</sup>, and 1.35<sup>a</sup> ( $P=0.05$ ) for Trt 1 through 4 respectively. Color stability was assed over a fifteen day period using repeated measures on shortloin steaks. The pasture groups (Trt 3 and 4) retained their redness better than Trt 1 and 2, and Trt 2 was significantly ( $P=0.01$ ) less red than Trt 1. Warner-Bratzler shear tests showed no significant differences in tenderness among treatments. A ten member trained taste panel test showed no difference in tenderness and juiciness among treatments. However, beef flavor was significantly ( $P=0.0001$ ) more intense in Trt 1 compared with Trt 4. Trt 4 had significantly higher ( $P=0.005$ ) off-flavor scores than other treatments. Raising cattle on forage and pasture with no grain supplementation enhances beef CLA content by 500%, but creates an off-flavor in the beef compared with beef from cattle fed typical feed lot diets.

**Key Words:** CLA, Beef, Pasture

**58 Evaluation of the melengestrol acetate / prostaglandin (MGA/PGF) estrous synchronization protocol with addition of GnRH at 48 hr post PGF on AI pregnancy rates in yearling beef heifers. D. S. Baker\*, P. D. Burns, and J. C. Whittier, Colorado State University, Fort Collins.**

An effective estrous synchronization protocol is critical when implementing an AI breeding program. Ideally, the protocol should be cost effective, require minimal labor, and allow for mass mating. The objective of this experiment was to determine if GnRH could be incorporated into the MGA/PGF synchronization protocol and allow for mass mating in yearling beef heifers. One hundred fifty-two yearling crossbred heifers were fed 0.5 mg/hd/d MGA for 14 days and then given an injection of PGF on day 19 following MGA withdrawal. At the time of PGF injection, heifers were randomly allotted to one of two treatment groups. Heifers assigned to treatment 1 (MGA/PGF) were observed a minimum of 60 minutes at dawn and dusk for estrual behavior during a 72 h period following PGF injection. Heifers detected in estrus were then artificially inseminated at 12 h after first observation of estrus. At 72 h post PGF injection heifers not detected in estrus were mass mated. Heifers assigned to treatment 2 (MGA/PGF + GnRH) were given 100 µg of GnRH 48 h after PGF injection and inseminated. Pregnancy rates following AI tended to be lower ( $P = 0.13$ ) in heifers assigned to the MGA/PGF + GnRH synchronization protocol when compared to pregnancy rates for heifers assigned to the MGA/PGF synchronization protocol (57% vs. 46%, respectively). In conclusion, when administered 48 h post PGF injection GnRH does not allow for successful mass mating when using the MGA/PGF synchronization protocol in yearling beef heifers.

**Key Words:** Estrous Synchronization, GnRH, Melengestrol Acetate

## MEAT SCIENCE & MUSCLE BIOLOGY

**59 A possible role of the leptin assay in assessing carcass fat and composition in beef cattle. T.W. Geary<sup>1</sup>, E.L. McFadin-Buff<sup>\*2</sup>, M.D. MacNeil<sup>1</sup>, R.N. Funston<sup>1</sup>, R.E. Short<sup>1</sup>, E.E. Grings<sup>1</sup>, and D.H. Keisler<sup>2</sup>, <sup>1</sup>USDA-ARS Ft. Keogh LARRL, Miles City, MT, <sup>2</sup>University of Missouri, Columbia.**

The hormone leptin is produced by adipocytes and is positively correlated with body fatness. In cattle, fat makes up approximately 36% of an animal's empty body weight. Approximately 70% of this fat is stored as either intermuscular, intramuscular, or kidney fat, which are all difficult to accurately estimate in the live animal. Our objective was to determine if a newly developed leptin radioimmunoassay (RIA) could be used to predict carcass merit in fed cattle. Two different groups of crossbred Bos taurus steers and heifers were managed under feedlot conditions in Miles City, MT. Blood samples were collected 24 hours prior to harvest. The first group (CGC) consisted of 88 Red Angus, Charolais, and Tarentaise composite steers and was harvested at the Con Agra processing facility in Greeley, CO. The second group (LB) consisted of Limousin, Hereford, or Piedmontese cross cattle and was harvested at a local processing facility in Miles City. Circulating leptin concentrations were significantly correlated to fat thickness measured between the 12th and 13th rib in both CGC and LB groups ( $r=0.34$ ,  $P=0.001$  and  $r=0.40$ ,  $P=0.0004$ , respectively). Leptin concentrations were also significantly correlated to marbling score in CGC and LB groups ( $r=-0.35$ ,  $P=0.0007$  and  $r=0.38$ ,  $P=0.0004$ , respectively) and KPH ( $r=0.42$ ,  $P<0.0001$  and  $r=0.49$ ,  $P<0.0001$ , respectively). Ribeye area was not significantly correlated to leptin in CGC steers ( $r=0.12$ ,  $P=0.3$ ), however there was a significant correlation in the LB group ( $r=-0.2$ ,  $P=0.02$ ). Leptin concentration was correlated to calculated yield grade in both CGC and LB groups ( $r=0.19$ ,  $P=0.06$  and  $r=0.37$ ,  $P=0.0003$ , respectively). Leptin has a significant association with fat deposition in feedlot cattle and may prove to be a powerful and accurate tool in assessing fat content in feedlot cattle.

**Key Words:** Leptin, cattle, carcass

**60 Genotype effects on cholesterol and fatty acids in longissimus and semitendinosus muscles from Hereford, Limousin, and Piedmontese F2 crossbred cattle at slaughter. D. C. Rule<sup>1</sup>, J. M. Rule<sup>\*1</sup>, R. E. Short<sup>2</sup>, E. E. Grings<sup>2</sup>, and M. D. MacNeil<sup>2</sup>, <sup>1</sup>University of WY, Laramie, <sup>2</sup>USDA-ARS Ft. Keogh LARRL, Miles City, MT.**

The objective was to determine cholesterol and fatty acid content in longissimus dorsi (LD) and semitendinosus (ST) muscles from sire breeds that differ in potential for lean growth but have similar mature BW. Hereford (normal muscling, H), Limousin (moderate increase in muscling, L), and Piedmontese (muscular hypertrophy, P) sires (20 to 25 per breed) were bred to crossbred cows at random to produce F1 calves that were inter se mated within sire breed to produce F2 calves. Calves were weaned at 6 mo of age, grown out, finished for either 90 or 132 d, and slaughtered. P-cross calves were genotyped for the G-A transition mutation at the myostatin locus characteristic of P. Genotypes were classified as having 0 (H, L, and P<sub>0</sub>), 1 (P<sub>1</sub>), or 2 (P<sub>2</sub>) copies of the mutant allele (mhP). Fatty acids and cholesterol were determined using capillary GLC. Saturated fatty acids were greatest in H and L in LD ( $P = 0.05$ , mean=42.8%) and ST ( $P = 0.04$ , mean=38.5%). Monounsaturated fatty acids were lowest ( $P < 0.01$ ) in P<sub>2</sub> for each muscle (34.5% in ST; 36.1% in LD). PUFA were highest ( $P < 0.01$ ) in P<sub>2</sub> LD (10.6%) compared with the other genotypes (mean=4.8%). In ST, PUFA were highest ( $P < 0.01$ ) in P<sub>2</sub> (12.7%), lowest ( $P < 0.01$ ) in H (5.8%), and intermediate in L, P<sub>0</sub>, and P<sub>1</sub> (mean=7.6%). In LD, n-3 fatty acids were highest ( $P < 0.01$ ) in P<sub>2</sub> (1.4%) and lowest in P<sub>0</sub> (0.5%). Weight percentage of total conjugated linoleic acid was not affected by genotype in LD ( $P = 0.25$ , mean=0.2%), or ST ( $P = 0.28$ , mean=0.2%). Cholesterol concentration was not affected by genotype in LD ( $P = 0.44$ , mean=50.5 mg/100 g.). In ST, cholesterol concentration was highest ( $P = 0.02$ ) in P<sub>2</sub> (54.6 mg/100 g.), and similar for the other genotypes (mean=51.1 mg/100 g.). We conclude that P<sub>2</sub> contain higher ST muscle cholesterol, and higher PUFA, in particular the n-3 fatty acids, in both LD and ST muscles.

**Key Words:** Piedmontese, Fatty acids, Cholesterol

**61 Changes in critical variables of the slaughter process and their effect on pork quality.** A.D. Alarcon-Rojo<sup>\*</sup>, J.G. Gamboa, A. Grado, and F.A. Rodriguez-Almeida, *Universidad Autonoma de Chihuahua, Chihuahua, MX.*

To investigate the effect of changes in critical variables of the slaughter process on pork physicochemical characteristics, three experiments were conducted in summer and winter using 340 pigs. Experiment 1, effect of group-stunning: 30 animals were stunned in groups of five, and 30 were individually stunned; Experiment 2, effect of time between stunning and bleeding (4 and 16 sec): 30 animals were assigned to each treatment in each season; Experiment 3, effect of scalding time (5 and 7 min): 20 pigs were assigned in summer and 30 in winter to each treatment. Model adjusted in each experiment included effect of treatment, season and their interaction. In both seasons, meat quality from animals stunned in groups was better ( $P \leq .05$ ) than that of individually stunned animals, showing a favorable mean difference of  $1.21 \pm 0.33$  % for drip loss (DL) in summer and  $1.24 \pm 0.33$  % in winter; an average increase of  $0.14 \pm 0.03$  in summer and  $0.17 \pm 0.03$  in winter for pH at 45 min *post mortem* (pH<sub>45</sub>); faster cooling rate at 45 min and 24 h *post mortem* (T<sub>45</sub> and T<sub>24</sub> respectively), and a decrease in electrical conductivity at 2 h *post mortem* (EC<sub>2</sub>) of  $0.98 \pm 0.34$  mS/cm in summer and  $0.61 \pm 0.31$  mS/cm in winter. When time between stunning and bleeding was reduced from 16 to 4 sec, DL showed an average decrease ( $P \leq .05$ ) of  $2.3 \pm 0.64$  % in summer and  $1.34 \pm 0.52$  % in winter, and meat from pigs in the 4 sec group showed better ( $P \leq .05$ ) physicochemical characteristics in both seasons compared to that from those pigs in the 16 sec group. Similarly, when scalding time was reduced from 7 to 5 min, DL was reduced ( $P \leq .05$ ) in an average of  $1.21 \pm 0.56$  % in summer and  $1.54 \pm 0.25$  % in winter. An average increase ( $P \leq .05$ ) of  $0.24 \pm 0.04$  in summer and of  $0.25 \pm 0.03$  in winter was observed for pH<sub>45</sub>, as well as a reduction ( $P \leq .05$ ) of  $1.54 \pm 0.15$  °C in summer and of  $0.93 \pm 0.18$  °C in winter for T<sub>24</sub>, and a decrease ( $P \leq .05$ ) of  $1.4 \pm 0.38$  mS/cm in summer and of  $1.82 \pm 0.39$  mS/cm in winter for EC<sub>2</sub>. Physicochemical characteristics of pork can be improved by stunning the pigs in groups instead of individually, and reducing time between stunning and bleeding from 16 to 4 sec, and scalding time from 7 to 5 min.

**Key Words:** Slaughter process, Pork quality, Stress

## NON-RUMINANT NUTRITION

**63 Ileal digestibility of amino acids in pigs fed wheat diets supplemented with a fungal protease.** M.A. Morales<sup>1</sup>, M. Cervantes<sup>2</sup>, M. Cuca<sup>1</sup>, J.L. Figueroa<sup>1</sup>, A. Pro<sup>1</sup>, A.B. Araiza<sup>2</sup>, S. Espinoza<sup>2</sup>, V. Gonzalez<sup>2</sup>, and N. Torrentera<sup>2</sup>, <sup>1</sup>Colegio de Postgraduados, Montecillos, Edo. Mx, <sup>2</sup>Instituto de Ciencias Agrcolas, UABC, Mexicali, B.C.

One experiment was conducted to evaluate the effect of adding a fungal protease to wheat-based diets on the apparent ileal digestibility (AID) of amino acids (AA). Four pigs adapted with a cannula in terminal ileum were used in two periods, according to a crossover design. The treatments were: 1) basal wheat-diet, 0.55% lysine, 0.10% threonine, vitamins and minerals, and 2) basal diet plus 0.3% protease. Both diets contained 0.4% chromic oxide. Feed was mixed with water, and offered twice a day, in equal rations, at 0700 and 1900 h, in two 12-d periods; 8 d adaptation to diet and 4 d for digesta collection. This was continuous from 0700 to 1300 h (9 and 11 d), and from 1300 to 1900 (10 and 12 d). There was no enzyme effect on the AID of AA ( $P > 0.10$ ). These results indicate that the addition of a fungal protease to wheat-based diets does not affect the AID of AA.

**Key Words:** Wheat, Swine, Enzyme

**64 Limiting amino acids in wheat for growing-finishing pigs.** M. Cervantes<sup>1</sup>, A. Pichardo<sup>2</sup>, M. Cuca<sup>2</sup>, A. B. Araiza<sup>1</sup>, and N. Torrentera<sup>1</sup>, <sup>1</sup>Instituto de Ciencias Agrcolas, UABC, Mexicali, B.C., <sup>2</sup>Colegio de Postgraduados, Montecillos, Edo..

Two experiments involving 68 crossbred (Landrace-Hampshire-Duroc) pigs were conducted to define the order of the first three limiting amino acids (AA) in wheat for growing-finishing pigs. In Exp. 1, 28 growing pigs (22.5 kg initial BW), were grouped by BW, age, sex and litter, in 4 treatments with 7 replicates. The treatments were: T1) base diet, 97%

**62 Comparison of muscle cholesterol and fatty acid profiles of bison, beef cattle, elk, and chicken.** D. C. Rule<sup>\*1</sup>, K. S. Broughton<sup>1</sup>, and G. Maiorano<sup>2</sup>, <sup>1</sup>University of Wyoming, Laramie, <sup>2</sup>Universiti degli Studi del Molise, Campobasso, Italy.

The objective was to compare cholesterol (CHOL) and fatty acid contents of longissimus dorsi (LD), semitendinosus (ST), and supraspinatus (SS) muscles of (n=10 for each) range bison (31 mo of age), grain-finished bison (18 mo of age), range beef cows (4 to 7 yr of age), feedlot steers (18 mo of age), free-ranging cow elk (3 to 5 yr of age), and chicken breast. Both lipids were analyzed by capillary GLC. Chicken breast CHOL was higher ( $P < 0.01$ , 59.3 mg/100 g) than LD CHOL, which was lowest for range bison (43.8 mg/100g), and intermediate for the other species. ST CHOL changed with species similarly to that observed for LD. SS CHOL was highest ( $P < 0.01$ ) for feedlot bison and feedlot steers, which were similar to chicken breast (mean = 61.2 vs. 52.8 mg/100 g for the other species). PUFA were higher ( $P < 0.01$ ) for chicken breast (24.6%) than for LD PUFA, which were lowest ( $P < 0.01$ ) for feedlot steers (5.0%). LD n-3 fatty acids were greatest ( $P < 0.01$ ) for range bison and elk (mean = 2.7%) and lowest ( $P < 0.01$ ) for feedlot steers (0.4%). ST PUFA were highest ( $P < 0.01$ ) for range bison, elk, and chicken (mean = 21.9%), and lowest for feedlot steers (6.1%), whereas n-3 fatty acids were greatest ( $P < 0.01$ ) for range bison (3.9%). PUFA of chicken breast were greater ( $P < 0.01$ ) than SS PUFA of bison, beef, or elk, and were lowest for feedlot beef (7.2%). SS n-3 fatty acids were greatest ( $P < 0.01$ ) for range bison, range beef, and elk (mean = 1.9%). LD conjugated linoleic acid (CLA, cis-9, trans-11) was greatest ( $P < 0.01$ ) for range beef (0.4%), and lowest for chicken and elk (mean = 0.1%). ST CLA was greatest ( $P < 0.01$ ) for range and feedlot bison and range beef (mean = 0.4%), and lowest for elk ST and chicken breast (mean = 0.1%). SS CLA was greatest ( $P < 0.01$ ) for range beef (0.5%), and lowest for chicken breast (0.1%). Mean total fatty acid concentration for all muscles in descending order was feedlot steers > feedlot bison > range bison > range beef > elk > chicken.

**Key Words:** Lipids, Feedlot, Range

wheat, T2) + .46% L-lysine, T3) + .46% L-lysine + .14% L-threonine, T4) + .46% L-lysine + .14% L-threonine + .05% DL-methionine. Crystalline lysine, threonine and methionine were added to raise their content in the diet to .83, .54, and .25%, respectively. In Exp. 2 40 finishing pigs (54.2 kg initial BW) were grouped in 4 treatments of 5 replicates (two pigs per replicate) each. The treatments were: T1) base diet, 97% wheat + .46% L-lysine, T2) base diet + .20% L-threonine, T3) base diet + .20% L-threonine + .05% DL-methionine, and T4) control, wheat-soybean meal diet. All diets were formulated to contain .75% lysine. In both experiments vitamins and minerals were added to meet or exceed their requirements; feed and water were provided ad libitum. In exp. 1, the addition of lysine to the base diet increased ( $P < .05$ ) the weight gain, as well as feed, lysine, treonina, and metionina, intake, and improved ( $P < .05$ ) feed conversion. Threonine supplementation additionally increased ( $P < .05$ ) weight gain and threonine intake, and improved ( $P < .05$ ) feed conversion. Methionine increased ( $P < .05$ ) the consumption of this AA, but did not affect ( $P > .10$ ) daily weight gain nor feed conversion. In exp. 2, the addition of treonina to the base diet did not affect ( $P > .10$ ) neither weight gain nor feed conversion, but the combined addition of threonine and methionine to the lysine-supplemented base diet, increased ( $P < .01$ ) daily weight gain and improved ( $P < .05$ ) feed conversion. These data indicate that lysine is the first limiting AA in wheat for growing and finishing pigs. These, also indicate that threonine is the second limiting AA in wheat for growing pigs, and that threonine and methionine are second colimiting AA for finishing pigs; methionine, does not limit the growth in young pigs fed wheat based diets.

**Key Words:** Pigs, Wheat, Amino acids

**65 In-vitro crude protein and starch digestibility of a gdhA transgenic corn. G.A. Apgar, K.E. Griswold, M. Zarate, R. Dado, D.A. Lightfoot, and M.J. Roeder\*, Southern Illinois University, Carbondale.**

A gene (gdhA) encoding an enzyme that improves N assimilation and amino acid accumulation in an energy independent manner has been isolated from *E. coli* and introduced into the corn genome. Five germplasms, B73\*LL3-2272 (A); LL3-272\*self (B); BD68\*LL17-463 (C); BD68\*LL2-63 (D) and BD68\*LL3-775 (E) with (+) or without (-) the gdhA transgene for nitrogen uptake were grown in the same season and analyzed for dry matter (DM); in vitro crude protein digestibility (IVCP) and starch digestibility (IVST); resistant starch (RS); total starch (TS); glucose liberation after 120 min ( $G_{120}$ ); total glucose (TG) and free glucose (FG) in an effort to estimate differences in starch components and digestibility due to gdhA transfection. Germplasms A and B were grown in one field and C, D and E were grown in two fields. Of the 293 samples, 200 were from individual plants analyzed for DM and

IVCP and 69 were composite samples analyzed for DM, IVCP, IVST, RS, TS,  $G_{120}$ , TG and FG. Combining plants within the same row of each germplasm created these composite samples. Data were analyzed using the GLM procedures of SAS (1992). The model for composite data included the effects of gene for A and B, and gene, location and gene x location for C, D, and E. The model for individual data included the effects of gene and row for A, gene for B, and gene, location and gene x location for E. In all five germplasms, there were no significant differences ( $P > .05$ ) between non-transgenic and their counterparts for IVCP, IVST, RS, ST,  $G_{120}$ , TG and FG. However, DM was lower for A+, C+, B+ and E+ ( $P < .05$ ) than their gdhA- counterparts. Location affected all measured criterion. There were gene x location effects in DM for C and D, and in  $G_{120}$  for E. The presence of the gdhA gene did not influence IVCP, IVST, or energy storage components in corn grain.

**Key Words:** Corn, transgenic, starch digestibility

## PASTURES AND FORAGES

**66 Estimation of forage mass using a visual obstruction technique. C. J. Ackerman, J. Sumner, and T. R. Shirley\*, Oregon State University, Corvallis.**

A visual obstruction technique and clipped quadrats were used to develop prediction equations for estimating forage mass of Perennial Ryegrass, Tall Fescue, Subterranean clover mixed (MIX) pastures near Corvallis, Oregon. The technique used was a modification of a procedure developed in Kansas during the 1970s. This technique estimates visual obstruction using a pole which is marked at 5 cm increments. When the pole is placed vertically in a sward and observed from a distance of 4 meters, visual obstruction, or the amount of the pole which is obscured from view by standing forage, can be estimated. In order to estimate forage mass of MIX pastures, 45 visual obstruction measurements and concurrent .19 m<sup>2</sup> quadrat clipped weights were collected monthly from each of two sample sites during June, July, August, and September of 2000. The two sample sites were managed differently; continuous or season-long grazing (CONT), and intermittent or rotational grazing (STOCK). Linear regression analysis was used to investigate the relationship between visual obstruction measurements and clipped forage weights and to develop equations for the prediction of forage mass. The  $r^2$  value for all values pooled across months and sample sites was .58. However, the  $r^2$  values were greater than .7 for each sample site during June, July and August, while  $r^2$  values were .50 or lower for each sample site during September. Further data analysis using indicator variable analysis identified a difference in both slopes ( $P < .01$ ) and intercepts ( $P = .09$ ) between the CONT and STOCK regression equations. Additionally, indicator variable analysis identified a difference ( $P < .10$ ) in either intercept or slope among regression equations for all months within both CONT and MIX sampling sites. Therefore, separate prediction equations must be reported for each sampling site and month. This analysis demonstrated that the relationship between visual obstruction measurements and clipped forage weights in the sampling sites utilized for this study was influenced by forage maturity and management. This technique has potential for practical use, however, accuracy of regression equations is dependant on season of use and pasture management.

**Key Words:** Forage Mass Estimation, Visual Obstruction, Perennial Forages

**67 Beet pulp supplementation of heifers grazing native flood meadow: performance and ruminal fermentation. D. W. Bohnert<sup>1</sup>, C. S. Schauer<sup>\*1</sup>, and T. DelCurto<sup>2,\*</sup>. <sup>1</sup>Eastern Oregon Agriculture Research Center, Oregon State University, Burns, <sup>2</sup>Eastern Oregon Agriculture Research Center, Oregon State University, Union.**

Sixty-four beef heifers ( $287 \pm 2$  kg) and 4 ruminally cannulated steers ( $286 \pm 4$  kg) were used in an 84-d study to evaluate beet pulp (BP) supplementation of early-to-mid season native flood meadow pasture. Treatments (TRT) consisted of an unsupplemented control (CON) and 0.25 (L), 0.50 (M), and 0.75 (H) kg/d dried BP. Heifers were gathered daily at 0730 from a common 35 ha pasture and sorted into pens (4 heifers/pen; 4 pens/TRT) and provided BP. After the BP was consumed (approximately 3 hr) heifers were returned to the common native

flood meadow pasture. Heifers were weighed every 28 d and available forage determined by clipping 25 randomly placed 0.19-m<sup>2</sup> quadrats. In addition, rumen fluid was obtained via stomach tube on d 42 from one heifer randomly selected from each pen 4 hr after supplementation. Cannulated steers were used to estimate diet quality on d 0, 28, 56, and 84 by rumen evacuation/masticate collection procedures. Diet quality estimates were 23, 18, 15, and 12% CP and 44, 49, 53, and 58% NDF for d 0, 28, 56, and 84, respectively. Heifer ADG was not affected ( $P > 0.10$ ) by BP supplementation (1.11, 1.08, 1.04, and 1.08 kg/d for CON, L, M, and H, respectively). In addition, ruminal NH<sub>3</sub> N and pH were not altered ( $P > 0.10$ ) by BP supplementation. These data suggest that BP is not a beneficial supplement to growing beef heifers consuming high-quality native flood meadow.

**Key Words:** Beet Pulp, Supplementation, Performance

**68 Livestock performance on seeded forages in the Northern Great Plains. M. R. Haferkamp\*, E. E. Grings, R. K. Heitschmidt, and M. D. MacNeil, USDA-ARS, Fort Keogh LARRL, Miles City, MT.**

Seeding perennial cool-season grasses can be used to extend grazing seasons on rangeland. Few available cultivars have been evaluated for livestock performance. Our objective was to evaluate livestock performance and persistence of three cultivars of wheatgrasses (WG). Twice replicated 3-ha pastures were seeded to 'Rosana' western WG (*Pascopyron smithii*), 'Luna' pubescent WG (*Elytrigia intermedia*), and 'Hycrest' crested WG (*Agropyron* spp.) in autumn 1994. Yearling steers (n = 8) grazed from May 9 to June 12, 1997, and April 24 to June 15, 1998. Yearling heifers grazed from April 27 to June 18, 1999. Hycrest produced the largest herbage yield in spring 1997 (912 kg ha<sup>-1</sup>) and 1998 (1,223 kg ha<sup>-1</sup>) ( $P < 0.05$ ); however, by spring 1999 yields were similar among cultivars (613 kg ha<sup>-1</sup>). Digestible OM yield of available forage did not differ among pastures of seeded species, but declined ( $P < 0.05$ ) from May to June each year. Crude protein yield varied among cultivars ( $P < 0.05$ ) in April and May 1998 and May 1999; however, no clear trends emerged. Crude protein yields consistently decreased from April-May to June. Diets generally consisted of > 40% green Hycrest and Rosana but < 40% Luna. Average daily gains were similar among cultivars in 1997, but ADG were greater ( $P < 0.05$ ) on Hycrest (1.28 kg d<sup>-1</sup>) than Rosana (1.03 kg d<sup>-1</sup>) in 1998. Gains on Hycrest (0.74 kg d<sup>-1</sup>) and Rosana (0.78 kg d<sup>-1</sup>) were greater ( $P < 0.05$ ) than on Luna (0.52 kg d<sup>-1</sup>) in 1999. Data from this study and others clearly show that in some years, crested WG provides more forage in spring than native species like western WG, and will allow an increase in livestock numbers. This happened in 1 of 3 yr in our study.

**Key Words:** Cool-season Forages, Yearling Cattle

**69 Variation of forage quality characteristics of barley. L.M.M. Surber, M. T. Stowe\*, J.G.P. Bowman, S. D. Cash, P. F. Hensleigh, and T. K. Blake, Montana State University, Bozeman.**

Annual forage barley has become an important winter feed for Montana livestock producers. The objectives of this study were to examine

the variation in forage quality of commonly grown forage barley varieties, grain barley varieties, and experimental lines. The 14 lines were grown under irrigated conditions in 1999 and 12 lines were grown under irrigated conditions in 2000 in a replicated ( $r = 4$ ) field trial near Bozeman, MT. Forage samples were collected at soft dough stage of maturity. Agronomic data collected included plant height, lodging index, heading date, and yield (t/h). In 1999, in situ DM digestibility (ISDMD) at 48 h was determined. A sub-sample of each line was evaluated for NDF, ADF, CP, and NO<sub>3</sub>-N. In 2000, samples were divided into heads and forage components. Heads and forage were analyzed for NDF, ADF, CP and NO<sub>3</sub>-N. Head and forage data was reconstituted to form whole plant data. Six varieties were in common between 1999 and 2000. In 1999, the range in ISDMD was 62.3 to 74.3% (CV = 3.8%), CP ranged from 10.5 to 15.8% (CV = 9.0%), and NO<sub>3</sub>-N ranged from 0.12 to 0.56% (CV = 38.0%). All forage quality characteristics were affected by variety ( $P < 0.10$ ). In 2000, the % heads ranged from 19.8 to 41.1% (CV = 20.1%), % forage ranged from 58.9 to 80.2% (CV = 7.7%), head NO<sub>3</sub>-N ranged from 0.01 to 0.33% (CV = 96.0%), forage NO<sub>3</sub>-N ranged from 0.02 to 0.92% (CV = 51.9%). Barley variety affected forage NO<sub>3</sub>-N ( $P < 0.01$ ), however, head NO<sub>3</sub>-N was not affected ( $P > 0.10$ ). Whole plant CP ranged from 10.5 to 18.3% (CV = 12.3%), NDF ranged from 50.0 to 66.8% (CV = 5.8%), ADF ranged from 24.1 to 44.1% (CV = 11.0%), and NO<sub>3</sub>-N ranged from 0.08 to 0.73% (CV = 50.8%). Year affected NDF and ADF ( $P < 0.002$ ) when common variety data was combined, however, CP and NO<sub>3</sub>-N were not affected ( $P > 0.10$ ). Neutral detergent fiber was 13% lower ( $P < 0.001$ ) and ADF was 7% lower ( $P < 0.01$ ) in 2000 than 1999 (53.5 vs. 61.7%, 31.0 vs. 33.4%, respectively). Haybetr barley had 8.8% lower NDF ( $P < 0.01$ ), 15.9% lower ADF ( $P < 0.001$ ), and 28.6% lower NO<sub>3</sub>-N ( $P < 0.001$ ) when compared to Westford barley (55.7 vs. 61.0%, 29.0 vs. 34.5%, 0.18 vs. 0.26%, respectively). Considerable forage quality variation is available for exploration to develop improved forage barley varieties.

**Key Words:** Forage barley varieties, Forage quality, Agronomic characteristics

#### 70 Nutritional quality of dormant high-sugar corn forage. V. Nayigihugu\*, B. W. Hess, L. Brokaw, and D. W. Koch, University of Wyoming, Laramie.

Our objective was to determine the nutritional quality of dormant male-sterile, high-sugar corn forage (Cargill HS 60A). Beginning on November 11, two ruminally cannulated Angus crossed steers (BW = 450 kg) continuously grazed a 1 ha pasture of high-sugar corn forage. Ruminal masticate samples were collected at 1300 on d-0, 7, 21, and 35 for determination of OM, NDF, ADF, N, rate and extent of in vitro OM digestibility (IVOMD), and in vitro VFA. Data were analyzed as a randomized complete block design (steer as the block effect). Effects of sampling date were evaluated using polynomial orthogonal contrasts. Masticate OM decreased from 95.2% on d-0 to 92.9% on d-21, then increased to 95.4% on d-35 (quadratic,  $P < 0.05$ ). Masticate N decreased (linear,  $P < 0.05$ ) from 2.2% on d-0 to 1.6% on d-35. A cubic effect was detected ( $P < 0.05$ ) for masticate NDF (d-0 = 61.1%; d-7 = 81.6%; d-21 = 78.1%; d-35 = 86.2%). Masticate ADF increased linearly ( $P < 0.05$ ) from 23.5% on d-0 to 44.2% on d-35. Extent of IVOMD at 3, 6, 9, 12, 24, and 48 h decreased (48 h IVOMD = 83.1 to 69.9%) linearly ( $P < 0.05$ ), which coincided with a linear decrease ( $P < 0.05$ ) in rate of IVOMD (13.1 to 6.4 %/h) with the advancement of the grazing period. Total VFA in ruminal fluid collected from the in vitro tubes declined linearly ( $P < 0.05$ ), whereas acetate:propionate ratio increased linearly ( $P < 0.05$ ) as the grazing season progressed. The decrease in masticate N, extent and rate of IVOMD, and in vitro VFA with concomitant increases in NDF and ADF suggest that nutritional quality of dormant high-sugar corn forage declined as the grazing season progressed.

**Key Words:** Cattle, Corn Forage, Nutritive Value

#### 71 Effects of direct-fed viable yeast culture on productivity of beef cows wintered on low-quality forages. B. R. Bowman\*, R. D. Wiedmeier, D. Y. Kim, B. A. Kent, and J. L. Walters, Utah State University, Logan.

The effects of dietary viable yeast culture (VYC) on performance and forage use of beef cows wintered on ammoniated wheat straw and grass hay diets were evaluated. Thirty-two mature crossbred beef cows (avg. 570 kg) were used for the study. Cows were stratified into 8 groups of 4 cows each such that each group was similar with regard to BW, BCS,

age and breed type and then randomly assigned to 8 pens. Two pens were then randomly assigned to one of four dietary treatments: ammoniated wheat straw (AWS) supplemented with alfalfa hay (AH) and viable yeast culture (VYC), AWS and AH without VYC, grass hay (GH) and VYC, and GH without VYC. The feeding period lasted for 165 d through late gestation and early lactation. Feed intake was measured daily, while BW and BCS were recorded monthly. During the precalving period no significant differences in DMI, BW change or BCS change were detected. During the postcalving period cows consuming the GH diets consumed 11% more DM than those consuming the AWS and AH diets ( $P < 0.07$ ). Addition of VYC had no effect on DMI. Forage type had no affect on BW or BCS change postcalving. Addition of VYC did improve BW change by 23.3 kg in cows consuming the AWS and AH diet and 17.1 kg in those consuming the GH diet ( $P < 0.07$ ). The addition of VYC had similar effects on BCS change. We concluded that VYC had no effect on DMI, but improved cow performance postcalving.

**Key Words:** Low-quality forage, Beef cows, Yeast culture

#### 72 Developing replacement beef heifers using diets based on ammoniated low-quality forages. M. L. Watson\*, B. A. Kent, R. D. Wiedmeier, and J. L. Walters, Utah State University, Logan.

The utilization of ammoniated low quality grass hay in diets for replacement beef heifers was evaluated. Sixty crossbred weanling heifers of approximately 240 d of age and weighing approximately 260 kg were stratified into six groups of ten animals each based on weight and breed in a randomized block design. Two pens each were then assigned to either rehydrated ammoniated tall fescue hay (TFH), air dried ammoniated TFH, or untreated TFH. Daily feed intake and monthly BW were recorded. All heifers were offered a supplement to ensure that nutritional requirements were met. This portion of the study lasted 60 d. No significant differences in DMI were found. There was a significant difference in ADG with heifers receiving the untreated TFH gaining nearly twice as much ( $P = 0.02$ ) when compared to heifers receiving the ammoniated hays. Feed efficiency was also significantly higher ( $P = 0.02$ ) for the heifers receiving the untreated tall fescue hay. After completion of this study, heifers remained in their original pens and were reassigned on of two dietary treatments. Diets consisted of either untreated tall fescue or ammoniated wheat straw (AWS). Daily feed intake and monthly BW were recorded. All heifers were again offered a supplement plus free-choice forage to ensure that nutritional requirements were met. This portion of the trial lasted 60 d. Dry matter intake was significantly less ( $P = 0.001$ ) for heifers consuming AWS. However, ADG tended ( $P = 0.08$ ) to be higher for the heifers receiving AWS. Feed efficiency was similar throughout the trial. All heifers reached an acceptable target weight for puberty by 13 months of age.

**Key Words:** Low-quality forages, Heifers, Performance

#### 73 Alfalfa versus grass hay as supplements for beef cows wintered on ammoniated wheat straw. K. Palmer\*, R. D. Wiedmeier, B. A. Kent, C. A. Fitzgerald, and J. L. Walters, Utah State University, Logan.

Thirty-two mature, crossbred beef cows (avg. 630 kg) were stratified into 8 groups of 4 cows each based on BW, BCS, age and breed. These groups were randomly assigned to 8 pens. Pens were randomly assigned to one of two dietary treatment groups: free choice ammoniated wheat straw (AWS) supplemented with alfalfa hay (AWSAH) or AWS supplemented with grass hay (AWSGH), 4 pens per treatment. During the first 60 d, cows on the AWSAH and AWSGH received 2.27 and 2.72 kg of DM from AH and GH, respectively. During the next 30 d the cows received 3.18 and 3.81 kg DM from AH and GH, respectively. During the last 60 d (lactation) the cows received 4.09 and 4.91 kg DM, respectively. The AWS was offered free choice with intake measured daily. During the first 60 d intake of AWS and total DM did not differ ( $P = 0.54$ ). During the next 30 d, cows receiving the AWSAH diet tended to consume more AWS than those fed the AWSGH diet (9.89 versus 9.05 kg, respectively) ( $P = 0.18$ ). During the last 60 d, cows on the AWSAH diet consumed more AWS and total DM than those assigned to the AWSGH diet (13.66 versus 12.64 kg, respectively) ( $P = 0.05$ ). By the end of the first 90 d no difference in cow BW could be detected ( $P = 0.5$ ). However, cows on the AWSAH exhibited higher BCS (5.25 versus 5.0) ( $P = 0.08$ ). By the end of the 150 d wintering period cows on the AWSAH diet exhibited higher BW (625 versus 595 kg) ( $P = 0.06$ ) and

BCS (5.0 versus 4.6) ( $P = 0.02$ ). We concluded GH was an adequate supplement for beef cows wintered on AWS during late gestation, but not during the early lactation period.

**Key Words:** Low-quality forage, Ammoniation, Beef cows

**74 Exogenous cellulase enhances the utilization of ammoniated wheat straw in pregnant and lactating beef cows.** B. M. Spratling\*, R. D. Wiedmeier, C. A. Fitzgerald, and B. A. Kent, *Utah State University, Logan*.

Low-quality forages such as wheat straw are abundant. Chemical treatments such as ammoniation can increase the feeding value of low-quality forages and provide an alternative to feeding expensive hay when supplemented properly. In this study, thirty-two crossbred beef cows in late-gestation were stratified by BW (avg. 634 kg) and placed in eight pens of four animals each. Animals were fed an ammoniated wheat straw (AWS) based diet for a 106 d wintering period. Animals were fed a supplement to ensure that nutritional requirements were met. Four pens received an exogenous fibrolytic enzyme (FE) for the last 79 days. The other four pens served as the control (C). Feed intake in each pen was measured daily. Individual cow BW and BCS were recorded each 30 d. Nutrient digestibility was measured for two 5-d collection periods starting on d 57 and 88 of the study. The FE treatment animals showed a significant increase in OM digestibility ( $P = 0.04$ ) and CP digestibility ( $P = 0.01$ ). During late gestation and early lactation, FE increased digestible OM intake 4.30 vs. 4.95 kg/h/d ( $P = 0.01$ ) and 4.50 vs. 5.02 kg/h/d ( $P = 0.01$ ), respectively. There was a significant difference ( $P = 0.02$ ) in BCS change for the C and FE cattle between d 21 and 78 in late-gestation (0.095 vs. 0.575, respectively). In summary, treating AWS with fibrolytic enzyme increased energy intake and animal performance.

**Key Words:** Low-quality forage, Beef cows, Cellulase

**75 Effects of fibrolytic enzyme addition on forage barley varieties for backgrounding steers.** K. N. Robison\*, J.G.P. Bowman, L.M.M. Surber, S. D. Cash, K. A. Anderson, R. L. Endecott, J. J. Kincheloe, and B. L. Robinson, *Montana State University, Bozeman*.

Ninety-six crossbred steers (avg initial wt 269kg) were allotted to 16 pens in a 2x2x2 factorial design to determine the main effects of fibrolytic enzyme addition (0 vs. 62.7 cellulase units/g; - vs. +), forage barley variety (Haybet vs. Westford), and growing location (Feedmill vs. Pavilion; F vs. P) on animal performance and nutrient digestion. Steers were given ad libitum access to their respective roughage sources, 0.45 kg head<sup>-1</sup>d<sup>-1</sup> of a 32% CP supplement, and 2.6 kg head<sup>-1</sup>d<sup>-1</sup> of Baronesse barley. Pen was the experimental unit in the 59-d trial. Steers were weighed and diet, ort, and fecal samples were obtained midway (d 30) and upon completion (d 59) of the trial. Diet and fecal samples were composited by pen and analyzed for DM, OM, N, NDF, ADF, and AIA. Acid insoluble ash was used as an internal marker to estimate fecal output and to calculate nutrient digestion. Block (side of feedlot) and period were included in the statistical model. Ending weight did not differ ( $P > 0.10$ ) among diets (340 kg). Steers fed Haybet gained 4 kg more ( $P = 0.05$ ) and had 5.8% greater ( $P = 0.05$ ) ADG compared with Westford-fed steers. Intake as % BW was 23% greater ( $P < 0.01$ ) for steers fed Haybet than for steers fed Westford. Steers fed + ate 6.2% more ( $P = 0.05$ ) than steers fed - when intake was expressed as a % BW. Digestible DM intake was greater ( $P < 0.001$ ) for Haybet-fed steers (6.91 kg/d) compared with Westford-fed steers (5.43 kg/d). Digestible NDF and ADF intake were greater ( $P < 0.10$ ) for the +fed steers (2.82 vs. 2.36 kg/d, and 1.58 vs. 0.95 kg/d, respectively) than for the -fed steers during the first 30 d. Forage barley variety influenced backgrounding steer performance and nutrient digestion. Haybet had superior feeding value for backgrounding steers compared with Westford forage barley. Fibrolytic enzyme addition improved digestible NDF and ADF intake during the first 30 d, and DMI throughout the study, however, average daily gain was not improved.

**Key Words:** Fibrolytic enzyme, Forage barley, Backgrounding

**76 Brief exposure of suckling beef calves to low-quality forages improves performances when re-exposed to these forages as mature cows.** R. D. Wiedmeier\*, F. D. Provenza, B. Burritt, and B. A. Kent, *Utah State University, Logan*.

Thirty-two mature crossbred beef cows (615 kg) were selected for the study. Half (16) of these cows had been exposed (EXPSD) to ammoniated wheat straw (AWS) as suckling calves for 40 to 60 d. The other 16 cows had no previous exposure to AWS (Naive). Cows were stratified into 8 groups of 4 cows each such that each group was similar with regard to BW, BCS, age, breed type and previous exposure to AWS. Each group was randomly assigned to one of eight pens. Cows remained in these pens for a 150 d wintering period (Dec-April) for three consecutive years. All cows were fed a diet of free-choice AWS supplemented with alfalfa hay and vitamin-mineral supplements. Cows and their calves grazed irrigated pastures the remainder of the year. Cow BW and BCS and calf BW were monitored monthly through the year. Milk production was measured on the cows monthly using weigh-suckle-weight. Postpartum interval (PPI) to rebreeding was monitored using consecutive calving dates. Improved BW and BCS changes were exhibited by EXPSD cows during all three years ( $P < 0.07$ , 0.05, 0.07, respectively). Shorter PPI was observed in EXPSD cows the first two years of the study ( $P = 0.00$  and 0.02, respectively). By the third year, PPI was similar ( $P=0.19$ ). The EXPSD cows produced more milk than Naive cows the first two years of the study ( $P=0.04$  and 0.07, respectively). By the third year, milk production was similar ( $P=0.74$ ). Exposing calves to AWS for a brief period early in life will improve performance of cows when re-exposed to this forage later in life.

**Key Words:** Low-quality forages, Beef cows, Pasture

**77 Effects of sheep grazing or mowing on the control of perennial pepperweed (*Lepidium latifolium* L.).** J. R. Allen\*, D. W. Holcombe, D. R. Hanks, M. Surian, M. McFarland, L. B. Bruce, W. Johnson, and G. Fernandez, *University of Nevada, Reno*.

*Lepidium latifolium* L. (perennial pepperweed, tall whitetop) is a creeping, invasive, non-native plant species, currently infesting riparian areas, wetlands, and native hay meadows in the western United States. This study examined the effects of sheep grazing or mowing as a control method for perennial pepperweed. Nine 4.9 x 9.7 m pastures, consisting of at least 75% perennial pepperweed were assigned to one of three treatments: 1) control (ungrazed and unmowed), 2) mowed, or 3) grazed. Pastures were grazed and mowed when plants were 10 to 15 cm tall at which time biomass for mowed pastures, plant height, and number of stems/plant for all pastures were determined. Plant identification was conducted in the beginning (March 27; d=0), middle (June 9; d=74), and end (October 4; d=191) of the study. A treatment x day interaction ( $P < 0.003$ ) was observed between plant height, number of stems/plant, and number of plants. Plant height and number of perennial pepperweed plants decreased (linear,  $P = 0.01$ ) for both grazed and mowed pastures. Perennial pepperweed was reduced from 37 plants/m<sup>2</sup> to 8.3 plants for grazed pastures and 38 plants/m<sup>2</sup> to 17.7 plants for mowed pastures, a reduction of 78% and 46%, respectively, for one season. Number of other plant species (scarlet globe mallow [*Sphaeralcea coccinea* (Pursh)*Rydb.*], saltgrass [*Distichlis spicata* (L.) Greene]) and the ratio of perennial pepperweed plants: other plant species were not affected ( $P > 0.28$ ) by treatment. Biomass collected from the mowed pastures showed a quadratic effect ( $P < 0.06$ ) over days. Sheep grazing or mowing reduced the number of perennial pepperweed plants without negatively impacting the growth of other native plant species, therefore, they provide an effective tool in managing perennial pepperweed. Additionally, grazing sheep on heavily infested areas and in topographically challenged regions may be more beneficial, especially if machine access is limited.

**Key Words:** Sheep, Noxious weed control

**78 Fibrous and non-fibrous carbohydrate supplementation to ruminants grazing forage from small grain crops.** D. E. Mount\*, J. C. Whittier, T. J. Steffens, and D. Schutz, *Colorado State University, Fort Collins*.

Three experiments were conducted to evaluate the effects of fibrous (beet pulp) and non-fibrous (corn) carbohydrate supplementation to ruminants consuming fresh forage from vegetative small grain crops. All

experiments contained similar supplementation treatment levels; no supplement (N), corn supplement (C) at 0.5% BW (Exp. 3, corn = 15.7% of diet DM) and dehydrated, pelleted beet pulp supplement (B) at 0.5% BW (Exp. 3, beet pulp = 15.5% of diet DM). Exp. 1 was a replicated 2 X 3 factorial arrangement of treatments, conducted in spring of 2000 to investigate supplement treatment effects on ADG of yearling replacement heifers ( $n = 48$ , BW =  $267 \pm 22$  kg) grazing triticale (CP =  $20 \pm 1.2\%$ ) or wheat (CP =  $27 \pm 8.1\%$ ). Exp. 2 was a nitrogen balance study to investigate supplement treatment effects on diet digestion and nitrogen metabolism by weaned lambs ( $n = 12$ , BW =  $36 \pm 3.7$  kg) consuming fresh triticale forage (CP = 15.4%). Exp. 3 was an in vitro study to determine supplement treatment effects on IVDMD, after 48-h incubation, of triticale forage (CP = 15.4%). In Exp. 1, neither supplementation treatment (P = .76) nor crop grazed (P = .64) had an effect on ADG of the yearling heifers, and there were no interactions (P = .69) between supplementation treatment and crop grazed. In Exp. 2, treatment B improved nitrogen retention (g/d) (P = .03), NDF and ADF digestion (P = .01), and DM digestion (P = .05) when compared to treatments N and C. In Exp. 3, rumen fluid pH was lower in treatments B and C as compared to N (P < .001), and IVDMD was lower (P < .001) in treatment C as compared to treatments N and B. It was concluded that supplementation of beet pulp (0.5% BW) to ruminants grazing spring triticale forage improved rumen bioavailability of dietary nutrients where use of a corn supplement showed no benefits. Neither supplement had any beneficial effect when animals on high quality small grain forage were experiencing significant compensatory gain.

**Key Words:** Small Grain Forage, Ruminant, Energy Supplementation

**79 Identification of genetics markers associated with forage quality characteristics in Lewis X Karl barley lines.** L.M.M. Surber\*, J.G.P. Bowman, T. K. Blake, K. N. Robison, R. L. Endecott, and B. L. Robinson, *Montana State University, Bozeman*.

Forage barley breeding programs have primarily selected new barley lines based on yield and awnless characteristics despite the importance of forage quality. Our objectives were to evaluate a 6-rowed population of Lewis/Karl barley lines for forage quality, identify Quantitative Trait Loci (QTLs) for forage quality, and examine more closely nitrate accumulation. The 146 lines were grown in a replicated field trial under dryland conditions in 1999 near Bozeman, MT. Forage samples were collected at plant anthesis and at peak forage yield. 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. Genetic variation was present between lines for N, NO<sub>3</sub>-N, and non-NO<sub>3</sub>-N at plant anthesis and for ISDMD at peak forage yield. At the plant anthesis sampling, population N ranged from 1.9 to 3.8% (CV = 10.2%), NO<sub>3</sub>-N ranged from 0.04 to 0.55% (CV = 38.2%), and non-NO<sub>3</sub>-N ranged from 1.7 to 3.2% (CV = 10.6%). At the peak forage yield sampling, ISDMD ranged from 62.6 to 79.9% (CV = 3.8%). Correlation analysis from plant anthesis samples indicated that ADF was negatively correlated with N ( $r = -0.15$ , P < 0.01) and non-NO<sub>3</sub>-N ( $r = -0.23$ , P < 0.01) and positively correlated with NO<sub>3</sub>-N ( $r = 0.19$ , P < 0.01). Plant anthesis ISDMD was positively correlated with N ( $r = 0.40$ , P < 0.001) and non-NO<sub>3</sub>-N ( $r = 0.36$ , P < 0.001). Peak forage yield correlation analysis found NO<sub>3</sub>-N was positively correlated with NDF ( $r = 0.34$ , P < 0.001) and N ( $r = 0.25$ , P < 0.001) but negatively correlated with non-NO<sub>3</sub>-N ( $r = -0.15$ , P < 0.01). Major QTLs were identified for N, NO<sub>3</sub>-N, non-NO<sub>3</sub>-N, and ISDMD at plant anthesis and peak forage yield and molecular markers associated with these traits were found on chromosome 2, 3, 4, and 6. Substantial genetic variation in forage quality and NO<sub>3</sub>-N accumulation was present in the 146 Lewis/Karl barley genotypes. This variation will be explored for the development of improved forage quality barley.

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

**80 Effect of ammoniation and exogenous fibrolytic enzymes on in vitro degradability of bluegrass straw.** A. V. Grove\*, C. W. Hunt, G. T. Pritchard, and J. I. Szasz, *University of Idaho, Moscow*.

Four in vitro experiments were conducted to identify an enzyme treatment that improved degradability of untreated or ammoniated bluegrass seed straw. Initially, 8 commercial enzymes were screened using a batch incubator, and 3 were selected for further evaluation: Xylanase 1, Xylanase 2, and Xylanase/Cellulase (XC). Xylanase 1 was applied to ammoniated straw at 0, 0.5, 1, and 2 times the manufacturer's recommended level of application, or added to the in vitro inoculum (Trial 1). Xylanase 2 and XC were applied to ammoniated and non-ammoniated straw at the same 4 levels in Trial 2 and at levels 0 and 1 in Trial 3. In Trial 4 XC was evaluated with ammoniated straw at two levels of enzyme application (0 and 1) and with four levels of barley (0, 25, 50, and 75% of substrate DM) added to the inoculum. Xylanase 1 did not improve (P > 0.10) IVDMD when applied to ammoniated bluegrass straw or when added to the inoculum. In Trial 2, Xylanase 2 applied at levels 1 and 2 increased (P < 0.05) 24-h IVDMD of ammoniated straw compared to ammoniated straw with 0 enzyme (36, 35, and 31%); however in Trial 3, IVDMD of Xylanase 2-treated straw was not different (P > 0.10) than untreated straw at 6, 24 or 48 h of incubation. IVDMD of XC-treated straw did not differ (P > 0.10) from untreated straw at 6, 24 or 48 h in Trial 2; however in Trial 3, 6 h IVDMD of XC-treated straw was 10% lower (P < 0.05) than untreated straw (18.9 and 21.1%). The application of XC to ammoniated straw in Trial 4 increased (P < 0.10) 24-h IVDMD compared to ammoniated straw without enzyme treatment (29.1 and 30.5%). While both IVDMD and pH at 24 and 48 h decreased (P < 0.01) with increasing level of added barley, no interaction (P > 0.10) between level of barley and enzyme application was observed. IVDMD of ammoniated straw was greater (P < 0.10) than that of non-ammoniated straw with no interaction (P > .10) between ammoniation and enzyme treatment. In vitro degradability of bluegrass straw was not consistently improved by the application of fibrolytic enzymes.

**Key Words:** Forages, Fibrolytic enzymes, IVDMD

**81 Influence of season and grazing management on diet quality, digestion, and ruminal fill in cattle grazing native range in western North Dakota.** H. P. Pitcher\*, J. S. Caton, L. L. Manske, and G. P. Lardy, *North Dakota State University, Fargo*.

Objectives were to determine changes in diet quality, digestibility, and ruminal fill in response to season and grazing management. Eight cross-bred steers (initial BW  $387.9 \pm 11.6$  kg) were fitted with ruminal and duodenal cannulas and used in three concurrent experiments. Steers grazed native mixed-grass prairie in western North Dakota. In Experiment 1, four steers were used to collect masticate samples on season-long (SL) and twice-over rotation (TOR) pastures. Sampling dates were early June, mid-to-late June, early July, late July, late August, and mid-September. Masticate samples were collected over 2 d within sampling dates. For Experiment 2, steers grazed either SL or TOR pastures. Sampling dates were late July, late August, and mid-September. In Experiment 3, four steers grazed a season-long pasture. Sampling dates were mid-to-late June, late July, late August, mid-September, and mid-November. In Experiment 1, there was an interaction between grazing management and sampling date (P < 0.1). In both SL and TOR, masticate ADF increased while CP decreased linearly (P < 0.01) with advancing season. Grazing management did not influence masticate ADF or CP percentages (P > 0.1) at individual sampling dates. In Experiment 2, absence of interactions (P > 0.05) permitted pooling data across sampling dates. Dietary chemical composition was not affected by grazing management (P > 0.14). Likewise, digestibility (IVOMD; 56.4 vs 58.4 ± 1.7%) and ruminal fill (56.2 vs 61.5 ± 1.2 kg) were not altered for SL and TOR, respectively. In Experiment 3, steers grazing SL had declining dietary CP and ruminal fill (P < 0.01) as season advanced. In vitro OM digestibility declined linearly with advancing season (P < 0.01; 70.3, 62.1, 53.0, 55.4, 47.1 ± 2.8%). These preliminary data indicate that diet quality of grazed native range in western North Dakota declines with advancing season and was not greatly altered by type of grazing management used in this study.

**Key Words:** Grazing, Native Range, Diet Quality

**82 Influence of rumen protein degradability and supplementation frequency on performance and nitrogen use in ruminants consuming low-quality forage: cow performance and efficiency of nitrogen use in wethers.** D. W. Bohnert<sup>\*1</sup>, C. S. Schauer<sup>1</sup>, and T. DelCurto<sup>2</sup>, <sup>1</sup>*Eastern Oregon Agriculture Research Center, Oregon State University, Burns*, <sup>2</sup>*Eastern Oregon Agriculture Research Center, Oregon State University, Union*.

**ABSTRACT:** Two experiments (Exp) were conducted to determine the influence of CP degradability (CPD) and supplementation frequency (SF) on performance and N efficiency of ruminants consuming low-quality meadow hay (5% CP). Treatments (TRT) included an unsupplemented control (CON) and degradable intake protein (DIP; 18% UIP) or undegradable intake protein (UIP; 60% UIP) provided daily, every 3 d, or every 6 d. Exp 1 was a N balance study using 7 wethers ( $36 \pm 1$  kg BW) with DIP and UIP TRT formulated to meet CP requirements. Exp 2 was a performance study using 84 cows ( $512 \pm 42$  kg BW) during the last third of gestation. Supplements were formulated so that the DIP TRT provided 100% of DIP requirement while UIP TRT were isonitrogenous compared with DIP TRT. In Exp 1 forage DMI and N intake decreased ( $P < 0.05$ ) linearly as SF decreased. Dry matter intake, N balance, N digestibility, and digested N retained were greater ( $P < 0.01$ ) for supplemented wethers compared with CON, with no difference ( $P > 0.10$ ) due to CPD or SF. Nitrogen balance decreased linearly ( $P < 0.05$ ) as SF decreased. Plasma urea (PU; mM), measured over a 6 d period, increased ( $P < 0.01$ ) with supplemented lambs compared with CON. In addition, PU linearly decreased ( $P < 0.01$ ) as SF decreased. In Exp 2 cow pre- and post-calving (within 14 d and 24 hr of calving, respectively) BW and BCS change were improved ( $P < 0.05$ ) for supplemented groups compared with CON. No differences ( $P > 0.10$ ) were observed for CPD or SF. Our results suggest CP supplements consisting of 20 to 60% UIP can be effectively used by ruminants consuming low-quality forage without adversely affecting N efficiency and animal performance, even when provided as infrequently as once every 6 d.

**Key Words:** Protein Degradability, Nitrogen, Supplementation Frequency

**84 Synchronization of estrus in beef cows using GnRH and PGF with estrus AI or timed AI 72 h after PGF with or without a second GnRH injection.** T. W. Geary<sup>\*1</sup>, J. C. Whittier<sup>2</sup>, R. G. Mortimer<sup>2</sup>, J. W. Young<sup>3</sup>, and R. R. Salverson<sup>4</sup>, <sup>1</sup>*USDA-ARS, Miles City, MT*, <sup>2</sup>*Colorado State University, Fort Collins*, <sup>3</sup>*Rex Ranch, Whitman, NE*, <sup>4</sup>*Select Sires, Columbus, OH*.

The objective of this study was to evaluate the pregnancy response of cows that were artificially inseminated following synchronization of estrus with the Select Synch protocol and bred following estrus up to 72 h after PGF or time inseminated at 72 h with or without a second GnRH injection. Mature beef cows ( $n = 994$ ) from two herds within the same ranch received GnRH (100 mcg) 1 wk before an injection of PGF (25 mg) to synchronize estrus. Cows ( $n = 257$ ) in herd 1 (mean body condition score, BCS = 5.5, and postpartum interval to AI, PPI = 69 d) were synchronized and bred during the 1997-breeding season, and cows ( $n = 737$ ) in herd 2 (BCS = 4.9, PPI = 77 d) were synchronized and bred during the 1999-breeding season. Cows that were observed in estrus received AI approximately 12 h later (EAI). Cows not detected in estrus by 72 h after PGF were divided into two groups and time inseminated at 72 h with (TAI+GnRH) or without (TAI) a second injection of GnRH (100 mcg). The 72-h estrous response was 51% and 27% for cows during 1997 and 1999, respectively ( $P < 0.01$ ). Pooled across years, pregnancy rate of EAI cows (60%) was greater ( $P < 0.01$ ) than pregnancy rate of TAI+GnRH (33%) or TAI (27%) cows. During 1997, pregnancy rates were not different ( $P > 0.10$ ) between EAI (61%), TAI+GnRH (54%), and TAI (55%) cows. During 1999, pregnancy rates were higher ( $P < 0.01$ ) for EAI (59%) cows but did not differ ( $P > 0.10$ ) between TAI+GnRH (30%) and TAI (23%) cows. We conclude that incorporating a timed AI at 72 h after PGF for cows synchronized with the Select Synch protocol may be feasible if the 72-h estrous response is high, but caution against timed AI at 72 h in herds when the 72-h estrous response is low. Also, addition of a second injection of GnRH at 72 h may be unnecessary.

**Key Words:** Estrous Synchronization, AI, GnRH

**83 Influence of rumen protein degradability and supplementation frequency on steers consuming low-quality forage: ruminal fermentation and site of digestion.** D. W. Bohnert<sup>\*1</sup>, C. S. Schauer<sup>1</sup>, M. L. Bauer<sup>2</sup>, and T. DelCurto<sup>3</sup>, <sup>1</sup>*Eastern Oregon Agriculture Research Center, Oregon State University, Burns*, <sup>2</sup>*North Dakota State University, Fargo*, <sup>3</sup>*Eastern Oregon Agriculture Research Center, Oregon State University, Union*.

**ABSTRACT:** Seven cannulated (rumen and duodenal) steers ( $264 \pm 8$  kg BW) were used to determine the influence of CP degradability (CPD) and supplementation frequency (SF) on DMI, ruminal fermentation, and nutrient digestion of low-quality forage (5% CP). Treatments (TRT) included an unsupplemented control and degradable intake protein (DIP) or undegradable intake protein (UIP; 60% UIP) provided daily, every 3 d, or every 6 d. The DIP TRT (18% UIP) were calculated to provide 100% of the DIP requirement while the UIP TRT (60% UIP) were provided on an isonitrogenous basis compared with DIP TRT. Forage DMI was not affected ( $P > 0.10$ ) by TRT. Total DM and N intake, duodenal N flow, and intestinal N disappearance increased ( $P < 0.01$ ) with supplementation. No differences in DMI, N intake, duodenal N flow, or intestinal N disappearance were observed due to CPD or SF ( $P > 0.10$ ). Supplemental CP increased ( $P < 0.01$ ) total tract DM and N digestibility with no difference ( $P > 0.10$ ) due to CPD or SF. Rumen fluid was collected 0, 3, 6, 9, 12, and 24 h after feeding on the d of and d before supplementation for all TRT. Ammonia N (mM) increased ( $P < 0.05$ ) the d of and the d before supplementation for all protein TRT. However, a CPD × SF interaction ( $P < 0.05$ ) on the d of supplementation indicated that NH<sub>3</sub> N increased at a greater rate for DIP as SF decreased compared with UIP. Ammonia N linearly decreased ( $P < 0.01$ ) as SF decreased the d before supplementation. Results suggest CP supplements consisting of 20 to 60% UIP can be effectively used by steers consuming low-quality forage without adversely affecting DMI and nutrient digestibility, even when provided as infrequently as once every 6 d.

**Key Words:** Protein, Degradability, Supplementation frequency

## PHYSIOLOGY

**85 A MGA-prostaglandin-GnRH estrus synchronization protocol suitable for timed artificial insemination.** D. L. Hixon\*, R. D. Landeis, B. M. Alexander, D. W. Moore, D. D. Carr, and G. E. Moss, *University of Wyoming, Laramie*.

The objective of this study was to contrast conception rates in beef cows bred either by appointment or after an observed synchronized estrus. Angus x Gelbvieh beef cows were randomly assigned to one of three synchronization treatments; prostaglandin (PG;  $n = 77$ ) cows received Lutalyse® on d 1 and 12, 7-11 treatment ( $n = 76$ ), and a modified 7-11 treatment (MOD;  $n = 77$ ). The 7-11 treatment consisted of feeding MGA d 1-7, injecting prostaglandin on d 7, GnRH (100 µg) on d 11, and prostaglandin on d 18. The MOD procedure was identical to the 7-11 protocol except that on d 20 all cows were simultaneously treated with GnRH and artificially inseminated. The PG and 7-11 groups were bred by artificial insemination 12 h following detection of estrus. Pregnancy was confirmed by rectal palpation at approximately 100 d. First service and overall conception rates did not differ (chi square;  $P > 0.05$ ) among treatments. First service and overall conception rates by the end of the 45 d breeding season were 58.4 and 88.3%, respectively, for PG cows. First service and overall conception rates were 61.8% and 94.7%, respectively, for 7-11 cows. In MOD cows, 72.7% of the cows conceived to timed AI and overall conception rate at the end of the breeding season was 90.9%. In conclusion, the modified 7-11 procedure yielded acceptable first service and overall conception rates. This procedure is an alternative approach to synchronization and artificial insemination without the need for detection of estrus.

**Key Words:** Estrus Synchronization, Timed A. I., Beef Cows

**86 Half dose GnRH does not affect pregnancy rates with the CO-Synch synchronization protocol.** H. Foster<sup>1</sup>, J.C. Whittier<sup>\*1</sup>, P.D. Burns<sup>1</sup>, J. Breummer<sup>1</sup>, T. Field<sup>1</sup>, and T.W. Geary<sup>2</sup>, <sup>1</sup>Colorado State University, Ft. Collins, <sup>2</sup>USDA-ARS, Miles City, MT.

Primiparous ( $n = 76$ ) and multiparous ( $n = 328$ ) lactating Angus cows were randomly assigned to receive either a 50 g or 100 g dose of GnRH at either the first or second GnRH injection of the CO-Synch estrus synchronization protocol to evaluate the efficacy of a reduced dosage in inducing a fertile ovulation. The result was four separate treatment groups: 50:50, 50:100, 100:50 and 100:100. The CO-Synch protocol traditionally consists of GnRH on d 0, followed by an injection of PGF<sub>2α</sub> on d 7. On d 9 cows were injected with another GnRH injection and mass inseminated. On d -10, and again on d 0, blood samples were obtained to examine progesterone levels and determine the proportion of anestrous cows. Calves were removed for a 48 h period on d 7 and were put back with the cows immediately after breeding. Clean-up bulls were turned in with the cows on 14 d following AI. Cows were pregnancy checked via transrectal ultrasonography 68 d after AI. Serum progesterone levels indicated that 34.9% of the cows were estrual at the start of breeding. All treatments were equally effective ( $P > 0.05$ ) in inducing anestrus cows to ovulate and become pregnant. There was no difference in pregnancy rates among the treatment groups (50:50=50.7%; 50:100=49.3%; 100:50=50.3%; and 100:100=44.6%,  $P > 0.05$ ), thus indicating that a reduced dosage of GnRH is effective in inducing fertile ovulation in the CO-Synch timed insemination protocol. We conclude that using a lower dose of GnRH is an effective method of reducing cost of synchronization with the CO-Synch protocol.

**Key Words:** Estrous synchronization, Beef cows, Fixed-time AI

**87 Effect of presence of bulls and restricted suckling on breeding performance of first-calf suckled beef cow using the Ovsynch protocol.** J. G. Berardinelli\*, K. Anderson, B. Robinson, and R. Adair, *Montana State University, Bozeman*.

The objective of this experiment was to evaluate the effectiveness of the Ovsynch protocol for inducing and synchronizing ovulation in first-calf beef cows. The hypotheses tested in this experiment were that ovulation rates after the first GnRH injection or pregnancy rates in response to timed breeding after the second GnRH injection do not differ among first-calf cows that were either exposed (BE) or not exposed (NE) to bulls and either suckled continuously (CS) or restricted to suckling twice daily (RS). Cows were stratified by calving date and assigned randomly to one of four treatments in a 2 x 2 factor arrangement. Treatments were: 1) BECS ( $n = 13$ ), 2) BERS ( $n = 13$ ), NECS ( $n = 14$ ), and NERS ( $n = 13$ ). Cows had been in their respective treatments for approximately 60 d before the start of the Ovsynch protocol. Cows were injected with the first GnRH (100 µg/head) injection on d -9, then injected with PGF<sub>2α</sub> (25 mg/head) on d 2, and given the second GnRH injection on d 0. All cows were bred by AI 24 h after the second GnRH injection. Bulls were removed from cows on d 0, and all cows were given free access to their calves after breeding. Blood samples were collected from each cow immediately before and at daily intervals after the first GnRH injection until the second GnRH injection and again 26 d later. Each cow was ultrasonically examined for the presence or absence of an embryo 37 d after breeding. There was no interaction ( $P > 0.10$ ) among treatments for any variable measured. More ( $P < 0.05$ ) BE cows were cycling before the first GnRH, and had sustained progesterone concentrations after the first GnRH injection than NE cows. Type of suckling did not affect ( $P > 0.10$ ) any variables. Overall pregnancy rates were 62, 56, 64, and 69% for BECS, BERS, NECS, and NERS cow, respectively. Neither overall pregnancy rates nor timed insemination pregnancy rates of cows given the second GnRH injection differed ( $P > 0.10$ ) among treatments. In conclusion, although bull exposure increased percentage of cows cycling and ovulation rate, neither exposure nor restricted suckling of first-calf suckled beef cows appeared to enhance pregnancy rates in combination with the Ovsynch protocol.

**Key Words:** Biostimulation, Suckling, Ovsynch

**88 Supplementation of whole sunflower seeds before AI in beef heifers.** R. N. Funston<sup>\*1</sup>, T. W. Geary<sup>2</sup>, R. P. Ansotegui<sup>1</sup>, J. J. Lipsey<sup>3</sup>, M. D. MacNeil<sup>2</sup>, and J. A. Paterson<sup>1</sup>, <sup>1</sup>Montana State University, Bozeman, <sup>2</sup>USDA-ARS, Miles City, MT, <sup>3</sup>American Simmental Association, Bozeman.

The objective of this study was to evaluate synchronization and pregnancy rates of beef heifers supplemented with 0.91 kg of whole sunflower seeds for either 0, 30, or 60 d before AI. Beef heifers from four locations ( $n = 1,014$ ) were assigned by BW to treatment (within location) and randomly to AI sire. Heifers at location 1 ( $n = 176$ ; mean BW = 332 kg) received either 0 or 60 d treatments. Heifers at location 2 ( $n = 397$ ; mean BW = 334 kg) were fed sunflower seeds for 0, 30, or 60 d. Heifers at locations 3 ( $n = 211$ ; mean BW = 345 kg) and 4 ( $n = 230$ ; mean BW = 343 kg) received 0 or 30 d treatments. Within location, diets were formulated to be isocaloric and isonitrogenous. All heifers received melengesterol acetate (0.5mg/hd/d) for 14 d followed 19 d later by an injection of PGF (25 mg). Heifers were bred by AI according to the AM/PM rule except on d 3 during which all heifers which had not exhibited estrus were mass AI'd. Data were combined for locations 1 and 2 to test the effect of 0 and 60 d sunflower feeding. Data from locations 2, 3, and 4 were combined to test the effect of 0 and 30 d sunflower feeding. Heifers fed the control diet had a higher ( $P < 0.01$ ) ADG than heifers fed sunflower seeds for 60 d. There was a location x treatment interaction ( $P < 0.01$ ) for ADG in the comparison of 30 and 0 d sunflower treatments. Neither 72 h estrous response nor pregnancy rate were affected ( $P > 0.10$ ) by 30 or 60 d sunflower feeding. There was no interaction of location by treatment ( $P > 0.10$ ) in either analysis; therefore, data were pooled across locations to test differences among all three treatments. Neither estrous response nor pregnancy rate were affected ( $P > 0.10$ ) by treatment. Pregnancy rate for heifers detected in estrus was 68% and 33% for mass bred heifers, estrous response by 72 h was 71%. In summary, feeding 0.91 kg of whole sunflower seeds for either 30 or 60 d before AI did not improve estrous response or pregnancy rate.

**Key Words:** Estrous Synchronization, Heifers, Fat Supplementation

**89 Transcervical artificial insemination in sheep: Effects of a modified transcervical artificial insemination instrument and traversing the cervix.** M. C. Wulster-Radcliffe\* and G. S. Lewis, *USDA-ARS U.S. Sheep Experiment Station, Dubois, ID*.

The difficulty of traversing the cervix severely limits the use of transcervical (TC) AI in sheep. In addition, cervical trauma and poorly designed instruments can reduce fertility after AI. In an attempt to overcome the problems associated with TC intrauterine AI (i.e., trauma induced as the instrument is manipulated through the cervix and into the uterus), we developed a new TC AI instrument. Thus, this experiment was conducted to determine whether our new TC AI instrument and/or using this instrument to perform TC AI affected fertilization and/or pregnancy rate. Ewes were assigned to one of three treatments: 1) TC intrauterine AI using the new TC AI instrument + sham intrauterine AI via laparotomy ( $n = 8$ ); 2) sham TC AI + intrauterine AI via laparotomy using a proven laparoscopic AI instrument ( $n = 7$ ); and 3) sham TC AI + intrauterine AI via laparotomy using the new TC AI instrument ( $n = 9$ ). To synchronize estrus, progestogenated pessaries were inserted and left in place for 12 d. On d 5 after pessary insertion, 15 mg of Lutalyse were injected i.m. At pessary removal, 400 IU of eCG were injected i.m. Inseminations were performed 48 to 52 h after pessary removal. Fresh, diluted semen (200 mL) pooled from the same four rams each day during the experiment was used. At approximately 72 h after AI, uteri were collected and flushed. Oocytes or embryos were recovered and evaluated morphologically for development. Treatments did not affect ( $P > 0.05$ ) ovum/embryo recovery rate ( $100 \times [\text{embryos} + \text{ova}] \div \text{number of CL}$ ; mean = 86%), fertilization rate ( $\text{embryos} \div [\text{embryos} + \text{ova}] \times 100$ ; mean = 58%), or pregnancy rate ([ewes pregnant  $\div$  number of ewes]  $\times 100$ ; mean = 63%). We conclude from these data that neither our new TC AI instrument nor TC intrauterine insemination using the new TC AI instrument should impair the success of TC AI in sheep.

**Key Words:** Artificial Insemination, Cervix, Sheep

**90 Effect of Heparin in in vitro fertilization media after Percoll separation of frozen thawed-bull semen? J.O. Mendes\*, J.F Sanchez, P. Burns, and G. Seidel, Colorado State University, Fort Collins.**

The literature indicates that heparin is important for the capacitation of the semen for in vitro fertilization. All these studies used swim-up or another technique for sperm separation. It was never describe if heparin is really needed in fertilization media when Percoll procedure is used. This study was concerned with the need for heparin in the fertilization medium in vitro produced bovine embryos when the Percoll technique is used for sperm separation. Four treatments (with or without heparin x 3 or 6 hours of co-culture of sperm and oocytes) and sperm from three different bulls were used to compare cleavage rates and embryo production. Cleavage rates were not different between the four different treatments or the three bulls ( $P > 0.05$ ). Embryo production did not differ between treatments or bulls ( $P > 0.05$ ). The time was not significant between treatments ( $P > 0.05$ ). These data show that the Percoll procedure may facilitate sperm capacitation. It was concluded that heparin is not needed in the fertilization medium when the Percoll procedure is used. Further studies are needed to determine the mechanisms of sperm capacitation induced by Percoll alone.

**Key Words:** Heparin, Capacitation, In vitro fertilization

**91 Treatment with estradiol benzoate and progesterone to induce emergence of a new ovulatory follicle in cattle. M.L. Mussard\*, H. Jimenez-Severiano, and J.E. Kinder, University of Nebraska, Lincoln.**

The aim of the present study was to determine the effect on; FSH increase, follicle wave emergence, estrus and ovulation in cattle that were in various stages of follicular wave development at the time of estradiol benzoate (EB) (2.5 mg) and progesterone (P4) (200 mg) treatment. At the time of EB and P4 treatment (EB and P4 treatment = h 0; Group 1 (n = 10) had 4-7 mm follicles, Group 2 (n = 9) had 7-9 mm follicles, Group 3 (n = 9) had a dominant follicle and Group 4 (n = 10) had a persistent follicle. Examinations of ovarian structures via ultrasonography commenced five d prior to EB and P4 treatment and continued daily until estrus was detected following treatment. Blood samples for FSH analysis were collected 12 h prior to EB and P4 treatment and taken every six h thereafter until follicular wave emergence was detected 4 to 6 d following treatment. Size of the largest follicle at the time of EB and P4 treatment was different among groups ( $P < 0.05$ ). The variance in interval to follicular wave emergence following EB and P4 treatment was less in Group 4 (67.4 h) than Groups 1 (297.6 h) or 2 (689.1 h) ( $P < 0.05$ ), but not Group 3 (118.6 h) ( $P > 0.10$ ). Variability in interval to estrus and ovulation following EB and P4 treatment was less for Group 4 (72.3 h and 109.7 h, respectively) than Groups 1 (250.4 h and 422.1 h) and 2 (548.4 h and 820.5 h) ( $P < 0.05$ ), but not Group 3 (189.8 h and 186.0 h) ( $P > 0.10$ ). Mean interval to estrus was less in Group 4 ( $55.6 \text{ h} \pm 2.5$ ) than Groups 1 ( $76.7 \text{ h} \pm 6.5$ ) and 2 ( $88.1 \text{ h} \pm 8.7$ ) ( $P < 0.05$ ), but not Group 3 ( $66.4 \text{ h} \pm 4.1$ ) ( $P > 0.10$ ). Mean interval to ovulation was less for Group 4 (83.8 h  $\pm$  3.3) than Groups 1 (113.1 h  $\pm$  6.8) and 2 (124.8 h  $\pm$  10.1) ( $P < 0.05$ ), but not Group 3 (95.5 h  $\pm$  4.8) ( $P > 0.10$ ). In conclusion, cows that have a persistent follicle at the time of EB and P4 treatment have a more synchronous interval to follicle wave emergence, estrus and ovulation than cows with ovarian follicles in recruitment or selection stages of development.

**Key Words:** Cattle, Ovarian follicles, Estradiol benzoate

**92 Effect of neuropeptide Y on GnRH-induced LH release from bovine anterior pituitary cell cultures. D. J. Denniston\*, M. G. Thomas, K. K. Kane, L. Canales, W. D. Bryant, C. N. Roybal, D. M. Hallford, and D. E. Hawkins, New Mexico State University, Las Cruces.**

Neuropeptide Y (NPY) receptors are present on the anterior pituitary gland; however, their function, if any, has yet to be elucidated. Objectives were to investigate the effect of NPY on GnRH-induced LH release from cultured bovine anterior pituitary cells of heifers in differing ovarian states. Hereford heifers (n = 15) were assigned to one of three groups: follicular (n = 5), luteal (n = 5) or ovariectomized (n = 5). One individual from each of the three groups was slaughtered on each of 5 d. Immediately postmortem, the anterior pituitary gland was removed, mid-sagittally sliced, and enzymatically dissociated. Cells were washed

by repeated centrifugation and cultured overnight. Following overnight incubation, cells were washed, counted, and stained to determine viability. Cells (85,000 to 110,000 per tube) were then equally distributed and each tube randomly assigned to one of three treatments: no NPY or GnRH, 10 nM GnRH, or 100 nM NPY + 10 nM GnRH. Each treatment was repeated in duplicate tubes. Cell cultures were incubated with or without NPY for 4 h and further incubated for an additional 2 h, with or without GnRH. Post incubation cells were centrifuged and supernatant collected for quantification of LH. Hormone variability among the five different culture days was not different ( $P > 0.10$ ). However, cells treated with GnRH alone or GnRH + NPY secreted more LH than those cultured in the absence of GnRH and NPY (412.1, 396.2, 352.8  $\pm$  11.8 ng /mL of incubation media, respectively;  $P < 0.05$ ). Additionally, there was no difference in the secretion of LH from pituitary cells harvested from follicular, luteal or ovariectomized heifers (417.9, 390.0, 353.3  $\pm$  103.8 ng / mL of incubation media, respectively;  $P > 0.05$ ). In conclusion, NPY does not attenuate GnRH-induced release of LH from the anterior pituitary cell; thus suggesting that any effect of NPY on reproduction may be limited to the hypothalamus.

**Key Words:** Bovine Anterior Pituitary, Neuropeptide Y, Cell Culture

**93 Serum thyroxine, body weights, and ovarian cyclicity in fine wool ewes subjected to thyroid suppression immediately before onset of anestrus. J.A. Hernandez\*, D.M. Hallford, and N.H. Wells, New Mexico State University, Las Cruces.**

Fourteen cycling fine wool ewes were assigned to three treatments to examine effects of thyroid suppression on time of onset of anestrus. Ewes remained in a single pen (12 x 4 m) with access to salt, shade, water, and alfalfa hay ( $1.8 \text{ kg} \cdot \text{animal}^{-1} \cdot \text{d}^{-1}$ ) throughout the experiment. Beginning on d 0 (January 17, first day of treatment), ewes received daily treatments (gavage) for 35 d consisting of either 0 (n = 4), 20 (n = 5), or 40 (n = 5) mg of propylthiouracil (PTU)/kg BW. Blood samples (jugular venipuncture) and weights were taken regularly until d 140. Serum samples were assayed for thyroxine ( $T_4$ ) and progesterone ( $P_4$ ). Ewe BW were similar ( $P > 0.90$ ) among treatments before the trial began with all ewes weighing 78 ± 4.5 kg. Likewise, all ewes had serum  $T_4$  concentrations of approximately 85 ng/mL on d 0 ( $P > 0.40$ ). After 11 d of PTU treatment, however, serum  $T_4$  was 90, 75, and 44 (14) ng/mL in ewes receiving 0, 20, and 40 mg of PTU/kg BW, respectively (linear,  $P = 0.04$ ). On d 20,  $T_4$  values in the three respective groups were 73, 51, and 16 (13) ng/mL (linear,  $P < 0.01$ ). Fourteen days after PTU treatment ended, serum  $T_4$  was similar ( $P > 0.50$ ) in the three respective groups (71, 72, and 56 ± 12 ng/mL). Although BW did not differ ( $P > 0.10$ ) among treatments during the experiment, ewes receiving PTU tended to weigh less on d 42 (84, 78, and 72 ± 5 kg for ewes treated with 0, 20, and 40 mg PTU/kg, respectively; linear,  $P = 0.10$ ). Day of onset of anestrus was designated as the day on which serum  $P_4$  fell and stayed below 1 ng/mL. Ewes treated with 0, 20, or 40 mg of PTU/kg BW became anestrus on d 16, 40, and 78 (12) of the experiment, respectively (linear,  $P < 0.01$ ). At the time the 35-d treatment period ended, 25, 60, and 100% of ewes receiving 0, 20, or 40 mg of PTU/kg were still cycling. Large dosages of PTU will dramatically lower serum  $T_4$  and this effect appears to inhibit onset of anestrus in fine wool ewes.

**Key Words:** Sheep, Propylthiouracil, Anestrus

**94 Bovine embryo development in vitro in the medium containing phytohemagglutinin or pokeweed mitogen. S. Wang<sup>1</sup>, K.E. Panter<sup>2</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.**

Pokeweed mitogen (PWM) and Phytohemagglutinin (PHA), the extracts from *Phytolacca americana* and *Phaseolus vulgaris*, 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 PWM and PHA on the preimplantation bovine embryo development. A randomized complete block (10 replications) design with three treatments (TRT) was used. Bovine oocytes (n = 1576) were aspirated from abattoir ovaries, *in vitro* matured (IVM) and *in vitro* fertilized (IVF). The IVM/IVF derived zygotes were then *in vitro* cultured (IVC) in modified CR2 medium containing PWM (Gibco, Cat. No. 15360-019) 10  $\mu\text{l}/\text{ml}$  (TRT1), PHA (Gibco, Cat. No. 10576-015) 10  $\mu\text{l}/\text{ml}$  (TRT2), or none of them (Control) in a humidified 5% CO<sub>2</sub> atmosphere at 39 °C. 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 86.4%, 86.2% and 87.2% for TRT1, 2 and Control, respectively. There was no difference in cleavage rates between the treatments ( $P > 0.05$ ). The percentage of morulae at d 6 of IVC was 23.8, 58.6 and 56.8; and the percentage of blastocysts at d 8 of IVC was 0.3, 21.7 and 23.0 for TRT1, 2 and Control, respectively. The embryos developed to morulae and blastocyst stages in PWM medium were much less than those in PHA and Control ( $P < 0.05$ ). There was no difference ( $P > 0.05$ ) between PHA and Control. In conclusion, preimplantation bovine embryo development may be adversely affected by mitogenic agents depending on their sources.

**Key Words:** Bovine embryo development, Phytohemagglutinin, Pokeweed mitogen

**95 Effect of feed restriction on ovulation and reproductive hormones in ewes.** Z. Kiyma\*, E. A. Van Kirk, W. J. Murdoch, and G. E. Moss, *University of Wyoming, Laramie.*

Mature ewes ( $n = 20$ ) were used to study effects of short-term feed withdrawal on endocrine changes and ovulation rates in ewes fasted during the luteal phase of the estrous cycle. Synchronized ewes were observed in estrus and randomly assigned to control ( $n = 10$ ) and fasted ( $n = 10$ ) groups. Control ewes were fed ad libitum throughout the experiment. Fasted ewes were not fed from day 7 to 11 of the estrous cycle. Daily blood samples were collected from day 6 through 11. On day 12 of the estrous cycle, all ewes were treated with 10 mg PGF<sub>2α</sub> (Lutalyse®) and fed ad libitum. Blood samples were collected at 2 h intervals for 72 h after PGF<sub>2α</sub> administration. Ovulation rates were deduced by laparoscopically counting corpora lutea 13 days after administration of PGF<sub>2α</sub>. Serum concentrations of progesterone (P<sub>4</sub>), insulin-like growth factor-I (IGF-I), and IGF-binding proteins (IGFBPs) were assayed. Ovulation rates of control and fasted ewes did not differ ( $P > 0.05$ ). Fasted ewes had higher ( $P < 0.05$ ) serum concentrations of P<sub>4</sub> from the second day of fasting until 8 h after PGF<sub>2α</sub>. In fasted ewes, serum IGF-I concentrations started to decrease ( $P < 0.05$ ) on the second day of fasting and continued to decline until the last day of fasting. After the resumption of providing ad libitum feed to the fasted ewes, serum concentrations of IGF-I began to increase and were comparable to control ewes within 3 days. Serum concentrations of IGFBPs did not differ between control and fasted ewes except at 96 h of fasting when IGFBP-1 and IGFBP-2 were higher ( $P < 0.05$ ) in fasted than control ewes. In summary, feed withdrawal from ewes for 5 days evokes endocrine changes that may perturb the estrous cycle.

**Key Words:** Fasting, Ovulation Rates, Reproductive Hormones

**96 Effects of supplemental protein provided to postpartum beef cows in liquid or cube form on metabolic, endocrine and reproductive functions.** K. K. Kane<sup>1</sup>, T. P. Schafer<sup>1</sup>, J. M. Harris<sup>2</sup>, D. M. Halford<sup>3</sup>, M. D. Remmenga<sup>3</sup>, and D. E. Hawkins<sup>3</sup>, <sup>1</sup>Angelo State University, San Angelo, <sup>2</sup>Westway Feed Products, Tomball, TX, <sup>3</sup>New Mexico State University, Las Cruces.

Metabolic, endocrine and reproductive functions in postpartum beef cows, supplemented with protein supplied as range cubes or liquid, were evaluated. Angus cows ( $n = 60$ ; 2 to 8 yr; mean BCS  $4.6 \pm 0.1$ ) were stratified by age and calving date and randomly assigned to one of two supplements (S): 20% CP natural protein range cubes (C) at 1.36 kg/d or 35% CP liquid supplement (L) at 0.91 kg/d, and one of two estrus synchronization (ES) protocols: Syncro-Mate B or CO-Synch. Cows grazed native range pastures and an additional 4.55 kg/d sudan grass hay (CP 6.1%) was fed from calving through ES. Six pastures, three/supplement, were utilized with 10 cows/pasture. Supplement did not affect cow BW or BCS, or calf BW ( $P > 0.05$ ). Serum insulin and thyroxine were similar between S groups ( $P > 0.05$ ). No differences existed between C and L in serum GH, glucose and IGF-I (GH: 28.9 and  $30.0 \pm 0.8$  ng/mL; glucose: 56.5 and  $56.3 \pm 1.2$  ng/mL; IGF-I: 60.9 and  $56.2 \pm 4.5$  ng/mL, respectively;  $P > 0.05$ ). Postpartum interval and pregnancy rate were similar in S and ES groups ( $P > 0.05$ ). Serum insulin, IGF-I, and thyroxine did not differ among cows returning to estrus prior to ES, with ES, or cows remaining anestrous through ES ( $P > 0.05$ ). However, GH was greater in cows remaining anestrous compared with cows returning to estrus prior to or with ES (33.1, 27.7 and  $29.5 \pm 1.7$  ng/mL, respectively;  $P = 0.04$ ). Serum glucose was greater in cows returning to estrus prior to ES than in anestrous cows or cows returning to estrus with ES

(58.2, 54.5, and  $55.8 \pm 1.3$  ng/mL, respectively,  $P = 0.03$ ). Protein supplemented as range cubes or liquid did not affect metabolic, endocrine or reproductive function in postpartum beef cows grazing native range. However, anestrous cows had similar insulin and IGF-I but greater GH and less glucose when compared with cows returning to estrus prior to ES.

**Key Words:** Postpartum Cow, Protein, Reproduction

**97 Differential relationships of metabolic hormones and serum glucose to growth and reproductive development of Angus, Brahman, and Brangus heifers.** R Lopez<sup>\*1</sup>, M.G. Thomas<sup>1</sup>, D.M. Halford<sup>1</sup>, D.H. Keisler<sup>2</sup>, B.S. Obeidat<sup>1</sup>, C.D. Morrison<sup>2</sup>, J.A. Hernandez<sup>1</sup>, W.D. Bryant<sup>1</sup>, R. Flores<sup>1</sup>, and M.D. Garcia<sup>1</sup>, <sup>1</sup>New Mexico State University, Las Cruces, <sup>2</sup>University of Missouri, Columbia.

Beef production systems in the desert southwest require replacement females that are physiologically and behaviorally adapted to high temperature and low forage quality. To learn about potential use of differing breeds, Angus, Brahman, and Brangus heifers ( $n = 8/\text{breed}$ ) of similar age were randomly selected from a group of 85 weanlings. Heifers were fed an alfalfa-corn-based diet (14.9% CP and 75% TDN) and evaluated for 78 d for differences in metabolic hormones and growth and reproductive performance. Angus heifers were heavier ( $P < 0.05$ ) than Brahman and Brangus heifers throughout the study. Initial and final BW for Angus, Brahman, and Brangus heifers were 313, 247, 287, and 421, 332, 392 10 kg. Despite Angus and Brangus heifers exhibiting greater ADG than Brahman, no differences were observed in DMI when expressed per unit of BW. Brahman heifers did have greater hip height ( $P < 0.05$ ) than Angus or Brangus, but Angus heifers had 55% more back fat than Brahman and 27% more than Brangus ( $P < 0.01$ ) at the end of the study. In parallel, serum concentrations of the adipose derived hormone leptin were greater ( $P < 0.05$ ) in Angus (4.4 0.2) than in Brangus and Brahman heifers (3.1 and 2.9 0.2) throughout the study. Partial correlation analyses with the effect of breed removed, revealed that serum concentrations of leptin were positively associated with back fat ( $r = 0.30$ ,  $P < 0.05$ ) and body condition score ( $r = 0.27$ ,  $P < 0.05$ ). Conversely, serum concentrations of GH ( $P < 0.13$ ) and glucose ( $P < 0.05$ ) tended to be greater in Brahman heifers relative to Angus and Brangus, whereas serum concentrations of IGF were greater ( $P < 0.05$ ) in Brangus and Brahman compared with Angus heifers throughout the study. Puberty was observed in 75% of the Angus, 75% of the Brangus and 0% of Brahman heifers during the study. Then, after a 90-d breeding season, 100% of the Angus, 75% of the Brangus, and 12% of the Brahman heifers were pregnant ( $\chi^2$ ;  $P < 0.05$ ). Metabolic hormones such as GH and leptin are known to be involved in puberty in most mammals. Data herein, suggest that these varying hormone concentrations could help explain some of the differences that occur in the rate of reproductive development between various breeds of Bos indicus and Bos taurus cattle.

**Key Words:** Leptin, Breeds, Heifer

**98 Serum thyroxine and reproductive characteristics of Rambouillet ewe lambs treated with propylthiouracil before puberty.** N. H. Wells\*, D. M. Halford, and J. A. Hernandez, *New Mexico State University, Las Cruces.*

Twenty-four fine wool ewe lambs (BW =  $43.7 \pm 1.2$  kg, 6 mo of age) were used to examine the effect of thyroid suppression before the onset of puberty on serum thyroxine (T<sub>4</sub>), BW, and date of puberty. Beginning in early September, ewe lambs were assigned to three treatments ( $n = 8$  lambs/treatment). All animals remained in a single pen (12 x 4 m) with access to salt, water, shade, and alfalfa hay (2.5 kg·animal<sup>-1</sup>·d<sup>-1</sup>) throughout the experiment. On d 0 (first day of treatment), all ewe lambs received daily treatments (gavage) for 15 d consisting of 0, 20 (low), or 40 (high) mg of 6-n-propyl-2-thiouracil (PTU)/kg BW. On d 16 the low and high treatments were lowered to 10 and 20 mg ·kg BW<sup>-1</sup>·d<sup>-1</sup>, respectively. All animals were treated for 28 d. Blood samples (jugular venipuncture) and weights were taken regularly. All serum samples were analyzed for T<sub>4</sub> and ovarian cyclicity was determined by twice weekly progesterone (P<sub>4</sub>) analysis. Thyroxine concentrations were similar on d 0 (62, 55, and  $57 \pm 2$  ng/mL,  $P = 0.16$ ) in ewe lambs receiving 0, 20, and 40 mg of PTU/kg BW, respectively. By d 7, both PTU-treated groups had T<sub>4</sub> values less than 20 ng/mL (9 and  $15 \pm 2$  ng/mL) compared with 78 ng/mL in controls ( $P < 0.01$ ). By 7 d after

termination of PTU treatment, serum T<sub>4</sub> had risen to 29 and 27 ( $\pm 2$ ) ng/mL in the low and high PTU groups, respectively. On d 66, control ewes had 55 ng T<sub>4</sub>/mL compared with 43 and 39 ( $\pm 2$ ) ng/mL for ewes in the low and high groups, respectively ( $P < 0.01$ ). Ewe lamb weights were similar ( $P > 0.50$ ) among groups throughout the treatment period. Average Julian day of puberty was also similar ( $P > 0.50$ ) among treatments (281, 288, 288  $\pm$  5; control, low, and high respectively). Control ewes had a pregnancy rate of 75%, while both PTU-treated groups had pregnancy rates of 88% ( $P > 0.20$ ). The PTU resulted in a rapid decline in serum T<sub>4</sub> but neither time of puberty nor pregnancy rates were affected by lowered T<sub>4</sub> values.

**Key Words:** Sheep, Reproduction, Puberty

**99 In vitro development of bovine embryos treated with isocupressic acid (ICA), a pine needle abortifacient toxin.** S. Wang<sup>1</sup>, K.E. Panter<sup>2</sup>, D.R. Gardner<sup>2</sup>, R.C. Evans<sup>1</sup>, and T.D. Bunch<sup>1</sup>, <sup>1</sup>Utah State University, Logan, <sup>2</sup>Poisonous Research Laboratory, Agricultural Research Service, USDA, Logan, UT.

Isocupressic acid [15-hydroxylabda-8(17),13E-dien-19-oic acid], a diterpene acid from the pine needles in Ponderosa pine (*Pinus ponderosa*), Lodgepole pine (*Pinus contorta*) and common juniper (*Juniperus communis*), is known to induce abortions during the last trimester of pregnancy when administered orally or by intravenous infusion to cattle. This study investigated the effects of ICA on bovine preimplantation embryo development using *in vitro* fertilization procedures. A randomized complete block (16 replications) design with four *in vitro* culture treatments (TRT) was used. Cumulus cell complete oocytes (n=2719) were aspirated from abattoir ovaries, matured and fertilized *in vitro*. The resulting zygotes were *in vitro* cultured (IVC) in the medium containing 2.6  $\mu$ g ICA/ml (TRT1), 1.3  $\mu$ g ICA/ml (TRT2), 10% sera from ICA-dosed cattle (TRT3), and 0  $\mu$ g ICA/ml (Control). The cleavage rates were 85.4%, 84.5% 85.6% and 87.0% and the percentage of morulae at d 6 of IVC was 58.3, 59.6, 55.8 and 50.3 for TRT1, TRT2, TRT3 and Control, respectively. There was no significant ( $P>0.05$ ) difference with respect to oocyte cleavage and morula production between treatments. The percentage of blastocysts at d 8 of IVC was 29.8, 22.5, 22.6 and 18.8 for TRT1, TRT2, TRT3 and Control, respectively. The blastocyst production was significantly higher ( $P<0.01$ ) in ICA-containing medium than Control. The percentage of expanded and hatched blastocysts at d 10 was 26.0, 18.9, 17.6 and 12.5 for TRT1, TRT2, TRT3 and Control, respectively. Both ICA TRTs had a higher ( $P<0.01$ ) production of expanded and hatched blastocyst compared to control. Furthermore, development of embryos from TRT1 (2.6  $\mu$ g/ml) was better ( $P<0.01$ ) than TRT2 (1.3  $\mu$ g/ml) with respect to the production of expanded and hatched blastocyst. In conclusion, isocupressic acid appears to promote bovine preimplantation embryo development *in vitro* in a dose dependent manner.

**Key Words:** Bovine, *In vitro* culture, Isocupressic acid

**100 Use of fluorogestone acetate or natural progesterone to induce estrus on seasonal anestrous goats with good or poor body condition.** A. Anchondo, A. Martnez, J. Gutirrez, A. Grado, and F.A. Rodrguez-Almeida\*, Universidad Autonoma de Chihuahua, Chihuahua, MX.

To evaluate effectiveness of two treatments to induce estrus and resulting pregnancy rates, 120 does, upgraded to dairy breeds and in seasonal anestrous, were used. Does were classified into good (GBC) or poor body condition (PBC) groups, and randomly assigned within each body condition (BC) group to treatments: T0 (n=20 with GBC and 20 with PBC), control; T1 (n=19 with GBC and 20 with PBC), intravaginal sponges impregnated with 45 mg of fluorogestone acetate (Chronogest<sup>®</sup>) during 21 d plus an i.m. injection of 250 IU of PMSG 48 h before the sponge was removed; and T2 (n=17 with GBC and 12 with PBC), controlled intravaginal device releasing progesterone (CIDR-B<sup>®</sup>) for 14 d plus an i.m. injection of 250 IU of PMSG at time of device removal. Twenty does were assigned to each of the six treatment-BC groups, but those that lost intravaginal devices were taken out of the experiment. Intravaginal devices were removed at the same time in T1 and T2. Estrus was detected visually from 0 to 72 h after device removal. Does in estrus were mated to a buck. No does were observed in estrus for T0; therefore, this group was removed from statistical analysis. A model with effects of BC group, treatment and their interaction was adjusted for both, continuous and categorical variables. Percentages of does detected in estrus

did not differ ( $P \geq 0.05$ ) between treatments and BC groups. For goats in GBC, average time from device removal to estrus was similar ( $P \geq 0.05$ ) between treatments (24.3 $\pm$ 1.6 h vs 24.2 $\pm$ 1.7 h for T1 and T2, respectively), but was different ( $P \leq 0.05$ ) between treatments for goats in PBC (25.6 $\pm$ 1.6 h vs 38.4 $\pm$ 2.3 h for T1 and T2, respectively). Percentages of does detected in estrus within 24 h after device removal were different ( $P \leq 0.05$ ) in goats with GBC (83.3 vs 50 % for T1 and T2, respectively), and were low in goats with PBC (27.7 vs 11.1 % for T1 and T2, respectively). Pregnancy rate was higher ( $P \leq 0.05$ ) in T1 than in T2 (83.3 vs 53.3 % for goats with GBC and 61.1 vs 22.2 % for goats with PBC). Chronogest<sup>®</sup> for 21 d plus 250 IU of PMSG resulted in better synchronization of estrus and higher pregnancy rates in anestrous goats than CIDR-B<sup>®</sup> for 14 d plus 250 IU of PMSG. Poor body condition increased time to estrus and reduced pregnancy rates in both treatments.

**Key Words:** Anestrous goat, Flurogestone Acetate, Progesterone

**101 Ram mating behavior is influenced by long-term selection for number of lambs born.** J. N. Stellflug<sup>\*1</sup>, J. G. Berardinelli<sup>2</sup>, and P. J. Burfening<sup>2</sup>, <sup>1</sup>USDA-ARS US Sheep Experiment Station, Dubois, ID, <sup>2</sup>Montana State University, Bozeman.

Selection for mating behavior is known to be heritable in several species, but it is not well known if selection schemes for ewe reproductive traits affect mating behavior of rams. Therefore, our objective was to determine if divergent (high vs low index) selection for a female reproductive trait (lambs born divided by age of ewe minus one) affects mating behavior of male offspring after extensive classification or during training to service an artificial vagina (AV). A series of serving capacity tests was used to estimate libido, and a sexual preference test was used to evaluate sexual orientation. In experiment 1, ram classification consisted of exposing each ram (n = 48) to three estrus ewes for 18–30-min periods. Thereafter, each ram was observed in a 30-min preference test with access to restrained rams and estrus ewes. There was no difference ( $P > 0.18$ ) in number of classed rams mounting (92 vs 78%) and ejaculating (88 vs 74%) between the high and low line, respectively. Only one high line ram was male-oriented. For experiment 2, five 30-min libido tests were conducted to assess mating behavior on an additional 29 rams being trained to service an AV. In this experiment, number of rams mounting (73 vs 36%) and ejaculating (67 vs 29%) differed ( $P < 0.01$ ) between high and low line, respectively. Results of this study indicate that long-term selection of ewes for litter size did not alter ram performance after extensive classification or affect incidence of male-oriented rams. Mating behavior observed at time of training to service an AV was decreased in low line rams compared to that in high line rams. We concluded that selection for female reproductive traits in sheep may alter the mating behavior patterns of offspring.

**Key Words:** Selection, Lambs born, Libido

**102 Bull introduction hastens the onset of the breeding season in reindeer.** M.P. Shipka<sup>\*1</sup>, G.L. Finstad<sup>1</sup>, T.F. Nichols<sup>1</sup>, and S.P. Ford<sup>2</sup>, <sup>1</sup>University of Alaska, Fairbanks, <sup>2</sup>Iowa State University, Ames.

Reindeer are seasonally polyestrus, short day breeders, with estrous cycles of approximately 20 d in length. The objective of this study was to investigate the effects of reindeer bull exposure on the onset of the reindeer cow breeding season and to investigate whether cows with calving experience responded differently than cows with no previous reproductive experience. The bull was removed from cows more than two months prior to the start of this experiment and housed at a separate facility approximately 2 km distant. Blood samples were collected from cows 3x weekly beginning on Aug. 11, 2000 (d 1) and continuing until Sept. 29, 2000 (d 50) and plasma was stored frozen for later assay of progesterone (P4). On d 6, cows were divided into two groups such that group one (early bull exposure; EBE), consisted of four cows that had calved the previous spring and four cows that had no reproductive experience (n = 8). Group two (late bull exposure; LBE), consisted of three cows that had calved the previous spring and three cows that had no reproductive experience (n = 6). EBE experienced bull introduction on d 13, 23 d earlier than the average onset of ovarian activity during 1999. LBE experienced bull introduction on d 46, 10 d later than the average onset of ovarian activity during 1999. Progesterone concentrations were analyzed by ANOVA procedures for repeated measures. Previous reproductive status had no effect on the onset of ovarian activity within EBE ( $P = 0.92$ ) or within LBE ( $P = 0.61$ ). Time of bull introduction

had a significant effect on the onset of ovarian activity when EBE was compared to LBE ( $P < 0.0001$ ). The first sustained increase in mean P4 concentration above 1 ng/ml occurred on d 25 in EBE reindeer and on d 41 in LBE reindeer. EBE reindeer initiated ovarian activity 12 d after bull introduction while LBE reindeer initiated ovarian activity 5 d before bull introduction. Results indicate that bull management effects the onset of the breeding season in reindeer cows, regardless of previous reproductive experience.

**Key Words:** Reindeer, ovarian activity, breeding season

**103 Body weight and body condition score changes and reproductive success in ewes fed Megalac® supplements.** J.L. Bollinger\*, T. T. Ross, D. J. Padilla, and D.M. Halford, *New Mexico State University, Las Cruces*.

Two experiments were conducted to determine effects of supplements containing Megalac® on BW and body condition score (BCS) change, ovulation rates, pregnancy rate, and LH release in response to a GnRH challenge. In Exp.1, 36 multiparous ewes (initial BW = 77.7kg) were randomly assigned to one of three pre-breeding supplementation treatments: 1) negative control (Neg. Con); no supplement, 2) isocaloric and isonitrogenous control (Iso.), 363g/d of ground whole corn, 3) Megalac®, 227g/d of 38.6% Megalac®, 36.0% ground whole corn, 23.0% soybean meal, and 2.4% molasses. In Exp.2, 34 estrually synchronized whiteface multiparous ewes (initial BW = 63.1kg) were randomly assigned to one of four treatments, with three treatments being similar to Exp. 1 and the fourth, Megalac® Repro. receiving 227g/d of 38.6% Megalac® Repro. 36.0% ground whole corn, 23.0% soybean meal, and 2.4% molasses. Ewes in Exp.1 were fed supplements 20-d prior to the introduction of the rams and 20-d into breeding. Ewes in Exp. 2 were fed for 30-d prior to introduction of rams and 20d into breeding season. In Exp.1, BW loss was less ( $P < 0.01$ ) for Megalac® compared with Neg. Con. and Iso. respectively. However, at the end of treatment in Exp. 2, no difference in BW change was detected with ( $P > 0.29$ ) among treatments. Body condition score change followed a similar pattern. In Exp.1, after the treatment period, Neg. Con. ewes lost ( $P < 0.01$ ) more body condition than the Iso. and Megalac®, respectively. A similar effect ( $P < 0.01$ ) was noted for Exp.2. Number of fetuses being gestated by treatment ewes in Exp. 1 was determined on d 69 after breeding. No difference was found for number fetuses per ewe ( $P > 0.29$ ) or pregnancy rates ( $P > 0.34$ ). No differences ( $P > 0.53$ ) for pregnancy rates and ( $P > 0.37$ ) ovulation rates among respective treatments were observed in Exp. 2. In these

trials, Megalac® does not seem to positively influence reproduction in ewes supplemented prior to the breeding season.

**Key Words:** Reproduction, Megalac®, Calcium salts of long chain fatty acids

**104 Effect of fasting and intramammary infusions of cephalin benzathine on hormone profiles and mammary characteristics in ewes following weaning.** M. E. Surian<sup>1</sup>, D. W. Holcombe<sup>\*1</sup>, D. Redelman<sup>1</sup>, J. R. Allen<sup>1</sup>, M. McFarland<sup>1</sup>, and D. M. Halford<sup>2</sup>, <sup>1</sup>*University Of Nevada, Reno*, <sup>2</sup>*New Mexico State University, Las Cruces*.

Eighty Rambouillet ewes (2 to 8-yr-old) were used to examine the effect of post-weaning fast and intramammary antibiotic infusion on hormone profiles, change in udder size, and somatic cell counts (SCC) during the drying off period. Animals were assigned to the following 2 x 2 factorial treatment combinations: 1) a 48-h post-weaning fast or non-fasted, and 2) intramammary infusion of 300 mg of cephalin benzathine at weaning or non-infusion. SCC were examined using a propidium iodine nuclear stain and flow cytometry on d 0 (weaning) and d 1. Udder circumference, serum growth hormone (GH) and insulin-like growth factor # I (IGF-1) were examined throughout the 11-d period. SCC were greater ( $P = 0.07$ ) in non-infused than infused udders; fasting had no influence ( $P = 0.50$ ) on SCC. SCC were lower on d 0 than d 1 ( $P = 0.0001$ ) across groups. Udders were further categorized into two groups using SCC on d 0: # 750 cells/l (high) and 750 cells/l (low). Udder halves having low SCC were not affected ( $P = .50$ ) by either fasting or infusion, but SCC did increase ( $P = 0.0001$ ) from d 0 (253 cells/l) to d 1 (1753 cells/l). On d 0, SCC was not affected ( $P > 0.50$ ) by treatments; on d 1, SCC were greater ( $P = 0.004$ ) in both fasted animals and non-infused treatments. Day effects showed SCC increased ( $P = 0.004$ ) from d 0 to 1 for fasted and non-infused animals with high SCC. Udder circumferences of the non-fasted ewes were greater ( $P = 0.0001$ ) than fasted ewes on d 1, 4, 9, and 11. Serum IGF-1 was similar ( $P = 0.70$ ) between non-infused and infused ewes; fasted ewes had lower ( $P = 0.03$ ) IGF-1 values than non-fasted ewes on d 5. Serum GH was greater ( $P = 0.0001$ ) in fasted/infused ewes than fasted/non-infused and non-fasted/infused ewes. Results indicate intramammary antibiotic infusion decreases SCC within 24 h after administration, particularly in udders with elevated SCC, whereas, fasting had no effect on SCC but hastened mammary involution.

**Key Words:** Ewes, Somatic Cell Count, Hormones

## RUMINANT NUTRITION

**105 Response of old world and little bluestem to spring prescribed fire.** T. N. Bodine, H. T. Purvis II, and D. M. Engle, *Oklahoma Agricultural Experiment Station, Stillwater*.

Ten plots (2 x 4 m) each of Old World bluestem ([OWB], *Bothriochloa ischaemum* [L.] Keng) and little bluestem ([LB], *Schizachyrium scoparium* [Michx.] Nash) containing other grasses and forbs, were spring burned or not burned to determine if an exotic grass (OWB) differed from a native grass (LB) in response to fire. Although they are taxonomically related bunchgrasses, OWB and LB have continentally separated origins (Old vs New World) and different selection histories (OWB for rapid growth vs LB for persistence). Following burning in April, clipped samples were harvested 12 times over 168 d to estimate primary production (PP) of total herbage, either grass (OWB or LB), other grasses, and forbs, along with phenological stage (to estimate maturity) and percentage leaf or stem for either grass from May to September. All response variables were regressed on days after burning, using the extensively researched LB as a reference for OWB, which has limited data on its response to fire. Burning reduced ( $P < 0.01$ ) PP of total herbage (1475 vs 2391 kg/ha), other grass species (190 vs 706 kg/ha), and forbs (27 vs 250 kg/ha) for 40 d post-fire, whereas burning did not alter ( $P > 0.29$ ) PP of total herbage (6850 vs 7273 kg/ha), or other grass species (450 vs 670 kg/ha) at the end of the growing season. Burning increased ( $P < 0.02$ ) PP of both grasses at the completion of the growing season (4727 vs 3062 kg/ha). Burning OWB plots eliminated ( $P < 0.01$ ) forbs during the trial, whereas at 40 d post-fire, unburned plots had 126 kg/ha. Burning did not alter ( $P > 0.44$ ) maturity, or percentage leaf or stem. Old World and little bluestem responded similarly to a spring fire, as burning increased productivity of both grasses, and had no effect on

maturity, or percentage leaf or stem in either grass. This indicates that the dichotomous selection history of these two grasses has not influenced their response to spring burning, suggesting that prescribed fire can be an efficacious and sustainable management tool for Old World bluestem.

**Key Words:** *Bothriochloa ischaemum*, *Schizachyrium scoparium*, Burning

**106 Effects of methionine hydroxy analog (MHA) and/or fat added to a liquid supplement on ruminal and postruminal digestion and duodenal flow of nutrients in beef steers consuming low-quality lovegrass hay.** G. D. Pulsipher<sup>\*1</sup>, C. R. Krebsiel<sup>2</sup>, L. A. Balstad<sup>3</sup>, M. K. Petersen<sup>3</sup>, D. V. Dhuyvetter<sup>4</sup>, M. S. Brown<sup>5</sup>, and B. M. Capitan<sup>3</sup>, <sup>1</sup>*Eastern Oregon Agriculture Research Center, Union*, <sup>2</sup>*Oklahoma State University, Stillwater*, <sup>3</sup>*New Mexico State University, Las Cruces*, <sup>4</sup>*Farmland Industries, Kansas City, MO*, <sup>5</sup>*West Texas A&M University, Canyon, TX*.

Five ruminally and duodenally cannulated beef steers (BW 339 ± 8 kg) were used in a 5 x 5 Latin square to evaluate effects of MHA and fat in a liquid supplement (61% CP DM basis) on digestion and duodenal flow of nutrients. Steers were fed low-quality hay (3.3% CP, 76.8% NDF) ad libitum and supplemented with 0.91 kg d<sup>-1</sup> of one of four supplements in a 2 x 2 + 1 factorial arrangement of treatments. Treatments were: 1) control (no supplement; NC), 2) molasses-urea supplement (U), 3) U plus 1.65% MHA (UM), 4) U plus 12% fat (UF), and 5) U plus MHA and fat (UMF). Ruminal, duodenal, and fecal samples were collected to determine flow by dilution of a daily dose of chromium (particulate) and cobalt (fluid) and digestibility. Supplementation increased ( $P < 0.01$ )

and MHA decreased ( $P < 0.01$ ) OM intake (38 and 15% respectively). Supplementation tended ( $P = 0.10$ ) to increase apparent ruminal OM digestibility compared with NC steers (42.6 vs 38.3%), while true ruminal OM digestibility was greater ( $P < 0.01$ ) in NC steers than in supplemented steers (56.6 vs 52.3%). Total tract NDF digestibility decreased 8% ( $P = 0.01$ ) in NC compared with supplemented steers and 7% in fat supplemented steers compared with steers not supplemented with fat. Supplementation and fat supplementation increased ( $P = 0.01$ ) ruminal and total tract digestibility of ether extract. Supplementation increased ( $P = 0.01$ ) duodenal flow of all N fractions except non-ammonia non-microbial N (NANMN). Duodenal microbial N flow and microbial efficiency each decreased 24% ( $P = 0.01$ ) with fat supplementation, but NANMN duodenal flow increased 6.6 g d<sup>-1</sup> ( $P < 0.01$ ). Supplementation increased ( $P = 0.01$ ) ruminal concentrations of total VFA. Urea supplementation improved ruminal fermentation. Added fat decreased fiber digestion without affecting overall OM digestion, while MHA decreased intake without affecting ruminal fermentation.

**Key Words:** Urea, Fat, Methionine Hydroxy Analog

**107 Site and extent of digestion in beef cattle consuming restricted amounts of forage and supplemental undegradable intake protein.** E. J. Scholljegerdes\*, J. Gould, B. W. Hess, and P. A. Ludden, *University of Wyoming, Laramie*.

Eight Angus × Gelbvieh heifers (594 kg ± 44.4) fitted with ruminal and duodenal cannulae were used in a 4 × 4 Latin square double crossover designed experiment to determine site and extent of digestion when beef cattle consume restricted amounts of forage and supplemental undegradable intake protein (UIP). Heifers were fed chopped (2.54 cm) bromegrass hay (6.7% CP, 68% NDF) at 30, 55, 80, or 105% of maintenance. Heifers fed below maintenance were given graded levels of a UIP supplement (6.8% blood meal, 24.5% feather meal, and 68.7% fish meal; DM basis) formulated to equalize essential AA supply at the small intestine to the 105% of maintenance treatment. Experimental periods were 21 d in length with 17 d adaptation followed by 4 d of intensive sample collection. Restricting intake from 105 to 30% of maintenance linearly decreased ( $P < 0.0001$ ) microbial and total OM flows at the duodenum. True ruminal OM and NDF digestion (g/d) declined linearly ( $P < 0.0001$ ) with decreasing intake, but did not differ ( $P \geq 0.31$ ) among treatments when expressed as a percentage of intake (54.2 ± 2.0% and 60.7 ± 2.6%, respectively). Total tract OM and NDF digestibility increased linearly ( $P \leq 0.02$ ) as intake decreased. Level of feed intake did not affect ( $P = 0.40$ ) true ruminal N digestibility; however, total tract N digestibility increased linearly ( $P < 0.0001$ ) as level of supplemental UIP increased. Microbial N flow decreased linearly ( $P < 0.0001$ ) as intake decreased from 105 to 30% of maintenance, but nonammonia-nonbacterial N (NANBN) flow did not differ ( $P = 0.18$ ) across treatments. Because supply of NANBN increased equally across treatments, irrespective of supplementation level, total N flow at the duodenum paralleled reduced microbial N flow observed with intake restriction. Therefore, effects of restricted intake on ruminal degradation and subsequent escape of dietary protein must be considered when formulating UIP supplements for cattle consuming restricted amounts of forage.

**Key Words:** Intake Restriction, Cattle, Undegradable Intake Protein

**108 Site and extent of digestion by beef heifers fed medium-quality hay and supplemental corn or soybean oil.** B. W. Hess\*, M. B. Whitney, and D. C. Rule, *University of Wyoming, Laramie*.

Eight ruminally and duodenally cannulated Angus × Gelbvieh heifers (BW = 234 kg) were used in a replicated 4 × 4 Latin square experiment to determine effects of supplemental corn and level of soybean oil supplementation on digestibility of OM, N, and NDF. Heifers were fed chopped (2.54 cm) bromegrass hay (99.2%) and 0.8% CaCO<sub>3</sub> at 2.82% of BW (HAY); 74% HAY, 19.9% cracked corn, and 6.1% soybean meal at 2.82% of BW (CRN); 77.6% HAY, 12.8% cracked corn, 6.7% soybean meal, and 2.9% soybean oil at 2.70% of BW (OIL3); or 81.7% HAY, 4.8% cracked corn, 7.8% soybean meal, and 6.2% soybean oil at 2.56% of BW (OIL6). Diets with supplements were formulated to provide equal N and TDN. Treatment differences were evaluated using contrasts for HAY vs. CRN, OIL3, and OIL6, as well as linear and quadratic effects within supplemental treatments. Postruminal and total tract OM digestibility did not differ ( $P = 0.20$ ) between cattle fed HAY and supplements, but total tract OM digestibility decreased linearly ( $P = 0.0005$ ) from CRN

to OIL6. Microbial N flow to the duodenum increased ( $P = 0.05$ ) in cattle fed supplements and did not differ ( $P = 0.30$ ) from CRN to OIL6. Microbial efficiency did not differ ( $P = 0.50$ ) between HAY and supplemented cattle and tended to increase (linear,  $P = 0.08$ ) from CON to OIL6. Postruminal and total tract N digestibility increased ( $P \leq 0.02$ ) with supplementation, reflecting the higher quality protein of corn and soybean meal. Ruminal NDF digestibility tended to be greater ( $P = 0.09$ ) for cattle fed supplements. Reduced (linear,  $P = 0.001$ ) total tract NDF digestibility for cattle fed OIL3 and OIL6 resulted from depressed (linear,  $P = 0.01$ ) ruminal NDF digestibility because postruminal fiber digestibility was not affected ( $P \geq 0.20$ ) by diet. Despite reduced ruminal NDF digestibility, cattle fed OIL3 and OIL6 had similar microbial N flow to the duodenum compared to CRN. Nonetheless, reduced NDF and OM digestibility should be considered when formulating fat supplements for cattle fed forage-based diets.

**Key Words:** Fat Supplementation, Cattle, Forage

**109 Urinary allantoin as an index of bacterial crude protein supply of cattle fed forage.** R.A. Mass<sup>\*1</sup>, D.J. Jordon<sup>1</sup>, T.L. Scott<sup>1</sup>, K.W. Creighton<sup>1</sup>, D.L. Harmon<sup>2</sup>, C.T. Milton<sup>1</sup>, and T.J. Klopfenstein<sup>1</sup>, <sup>1</sup>*University of Nebraska-Lincoln*, <sup>2</sup>*University of Kentucky-Lexington*.

A metabolism trial compared purine derivative (PD) excretion (as estimated by urinary allantoin excretion) to duodenal purine flow in beef cattle. Six ruminally and duodenally cannulated yearling steers (mean = 375 kg) were used. Duodenal purine flows served as reference estimates of bacterial crude protein (BCP) supply. Total urine collections were made and daily allantoin excretion was measured. It was assumed that allantoin excretion was a constant portion (90%) of total PD excretion. The basal forage was switchgrass hay (*Panicum virgatum*; 5.2% CP, 77.7% NDF, and 51.8% IVDMD). Cattle were fed a constant amount of hay (95% of their individual *ad libitum* DMI; mean = 7.1 kg/d) and treatments (0, 1.4, or 2.3 kg/d of supplemental wet corn gluten feed DM) were applied in a duplicated 3 × 3 Latin square design. To ensure degradable protein was not limiting for the control treatment, each day's forage allotment was topdressed with an aliquot of urea dissolved in a minimal amount of water. Each aliquot delivered 50 g of urea/d. Periods were 21 d with duodenal sampling on d 15 to 17 and urine collection on d 18 to 21. Both PD excretion and duodenal purine flow increased ( $P < 0.01$ ) as TDN intake increased. Excretion of PD (mmol/d) was a linear ( $P < 0.0001$ ) function of purine flow (mmol/d) at the duodenum and was described by the following equation: PD = 2.83 + 1.04 Purine;  $R^2 = 0.83$ . Data from this trial were combined with data from a previously reported trial for development of the following prediction equation: Purine (mmol/d) = 8.88 + 1.02 PD (mmol/d),  $R^2 = 0.78$  ( $P < 0.0001$ ). Users may predict duodenal bacterial CP flow from urinary PD excretion after applying a purine:bacterial CP ratio to the predicted amount of duodenal purine flow. Urinary PD excretion was an effective estimate of BCP supply because of its noninvasive nature and unity with measurement of duodenal purine flow.

**Key Words:** Bacterial Markers, Protein, Cattle

**110 A mechanistic approach to the estimation of intake of ruminants by methane excretion and *in vitro* fermentation characteristics.** M. Blummel<sup>1</sup>, E. E. Grings<sup>\*1</sup>, A. R. Moss<sup>2</sup>, and D. I. Givens<sup>2</sup>, <sup>1</sup>*USDA-ARS, Fort Keogh LARRL, Miles City, MT*, <sup>2</sup>*ADAS Nutritional Sciences Research Unit, Stratford on Avon, UK*.

The accuracy of calculating organic matter intake by *in vivo* methane (CH<sub>4</sub>) production together with *in vitro* fermentation characteristics was examined for 15 roughages offered individually to mature wether sheep *ad libitum* (4 sheep per roughage). Methane production was measured by open circuit calorimetry and organic matter intake (OMI), and *in vivo* digestibility measurements were obtained in metabolic cages. *In vitro* roughage fermentation characteristics examined were total and proportional short chain fatty acid (SCFA) production, the efficiency of microbial biomass production (EMP), true substrate degradability, and gas production. These variables were used together with stoichiometrical principles of rumen fermentation to compare measured and calculated OMI. Relationships between calculated and measured values were evaluated using linear regression procedures. Measured OMI and methane production were related ( $R^2 = 0.86$ ,  $P < 0.01$ ), but CH<sub>4</sub> production per kilogram organic matter digested *in vivo* varied

significantly ( $P < 0.05$ ) between roughages. By using CH<sub>4</sub> production, *in vitro* digestibility measurements and various constant values for SCFA proportions (0.7:0.2:0.1; 0.6:0.3:0.1; 0.5:0.4:0.1) for the acetate:propionate:butyrate ratio and for the efficiency (0.2 and 0.4) of microbial production, a maximum R<sup>2</sup> of 0.58 was obtained for the relationship between measured and calculated OMI. By measuring the actual *in vitro* SCFA proportions and EMP, this R<sup>2</sup> could be improved to 0.79 depending on which *in vitro* technique was employed for the estimations of EMP.

**Key Words:** Organic Matter Intake, Methane Excretion, *In Vitro* Fermentation

**111 Relationship between hip height and live weight on growth characteristics and carcass composition of calf-fed Holstein steers.** M. Machado\*, N. Torrentera, and R. A. Zinn, *University of California, Davis*.

Growth characteristics of 255 calf-fed Holstein steers were evaluated. Initial and final shrunk weights averaged 118 and 572 kg, respectively. Carcass specific gravity (SG) decreased with increasing LW (SG = 1.0588 + .00014LW - .000000266LW<sup>2</sup>; R<sup>2</sup> = .77). Empty body fat (EBF) increased in a near linear fashion with LW (EBF, % = 12.01 + .0000LW<sup>2</sup>; R<sup>2</sup> = .74). Hip height (HH, cm) was very closely associated with LW (LW, kg = 1720 - 34.2HH + .182HH<sup>2</sup>; R<sup>2</sup> = .994). However, the nature of the relationship differed depending on growth implant strategy. For Holsteins that received no implant, the relationship was: LW, kg = 1448.58 - 29.08HH + .158HH<sup>2</sup> (R<sup>2</sup> = .993). For Holsteins that received a more intensive implant program (Synovex C on arrival followed by Synovex S on d 84, and Revalor on d 168 and 196, the relationship was: LW, kg = 1946.59 - 38.07HH + .199HH<sup>2</sup> (R<sup>2</sup> = .993). For Holsteins that were delay-implanted (first implanted on d 112 with Revalor and reimplanted on d 196 with Revalor) the relationship was: LW, kg = 1783.25 - 35.72HH + .191HH<sup>2</sup> (R<sup>2</sup> = .995). In all cases, the relationship between HH and LW was similar until cattle reached approximately 140 d on feed. This similarity in HH:LW ratio for implanted and non-implanted calves supports the observation that benefits to early implanting Holstein calves are small. After the initial approximately 140 d in the feedlot, LW increases at a greater rate than HH. The HH:LW ratio is lower per unit weight for implanted steers than for non-implanted steers, suggesting greater retail yield. Beginning at 160 d HH:LW ratio, alone, can explain 22 to 32% of the variation in marbling score of calf-fed Holsteins marketed at an average LW of 572 kg.

**Key Words:** Holstein, Growth, Prediction

**112 Effects of concentrated separator by-product on intake, digestion, and *in situ* dry matter disappearance in yearling beef steers.** S.M. Shellito\*, J.S. Caton, C. Navanukraw, A.M. Encinas, G.P. Lardy, and M.L. Bauer, *North Dakota State University, Fargo*.

Four ruminally and duodenally cannulated steers (332 ± 2.3 kg) were used in a 4 x 4 Latin square to investigate effects of concentrated separator by-product (CSB) on intake, digestion, and *in situ* rate of DM disappearance. Treatments were arranged in a 2 x 2 factorial. Factors were chopped grass hay (12.4% CP) intake (ad libitum; AL, vs restricted; RS to 1.25% BW) and CSB (0% vs 10%). Concentrated separator by-product was mixed as a proportion of diet DM in CSB added diets. Experimental periods were 21 d with the last 7 d used for intake, digestion, and *in situ* measurements. Grass hay with and without CSB (0% vs 10%) was placed separately into *in situ* bags and ruminally incubated within steer during each period. As expected, DMI and OMI (g/kg BW) were greater ( $P < 0.01$ ) for animals consuming AL diets compared with RS (18.8 vs 13.1 ± 0.69 and 16.8 vs 11.1 ± 0.62, respectively). Main effect means for intake were not influenced by CSB. However, within AL fed steers, CSB tended ( $P = 0.12$ ) to improve DMI (6.0 vs 6.6 ± 0.23 kg for 0 and 10% CSB, respectively). Feeding 10% CSB resulted in similar DM ( $P > 0.1$ ; 53.4 vs 52.0 ± 1.36%) and OM ( $P > 0.1$ ; 56.5 vs 56.2 ± 1.44%) digestibility compared with 0% CSB. Likewise, there were no effects of CSB on apparent total tract NDF, ADF, and N digestion. Steers fed AL and RS had similar ( $P > 0.22$ ) digestion coefficients. Evaluating *in situ* forage type (0% vs 10% CSB) resulted in 10% CSB forage having faster rates of DM disappearance ( $P < 0.01$ ; 4.9 vs 6.9 ± 0.33%). Restricted intake increased rate (%/h) of *in situ* DM digestion ( $P < 0.1$ ; 6.4 vs 5.3 ± 0.33%) compared to AL. Total ruminal fill (kg and g/kg BW) was greater in AL compared with RS

( $P < 0.1$ ; 48.7 vs 42.6 ± 1.29 and 144.6 vs 133.3 ± 3.02, respectively). Contrary to other published data, these results suggest that intake and total tract digestion are not greatly altered by CSB. Dietary restriction resulted in faster rates of *in situ* DM digestion and lower ruminal fill.

**Key Words:** Concentrated Separator By-product, Forage, Digestibility

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

Two experiments were conducted to determine the effects of supplemental vitamin E on performance, health, and immune response of highly stressed, newly received feedlot cattle. In Exp. 1, 200 Continental x British heifers were assigned to one of three vitamin E treatments (285, 570, or 1,140 IU/animal daily in a 70% concentrate diet). Heifers were weighed on d 0, 14, and 28; daily DMI and gain:feed (G:F) were calculated for each period. Performance data were analyzed with pen as the experimental unit, and orthogonal polynomials were used to evaluate responses to vitamin E. Heifers were monitored daily for signs of bovine respiratory disease and were considered morbid when their rectal temperature was 37.5 °C or greater. A linear ( $P = 0.10$ ) increase in ADG with increasing vitamin E was noted for the first 14 d; however, ADG decreased linearly thereafter ( $P = 0.06$ ) with increasing vitamin E. For the 28-d period, ADG did not differ ( $P > 0.10$ ); daily DMI did not differ among treatments, and G:F was not affected by vitamin E for the first 14 d. However, a linear decrease ( $P = 0.04$ ) was noted in G:F with increasing vitamin E for d 14 to 28, and an overall linear ( $P = 0.03$ ) decrease for d 0 to 28. There were no differences in percent morbidity; however, cattle fed the 1,140 IU diet tended to have lower percentage morbidity. In Exp. 2, 17 Continental x English crossbred beef steers were used to evaluate effects of dietary supplemental vitamin E on humoral immune response. Diets fed were similar to those in Exp. 1. Ovalbumin vaccine (OVA) was given on d 0 to stimulate a humoral response, and blood samples were collected on d 7, 14, and 21. No differences were detected in serum IgG titers to OVA among vitamin E levels; however, cattle receiving 1,140 IU of vitamin E daily had the highest titer response. Results indicate that vitamin E supplementation had limited effects on performance and immune response in beef cattle.

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

**114 Phytic acid levels in barley.** N. Taylor<sup>\*1</sup>, J.G.P. Bowman<sup>1</sup>, T.K. Blake<sup>1</sup>, L.M.M. Surber<sup>1</sup>, K. Anderson<sup>1</sup>, V. Raboy<sup>2</sup>, and J. Broyles<sup>1</sup>, <sup>1</sup>*Montana State University, Bozeman*, <sup>2</sup>*USDA-ARS, National Small Grains Germplasm Research Facility, Aberdeen, ID*.

Three experiments were conducted to evaluate the effects of reduced levels of phytic acid in barley on heifer growth and diet digestibility in cows. In Experiment 1, eighty-four heifers (avg wt 366 kg) were fed chopped grass-alfalfa hay and 1.13 kg/d of one of four barley varieties: 1) Harrington (3.4 g/kg phytic acid), 2) 422 (2.6 g/kg phytic acid), 3) 635 (0.96 g/kg phytic acid), and 4) 955 (0.08 g/kg phytic acid) in a 56-d growth trial. All of the barleys contained similar levels of total P (avg 5.5 g/kg). Heifers fed Harrington had the lowest ( $P = 0.001$ ) ADG (0.53 kg/d). Heifers fed 422 had lower ( $P = 0.001$ ) ADG (0.59 kg/d) than heifers fed 955 (0.70 kg/d), with 635-fed heifers intermediate (0.64 kg/d). In Experiment 2, eighty heifers (avg wt 282 kg) were fed chopped grass-alfalfa hay and the same barley diets as in Experiment 1 for 56 d. Heifers fed Harrington and 955 had greater ( $P = 0.001$ ) ADG (avg 1.01 kg/d) than heifers fed 635 and 422 (avg 0.86 kg/d). In Experiment 3, 32 pregnant crossbred cows individually fed chopped hay (6.28% CP) ad libitum in Calan gates were assigned to one of the same four barley diets as above. Cows were individually fed hay and 1.36 kg barley at 0700 daily, hay at 1600 and feed refusals were weighed to determine forage intake. There was no effect of barley variety on hay DM, OM, CP, NDF, or ADF intake or digestibility ( $P > 0.60$ ). It appears that phytic acid levels in barley may have an effect on weight gain of heifers, but the mechanism of action is unclear.

**Key Words:** Phytic acid, Barley, Beef cattle

**115 Influence of re-alimentation protocol on ruminal parameters of feedlot cattle following a missed feeding.** M. F. Montano<sup>\*1</sup> and R. A. Zinn<sup>2</sup>, <sup>1</sup>Universidad Autonoma de Baja California, Mexicali (Mexico), <sup>2</sup>University of California, Davis.

Ten Holstein steers (363 kg) with ruminal cannulas were used in a replicated 5 x 5 Latin square experiment to evaluate the influence of realimentation protocol on ruminal pH and lactic acid concentration following a missed feeding. The diet contained 80% steam-flaked sorghum. Experimental periods were of 7 d duration. For d 1 through 5 steers were fed 4 kg (DM basis) twice daily at 0800 and 2000. On d 6 at 0800 steers were fed 2.4 kg. Steers were not fed again until d 7 when five realimentation strategies were compared: 1) 8.0 kg at 0800; 2) 2.4 kg at 0800 and 5.6 kg at 1000; 3) 2.4 kg at 0800 and 5.6 kg at 1200; 4) 2.4 kg at 0800, and 5.6 kg at 1400; and 5) 2.4 kg at 0800 and 5.6 kg at 1600. Ruminal samples were obtained via the ruminal cannula on d 7 at 0700, 0900, 1100, 1300, 1500 and 1700. Average ruminal pH and lactic acid concentration were similar ( $P > .10$ ) across treatments at 0700. Lactate concentration decreased and ruminal pH increased (linear effect,  $P < .01$ ) with increasing interval between first and second realimentation feeding. With treatment 1 ruminal pH decreased and ruminal lactate increased during the initial 5 h after feeding. With treatment 2, ruminal lactate increased during the initial 7 h after feeding the second realimentation meal, but these levels were lower than treatment 1. The rest of the treatments only increased ruminal lactate during the first h after second realimentation meal. Treatment 1 decreased ruminal pH to values less than 6 during the initial 7 h after feeding. Following the second realimentation feeding with treatments 2, 3, and 4, ruminal pH was lower than 6 for 3 to 5 h. With treatment 5, ruminal pH did not decrease below 6.5. Ruminal fluid glucose concentration was highest (linear effect,  $P < .01$ ) for treatment 1, attaining a peak of 16.13 mg/dL 1 h after feeding, and requiring 4 h to return to prefeeding levels. Ruminal glucose also increased with the other 4 treatments, but were higher than prefeeding values only during the first h after the second realimentation feeding. There were no treatment effects on ruminal protozoa counts ( $P > .10$ ). We conclude that extending the interval between the first and second realimentation feeding to 8 h will minimize effects on lactate accumulation, and ruminal pH.

**Key Words:** Acidosis, Cattle, Alimentation

**116 Variation in ruminal starch digestion due to dry rolling versus steam flaking corn and sorghum can be reliably predicted based on changes in starch solubility and 6-h amylose reactive insoluble starch.** S. Rodriguez<sup>\*1</sup>, J. F. Calderon<sup>1</sup>, and R. A. Zinn<sup>2</sup>, <sup>1</sup>Universidad Autonoma de Baja California, Mexicali (Mexico), <sup>2</sup>University of California, Davis.

Amyloglucosidase reactivity (AGR; a measure of starch solubility) has been used for many years to assess changes in ruminal starch availability due to steam flaking. Alone, it explains approximately 67% of the variation in measures of ruminal starch digestion. This study was conducted to evaluate the benefit of combining measures of enzymatic reactivity of insoluble starch with measures of soluble starch for enhancing the predictability of changes in ruminal starch digestion due to processing of corn and sorghum. Reactivity of insoluble starch (ISR) was determined as follows: 1) samples of the test grain were ground to pass through a 20 mesh screen; 2) approximately .15 g of the ground sample was placed in a 20 mL culture tube along with 2 stainless steel bearing (22 mm diam); 3) 20 mL of a phosphate buffer-enzyme solution (8.71 g potassium phosphate, .65 g sodium carbonate, 1.75 g calcium carbonate, .55 mg amyloglucosidase, 8mg alpha-amylase, 8 mg pancreatin, 2 mg lytic enzyme, and 2 mg protease in 1 L water) and a drop of toluene was added to the culture tube; 4) the tube was mixed and then incubated in a 39° C shaking water bath for 6 h; 5) the tube was removed from the bath, 2 mL zinc sulfate, and the was cooled in an ice bath for 10 min before proceeding with glucose analysis. Digestible of insoluble starch (DIS) was calculated as follows: DIS = (ISR - AGR)/((ISR - AGR) + .05), where .05 represents passage rate of grain from the rumen. In this manner, the DIS for dry rolled and steam flaked corn and sorghum were 73.8, 78.2, 74.5, and 77.3%, respectively. Applying these coefficients to measures of AGR in metabolism trials involving corn (5 trials) and sorghum (3 trials) the following equation was obtained: ruminal starch digestion = .88AGR + .83DIS ( $R^2 = .80$ ). We conclude that variation in ruminal starch digestion of corn and sorghum can be reliably predicted based on

simple laboratory measure of starch solubility and enzymatic reactivity of insoluble starch.

**Key Words:** Starch, Digestion, Rumen

**117 Influence of dietary forage on the comparative feeding value of dry rolled and whole shelled corn.** N. Torreneta<sup>\*1</sup>, R. A. Ware<sup>2</sup>, and R. A. Zinn<sup>2</sup>, <sup>1</sup>Universidad Autonoma de Baja California, Mexicali (Mexico), <sup>2</sup>University of California, Davis.

Sixty-four medium-framed crossbred steers were used in a comparative slaughter trial to evaluate the interaction of dietary forage level (10 versus 20%) on the feeding value of dry rolled (DRC) and whole shelled (WSC) corn. Corn comprised 73.5 and 66.4% of diets containing 10 and 20% forage. The forage (50:50 blend of alfalfa and sudangrass hay) was ground in a hammer mill to pass through a 2.54 cm screen. There was a forage level by corn processing interaction ( $P < .05$ ) on empty body gain, gain efficiency, and dietary NE. With the 10% forage diet gain was similar for DRC and WSC. However, with the 20% forage diet gain was 19% greater for DRC than for WSC. Across forage levels, DMI was greater (8.5%,  $P < .05$ ) for DRC. Consequently, with the 10% forage diet gain efficiency and dietary NE were greater for WSC than for DRC. In contrast, with the 20% forage diet gain efficiency and dietary NE was greater for DRC than for WSC (interaction,  $P < .05$ ). Four Holstein steers were used in a 4 x 4 Latin square experiment to evaluate treatment effects on site and extent of starch digestion. There were no treatment effects ( $P > .10$ ) on ruminal digestion of starch, averaging 67%. Dry rolling increased total tract starch digestion by 5% at the 10% forage level and 12% at the 20% forage level (interaction,  $P < .10$ ). The marked reduction in total tract starch digestion with WSC at the 20% forage level is consistent with greater gain efficiency and dietary NE observed for DRC vs WSC at the 20% forage level in the growth performance trial. We concluded that the comparative feeding value of whole shelled corn is decreased as forage level increases above 10%.

**Key Words:** Corn, Processing, Cattle

**118 Fermentation characteristics of a diet containing equal portions of forage and concentrate as affected by pH in continuous cultures of rumen contents.** B. H. Thran\*, H. S. Hussein, and H. Han, University of Nevada-Reno.

This study was designed to investigate the effects of pH on ruminal fermentation characteristics of a diet (15% CP on DM basis) containing 50% forage (grass hay) and 50% concentrate (corn, soybean meal, and a vitamin/mineral supplement). Eight pH treatments (5.5, 5.75, 6.0, 6.25, 6.5, 6.75, 7.0, and 7.25) were examined in a completely randomized design experiment. Eight dual-flow continuous culture fermenters were used in three experimental periods (10 d each with 3 d for gradual adjustment of the microbial population in the rumen fluid inoculum [pH = 6.2] to the pH treatments; 4 d for adjustment to the diet under the new pH; and 3 d for sample collection). Therefore, each pH treatment was replicated three times. The liquid and solid dilution rates were maintained at 10 and 5%  $h^{-1}$ . Orthogonal contrasts were used to test for the linear and quadratic effects of pH. Concentrations of total VFA (79.7, 87.4, 95.7, 117.8, 122.0, 124.8, 123.5, and 111.0 mM, respectively) and acetate (40.4, 50.8, 58.4, 75.0, 79.6, 84.2, 83.6, and 76.1 mM, respectively) increased linearly ( $P < .05$ ) with increased pH. Propionate concentrations were not affected ( $P > .05$ ) by pH (averaging 19.7 mM) but butyrate concentrations showed a quadratic ( $P < .05$ ) response (14.5, 15.9, 16.1, 18.8, 15.6, 14.7, 13.0, and 11.0 mM, respectively) to increased pH. Except for concentrations of isobutyrate (increased linearly [ $P < .05$ ] with increased pH), no clear response was found for other branched-chain VFA. Concentrations of NH<sub>3</sub>-N increased ( $P < .05$ ) in a linear fashion (1.1, 3.1, 9.6, 16.8, 19.8, 23.5, 20.8, and 19.0 mg/100 mL, respectively) with increased pH. Results indicated that ruminal fermentation of dietary carbohydrates and degradation of dietary proteins (measured as concentrations of VFA and NH<sub>3</sub>-N, respectively) were enhanced by maintaining higher ruminal pH.

**Key Words:** Continuous culture, Rumen pH, Fermentation

**119 Effect of nutritional management for either constant or stair-stepped rates of gain on subsequent breeding performance of beef heifer calves. W. Poland\* and K. Ringwall, North Dakota State University, Dickinson.**

The effect of nutritional management for either constant or stair-stepped rates of gain on breeding performance of beef heifers was assessed in three experiment. In each experiment, heifers were assigned one of two winter management strategies. Strategies included either management of heifers for a constant rate of gain (CO) or for a low rate of gain followed by a period of rapid growth rate (SS). Estrus was synchronized in each experiment and heifers were either bred artificially (AI) on subsequent expression of heat or allowed an opportunity for natural service. Heifers that were artificially inseminated following synchronization were subsequently exposed to fertile bulls. Ultrasonographic estimates of fetal presence and age (if present) were used to subsequently classify heifers as having conceived early (to AI), within one of three 21-d breeding cycles or open. Pooled across experiments, BW and BCS at breeding were 381 and 389 kg and 6.3 and 6.8 for CO and SS, respectively. Cumulative conception rate was improved by SS ( $P < .05$ ). Difference in cumulative conception rate between SS and CO increased through the second breeding cycle (-5.4, 9.8, 14.2 and 14.0 for heifers conceiving to AI or by 21, 42 or 63 d, respectively). Heifers calves managed for a stair-stepped growth pattern during the winter prior to breeding had higher cumulative conception rates compared to heifers managed for a constant rate of gain.

Table 1. Cumulative conception rate (%) to AI, by day of breeding season or open

	N	AI	21-d	42-d	63-d	Open
CO	96	27.1	42.7	70.8	80.2	19.8
SS	120	21.7	52.5	85.0	94.2	5.8
P value	-	.36	.15	.01	<.01	<.01

**Key Words:** beef heifers, stair-step, conception rate

**120 Development of a low-cost, easy-to-assemble, and durable ruminal cannula for cattle. E. G. Alvarez\* and R. A. Zinn, 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:** Cannula, Ruminal, Cattle

**121 Comparison of one or two sustained-release chromic oxide boluses for sheep to estimate fecal output in calves. H.Q. Winger<sup>1</sup>, K.C. Olson<sup>\*1</sup>, J.A. Walker<sup>2</sup>, and B.R. Bowman<sup>1</sup>, <sup>1</sup>Utah State University, Logan, <sup>2</sup>South Dakota State University, Pierre.**

The objective was to evaluate the ability to estimate fecal output in calves using either 1 or 2 Captec<sup>®</sup> sustained-release boluses for sheep. A second objective was to determine the capacity to identify if a calf dosed with 2 boluses had regurgitated 1 but not both based on fecal Cr concentration. Three trials were conducted during a 4-mo period utilizing total fecal collections. Nine Holstein steer calves were ruminally fistulated at about 2 mo of age and randomly assigned to 1 of 2 groups. One group ( $n = 5$  in trials 1, 2, and 3) received 1 bolus and

the other group ( $n = 4$  in trials 1 and 2, and  $n = 3$  in trial 3) received 2 boluses. Diets consisted of a grain mix fed at 1% BW, alfalfa pellets fed at 1% BW, and chopped grass hay fed at 110% of the previous day's intake. Calves were fed twice daily in equal portions at 0800 and 1700 and had free access to water. Mean BW were 104, 125, and 178 kg in trials 1, 2, and 3, respectively. Release rate from boluses did not differ between number of boluses ( $P = 0.37$ ) or among trials ( $P = 0.17$ ). Precision of the marker estimate did not differ between number of boluses ( $P = 0.09$ ) or among trials ( $P = 0.49$ ). Accuracy of estimated OM fecal output on a kg per d basis was greatest using 1 bolus in the first trial and was greatest using 2 boluses in trial 3, but accuracy was low for both treatments in trial 2. Accuracy of estimated OM fecal output on a percentage of BW basis was greatest using 1 bolus in the first trial and by using 2 boluses in trials 2 and 3. Concentration measured as mg of Cr per kg of fecal OM differed between number of boluses ( $P = 0.01$ ) and among trials ( $P = 0.02$ ). This suggests that a difference in Cr concentration in the feces should be detectable if 1 bolus is regurgitated from a calf dosed with 2 boluses. Precision was adequate for relative comparison among treatments, but accuracy was inadequate to assume forage intake estimated from fecal output reflects the actual amount of forage consumed.

**Key Words:** Calves, Chromium concentration, Fecal output

**122 Comparison of high fat and protein self fed supplements made from corn distillers byproducts and biuret for pregnant beef cows. S. J. Bartle\*, ADM-MoorMan's, Inc., Quincy, IL.**

Voluntary intake and animal performance of two treatments: 1) a self-fed high energy supplement (HE) containing 20% fat (added fat primarily from soy acid oil) and 20% CP (4.0 units from biuret), and 2) a commercial self-fed protein supplement (XL30) containing 5% fat and 30% CP (17.5 units from biuret) were evaluated using a randomized complete block design. Hereford X Angus cross cows ( $n = 120$ ) in the last trimester of pregnancy and body condition score of 5 to 6 were divided into three age-weight blocks and randomly allotted by weight into 12 pens. The base diet consisted of 0.9 kg/d of a soy hull-wheat mid pellet (13.5% CP), and ad libitum access to fescue hay (6.5% CP) in large round bales. Individual bales were weighed prior to delivery to cradle-type bale feeders. Supplement ingredients were primarily corn distillers grains, condensed distillers solubles, biuret, minerals and vitamins. Supplements were self-fed as 114 kg tubs from December 15, 1998 to March 20, 1999. Calves were born between February 8 and April 3, 1999 (54 d). Because of mud, cattle were consolidated within treatment into 8 pens on March 6. Treatment assignments were tracked through calf weaning. Supplement intakes (adjusted to 454 kg BW) were 1.0 kg/d for the HE tub (target intake = 0.9 to 1.8 kg/d), and 0.45 kg/d for the XL30 tub (target intake = 0.23 to 0.68 kg/d). Cows fed the HE tub consumed about 0.065 kg/d more CP and 0.18 kg/d more fat than the XL30 fed cows. Cows fed the HE tub were: 1) offered 1.1 kg/d less hay ( $P = .06$ , 14.4 vs 15.5 kg); 2) lost 9.7 kg less weight ( $P = .13$ , 12.9 vs 22.6 kg) between mid December and 24 h post calving; and 3) tended to have heavier calves ( $P = .21$ , 36.8 vs 35.2 kg) than XL30 fed cows. No differences ( $P > .3$ ) were observed in calf ADG to weaning (0.79 vs 0.80 kg) or percentage of cows that rebred (92.6 vs 92.0%) between HE and XL30 treatments. In conclusion, a self-fed supplement containing 20% fat from soy acid oil provided appropriate intake control and delivered useable energy to pregnant cows.

**Key Words:** Cows, Fat, Supplement

**123 Effect of season on Eastern Colorado native range crude protein levels. P.A.G.A. Sampaio\*, J.C. Whittier, B.A. Riggs, D.N. Schutz, and D. Couch, Colorado State University, Fort Collins.**

The objective of this study was to determine the effect of growing season on crude protein levels of native range in Eastern Colorado. Diet samples from three ruminally fistulated cows, were collected over 12 mo (October 1999 to September 2000) in a repeated measures experiment with animal as the experimental unit. Native range consisted of warm (prairie sandreed, sand bluestem, blue grama) and cool (needle and thread, western wheatgrass, and sun sedge) season grasses. Spring (April, May) and summer (June, July, August) samples were collected twice per month, and fall (September, October) and winter (November, December, January, February, March) samples were collected once per

month. Following rumen evacuation, cows were allowed to graze for 1 h, and diet samples were then collected from the rumen. Samples were immediately frozen, freeze dried, and later analyzed for crude protein. Crude protein levels in the collected diet samples were similar ( $P > 0.05$ ) between the three ruminally cannulated cows. Least squares means for crude protein ranged from 11.9 to 12.5% for the three animals across all samples. No interaction between individual animals and growing season was found ( $P > 0.05$ ). Growing season had an effect on crude protein level ( $P < 0.05$ ). Spring (16.0%) crude protein levels differed ( $P < 0.05$ ) compared to early summer, late summer, fall and winter (13.7, 11.2, 10.4 and 9.5%, respectively). Late summer and fall protein values were not different ( $P > 0.05$ ). Understanding the seasonal effects on native range crude protein levels is important for developing cost effective nutrition programs for the cow herd.

**Key Words:** Metabolizable Protein System, Protein Degradability, Beef Cows

**124 Prepartum supplementation with protein or fat and protein for grazing cows in three seasons of calving. E. E. Grings\*, R. E. Short, M. Blummel, M. D. MacNeil, and R. A. Bellows, USDA-ARS, Fort Keogh LARRL, Miles City, MT.**

A 2-yr study was conducted to evaluate prepartum supplementation of cows ( $n = 177$ ) grazing native rangeland with a combination of safflower seed and meal (high fat, HF: 21.7% CP, 14.8% ether extract, EE) compared to safflower meal and barley (low fat, LF: 22.5% CP, 2.6% EE) on cow performance pre- and postpartum. Interactions with calving date and cow age were also evaluated. Each year, 30 cows (15 three-year-olds and 15 five-year-olds or older) from each of three seasons of calving (SC; February, April, or June) were assigned to supplementation type (ST). Cows were assigned to one of two pastures per SC and supplements were group fed within pastures for 49 d. Cows were then moved to drylot and fed sudangrass hay plus supplements until calving (average = 22 d). Quality of grazed forage varied from 4% CP in December of yr 2 to 17% in May of yr 1. Alfalfa hay was provided when snow cover prevented grazing. While effects of SC and cow age were pronounced for performance measures, effects of ST were limited and were only found in interactions. Changes in BW during the prepartum grazing period were affected by SC ( $P < 0.01$ ), a year by cow age interaction ( $P < 0.05$ ), and an interaction among SC, ST, year, and cow age ( $P < 0.05$ ). Body condition score changes were affected by cow age and SC ( $P < 0.01$ ). In the April calving group, proportion of 3-yr-olds exhibiting estrous cycles at the beginning of breeding was 0.46 compared with 0.92 in the older cows, but there was no effect of cow age in the February or June groups (SC by cow age interaction,  $P < 0.05$ ). Pregnancy rates exhibited an SC by ST by cow age interaction ( $P < 0.05$ ; subclass  $n = 15$ ). Three-year-old cows calving in February and 5-yr-old cows calving in April receiving HF had greater pregnancy rates than cows fed LF; the opposite effect was found for 3-yr-olds calving in April. There was no effect of ST on pregnancy rates of cows calving in June. Varying conditions associated with SC affected cow performance and response to supplementation.

**Key Words:** Calving Date, Fat, Protein

**125 Optimal level of rumen degradable protein in high-grain diets fed to feeder lambs. A. M. Encinas\*, E. R. Loe, M. L. Bauer, G. P. Lardy, and J. S. Caton, <sup>1</sup>North Dakota State University, Fargo.**

Eighty Hampshire crossbred ram lambs ( $38.5 \pm 0.3$  kg initial BW) were used to determine the optimal level of rumen degradable intake protein (DIP) in high-grain feeder lamb diets. Lambs were weighed for three consecutive days, blocked by BW, housed (4 lambs/pen), and allotted randomly to one of four dietary levels of DIP: 6.1, 7.7, 9.4, or 11.0% of diet DM. Urea (U) and soybean meal (SB) were used as DIP sources, and fed at levels of 0% U-0% SB, 0.33% U-3.0% SB, 0.67% U-6.0% SB, and 1.0% U-9.0% SB in respective DIP treatments. Level of rumen undegradable intake protein (UIP) was maintained at 7.3% across all treatments using a feather and blood meal combination (4:1, respectively). Dehydrated beet pulp pellets were used as the roughage source to prevent sorting. Dietary treatments were formulated to contain a minimum of 13.4% CP, 0.7% Ca, 0.3% P, and 0.6% K, and fed once daily (a.m.) as a total mixed ration. Lambs were marketed for slaughter when 0.5 cm fat thickness was presumed. Heavy BW blocked lambs were fed for 38 d (3 pens/treatment) and remainder of lambs were fed for 60 d (2

pens/treatment). Final BW were an average of three consecutive day weights. Standard carcass data was recorded on all lambs. Dry matter intake responded quadratically ( $P = 0.09$ ) to DIP and was highest for 0.33% U-3.0% SB ( $1.71 \pm 0.03$  kg) and 0.67% U-6.0% SB ( $1.72 \pm 0.03$  kg) and lowest for 1.0% U-9.0% SB ( $1.64 \pm 0.03$  kg). Average daily gain ( $0.48 \pm 0.01$  kg;  $P = 0.95$ ) and feed efficiency (gain:feed,  $0.285 \pm 0.005$ ;  $P = 0.51$ ) were not influenced by level of DIP. Ribeye area decreased linearly ( $P = 0.05$ ) with DIP. Leg score responded quadratically ( $P = 0.07$ ), with 1.0% U-9.0% SB lambs having the highest leg scores (11.7). Marbling score ( $402 \pm 17$ ;  $P = 0.40$ ) and yield grade ( $2.2 \pm 0.2$ ;  $P = 0.79$ ) were not influenced by DIP level. Results of the current study indicate that the optimal level of DIP, when using U and SB as DIP sources, is not above 6.1%. However, lamb performance and carcass characteristics were not impaired at levels up to 11.1%.

**Key Words:** Feeder Lamb, Degradable Intake Protein, Urea

**126 Feedlot performance and carcass characteristics of lambs supplemented with rolled safflower seeds. H. Van Wagoner\*, P.G. Hatfield, R. Kott, J.A. Boles, and J. Heeg, Montana State University, Bozeman.**

Fifty wether lambs (average initial BW 38.9 1.1kg) were used in a 48-d finishing study to evaluate the effects of safflower seed supplementation on feedlot performance and carcass characteristics. The finishing period was preceded by a 21-d adaptation period when wethers were gradually adjusted to their treatment diets. Wethers were assigned to one of 10 feedlot pens (5 wethers/pen), based on equal pen weight. Pens were assigned to one of two dietary treatments (5 pens/treatment). Treatments were either a diet containing 15% safflower seed (S) or an isochloric (83.2% TDN) and isonitrogenous (15% CP control) (C) diet. Safflower seed containing 37% oil with a composition of 79.1% linoleic, 6.2% palmitic, 2.1% stearic and 10.3% oleic fatty acid was utilized. Diets were 80% concentrate and 20% pelleted alfalfa. Wethers were weighed at the beginning and end of the finishing period after an overnight fast without food or water. Ten wethers per treatment were slaughtered immediately following termination of the finishing period, in a commercial slaughter facility. Feedlot and carcass data were analyzed as a complete randomized design, with hot carcass weight as a covariance for carcass data. Wethers fed the S diet had greater ( $P = 0.04$ ) ADG than wethers fed C diet (0.29 vs. 0.25 kg/d respectively). Gain to feed ratio was greater ( $P = 0.02$ ) for S than C wethers (0.15 vs. 0.13 kg/100 kg of feed, respectively). Dressing percent and internal fat weight did not differ ( $P > 0.30$ ) between wethers fed S or C diets. However, back fat thickness tended to be greater ( $P = 0.17$ ) for the wethers fed S than C diet (4.03 vs. 3.03 mm, respectively). A finishing diet supplemented with safflower seed resulted in greater ADG and feed efficiency, but tended to produce lamb carcasses with greater back fat thickness.

**Key Words:** Back fat, Lambs, Safflower

**127 Enzyme supplementation to overcome the negative associative effects of supplemental fat on fiber digestion in cattle. R. A. Ware\* and R. A. Zinn, University of California, Davis.**

Four Holstein steers (522 kg) with cannulas in the rumen and duodenum were used in a 4 # 4 Latin square design to evaluate the interaction of supplemental fat (0 vs 4%) and fibrolytic enzymes (0 vs 15 g/d Fibrozyme) on characteristics of digestion. Fibrozyme was incorporated into the diet at the time of feeding. Feed intake was restricted to 2% of BW. Fat supplementation depressed ruminal digestion of OM ( $14\%$ ,  $P < .01$ ) and N ( $10\%$ ,  $P < .05$ ). There was a supplemental fat by enzyme interaction ( $P < .10$ ) on ruminal NDF digestion. In the absence of supplemental fat, ruminal NDF digestion was high (51%) and not affected by enzyme supplementation. In the absence of supplemental enzyme, fat supplementation depressed ruminal NDF digestion (30%,  $P < .05$ ). Fibrozyme addition to the fat supplemented diet increased (25%,  $P < .05$ ) ruminal NDF digestion to a level similar to that of non-fat supplemented diets (47%). Fibrozyme supplementation tended (6%,  $P < .10$ ) to increase ruminal degradation of feed N. There were no treatment effects ( $P = .45$ ) ruminal microbial efficiency. There were no treatment interactions ( $P > .10$ ) on total tract digestion. Fat supplementation depressed total tract digestion of OM (5%,  $P < .01$ ), NDF (17%,  $P < .01$ ), and N (4%,  $P < .05$ ). Fibrozyme supplementation increased (8%,  $P < .10$ ) total tract digestion of NDF. We conclude that Fibrozyme supplementation can overcome the negative associative effects of supplemental

fat on ruminal fiber digestion of growing-finishing diets fed to feedlot cattle.

**Key Words:** Fat, Fiber, Digestion

**128 Interaction of dietary eNDF level and supplemental fibrolytic enzymes on site and extent of fiber digestion in cattle fed a 35% forage growing diet.** M. Ambrosia<sup>\*1</sup>, E. G. Alvarez<sup>1</sup>, and R. A. Zinn<sup>2</sup>, <sup>1</sup>Universidad Autonoma de Baja California, Mexicali (Mexico), <sup>2</sup>University of California, Davis.

Eight Holstein steers (250 kg) with cannulas in the rumen and proximal duodenum were used in a replicated 4 × 4 Latin square experiment to evaluate the interaction of dietary eNDF (53, 65, 78, and 90% of NDF) and Fibrozyme® (an enzyme blend having both xylanase and cellulase activity; Alltech Inc., Nicholasville, KY) supplementation on digestive function. Fibrozyme was added to the diet at time of feeding. Level of eNDF as a percentage of total dietary NDF did not influence ( $P > .10$ ) either ruminal microbial efficiency or site and extent of OM, NDF, starch and N digestion. Fibrozyme supplementation also did not influence ( $P > .10$ ) starch digestion, but it increased ruminal digestion of NDF (42.5 vs 50.3%,  $P < .01$ ) and feed N ( $P < .10$ ). Fibrozyme did not influence ( $P > .10$ ) total tract NDF digestion. We conclude that when ruminal NDF digestion is less than 45%, supplementation with fibrolytic enzymes will enhance ruminal NDF digestion. Under conditions where digestive tract fill is a limiting factor on energy intake, improving ruminal NDF digestion may enhance energy intake and hence, animal performance.

**Key Words:** Enzyme, Fiber, Cattle

**129 Influence of Fibrozyme on growth performance of yearling steers.** A. Peirera\* and R. A., Zinn, University of California, Davis.

Seventy two yearling crossbred steers (384 kg) were used in a 121-d randomized complete block experiment to evaluate the influence of Fibrozyme® (an enzyme blend having both xylanase and cellulase activity; Alltech Inc., Nicholasville, KY; 0 vs 15 g/d) supplementation on growth performance. During the first 84 d (growing phase) the basal diet contained 22% forage and 65% steam-flaked sorghum. From d 85 to d 121 (Finishing phase) the basal diet contained 12% forage and 75% steam-flaked sorghum. Fibrozyme supplementation increased ( $P < .10$ ) ADG by 6% during the growing phase, and by 20% during the finishing phase. Over the entire study, Fibrozyme supplementation increased ADG by 10%. Fibrozyme supplementation did not influence ( $P > .10$ ) DMI. But, it increased ( $P < .10$ ) gain efficiency (6.3%) and dietary NE for gain (5.8%). Fibrozyme supplementation increased (2.7%,  $P < .05$ ) carcass weight, but did not influenced ( $P > .10$ ) dressing percentage. Increased ADG without concurrent increases in DMI with Fibrozyme supplementation were not expected, particularly during the late finishing phase when dietary fiber levels were low. Results suggest that Fibrozyme supplementation may enhance cattle performance in a manner independent of its effects on fiber digestion.

**Key Words:** Enzyme, Fiber, Cattle

**130 The effect of feeding wheat middlings to growing and finishing beef steers on production, digestibility, and carcass characteristics.** D.R. ZoBell\*, K.C. Olson, C.A. Stonecipher, and R.D. Wiedmeier, Utah State University, Logan.

Studies were conducted to determine the effect of feeding various levels of wheat middlings (WM) to growing and finishing steers on production, digestibility and carcass characteristics. Growing and finishing trials were conducted using 32 and 24 predominantly British crossbred steer calves, respectively. Steers were individually fed in a completely randomized design where animal was the experimental unit. In both trials, calves were stratified by weight and age and assigned to treatment. The growing study utilized a corn silage/alfalfa hay-based diet where the concentrate portion was either dry-rolled corn grain (C) or WM with 16 animals per treatment. Treatments in the 107d finishing study consisted of diets that contained either dry-rolled corn as the concentrate source (C), 35 (WM35) or 50 (WM50) wheat middlings with 8 animals per treatment. All steers were slaughtered on the same day and carcass data obtained. A digestibility study was also conducted utilizing a single crossover design with four cannulated yearling heifers fed either

the C or WM50 diets from the finishing study. Results from the growing and finishing trials showed that ADG, DMI and FE were not affected by treatment ( $P > .05$ ). Carcass data from the finishing trial showed there were no differences between treatments for any of the traits measured which included hot carcass weight, ribeye area, backfat, yield and quality grade, and cutability ( $P > .05$ ). Results from the digestibility trial indicated total VFA's were increased in the WM diet ( $P = .023$ ), with acetate lower in the C group ( $P = .0003$ ), and pH levels of 5.81 and 5.55 for the C and WM treatments respectively ( $P = .011$ ). Dry matter and NDF digestibilities were not affected by treatment ( $P > .05$ ). It is concluded from these studies that WM can be fed to growing and finishing steers as an alternative to other concentrates and could replace up to 50% of the concentrate in a finishing diet.

**Key Words:** wheat middlings, growing, finishing

**131 Feedlot performance and carcass characteristics of Tarentaise and Red Angus steers as affected by fish oil supplementation of a high-forage finishing diet.** S. L. Lake<sup>\*1</sup>, H. S. Hussein<sup>1</sup>, H. A. Glimp<sup>1</sup>, T. P. Rinkob<sup>1</sup>, and J. Johnson<sup>2</sup>, <sup>1</sup>University of Nevada-Reno, <sup>2</sup>Omega Protein.

The objective of this study was to determine the effects of beef cattle breed and fish oil supplementation of the finishing diet on feedlot performance and carcass characteristics of steers. Sixteen steers (initial BW = 396.5 kg) from two breeds (8 Tarentaise [TT] and 8 Red Angus [RA]) were assigned at random to two dietary treatments in a completely randomized design experiment. Treatments were arranged as a 2 × 2 factorial. The main factors were two breeds (TT or RA) and two fish oil supplementations (0 or 3% of dietary DM). The finishing diet contained 20% concentrate (corn and a vitamin/mineral supplement) and 80% chopped forage (50% alfalfa hay and 50% grass hay) and had 15% CP on DM basis. The steers were fed individually via Calan gates and had ad libitum access to their diets and water. The steers were harvested at 524.3 kg of BW. No interactions ( $P > .05$ ) between steer breed and fish oil supplementation were detected for any of the measurements evaluated. Therefore, results of the main factors were summarized. With the exception of days on feed, feedlot performance was not affected ( $P > .05$ ) by breed. The TT steers tended to gain faster (1.52 vs 1.26 kg/d;  $P = .15$ ) and, therefore, were finished earlier (85 vs 102 d;  $P < .05$ ) than the RA steers. The TT steers also had heavier ( $P < .05$ ) carcasses (321.1 vs 297.7 kg), larger ( $P < .05$ ) longissimus muscle area (79.7 vs 72.5 cm<sup>2</sup>), less ( $P < .05$ ) backfat thickness (.3 vs .6 cm), less ( $P < .05$ ) marbling (4.1 vs 4.7; with 4 being slight and 5 being small), and better ( $P < .05$ ) yield grade (1.89 vs 2.42). Fish oil supplementation did not affect ( $P > .05$ ) feedlot performance or carcass characteristics of the steers. With the exception of marbling, results suggest significant feedlot and carcass advantages for TT over RA cattle when finished on a high-forage diet. Increasing the energy density of the diet by fish oil supplementation at 3% of dietary DM, however, appears to have no feedlot or carcass benefits.

**Key Words:** Feedlot performance, Carcass characteristics, Fish oil

**132 Influence of fat titer and method of addition on characteristics of ruminal and total tract digestion.** A. Plascencia<sup>1</sup>, M. Cervantes<sup>\*1</sup>, and R. A. Zinn<sup>2</sup>, <sup>1</sup>Universidad Autonoma de Baja California, Mexicali (Mexico), <sup>2</sup>University of California, Davis.

Twelve Holstein steers (340 kg) with cannulas in the rumen and proximal duodenum were used to study the influence of fat titer (36 vs 41° C) and method of fat inclusion (mixed in a portion of steam flaked corn in the proportion 25% fat and 75% corn, prior to adding others ingredients vs addition of fat to the mixer as the penultimate step, just before adding molasses) on characteristics of digestion. The basal diet contained 74.4% steam-flaked corn and 5% supplemental fat. There were no treatment effects ( $P > .10$ ) on site and extent of OM, starch, N, lipid, and ADF digestion, nor on ruminal VFA molar concentrations. Post-ruminal lipid digestion averaged 69.3%, in close agreement with expected (71%; where fat digestion, % = 83.18 - 4.52FI - .68FI<sup>2</sup>; Zinn, 1994) based on level of fat intake (FI, g/kg of body weight). We conclude that method of fat supplementation does not influence the feeding value of supplemental

fat. Differences in titer between fat sources does not modify the characteristics of ruminal starch digestion when fats are coated onto a portion of steam-flaked corn.

**Key Words:** Fat, Cattle, Digestion

**133 Comparative feeding value of tallow vs yellow grease in finishing diets for feedlot cattle.** A. Plascencia<sup>1</sup>, M. Cervantes<sup>1</sup>, and R. A. Zinn<sup>2</sup>, <sup>1</sup>*Universidad Autonoma de Baja California, Mexicali (Mexico)*, <sup>2</sup>*University of California, Davis*.

Ninety-two crossbreed steers (402 kg) were used in a 94-d feeding trial to evaluate the comparative feed value of tallow and yellow grease. The basal diet contained 74.4% steam-flaked corn and 5% supplemental fat. The trial was analyzed as a randomized complete block design. Feed intake was greater (3%,  $P < .05$ ) for tallow than for yellow grease supplemented diets. However, ADG, and feed efficiency were similar ( $P > .10$ ). Feed intake and gain efficiency were consistent with BW and ADG (observed dietary NE was 99% of expected based on diet formulation). Steers fed tallow supplemented diets had greater KPH fat than steers fed yellow grease (3.05 vs 2.74%,  $P < .05$ ). Otherwise, treatment effects on carcass characteristics were small ( $P > .10$ ). We conclude that the acceptability (palatability) and nutritive value of tallow and yellow grease fed to finishing cattle are similar, even at high levels of inclusion.

**Key Words:** Fat, Cattle, Performance

**134 Effect of roasting dry or tempered Gallatin barley on in situ extent and rate of ruminal disappearance.** S. J. Sorensen\* and D. D. Hinman, *University of Idaho, Caldwell*.

The object of this trial was to determine if dry roasting rolling barley would slow down the rate of ruminal digestion. Gallatin barley was treated three different ways and compared to dry rolled corn (DRC). Barley was either dry rolled (DRB), or roasted at 177°C for 5 min and rolled through a standard rolling mill while hot (DRR), or tempered at 20% moisture for 24 h, then roasted at 177°C for 5 min and rolled while hot (TRR). Four ruminally cannulated steers were used in a 4 x 4 factorial in situ study. Nylon bags containing the treatments were incubated in the rumen for 0, 1, 2, 4, 6, 8, 12, 24, and 48 h. Amounts of DM, CP, ADF, ADIN, and starch were measured in the residue to determine extent and rate of disappearance. Roasting the barley increased the amount of ADIN from .04% to .13%, and roasting in the presence of free water increased the amount of ADIN found in the TRR treatment to .22%. Extent of DM remaining was not different ( $P > .10$ ) at 48 h between treatments. Rate of DM disappearance was greatest ( $P < .10$ ) for TRR in the first 6 h of incubation as well as for the entire 48 h period. Rate of CP disappearance was faster ( $P < .10$ ) for DRB than the other treatments for the first 6 h of incubation. Tempered roasted rolled barley had a faster ( $P < .10$ ) 48 h CP disappearance rate than DRR, though the amount of CP remaining at 48 h was similar ( $P > .10$ ) for all treatments. The amount of starch remaining was greater ( $P < .10$ ) for DRC at all hours until 48 h when the amounts of starch remaining were similar ( $P > .10$ ) among treatments. During the first 6 h of incubation the starch disappearance rate was most rapid ( $P < .10$ ) for TRR. The starch disappearance rate for the entire 48 h incubation period was greater ( $P < .10$ ) for DRC than DRB and was similar ( $P > .10$ ) to DRR and TRR. Extent of starch disappearance at 48 h was similar ( $P > .10$ ) for all treatments. The results of this study indicate that dry roasting then rolling Gallatin barley decreases the rate of ruminal digestion.

**Key Words:** Barley, Roasting, Tempering

**135 Evaluation of concentrated separator by-product in beef steer receiving diets.** E. R. Loe, M. L. Bauer\*, G. P. Lardy, J. S. Caton, and A. M. Encinas, *North Dakota State University, Fargo*.

Two hundred sixty newly received crossbred steers (266.8 18.1 kg initial BW) were used to evaluate effect of concentrated separator by-product (CSB; desugared molasses) and weaning management on DMI, growth, and health. Trial was conducted in two consecutive yr with steers shipped approximately 300 km. Upon arrival steers were allowed free access to long-stemmed grass hay and water, weighed, and given a bovine respiratory disease (BRD) complex booster. Steers were stratified by weight and allotted randomly to treatment. Treatments were arranged in a 2 x 2 factorial. Factors were dietary CSB (0 or 5%; DM basis)

and weaning management: weaned day of shipping (SHIP) or weaned 3 to 5 wk prior to shipping (WEAN). Diets with CSB contained 50% alfalfa-brome hay, 40.5% corn, 5% CSB, and 4.5% supplement; while diets without CSB contained 50% alfalfa-brome hay, 44% corn, and 6% supplement. Water was added to 0% CSB diets at same percent (as fed basis) as CSB in the 5% CSB diets to eliminate affects of diet acceptability. Diets were formulated to contain a minimum 13.5% CP, 0.7% Ca, 0.32% P, 0.9% K, and 13.9 g/ton decoquinate. Steers were fed for 27 d (yr 1) and 28 d (yr 2). Performance data was analyzed with GLM procedure of SAS and health data was analyzed with Chi-square, no CSB x yr interactions were detected ( $P > 0.50$ ). Weaning management x yr interactions for BW ( $P < 0.001$ ) occurred due to WEAN steers being lighter in yr 2 vs yr 1; WEAN steers were heavier ( $P < 0.001$ ) throughout. Dry matter intake was 9.8% greater ( $P = 0.006$ ) for entire feeding period for steers consuming 5% CSB. Weaned steers consumed 5.5% more ( $P = 0.05$ ) of their BW in feed compared with SHIP steers. Dietary addition of CSB did not affect morbidity ( $P = 0.39$ ) or mortality ( $P = 0.93$ ). Weaning calves 3 to 5 wk prior to shipping reduced number of calves displaying signs of BRD ( $P = 0.07$ ). Inclusion of 5% CSB in diets fed to newly received steers increases DMI, which may improve health and performance of calves under higher degrees of shipping stress.

**Key Words:** Concentrated Separator By-product, Receiving, Intake

**136 Effect of potato-processing waste in finishing diets on performance and carcass characteristics of yearling heifers.** A. E. Radunz\*, M. L. Bauer, G. P. Lardy, P. T. Berg, and E. R. Loe, *North Dakota State University, Fargo*.

Inclusion of potato-processing waste (PW) from frozen potato products manufacturing was evaluated in high-grain finishing diets fed to one hundred twenty-five crossbred yearling heifers (365 0.3 kg initial weight) for 84 and 105 d. Heifers were blocked by weight and allotted randomly to one of five dietary treatments (5 pens/treatment). Initial weights were determined by a three-day average. Final weights were calculated from hot carcass weight divided by a 62% dress. Heifers were implanted with estradiol/trenbolone acetate on d 1. Control diet contained 80% corn, 10% alfalfa hay, 5% concentrated separator by-product (CSB), 5% supplement. Potato waste replaced 0, 10, 20, 30 and 40% of corn and CSB in the diet on a DM basis. Diets were formulated to contain at least 27.5 mg monesin/kg, 11 mg tylosin/kg, and 0.44 mg melengestrol acetate/kg, 13% CP, 0.7% Ca, 0.3% P, and 1% K. Linear, quadratic and cubic contrasts were used to compare levels of PW. Dry matter intake decreased (linear;  $P = 0.007$ ) from 10% to 40% PW. Increasing PW decreased gain (linear, quadratic, and cubic;  $P < 0.01$ ) and feed efficiency (linear and quadratic;  $P = 0.001$ ). Apparent dietary NEm and NEg were not different among treatments ( $P = 0.18$ ). Final and carcass weight decreased from 0 to 30% and then increased at 40% (linear, quadratic and cubic;  $P < 0.01$ ) with addition of PW. Level of PW did not affect backfat, ribeye area, yield grade or marbling ( $P > 0.3$ ). Inclusion of PW in finishing diet reduced intake, gain, efficiency, and final weight; however, PW did not affect carcass quality. Optimal inclusion of PW in finishing diets may be dependent upon cost of diet.

Potato-processing waste replacement of corn and CSB, %

Item	0	10	20	30	40	SEM
Initial wt, kg	365.4	365.0	365.4	365.4	365.0	0.3
Final wt, kg	496	492	474	469	477	3
DMI, kg/d	9.28	9.47	8.85	8.70	8.66	0.21
ADG, kg/d	1.36	1.32	1.13	1.08	1.17	0.06
Gain: Feed	0.146	0.139	0.128	0.124	0.135	0.003

**Key Words:** Potato-processing waste, Heifers, Feedlot

**137 Influence of supplement level on forage intake and digestibility for beef cows.** N. Taylor\*, J.G.P. Bowman, B.F. Sowell, and J. Broyles, *Montana State University, Bozeman*.

Thirty-two pregnant crossbred cows individually fed chopped hay (6.28% CP) ad libitum in Calan gates were used to determine the effects of four levels of liquid supplement on forage and nutrient intake and digestibility. Eight cows were assigned by weight to one of four treatments: 0, 0.45, 0.91, or 1.36 kg (as-fed) of a molasses-based liquid supplement, which supplied 0, 100, 203, or 303 g CP daily. All four supplement levels were represented in each of eight pens. Cows were individually fed

hay and supplement at 0700 daily, hay at 1600, and feed refusals were weighed each morning and evening prior to feeding to determine forage intake. There was no effect of supplement level on hay DMI (kg;  $P=0.55$ , %BW;  $P=0.84$ ), hay DM digestibility ( $P=0.98$ ), or hay digestible DMI (kg;  $P=0.53$ , %BW;  $P=0.78$ ). There was a linear increase in total diet DMI (kg;  $P=0.04$ ) due to supplement level, but there were no differences in total diet DMI on a %BW basis ( $P=0.19$ ). A linear increase in total diet digestible DMI (kg;  $P=0.004$ , %BW;  $P=0.05$ ) was due to supplement intake. There was no effect ( $P=0.13$ ) of supplement level on diet DM digestibility. There were no treatment differences ( $P\geq0.35$ ) in hay nutrient intake or digestibility for OM, CP, NDF, or ADF on either a kg or %BW basis. Total diet CP intake, CP digestibility, and digestible CP intake were all linearly increased ( $P<0.001$ ) by supplement intake. In this study, increasing CP supplement level had no effect on hay intake or digestibility, but total diet digestible DMI and CP intake were increased.

**Key Words:** Supplement level, Forage intake, Beef cows

**138 Feeding value of Lewis and Baronesse barley lines for finishing steers.** R. L. Endecott\*, J.G.P. Bowman, L.M.M. Surber, D. L. Boss, K. N. Robison, and T. K. Blake, *Montana State University, Bozeman*.

Eighty steers (avg initial wt 346 kg) were allotted to 16 pens in a completely randomized design to determine the effects of four barley varieties on feedlot performance, nutrient digestion, and carcass characteristics. Four diets based on: 1) Baronesse; 2) LB13; 3) Lewis; and 4) Valier were balanced to be isonitrogenous (2.24% N) and isocaloric (1.35 Mcal NE<sub>g</sub>/kg). LB13 and Valier were offspring of a Lewis x Baronesse cross, selected from a larger population based on desirable agronomic characteristics. Pen was used as the experimental unit in the 112-d trial. Steers were weighed and diet, ort, and fecal samples were obtained every 28 d. Diet and fecal samples were composited by pen and analyzed for DM, N, ADF, AIA, and starch. Acid insoluble ash was used as an internal marker to estimate fecal output and to calculate nutrient digestion. Steers were harvested when 70% were visually estimated to grade Choice. Final weight (avg 511 kg) and ADG (avg 1.48 kg/d) did not differ ( $P > 0.10$ ) among diets. No differences ( $P > 0.10$ ) were seen in intake (avg 8.35 kg/d), gain/feed (17.7 kg/100 kg) or carcass characteristics (avg 304 kg hot carcass wt, 4.9 marbling score, 2.1% kidney, pelvic and heart fat, 0.90 cm fat thickness, 73 cm<sup>2</sup> longissimus area, low Choice quality grade, and 2.7 yield grade). In vivo DM digestibility averaged 76.3% with no differences ( $P = 0.27$ ) between diets. However, barley NE<sub>m</sub> and NE<sub>g</sub> were greater ( $P = 0.10$ ) for LB13 and Valier than for the parents, Baronesse and Lewis (2.46 vs 2.37 Mcal/kg; 1.76 vs 1.68

Mcal/kg, respectively). Valier was recently released by the Montana State University Experiment Station, and is the first barley variety to have proven feeding quality.

**Key Words:** Feeding Value, Feedlot Performance, Barley

**139 Feeding value of Morex, Steptoe, and two experimental backcross barley lines for finishing steers.** J. J. Kincheloe\*, J.G.P. Bowman, L.M.M. Surber, K. A. Anderson, K. N. Robison, R. L. Endecott, B. L. Robinson, and T. K. Blake, *Montana State University, Bozeman*.

Eighty crossbred steers (avg initial wt 391 kg) were assigned by weight to 16 pens to determine the effects of two barley varieties and two back-cross experimental lines on feedlot performance, nutrient digestion, and carcass characteristics. Four diets based on: 1) Morex; 2) SM3; 3) SM5; and 4) Steptoe barley were balanced to be isonitrogenous (2.24% N) and isocaloric (2.01 Mcal NEm/kg and 1.35 Mcal NEg/kg). Pen was the experimental unit in the 112-d experiment. Steers were weighed and diet, ort, and fecal samples were obtained every 28 d. Diet and fecal samples were composited by pen and analyzed for DM, OM, N, ADF, AIA, and starch. Acid insoluble ash was used as an internal marker to estimate fecal output and to calculate nutrient digestion. Steers were harvested when 70% were visually estimated to grade Choice. Final weights and overall average daily gain did not differ ( $P > 0.10$ ) among diets (avg 556 kg and 1.47 kg/d, respectively). Intake was greatest ( $P < 0.001$ ) for steers fed Morex (9.50 kg/d), intermediate for steers fed Steptoe (9.08 kg/d), and least for steers fed SM3 and SM5 (avg 8.75 kg/d). Feed efficiency did not differ ( $P > 0.10$ ) among diets (avg 16.3 kg gain/100 kg feed). Steers fed Morex and SM5 had higher ( $P = 0.08$ ) marbling scores than steers fed SM3 (avg 4.4 vs. 4.1). No differences ( $P > 0.10$ ) were detected for any other carcass characteristic (avg 331 kg hot carcass wt, 1.8% KPH, 1.1 cm fat thickness, 75.8 cm<sup>2</sup> longissimus area, 2.9 yield grade, low choice quality grade). Digestible DM and starch intake were greatest ( $P = 0.003$ ) by Morex-fed steers (7.5 and 4.4 kg/d, respectively), intermediate for SM3- and Steptoe-fed steers (avg 6.6 and 4.2 kg/d, respectively), and lowest for SM5-fed steers (7.3 and 3.9 kg/d, respectively). SM3 and SM5 barleys had 4.0 and 4.8% greater ( $P = 0.05$ ) NE<sub>m</sub> and NE<sub>g</sub> values than Morex and Steptoe (avg 2.45 vs. 2.36 Mcal/kg, and avg 1.76 vs. 1.68 Mcal/kg, respectively). In this study, barley variety influenced nutrient digestion and marbling score, however, feedlot performance was not affected. Experimental backcross barley lines SM3 and SM5 showed improved grain NE<sub>m</sub> and NE<sub>g</sub> values when compared to the parent lines, Morex and Steptoe.

**Key Words:** Barley, Feed quality, Experimental barley lines