

FFA. The concentrations of n3 FFA and n6 FFA in sow milk decreased ($P<0.05$) from farrowing (17.5% and 21.9%; SEM=0.3) to d 8 (7.4% and 12.1%; SEM=0.3) and to d 16 (6.2% and 10.1%; SEM=0.3). FS supplementation to sows before farrowing will be advantageous for sows (to maintain backfat) and piglets (to increase in milk fats). An increase of FS in diets reduced SFFA ($P<0.05$) and increased UFFA ($P<0.01$) in milk. The 10% FS and 5% FS diets had 7.9% and 4.4% more ($P<0.05$) UFFA, respectively, in milk than control diet. In conclusion, The diet supplemented with 10% FS fed to sows increased n6 FFA in the serum of sows, UFFA, n3 and n6 FFA in the milk, and n3 FFA in the serum of pigs at birth.

Key Words: Sows, Flaxseed, Fatty acids

W106 Carry over effect of dietary protein supplied to pregnant sows on protein utilization during lactation. P. K. Theil*, H. Jorgensen, and K. Jakobsen, *Danish Institute of Agricultural Sciences, Denmark.*

Lowering the supply of dietary protein in swine diets has been in focus the last decade in order to minimize nitrogen (N) excretion to the environment. This experiment was conducted to quantify the protein metabolism in 8 sows fed low (LP) or standard (SP) dietary protein during pregnancy and either low (LF) or high (HF) dietary fat during lactation. The experimental setup was a crossover design between pregnancy diets (LP, SP) and lactation diets (LF, HF). The dietary change occurred at the day of farrowing. Diet formulation and feeding level were in accordance with Danish recommendations. This implied an elevated feeding level during the last month of pregnancy, while lactating sows were fed according to litter size. The LP and SP diets supplied 7.39 and 10.29 g fecal digestible protein/MJ ME, respectively, while LF and HF diets supplied 10.18 and 10.04 g fecal digestible protein/MJ ME. Nitrogen balance was quantified in three balance periods during lactation by total collection of feces and urine on days 9-12, 16-19, and 23-26. Milk production, determined during the balance trials by D₂O dilution, increased from 831 g/piglet/d (d 10) to 1151 g/piglet/d (d24) ($P<0.001$), with no effect of pregnancy diets ($P=0.73$). Milk contained 17.7 % of DM and milk protein content (N x 6.38) was 28.1 % of DM, with no effect of stage of lactation ($P=0.89$). As the milk production increased, milk protein yield increased ($P<0.01$) as lactation progressed, whereby the protein retention (N x 6.25) decreased concomitantly ($P<0.05$). The LP and SP sows were supplied with comparable amounts of metabolized protein during lactation. The data show that sows fed the LP diet during pregnancy retained considerable amounts of protein during lactation at the expense of milk protein yield.

Item	LP ^a	SP ^a	SEM	P
N balance of lactating sows (g/d)				
Intake	141	151	11.8	0.59
Feces	24	27	2.4	0.45
Urine	38	46	3.8	0.16
Milk	66	78	6.9	0.27
Retention	13	0	2.9	<0.01
Milk production (kg/d)	9.02	9.54	1.00	0.72
Litter size	9.0	9.5	0.73	0.64
Litter gain (kg/d)	1.86	2.03	0.12	0.35

Animal Behavior & Well-Being: Social and Physical Environments

W108 Analysis of the effect of gestation housing systems on fertility and piglet death. L. Anil*, S. Baidoo, J. Deen, R. Walker, S. Anil, and R. Morrison, *University of Minnesota.*

Records of 1426 litters from 664 sows of parity 1-4 were analyzed to compare the production performance in terms of farrowing rate and piglet deaths/litter among sows housed in individual stalls and pens with electronic sow feeder during gestation and farrowing in crates. A major cause of piglet death, death due to laid-on, which is related to housing systems was also compared. The means in each group were compared using Independent-samples T test. Farrowing rate was significantly ($P<0.001$) higher among sows housed in individual stalls during gestation compared to sows housed in pens with electronic sow feeder during gestation (86.22 and 79.49 respectively). There was no significant difference in mean percentage of pig death/born alive (7.94 ± 0.46 and 7.60 ± 0.42 per litter in stalls and pens respectively), average number of mum-

^a Pregnancy diet

Key Words: N utilization, Milk protein, Balance experiment

W107 A dynamic computer-model to estimate the changes of body composition during lactation in sows. J. G. Kim* and K. Y. Whang, *Korea University, Seoul, Korea.*

A lactating sow model was developed to estimate body composition changes and nutrient flow based on body weight (BW), P2 back fat depth (P2), and litter size (LS) and to propose the nutrient requirements to support ideal body condition. Input variables were BW, P2 at farrowing, feed intake (FI) during lactation, number of suckling piglets, piglets weights at farrowing and weaning. The BW and P2 were used to determine body composition. Difference of piglet weight between farrowing and weaning (PWC) was employed to determine average daily gain and daily milk requirement for piglets. General feed intake pattern (FIP) was also modeled to reach maximum feed intake at 7 day post-farrowing. The model showed body composition of sow (fat, protein, water, and ash), BW, and P2. An example of model (BW:200 kg; P2: 20 mm; LS: 9; PWC: 5.5 kg; FI: 120 kg; FIP: 7 days) showed that fat and protein contents and BW of sow decreased until 5 d post-farrowing and increased after on. A reversed pattern showed in P2. Estimated values of this model indicated that piglet body weight change was main factor that affected body composition and BW of sow. Feed intake was also important factor on body composition and BW of sow. But effects of feed intake pattern of sows were relatively less important than weight change of piglets.

Item	Fat 7 day	Protein 7 day	BW	P2	Fat 21 day	Protein 21 day	BW	P2
PWC(kg)								
4.5	29.50	43.25	191.39	20.55	32.14	45.24	204.83	19.81
5.5	28.39	42.64	185.99	21.83	29.63	44.01	192.75	20.89
6.5	27.21	41.96	180.18	21.44	26.78	42.50	178.93	22.05
FI(kg)								
110	28.07	42.25	184.18	21.00	28.48	42.89	186.62	21.07
120	28.39	42.64	185.99	21.83	29.63	44.01	192.75	20.89
130	28.70	43.01	187.73	20.97	30.72	45.06	198.58	20.72
FIP(days)								
5	29.16	43.58	190.30	20.98	29.89	44.42	194.31	20.94
7	28.39	42.64	185.99	21.83	29.63	44.01	192.75	20.89
9	27.67	41.75	181.93	21.00	29.38	43.61	191.28	20.83

Input variables of standard lactating model were BW: 200 kg; P2: 20 mm; LS: 9 pigs; PWC: 5.5 kg; FI: 120 kg; FTP: 7 days

Key Words: Sow, Computer model, Body composition

mies/litter (0.22 ± 0.02 in both) and average number of stillborn/litter (0.56 ± 0.04 and 0.53 ± 0.04 in stalls and pens respectively) among sows housed in the two systems. Piglet death per litter due to laid-on was also similar in the two housing systems (0.20 ± 0.020 in both), indicating that factors such as previous experience in stalls or muscle weakness due to stall-housing are not critical in determining piglet death due to laid-on. The results indicate that in terms of the production parameters studied, neither system is superior to the other.

Key Words: Housing, Gestation, Fertility

W109 Effect of a cooling system to reduce heat stress during the dry period. L. Avendao-Reyes*¹, D. Alvarez-Valenzuela¹, F. Rivera-Acua¹, R. Hurtado-Durn¹, A. Correa-Caldern¹, S. Saucedo-Quintero¹, J. Verdugo-Zarate¹, and P. H. Robinson², ¹ICA, Universidad Autonoma de Baja California, Mexicali, Mexico, ²UCCE, Dept. of Anim. Sci., UC Davis, Davis, CA.

Thirty five multiparous Holstein cows were blocked by body condition score and assigned to one of two treatments 60 d prior to their anticipated calving date in two consecutive summers (24 cows in year 1; 11 cows in year 2). Treatments for both years were: (1) no cooling system and, (2) with a cooling system based on fans with water spray. The cooling system operated from 10:00 to 18:00 h daily during the entire dry period of the cows, which consisted of the hot summer months (extreme low and high temperatures of 18° C and 48° C) in both years. Cows were fed a totally mixed ration ad libitum twice daily at 7:00 and 14:00 h consisting of alfalfa hay (60% of dry matter), wheat straw (18%), wheat grain (15%), wheat bran (5%), and a vitamin/mineral premix (2%). Rectal temperatures and respiration rates were recorded twice daily at 9:30 and 14:30 h on Tuesday and Friday each week. There was a third measurement of both variables at 18:00 h during year 2 only. Body condition was scored weekly and calf birth weights were recorded. After calving, all cows were moved to the same pen, which was provided with shades, but had no fans or misters, and fed a ration appropriate for cows in early lactation. Cows were milked twice daily at 5:00 and 17:00 h and milk yield was recorded weekly through week eight. Data were analyzed by linear models with the fixed effects of year, treatment and year x treatment interaction. During the dry period, interaction year x treatment was not significant ($P > .05$) on rectal temperatures or respiration rates at 9:30 h. However, cooled cows in year 2 had lower ($P < .05$) respiration rate (66.5 ± 2.2 breaths/min) and rectal temperatures (38.9 ± 0.06 °C) at 14:30 h. Body condition score was higher ($P < .05$) for cooled cows in year 1 (4.03 ± 0.02), but the interaction was not significant ($P > .05$) for calf birth weight and milk production. Cooling dry cows using fans with water spray reduced heat stress and increased cow comfort under these very hot conditions, as indicated by afternoon respiration rates and rectal temperatures, but had little impact on subsequent postpartum productivity.

Key Words: Hot weather, Respiration rate, Rectal temperature

W110 Validation of 24h Polar RR Recorder for measuring heart rate variability in pigs. R. M. Marchant-Forde*¹, D. J. Marlin², and J. N. Marchant-Forde³, ¹De Montfort University, Lincoln, UK, ²Animal Health Trust, Newmarket, UK, ³USDA-ARS, West Lafayette, USA.

Measures of heart rate variability (HRV) can yield important information about the functioning of the autonomic nervous system, and are potentially powerful tools in the assessment of animal well-being. The equipment necessary for data collection has been difficult to obtain and use, but recently an ambulatory monitor designed to collect 24h of data has been developed but not validated for use in animals. Our objectives were to measure the accuracy of the Polar RR Recorder using gold standard ECG and to examine and categorise occurring anomalies and to ascertain their impact on the outcome of HRV analysis. Five one-year-old gilts were socially isolated from their pen mates and cardiac activity was simultaneously measured using 2 systems, a Polar RR Recorder and a telemetric ECG system, for 20 min. The Polar data was manually assessed both against and in isolation of the ECG data to identify anomalous beats, which were then assigned to one of 5 identified error categories. The anomalies in the Polar data were corrected and statistical comparisons were performed between the 3 data sets to evaluate the effects of anomalies on HRV analysis. Bland-Altman analysis was used to measure the level of agreement between the ECG, uncorrected Polar, and corrected Polar data. No anomalies or ectopies were found in the ECG data but 46 (0.81% of total interbeat intervals [IBIs]) were located in the Polar uncorrected data. Manual identification and editing procedures reduced this error to 0.018%. Mean heart rate and IBI parameters were unaffected by error ($P > 0.05$). SD and RMSSD were 45 and 50% higher when anomalies were present in the data ($P < 0.001$). The mean difference between the ECG and uncorrected Polar data was 1.36ms (limits of agreement - 69.03 to 71.74ms). This was greatly improved to 0.36ms (limits of agreement - 5.37 to 6.10ms) after editing. Overall, just a small proportion of error can bias the outcome of HRV analysis. This bias is greatly reduced by correcting the anomalous beats. Bland-Altman analysis demonstrated that when there is error present

in the Polar data it cannot be used interchangeably with the ECG data. However, if there are no anomalies present or if anomalies are classified and corrected then the 2 systems can be used interchangeably.

Key Words: Swine, Heart rate variability, Well-being

W111 Use of digital infrared thermography to assess thermal temperature gradients and pathologies of the bovine claw. S. J. Schmidt*¹, S. D. Bowers¹, K. B. Graves¹, R. Carroll², J. White¹, and S. T. Willard¹, ¹Mississippi State University, Mississippi State, MS, ²Carroll Trimming, Palastine, TX.

Lameness is a major problem in dairy cattle, and alternative methods for assessing claw health are needed. In this study, digital infrared thermal imaging (DITI) of regions of the bovine claw (Holstein cows; $n = 21$) were acquired following routine claw trimming procedures to determine whether thermal gradients of the claw exist that might be related to lameness. Using WinTES software, rectangular transects were drawn through thermal images of the claws and temperatures quantified (MAX, AVG, MIN and standard deviation, (SD); °C) relative to the bulbar, prebulbar, subapical and apical regions. The medial and distal digits of the claw were analyzed separately for each fore- and hind-limb. A lameness data capture form was used to document any detectable pathologies of each claw (e.g., laminitis, abscesses, infections), and a severity score assigned (1 = mild/slight; 3 = severe). Data were analyzed comparing thermal gradients among respective claw regions. Across all claws examined, a temperature gradient was observed with AVG bulbar, prebulbar, subapical and apical temperatures as follows: 29.4 ± 0.21 , 29.8 ± 0.19 , 30.7 ± 0.21 and 30.02 ± 0.21 °C, respectively. AVG center claw medial and distal digit temperatures were higher (31.08 ± 0.23 ; $P < 0.05$) than outer claw laminar surface temperatures (28.42 ± 0.15 °C). The highest temperatures of the claw were observed in the subapical region (32.63 ± 0.24 °C), while the lowest temperatures were observed in the prebulbar region (27.59 ± 0.15 °C). All regions of the claw were highly correlated with one another ($r = 0.71$ to 0.94 ; $P < 0.0001$), as were center and laminar surface temperatures ($r = 0.77$; $P < 0.0001$); suggesting that while temperatures differed by region they changed proportionately to one another. The greatest amount of variability in temperatures was observed (as determined by SD values) in the subapical region (1.21 ± 0.04 °C), and the least variability observed in the region of the bulb (0.69 ± 0.03 °C). Where case studies (pathologies) were identified, an association between lameness score and anomalies in claw temperature were evident. These data indicate that thermography may be a useful tool for assessing claw abnormalities, pathologies, and other predisposing factors to bovine lameness.

Key Words: Bovine, Lameness, Digital infrared thermography

W112 Evaluation of drop versus trickle feeding for crated and penned pregnant gilts: Immune measures. Leslie Dabovich*¹, Julie Morrow², Anthony Rudine¹, Lindsey Hulbert¹, Barbara Smith¹, and John McGlone¹, ¹Texas Tech University, ²USDA-ARS.

Seventy nine Camborough-22 (PIC USA) gilts with known estrous dates were used to determine the effects of two penning systems (5 crates vs. pens of 5) and two feeding systems (drop fed vs. trickle fed) on immunity. The four treatments were arranged in 2 X 2 factorial. Drop-fed gilts (DROP) received their entire 2.7 kg daily meal in a single drop. Trickle-fed (TRICK) gilts were fed 2.7 kg over a 30 min period. Immune measures were collected five to six weeks before expected farrowing. Data were analyzed as a randomized complete block design with a 2 X 2 factorial arrangement of treatments. Immune measures were collected including total number of white blood cells (WBC), differential counts, red blood cell numbers, hemoglobin, hematocrit, lymphocyte proliferation under phytohemagglutinin and lipopolysaccharide mitogens, neutrophil chemotaxis, and neutrophil phagocytosis. The interaction between penning and feeding systems was statistically significant for percent phagocytosis (77.97, 97.00, 91.04, and 74.16, SE_p = 5.01, $P < 0.05$ for DROP-Crate, DROP-Pen, TRICKLE-Crate, and TRICKLE-Pen, respectively) and average number of beads phagocytized (5.38, 5.61, 5.55, and 5.11, SE_p = 0.07, $P < 0.05$, respectively). In general, the efficiency of neutrophil phagocytosis (measured by both % of neutrophils that phagocytized and the numbers of beads phagocytized) was higher among Crated gilts that were Trickle-fed than Drop-fed; however, among penned gilts, the neutrophil efficiency was reduced among

Trickle-fed gilts compared with Drop-fed gilts. Generally, all other immune measures and plasma cortisol were not different among treatments or their interactions. In conclusion, most immune measures were not influenced by the penning or feeding systems evaluated. However, neutrophil phagocytosis efficiency may be improved for crated gilts that are trickle rather than drop fed. Among penned gilts, trickle feeding reduced neutrophil efficiency compared with neutrophils from gilts that were drop fed.

Key Words: Pig, Welfare, Immunity

W113 Evaluation of drop versus trickle feeding for crated and penned pregnant gilts: behavioral measures. L. Hulbert^{*1}, J. Morrow², J. Dailey², and J. McGlone¹, ¹Texas Tech University, ²USDA-ARS.

Seventy-eight Camborough-22 (PIC USA) gilts in mid gestation were used to determine the effects of two penning systems (crates vs. pens of 5) and feeding system (drop fed vs. trickle fed) on gilt behavior. The four treatments were arranged in a 2 X 2 factorial. Drop-fed gilts (DROP) received their entire 2.7 kg daily meal in a single drop at 0730 h. Trickle-fed (TRICK) gilts were fed 2.7 kg over a 30 min period at 0730 h. Gilts with a known estrus date and a predicted next estrus date were randomly selected and moved from their acclimation group pen to their assigned treatment. Behavioral measures were collected from time lapse video recordings made over a 24-h period from d 50 to 70 of gestation. Measures of reproductive performance and physiology will be reported elsewhere. Behaviors recorded and summarized included standing, lying, sitting, drinking, feeding, social interactions and oral/nasal/facial (ONF) behaviors. The statistical model was a randomized complete block design with a 2 X 2 factorial arrangement of treatments, four complete blocks and a split plot over time (4 h time periods over a 24-h day). Overall activity levels of gilts were statistically similar ($P > 0.10$) among treatments. However, gilts in some treatments expressed different durations of behaviors at certain times of day. Gilts in Pen-DROP showed more ($P < 0.05$) ONF around 1200 h than gilts in the other treatment groups. Over the entire 24-h period, ONF duration was not different among treatments. Crated gilts showed less ($P < 0.01$) standing but more ($P < 0.05$) sitting than penned gilts (for Crated and Penned gilts, respectively, standing: 0.25 vs. 0.06 ± 0.024 h and sitting: 0.10 vs. 0.04 ± 0.17 h). Crated gilts spent more ($P = 0.05$) time feeding than penned gilts (0.09 vs. 0.07 ± 0.007 h) while the time to feed was not significantly different between Drop- and Trickle-fed gilts. Agonistic and non-agonistic social interactions did not differ ($P > 0.10$) among treatments during this mid gestation sample period. In conclusion, while overall behavioral activity levels were statistically similar among treatments, pregnant gilts expressed different forms of activity depending on the available space.

Key Words: Pig, Welfare, Behavior

W114 Effect of mixing and transportation on behavior and cortisol response in relation to Salmonella infection in swine. D. C. Lay Jr.^{*1}, T. J. Stabel², M. J. Toscano¹, and B. A. Vote², ¹ARS-USDA, Livestock Behavior Research Unit, ²ARS-USDA, National Animal Disease Center.

When apparently healthy swine are transported, it is not uncommon for a small portion of them to be shedding Salmonella. It is theorized that some 'non-shedders' start to shed. Our goal was to identify characteristics of those individuals that shed Salmonella and those that do not shed Salmonella. Thus, we experimentally created transportation stress in order to induce recrudescence of Salmonella in pigs. Two experiments were conducted using 30 pigs in each experiment. Experiment 1 (Exp. 1) differed from Experiment 2 in that Exp. 1 established catheters in the pigs while catheters were not established in Exp. 2. Salmonella-free pigs were inoculated intranasally with 5×10^5 or 1×10^6 cfu of Salmonella choleraesuis/pig 3 weeks prior to mixing and transport. Fecal samples were collected and cultured for S. choleraesuis at various time points post inoculation: 8h, 24h, 48h, 7d, 14d, 21d (pre-stress), 21d (post mixing/transport), 21d (post mixing/transport/mixing), 22d (1d post stress), and 23d (2d post stress). Ileocecal lymph node samples were collected 23d post inoculation (2d post stress), and cultured for S. choleraesuis. Pigs were mixed for 2 h, transported for 2 h, placed back in a pen together for 2 h, and then return to their individual pens. During the initial mixing, the number and individuals engaged in agonistic behavior was recorded. Blood samples were collected at 0, 3, 5, 7, 24,

and 48 h for cortisol analysis. Upon necropsy the body condition was given a score to indicate degree of wounds due to fighting. Data were analyzed in relation to the expression of Salmonella infection. Pigs were classified as positive for Salmonella in the feces, lymph nodes, or combinations thereof. In both Exp. 1 and 2 we found no differences in the number of fights, degree of wounds on body due to fighting, or plasma cortisol concentrations in relation to the Salmonella status of the pigs ($P > .10$). In each experiment, we had only one pig that was considered a persistent shedder. Interestingly, both of these had plasma cortisol concentrations that were below the mean and median for the group. It was thought that shedders would be more stressed, thus this observation is interesting and warrants further investigation.

Key Words: Stress, Swine, Salmonella

W115 Effects of an environmental enrichment on the behavior, physiology and growth of beef cattle. T. Ishiwata^{*1}, K. Uetake¹, N. Abe², and T. Tanaka¹, ¹School of Veterinary Medicine, Azabu University, ²Faculty of Agriculture, Tamagawa University.

To determine the effects of an environmental enrichment on behavior, physiology and growth, 35 9-mo-old Japanese Black X Holstein steers were allocated to 3 pens (6.0 X 9.5 m each): Pen C consisted of a feeding alley, a trough and a water bowl (control, n=11); Pen D included a drum (58 X 90 cm) containing hay (n=12); Pen GD included a drum with a plastic carpet (30 X 120 cm) for grooming (n=12). Behavioral observations were made for 2 h at 10 min intervals after morning and evening feedings for 3 d in 5 successive mo. Agonistic behavior was observed for 1 h after both feedings to assess the dominance order (DO). Jugular vein blood samples were collected and body weight recorded every 2 mo. ANOVA and post-hoc test, and correlation analysis were performed. The effect of the pen was significant in the evening observations, but that of the plastic carpet was not significant. The steers continued frequent access to the drum for 3 mo after its installation (in both Pen D and GD, 0-3 mo: 4 mo after installation, $P < 0.05$). The installation of a drum increased the frequencies of active behaviors especially eating, and reduced those of self-grooming, licking bar, and inactive behaviors (resting and rumination) for 5 mo (for all behaviors, Pen D, GD: C, $P < 0.05$). The average daily gain (ADG) was not different between pens, but it was correlated with eating hay at the drum in Pen D from 2 to 4 mo after installation ($r_s = 0.63$, $P < 0.05$). In Pen C, ADG was correlated with eating hay at the trough from 2 to 4 mo after installation ($r_s = 0.76$; $P < 0.05$). DO was correlated with access to the drum in Pen GD ($r_s = -0.73$; $P < 0.05$). Plasma dopamine concentrations were higher in Pen D than in Pen C ($P < 0.05$). Serum triglyceride concentrations were higher in Pen C than in Pen GD ($P < 0.05$). Although social factor affected the steers' access to the drum with a plastic carpet, the drum kept the steers attracted, and promoted their growth by encouraging their eating and activity for several months.

Key Words: Beef cattle, Environmental enrichment, Behavior

W116 Age and castration stress influence the thermal nociceptive response of calves. S. T. L. Ting^{1,2}, B. Earley¹, I. Veissier³, S. Gupta^{*1,2}, and M. A. Crowe², ¹Teagasc, Grange Research Centre, Dunsany, Co. Meath, Ireland, ²Faculty of Veterinary Medicine, University College Dublin, Belfield, Dublin 4, Ireland, ³INRA, Centre Clermont-Ferrand-Theix, F-63122 Saint Genes Champanelle, France.

To determine the effect of age and castration stress on the thermal nociceptive (or pain) threshold (TPT) of calves, and the presence of stress-induced hypoalgesia (i.e., increased thermal pain threshold) following castration, 60 Friesian calves were allocated to one of six treatments (n=10/treatment): Sham controls at 21 wk of age (C), burdizzo castration at 6 (6-wk), 10 (10-wk), 14 (14-wk), 19 (19-wk) and 22 (22-wk) wk of age. The TPT of each calf was assessed 72 h before treatment, and at 12, 24 and 48 h after treatment using a far infrared (10600 nm) CO₂ laser device (MPB Lamsor Inc., Dorval, QC, Canada). The CO₂ laser beam (5.5 watt) was applied to a shaved area of the skin on the caudal aspect of the metatarsal. The latency of each calf to react by moving the leg at which the CO₂ beam was aimed was recorded. Two alternated measurements were taken from each leg of the calves, with at least 30 s between the two measurements. Mean latencies for the four measurements were calculated. At -72 h before treatment, there were no

differences ($P > .20$) in the TPT between C calves and the 10- to 22-wk-old calves. However, 6-wk-old calves had higher TPT than C at -72 h ($P = .0001$), and at 24 ($P = .002$) and 48 h ($P = .0004$) after treatment, but the values were not different at 12 h ($P = .06$). While the overall TPT (mean of 12 to 48 h data) after treatment were higher in 10-wk ($P = .004$), 14-wk ($P = .0001$), 19-wk ($P = .0001$) and 22-wk-old ($P = .03$) calves than their respective values at -72 h, the TPT values did not change with time in C ($P = .07$) and 6-wk-old calves ($P = .94$). In conclusion, calves at 6 wk of age are less sensitive to thermal pain than older calves (10- to 22-wk), and their sensitivity to pain is not modified by castration. The TPT of the older calves (10- to 22-wk) increased following castration, indicating the presence of stress-induced hypoalgesia.

Key Words: Cattle, Castration, Hypoalgesia

W117 Effects of age at transport on development of neonatal dairy calves. T. A. Johnson¹, S. D. Eicher², J. N. Marchant-Forde², and A. G. Fahey¹, ¹Purdue University, West Lafayette, IN, ²USDA-ARS, West Lafayette, IN.

Transportation stress at an early age can influence performance and the developing immune system. The purpose of this study was to evaluate the effects of age at transport on growth and health of neonatal calves. Holstein calves ($n = 47$) were randomly assigned to treatments that were by age at transport; 2-3 d (A), 4-5 d (B), or 6-8 d (C) within a completely randomized design. Colostrum was given for the first 24 h after

birth and followed by 2 daily feedings of milk replacer (4 L/d) and ad libitum grain-based dry feed. Calves were transported (6 h) and then placed in outdoor individual hutches. Weights were collected pre- and post-transport then on d 7, 14, 21, 28, 35, and 42. Clinical and fecal scores, and nasal and ocular discharge were evaluated five times a wk for each calf. Repeated procedures in Mixed Models of SAS were used to analyze the data. Calf weights decreased from d 0 through post-transport for all treatments, then increased throughout the rest of the study ($P < .05$). Intake also increased over time ($P < .05$). Fecal scores were affected by treatment and time ($P < .05$), with group C having lower fecal scores throughout the 5 wk and all group scores decreasing over time. Additionally, the B group had greater (worsened) fecal scores at wk 2 than group C ($P < .05$) and tended to have greater scores than group A ($P = .10$). Eye lacrimation increased over time ($P < .05$), but was not different among treatments. Nasal discharges were different over time ($P < .05$), and tended to be different by treatment ($P = .06$). The A group had greater nasal discharge scores compared to the C group at wk 1 to 5, and than group B at wk 5 ($P < .05$) and tended to be greater ($P = .07$) than group B at wk 1 and 2. Clinical scores were different over time ($P < .05$), and at wk 5 the A clinical score was less than that of the C group ($P < .05$) and tended to be less than that of the B group ($P = .06$). These data suggest that calves may have increased susceptibility to intestinal disease when transported at 4 to 5 d-of-age and respiratory disease when transported at 2 to 3 d-of-age.

Key Words: Dairy calves, Transport, Stress

Goat Species: Forage/Browse Utilization

W118 Goat kid preference for forage. T. W. White*, H. G. Bateman, C. C. Williams, and S. Alford, Louisiana State University Agricultural Center, Baton Rouge, LA.

Six Boer x Spanish wether kids (mean BW = 18.7 ± 0.68 kg) were used in a preference experiment comparing alfalfa hay (AH), Coastal bermudagrass hay (CBH), fresh cut wheat (W), oat (O), white clover (WC), crimson clover (CC), rape (R), mustard (M), or turnip (T) forage. Fresh forages were cut daily, and all forages were sampled prior to feeding at 0800. Samples of each forage were composited weekly for analysis. Kids were exposed to each forage for 2 d prior to beginning the experiment. During the experiment, each kid was randomly offered known weights of two forages simultaneously in every combination for 2 d. After 3 h, remaining forages were removed and weighed and DMI calculated for each forage. Kids had access to grass hay until the next day. Data were analyzed by ANOVA with preplanned contrasts. Average DM consumption of the respective forages was 235, 195, 97, 113, 9, 15, 79, 32, and 37 g per day. As fed consumption was 260, 213, 560, 589, 48, 88, 569, 265, and 299 g per day. Average consumption as fed was higher ($P < 0.01$) for fresh forage than hay; however, on DM basis this was reversed ($P < 0.01$). Kids preferred AH ($P < 0.01$) to CBH on DM basis. Preference for fresh forages was similar when expressed on fresh and dry basis. Consumption of O and W was higher ($P < 0.01$) than for M, R and T or CC and WC. Kids preferred R ($P < 0.01$) to M or T. Kids consume relatively high amounts of O, W, and R but will ingest more DM in a given time when fed hay.

Key Words: Goats, Forage, Preference

W119 Effect of feeding shrub and tree leaves on carcass characteristics in growing goat kids. M. Guerrero-Cervantes, A. S. Juarez-Reyes, F. Rios-Rincon, and M. A. Cerrillo-Soto*, Universidad Juarez del Estado de Durango. Durango, Dgo. Mexico..

Foliage from shrubs and trees is an important source of protein, vitamins and minerals in arid regions specially during the dry season when other sources of food are scarce. Therefore, a study was undertaken to evaluate the effect of supplementing *Quercus grisea*, *Quercus eduardii*, *Acacia shaffneri*, and *Opuntia spp.* leaves to an oat straw-based diet on performance and carcass traits in male kids. Twenty intact male kids (14.9 ± 0.7 kg BW) were blocked by weight and randomly assigned to one of five treatments, four supplements and one control. The leaves were included in a proportion of 15% of the diet (isonitrogenous, CP = 14.2%). The kids were fed in individual stalls for an average of 120 days before they were humanely slaughtered. Analysis of variance (SAS) was conducted for a completely randomized design using live weight as

covariate. Slaughter weights were similar for all treatments ($P > 0.05$). Hot carcass weights were similar in kids supplemented with *Q. eduardii*, *Q. grisea* and *A. shaffneri* but were heavier than for kids fed *Opuntia* or control diets ($P < 0.05$). Kids supplemented with *Q. eduardii* had the heaviest empty body weight ($P < 0.05$). Kids fed *Q. grisea* and *A. shaffneri* had similar empty body weight ($P > 0.05$) but values were greater than for kids fed *Opuntia* or control diets ($P < 0.05$). A similar tendency was noted for rib eye area. Dressing percentages were similar among treatments ($P > 0.05$). It is concluded that feeding leaves from shrubs and trees commonly consumed by range animals might improve goat production via enhanced carcass characteristics.

Item	Treatments				
	<i>Quercus eduardii</i>	<i>Quercus grisea</i>	<i>Acacia shaffneri</i>	<i>Opuntia spp.</i>	Control
Initial weight (kg)	15.7±2.4	15.2±1.91	15.1±1.3	14.6±1.1	14.1±0.7
Slaughter weight (kg)	25.2±3.6	23.2±1.8	24.5±2.7	20.7±2.0	20.7±3.3
Hot carcass weight (kg)	11.3±1.9 ^a	11.0±1.8 ^a	10.9±1.2 ^a	8.9±1.0 ^b	9.0±1.8 ^b
Dressing (%)	46.8±1.9	44.4±1.4	43.9±0.7	43.0±1.2	43.0±1.6
Empty body weight (kg)	21.0±3.3 ^a	18.7±2.2 ^b	19.5±2.3 ^b	17.1±2.0 ^c	16.4±2.7 ^c
Rib eye area (cm ²)	13.5±2.4 ^a	12.2±2.3 ^{ab}	11.0±1.3 ^{ab}	7.5±0.6 ^b	10.0±1.1 ^{ab}

^{abc}Means within rows with same superscript differ ($P < 0.05$).

Key Words: Goat kids, Shrubs, Trees

W120 Effects of method of exposure of crossbred Boer wether goats to Eastern red cedar foliage on cedar consumption. G. Animut^{1,2}, A. L. Goetsch¹, R. C. Merkel¹, G. Detweiler¹, L. J. Dawson³, R. Puchala¹, T. Sahl¹, and R. E. Estell⁴, ¹E (Kika) de la Garza American Institute for Goat Research, Langston University, Langston, OK, ²Animal Science Department, Oklahoma State University, Stillwater, OK, ³School of Veterinary Medicine, Oklahoma State University, Stillwater, OK, ⁴USDA ARS Jornada Experimental Range, Las Cruces, NM.

This study was conducted to determine effects on present and future consumption of Eastern red cedar (*Juniperus virginiana*) foliage (CF) by goats of stepwise increases in dietary level of CF compared with a constant relatively high level and subsequent availability of low-quality forage. Twenty-four yearling wethers (23.5 ± 2.31 kg initial BW) were penned individually in Phases 1 and 3. In Phase 1 (8 wk), a concentrate-based diet (12.6% CP and 35.5% NDF) was offered at approximately