

## Production, Management and the Environment: Beef, Sheep, Swine

**268 Substituting ground redberry juniper leaves and stems for oat hay in lamb feedlot diets: Growth performance, serum urea nitrogen, serum insulin-like growth factor-1, and wool characteristics.** T. R. Whitney<sup>\*1</sup>, C. D. Swening<sup>1</sup>, J. P. Muir<sup>2</sup>, C. J. Lupton<sup>1</sup>, and W. C. Stewart<sup>1</sup>, <sup>1</sup>Texas AgriLife Research, San Angelo, <sup>2</sup>Texas AgriLife Research, Stephenville.

The abundance of redberry juniper throughout southwest rangelands presents rangeland management challenges, yet presents opportunity as an untapped feed resource. Drought and rising feed costs also make ground redberry juniper forage a cost-effective alternative roughage. Rambouillet lambs (n = 45) were used to evaluate effects of substituting redberry juniper for oat hay on feedlot performance, serum urea nitrogen (SUN), IGF-1 concentrations and wool characteristics. In a completely randomized design study with 2 feeding periods (Period 1 = 64% concentrate diet, 35 d; Period 2 = 85% concentrate diet, 61 d), lambs were individually fed ad libitum diets containing 40% dried distillers grains with solubles (DDGS) and ground juniper leaves and stems that replaced 0%, 33%, 66%, or 100% of the ground oat hay. In Period 1, a positive quadratic effect was observed in lamb ADG and DMI as juniper replaced 0% to 100% of oat hay ( $P < 0.003$ ). In Period 2, a linear response occurred in lamb ADG as juniper replaced up to 100% of oat hay ( $P = 0.007$ ), whereas DMI was unaffected ( $P > 0.10$ ) after d 49. Overall, final BW of each period quadratically increased ( $P < 0.04$ ) and there was no effect ( $P > 0.32$ ) of treatment on G:F. During Period 2, a positive quadratic effect on SUN ( $P = 0.002$ ) and a linear effect on fecal N ( $P = 0.001$ ) were observed, due in part, to a combined effect of DMI and dietary urea concentrations. No differences ( $P > 0.18$ ) were observed in serum IGF-1, Ca, P, or fecal P. Wool characteristics were unaffected by treatments with the exception of a negative quadratic effect in grams of wool produced/kg of BW. From these findings we can conclude that redberry juniper stems and leaves can effectively replace oat hay in lamb feedlot diets and is a viable alternative roughage source for lamb diets.

**Key Words:** lamb, feedlot, juniperus

**269 Dietary betaine improves physiological responses in sheep under chronic heat load in a dose dependent manner.** K. DiGiacomo,<sup>\*</sup> S. Simpson, B. J. Leury, and F. R. Dunshea, *Melbourne School of Land and Environment, The University of Melbourne, Parkville, Vic, Australia.*

Heat stress (HS) results in decreased production, health issues and economic losses in ruminants. Dietary betaine is an organic osmolyte implicated in maintaining cellular osmotic balance and reducing energy expenditure and may help to maintain thermal tolerance. Thirty-six Merino ewe's (40 kg, n = 6 per group) were housed in climate chambers maintained at either thermoneutral (TN) (n = 18, 21°C) or cyclical HS (n = 18, 18–43°C) conditions for 21 d, and supplemented with either 0, 2 or 4 g betaine/d. Animals had ad libitum access to water and were pair fed such that TN intake matched that of HS animals who were fed ad libitum. Water and feed intake was measured twice daily, and plasma samples were obtained at 1500h 3 times per week. Heart rate (HR), respiration rate (RR), skin temperature ( $T_s$ ) and rectal temperature ( $T_R$ ) were measured at 0900, 1300 and 1700 h daily. Betaine supplementation did not alter feed intake ( $P = 0.66$ ). All physiological measures differed with time of day ( $P < 0.001$ ) and average daily  $T_R$  was increased by HS (39.4 to 40.1°C,  $P < 0.001$ ) and altered by betaine supplementation (39.7, 39.6 and 39.8°C for 0, 2 and 4 g betaine respectively,  $P < 0.001$ ). Heat increased  $T_s$  (38.0 to 39.1°C,  $P = 0.002$ ), while betaine did not

affect  $T_s$  ( $P = 0.48$ ). Heat increased RR by 47 breaths  $\text{min}^{-1}$  ( $P < 0.001$ ) and 2 g betaine decreased RR (113, 102 and 116 breaths  $\text{min}^{-1}$  for 0, 2 and 4 g betaine respectively,  $P < 0.001$ ). Heat increased HR by 8 beats  $\text{min}^{-1}$  ( $P < 0.001$ ), while 2 g betaine decreased HR (95, 88 and 99 beats  $\text{min}^{-1}$  for 0, 2 and 4 g betaine respectively,  $P < 0.001$ ). Heat stress did not alter plasma glucose and NEFA concentrations ( $P > 0.50$ ), while betaine supplementation decreased plasma NEFA concentrations (80, 55 and 54mM for 0, 2 and 4 g betaine respectively,  $P = 0.05$ ). These data suggest that dietary betaine supplementation in sheep has dose dependent responses, with the 2 g betaine dose able to decrease heat load in sheep.

**Key Words:** betaine, heat stress, ruminants

**270 Evaluation of body temperature and sweating rate of Senepol and crossbred heifers in the tropics.** R. W. Godfrey<sup>\*1</sup>, A. J. Weis<sup>1</sup>, P. E. Hillman<sup>2</sup>, K. G. Gebremedhin<sup>2</sup>, C. N. Lee<sup>3</sup>, and R. J. Collier<sup>4</sup>, <sup>1</sup>University of the Virgin Islands, St Croix, VI, <sup>2</sup>Cornell University, Ithaca, NY, <sup>3</sup>University of Hawaii, Manoa, <sup>4</sup>University of Arizona, Tucson.

Heat stress is a common problem in livestock production throughout the tropics. Senepol (SEN) cattle are well adapted to the tropical environment but other *Bos taurus* breeds are not as well suited for the climate. The objective of this study was to compare the body temperature and sweating rate of SEN (n = 6) and Charolais × Angus × SEN (XBRED; n = 4) heifers. All heifers were nulliparous and 1.3 y of age. Temperature data loggers, programmed to record vaginal temperature (VT) at 10-min intervals, were inserted into the vagina of each heifer and removed after 72 h. Rectal temperature measured using a digital veterinary thermometer (RT), eye temperature measured using infrared images of the left eye (IREYE), surface temperature over the rump measured using a hand-held infrared thermometer (IRR), respiration rate measured as breaths per minute (bpm) using visual observation (RR) and sweating rate (SWR) measured at a site on the rump of each heifer using a hand-held closed-chamber VapoMeter were collected between 1200 and 1430 h. Heifers were evaluated in the shade on d 1 and d 3 and in the sun on d 2 and d 4. Data were analyzed using GLM procedures of SAS with breed, sun exposure and the interaction in the model. Serial VT measurements were analyzed using time and breed in the model. Mean temperature, relative humidity and THI during the data collection were 28.3°C, 83.7% and 80.6, respectively. There was no difference between SEN and XBRED heifers in IREYE or RR ( $P > 0.10$ ). The SEN heifers had lower ( $P < 0.05$ ) VT and RT than XBRED heifers (38.87 ± 0.11 vs. 39.22 ± 0.13°C and 39.14 ± 0.07 vs. 39.36 ± 0.09°C, respectively). There was no difference ( $P > 0.10$ ) in RT or VT between heifers in the sun or shade within breed. The VT of SEN heifers in the shade was lower ( $P < 0.06$ ) than VT of XBRED heifers in sun or shade (38.75 ± 0.15 vs. 39.22 ± 0.18°C, respectively). The IRR of SEN heifers was lower ( $P < 0.008$ ) than that of XBRED heifers (37.39 ± 0.21 vs. 38.38 ± 0.28°C, respectively) and IRR was higher ( $P < 0.0001$ ) in the sun than in the shade (40.60 ± 0.26 vs. 35.16 ± 0.24°C, respectively). The SWR of SEN heifers was higher ( $P < 0.001$ ) than that of XBRED heifers (23.96 ± 0.71 vs. 19.75 ± 0.93 g/m<sup>2</sup>, respectively). The SWR of SEN heifers in the sun was higher ( $P < 0.03$ ) than SWR of SEN heifers in shade or XBRED heifers in sun or shade (27.37 ± 1.08 vs. 20.54 ± 0.93 vs. 20.48 ± 1.32 vs. 19.03 ± 1.32 g/m<sup>2</sup>, respectively). The higher SWR of SEN heifers may play a role in their lower RT and VT and their adaptation to the tropical climate.

**Key Words:** heat stress, sweating rate, Senepol

**271 Evaluation of body temperature and sweating rate of Senepol cows in the tropics.** R. W. Godfrey<sup>\*1</sup>, A. J. Weis<sup>1</sup>, P. E. Hillman<sup>2</sup>, K. G. Gebremedhin<sup>2</sup>, C. N. Lee<sup>3</sup>, and R. J. Collier<sup>4</sup>, <sup>1</sup>University of the Virgin Islands, St Croix, VI, <sup>2</sup>Cornell University, Ithaca, NY, <sup>3</sup>University of Hawaii, Manoa, <sup>4</sup>University of Arizona, Tucson.

Senepol cattle are well adapted to the tropical environment and there is interest in determining what physiological traits contribute to their adaptation. The objective of this study was to evaluate the body temperature and sweating rate of Senepol cows in the tropics. Primiparous (n = 3) and multiparous (n = 7) cows were evaluated in July (2.3 to 11.4 y of age). Three cows were pregnant (6 mo of gestation) at the time of data collection. Temperature data loggers, programmed to record vaginal temperature (VT) at 10-min intervals, were inserted into the vagina of each cow and removed after 72 h. Rectal temperature measured using a digital veterinary thermometer (RT), eye temperature measured using infrared images of the left eye (IREYE), surface temperature over the rump measured using a hand-held infrared thermometer (IRR), respiration rate measured as breaths per minute (bpm) using visual observation (RR) and sweating rate (SWR) measured at a site on the rump of each cow using a hand-held closed-chamber VapoMeter were collected. Evaporative heat loss (EVHL) was calculated from measured air properties passing over a sample area of the cows' body by a Bovine Evaporation Meter. Cows were evaluated over 3 d in the shade and in the sun after a 20 min acclimation to each condition on each day. Data were analyzed using GLM procedures of SAS with sun exposure and time of day as the main effects in the model. Serial VT measurements were analyzed using time and pregnancy status in the model. Mean temperature, relative humidity and THI during the data collection were 28.3°C, 83.7% and 80.6, respectively. There was no difference ( $P > 0.10$ ) in SWR or VT between the sun and shade (20.95 ± 2.6 vs. 22.98 ± 2.9 g/m<sup>2</sup> and 38.86 ± 0.22 vs. 38.41 ± 0.23°C, respectively). The IREYE, IRR, RT, RR and EVHL were higher ( $P < 0.02$ ) in the sun than in the shade (38.87 ± 0.14 vs. 38.19 ± 0.19°C, 40.16 ± 0.25 vs. 34.64 ± 0.27°C, 39.15 ± 0.06 vs. 38.93 ± 0.06°C, 72.4 ± 0.9 vs. 68.1 ± 1.0 bpm and 344.8 ± 13.7 vs. 179.5 ± 14.9 g·m<sup>-2</sup>·h<sup>-1</sup>, respectively). Pregnant cows had a lower ( $P < 0.01$ ) RT than open cows (38.88 ± 0.07 vs. 39.12 ± 0.05°C, respectively). Pregnant cows had higher ( $P < 0.0001$ ) VT than open cows at all times of the day except during the morning (0600 to 1200 h). These data provide more information on the heat tolerance traits of Senepol cattle.

**Key Words:** heat stress, sweating rate, Senepol

**272 Variation in skin surface temperature in different body parts of pigs in response to varying air temperatures.** A. Sapkota\* and J. J. McGlone, *Pork Industry Institute, Texas Tech University, Lubbock.*

Surface skin temperature may vary with the environmental temperature in mammals and may be a non-invasive method to evaluate the welfare of pigs. Surface skin temperatures may vary with body regions. The objective of this study was to evaluate how surface skin temperature of pigs varied with changes in external environmental temperature (both warm and cold) and over time. An infrared thermometer was used to record surface skin temperature every minute on body parts: rooting disc, bridge, ear, neck, throat, thorax, loin, abdomen, front leg, hind leg and ham of market size pigs. Data were recorded in the home pen (HOME), hallway (HALL), outside the building (OUT), back again in hallway (HALL2) and in home pen (HOME2) during cold (n = 24) or warm (n = 24) weather. Statistical models included the effects of air temperature and time (per min for 5 min; linear and quadratic effects).

During winter, pigs in HOME (avg temp = 17.8 C) showed no time effects. When pigs were moved to the HALL (avg temp = 16.4 C), there was a quadratic effect ( $P < 0.05$ ) for bridge, thorax, loin, abdomen, front leg, hind leg and ham. When pigs were moved to OUT (avg temp = 6.3 C), the disc and bridge regions showed a quadratic change over time ( $P < 0.05$ ). When again moved to HALL2 (avg temp = 9.6 C), the quadratic effect over time ( $P < 0.05$ ) was seen in all body parts except ear and thorax. Finally, when pigs were moved to HOME2 (avg temp = 16.4 C), the quadratic change over time was observed for all body parts except bridge, ear and thorax ( $P < 0.05$ ). During summer, pigs in HOME (avg temp = 31.8 C) showed no time effects. When pigs were moved to HALL (avg temp = 32.4 C), there was quadratic time effect ( $P < 0.05$ ) only for ham. When pigs were moved to OUT (avg temp = 35.6 C) and HALL2 (avg temp = 33.9 C), the quadratic time effect was observed in all body parts except disc ( $P < 0.05$ ). Finally, when pigs were moved to HOME2 (avg temp = 32.3 C), there were no time effects. When body parts were compared, the rooting disc was the coolest body part in summer. However, during the winter, body regions had more uniform surface temperatures. Only some of the pigs' body regions (esp. rooting disc) were responsive to warm air temperature. More data are needed to model surface temperature effects on core body temperature and behavior.

**Key Words:** surface temperature, pigs, welfare

**273 Routine exercise of feedlot cattle: Implications for stress response, productivity, and beef quality.** N. Miller,\* B. Gerlach, H. Glynn, K. Miller, C. van Bibber, L. Edwards-Calloway, J. Drouillard, and T. Houser, *Kansas State University, Manhattan.*

Feedlot cattle normally are limited in the amount of physical activity in which they regularly participate. The objectives were to determine if cattle become conditioned to handling with routine exercise during the finishing period, and to determine if routine exercise affects behavioral and physiological changes, growth performance, and carcass characteristics. Steers (n = 419) were stratified by weight and randomly assigned within strata to one of 4 treatments: 1) exercised 3 times/wk for the entire finishing period (ALL); 2) exercised 3 times/wk for the first 10 wk (E); 3) exercised 3 times/wk for the last 7 wk (L); and 4) no exercise during the 116-d finishing period (CON). Cattle were exercised by animal handlers for a minimum of 20 min at a trotting pace. Temperament scores (TS) and BW were obtained from all cattle on d 0, 72 and 116. Blood was obtained from 3 cattle randomly selected from each pen (n = 84) on these days and at exsanguination for analysis of serum concentrations of cortisol, insulin, glucose, and lactate, and plasma concentrations of epinephrine, norepinephrine, and  $\beta$ -endorphins. Data were analyzed as a mixed model, with fixed effect of treatment and random effect of pen. Date was included as a fixed effect for analyses of blood constituents and TS. There were no treatment x date interactions for blood constituents ( $P > 0.10$ ) or TS. Exercise influenced pre-harvest insulin ( $P < 0.01$ ; 0.75, 0.47, 0.60 and 0.78 ng/mL for ALL, E, L, and CON, respectively), but had no impact on other pre-harvest or post-harvest blood measurements ( $P > 0.10$ ). TS were similar across treatments ( $P > 0.10$ ), indicating no adaptation due to routine exercise or handling. Treatments did not differ with respect to ADG ( $P > 0.8$ ). DMI were 10.29, 10.44, 10.26, and 10.58 kg/d ( $P = 0.10$ ); G:F were 0.197, 0.197, 0.176, and 0.189 ( $P = 0.28$ ); and HCW ( $P = 0.77$ ) were 390, 391, 393, and 389 kg for ALL, E, L, and CON, respectively. Other carcass characteristics were unaffected by exercise regimen ( $P > 0.10$ ). In summary, routine exercise had little impact on blood parameters, feedlot performance, or carcass traits of finishing steers.

**Key Words:** exercise, cattle, stress

**274 Effects of different implant management options on performance of pre and post weaned calves.** H. B. Jones<sup>\*1</sup>, J. D. Rivera<sup>1</sup>, and R. C. Vann<sup>2</sup>, <sup>1</sup>MAFES South Mississippi Branch Experiment Station, Poplarville, <sup>2</sup>MAFES Brown Loam Branch Experiment Station, Raymond, MS.

Fifty-one head of crossbred (primarily *Bos taurus*) beef steers (BW = 166 kg) were used in year one of a multi-year study to evaluate effects of growth implants on performance, in a randomized complete block. Calves were implanted either at calfhooed vaccination (approximately 3.5 mo old) with 100 mg of progesterone and 10 mg estradiol benzoate (CALF); at calfhooed and again at weaning with 40 mg of trenbolone acetate and 8 mg of estradiol (WEAN); or not implanted (NONE). Cattle were weighed at weaning, and subsequently on d 28, 45, and 80 post weaning. On d 80, all steers were ultrasounded to measure longissimus area (LMA), intramuscular fat (IMF), and fat thickness. Data were analyzed using PROC GLM of SAS, steer was the experimental unit. At weaning, steers implanted at calfhooed, had greater pre-weaning ADG compared with non-implanted steers (1.12 vs 1.0 kg, respectively;  $P = 0.04$ ). At 28 d post weaning, no differences were detected among groups regarding ADG. Additionally, at 45 d post weaning, no differences were noted for BW; however, a difference was noted in ADG from weaning to d 45 between CALF and NONE (0.61 vs. 0.48 kg, respectively;  $P < 0.10$ ). Surprisingly, no difference was detected in ADG between NONE and WEAN (0.48 vs 0.52 kg, respectively). Moreover, a tendency was noted in ADG ( $P = 0.14$ ) between NONE and both implanted groups for the period between weaning and d 80 (0.82, 0.90, and 0.90 kg, respectively). Overall ADG was greater ( $P < 0.10$ ) for cattle that were implanted compared with untreated controls (0.88, 0.98 and 0.92 for NONE, CALF and WEAN, respectively). Ultrasound measurements noted a tendency for increased LMA in CALF group ( $P = 0.12$ ), and a tendency for decreased IMF for the CALF and WEAN compared with controls ( $P = 0.12$ ). Results suggest that use of growth promoting implants may be of benefit to cattle producers; however, longer retention periods post weaning may be needed to realize full benefit of implanting.

**Key Words:** beef cattle, growth, implants

**275 Comparison of chelated versus inorganic trace minerals on rate and efficiency of gain and pregnancy rates in beef heifers.** W. A. Whitehurst<sup>\*1</sup>, J. A. Paterson<sup>1</sup>, M. M. Harbac<sup>1</sup>, M. K. Petersen<sup>2</sup>, G. C. Duff<sup>2</sup>, and T. W. Geary<sup>2</sup>, <sup>1</sup>Montana State University Bozeman, Bozeman, <sup>2</sup>USDA-ARS Fort Keogh, Miles City, MT.

Objectives of this experiment were to compare rate and efficiency of gain, and conception rates of yearling heifers supplemented with Cu, Zn and Mn as either metal methionine hydroxy analog chelated trace mineral (CTM; provided as Mintrex) or the same trace minerals in an inorganic  $SO_4$  form. The experimental design utilized 3 ranches, each having 2 replications per treatment with pen as the experimental unit for ADG, DMI and G:F. Individual heifer was the experimental unit for pregnancy rates. Ranch A contained 498 Angus cross heifers, ranch B, 236 Red Angus cross heifers, and ranch C, 1,742 Angus cross heifers. All heifers were fed silage based diets that contained approximately 13.5% CP, 64% TDN (DM basis) and had no significant levels of  $SO_4$ , Mo, or Fe in feed or  $H_2O$ . Diets contained an average of 24 ppm Cu, 70 ppm Zn and 64 ppm Mn. Supplements were fed for 181 d (Ranch A), 149 d (Ranch B) and 151 d (Ranch C) before breeding. Heifers were weighed once at trial initiation (initial BW 270 kg  $\pm$  2.8), end of drylot feeding, at breeding and at pregnancy diagnosis. Ranch A heifers were bred by

AI followed by natural service (45 d breeding), Ranch B heifers were bred by natural service (50 d breeding) and Ranch C heifers were bred by AI once. Pregnancy was determined via ultrasound using trained technicians. Ranch effects were significant ( $P < 0.001$ ) for gain, ADG, G:F and overall pregnancy rate, but not for conception in the first 21 d. No ranch x treatment interactions were detected for any measurements ( $P \geq 0.47$ ) and no differences ( $P \geq 0.46$ ) were detected between treatments for total gain, ADG, G:F or the number of heifers that conceived during the first 21 d on Ranches A or B. Conception rate increased ( $P = 0.03$ ) for CTM heifers from ranch C with one AI breeding. Across ranches, conception rates during the first 21 d of breeding did not differ ( $P = 0.12$ ) between treatments but overall pregnancy rate was greater ( $P = 0.05$ ) for heifers supplemented with CTM. Under the conditions of this experiment results suggest that supplementation with CTM contributed to higher pregnancy rates in heifers.

**Key Words:** chelated minerals, mineral nutrition, fertility

**276 Relationships between postweaning residual feed intake in heifers and efficiency, digestibility, and productivity of Bonsmara cows.** A. N. Hafila<sup>\*1</sup>, G. E. Carstens<sup>1</sup>, T. D. A. Forbes<sup>2</sup>, J. C. Bailey<sup>1</sup>, J. T. Walter<sup>1</sup>, J. G. Moreno<sup>1</sup>, and J. R. Johnson<sup>1</sup>, <sup>1</sup>Texas A&M University, College Station, <sup>2</sup>Texas AgriLife Research, Uvalde.

The objective of this study was to examine phenotypic relationships between heifer postweaning residual feed intake (RFI), and performance, efficiency, digestibility and productivity of mid-gestation cows.  $RFI_h$  was measured in growing Bonsmara heifers ( $n = 115$ ) during 2 yr. Dry matter digestibility (DMD) was measured in 38 heifers with divergent RFI. Low  $RFI_h$  heifers consumed 20% less feed ( $P < 0.05$ ) compared with those with high  $RFI_h$  heifers, but had similar BW, ADG and backfat depth. DMD was not affected by RFI group. Heifers with the lowest ( $n = 12/yr$ ) and highest ( $n = 12/yr$ )  $RFI_h$  were retained for breeding and use in the cow feeding trial. Subsequently, the mid-gestation females (19 s-parity cows, 23 primiparous heifers) were fed chopped hay (ME = 2.11 Mcal/kg DM) in pens equipped with GrowSafe bunks to measure individual intake. BW were measured at 7-d intervals and BCS and ultrasound measurements of rump fat thickness obtained on d 0 and 77 of trial. DMD was measured on 32 of the pregnant females. Mixed model included fixed effect of  $RFI_h$  class, age and 2 way interaction. Low  $RFI_h$  females had lower ( $P < 0.01$ ) DMI (9.00 vs 11.6  $\pm$  0.54 kg/d) compared with females with high  $RFI_h$ , but initial BW, ADG, BCS and rump fat thickness were similar. Age at calving was not affected by  $RFI_h$  classification. An interaction ( $P < 0.05$ ) between  $RFI_h$  classification and female age group was found for calf birth weight. Calves from primiparous heifers with low  $RFI_h$  were lighter at birth (27 vs 32  $\pm$  1.2 kg;  $P < 0.05$ ) compared with high- $RFI_h$  females, but RFI classification did not affect BW of calves born to second-parity cows. RFI for pregnant cows ( $RFI_c$ ) was calculated as the residual from the linear regression of DMI on conceptus-adjusted ADG and mid-test BW<sup>0.75</sup>.  $RFI_c$  was highly correlated with DMI (0.79), but not BW, ADG, backfat depth or BCS. Moreover,  $RFI_c$  was moderately correlated to  $RFI_h$  (0.50). DMD tended ( $P < 0.08$ ) to be greater (58 vs 54  $\pm$  1.6%) for cows classified as having high  $RFI_h$ . Heifers classified as having low RFI continued to consume 22% less feed during mid-gestation with similar BW and BCS compared with heifers classified as having high RFI. While some reranking of animals occurred between RFI in heifers and mid-gestation females, differences in intake were still evident. Between-animal variation in digestibility and body composition did not contribute to variance in RFI in this study.