ABSTRACTS
AMERICAN SOCIETY OF ANIMAL SCIENCE

WESTERN SECTION

March 26–28, 1997
San Luis Obispo, CA

***Author presenting paper.**

BEHAVIOR/BREEDING AND GENETICS

1 Feeding area selection: the leader-follower phenomenon. P. L. Greenwood*, L. R. Rittenhouse, *Colorado State University, Fort Collins.*

Previous studies provided empirical evidence cattle sequentially move to different landscape positions following a foci event, like watering. We assumed this non-random activity resulted from a leader-follower behavior. It was hypothesized that one characteristic of a herd leader was the possession of "special knowledge" of a resource which conveyed information to the rest of the herd (followers) by body language--most notably, a purposeful manner of movement toward the resource. To test the hypothesis we trained selected individuals to know the location of high quality resources. Fourteen cows were randomly divided into two pairs of leaders and two herds of followers. Each leader pair was trained to a goal in the study pasture, about 40 acres. The two herds of followers were not trained to any goal. The leader's influence on the herd and the herd's inclination to follow were observed in six trials. Leaders were placed with both their respective and opposite herds. Followers were also observed without leaders. Followers responded to purposeful movement of the trained animal. The order of following, once established, seldom changed. Observed behaviors in this study indicate that leaders can influence the feeding area selected by the herd, and consequently establish where the herd begins a grazing bout following a foci event.

Key Words: Cattle, Leader-follower, Feeding area

2 Characterization of biological types of beef cattle under an extensive rangeland system. A. Pérez*, C. Pinedo, and H. Gonzalez, *Universidad Autonoma de Baja California, Mexicali, Mexico.*

Genetic parameters for calving difficulty, weights at birth and weaning were evaluated using a least squares procedure. Cows were F_1 involving inheritance of Zebu, Charolais, Hereford, and a local strain bred to Gelbvieh. These sires were mated to 98 cows to produce calves at 28 and 39 month of age. Mean birth weight was 33.4 kg in calves from 28 month old cows. Birth weight ranged from 31.5 kg in calves involving inheritance of local strains mated to Gelbvieh sires to 44.76 kg in crossbred Gelbvieh sired calves from Charolais × Hereford females. Mean birth weight of the Gelbvieh sired calves from Charolais × Hereford cows 39-month-old was 39.07 kg. Birth weight ranged from 34.96 kg in calves from crossbred cows of local strains inheritance to 44.60 kg in crossbred Gelbvieh sired calves from crossbred Charolais × Hereford females. Calving difficulty was greater ($P<.05$) in Gelbvieh sired calves from crossbred Charolais × Hereford of 28-month-old cows (1.40 ± .36). Less calving difficulty was observed in females involving Zebu × local strains inheritance mated to Gelbvieh sires. Breed rank for birth weight was highly associated with age at puberty. Calf crop weaned (%) was higher ($P<.05$) to matings involving Charolais × Hereford inheritance, mean weaning weight at 200-day was highest ($P<.05$) 215.76 kg in crossbred Gelbvieh sired calves from Charolais × Hereford females. Zebu and local strains inheritance resulted in the lightest calves at weaning. Heritability values to calving difficulty, and weights at birth and weaning were (.05 ± .04, .30 ± .03, and .20 ± .04) respectively. These results which are based on limited numbers of observations suggest the advantage of using the Gelbvieh breed as paternal line in matings involving crossbred females.

Key Words: calving difficulty, heifers mating, weaning weight

3 Additive genetic relationships among heifer pregnancy, subsequent rebreeding, and stayability in Angus cattle. S. P. Doyle*, B. L. Golden, J. S. Brinks, R. G. Mortimer, and R. D. Green, *Colorado State University, Fort Collins.*

The objective of this study was to determine the nature of additive genetic relationships among heifer pregnancy (HP), subsequent rebreeding (SR), and stayability (S(5 | 1)) in an experimental population of Angus cattle. Data included pedigree information for 20,445 animals with binary observations for HP on 1,310 Angus heifers, for SR on 789 Angus two–year–olds, and for S(5 | 1), defined as the probability of a female having five calves given she becomes a dam, on 3,109 Angus females from the John E. Rouse Colorado State University Beef Improvement Center, Saratoga, WY. Additive genetic groups were used in determining the relationships among these fertility traits. Breeding value predictions on the liability scale were obtained for each trait using a maximum *a posteriori* (MAP) probit threshold model. Additive genetic groups were then formed on one trait's breeding values and used in the prediction of another trait's breeding values. When HP additive genetic groups were included in the genetic prediction of SR, MAP procedures failed to converge. When SR additive genetic groups were included in the prediction of HP, animals grouped on moderate SR breeding values exhibited the lowest percent probability for HP; however, interpretation of results involving SR requires caution due to the use of a h^2 from an analysis of SR with a 53.7% convergence rate. When HP additive genetic groups were included in the prediction of S(5 | 1), the high HP group exhibited high S(5 | 1) with the moderate HP group exhibiting the lowest S(5 | 1). Only numerical differences were present when S(5 | 1) additive genetic groups were fit into the genetic prediction of HP. The high S(5 | 1) group exhibited the lowest HP with the moderate S(5 | 1) exhibiting the highest HP. The additive genetic relationships among HP, SR, and S(5 | 1) were non–linear. The potential non–linear relationships seen between HP, SR, and S(5 | 1) indicate that selection for improved female fertility will be most effective by having predictions of all three traits.

Key Words: Beef cattle, Pregnancy, Fertility

ENVIRONMENT AND LIVESTOCK PRODUCTION

4 Evaluation of spent fruit fly media as a potential livestock feed. R. Y. Niino-DuPonte, J. R. Carpenter*, H. T. Chan, Jr., and H. M. Ako, *University of Hawaii at Manoa, Honolulu and USDA-ARS Trop. Fruit and Veg. Res. Lab., Hilo, HI.*

Mediterranean fruit fly larvae used in eradication efforts are reared on a media containing wheat mill run, sugar, yeast, preservatives and water at several facilities throughout the world. As much as 1.66 million kg of spent fruit fly media (SFFM) can be produced annually from a single facility at full production, posing a major disposal problem due to its quantity and high moisture and organic content. Our objective was to evaluate SFFM's potential as livestock feed by determining its nutrient composition, *in vitro* digestibility, and fermentation characteristics during ensiling. Fresh and spent media were collected four times from three fruit fly rearing facilities at two-week intervals and subsampled for nutrient analysis. The SFFM from each site and sampling period was ensiled in three 18 l plastic buckets and pH was monitored on days 0, 1, 3, 5, 10, 15 and 30. Each bucket was subsampled on day 30, dried and analyzed. Comparison of the average nutrient composition of fresh to spent samples indicated increases (P<.05) in CP from 15.6 to 17.1%, EE from 2.7 to 4.2%, and total ash from 4.3 to 5.0%, probalby due to larval remnants in the spent media. SFFM was also higher (P<.05) in fiber (NDF 26.8 to 35.6%; ADF 8.6 to 12.7; cellulose 6.2 to 8.8%; lignin 2.6 to 3.8%) which was concentrated as the larvae digested the media's soluble nutrients. Ensiling the SFFM did not alter (P>.05) its nutrient composition. Average pH of SFFM was 4.19 on day 0 and 3.70 on day 30. The pH from one site declined at a slower (P<.05) rate than the other two sites, possibly due to its antibiotic content. While SFFM can be ensiled successfully, its acidity and/or antibiotic content may inhibit *lactobacillus* fermentation after 30 days, resulting in poor storage characteristics. These results indicate that SFFM has potential as an ingredient for both ruminants and monogastric diets.

Key Words: Spent fruit fly media, Nutritive value, Silage, pH

5 Effect of respiratory illness on calf final weight. T.M.M. Bernardini*, D. D. Kress, and D. C. Anderson, *Montana State University, Bozeman.*

Health and performance records of 2,424 beef calves from inbred and outbred populations were evaluated for a 12-yr period (1981 to 1988, 1991 to 1994) to determine the incidence and effect of respiratory illness (RI) on final weight (FWT). Animals were maintained at the Northern Agricultural Research Center near Havre, Montana. Management of calves differed depending on sex of calf. Inbred animals were linebred, Hereford cattle (average F_x=.25). Outbred animals were Hereford, Angus × Hereford, Simmental × Hereford crosses and backcrosses, and Tarentaise × Hereford crosses and backcrosses. Incidence of RI was analyzed using CATMOD of SAS. The model included year, age of dam (AOD), line (inbred or outbred), sex of calf (heifer, bull, or steer), and scours (calves contracting scours versus calves free of scours in the first 4 mo of life). All main effects were important (P<.01), except scours (P<.14). However, removing the main effect of sex of calf from the model resulted in scours being important (P<.05). FWT was analyzed by GLM of SAS. The model included year, AOD, line, sex of calf, and date of birth as a covariate. All main effects were important (P<.01). Interactions of year × AOD, year × line, year × RI, line × AOD, and AOD × sex of calf were detected (P<.01). Incidence of RI ranged from 5% in 1991 to 43% in 1986. Incidence of RI was higher in inbred calves (33%) than outbred calves (11%). Incidence of RI was greatest in calves born to young dams, with rates of 37% and 13% in calves born to inbred and outbred dams, respectively. The least squares mean FWT for calves contracting RI was 387 kg and 399 kg for calves free of RI. The non-significant line × RI interaction (P<.84) indicated the effect of RI on final weight was not different for inbred versus outbred cattle. The results indicate incidence of RI was highest in calves born to young, inbred dams, and RI negatively impacted FWT.

Key Words: Beef cattle, Respiratory illness, Final weight

6 Pregnancy rates of cows synchronized with Syncro–Mate B or the Ov–Sync protocol and time inseminated. T. W. Geary*, E. R. Downing, D. G. LeFever, J. C. Whittier, T. M. Nett, and G. D. Niswender, *Colorado State University, Fort Collins.*

The objective of this study was to evaluate pregnancy rates of beef cows synchronized with either the Syncro–Mate B or the Ov–Sync protocol and time inseminated. Multiparous Angus cows (n=423) were stratified by age, postpartum interval, and AI sire, and randomly divided into two estrous synchronization treatment groups. Cows in the Syncro–Mate B treatment group (n = 209) received the standard protocol consisting of the insertion of the norgestomet implant and administration of the norgestomet + estradiol valerate injection on d 0, removal of the implant and calves on d 9, and timed insemination coupled with return of the calves beginning 48 hr later. Cows in the Ov–Sync treatment group received an injection of GnRH (100 μg) on d 0, an injection of $PGF_{2\alpha}$ (25 mg) and 48 hr calf removal on d 7, another injection of GnRH and calf return on d 9, and timed insemination 24 hr later. Equal numbers of cows from each treatment group were inseminated by one of two technicians. Blood samples were collected from all cows prior to treatment to identify anestrous and cycling females. Mean body condition scores at the time of breeding for Syncro–Mate B and Ov–Sync treated cows were 4.82 and 4.88, respectively. Pregnancy rates were higher ($P < .05$) for cows receiving the Ov–Sync protocol (52%) than for cows receiving Syncro–Mate B (39%), regardless of estrual status. Forty five percent (45%) of Syncro–Mate B and 48% of Ov–Sync treated cows were cycling at the onset of the study ($P > .1$). Pregnancy rates of cyclic and anestrous Ov–Sync treated cows (57% and 47%) were higher ($P < .1$) than pregnancy rates of cyclic and anestrous Syncro–Mate B treated cows (43% and 36%). These data demonstrate that the Ov–Sync protocol is capable of inducing a fertile estrus in both cyclic and anestrous cows, and that pregnancy rates to a timed insemination are higher than those obtained with synchronization of estrus using Syncro–Mate B.

Key Words: Estrous Synchronization, Pregnancy, Gonadotropin Hormone Releasing Hormone

7 Production of 300–day old slaughter–weight calves, yearly energy budgets. R. D. Wiedmeier, H. T. Shenton, K. C. Olson, B. R. Bowman, B. A. Kent, J. L. Walters, *Utah State University, Logan.*

The objective of the study was to develop an efficient cow–calf production system matched to improved, irrigated pastures for producers faced with curtailments of grazing on public lands. Thirty–two high–producing beef cows (614 kg) of mixed breeding were used. Sixteen were mated to bulls proven to pass exceptional growth capability to their offspring using artificial insemination (RGC). The other sixteen cows were naturally mated to bulls shown to pass average growth capability to offspring (AGC). Resultant cow–calf pairs grazed adjacent irrigated pastures of mixed orchard and brome grass (May 15–October 31). Calves were offered a cereal–grain based creep feed on a free–choice basis starting at about 100 days of age (June 15). Creep feed consumption was monitored daily. Pasture forage harvested by the pairs was estimated each 30 days using a strip grazing–clipping method. After weaning (October 31) calves were penned by sire and fed a finisher diet until reaching slaughter weight. Intake was monitored daily. After calves were weaned cows grazed hay–crop aftermath for approximately 30 days. Intake was estimated using the strip–grazing clipping method. Cows were then placed on ammoniated straw–based diets (December 1–May 15). Intake was monitored daily. Total metabolizable energy (ME) consumed by cow and calf by the time calves reached slaughter weight was reduced by 13% (15602 versus 17658 Mcal) with the RGC mainly since those calves reaching slaughter weight 93 days earlier than AGC (309 versus 402 days, $P < .0001$). Although AGC produced heavier carcasses (319 versus 307 kg, $P < .0001$), RGC produced higher yielding carcasses (USDA yield grade 2.3 versus 3.2, $P < .0001$) such that boneless, closely trimmed retail cut yield was similar. The system using RGC produced 10.2 g of retail cut/Mcal ME used by cow and calf, while the AGC system produced only 8.9 g.

Key Words: Slaughter Weight Calves, Energy, Budget

8 Prevalence of *Cryptosporidia parvum*, *Giardia duodenalis*, and *Campylobacter jejuni* in beef calves and impacts on pre-weaning gain and weaning weight. D. J. Drake[1]*, E. R. Atwill[1], J. M. Connor[1], and D. Jones[2], [1]*University of California, Davis,* [2]*California State University, Fresno.*

Three herds (L1 n=39, L2 n=32, L3 n=20) of crossbred beef calves were tested for fecal shedding of *Campylobacter jejuni* (CJ) and protozoal eggs from *Cryptosporidia parvum* (CP) and *Giardia duodenalis* (G). Parasitism impact on pre-weaning ADG and adjusted weaning weight was determined. Fecal grab samples were randomly obtained from calves at 2-3 months of age and again at weaning. Calves were identified as positive(+) or negative(–) for each parasite. CJ was not determined for calves at L2, and only at weaning at L1. Statistical analysis included location and sex effects (sire effects were not significant). Percent positive calves were 12.8, 28.1 and 15.0 for CP and 69.2, 75 and 100 for G at L1, L2 and L3, respectively, and 20.5 and 35 for CJ at L1 and L3. Adjusted weaning weights and ADG of CP+ calves were similar to CP- calves at L1 and L3. At L2, CP+ calves' adjusted weaning weights were 24 kg (SE=12, P=.02) and ADG 127 $gm \cdot day^{-1}$ (SE=54, P=.004) more than CP- calves. No significant differences in adjusted weaning weights or ADG of G+ calves were detected at L1 or L2. However, ADG of G+ calves at L1 tended higher (68 $gm \cdot day^{-1}$ SE=36, P=.07) than G- calves. CJ parasitism did not significantly impact adjusted weaning weight or ADG of calves. This work suggests calves shedding CP, G, or CJ do not have reduced weaning weights or ADG. At one of three locations, CP+ calves had larger weaning weights and ADG. Due to episodic shedding and only periodic sampling, calves identified as non-infected may have been carriers, and reduced the potential to detect differences.

Key Words: Beef cattle, Parasitism, Performance

9 Influence of dietary fat inclusion on milk production, growth of calves, and pregnancy of beef cows on range. J. L. Espinoza*, R. Ortega, S. S. Simental, and A. Palacios, *Universidad Autónoma de B.C.S., Mexico.*

Sixty mature Charolais (Ch) and Brahaman x Criollo (BCr) cows (n = 20 cows per group) were used to determine the influence of calcium soaps of long chain fatty acids (CSFA) or bovine tallow (BT) incorporated into range supplements on daily milk yield, calf growth, body weight, body condition score, and fertility. Cows were assigned randomly to receive 2 $kg \cdot cow^{-1} \cdot d^{-1}$ of isoenergetic (ME = 3.1 Mcal/kg of DM) and isonitrogenous (CP = 16.6%) supplements containing 9.8% of CSFA (M), 9.6% of bovine tallow (T), or no added fat (C). Supplements were used during 100 d, beginning at 30 d precalving. Daily milk yield at 35 d (M35) and 90 d (M90) postcalving were higher in fat fed cows ($P < .01$; M35 = 4 ± .12, 4.7 ± .12, and 4.6 ± .12; M90 = 3.3 ± .11, 3.9 ± .11, and 4 ± .11 $kg \cdot cow^{-1} \cdot d^{-1}$ for C, M, and T, respectively). Body weight of calves at 90 d of age (WC90) was higher ($P < .05$) in M and T than C (53.3 ± .84, 55.6 ± .84, and 57 ± .84 kg for C, M, and T, respectively). Body condition score at calving (BCC) was similar ($P > .05$) between groups. Body condition score 90 d postcalving (BC90) was lower ($P < .05$) in C cows (4.08 ± .12, 4.55 ± .12, and 4.45 ± .12; for C, M, and T, respectively). Body condition score change between calving and 90 d postcalving was affected ($P < .01$) by supplemental fat (C = –1.4 ± .09, M = –.86 ± .09, T = –.81 ± .09) and breed ($P < .05$; Ch = –1.16 ± .07, BrC = –.9 ± .07). Body weight of cows at calving was similar ($P > .05$) between treatments yet, at 90 d postcalving was higher ($P < .05$) in M (353.5 ± 4.6 kg) and T (358.6 ± 4.6 kg) than C (340.8 ± 4.6 kg). Percentage of pregnant cows at end of the breeding season was greater ($P = .057$) in M (70%) and T (80%) than C (45%) cows. In this trial, CSFA and bovine tallow fed to beef cows on range during pre- and postpartum periods improved body condition score, milk yield, fertility, and growth of calves.

Key Words: Beef Cows, Fat intake, Fertility

10 Using Reproductive Tract Scores to Select Replacement Heifers. G. M. Veserat*, J. W. Oltjen, W. E. Van Tassel, *University of California – Cooperative Extension.*

Increasing reproductive efficiency in Western beef herds depends, in part, on maximizing the proportion of females that calve early in the calving season. Achieving this goal requires selecting heifers that conceive early in the breeding season and therefore, calve early. Heifers that calve early tend to repeat that performance throughout their lifetime. This study evaluates fall calving heifers' body condition effects on their ability to reach puberty as determined by assessing their Reproductive Tract Score (RTS), and the relationship of RTS to conception in the subsequent breeding season. Replacement beef heifers (n=238) were raised in the central Sacramento valley of California. They were born July to September (fall calving) of 1994, nursed while their dams grazed on irrigated pasture until the winter rains November – December) provided enough forage to move to annual grass rangelands. The heifer calves were weaned June 1995 and grazed on irrigated pasture until October 1995, mean age 395 days. At that time they were evaluated for the following parameters: body weight, body condition scores (BCS), (1 = emaciated through 9 = obese), reproductive tract scores (RTS), (1 = immature through 5 = corpus luteum present), and immediately began a 90 day breeding season. They were pregnancy checked in May 1996. Heifers in body condition score of 5 or greater and having a RTS of 3 or greater were more likely to become pregnant (P<.05). Reproductive tract scores accounted for nearly twice as much variation in pregnancy rate than BCS (R^2, 13.0% vs 7.4%). Replacement beef heifers with RTS ≥3 and BCS ≥5 at 395 days of age were more likely to become pregnant than heifers with a RTS <3 and BCS <5 (P<.05).

Key Words: Body condition score, Beef cattle, Reproduction

11 Improving economic efficiency by optimizing beef cattle winter feeding programs. R. L. Hathaway*, T. DelCurto, and D. J. Carroll, *Oregon State University, Corvallis.*

Oregon's beef cattle industry, like most in North America, is experiencing difficult times due to low prices. In addition, winter feed costs represent an additional economic burden relative to other areas with approximately 50% of the variable cost of production being attributed to winter feeding. Most beef producers, however, do not make use of available technologies that would improve the nutritional management of their herds over the winter feeding period. Therefore, Oregon State University has developed a "Beef Winter Feeding Management" educational program that effectively integrates and uses Extension and Research faculty expertise. The overall goal of this program is to optimize winter nutritional management with beef cattle production goals while minimizing economic inputs. First, the program has instituted a systematic and voluntary approach to encourage producers to submit feed samples for nutritional analysis. The information is used, in turn, to formulate winter feeding strategies that reduce winter feed cost yet maintain an acceptable level of production. This process also lays the foundation for training university field personnel and producers alike in utilizing available beef cattle ration formulation software. In addition, the winter feed samples will ultimately be used to compile an "Oregon Feed Library" that will assist all producers in making better use of the 1996 Beef NRC, as well as other nutritional assistance software. Because Oregon's Beef Cattle Industry is dominated by spring calving cow–calf production, the focus of this program is on third trimester and early post–partum nutritional management. Self reported information from participants in this educational program suggest winter feeding costs averaged $15.00/cow less for the 1995–1996 season. Therefore, a comprehensive winter feeding program based on feed analysis and nutrient requirements can reduce production costs and increase income of ranchers.

Key Words: Beef Cattle, Winter Feeding, Management

12 Reproductive responses of heifers implanted with estradiol benzoate or zeranol. R. M. Brownson*[2], R. B. Staigmiller[3], J. Broesder[4], B. D. Nisley[4], L. C. Gagnon[2], M. W. Tess[2], C. B. Campbell[5], and S. Bellows[3], [2]*Montana State University, Bozeman* [3]*Fort Keogh Livestock–Range, USDA, ARS, Miles City, MT* [4]*Bandy Experimental Ranch, Ovando, MT* [5]*Pharmacia & UpJohn Co., Kalamazoo, MI.*

An implant study was conducted involving 53 heifers at the Bandy Experimental Ranch in western Montana. Heifers were Hereford and Angus crossbred. Heifers were blocked by age of dam and randomly assigned within blocks to one of three treatment groups, (control, Ralgro® implant, (35 mg zeranol) and Calf–oid® implant, (100 mg progesterone and 10 mg estradiol benzoate). Heifers were implanted between 60 and 72d of age at assignment to treatment. Individual weights were taken at implant time, weaning, and at pregnancy testing when heifers were 18 to 19 months of age. Age at puberty was established by visual estrus detection, two consecutive weekly blood progesterone concentrations > 1 ng/ml, ultrasound scanning of the reproductive tract and the Heat Watch® system. Pelvic measurements were made at approximately 12 months and 18 months of age. Estrous was synchronized with Syncro–Mate–B® and heifers showing estrus were bred AI for a single service and were then pastured with fertile bulls for the remainder of a 60 day breeding season. Pregnancy examination was completed with ultrasound 25–30d post breeding and again at approximately 18 months of age. Data were analyzed by least squares procedures. The statistical model included the main effects of treatment, age of dam, and linear covariates for age of heifer or weight at time of measurement. Dependant variables studied were yearling weight, pelvic area, age at puberty and pregnancy rate. Age at puberty was not affected by implants. Weaning weight had a significant effect (P<.01) on age at puberty. As weaning weight increased age at which heifers reached puberty decreased. Calf–oid® implants significantly increased (P<.05) the rate of growth in pelvic size up to one year of age. By the time heifers were 18 to 19 months of age the non–implanted heifers had increased their pelvic growth rate and there was no significant difference between treatment groups in pelvic area. Treatment did not affect pregnancy rate in heifers at either the AI mating or the natural service mating.

Key Words: Implantation, Puberty, Pelvic

13 California feedlot personnel quality assurance training program. J. N. Guerrero*, J. W. Oltjen, and B. B. Norman, *University of California, Davis.*

The feedlot quality certification program of the Feeder Council of the California Cattleman's Association (CCA) requires that specific feedlot personnel attend a training program to become familiar with the standards of the California quality assurance program. The University of California Cooperative Extension (UCCE) assists the CCA with its training program. Each participating feedlot sends personnel from the cowboy and from the mill crew to these training sessions. A CCA/UCCE feedlot personnel training program was conducted on November 7–10, 1995 in El Centro. The training program was attended by 44 feedlot cowboys and 22 feedlot mill personnel. Given the demographics of the area, the training programs were conducted in both English and Spanish, each participant choosing his/her language preference. Thirty three percent (n=22) took the program in English and 67% (n=44) took the program in Spanish. Two day training sessions were conducted for each feedlot personnel sector. The first day of the program consisted of training videos and the second day of training consisted of applied sessions at a local cooperating feedyard. CCA/UCCE feedlot quality assurance videos, in English or Spanish, focused on feedlot health and mill quality assurance standards, were emphasized. To assess degree of learning, tests were administered to the program participants at the initiation of the program and the same test was taken at the end of the program. With 15 being the maximum grade, pre–test and post–test means for the animal health exam were 11.95±.37 and 14.26±.13, respectively. With 10 being the maximum grade, pre–test and post–test means for the feed handling exam were 5.73±.44 and 8.67±.21, respectively. The differences between the pre–test and post–test indicated that feedlot animal health workers increased (P < .01) their knowledge of the CCA feedlot quality assurance program. The differences between the pre–test and post–test indicated that feedlot mill workers increased (P < .01) their knowledge of the CCA feedlot quality assurance program.

Key Words: Feedlot, personnel, training

14 Watershed management – bringing the community together. S. Larson*, W. J. Clawson, *University of California, Cooperative Extension, Santa Rosa and Davis.*

"Watershed Management" involves multiple sources and uses of water within a defined watershed. This can lead to the participation of many interests in seeking management solutions to address water quality. Too often it is the agencies and non–agricultural interests that initially identify problems or surface concerns. Interests that are based on uses of large tracts of land, such as agriculture and forestry, are frequently left out of the picture except to be blamed for the problems. Livestock producers will need to be educated on the issues and concerns facing watersheds and the management practices that will need to be implemented. Watershed management envisions partnerships among local stakeholders which may include a public process for management planning. Extension personnel will need to determine what their roles will be in bringing a watershed community together. These roles may involve being an educator, resource expert or facilitator and then, the development of a public process to address the needs of the watershed.

Key Words: Watershed, Facilitation, Management practices

15 Native species management in vernal pools. S. J. Barry, *University of California Cooperative Extension, Tehama County, Red Bluff, California.*

Vernal pools in the Sacramento Valley of California are essentially islands of native flora among a grassland composed primarily of exotic annual species. In managing the vernal pool landscape to sustain these islands of native flora, the integrity of the landscape's hydrology must be maintained. One management decision that may indirectly affect hydrology is complete rest from grazing. Although the native vernal pool flora may not have evolved under extensive grazing, the current hydrology and ecology of most vernal pool landscapes in the Sacramento Valley have evolved under a livestock grazing regime. Observations of vernal pool sites under complete rest for the past fifteen years indicate that removal of livestock favors exotic annual species around the margins of vernal pools. Complete rest may also alter the hydrology of the vernal pool landscape by increasing residual dry matter and altering the soil structure. Sustaining the native flora of the vernal pool landscape requires vegetation management. Land managers/owners should assess current conditions, understand management history, and determine a landscape goal for a vernal pool site before developing a management plan. Planning for management with grazing livestock, land managers, owners should consider the effects of selection of grazing animal species, season of grazing and grazing intensity. Monitoring plant species composition, residual dry matter, and utilization will allow land managers/owners to adjust their management plan to sustain native flora and fauna.

Key Words: Grazing, Vernal pools, Natives

16 Multispecies grazing: the ecological advantage. John W. Walker, *USDA Agricultural Research Service, U.S. Sheep Experiment Station, Dubois, Idaho.*

Grazing of several species of herbivores on the same area results in more efficient utilization of forage resources and increases sustainable production. These benefits are the result of different dietary habits of the animals because plants avoided by one kind of livestock may be relished by another. Differences in dietary habits are related to the physical limitation on the ability to select and physiological limitation on the ability to digest and/or detoxify forage phytochemicals. Compared to cattle, sheep diets usually have more forbs and less grass. Sheep can graze lower in the forage canopy, have a greater ability to select from a fine-scale mixture, and have a more varied diet than cattle. Across a wide range of studies cattle diets averaged 70% grass and 15% each of forbs and browse. Sheep diets averaged 50% grass, 30% forbs and 20% browse. Goats tend to be browsers and their diets averaged 60% browse, 30% grass and 10% forbs. As available forage decreases, dietary overlap between sheep and cattle declines. Decreased dietary overlap occurs due to cattle selecting a lower quality diet which is more abundant. Sheep on the other hand can continue to select their preferred diet. Averaged across a wide range of studies, multispecies grazing increased meat production 24% compared to cattle only grazing and 9% compared to sheep only grazing. This advantage is usually caused by both increased individual animal performance, and increased carrying capacity. Despite the potential increases in economic and biological efficiency multispecies grazing is not widely practiced. This valuable management practice should be promoted based on its ability to meet societal goals for more environmentally sound agricultural production practices. Compared to single species grazing, multiple species of animals use vegetation resources more uniformly, which can enhance ecosystem stability.

Key Words: Sheep, Cattle, Goat

17 Grazing livestock as a management tool in the Intermountain West. J. A. Young*, J. L. McLain, *USDA, ARS, Reno, NV. and Resource Concepts Inc., Carson City, NV.*

Managers of range resources in the Intermountain Area face restrictions on the use of pesticides for range improvement, the use of mechanical treatments because of cultural resource concerns, and a seemingly endless list of why they can not institute range improvement practices. The only tools left to public land managers are the grazing animal and fire. Obviously, there are restrictions on the use of prescribed burning because of air quality concerns, but wildfires occur in spite of human imposed restrictions. The grazing animal and wildfires are directly linked, especially on ranges dominated by *Bromus tectorum*. You can graze the herbage, or you can let it burn in destructive wildfires. *Bromus tectorum* dominated ranges represent the degraded range resource end of the spectrum of Intermountain Area ranges. High condition ranges dominated by perennial grasses, also will burn if accumulations of herbage is not reduced by grazing. The worse alternative for most Intermountain ranges is the exclusion of grazing animals.

Key Words: grazing, wildfire

18 Control of endometrial responsiveness to oxytocin during diestrus and early pregnancy in pigs. T. E. Ludwig*, K. G. Carnahan, M. Uzumcu, M. A. Mirando, *Washington State University, Pullman.*

Oxytocin (OT) stimulates luteolytic secretion of endometrial prostaglandin (PG) F_{2a} in ruminants and recently has been implicated in luteolytic PGF_{2a} release in pigs, but the regulatory mechanism is unclear. This study investigated the regulatory mechanism in cyclic and pregnant pigs on d 10, 12, 14 and 16 post–estrus. Number of OT receptors (OTr) in cyclic gilts was constant on d 10–16, but increased (p<0.05) in pregnant gilts on d 12 and tended to decrease (p<0.09) on d 16. Treatment of endometrial explants with OT increased (p<0.05) phospholipase C (PLC: a possible pathway for OT–induced $PGF_2\alpha$ release) activity and $PGF_2\alpha$ secretion in cyclic gilts on d 16 only. Treatment with AlF_4^-, to activate PLC–associated G–protein, resulted in increased (p<0.05) PLC activity and $PGF_2\alpha$ secretion in cyclic gilts which was maximal and constant on d 10–16, and which did not differ from that induced by OT on d 16. In pregnant pigs, OT increased (p<0.05) PLC activity only on d 12, but did not stimulate $PGF_2\alpha$ release on any day. Treatment with AlF_4^- increased (p<0.01) PLC activity in pregnant gilts on all days, but the response was less (p<0.01) on d 14–16 than on d 10–12. Treatment with AlF_4^- increased (p<0.01) $PGF_2\alpha$ secretion in pregnant gilts on d 10–14, but not on d 16. Concentration of plasma progesterone declined (p<0.05) between d 14 and 16 in cyclic pigs, but was maintained through d 16 in pregnant ones. These results indicated that: (1) control of $PGF_2\alpha$ secretion in cyclic gilts occurred primarily at the level of OTr coupling to G–protein, but apparently occurred at multiple levels during pregnancy including OTr number, OTr coupling to G–protein, PLC, and possibly at steps subsequent to PLC and (2) endometrium was responsive to OT during luteolysis in cyclic gilts, but not during luteal maintenance in pregnant gilts. This research supported by USDA Grant 93–37203–9070.

Key Words: Oxytocin, Prostaglandin $F_2\alpha$ Pig

19 Scrotal circumferences associated with age in Wagyu bulls. J. M. Sosa*, D. M. de Avila, J. J. Reeves, *Washington State University, Pullman.*

Wagyu is a Japanese breed of cattle which is being used in the U.S.A. for the export market. Scrotal circumference (SC) of bulls is one important indicator of their fertility and age at puberty of their daughters. The Society of Theriogenology has set minimal standards of SC size for various age animals. Bulls need to meet or surpass these standards to be considered acceptable for breeding. These standards have been considered applicable to all breeds; however, it appears that in the case of the Wagyu breed these standards might need to be modified. The objective of this preliminary study is to investigate Wagyu cattle as a breed in terms of SC and age. Body weights and SC were taken monthly on American purebred Wagyu (93% or more Wagyu) and fullblood (all ancestors from Japan) bulls 5-19 mo of age at a commercial operation and 16-41 mo of age at a commercial bull stud. Mean SC are compared to the minimal standards for scrotal circumferences set by the Society of Theriogenology in the following table:

	Scrotal Circumferences (cm)		
Wagyu Bull Age (m)	Minimal Requirement	Measured Mean ± SE	(n)
5–8	—	20 ± 0.57	(21)
9–11	—	25 ± 0.43	(25)
12–14	30	29 ± 0.53	(34)
15–17	31	33 ± 0.52	(24)
18–20	32	34 ± 0.77	(19)
21–24	33	35 ± 1.5	(4)
>24	34	35 ± .75	(22)

Wagyu bulls are not passing breeding soundness exams at 12–14 mo of age because of small SC, and only half are passing at 21–24 mo of age. It appears this breed of cattle should be evaluated on different scrotal circumference standards than other domestic breeds.

Key Words: Wagyu bulls, Scrotal circumferences, Breeding soundness exams

20 Effects of breed and sire within breed on carcass and meat quality. T. A. Klein* and S. K. Duckett, *University of Idaho, Moscow.*

Twenty six beef carcasses from Angus (A), Tarentaise (T), or Charolais (CH) sired steers were used to determine the effects of breed and sire within breed on carcass traits, ribeye composition, and tenderness. Calpastatin activity (CALP), proximate analysis, and mineral content were determined at 48 hours postmortem on the raw ribeye steak. Warner-Bratzler shear force (WBS) was obtained from ribeye steaks aged 2 (WBS2) or 14 (WBS14) days postmortem. Two steaks, removed at 48 hours postmortem, were marinated in either .15M $CaCl_2$ (WBSCA) or tap water ($WBSH_2O$) for 24 hours and shear force measured. Kidney, pelvic, and heart fat, marbling score, lipid, and zinc differed (P < .01) among sires within breed. Fat thickness, yield grade, WBSCA and WBS2 differed (P < .05) between breeds. Fat thickness for A was higher than T which was higher than CH. Angus and T had a higher YG than CH. Day 2 Warner-Bratzler shear force and WBSCA were higher for CH than A and T; however after aging, WBS14 were similar (P > .05). Time on feed, hot carcass weight, dressing percent, ribeye area, moisture, ash, calcium, CALP, and $WBSH_2O$ did not differ (P > .05) between breeds or sire within breed. Calpastatin activity showed a low relationship (r = –.32, P < .1) with the change from WBS2 to WBS14. At day 2, 27% of the steaks were considered tender (WBS < 4.1) and 81% were tender after aging 14 days. Of the day 14 tender steaks, 57% and 43% were from the select and choice grades, respectively. When using stepwise regression and all variables for the prediction of WBS14, the following equation was found: –23.83 + 0.74*WBSCA + 0.28*moisture + –0.26*CALP + 0.60*lipid + 0.21*ribeye area; R^2 = .69. Tenderness differed between breeds at day 2 postmortem; however, aging 14 days removed the breed effect. Breed differences were noted in external lipid and yield grade; whereas sire within breed influenced internal and intramuscular lipid amounts.

Key Words: Beef, Tenderness, Breed

21 In vitro effect of swainsonine on bovine and ovine lymphoblastogenesis. J. B. Taylor, J. Nordyke, L. F. Gulino Klein, J. R. Strickland, *New Mexico State University, Las Cruces.*

Peripheral blood lymphocytes were obtained from heifers and wethers to assess the in vitro effects of swainsonine (SW). Stimulated and non-stimulated lymphocytes (2×10^5/well; 96 well plates) were incubated in the presence of SW (2, .2, .02, .002, 0 μg/mL; n=32) for 72 h. Mitogens used to stimulate lymphocytes were concanavalin A (Con A; 5 μg/mL), phytohemagglutinin-P (PHA-P; 5 μg/mL), phytohemagglutinin-M (PHA-M; 5 μg/mL), pokeweed mitogen (PWM; 5 μg/mL), and lipopolysaccharide (LPS; 10 μg/mL). Controls received no SW or mitogen. Effects of SW are expressed as percent stimulation of control (stimulation index; SI). Non-stimulated bovine lymphocytes treated with 2 μg/mL SW exhibited a depressed (P<.001; SI of 87 and 100 for 2 μg/mL and control, respectively; SE=2.7) SI. At concentrations of .2 and 2 μg/mL, SW inhibited (P<.001; SI of 351, 310, and 464 for .2, 2 and 0 μg/mL, respectively; SE=27.1) lymphocyte proliferative response to PHA-P. SW had a mitogenic effect on non-stimulated ovine lymphocytes at .2 and 2 μg/mL (P<.05; SI of 118, 113, and 100 for .2, 2 μg/mL and control, respectively; SE=4.4). Swainsonine inhibited ovine proliferative responses to PHA-P at .2 and 2 μg/mL (P<.005; SI of 190, 178 and 228 for .2, 2 and 0 μg/mL, respectively; SE=9.4) and to PHA-M at .002 and 2 μg/mL (P<.03; SI of 165, 167 and 192 for .002, 2 and 0 μg/mL, respectively; SE=7.9). However, SW augmented PWM induced ovine proliferation at concentrations of .2 and 2 μg/mL (P<.005; SI of 110, 126 and 84 for .2, 2 and 0 μg/mL, respectively, SE=6.1). The decreased SI of non-stimulated bovine lymphocytes by SW may indicate a cytotoxic effect. In contrast, SW was mitogenic to non-stimulated ovine lymphocytes. Swainsonine suppression of PHA-P and PHA-M induced proliferation would indicate a negative effect on T-cell function. However, SW augmented PWM induced stimulation of ovine lymphocytes which may indicate enhancement of T-cell/B-cell interactions.

Key Words: Cattle, Sheep, Swainsonine, Lymphocytes

22 Different uses of protein supplements by two-year old range cows during a drought. L. A. Appeddu*, J. E. Sawyer, J. S. Serrato-Corona, L. Knox, H. Albertini, E. E. Parker, D. E. Hawkins, G. B. Donart, D. H. Hallford, and M. K. Petersen, *New Mexico State University, Las Cruces.*

Two supplements [high vs low vs no undegradable intake protein (UIP)] were fed to postpartum cows to evaluate nutrient partitioning and rebreeding in drought conditions. In spring 1996, 2 yr-old crossbred cows grazing winter range were blocked by calving date and randomly allotted to: (1) High Protein cube (HP; n=19), (2) Low Protein cube (LP; n=18), or (3) No Supplement (NS; n=15). Supplemented cows were individually fed 2 d/wk at a rate of 751 g/hd/d from April 1 (16±10.7 d postpartum) to June 10 (28 d after breeding started). Supplements were isocaloric and provided equal amounts of ruminally degradable protein (182 g/hd/d), with 256 vs 52 g additional protein as UIP in HP vs LP, respectively. Supplemented cows lost less (*P=.04*) weight than NS cows by June 10 (–18, –21, and –30±4.3 kg for HP, P, and NS, respectively). Compared to cows supplied LP, the HP-fed group used additional UIP to produce more milk in 4 h on d 38 postpartum (918 vs 678±87 g; *P=.07*) and tended to wean heavier calves (211 vs 205±3.3 kg; *P=.14*). The LP-fed and NS cows had similar milk yields and weaning weights. Reproductive traits were evaluated in the fall via rectal palpation and confirmed with biweekly serum progesterone samples. Protein supplementation decreased (*P=.02*) days to rebreeding (94, 92, and 108±5.7 d postpartum for HP, LP, and NS) and numerically increased the percentage of cows pregnant during the first 25 d of the 70 d breeding season (26, 39, and 13% for HP, LP, and NS). Although 100% HP-fed cows had cycled by d 40 of the breeding season versus 67% LP-fed and 67% NS cows (*P=.02*), they all had not conceived. Overall pregnancy rates were not different (100, 94, and 100% for HP, LP, and NS). While feeding protein versus no protein during a drought decreased cow weight loss and caused earlier postpartum conception, supplying high versus low UIP increased calf gain without changing time to rebreeding.

Key Words: Protein, Supplementation, Reproduction, Lactation

23 Effect of level and source of dietary selenium on concentrations of thyroid hormones and immunoglobulins in cows. F. T. Awadeh*, R. L. Kincaid, and K. A. Johnson, *Washington State University, Pullman.*

This study examined the effect of dietary level and chemical form of Se on triiodothyronine (T_3) and thyroxine (T_4) in plasma, distribution of Se in serum, and immunoglobulins (IgG and IgM) in plasma and colostrum of cows. Pregnant cows (n=60) were allocated among four dietary treatments: 20, 60, 120 ppm Se as selenite, and 60 ppm as selenomethionine from selenized yeast (SeY) in a salt offered free–choice. Treatments began 90 d prepartum. At parturition, cows given salt with 20 ppm Se had lower (P <.05) concentrations of Se in blood (.14 μg/ml) compared to cows with access to salts with 60 (.16 μg/ml) or 120 ppm Se (.19 μg/ml). Concentrations of Se in blood of all cows and activities of glutathione peroxidase (GSHPx) were higher at parturition (P >.01) compared to 24 wk postpartum. Concentrations of Se, T_3, and GSHPx activities in blood decreased (P <.01) with time after calving. Concentrations of T_3 in plasma of cows with access to salt with 20 ppm Se were lower (P <0.01) than in plasma of cows supplemented with 60 ppm Se. Selenium distribution in protein fractions did not differ significantly among treatments. In all treatments the highest (P <.01) Se concentrations were associated with selenoprotein P (31.63 ng/ml), the lowest with GSHPx (4.69), and intermediate (8.5) for albumin fractions. Serum IgG in cows and calves, colostrum, and Se concentrations in colostrum, casein and whey were lower (P <.01) for cows given salt with 20 ppm Se compared to other treatments. Cows given salts with 60 ppm Se as SeY had significantly higher (P <.05) Se concentrations in casein and whey. While these data did not show a difference between selenite and SeY on concentrations of T_3 and T_4, IgG levels in cows given Se as selenite were higher than in cows given SeY. At wk 8 post partum, there were significant (P <.05) correlations between T_4 and blood Se (r= −50.5) and between GSHPx and blood Se (r= 45.1). Thus, the salts with concentrations of 60 ppm and 120 ppm Se improved measures of Se status in cows and calves.

Key Words: Cattle, Selenium, Thyroid hormones, Immunoglobulins

24 Evaluation of Cetrorelix SB-75 in inhibiting serum LH concentrations in heifers. H. Ulker*, B. T. Gant, D. M. de Avila, J. J. Reeves, *Washington State University, Pullman.*

The objective of this study was to evaluate the suppressive effect of LHRH antagonist Cetrorelix (SB-75) on LH pulses and luteal function in beef heifers. In experiment I, eight heifers were randomly assigned to either control or treatment (n = 4 animals per group). Treatment animals received a single im injection of 10 μg/kg of body weight of SB-75 on d 3 of the estrous cycle (d 0 = estrus). Blood samples were taken at 15 min intervals for 6 h on d 3, 4, 10, 20 and 25. Mean serum concentrations of LH were reduced only on d 3 of the estrous cycle in SB-75 treated heifers (.07 ± .3 ng/ml) compared to control heifers (.40 ± .06 ng/ml). SB-75 at this dose did not alter progesterone concentration or length of the estrous cycle. In experiment II, 12 beef heifers were randomly assigned into three groups: control, single or multiple injection. Heifers in single injection group received 100 μg/kg of body weight of SB-75 on d 3 of the estrous cycle. The multiple injection heifers received 20 μg/kg of body weight of SB-75 on d 3, 4, 5, 6 and 7 of the estrous cycle. Heifers in all groups were bled at 15 min intervals for 6 h on d 3, 5, 7, 9, 14 and 20. SB-75 suppressed LH pulses 2 h after injection until d 14 in both treatment groups. There were no differences (P > 0.1) between the two SB-75 treatment groups in mean LH concentrations on d 3, 5, 7, 9 and 14. Even though LH was depressed due to treatment, the length of the estrous cycle was not shortened due to the LHRH antagonist.

Key Words: LHRH antagonist, Cattle, Serum LH

25 Relationships between birth weight, preweaning and postweaning gains with scrotal circumference, hip height and body weight in bulls fed two levels of energy. N.H.A. Morsy[1*], F.M.R. El-Feel[1], M. Makarechian[2], and H. A. Hassan[1], [1]*University of El-Minia, Minia, Egypt,* [2]*University of Alberta, Edmonton, Alberta, Canada.*

Records of 125 bulls were analyzed by stepwise regression analysis to study the relative influence of birth weight (BW), preweaning daily gain (PWG) and postweaning daily gain (POG) on final body weight (WT), scrotal circumference (SC) and hip height (HHT) measured at the end of 140-d feedlot test. The bulls were from two synthetic breed groups (beef synthetic and dairy synthetic) and were on average 188 days old at the start of the feedlot test. The bulls were fed either a high concentrate (85% grain) or low concentrate (55% grain) diet in feedlot. WT, SC and HHT were measured at 28-day intervals during the test. Among the independent variables (BW, PWG and POG), postweaning daily gain had by far the highest explanatory power for the variations in final weight and scrotal circumference under the high energy diet (R^2 = 74% and 50%) or low energy diet (R^2 = 67% and 42%), and in beef synthetic group (R^2 = 67% and 61%) or dairy synthetic group (R^2 = 75% and 55%), respectively. HHT measurement at the end of test was influenced largely by preweaning daily gain (R^2 ranged from 0.34 to 0 0.52) in both diets and breed groups. The relationships were all linear ($P<0.01$) as the quadratic terms were not significant. The stepwise regression analysis indicated that within the diets and within the breed groups, using both POG and PWG as independent variables provided the best predictor for body weight and scrotal circumference. Also combination of BW and PWG provided the best predictor for HHT trait. These results indicated that genetic and environmental factors influencing growth rate have major influence on testicular development and final weight of the bulls during the postweaning period in feedlot.

Key Words: Beef Bulls, Feedlot Traits, Relations

26 Body weight, scrotal circumference, hip height and their relationships with the ultrasound estimates of backfat thickness, lean meat yield and rib eye area in feedlot bulls fed two levels of energy. N.H.A. Morsy[1*], M. Makarechian[2], H. A. Hassan[1], and F.M.R. El-Feel[1], [1]*University of El-Minia, Minia, Egypt,* [2]*University of Alberta, Edmonton, Alberta, Canada.*

Body weight (WT), scrotal circumference (SC), hip height (HHT) and ultrasound estimates of backfat thickness (BF), lean meat yield (LMY) and rib eye area (REA) were recorded in 64 bulls from two synthetic groups. The bulls were fed either a high concentrate (85% grain) or low concentrate (55% grain) diet. WT, SC, HHT, BF, LMY and REA were recorded on days 100, 128 and 156 of feedlot test. The data were analyzed by stepwise regression analysis considering the separate effects of each diet and breed group. The results indicated that in general among the independent variables (WT, SC and HHT), average body weight had the maximum correlation coefficients with the ultrasound estimates of BF, REA and LMY during the test period. Under the high energy diet, combination of average WT, average SC and average HHT accounted for 39% of variation in BF and 27% of variation in LMY. Average WT alone accounted for 56% of variation in REA under the high energy diet. Under the low energy diet, average body weight alone was the best predictor of the ultrasound estimates of carcass traits. The results indicated that the level of energy had significant influence on the relationships between WT, SC and HHT with the carcass traits. The relationships between WT, SC and HHT with the carcass traits were also influenced by the breed group.

Key Words: Beef Carcass, Prediction

27 Effect of freezing on calpastatin activity and tenderness of callipyge lamb. S. K. Duckett[1*], K. Leckie[2], T. A. Klein[1], J. R. Busboom[2], and G. D. Snowder[3], [1]*University of Idaho, Moscow,* [2]*Washington State University, Pullman, and* [3]*U.S. Sheep Experiment Station, Dubois, ID.*

Twelve lambs (8=callipyge (CLPG); 4=normal (N); 50kg) were used to assess the effect of freezing prior to aging on tenderness of callipyge lamb. At 24 h postmortem, chops (.64 and 2.54 cm) were cut from the rack and loin of the left side. Two chops (.64 and 2.54 cm) from the CLPG carcasses were randomly assigned to one of six freezing times (0, 2, 4, 8, 20, 42 d). Two chops (.64 and 2.54 cm) were also randomly selected from the four normal (N) carcasses for fresh analysis. At the specified freezing time, the chops were removed from the freezer. The .64 cm chop was immediately assayed for calpastatin activity (CA). The 2.54 cm chops were thawed, aged at 2°C for 14 d, and refrozen for subsequent Warner-Bratzler shear force (WBS) measurement. Results are as follows:

	Callipyge						Normal
Freezing time, d	0	2	4	8	20	42	0
CA, activity/g	4.42^a	3.54^b	3.13^{bc}	3.08^{bc}	2.87^{bc}	2.46^c	2.20^c
WBS, kg	5.82^a	4.94^{ab}	4.64^{bc}	4.05^{bcd}	3.81^{cd}	3.52^d	3.37^{cd}
% WBS < 4.1 kg	12.5	37.5	37.5	50.0	75.0	87.5	75.0

^{a,b,c,d}Means in the same row with uncommon superscripts differ ($P < .05$).

Freezing prior to aging reduced calpastatin activity and Warner-Bratzler shear force in callipyge loin. The length of freezing time required to lower CA and WBS was 4 d and 8 d. However, increasing the length of freezing time to 20 or 42 d resulted in a greater percentage of loin chops being tender (WBS < 4.1 kg). Freezing prior to aging appears to be a viable method for increasing the tenderness of callipyge loin.
Key Words: Callipyge, Calpastatin, Tenderness

28 Carcass characteristics of extremely heavy lambs expressing the callipyge gene. R. A. Field*, O. Kucuk, F. C. Hinds, M. L. Riley, W. C. Russell and G. D. Snowder, *University of Wyoming, Laramie and U.S. Sheep Research Station, Dubois, ID.*

Eight extremely heavy carcasses (46 kg) and eight lighter carcasses (33 kg) from Columbia type ewe lambs expressing the callipyge gene were compared to eight normal carcasses (33 kg) from black–faced lambs to determine if feeding callipyge lambs to extremely heavy weights would improve tenderness. Loin roasts 10 cm thick were removed posterior to the 12th rib of each carcass after 14 d aging at 2 to 4°C and frozen storage at -30°C for 3 to 6 mo before Warner–Bratzler shear analyses were conducted. Chops cut 3.2 cm thick from each frozen roast were thawed overnight at 4°C and roasted at 177°C in a convection oven to an internal temperature of 74°C. Moisture by drying and fat by the Goldfisch method were obtained on portions of longissimus muscle trimmed of all epimysial tissue and subcutaneous fat. Moisture and fat percentage were similar for longissimus muscle from callipyge lamb carcasses weighing 46 and 33 kg but fat content was lower in both weight groups ($P<.01$) when compared to normal lambs. Shear values on 1.27 cm diameter cores from heavy, lighter and normal lambs were all different ($P<.03$) at 5.31, 7.65 and 3.40 kg, respectively. Therefore, feeding lambs expressing the callipyge gene to extremely heavy weights improves shear values but the values still are not as desirable as those from normal lambs. In addition, 46 kg carcasses from lambs possessing the callipyge gene had .70 cm of fat over the longissimus muscle compared to .35 cm for 33 kg callipyge carcasses ($P<.01$). Reduced shear values for extremely heavy carcasses when compared to lighter carcasses are probably a result of greater amounts of subcutaneous fat and a greater muscle mass both of which result in slower carcass chilling. An attempt to modify shear values and make chops from callipyge lambs more acceptable to consumers by feeding to heavier weights probably isn't feasible because it would result in extended feeding, increased fatness and an anticipated decrease in feed efficiency.

Key Words: Lambs, Tenderness, Callipyge, Composition

29 Freezing improves myofibril fragmentation in longissimus muscles from Callipyge lambs. R. D. Sainz, M. S. Espindola, J. S. Cubbage*, and Y. B. Lee, *University of California, Davis.*

Lambs expressing the callipyge phenotype exhibit marked muscle hypertrophy, particularly in the loin and hindquarters, but the meat is very tough due to reduced myofibrillar fragmentation. In an effort to improve meat quality, loin and rib chops from normal (N) or callipyge (C) ewe lambs were either stored at –0.5°C or frozen and thawed prior to storage at –0.5°C for up to 14 days. Birth, weaning and slaughter weights were similar in N and C lambs. Carcasses of C lambs had greater loin eye areas (+48%) and less backfat (–37%) and total fat content (–18%) than those of N lambs. Yield of major primal cuts was higher (+13%) in C than in N lambs. The concentration of DNA in the longissimus muscle was slightly lower, and the ratio of protein:DNA was higher in C than in N lambs, indicating that the increased muscle growth was indeed hypertrophic. At slaughter, activities of μ–calpain in longissimus muscles were similar, but m–calpain and calpastatin were higher (+101% and +113%, respectively) in C than in N lambs. Freezing and thawing chops did not seem to alter m–calpain and calpastatin activities, but greatly reduced μ–calpain in both phenotypes. Myofibrillar fragmentation (MFI) was essentially complete by day 7 postmortem in N lambs, and was virtually absent in C lambs, even by day 14. Freezing and thawing chops prior to storage had little or no effect in N lambs, but increased MFI in C lambs so that they were almost acceptable by day 14. Examination of specific proteins by SDS–PAGE confirmed these results. Freezing and thawing muscles prior to aging may be a useful approach to improving the quality of meat from callipyge lambs.

Key Words: Lambs, muscle hypertrophy, calpains, myofibril fragmentation

30 Effect of implanting on longissimus muscle fatty acid and cholesterol content. S. K. Duckett[1]* and D. G. Wagner[2], [1]*University of Idaho, Moscow and* [2]*Oklahoma State University, Stillwater.*

Sixty ribeye steaks were used to determine the effects of implanting on longissimus muscle fatty acid and cholesterol content. The steaks were randomly selected from 120 carcasses of four treatment groups (C=non-implanted control , ET=28 mg estradiol benzoate plus 200 mg trenbolone acetate, ETET=ET on d 0 and d 61, and SET=20 mg estradiol benzoate plus 200 mg progesterone on d 0 and ET on d 61). Carcass grade traits were evaluated at 66 h postmortem. Implanting increased (P = .04) ribeye area (REA) and reduced (P < .05) marbling score (MS), quality grade (QG), and total fatty acid content (g/100g; FA) compared to C. This resulted in the FA per REA to be lower (P = .01) for implanted compared to C. Reimplanting (ETET) versus single implant (ET) increased (P = .05) REA and tended to lower (P = .08) QG. Implanting with an estrogen first (SET) compared to ETET reduced (P < .05) carcass weight and did not alter (P > .05) REA, MS or QG. Stearic (C18:0) and linolenic (C18:3) acids were increased (P < .05) in concentration with implanting; whereas, oleic (C18:1) acid concentration was reduced (P = .01). These changes translate to increased (P < .05) saturated (SFA) and polyunsaturated (PUFA), and reduced (P < .05) monounsaturated (MUFA) fatty acid contents in the longissimus muscle with implanting. Reimplanting (ETET) versus a single implant (ET) did not alter (P > .10) fatty acid composition. Implanting with SET compared to ETET increased (P = .05) the percentage of palmitic (C16:0) acid and reduced (P < .05) linoleic (C18:2) acid and PUFA concentrations. Correlations across all treatments between MS and PUFA (r = –.44) or REA (r = –.40) were moderate. Ribeye area and PUFA content were also moderately associated (r = .30). The prediction equation developed for MS using stepwise regression was: MS (500=Small) = 508 + 29.98*FA, g/100g – 27.65*PUFA, %; R^2=.47, SEp=52.3. Thus, implanting enlarges ribeye area without a concomitant increase in lipid deposition thereby reducing marbling score.

Key Words: Beef, Implants, Lipid

31 Monitoring lipid and muscle deposition in feedlot steers of different breeds using real-time ultrasound. S. K. Duckett and T. A. Klein, *University of Idaho, Moscow.*

Thirty-five steers (353 kg) from Angus (A), Tarentaise (T), and Charolais (CH) sires were ultrasounded every 14 d throughout the finishing phase to monitor changes in lipid and muscle deposition. Steers were slaughtered when live weight reached 614 kg or fat thickness measured 1.14 cm. Live weight increased (P = .01) across time-on-feed (TOF) in a linear manner (LW, kg = 381 + 1.47*TOF, d; R^2=.80, SEp=30) for all breeds (P = .54). Subcutaneous fat deposition increased (P = .01) in a linear manner across TOF but at different rates for each breed (P = .02; A-FT, cm =.43 + .0037*TOF, d, R^2 = .53; T-FT, cm = .29 + .0036*TOF, d, R^2 = .43; CH-FT, cm = .33 + .0019*TOF, d, R^2 = .18). Muscle depth increased (P = .01) across TOF in a quadratic manner (MD, cm = 2.49 + .07*TOF, d – .0003*TOF^2, d, R^2 = .41) for all breeds (P = .48). Prior to slaughter, ultrasound measures of fat thickness (UFT) and muscle depth (UMD) were taken and then compared to actual carcass measures (FT, MD). Percent intramuscular lipid (IML) was also measured using real-time ultrasound to predict quality grade prior to slaughter (QG; Choice > 4.2%; Select < 4.2%). The correlation coefficients (r), coefficient of determination (r^2), and standard error of prediction (SEp) between carcass and ultrasound measures are as follows:

	r	r^2	SEp
FT, cm	.74	.55	.13
MD, cm	.53	.22	.91
QG (5 = Choice)	.56	.32	.35
IML, %	.34	.12	1.34

Quality grade was correctly predicted from ultrasound IML content for 75% of the steers. Thus, ultrasound technology can be used to monitor lipid and muscle deposition across time-on-feed for prediction of optimal slaughter endpoints.

Key Words: Beef, Feedlot, Ultrasound

32 Effect of chromium picolinate on performance and carcass components of broiler chickens. R. Gonzalez*, J. Jimenez[1], H. Hernandez, and J. L. Espinoza, *Universidad Autonoma de Baja California Sur, La Paz, Mexico,* [1]*Universidad Autonoma de Chihuahua, Chihuahua, Mexico.*

Thirty six broiler chickens (Peterson line) were individually placed in cages and used to determine the effects of chromium picolinate (CrP) on performance and carcass components. Broiler chickens were randomly assigned to one of four treatments: 0 (C0), 400 (C4), 600 (C6) or 800 (C8) ppb of CrP (n = 9 chickens per group) added to drinking water over a 42-d period, beginning at 1 d of age. Each chicken within treatment represented an experimental unit. They received commercial diets (starting diet = 23% CP, and 3200 kcal/kg ME from 0 to 21 d of the experimental period; finishing diet = 20% CP and 3200 kcal/kg ME from 22 to 42 d of the experimental period). Feed intake and body weight gain were similar among treatments (P > .05). Feed:gain (kg feed/kg gain) was lower (P < .05) in C8 (1.75:1) than C0 (1.82:1). Carcass weight (CW), total lean meat (TLM), breast meat (BM), thigh weight (TW), drumstick weight (DW), total fat deposition (TFD), subcutaneous fat (SF), and deposition of abdominal fat (DAF) were:

Item, g	C0	C4	C6	C8	SE
CW	1214.1^a	1213.8^a	1260.1^{ab}	1331.2^b	27.2
TLM	503.1^a	504.1^a	541.1^b	540.6^b	11.4
BM	192.5^a	194.2^a	199.7^{ab}	206.4^b	4.3
TW	118.3^a	117^a	128^b	130.4^b	2.6
DW	257.4^a	256.4^a	289.7^b	278.5^b	5.9
TFD	131.3^a	130.1^{ac}	99.1^b	128.3^c	2.5
SF	96.8^a	89.3^b	63.7^c	89.1^{bd}	1.7
DAF	34.8^a	40.8^b	35.3^a	34.4^a	.8

^{a,b,c,d}Means within rows with different superscripts differ (P < .05).

Key Words: Broiler Chickens, Chromium Picolanate, Carcass Composition

33 Meat quality characteristics from feedlot lambs supplemented daily with selenium enriched yeast and vitamin E. K. D. Kirby*, J. D. Thomas, and T. T. Ross, *New Mexico State University Las Cruces.*

The objective of this study was to evaluate the effect of daily supplementation of selenium enriched yeast and (or) vitamin E (D–α–tocopherol) to western white face feeder lambs, on retail meat quality characteristics. Upon arrival on New Mexico State University campus, lambs were randomly assigned to treatments and treatments randomly assigned to pens. Treatments consisted of: 1) no supplementation; 2) non–selenium yeast; 3) 200 IU D–α–tocopheroly·animal^{-1}·yd^{-1}; 4) selenium enriched yeast; and 5) 200 IU D–α-tocopheroly·animal^{-1}·yd^{-1} and selenium enriched yeast. Non–selenium yeast and selenium enriched yeast were added to the feed at 30 g/kg of feed (DM basis), approximating a selenium supplementation rate of 10 ppm selenium/kg of feed (DM basis). Vitamin E was added daily to feed as a top dressing. Lambs were fed for 84 d and then humanely slaughtered. Wholesale cut loins were vacuum packaged and frozen for 3 months before shelf life data were collected. Retail shelf life and cooking data were collected. Retail display color analysis indicated that loin chops from vitamin E (trt 3) and selenium enriched yeast plus vitamin E (trt 5) treatments retained a brighter, more desirable color than other treatments when compared to controls on day 0 ($P<.05$), day 2 ($P<.05$), day 4 ($P<.05$), and day 7 ($P<.05$). Retail display drip loss data analysis showed no differences for thaw drip loss ($P=.35$), display time drip loss ($P=.23$), and total drip loss ($P=.29$). No differences for cooking drip loss ($P=.75$) and meat tenderness ($P=.95$) were found. Supplementing with selenium and (or) vitamin E to feeder lambs may be of value relative to meat quality characteristics. Vitamin E treatment cuts retained a more desirable color throughout retail display.

Key Words: Lamb, Selenium, Vitamin E

NONRUMINANT NUTRITION

34 Effects of supplemental chromium picolinate and lower dietary lysine on growth performance and carcass characteristics of barrows. Z. Yi, R. L. Park, L. E. Orme, and E. W. Hawkins, *Brigham Young University, Provo, Utah.*

An experiment was conducted to evaluate the effects of supplemental chromium picolinate (CrP) and lower dietary lysine on growth performance and carcass characteristics of barrows. Crossbred pigs ($n = 34$) were treated with three diets from 37 kg to 60 kg: 1) 0 Cr and .80% lysine; 2) 200 μg Cr/kg of diet from CrP and .80% lysine; and 3) 200 μg Cr/kg of diet and .64% lysine. Dietary lysine levels were changed to .60, .60 and .48% for treatments 1, 2, and 3, respectively, when pigs were 60 to 110 kg. Two pig sources were used with 5, 5, and 6 pigs from Brigham Young University (BYU) and 6, 7, and 5 pigs from Circle Four Farm (CFF), respectively, in Treatments 1, 2, and 3. Pigs were fed in three pens (one treatment per pen) with computer controlled feeding systems in an open-front building during winter cold weather. Supplemental CrP increased ADG of the pigs from BYU (655 vs 869 g, $P < .05$) and from overall BYU and CFF pigs (712 vs 817 g, $P < .10$), and increased loin cut percentage of CFF pigs only (18.1 vs 19.1%, $P < .10$), but did not change ($P > .10$) other carcass characteristics and compositions of the pigs from either source or overall sources. Supplementation of CrP and reduced dietary lysine decreased ($P < .10$) ADG (817 vs 674 g), carcass weight (87.2 vs 78.8 kg), and loin eye area (40.7 vs 36.5 cm^2), and decreased ($P < .05$) loin cut percentage and lean (loin, ham, and shoulder) cuts (kg) of overall pigs. However, the deceased effects by lowering dietary lysine came from CFF pigs only ($P < .05$ to .10), not from BYU pigs ($P > .10$). The results also indicate that CFF pigs have more lean percentage (38.3 vs 36.7%, $P < .01$), lower 10th rib fat depth (21.6 vs 28.1 mm, $P < .01$), and longer carcass length (82.0 vs 78.7 cm, ($P < .05$), compared with BYU pigs.

Key Words: Pig, Chromium Picolinate, Performance

35 Rice bran with antioxidants as a supplemental feed for growing horses. H.G.W. Coombs*, R. D. Wiedmeier, B. A. Kent, B. R. Bowman, J. L. Walters, *Utah State University, Logan.*

Sixteen horses (372 kg) of mixed breeding were used to compare rice bran (RB) to oats as supplemental feeds with regard to growth rate and immunocompetancy. Since RB is much higher in fat content than oats, the effects of fortification with antioxidant vitamins and minerals was also tested. Horses were individually penned and assigned one of four supplement treatments such that each treatment group was comparable with respect to age, body weight and sex. Supplements were RB with antioxidants (RBWA), RB without antioxidants (RBWOA), oats with antioxidants (OWA), and oats without antioxidants (OWOA). The diet consisted of 70.6% alfalfa hay, 17.6% ammoniated barley straw, and 11.8% of assigned supplement. Diets were offered on a free–choice basis with intake monitored daily. Horses were weighed each 28 days during the 120–day study. Blood samples were taken via jugular puncture at the beginning and end of the study to ascertain the effect of supplement treatments on immunocompetancy using a lymphocyte proliferation test. Resultant average daily gains (ADG) were .72, .79, .85, and .87 kg with respect to the OWOA, OWA, RBWOA, and RBWA supplements. The addition of antioxidants to either oats ($P=.19$) or RB ($P=.74$) did not improve ADG. Horses receiving OWOA gained less than those receiving either RBWOA ($P=.01$) or RBWA ($P=.008$). However the use of OWA resulted in similar ADG to both RBWOA ($P=.198$) and RBWA ($P=.097$) indicating similar performance with oats or RB if oats are fortified with antioxidants. Change in lymphocyte proliferation from the beginning to end of the study showed a similar pattern with similar immunocompetancy resulting from the use of either oats or RB if oats are fortified with antioxidant vitamins and mineral.

Key Words: Horses, Rice Bran, Oats, Growth Immunocompetancy

36 Effects of frequency of supplementation of adult cows in western Texas. J. E. Huston[1*], H. Lippke[2], and T.D.A. Forbes[2], J. W. Holloway[2], R. V. Machen[2], and B. G. Warrington[2], [1]*Texas Agricultural Experiment Station, San Angelo,* [2]*Texas Agricultural Experiment Station, Uvalde.*

Brangus and Hereford × Brangus cows (3 to 10 yr) were grazed and supplemented at three locations to determine effects of frequency of supplementation on the intake of supplement and forage and on winter changes in live body weight and condition score. Treatments were control (C; no supplemental feed) and the equivalent of .91 kg per day of cottonseed meal fed daily (D), three times per week (3/WK), or one time per week (WK). At each location, one pasture group of 16 cows was given all four treatments (4 cows/treatment) using Calan gates and each of four pasture groups was given one of the four treatments as a group. Treatments were imposed between Dec. 1, 1995, and Mar. 20, 1996, during which parturition occurred. A double marker technique was used to determine total (Cr – bolus) and supplement (Yb) intake in the group–fed cows. Only the Cr – bolus for total intake was used in the Calan cows. Cows that did not have a live calf one week before termination or, if in a Calan group, did not consume all of the offered feed or did not show sufficient fecal Cr concentration (lost the bolus) were not included in the summarized data. Data included initial and final cow weights and condition scores and supplement, forage, and total intake. For the group–fed cows, live body weight change and forage intake differed for location ($P < .05$) and treatment ($P < .05$), but there were no location × treatment interactions. The control group lost more ($P < .05$) live weight (19.1%) and body condition score (1.52) and consumed more ($P < .05$) forage dry matter (10.3 kg/day) compared with the fed groups. The cows fed daily lost less ($P < .05$) live weight and body condition score than those fed three times per week or weekly which did not differ. Forage consumption was not different among the fed groups. These data indicate that feeding as infrequently as one time per week can be effective nutrition management for grazing adult cows.

Key Words: Supplement, Feeding frequency

37 Lamb grazing strategies for the irrigated Sonoran Desert. J. N. Guerrero* and V. L. Marble, *University of California, Holtville.*

A lamb grazing trial on three year old established alfalfa stands was conducted during the winters of 1987/88 and 1988/89 at the University of California Desert Research and Extension Center. Four commercial wethers, initial mean weight of 37.5 kg and initial age of 5 to 7 months, grazed 20.1 × 20.1 m paddocks to emulate the customary Sonoran Desert grazing method of 1600 lambs on 16.2 ha for 14 d (14SS). A nonselective grazing method (SG) had the same paddock size as 14SS but all the lambs grazed strips for 4 to 5 d. A less intensive system (21SS) had paddocks of 32.2 × 20.1 m to emulate 2000 lambs on 32.4 ha for 21 d. The lambs grazed in December and January of both years. Each year lambs came from the same source and origin. Each year each treatment was repeated 4 times, for a total of 48 lambs. Lambs in 1988/89 gained more ($P = .09$) weight than in 1987/88. The year × treatment interaction affected ($P = .06$) lamb gains. During the 1987/88 season, lamb gains for the three treatments were .08 to .10 kg/d with no ($P > .05$) treatment differences. During the 1988/89 season, lamb gains for treatments SG, 14SS, and 21SS were .10, .14, and .21 kg/d, respectively, with 21SS lambs gaining more ($P < .05$) than SG or 14SS lambs. The treatment × month interaction affected ($P = .01$) lamb gains. In December, lamb gains for SG, 14SS, and 21SS were .08, .12, and .17 kg/d, respectively, each treatment being different ($P < .05$) from each other. During January there were no ($P > .05$) treatment differences. Since under a few circumstances the 21SS lambs gained more weight than SG or 14SS lambs, and 21SS lambs required fewer lambs movements during the grazing season, we recommend that on established alfalfa fields, the 21SS grazing method would be more advantageous than the SG or 14SS methods for the lamb graziers of the irrigated Sonoran Desert.

Key Words: Sheep, Grazing, Alfalfa

38 Impact of dietary supplementation of grazing steers on *in situ* digestibility of fresh and dried tropical grass. J. R. Carpenter*, R. Y. Niino–DuPonte and M. Kaheiki, *University of Hawaii at Manoa, Honolulu.*

Dietary protein and/or energy supplementation are ways of improving ruminant production on tropical pastures. It is unclear whether this is due to the supplement's nutrient content, altered digestibility or if they provide any limiting factors to rumen microbial activity. Two rumen–fistulated steers were used to assess the impact of dietary supplementation on *in situ* digestion rates of fresh and dried tropical grass. In trial 1, steers grazing kikuyu/pangola grass pasture received no supplementation; in trial 2, they received a molasses–based supplement (77.9% DM; 18.2% CP; 80% TDN) at 0700 at .5% of body weight. In both trials, nylon bags of fresh and oven–dried (50°C) tropical grass (4 wk regrowth, pangola, *Digitaria decumbens*) with 12 to 13 g of DM were inserted into the rumen of each steer. At 2, 4, 8, 12, 18, 24, 36, 48, 72 and 96 h, two bags for each grass type were removed from each steer, rinsed and frozen for nutrient analysis. Nutrient composition of shredded fresh grass (12.1% DM) and dried grass (87.2% DM) were similar ($P>.05$) (average 17.1% CP; 60.8% NDF, 5.7% lignin; 9.1% ash, .38% Ca; .51% P); however, ADF and cellulose were higher ($P<.05$) in fresh (36.8% ADF, 28.5% cellulose) than in dried grass (34.9% ADF, 26.8% cellulose). Extent of DM digestion of fresh and dried grasses by 48 hours was similar ($P>.05$) whether supplement was consumed (65.6%) or not (71.8%). With no supplement, rates of potentially digestible (PD) DM, NDF, ADF and cellulose disappearance were faster ($P<.05$) for fresh (–.056,–.060,–.052,–.050) than dried grass (–.048, –.047,–.043,–.045), but the rate of PDCP disappearance (–.058) did not differ ($P>.05$). With supplement, rate of PDDM disappearance was faster ($P<.05$) for fresh (–.038) than dried grass (–.033) but similar for all other nutrients ($P>.05$). Results show that nutrient disappearance was faster ($P<.01$) when animals grazed than when fed dried forages, and that supplementation slowed ($P<.01$) rates of DM, CP and fiber digestion.

Key Words: Tropical grass, Nutritive value, *In situ* digestibility

39 Evaluation of the effects of spine removal by burning on the nutritive quality of cholla cactus for an emergency feed. J. E. Sawyer*, L. A. Knox, G. B. Donart, and M. K. Petersen, *New Mexico State University, Las Cruces.*

A study was conducted to evaluate the nutritive quality and composition of cholla cactus (Opuntia imbricata) after spine removal by burning. The study was conducted at the Corona Range and Livestock Research Center, 15 km east of Corona, NM during June,1996. Cholla cactus grows as a series of jointed sections, and may serve as an emergency feedstuff when forage is unavailable. Cattle consume small quantities of cholla, but the spines must be removed to encourage higher levels of consumption. Six samples were collected for each treatment. Treatments were either unburned (UN) or burned (BU). BU samples were burned with a propane torch until all spines were removed. Each sample consisted of two burned and two unburned sections from each of five plants. All samples were considered to be representative of material cattle would normally select. One sample from each treatment was weighed immediately upon collection and used only for determination of dry matter content. The remaining samples were evaluated for crude protein (CP) and neutral detergent fiber (NDF) content. In situ DM disappearance was determined at 20 and 68 h by incubating 3g DM in two ruminally cannulated cows grazing native range. The results were statistically evaluated by analysis of variance. The DM content of burned cholla was 12.7% and unburned contained 12.4% DM. Crude protein levels were not affected by burning ($P>.7$; 10.7% UN, 11.0% BU, SE±.60). However, BU had less NDF than UN ($P<.01$; 31.1% vs. 40.1%, SE±.84). Burned cholla tended to have greater in situ DM disappearance at 20h ($P<.1$; 76.8% BU vs. 67.0% UN, SE±3.15), and had greater disappearance at 68h ($P<.01$; 87.1% BU vs. 79.5% UN, SE±1.22). These measurements indicate that cholla cactus has relatively high nutrient quality, and that removing the spines by burning may enhance its palatability and nutritive quality. However, the excessive moisture content would require large amounts to be fed.

Key Words: Cholla, *Opuntia*, Alternative feeds, Cactus, Drought

40 Intake and performance of heifers consuming medium-quality meadow hay supplemented with corn or beet pulp. L. A. Burgwald-Balstad*, D. W. Sanson, D. L. Hixon, D. W. Moore, and D. G. Bradley, *University of Wyoming, Laramie.*

Seventy-five Angus-Gelbvieh cross heifers (BW=271 ± 10 kg) were used to determine the effect of increasing levels of either supplemental cracked corn or beet pulp pellets on intake of medium-quality meadow hay (8.43% CP) and on weight gain. Heifers were stratified by BW and randomly assigned to one of five treatments (5 heifers per group; three replicates per treatment) for the 91-d trial. Treatments were hay (CON), hay plus .82 kg corn (LC), hay plus 1.6 kg corn (HC), hay plus .82 kg beet pulp (LBP), or hay plus 1.6 kg beet pulp (HBP). Supplements were fed each morning at 0700. Following supplement feeding, hay was offered at levels to insure 10% refusal. Diet refusal was measured weekly. Heifers were weighed full on two consecutive days at the start and end of the trial. Data were analyzed as a one-way ANOVA. Pen was used as the experimental unit. Contrast analysis was used to compare CON to the average of the supplement groups, LC to HC, LBP to HBP, and the average of beet pulp to the average of corn. Average daily gain was higher for heifers receiving supplements compared to heifers receiving only hay (.69 vs. .79 ± .03 kg; P=.02). There was no difference in average daily gain of heifers receiving corn vs. beet pulp (P=.82), or between heifers receiving LC vs. HC (P=.52). There was a trend for higher ADG with heifers fed HBP compared to heifers fed LBP (.76 vs. .83 ± .03 kg; P=.14). Forage intake of heifers fed no supplement was higher than forage intake of heifers that received supplements (2.53 vs. 2.09 ± .03% BW; P<.001). Forage intake was lower in heifers supplemented with beet pulp compared to heifers supplemented with corn (2.0 vs. 2.2 ± .03% BW; P<.001). Heifers supplemented with beet pulp consumed less total feed than heifers supplemented with corn (2.38 vs. 2.58 ± .04% BW; P<.001), and heifers supplemented with LBP consumed less total feed than heifers supplemented with HBP (2.32 vs. 2.45 ± .04% BW; P=.03). These data suggest that beet pulp as an energy supplement results in similar heifer performance to corn supplementation for medium-quality meadow hay when fed at .5% BW or less.

Key Words: Heifers, Beet pulp, Corn

41 Assessment of alfalfa and Jose tall wheatgrass seeded separately or in combination. R. Cabanillas-Cruz*, C. R. Krehbiel, R. E. Kirksey, G. B. Donart, and M. K. Petersen, *New Mexico State University, Las Cruces.*

The objective was to determine dry forage availability and nutritive value of alfalfa (*Medicago sativa*) and Jose tall wheatgrass (*Agropyron elongatum*) sown alone or in combination. Replicated, irrigated pastures (1.6 ha) were located at the New Mexico State University Agricultural Science Center at Tucumcari, NM. Forage mixtures in each replicated pasture were alfalfa 100%/wheatgrass 0% (A), alfalfa 0%/wheatgrass 100% (W); and the combinations of 67%/33% (A/W–1) or 33%/67% (A/W–2) for alfalfa and wheatgrass, respectively. A 30.5 cm × 101.6 cm quadrant was used to collect forage samples. Each forage mixture was clipped every 28 days, beginning April 24, 1996 and ending October 8, 1996. Forage samples were frozen for later analysis. Forage availability (kg/ha) and the percentages of organic matter (OM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent insoluble nitrogen (ADIN) were estimated. Data were analyzed as a split plot in time. Over the entire period, mixes (A/W–1 and A/W–2) had the highest ($P < .02$) forage availability with an average of 1532 kg/ha. Between A and W availability was similar ($P > .05$) with an average of 958 kg/ha. A treatment × sampling date interaction occurred for OM. For alfalfa, OM decreased from April to October while treatments W, A/W–1, and A/W–2 showed an increase from April to June and then a decrease for each following month. In addition, differences ($P < .02$) in OM were observed between mixes (88.1%) and A (85.5%) but mixes were not higher ($P > .05$) than W (86.8%). No treatment × sampling date interactions ($P > .05$) were found for nutrient concentration. The greatest ($P < .001$) CP was for A (22.1%) and the lowest for W (16.3%). The percentage of NDF was the same ($P > .05$) between mixes (45.2%), while W had the highest ($P < .01$; 60.7%) and A the lowest (33.1%) percentage. Between A/W–1 and A/W–2, ADF was similar ($P > .05$); however, W and A were highest and lowest with 34% and 26.1%, respectively. Wheatgrass 100% had a lower ($P = .01$) ADIN than A/W–1 and A/W–2 but was similar ($P > .05$) to A. Combinations of alfalfa and wheatgrass provided the greatest forage availability, but alfalfa seeded as a single crop produced a higher quality forage with less structural carbohydrates, ADIN and a higher percentage of CP.

Key Words: Forage quality, Alfalfa, Wheatgrass, Irrigated pasture

42 Effects of nutrient supplementation in cows fed snakeweed. L. F. Gulino Klein, T. T. Ross, M. K. Petersen, T. May, S. Slate, J. B. Taylor, and J. R. Strickland*, *New Mexico State University, Las Cruces.*

Two replicate trials were conducted to determine the effects of supplementation on snakeweed (SW) toxicity in cows of poor body condition. Each trial consisted of two phases (phase 1, dietary treatments; phase 2, dietary treatments + snakeweed at 10% of DMI). Diets were control (CON; n=3/trial; grass hay, 9.5% CP; DMI=1.3% BW), corn (n=3/trial; CON diet + .626 kg cracked corn), and protein (PROT; n=3/trial; CON diet + .78 kg 42% CP supplement). Corn and PROT diets were isocaloric. Serum was collected on days 28, 42 and 56 of each phase. Bromosulphothalein (BSP) elimination half life (t1/2) was higher (P<.05) for CON (24.87 ± 3.9 min.) than either corn (13.89 ± 3.5 min.) or PROT diets (11.58 ± 3.5 min.). Blood urea nitrogen (BUN) was increased (P<.05) on days 28 (13.58 ± .71 mg/dL), 42 (12.72 ± .71 mg/dL), and 56 (12.22 ± .71 mg/dL) of phase 2 vs. baseline (BASE; 9.44 ± .71 mg/dL). Total bilirubin (BIL) was increased (P<.05) by days 28 (.236 ± .008 mg/dL), 42 (.203 ± .008 mg/dL), and 56 (.210 ± .008 mg/dL) in phase 2 vs. BASE (.191 ± .008 mg/dL). Indirect BIL was higher (P<.05) on days 28 (.202 ± .0088 mg/dL), and 56 (.180 ± .0088 mg/dL) in phase 2 vs. BASE (.1536 ± .0088 mg/dL). Direct BIL increased (P<.05) in phase 2 on day 28 (.058 ± .005 mg/dl) in the corn diet vs. BASE (.037 ± .005 mg/dL), but decreased on day 28 (.036 ± .005 mg/dL), 42 (.035 ± .005 mg/dL), and 56 (.035 ± .005 mg/dL) in PROT vs. BASE (.052 ± .005 mg/dL). Alkaline phosphatase (ALK-P) was higher (P<.05) in CON by day 28 (162 ± 6.04 mg/dL) vs. BASE (130.5 ± 6.04 mg/dL), but lower with the PROT on days 28 (130 ± 5.41 mg/dL), 42 (116.5 ± 5.41 mg/dL) and 56 (110.7 ± 5.41 mg/dL) vs. BASE (149 ± 5.41 mg/dL). Increased BIL may indicate slight toxicosis of the liver. Increased ALK-P in CON and not in the other diets may indicate an effect of supplementation on improving animal tolerance toward SW. Decreased t1/2 of BSP in PROT may indicate increased potential for liver clearance of xenobiotics.

Key Words: cattle, snakeweed, tolerance

43 Effects of dietary fat composition and content, breed and calf sex on birth weight, dystocia, calf vigor and postpartum reproduction in first calf beef heifers. M. A. Lammoglia[1]*, R. A. Bellows[1], E. E. Grings[1], J. W. Bergman[2], R. E. Short[1], and M. D. MacNeil[1], [1]*USDA-ARS, Miles City, MT 59301,* [2]*Eastern Agricultural Research Center, Sidney, MT 59270.*

One hundred fifty-six first calf F1 heifers (50% crossbred and 50% Hereford, Limousin, or Piedmontese) bred to the same genotypes to produce F2 offspring, received basal diets with: 1.7% (control, C), 4.2% (80% oleic acid, O) or 4.9% (80% linoleic acid, L) fat. Both O and L fat sources were from safflower seeds. Rations were fed from d 230 of gestation until calving. Calf data were taken within 24 h after calving (calving difficulty, 1 = no assistance, and 4 = major pull or cesarean section; vigor score, 1 = alive, normal vigor, and 4 = dead at birth or died shortly after). During the subsequent breeding season, lactating dams were artificially inseminated during a 53 d breeding season which started when dams had been off the gestation rations for an average of 55 d. Calves born to cows receiving L were heavier (37.8 kg; P < .01) than calves born to C (36.1 kg) and O (35.1 kg) cows. Limousin (37.9 kg) and Piedmontese (36.7 kg) calves were heavier (P < .01) than Hereford (34.4 kg) calves. Female calves were lighter (P < .01) than male calves (34.6 vs 38.1 kg). The diet × sex interaction (P < .01) showed that O male (36.5 kg) calves were lighter than C (38.0 kg) and L (39.8 kg), but there were no differences among C, O or L female calves. Calving difficulty scores were lower (P < .01) in O (1.4) than L (1.8) dams and tended to be lower (P < .10) than C (1.7) dams. Piedmontese dams had higher (P < .01) difficulty scores (1.9) than Hereford (1.5) or Limousin (1.5). O calves had the best (P < .01) vigor condition score (1.0), C intermediate (1.1) and L calves the poorest (1.3). Pregnancy rates were greater (P < .06) in O (74.5%) and L (76.7%) than C (57.1%) cows. In conclusion, feeding high fat diets with increased concentrations of oleic acid before calving may decrease birth weight and calving difficulty and improve calf vigor. High fat diets increased postpartum pregnancy rates by 18.5% compared to controls, regardless of fatty acid composition.

Key Words: fat supplementation, birth weight, postpartum, reproductive performance.

44 Changes in 2,3–diphosphoglyceric acid with acclimatization to altitude in the horse. T. P. Anderson*, S. J. Wickler, E. A. Cogger, R. E. Bray, H. M. Greene, C. C. Lewis *Equine Research Center, California State Polytechnic University, Pomona.*

The present study was designed to measure the temporal response of 2,3–diphosphoglyceric acid concentration (2,3–DPG) and packed cell volume in horses transported to high altitude and subsequently returned. Previous studies have shown that organophosphate compounds act to decrease the hemoglobin affinity for oxygen, facilitating oxygen delivery to the tissues. Six horses were sampled at rest for packed cell volume and 2,3–DPG before, during, and after an 8 day exposure to 3810 m. Blood samples were analyzed spectrophotometrically for 2,3–DPG which were adjusted using pack cell volumes. Data were analyzed with repeated measures ANOVA utilizing a Fisher's PLSD post–hoc test (p<0.05 considered significant). Values are expressed as mean ± 1 SEM in μmoles 2,3–DPG per ml packed cells. Concentrations of 2,3–DPG increased from 6.04 ± 0.17 at low altitude (300 m), to 6.9 ± 0.17 at day 2 (3810 m), and to 8.36 ± 0.15 after 8 days. Concentrations of DPG were still elevated 48 hours after returning to 300 m (7.57 ± 0.54). The increase in 2,3–DPG with altitude is consistent with other vertebrates and acts to facilitate delivery of oxygen to the tissues. It is unknown if this facilitated oxygen delivery could act to improve athletic performance either at high altitude or shortly upon return to low altitude.

Key Words: Diphosphoglyceric acid, High altitude, Horse

45 The effect of 24 hour shipping on fresh transgenic bovine embyros. N. Putnam*, W. Plummer, *California Polytechnic State University, San Luis Obispo.*

A joint project between UC Davis and Cal Poly San Luis Obispo involved fresh transgenic bovine embryos that were shipped 300 miles from UC Davis to Cal Poly SLO. These embryos had been in vitro fertilized, incubated in sheep oviducts and (or) an incubator, and DNA injected. The effects of these insults on their viability during shipping has not been investigated. Embryos were shipped in 1.5 ml vials containing Tissue Control Medium 199(TCM) in an insulated, thermally controlled environment of 35°C via ground service on Wednesday afternoon, received Thursday afternoon and immediately transferred into waiting recipients. Before packing, embryos were graded as excellent, good and fair, with no poor ones being shipped. Upon reception they were evaluated to determine degradation during shipping. Embryos were usually at the 7 day blastocyst stage when shipped though some hatched before arrival. From November 1993 through November 1996, 94 embryos were shipped and, interestingly, 103 were received. At UC Davis embryos graded (% of total shipped): excellent-4 (4.26%); good-51 (54.26%); good/fair-8 (8.51%); fair-22 (23.40%); ungraded (but within the preceeding categories)-9 (9.57%). At Cal Poly embryos graded: excellent-1 (0.97%); good-27 (26.21%); fair-14 (13.59%); poor-40 (38.84%); unusable- 21 (20.39%). This indicated a 59% loss of embryos graded as excellent to fair. Eighty-two embryos were transferred into 67 heifers resulting in 9 pregnancies (13.43%). The transport of fresh embryos via thermos and ground service is not as efficient as other methods such as the oviducts of sheep and rabbits potentially are.

	Excellent–good	Good/fair–fair	Poor	Unusable	Ungraded	Total
Shipped (n = 94)	59 (58.52%)	30 (31.91%)	0	0	9 (9.57%)	100.00%
Received (n = 103)	28 (27.18%)	14 (13.59%)	40 (38.84%)	21 (20.39%)	0	100.00%

Key Words: Embryo, Shipping, Bovine

46 Effects of elk and cattle rumen contents and dietary fat on abortifacient activity of pine needles. R. E. Short[1,*], E. E. Grings[1], M. A. Lammoglia[1], C. A. Davison[2], N. J. Biensen[2], and S. P. Ford[2], [1]*USDA,ARS, Miles City, MT,* [2]*Miles City Veterinary Service,* [3]*IA St. Univ., Ames.*

When fed needles from Ponderosa pine (PN), elk do not abort and do not have increased vasoconstrictive activity in plasma as do cattle. These experiments were conducted to determine if transferring ruminal fluid (RF) from elk to cattle or if diets high in fat will prevent the abortifacient effects of feeding PN to cattle and to determine if in vitro incubation of elk RF with PN will decrease vasoconstrictive activity of PN. In Experiment 1, pregnant cattle were assigned to receive RF collected from steers (S) or female elk (E). Ruminal contents were collected via ruminal fistula, filtered through cheese cloth, and the RF (1–2 L) transferred by gavage to pregnant (247 d) cattle at −13, −10, −7, −4, and 0 d from the start of PN feeding (2 kg/d). In Experiment 2, the treatments and protocols from Exp 1 were repeated with the addition of a group that was fed a diet high in fat (HF, 5.2% vs 1.8% for control diet) for 30 d before PN feeding started. In Experiment 3, RF from 5 different collections from S and E were incubated in vitro with 0 or 25% PN in the substrate for 48 hr. Methylene dichloride extracts of these incubates were assayed for vasoconstrictive activity in a placentome perfusion assay. In Exp. 1, ERF delayed parturition in 2 of 4 cows as compared to 0 of 8 in the SRF group (interval to parturition = 11.3 vs 6.5 d, P = .1). In Exp. 2, there was no effect of HF or ERF on interval to parturition (HF = 4.5, ERF = 6.5, and SRF = 4.8 d; P > .2). In Exp. 3, ERF reduced vasoconstrictive activity (change between 0 and 25% PN in baseline perfusion pressure, SRF = 6.25%, ERF = 0%; P < .05 and in perfusion pressure after membrane depolarization, SRF = 60%, ERF = −21%; P < .1). We conclude that dietary fat does not affect abortifacient effects of PN, that ERF decreases vasoconstrictive activity of PN, and that in vivo transfer of ERF to cattle elicited some response, but it was not sufficient to affect a majority of cattle.

Key Words: Pine needles, Cattle, Elk

47 **Comparative testicular echotexture and sperm production of young and older Holstein–Friesian bulls.** G. Gábor[1*], R. G. Sasser[2], G. Falkay[3], S. Bozó[1], J. Völgyi–Csík[1], I. Bárány[1], G. Boros[4], [1]*Research Institute for Animal Breeding and Nutrition, Herceghalom, Hungary,* [2]*University of Idaho, Dept. Anim. and Vet. Sci., Moscow,* [3]*A. Szent–Gyorgyi Med. Univ. Dept. of Pharmacodynamics, Szeged, Hungary,* [4]*Boros es Tarsa Ltd., Budapest, Hungary.*

The aim of this study was to evaluate the relationship between semen characteristics and digitized echographic frames of testes of young and older breeding bulls. During the ultrasonic examinations a constant pressure was applied between the probe and the scrotal skin by use of a self-developed electromechanical device. A Scanner 450 with a 7.5 MHz linear transducer (Pie Medical, Maastricht, The Netherlands) was used and was connected to an IBM PC notebook (360 CSE, with a 340 MB hard disk) in order to save images. The ultrasonic images were analyzed by the Testigabsas software developed by the authors. The echotexture (on a 64 gray scale) was characterized by the software on a standard area of each testicular image. Twenty–two, Holstein–Friesian young breeding bulls (27.3 ± 6.6, $\bar{x}$ ± SD, mo of age) and twenty Holstein-Friesian older breeding bulls (71.3 ± 4.4, $\bar{x}$ ± SD, mo of age) were examined three times at 30–day intervals. Data collected were scrotal size, echotexture (ET), semen volume (SV), total sperm number per ejaculate (TSN) and live cells. Semen was collected two (young bulls) or three (older bulls) times a week and measured by visual (young bulls) or HTM 2000 motility analyser (older bulls). Within young bulls, animal age correlated highly with predicted testis volume (PTV; r= .70, P<.001), ET (r=–.67, P<.001) and moderately with TSN (r=.64, P<.001). The scrotal circumference (SC) was negatively correlated with ET (r=–.51, P<.01) and positively with TSN (r=.58, P<.01). The ET had a negative correlation with PTV (r=–.59, P<.01) and TSN (r=–.58, P<.01). Within the older bulls animal age was negatively correlated with SV (r=–.49, P<.05) and positively with ET (r=.19, P>.05) and SC (r=.21, P>.05). A significant difference was found between age groups in all examined parameters (P<.01 or P<.001) with the exception of TSN. This means that sperm concentration was greater for the younger bulls. Generally the correlation among the testicular morphological parameters and semen characteristics were higher in younger than in older bulls and may have been a results of more lesions in the testes of older bulls. On the basis of these results it is concluded that there is an association between ultrasonic recordings of testes and semen characteristics.

Key Words: Bulls, Testicles, Ultrasound

RUMINANT NUTRITION

48 **The effect of dietary cation anion balance on the ruminal fermentation and methane emissions in beef cows.** W. H. Wilson*, K. A. Johnson, H. H. Westberg and J. J. Michal, *Washington State University, Pullman.*

The impact of dietary cation anion balance (CAB) on the ruminal fermentation and methane (CH_4) emissions in beef cows fed a forage diet at maintenance was examined. Four ruminally fistulated cows fed a diet consisting of 65% alfalfa haylage and 35% ryegrass seed screenings (DM basis) twice daily were used in a Latin square design. Salts were added intraruminally twice daily to create CAB levels, [(Na + K)–Cl], of 10, 30, 50 and 70 meq/100g DM. Salts used to create the CAB levels included $CaCl_2$, NH_4Cl, $CaCO_3$, C_2HNa_3-O_6 and urea. All diets were isonitrogenous and isocalcemic. After 21 d of acclimation to the treatment, ruminal fluid was collected every 3 hr over 24 hr for determination of pH, osmolarity, ammonia (NH_3) and volatile fatty acids (VFA). Twenty four hr CH_4 emissions were measured for 4 d with 3 collection periods: 7:00-13:00, 13:00-19:00, 19:00-7:00 per d. Alteration in CAB level did not affect ruminal pH (6.6±.03) or osmolarity (298.5±5.1 mOsm), although both measures varied over time (P<.0001). Ruminal NH_3 was lower (P<.004) for the 10 and 70 CAB levels (28.2, 32.8 mg NH_3/ml) than the 30 and 50 (36.9, 45.5 mg NH_3/ml) and exhibited a time × treatment effect (P<.0001). There was no effect on concentrations of acetate, butyrate, isovalerate, valerate or total VFA. Concentrations of propionate and isobutyrate tended (P<.07) to be lower for the 10 and 70 CAB levels (25.2, 26.2±1.0; 2.0, 2.2±.08 μmol/ml) than the 30 and 50 treatments (28.7, 29.2±1.0; 2.3, 2.4±.08 μmol/ml). There was no effect of day or treatment × day on CH_4 emissions. Methane emissions were impacted (P<.01) with the 70 level lower than the 10, 30 and 50 levels (303.2, 342.5, 314.4, 355.8±18 L/d, respectively). Manipulation of ruminal ion balance with addition of salts impacts the ruminal fermentation and methane production.

Key Words: Cattle, Fermentation, Cation anion balance, Methane

49 **Response of the bovine neonate to dried plasma in milk replacer and starter feeds.** G. McGinty[1*], D. Johnson[1], M. Jarosz[1], F. Garry[1], J. Godfredson-Kisic[2], [1]*Colorado State University, Fort Collins,* [2]*DuCoa, Highland, Illinois.*

The objective was to determine effect of spray-dried bovine plasma (SDBP) in milk replacer and starter diets on calf performance. Twenty-four Holstein male calves (initial wt, 44 kg) were randomly allotted to milk replacer treatments at approximately 3-d of age. At 38-d of age calves were weaned and reallocated to starter treatments within prior milk replacer groups. The two treatments were control (5% casein) or 5% SDBP in milk replacer pre-weaning and then starter feed post-weaning. All animals were tethered and given ad libitum water and starter feed during the 5-wk pre-weaning and 4-wk post-weaning experiment. Milk replacer and starter intake and gains for calves with SDBP in their milk replacer pre-weaning were similar to control calves (P>.10). However, the overall 4 week post-weaning gains were improved (P<.05) by 14 percent. The largest increase in gain was an 18% increase during wk 2, although no individual week was statistically different. Consumption of starter feed was similar by treatment resulting in improved gain/feed across the 4 weeks (P<.01).

Item	Post-weaning Treatment 5% Casein	5% SDBP	P-value
Average Daily Gain (g/day)			
8-14 days	888 ± 91	1051 ± 99	.24
0-28 days	895 ± 42	1022 ± 45	.05
Feed Efficiency (gain/feed)			
8-14 days	.37 ± .03	.46 ± . 04	.06
0-28 days	.32 ± .01	.39 ± . 02	.004

Key Words: Calf, Spray Dried Bovine Plasma, Average Daily Gain

50 Inoculants for alfalfa silage: effects on aerobic stability, digestibility and the growth performance of feedlot steers. T. A. McAllister*, R. Feniuk, Z. Mir, P. Mir, L. B. Selinger, and K.–J. Cheng, *Agriculture and Agri–Food Canada Research Centre, Lethbridge, AB.*

Chopped alfalfa forage was treated at the time of ensiling with water or bacterial inoculant (2008, containing *Lactobacillus plantarum* and *Enterococcus faecium*; or 3644, containing only *L. plantarum*; both from Pioneer Hi–Bred International, Inc.; administered at 1×10^5 cfu g^{-1} forage). Aerobic stability and digestibility of the silages, and growth performance of feedlot cattle receiving the silages were compared. Background epiphytic populations of lactic acid–producing bacteria (LAB) exceeded 2×10^8 cfu g^{-1}. Quality of all silages was good (pH < 4.55, high lactic acid concentration). Both inoculated silages tended to contain less water soluble carbohydrate than did control silage, whereas LAB populations tended to be larger only in 2008 silage. Bacterial populations (culturable on nutrient agar) were similar among treatments. Yeasts and molds were not detected after ensiling. Both inoculants increased ($P < .1$) DM intake by lambs in the digestibility study, but digestion of DM and OM were increased ($P < .05$) only by 3644. Intake ($P < .05$), digestion ($P < .05$) and retention ($P < .1$) of nitrogen by lambs were increased by 2008. Inoculant 2008 increased ($P < .05$) DM intake, ADG and feed efficiency of feedlot cattle. Yeast populations became higher ($P < 0.05$) in 3644 silage after 2 d of exposure to air, but remained low ($< 10^2$) in the other silages throughout the 16–d exposure period. Bacterial numbers were higher ($P < .05$) in the control silage, than in inoculated silages at d 13 of aerobic exposure, temperature was higher ($P < .05$) at d 8 and beyond, and the increase in bacterial populations was accompanied by a rise in pH. Multi–species inoculants may be more effective than single–species inoculants for improving animal productivity from alfalfa silage.

Key Words: Alfalfa silage, Inoculant, Cattle, Digestion

51 Comparison of cull beans, sunflower meal or canola meal as protein sources for beef cows grazing native winter range. H. H. Patterson*, J. C. Whittier, T. L. Stanton, and D. Schutz, *Colorado State University, Ft. Collins.*

A study was conducted in Eastern Colorado to determine the effects of locally available protein sources as supplements for beef cows grazing winter range on weight change, body condition score change and subsequent calf weight. Ninety five pregnant crossbred cows (541 ± 12 kg) were assigned to one of five treatments (19 per treatment) based on age, weight, body condition score and stage of gestation. Treatments included Great Northern beans to supply 182 g (GNB), canola meal to supply 182 g (CM), a mix of Great Northern beans and sunflower meal to each supply half of the 182 g (MIX), sunflower meal to supply 182 g (SFM+), and sunflower meal to supply 91 g CP hd^{-1} d^{-1} (SFM-). Total CP levels in each treatment were increased by 50% approximately 30 d prior to calving and increased another 66% at calving. The trial was divided into a gestation phase and lactation phase for each animal. All treatments showed average daily weight and daily body condition change losses throughout both phases (–.39 $kg \cdot d^{-1}$ and –.01 $BCS \cdot d^{-1}$, respectively). There were no differences among treatments in overall average daily weight change, overall daily body condition change, lactation phase average daily weight change, lactation phase daily body condition change, gestation phase daily body condition change, calving date or birth weight. The SFM+ group lost less weight during the gestation phase than the SFM- group (P=.07) and had higher calf weights off test than the SFM- group (P=.03). The SFM+ group also had higher calf weights off test than the GNB group (P=.08). The GNB treatment had a lower calf weight per day of age than the MIX treatment (P=.04). These data suggest that there was a response to the high protein level (182 g versus 91 g), regardless of source, on weight change throughout the gestation period. There was also a response to protein level on calf weights, and the GNB supplementation yielded lower calf weights than SFM+ or MIX treatments.

Key Words: Cows, Protein, Supplement

52 Influence of feed intake fluctuation and frequency of feeding on performance in limit-fed steers. S. A. Soto-Navarro[1]*, G. C. Duff[2], M. L. Galyean[3], K. J. Malcom-Callis[2], and C. R. Krehbiel[1], [1]*New Mexico State University, Las Cruces,* [2]*Clayton Livestock Res. Center,* [3]*West Texas A&M University, Canyon.*

One hundred eight crossbred beef calves (average initial BW = 229 kg) were used to determine the effects of feeding frequency and feed intake fluctuation on performance of steers under limit-fed conditions. Steers were assigned randomly to one of four dietary treatments: 1) feed offered once daily at 0800, 2) feed offered once daily at 0800 with a 10% fluctuation in day-to-day feed intake, 3) feed offered twice daily at 0800 and 1700, and 4) feed offered twice daily at 0800 and 1700 with a 5% fluctuation in day-to-day feed intake. The diet was 90% concentrate, fed in quantities sufficient to provide for a daily gain of 1.25 kg. The trial lasted 84 d, with intermediate weights taken at 28-d intervals before the 0800 feeding. The initial and final body weight measurements were obtained after the steers in each treatment group were withheld from feed and water for a 16-h period. During d 0 to 28, ADG was numerically greater (1.59 vs 1.48 kg) and feed efficiency (F/G) was numerically lower (1.52 vs 1.63) when steers were fed twice daily than when steers were fed once daily, respectively. In contrast, during d 57 to 84, ADG (1.39 vs 1.30 kg) was greater and F/G was lower (2.11 vs 2.25; $P < .07$) when steers were fed once daily vs twice daily, so that over the 84-d feeding period no effects ($P > .10$) of feeding frequency were observed. During d 0 to 56, steers fed once daily with a 10% fluctuation in day-to-day feed intake had a numerically lower ADG (1.40 vs 1.45 kg) and a numerically higher F/G (1.77 vs 1.73) than steers on the other treatments. However, during d 57 to 84, ADG was greater (1.45 vs 1.32 kg) and F/G was lower (2.01 vs 2.23; $P < .10$) for steers fed once daily with a 10% fluctuation in day-to-day intake than for the other treatments. Results of this experiment suggest little effect of frequency of feeding on performance by limit-fed beef steers. In addition, steers fed once daily with a 10% fluctuation in day-to-day intake may become adapted to variation in feed intake over an 84-d period.

Key Words: Feeding Frequency, Feed Intake Fluctuation, Beef Cattle.

53 Effect of protein restriction in the ewe and first colostrum feeding in the lamb on passive immune transfer. B. L. Roeder*, V. M. Thomas, R. W. Kott, D. Burgess, R. P. Ansotegui, *Montana State University, Bozeman.*

Fifty-eight mature, twin bearing Targhee and Columbia ewes were stratified by breed to study effects of short term, prepartum protein restriction on passive immune transfer. Ewes were fed 1.3 kg of an alfalfa-grass hay (8% CP) at the PM feeding. In the AM, ewes were fed either .42 kg (11% CP) of a restricted (RES) diet, .42 kg (24% CP, 34% UIP) of a soybean meal (SBM) diet, or .37 kg (26% CP, 61% UIP) of a blood meal-feather meal (BM-FM) mix diet. Treatment rations were fed 21 d prepartum. Lambs were either allowed to suckle naturally, fed a maximum of 60 ml of colostrum using an esophageal tube, or received no colostrum from the first milking. Lamb serum samples were taken at 3 d of age. A treatment by colostrum consumed interaction was detected (P<.07) in lamb serum IgG concentrations. Lambs receiving no colostrum from the first milking tended to have the lowest (P<.13) serum IgG concentrations. Lamb serum IgG concentrations were not correlated with either dam's colostral IgG (mg/ml) (r^2=.02) or g of IgG (DM basis) consumed in the first feeding (r^2=.39).

Key Words: Sheep, Vitamin E, Colostrum

54 Digesta kinetics and energy intake of grazing beef cattle differing in adaptation to heat. J. E. Sprinkle[1,*], J. W. Holloway[1], B. G. Warrington[1], W. C. Ellis[2], J. W. Stuth[2], T. D. A. Forbes[1], and L. W. Greene[2], [1]*Texas Agricultural Experiment Station, Uvalde,* [2]*Texas A & M University, College Station.*

The objective was to determine if digesta kinetics or energy intake (EI, kcal ME intake·kg$^{-.75}$·d^{-1}) differed by breed, lactational state (LAC), or season of year among cattle presumed to vary in adaptability to the subtropics. Fecal organic matter output (FOMO), passage rate (PR), residence times, and digestive system compartmental mass (CMS) were determined over 4 d during early (ES, July 18 to 28) and late summer (LS, Sept. 12 to 22). Two–year–old lactating and nonlactating Brahman × Angus (BA, n = 5, n = 5), Tuli × Angus (TA, n = 5, n = 4), and Angus (A, n = 4, n = 4) cows were used. Repeated rectal temperatures were obtained during both ES and LS. Digestibility was estimated by near infrared spectroscopy of fecal samples and organic matter intake (OMI) and EI calculated. Data was analyzed by least squares with breed, LAC, and breed × LAC as fixed main effects and cow weight as a covariate. The covariate was excluded for EI and rectal temperature analyses. Means across periods were separated by t–Tests. The interaction of breed and LAC was not important (P > .10) for either ES or LS. During ES, lactating cattle had greater CMS (P < .001) and FOMO (P < .05) than nonlactating and tended (P < .10) to have greater OMI, but nonlactating cattle tended (P < .10) to have greater PR (.049 ± .003 vs .040 ± .003) than lactating cattle. Although BA were the largest, they had the smallest CMS and fastest PR (P < .05) in ES. Each 1 kg increase in CMS resulted in .11% less FOMO/100 kg of cow weight for lactating cattle (P < .05). During LS, lactating cattle had greater CMS, FOMO, and OMI than nonlactating cattle (P < .01). A had greater FOMO and OMI than BA (P < .01) and TA (P < .05), who were similar (P > .10). Increased early morning rectal temperature was associated with decreased EI in LS (P < .05), with each 1°C increase in rectal temperature resulting in a corresponding 68 kcal ME·kg$^{-.75}$·d^{-1} decrease in EI. Greater CMS appeared to be related to less heat tolerance.

Key Words: Beef Cattle, Kinetics, Breeds

55 Effect of protein supplementation on plasma urea nitrogen concentration and nitrogen retention in postpartum beef cows. J. S. Serrato-Corona*, L. Appeddu, A. Gomez-Carabali, R. Cabanillas, I. Tovar-Luna, J. Sawyer, L. Knox, and M. K. Petersen, *New Mexico State University, Las Cruces, NM.*

The effect of amount of protein supplementation on body nitrogen retention, milk yield, and blood urea nitrogen (BUN) concentration, were investigated. Six Angus × Hereford 2 yr old lactating cows (350 ± 25 kg) were used in a 5 × 5 latin square arrangement of treatments. Each period consisted of 2-d consumption of only grass hay (7% CP) followed by 10-d of hay plus supplement. Day 8 milk production was determined by a modified weigh suckle weigh technique using a portable milking machine. Day 10 heifers were bled 2 h before supplementation and every 30 min for 12 h after supplementation to measure BUN. On day 13 fecal collection bags were fitted for 5 d to assess total fecal and urine N output. Cows were individually fed and received a basal diet of sudan grass hay at 2.2% of BW (as fed) at 0600 h. Animals were randomly assigned to one of the five quantities of protein supplementation; control (T1, no supplement), T2 (310 g/d), T3 (620 g/d), T4 (930 g/d), and T5 (1200 g/d) to supply 0, 155 g, 311 g, 466 g, and 602 g of protein/d (50:50 degradable: undegradable intake protein) for T1, T2, T3, T4, and T5 respectively. Cows were weighed at the beginning and at the end of each period. Body weight change and milk production data were analyzed by analysis of variance, while BUN data were analyzed by split plot analysis of variance using treatment × period × cow as the main error term. Body weight loss was the greatest and milk production the highest when cows were fed T5 ($P<.05$) (8.3, 4.4, 4.3, –.2 and –2.5 kg ± 2.27 of body wt; 3.6, 4.1, 4.0, 4.0 and 4.8 ± .4 kg mlk/d for T1, T2, T3, T4, and T5 respectively). Body N retention increased with ($P<.05$) each level of protein intake (–22, 67, 340, 388 and 510 ± 52 g CP/d for T1, T2, T3, T4 and T5 respectively). Blood urea nitrogen concentration increased in response to protein supplementation ($P<.01$) (6.5, 10.5, 12.2, 13.5 and 15.8 mg/dl ± .4 for T1, T2, T3, T4, and T5 respectively). Young beef cows fed low quality forages and supplemented with varying amounts of protein produced more milk as protein intake increased at the expense of body weight, while body N retention increased. Thus showing that dietary protein stimulated milk production and mobilization of adipose stores while replacing material protein tissues.

Key Words: Beef cattle, protein, nitrogen retention, lactation

56 Growth performance, carcass characteristics and tenderness of meat from beef cattle with Wagyu genetic influence. P. S. Mir*[1], D.R.C. Bailey[2], Z. Mir[1], S.D.M. Jones[1], R. J. Weselake[3], F. J. Lozeman[4], *Agriculture and Agri-Food Canada,* [1]*Lethbridge, AB.,* [2]*Charolettetown, PEI* [3]*University of Lethbridge, Lethbridge AB., and* [4]*Lozeman Family Farms, Claresholm, AB.*

A feeding trial was conducted to compare growth performance, carcass characteristics and quality of meat from beef cattle with 0% Wagyu influence (six continental crossbred steers), 50% Wagyu influence (24 heifers and 16 steers 50/50 Wagyu/Angus crossbreds) and 75% Wagyu influence (15 heifers and 12 steers containing 25% from other European breeds). Cattle were housed in individual pens and fed a backgrounding diet containing 35% barley grain and 65% barley silage until they weighed 400 kg, after which they were adapted to a finishing diet consisting of 80% barley and 20% barley silage. Cattle were weighed every four weeks. Back fat depth was measured by ultra-sonography every eight weeks. When cattle had more than 10 mm of backfat they were processed and carcass information obtained. A three-rib section was removed from 41 carcasses selected randomly from each group and Warner-Bratzler shear force was determined. During backgrounding average daily gain (ADG) of 50% Wagyu heifers (.9kg/d) and all 75% Wagyu cattle (.9 kg.d) were lower (P < .05) than for continental crossbred steers (1.03 kg/d) and 50% Wagyu steers (1.03 kg/d). Continental crossbred steers had higher (P < .05) ADG than Wagyu crossbred cattle during the finishing phase (1.47 vs .82 kg/d). Total days on feed and age at slaughter were less (P < .05) for continental relative to Wagyu crossbred cattle (218 vs 317 and 441 vs 529 days respectively). Carcass weights of 75% Wagyu crossbred cattle were lower (P < .05) than that of continental crossbred cattle (257 vs 292 kg). However, 60 of 65 carcasses from Wagyu crossbred cattle graded, "Canada AAA", or containing more than a small amount of intramuscular fat. Twenty of these carcasses graded what is considered as "Canada Prime- AAAA", while only two of the six continental crossbred cattle graded "Canada AAA". Meat from all treatment groups had low Warner-Bratzler shear forces and mean values ranged from 3.8 to 4.5 kg when a 19 mm. core was extracted. Wagyu genetic influence appeared to enhance marbling potential in beef cattle however a concomitant decline in growth rate and carcass size was observed.

Key Words: Wagyu, Carcass characteristics, Warner-Bratzler shear force.

57 Stability of exogenous polysaccharide-degrading enzymes in the rumen. A. N. Hristov[1*], T. A. McAllister[1], R. J. Treacher[2], and K. -J. Cheng[1], [1]*Research Centre, Agriculture and Agri-Food Canada, Lethbridge, AB, Canada,* [2]*FinnFeeds International, Marlborough, UK.*

The experiments in recent years with direct-fed fibrolytic enzymes have produced controversial animal responses. Due to the belief that supplemental enzymes are rapidly degraded in the rumen the effect of feeding exogenous fibrolytic enzymes on the polysaccharide-degrading activity in the lower digestive tract was largely ignored. In the present experiment two commercial preparations of polysaccharide-degrading enzymes (E1 and E2, FinnFeeds Int) were tested in vitro and in vivo for rumen stability. In vitro the enzymes were incubated with rumen fluid and the recovery of the remaining substrate-degrading activities (on carboxymethyl-cellulose, xylan and starch) were followed for up to 6 h. In vivo the enzyme preparations were introduced directly into the rumen of a lactating dairy cow and duodenal samples were analyzed for substrate-degrading activities up to 15 h after the enzyme was administered. Both enzyme preparations were remarkably resistant to microbial fermentation in in vitro conditions. The in vivo experiment showed that the enzyme supplementation greatly affected the polysaccharide-degrading activities of the fluid phase of rumen content. The average xylanase activity was increased from 70.9 nmol·ml^{-1}·min^{-1} (Control) to 105.9 (P<.05) and 336.6 (P<.05) nmol·ml^{-1}·min^{-1} (E1 and E2, respectively). The xylanase component of E2 evidently partially escaped intact the reticulo-rumen and the abomasum and dramatically increased the xylanase activity of duodenal digesta: .84, 2.8 (P<.05) and 23.3 (P<.05) nmol·ml^{-1}·min^{-1}, Control, E1 and E2, respectively. These data suggest that some exogenous enzymes may remain active and by-pass the rumen-abomasum and eventually affect the utilization of nutrients in the small intestine.

Key Words: Polysaccharide-degrading enzymes, Ruminants

58 Effects of yucca extract (sarsaponin) on ruminal bacterial activity in the RUSITEC, and on bacterial degradation of saponins. Y. Wang*[1], T. A. McAllister[1], J. Newbold[2], and K. -J. Cheng[1], [1]*Agriculture & Agri-Food Canada Research Centre, Lethbridge, AB,* [2]*Rowett Research Institute, Aberdeen.*

The rumen simulation technique (RUSITEC) was used to study the effect of sarsaponin (in yucca extract, YE) on ruminal bacterial activity and saponin degradation. Yucca extract was included at 0 (control) or .5 mg/mL in the artificial saliva which was infused continuously (dilution rate = 0.75/d) into the fermentation vessels (4 per treatment) of a RUSITEC fed 5 g chopped alfalfa hay and 5 g concentrate daily for 22 days. Effluent and gas production volumes were recorded daily, and ammonia in the effluent was measured on 10 d during the study. During the last 6 d, methane and total gas production and DMD from hay and from concentrate were measured, and homogenates of feed particles and vessel liquids were prepared. From the homogenates, protozoal and cellulolytic bacterial populations, and total bacterial populations culturable in the presence and absence of sarsaponin (5 mg/mL YE) were determined. Homogenates were also assayed for saponin-degradative activity and protease and deaminase activities. Ammonia concentrations were lower ($P < .05$) in effluent from vessels receiving sarsaponin than from controls for the first half of the study, but did not differ thereafter. Yucca extract at .5 mg/mL did not affect ($P > .05$) DMD, gas volume or methane production, or total or cellulolytic bacterial populations. Protozoal populations were substantially reduced ($P < .01$) by sarsaponin (.5 mg/mL YE), and protease activity was increased ($P < .05$). Degradation of saponin was observed with inoculum from the sarsaponin-supplemented vessels but not from the controls. Inclusion of 5 mg/mL YE in the incubation medium markedly reduced ($P < .01$) the total and cellulolytic bacterial populations culturable from both control and treatment vessels. Yucca extract at .5 mg/mL changed proteolytic activity and reduced protozoal populations, but did not affect DMD or bacterial activity, and did not induce resistance to 5 mg/mL levels.

Key Words: Yucca extract, RUSITEC, Proteolysis, Saponins

59 Ruminal undigestible intake protein value and postruminal digestibility of menhaden fish meal versus two high–bypass animal–protein blends in an 88% concentrate finishing diet for feedlot cattle. R. A. Zinn, M. Montaño*, and Y. Shen, *University of California, El Centro.*

Four Holstein steers (466 kg) with cannulas in the rumen and proximal duodenum were used in a 4 × 4 Latin square design experiment to evaluate the ruminal escape protein value and postruminal digestibility of menhaden fish meal (FM) versus two high–bypass protein blends in an 88% concentrate finishing diet. Blend 1 (B–1) contained 5% fish meal, 25% meat and bone meal, 20% blood meal, and 50% hydrolyzed feather meal. Blend 2 (B–2) contained 10% meat and bone meal, 55% blood meal, and 10% feather meal. Ruminal OM digestion was similar for FM, B–1, and B–2 supplemented diets. However, total tract OM digestion was greater ($P < .10$) for FM than for the protein blends. This difference was due to a 5.0% greater ($P < .10$) postruminal OM digestibility for the FM supplemented diet. Ruminal digestible intake protein was greater ($P < .01$) for FM than for the protein blends. Ruminal undigestible intake protein values averaged 52, 69, and 71%, for FM, B–1 and B–2, respectively. Postruminal protein digestibility was greater ($P < .05$) for FM than for the protein blends. Postruminal protein digestibility was greater (4.9%, $P < .10$) for the B–2 than for the B–1 supplemented diets. Postruminal protein digestibilities of FM, B–1, and B–2 were 95.7, 77.6, and 87.0%, respectively.

Key Words: Cattle, Protein, Metabolism

60 Effects of program-feeding strategies on growth–performance and carcass characteristics of feedlot cattle. R. A. Zinn*, and Y. Shen, *University of California, El Centro.*

Ninety–six crossbred yearling steers were used in a 124–d finishing trial to compare 3 program feeding strategies with conventional ad libitum feeding on growth–performance, carcass characteristics, and NE value of the diet. Feed intake of program–fed steers was restricted to permit 1.5 kg/d weight gain for the initial 28, 56, or 84 d of the finishing period. Thereafter, steers were allowed ad libitum feed access. Steers were fed an 85% concentrate steam–flaked corn–based finishing diet twice daily. Overall ADG was 1.57, 1.50, 1.68, and 1.60 kg/d for ad libitum and 28–, 56–, and 84–d feed restriction, respectively. The ADG of ad libitum vs restricted–fed steers did not differ ($P > .10$). Although, there was a quadratic effect ($P < .05$) of duration of feed restriction on ADG. Overall DMI/ADG was not affected by treatments, averaging 5.36, 5.56, 5.29, and 5.34, respectively. Dietary NE was also not affected by treatments, averaging 103, 100, 103, and 102% of expected, respectively. Carcass marbling score was greater ($P < .10$) for ad libitum than for restricted–fed steers, averaging 4.28, 3.92, 4.00, and 3.88, respectively.

Key Words: Cattle, Dry Lot Feeding, Performance, Feed Intake

61 Variation in feed quality characteristics in the world barley collection. J.G.P. Bowman*, L.M.M. Surber, T. K. Daniels, J. T. Daniels, D. P. Kirschten, N. T. Cote, and T. K. Blake, *Montana State University, Bozeman.*

The objective of this study was to evaluate the range of variation in feed quality characteristics available in barley from around the world. A sampling (1500 genotypes) from the World Barley Core Collection was planted in Bozeman in the Spring of 1995. In situ DM digestibility after 3 h of incubation of 1480 genotypes was evaluated using 2 ruminally cannulated steers. Seventy–three genotypes were selected based on variation in DMD (highs and lows) and were planted in two field replications in Bozeman in the Spring of 1996. These 73 genotypes and 8 control varieties were evaluated for DM, starch, in situ DMD, ADF, in situ starch digestibility, digestible starch content, and particle size after dry rolling. The range in DMD in the World Core Collection was 15.6 to 62.1%, with a mean of 39.9% (SD = 7.42). The range, mean, and SD in starch, ADF, DMD, starch digestibility and particle size of the selected 73 genotypes was 36.2 to 58.1%, 51.8%, 4.31; .8 to 8.3%, 3.8%, 1.65; 11.9 to 63.5%, 38.6%, 18.24; 9.4 to 79.3%, 43.3%, 23.84; and 1037 to 1408 μm, 1179 μm, 76.03; respectively. Two–row head genotypes had higher ($P < .10$) starch content, higher ($P < .001$) DMD, higher ($P < .001$) starch digestibility, and lower ($P < .001$) ADF compared with 6–row head genotypes. There were no differences ($P > .10$) in feed quality measures between normal and dark colored aleurone genotypes, however, black genotypes (both the hull and aleurone were black) had lower ($P < .01$) starch, lower ($P < .10$) DMD, and lower ($P < .05$) starch digestibility than the normal or dark aleurone genotypes. There is substantial variation in the World Barley Core Collection for feed quality measures, and this variation could be exploited to design barley varieties specifically for feed quality.

Key Words: Barley, Feed Quality, Digestibility

62 Pretanned leather shavings mixed with soybean meal for steers grazing a dormant wheatgrass pasture. A. Mendoza-Reyes*, C. J. Ackerman, C. C. Balok, M. B. Judkins, and D. W. Holcombe, *School of Veterinary Medicine, University of Nevada, Reno.*

Twelve crossbred steers (4 steers/treatment; average BW = 533 kg) fitted with ruminal cannulas were used in a split-plot design to evaluate the effects of a mix of pretanned leather shavings and soybean meal on in situ organic matter disappearance of the supplements, forage OM intake, daily grazing time and harvesting efficiency. Steers continuously grazed a dormant wheatgrass (*Thinopyrum intermedium*) pasture from January 21 to March 5, 1995. Two collection periods were conducted on February 3 to February 16 (FEB) and February 17 to March 5 (MAR). The treatments were: no supplementation (CON), supplementation with soybean meal (SBM) at .2% of BW (as-fed basis), or a mix of soybean meal and pretanned leather shavings (LS; 17:8 ratio) at .16% of BW (as-fed basis; isonitrogenous to SBM). Steers were supplemented intraruminally at 0700. Only the supplemented steers were used for the in situ trial. A significant difference ($P < .05$) was observed at all times for the in situ data. In situ OM disappearance of LS was 28% lower at 1 and 12 h, 26% lower at 3 h, 29% lower at 6 h, 32% lower at 9 h, and 24% lower at 24 and 48 h than SBM. Daily grazing time (min; CON = 517.3, SBM = 540.1, and LS = 567), harvesting efficiency (g of forage OM intake·kg of BW^{-1}·min of daily $grazing^{-1}$; CON = .04, SBM = .03, and LS = .03), and forage OM intake (g/kg of BW; CON = 18.4, SBM = 18.8, and LS = 19.7), were not altered ($P > .10$) by supplementation or type of supplement. In situ results suggests that the pretanned leather portion of the LS treatment is poorly degraded in the rumen by the microbes. Results on daily grazing time, harvesting efficiency, and forage OM intake indicate that LS supplementation did not negatively affect grazing behavior and the effects were similar to those of SBM alone. We conclude that a combination of leather shavings and soybean meal may be used to supplement cattle grazing wheatgrass during the winter in substitution of soybean meal. This substitution may not alter any of the benefits of supplying soluble protein on grazing activity or forage intake.

Key Words: Cattle, Supplementation, Behavior

63 Effects of roughage, fat, and ionophore level on finishing steer performance. S. A. Soto-Navarro[1]*, M. L. Galyean[2], G. C. Duff[3], K. J. Malcom-Callis[3], and C. R. Krehbiel[1], [1]*New Mexico State University, Las Cruces,* [2]*West Texas A&M University, Canyon,* [3]*Clayton Livestock Res. Center, NM.*

Two experiments evaluated the effects of dietary levels of roughage and fat in finishing cattle diets. Exp. 1 used 108 crossbred steers (average initial BW = 318 kg) in a completely random design. Steers were assigned to three dietary treatments, which were formulated to have either 1) 7.5% roughage (R)/1.5% yellow grease (F), 2) 11.25% R/3.75% F, or 3) 15% R/6% F. Added yellow grease compensated for the dilution of energy as the roughage level increased. At each 28-d interval of the trial except d 0 to 28, ADG was influenced quadratically by roughage level ($P < .06$), with greatest gains for the 11.25% R/3.75% F treatment. Similarly, DMI was greatest throughout the trial for the 11.25% R/ 3.75% F treatment, intermediate for 7.5% R/1.5% F, and least for 15% R/6% F (quadratic effect, $P < .05$). Feed:gain ratio generally did not differ among the three treatments. Results suggest the effects of dietary roughage level on DMI are not solely a result of dilution of dietary energy density. In Exp. 2, 360 crossbred steers (average initial BW = 336 kg) were blocked by weight and assigned to one of 12 treatments. Treatment diets contained either 0 or 4% added fat, 6 or 12% dietary roughage, and either no ionophore (control), lasalocid (33 mg/kg) plus oxytetracycline (OTC; 8.8 mg/kg) or monensin (33 mg/kg) plus tylosin (8.8 mg/ kg). There was no ionophore × fat interaction ($P > .10$) for performance data for the overall trial. Daily gain was greater ($P < .10$) for the average of the two ionophores vs control. Dry matter intake was greater ($P < .01$) for lasalocid/ OTC than for monensin/ tylosin. Feed:gain was lower ($P < .03$) for the average of the two ionophores compared with the control and lower ($P < .04$) for monensin/tylosin than for lasalocid/OTC. The absence of interactions for performance data among the three factors considered in this experiment suggests that the efficacy of an ionophore in high-concentrate diets is independent of either added fat or dietary roughage level.

Key Words: Roughage, Fat, Ionophores, Feedlot Cattle

64 Efficacy of monensin included in milk replacer versus monensin or decoquinate fed in calf starter on body weight, starter intake and fecal oocysts in Holstein calves. S. VanderVegt and E. H. Jaster*, *California Polytechnic State University, San Luis Obispo.*

This study was conducted to determine the effects of a monensin supplement fed with milk replacer on daily feed intake and growth rate of calves. In addition, anti–coccidial compounds (monensin and decoquinate) were fed in a calf starter to evaluate protection against coccidiosis, daily feed intake and growth rate of calves. Thirty–two Holstein bull calves were grouped according to body weight (BW) and fed a milk replacer (MR) reconstituted to 12.5% DM fed at 10% of BW (adjusted weekly) and assigned randomly to the following dietary treatments for an 84 day trial: 1) MR plus 11.5 g of a supplement containing 2.2 g/kg monensin (MMR) poured on top of the milk replacer immediately prior to feeding, along with a non–medicated calf starter, 2) MR plus starter containing 19.8 mg decoquinate (DCS)/kg (as fed) and 3) MR plus starter containing 33 mg monensin (MCS)/kg (as fed). At the beginning of week seven (day 43), milk replacer was fed once per day for one week. Calves were no longer fed MR at the beginning of week 8. Feeding calves supplemental monensin in milk replacer and calf starter showed improvements ($P<.05$) in BW gain and height at withers over feeding calves decoquinate in calf starter. Calves fed monensin in the milk replacer (MMR) gained 8.9 kg more BW ($P<.05$) than calves fed decoquinate in the calf starter (DCS) and 2.1 kg more BW than calves fed monensin in the calf starter (MCS). Calves fed monensin in the calf starter gained 6.8 kg more BW ($P<.05$) than calves fed decoquinate in the calf starter. Addition of monensin supplement mixed with non-medicated milk replacer resulted in a 15% increase ($P<.05$) in both accumulated body weight and height at withers, respectively, compared with the group fed decoquinate in the starter. Feed efficiency (kg feed/kg gain) for the three dietary groups were 2.09, 2.38 and 2.12 for treatments MMR, DCS and MCS, respectively. No incidence of coccidiosis infection was detected. Results of this study show that feeding calves monensin in their diets appears to enhance growth and development. Feeding monensin in the milk replacer had the greatest effect on growth and development of calves.

Key Words: Dairy Calves, Anti-coccidial Compounds, Growth

65 In vitro fermentation and digestion characteristics of six cereal grains. D. R. ZoBell[1]*, R. D. Wiedmeier[2], T. A. McAllister[3], T. Entz[3], M. Goto[4], and K.–J. Cheng[3], [1]*Alberta Agriculture, Food and Rural Development, Lethbridge, AB,* [2]*Utah State University, Logan, UT,* [3]*Agriculture and Agri-Food Canada Research Centre, Lethbridge, AB,* [4]*Mie University, Tsu, Japan.*

Six cereal grains were incubated in vitro (using a modified Tilley and Terry method) for direct comparison of their fermentation and digestion characteristics. Corn, barley, triticale, dehulled oats, hard red spring wheat and soft white wheat were incubated, in ten replicates of .5 g, for 30 h. Gas production (GP) was measured at 4, 8, 16, 20, 24, and 30 h. Starch degraded and starch dry matter digestibility (SDMD) from each grain, and volatile fatty acid (VFA) concentration, pH, and endoglucanase and α-amylase activities of the fermentation liquid were determined at 30 h. Clear differences in digestibility were evident among the grains, with oats most digestible and corn least so. Beyond 20 h, GP from each of the six grains differed ($P < .05$). At 30 h, GP ranged from 12.64 mL/100 mg DM (from oats) to 6.00 mL/100 mg DM (from corn). Starch degraded and SDMD were highest ($P < .05$) in oats (.189 g and 71.5%, respectively) and lowest ($P < .05$) in corn and triticale (.108 and .075 g, and 31.8 and 29.6%, respectively). Total VFA concentrations were highest ($P < .05$) from oats (73.6 mM) and lowest ($P < .05$) from corn (34.9 mM). Acetate/propionate ratios were lowest ($P < .05$) from oats and barley (A/P = 1.00 and 1.03, respectively) and highest ($P < .05$) from corn (A/P = 1.45). Fermentation liquid pH at 30 h differed ($P < .05$) for each grain. It was lowest for oats (at 5.64) and highest for corn (6.38). Endoglucanase and α–amylase activities were higher ($P < .05$) in liquid from oats (.161 and .279 units/mL, respectively) than from any other grain. Evidence of the inherent differences in in vitro fermentation characteristics and digestibility among the grains surveyed was consistent across the variables measured.

Key Words: Ruminal digestibility, Oats, Corn

66 Effects of dietary calcium levels on growth–performance and digestive function in cattle fed a high–fat finishing diet. R. A. Zinn, Y. Shen, M. Montaño, E. Alvarez, and E. Ramirez*, *University of California, El Centro.*

Sixty medium–framed crossbred yearling steers (395 kg) were used in a 90–d feeding trial to evaluate the effects of .5, .7, and .9% Ca in a high–fat (6%) finishing diet on growth–performance. Increasing dietary Ca level enhanced ADG (linear effect, $P < .10$) and feed efficiency (linear effect, $P < .05$). In both cases, the bulk of the improvement occurred when Ca level was increased from .7 to .9%. There were linear ($P < .05$) and quadratic ($P < .10$) components to Ca level effects on diet NE. As with ADG and feed efficiency, responses to .5 and .7% dietary Ca were similar. Increasing Ca level to .9% increased diet NE_m and NE_g by 6.5 and 8.0%, respectively. There also, were positive linear components ($P < .10$) to Ca level effects on dressing percentage and ribeye area. Ten Holstein steers (348 kg) with were used in a crossover design experiment to evaluate the influence of .7 and .9% dietary Ca on digestive function. Increasing Ca level decreased ruminal digestion of OM (5%, $P < .05$), ADF (37%, $P < .10$), and feed N (18%, $P < .05$), and increased ruminal microbial efficiency (12%, $P < .10$) and ruminal N efficiency (14%, $P < .01$). Increasing Ca level enhanced postruminal digestibility of OM (4%, $P < .05$) and N (4%, $P < .01$). There were no treatment effects ($P > .10$) on total tract digestion of OM, ADF, starch or N. The net effect of increasing Ca level was greater postruminal absorption of OM (12%, $P < .01$), N (19%, $P < .01$) and lipid (10%, $P < .10$). Increasing Ca level did not affect ($P > .10$) either ruminal pH or soluble Ca. Ruminal soluble Ca (Cas, mM) was closely associated with ruminal pH ($R^2 = .93$). It is concluded that dietary Ca levels greater than .7% are necessary to achieve optimal performance of feedlot steers fed a high–fat finishing diet.

Key Words: Cattle, Calcium, Fat, Dry Lot Feeding, Metabolism

67 Effect of carbohydrate level and ammonia availability on utilization of α-amino N by mixed ruminal microorganisms in vitro. A. N. Hristov*, T. A. McAllister, and K. -J. Cheng, *Research Centre, Agriculture and Agri-Food Canada, Lethbridge, AB, Canada.*

The stimulatory effect of amino acid and peptide N on the synthesis of protein by rumen microorganisms is well documented. The Cornell Net Carbohydrate and Protein System recognized these observations by adopting a fixed ratio of peptide- to ammonia-derived microbial protein of 66:34. It is not clear whether this assumption regarding N incorporation is valid when ammonia and amino acid N are provided simultaneously and carbohydrates are not limiting. Rumen inoculum obtained from a steer fed either forage/concentrate (50:50) or high concentrate (95%) diets (FC and HC, respectively) was incubated with five levels of carbohydrates: 0, 1, 5, 15 and 30 g/L (sugars - 75%; starch - 25%) and five N sources: Ammonia (NH), Casein-HCl (AA), AA plus NH (AANH), Pepticase (tryptic digest of casein, P) and P plus NH (PNH). The ammonia pool in all treatments was labeled with $(^{15}NH_4)_2SO_4$. At 0, 2, 4 and 8 h the incorporation of $^{15}NH_3$ into the high speed pellets was determined. The level of carbohydrates (up to 15 g/L) positively affected ($P<.05$) the incorporation of NH_3-N into the total N (pellets). The NH treatment resulted in the highest percentage of NH_3-derived N - up to 45 and 33% (at 8 h, FC and HC diets, respectively). The AA and P treatments had the lowest percentages of 16.5% and 14.5% (FC) and 14.5% and 9.1% (HC). When ammonia N was provided in addition to the free amino acid (AANH) or peptide-bound N (PNH) an increased incorporation of NH_3-N was observed: 22.1% and 22.8% (FC) and 23.9% and 18.5% (HC), respectively ($P<.05$). These data suggest that the level of utilization of α-amino N for cell growth in the rumen is not a constant and may depend on the availability of energy and ammonia N.

Key Words: Rumen microorganisms, Nitrogen utilization

68 Effects of undegradable intake protein supplementation on body weight change and intravenous acetate tolerance test in ewes in positive and negative energy balance. I. Tovar–Luna, C. R. Krehbiel, S. Serrato–Corona, L. Appeddu, T. Ross, and M. K. Petersen, *New Mexico State University, Las Cruces, NM.*

Two experiments were conducted to study the effect of undegradable intake protein (UIP) on acetate metabolism through an acetate tolerance test in ewes in positive and negative energy balance. Exp. 1: Eighteen non–pregnant non–lactating Rambouillet ewes slightly above maintenance were given ad libitum access to Buffalo grass hay for 24 d (8.4% CP, 73% NDF) and one of three supplements: 1) free access to mineral salt mix (C), 2) 150 g of a 25% CP supplement (L; 14 g of UIP$\cdot$head$^{-1}\cdot$d^{-1}), and 3) 114 g of a 45% CP supplement (H; 30 g of UIP$\cdot$head$^{-1}\cdot$d^{-1}). Exp. 2: Eighteen lactating Suffolk ewes were fed sudangrass hay (9.8% CP, 59% NDF) at 3% of BW and the same supplements as in Exp. 1 for 24 d. An acetate tolerance test was performed the last day in both experiments. Data were analyzed as a completely randomized design. In Exp. 1, BW change was not affected ($P = .8$) by UIP level (4.2, 4.2, and 3.7 kg ± 2.3, for C, L and H, respectively). In Exp. 2, ewes BW change was similar ($P = .2$) between C (−8.8 ± 1 kg) and L (−8 ± 1 kg), whereas the H (−6.2 ± 1 kg) lost the least ($P = .09$). Acetate half life was numerically lower as UIP increase in Exp. 1 (63, 51, 47 min ± 9, for C, L, and H; $P = .4$). In Exp. 2, acetate half life was similar between C (28 ± 1.8 min) and L (26 ± 1.9 min), but ewes supplemented with H showed the shortest ($P = .07$) acetate half life (23 ± 1.9 min). Undegradable intake protein supplementation did not affect ewe BW change in positive energy balance. But, the reduction of BW loss in ewes losing weight receiving UIP supplementation might be the result of improved acetate metabolism through a better supply of gluconeogenic precursors via amino acids.

Key Words: Ewes, Undegradable Intake Protein, Acetate Tolerance Test

TEACHING

69 Reproductive anatomy on a compact disk. W. E. Plummer, *California Polytechnic State University, San Luis Obispo.*

Curriculum changes at Cal Poly and the astounding increase in science knowledge has forced the inclusion of more information in current coursework. During the past several years a sense of frustration arose when trying to get all necessary areas covered in Reproductive Physiology ([ReproPhys] Animal Science 401) during any given quarter. In addition, students in Animal Science have not been exposed to enough endocrinology before taking ReproPhys to be able to step directly into reproductive endocrinology, and, as formerly taught, the course had two weeks of anatomy lectures in a 10 week course. Reproductive anatomy has not changed over the years but reproductive endocrinology has changed drastically, for in 1979 there were essentially 7 reproductive hormones and now the list is over three pages long. In order to adequately teach what has become a semester course in a quarter system requires some outside work by the students. Thus to increase endocrinology and reduce anatomy lecture times, the idea of putting all of the anatomy on a compact disk (CD) occurred. Funding came from three $2000 grants— two from the Interactive Learning Group of the University and a matching one from the College of Agriculture. All monies were funneled through the campus Faculty Multimedia Development Center with 80% of expenditures used for student labor and 20% for software. These grants allowed the development to proceed in three phases: 1– initial digitizing of slides, graphs, and drawings; 2– adaptation of same to the expected format of the CD; and 3– the addition of audio, animation and boxed definitions when the pointer is placed on an image or word. To date the program occupies about 19 megs of text and pictures plus approximately 70 megs of audio and animation and can run on a computer with an 80486 processor. Three trial runs have occurred to date with student and teacher suggested changes being incorporated each time. Student acceptance has been positive (based on in–class evaluations) and the students have requested that CDs be developed for similar classes. Observations by the instructor and post–use testing indicate that the CD serves as an adjunct study device only. It reinforces hands on learning but does not replace it, leading to one laboratory and portions of 4 other labs being dedicated to anatomy. Lecture time for endocrinology has increased and this has been very helpful, but time devoted to anatomy in laboratory has also increased.

Key Words: Reproductive anatomy, Compact disk

70 Applied teaching and learning in animal sciences. N. Irlbeck, *Colorado State University, Fort Collins, Colorado.*

Future employers of animal science students claim graduates need enhanced problem solving, computer, team working and communication skills. In the fall of 1996, an applied nonruminant nutrition class was taught in an innovative format in an attempt to answer that need. Four species were emphasized; aquaculture, ratites, swine and poultry. Communication skills stressed included; listening, verbal, written, computer and team working skills. The class was divided into three sections, each section emphasizing one of the species and lasting three time periods. Students were divided into groups of two, the groups changing for each species. The first class was a traditional lecture on the designated species, after which each group was given a case study. By next class, groups E–mailed a tentative outline on how to solve their problem. The second class incorporated discussion to answer questions or solve problems, followed by an invited speaker from the industry. In the final class, groups gave a verbal response to the case study, followed by a question and answer session and submission of a written response in the form of a business letter. An incorporated bibliography documented world wide web usage. Students found the need to incorporate nutrition, behavior, reproduction and management principles to answer their case studies. The final involved a written extension-like publication emphasizing the feeding of a selected species. All students without exception favored this teaching format to traditional lecture. The class resulted in enhanced problem solving, computer, team working and communication skills among the students, plus they learned to teach themselves.

Key Words: Communication, Students, Teaching

71 California universities target low enrollment specialty equine courses by sharing classes and faculty expertise through mediated instruction. R. E. Bray[1]*, S. J. Wickler[1], J. Roser[2], R. Hunt[3], and A. Rodiek[4], *[1]California State Polytechnic University, Pomona, [2]UC Davis, [3]California Polytechnic State University, San Luis Obispo, [4]California State University, Fresno.*

Four California universities animal science programs cooperatively share equine specialty courses that collectively provides faculty expertise in physiology, nutrition, reproduction and farrier science. Three of the universities have faculty expertise in only one of the respective disciplines in the equine sciences and one university has faculty expertise in three of the respective disciplines. The courses shared through mediated instruction include Equine Exercise Physiology, Equine Nutrition, Farrier Science and Equine Reproduction. Prior to mediated instruction these courses were not all offered by each of the respective institutions and these upper division courses traditionally have had low enrollment; i.e., 12 - 20 students at the respective institutions. The average enrollment for the courses completed through mediated instruction has been approximately 56 students, regardless of whether 3 or 4 universities participated in the course. Student overall satisfaction with the mediated instruction format on a 5 point scale (1 = poor; 5 = excellent) for Equine Exercise Physiology, Equine Nutrition and Farrier Science were 4.2, 4.5, 2.4, respectively. Equine Reproduction will be offered for the first time during the spring, 1997. Three of the universities are on the quarter system and one is on the semester system. The respective Departments of Animal Sciences have cooperatively worked towards adjusting the starting and ending dates of the classes and the number of credit units for the respective courses. Any laboratories associated with a course (Farrier Science) have been conducted by the respective institutions independent of the lectures. Mediated instruction has expanded the course offerings in the equine sciences and facilitated inter-campus collaboration. Student evaluations of mediated instruction for the courses conducted have been favorable and have provided direction in improving the distance learning format.

Key Words: distance learning, mediated instruction, interactive, equine