present in saliva at 9 ng/mL.

Key Words: cortisol, fermentation, rumen

1671 WS Shifting the paradigm of liver abscess dogma in USA feedlots. Z. Bester*[1], M. Hubbert[2], R. E. Carey[1], K. L. Samuelson[1], and C. A. Loest[1], *[1]New Mexico State University, Las Cruces, [2]Clayton Livestock Research Center, NMSU, Clayton, NM.*

Liver abscesses in feedlot cattle are a major economic, welfare, and production concern to the cattle feeding industry. Severe liver abscesses (LA) reduce ADG by as much as 0.20 kg, DMI by 5%, trimming loss by 0.43%, carcasses grading choice by 7%, and HCW by 36 kg. In processing facilities, LA introduce operational and food safety concerns. These include a reduction in processing efficiency, lost time as a result of line stoppages, and offal condemnation in addition to the consumer risk associated with LA contamination of edible meat. Tylosin phosphate, a macrolide antibiotic, has been shown to reduce LA by 75% and level of *Fusobacterium Necrophorum* in the rumen by 80 to 90%. During this initial observational study, a total of 83 feedlot pens (each individual feed yard exceeding 40,000 head capacity) within three geographical regions (Arizona, Colorado, and the Texas Panhandle) were sampled. Feedlot pen data were collected within 1 wk before harvest and cattle were traced to the packing plant. Every third rumen and its matching liver were tagged (if condemned only). Rumens were scored for consolidation, scars, moderate and acute lesions, and a sample was taken. Livers were scored based on an adaptation of the Elanco Liver Check scoring system. Holstein cattle had a greater ($P < 0.05$) percentage of LA than beef breeds (30.3 vs. 20.0%). Additionally, Holstein cattle had 11% severe LA (A+) compared with 4% for beef breeds ($P < 0.05$). No geographical difference ($P \geq 0.10$) were detected for liver abscess prevalence and averaged 23, 25, and 26% for the Texas Panhandle, Arizona, and Colorado regions, respectively. Liver abscess rate and severe LA (A^+) incidence differed between feedlots ($P < 0.05$) with within feedlot variation. A correlation was observed for LA% and days on feed ($R^2 = 0.22$; $P = 0.04$) and for LA % and breed ($R^2 = 0.29$; $P = 0.01$). No correlation was observed between LA percentage and tylosin phosphate, and between LA percentage and rumen lesions ($P \geq 0.10$). These data indicated no association between LA and rumen damage as a result of acidosis. Rumen lesions averaged 12.2%, of which 9.3% were consolidated, 2.4% scar tissue, and the remainder moderate and acute lesions. This study justifies further investigation of feedlot soil and manure as the source of LA causing pathogens to evaluate the within feedlot variation observed for in LA percentage in cattle.

Key Words: cattle, feedlot, liver abscess

SMALL RUMINANT

1672 Protein supplementation and herbage allowance for pregnant ewes grazing low-quality pasture. C. H. E. C. Poli*[1,2], B. M. Paulino[1], A. B. Moraes[1], Z. M. S. Castilhos[3], F. C. A. Silva[3], N. M. Fajardo[1], C. M. Pimentel[4], D. B. David[5], E. B. Azevedo[6], and J. J. Villalba[2], *[1]Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil, [2]Utah State University, Logan, [3]Fundação Estadual de Pesquisa Agropecuária, Porto Alegre, Brazil, [4]Universidade de Brasília, Brasília, Brazil, [5]Fundação Estadual de Pesquisa Agropecuária, São Gabriel, Brazil, [6]Universidade Federal do Pampa, Itaqui, Brazil.*

Protein supplements mixed with mineral salt have been widely used in beef production in tropical countries, but few studies have been performed to test their use with sheep or pregnant animals. This study assessed the effect of protein supplementation under two herbage allowances aiming at overcoming ewe undernutrition during gestation and lactation in low-quality pastures during winter. At approximately fifty days of gestation, 36 ewes carrying singletons and of similar stage of pregnancy were chosen from a group of 50 using an ultrasound technique. Ewes were allocated into four treatments in a randomized block design with three replications, where each paddock with 3 ewes was considered the experimental unit. The treatments were arranged in 2 x 2 factorial design of two herbage allowances: 1) low (LH) 10 kg^{-1} dry matter (DM) per 100 kg liveweight (LW) and 2) high (HH) 20 d^{-1} DM per 100 LW; and two supplements: 1) protein plus a mineral salt mix (PS) and 2) mineral salt alone (S). Both supplements were offered in ad libitum amounts. Due to differences in daily nutrients requirements and pasture quality, the trial was divided into two periods: pregnancy and lactation. Animals grazed a low-quality *Brachiaria arrecta* cv. Napier (crude protein: 67 g kg^{-1}, neutral detergent fiber: 710 g kg^{-1}) pasture. Animal performance was assessed every 21 d. Other variables such as herbage structure and composition, lamb birth weight, daily supplement intake, and placenta weight were also measured. There was no effect ($P \geq 0.05$) of PS on ewe average daily gain (ADG), placenta weight, lamb birth weight or lamb ADG. Protein supplement intake was greater ($P \leq 0.05$) than mineral salt intake in both reproductive stages, being greater during lactation, but it was not enough to increase the productive performance of ewes during the last third of pregnancy or during lactation. In conclusion, regardless of herbage allowance, the use of protein supplements on low-quality pastures does not improve the nutritional status of ewes or lambs before weaning. **Key Words:** fetal development, maternal nutrition, sheep

Fig 1673.

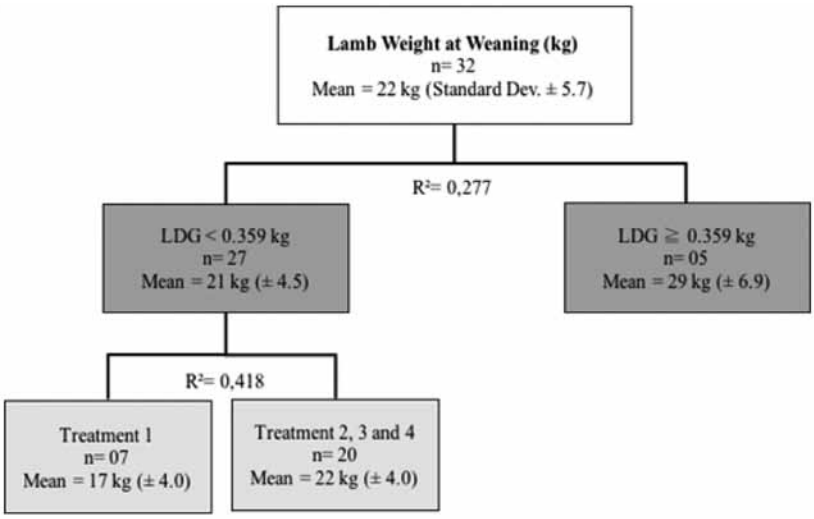

Figure 1 Decision Tree Test showing the lamb weight at weaning partitioned through R^2-values, explained by lamb daily gain (LDG) and treatments (food restriction during different ewe pregnancy periods).

1673 Food restriction in ewes during different pregnancy periods affects milk production and lamb growth. C. H. E. C. Poli*[1,2], L. A. Sphor[2], A. L. G. Monteiro[3], J. F. Tontini[2], C. Bremm[2], P. C. F. Carvalho[2], and J. J. Villalba[1]. *[1]Utah State University, Logan, [2]Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil, [3]Universidade Federal do Paraná, Curitiba, Brazil.*

This study assessed the effect of food restriction during different periods of ewe pregnancy on milk production and lamb growth. Thirty-five adult pregnant ewes were assigned to four treatments (7–10 animals/treatment), which varied in the period when food restriction (removal of a supplement fed at 150 g/Kg BW/day) was applied: first third period of pregnancy (T1); second third period of pregnancy (T2); third third period of pregnancy (T3), or no supplement restriction (Control; T4). All ewes grazed together in a Bermuda grass cv. Tifton-85 pasture of low biomass (below 1000 kg DM/ha), and once a day they received the supplement [14% CP; 3.5% EE; 16% ADF], or not, according to treatment. Ewes were weighed every 14 d during pregnancy. Lamb birth weight (LBW) and placenta weight (PW) were assessed at lambing. Daily milk production (MP) and lamb daily gain (LDG) were recorded until weaning. The experiment was performed in a completely randomized design, and the data were analyzed by a Decision Tree multivariate analysis. Treatments explained 23% of MP, with greater milk production per day for T2 and T4 (3423 g ± 1047.7 g SD) than for T1 and T3 (2294 g ± 1091.1 g SD). LBW was best explained by the number of lambs per ewe (R^2 = 0.52), and PW had a positive correlation (R^2 = 0.72) with LBW, independent of the number of lambs per ewe. When the LDG was lower than 359 g, the lowest LDG and the lamb weight at weaning were observed in T1 (Fig. 1). Despite the relatively low nutrient requirements from ewes during early pregnancy, these results point to the importance of avoiding dietary restriction during this period to enhance MP and LDG. On the other hand, nutrient restriction during mid-pregnancy had no consequences on milk production or lamb growth.

Key Words: sheep nutrition, sustainability, fetal development

1674 Relationship between infrared thermography measures and feed efficiency in New Zealand sheep. S. P. Miller*[1], S. Dowling[2], J. C. Munro[3], Y. R. Montanholi[3], J. R. Webster[2], and P. L. Johnson[1], *[1]AgResearch, Mosgiel, New Zealand, [2]AgResearch, Hamilton, New Zealand, [3]Department of Plant and Animal Sciences, Faculty of Agriculture, Dalhousie University, Truro, Canada.*

A data set to investigate genetic parameters for feed efficiency in New Zealand maternal sheep is being collected. As measurement of this trait is expensive, route to market for breeders will be through genomic selection. Another potential way to enable breeders to select for this difficult to measure trait, combined with genomics will be through predictor traits. Using custom built electronic feeding stations, individual feed intake was collected on 197 ewe lambs born in September 2014 with the 6-wk feed intake trial taking place June-August 2015. Residual feed intake (RFI; MJ/day) was determined using a prediction model that included mid-point body weight ($kg^{0.75}$) and average daily gain. Infrared thermography measures were investigated as a potential indicator trait with images collected at two time points. A thermal video captured the left side of the head, and back of the ear (approximate distance of 0.5 m), using an infrared camera (ThermaCamS60, FLIR, Systems AB, Dandoryd, Sweden). Four head sub-regions were identified

and maximal and average temperature calculated for the eye, bridge of the nose, muzzle, and middle of the back of the ear. To identify potential regions of influence a sub-set of images from 30 individuals were interpreted representing the six most extreme RFI animals (three high RFI; three low RFI), and also individuals with extreme RFI values from four sires identified as the producers of the most extreme RFI progeny (two high RFI sires; two low RFI sires). The difference in RFI was significant ($P < 0.001$) between the extreme groups (-1.5 ± 0.28 MJ/day vs. $+1.6 \pm 0.29$ MJ/day). Within a time point, the average temperature measurements for the four different positions were significantly correlated (all $P < 0.01$). Between time points, back of the ear measurements showed the highest correlation ($r = 0.7$; $P < 0.001$) and the greatest mean temperature difference between groups at each measurement point. At the first time point, the estimated average ear temperature of the lowest RFI animals was 26.7 ± 0.67°C vs. 29.2 ± 0.69°C for the highest RFI animals ($P = 0.015$), with corresponding values at the second time point of 27.2 ± 0.55°C vs. 29.5 ± 0.59°C ($P = 0.011$). These results provide evidence of a relationship between thermal images and feed efficiency in maternal growing sheep that will be investigated further as a potential indicator trait for selection in industry.

Key Words: indirect, phenotyping, selection

1675 Ground redberry juniper and urea in supplements fed to Rambouillet ewe lambs on growth, blood serum, and fecal N.

T. R. Whitney[*1] and J. P. Muir[2], *[1]Texas A&M AgriLife Research, San Angelo, [2]Texas A&M AgriLife Research, Stephenville.*

Effects of using ground redberry juniper and urea in dried distillers grains with solubles (DDGS)-based supplements fed to Rambouillet ewe lambs ($n = 48$; 42 kg ± 3.8) on growth, blood serum, and feces were evaluated. In a randomized design study (40 d), individually-penned lambs were fed a basal diet of ground sorghum-sudangrass hay (ad libitum) and of 1 of 8 supplements (fed separately from the hay; 6 lambs/treatment; 496 g/d; DM basis) in a 4 × 2 factorial arrangement with 4 concentrations of ground juniper (15, 30, 45, or 60% of DM) and 2 levels of urea (1 or 3% of DM); dried distillers grains with solubles was replaced as percentage of juniper increased. Lamb growth was evaluated on d 0, 5, 12, 19, 26, 33, and 40. Blood serum was evaluated on d 6 to 8, 20 to 22, and 34; feces were collected on d 34. A repeated measures analysis showed factorial by day interactions ($P < 0.001$) for hay DMI, total daily DMI, BW, ADG, and G:F, with only a few differences within day. Overall, hay and total DMI were similar among lambs ($P > 0.44$), but lambs fed 60% juniper-based supplements had the least amount of supplement intake ($P < 0.01$). Overall, lambs fed 15% juniper-based supplements had the greatest ($P < 0.04$) ADG and G:F vs. the other lambs. Percentage of urea in the supplement did not affect ($P > 0.23$) overall intake of hay or supplement, ADG, or G:F. However, lambs fed 15% juniper-based supplement tended to have greater ($P = 0.07$) final BW than lambs fed 60%, and urea used at 1% of supplement vs. 3% resulted in reduced final BW ($P = 0.03$). Fecal DM was similar ($P > 0.15$) among lambs, but fecal N was greater ($P < 0.02$) for lambs fed the 15% and 45% juniper-based supplements vs. 60% juniper-based supplement. In conclusion, when ewe lambs were fed a low-quality basal hay diet, growth performance declined when 60% juniper or 3% urea was used in supplements. This decline can be attributed to differences in supplement concentrate:forage ratio, fiber, degradable N, and plant secondary compounds, all of which can affect intake and growth. However, an economic analysis is needed to determine maximum inclusion rate of juniper and urea in rangeland supplements, especially when trying to only meet the maintenance requirement of the animal.

Key Words: juniper, lambs, supplement

1676 The relationship between body condition score and body weight, body linear measurements and real-time ultrasound body composition measurements in Alpine does before breeding and kidding.

F. R. B. Ribeiro[*1], B. Barcelos[2], L. C. Nuti[1], W. B. Foxworth[1], S. K. Lewis[1], Y. Jung[1], S. Horner[1], B. L. Jackson[1], and G. R. Newton[1], *[1]Prairie View A&M University, Prairie View, TX, [2]School of Animal Science and Food Engineering, University of Sao Paulo, Pirassununga, Brazil.*

The objective of this study was to determine the relationships between body condition score (BCS) and body weight (BW), hip height (HH), wither height (WH), girth circumference (GC), and real-time ultrasound (RTU) measurements of body composition in Alpine does before breeding ($n = 66$) and before kidding ($n = 34$). Thirty-two animals were not included in the before kidding measurements due to culling or failure to give birth. The body composition traits measured by RTU were 12th–13th rib fat thickness (uBF) and rump fat thickness (uRUMP). Ultrasound measurements were taken using an Aloka 500 with a 12 cm 3.5 MHz transducer. Hair was clipped and vegetable oil was used as a coupling agent to enhance image quality. Data were analyzed using the Proc CORR and Proc REG procedures of SAS. Body condition score was highly correlated ($P < 0.01$) with uBF and uRUMP before breeding ($r = 0.45$ and 0.39, respectively) and before kidding ($r = 0.84$ and 0.74, respectively). Body weight and HH were highly correlated before breeding ($r = 0.63$; $P < 0.0001$), but not before kidding ($r = 0.27$; $P = 0.12$). Girth circumference was highly correlated to BW ($r = 0.78$; $P < 0.0001$) and correlated to HH ($R = 0.38$; $P = 0.037$) before kidding. Wither height and HH were highly correlated only when measured before kidding time ($r = 0.63$; $P < 0.001$). Prediction equations were developed to predict BCS using a stepwise procedure. Body condition score before breeding can be predicted from uBF with an R^2 of 0.21. Prediction of

BCS before kidding using uBF had an R^2 of 0.63, which was the first variable included in the model. Inclusion of three additional variables (uRUMP, HH, and WH) in the full model improved the R^2 to 0.76. Results indicate that RTU body composition traits are highly correlated with BCS in Alpine goats and that the accuracy of prediction was improved when does were close to parturition. More research is needed to refine the models and improve accuracy of prediction.

Key Words: body composition, goat, ultrasound

1677 Effects of selection for high and low juniper-consuming goats on rumen fermentation characteristics. W. C. Stewart*[1], T. R. Whitney[2], E. J. Scolljegerdes[3], D. F. Waldron[4], J. W. Walker[4], and J. M. B. Musser[5], *[1]Montana State University, Bozeman, [2]Texas A&M AgriLife Research, San Angelo, [3]New Mexico State University, Las Cruces, [4]TX A&M AgriLife, San Angelo, [5]Texas A&M, College Station.*

The objective of this study was to determine if ruminal fermentation characteristics differed in goat lines selected for high (HIGH) or low (LOW) juniper-consumption. Five Boer × Spanish-composite bucks (age = 2 yr; initial BW = 67.2 ± 4.3 kg) selected from each line were subjected to three different 25-d periods: 1) native range infested with juniper (Period 1); 2) group fed ad libitum sorghum × sudangrass hay (Period 2); 3) individually fed 3% BW of sorghum × sudangrass hay and ad libitum redberry juniper foliage offered fresh daily (Period 3). During each period, rumen fluid was evaluated for pH, VFA, ammonia N (NH_3–N), and IVDMD of juniper foliage. There was a period effect ($P < 0.02$) for all response variables. A selection line × Period interaction was observed for total VFA ($P < 0.01$) because HIGH, which exceeded LOW during Periods 1 and 3 was lower in Period 2. However, total VFA did not differ within period between HIGH and LOW. During Period 1, when goats grazed juniper infested native rangelands, rumen fluid from HIGH contained greater ($P < 0.05$) ruminal isovalerate, and tended to have greater ruminal isobutyrate ($P = 0.09$) and NH_3–N ($P = 0.07$) than LOW. When transitioned to a sorghum × sudangrass hay diet (Period 2), total ruminal VFA concentrations declined 26 and 4% for HIGH and LOW, respectively, and total VFA ($P = 0.08$) and valerate ($P = 0.09$) tended to be greater for LOW compared to HIGH. In vitro digestibility of juniper did not differ ($P = 0.48$), but declined 13 and 12% for HIGH and LOW, respectively, from Period 1 to 2. During Period 3, when transitioned to individual pens with ad libitum access to sorghum × sudan hay and juniper foliage, juniper intake did not differ ($P = 0.16$) with HIGH consuming 1.2 g/kg BW of juniper compared to 0.62 g/kg BW for LOW. Although no differences were detected ($P > 0.05$) for VFA, NH_3–N, pH, and IVDMD between HIGH and LOW goats during Period 3, total VFA from HIGH increased 48% vs. 7% in LOW from period 2 to 3. Propionate increased 16% in HIGH compared to a 5% decrease in LOW from Period 2 to Period 3. Overall, results indicate that ruminal fermentation characteristics differ between divergent goat lines selected for high and low juniper consumption when consuming diets with and without juniper.

Key Words: genetic selection, goats, juniper

1678 Ground redberry juniper and urea in DDGS-based supplements do not adversely affect ewe lamb rumen microbial communities. S. L. Ishaq*[1], C. J. Yeoman[1], and T. R. Whitney[2], *[1]Montana State University, Bozeman, [2]Texas A&M AgriLife Research, San Angelo.*

Effects of using ground redberry juniper and urea in dried distillers grains with solubles (DDGS)-based supplements fed to Rambouillet ewe lambs ($n = 48$; 42 kg ± 3.8) on ruminal parameters and microbial communities were evaluated. In a randomized design study (40 d), individually-penned lambs were fed ad libitum, a basal diet of ground sorghum-sudangrass hay and of 1 of 8 supplements (6 lambs/treatment; 496 g/d; DM basis) in a 4 × 2 factorial arrangement with 4 concentrations of ground juniper (15, 30, 45, or 60% of DM) and 2 levels of urea (1 or 3% of DM). Growth performance, serum, and fecal characteristics were reported. Ruminal fluid was collected via oral lavage at the end of the trial (d 34). Total VFA was unchanged ($P > 0.51$) with supplements. As a percentage of total VFA, propionic was similar ($P = 0.34$), acetic acid increased ($P = 0.004$) and butyric acid decreased ($P = 0.03$) as concentration of juniper increased in the supplement; urea did not have an effect ($P > 0.10$). Ammonia N was not affected ($P > 0.12$), but ruminal pH increased ($P < 0.001$) with juniper concentration; not with urea ($P > 0.89$). Treatment (individual juniper or urea concentrations, or juniper × urea) effects on operational taxonomic unit (OTU) abundance were not significant using ANOSIM ($P > 0.05$), AMOVA ($P > 0.01$), or PERMANOVA ($P > 0.05$). Treatments did not produce significantly different phylogenetic trees by structure ($P > 0.05$, unweighted UniFrac), but did produce some small, yet significant pairwise comparisons by abundance (weighted UniFrac). Samples did not significantly cluster by diet or supplements using metric multi-dimensional scaling plots. Families Prevotellaceae and BS11 gut group (Bacteroidetes) decreased with increasing concentrations of both juniper and urea, while families Acidaminococcaceae and S24–7 increased. Christensenellaceae and Lachnospiraceae increased with juniper concentration at a 1% urea. High concentrations of juniper were associated with Moraxella and Streptococcus, low concentrations of urea were associated with Fretibacterium, and high concentrations of urea were associated with Oribacterium and Pyramidobacter. In conclusion, on a low-quality basal hay diet, ewe lamb ruminal parameters can be attributed to differences in the concentrate:forage ratio, fiber, degradable N, and secondary compounds. Despite some differences in bacterial

diversity between treatments, due to changes in volatile fatty acid profile, ammonium, and pH, there was not a significant difference in OTU presence or abundance.

Key Words: bacterial diversity, lambs, supplement

1679 Fatty acid profile, sensory traits, and aromatic compounds of chops from lambs fed ground woody plants as roughage in feedlot finishing diets. K. R. Wall[*1], C. R. Kerth[1], T. R. Whitney[2], S. B. Smith[1], J. L. Glasscock[2], and J. T. Sawyer[3], [1]TX A&M University, *College Station, [2]Texas A&M AgriLife Research, San Angelo, [3]Tarleton State University, Department of Animal Science and Veterinary Technology, Stephenville, TX.*

We hypothesized that ground woody plants in feedlot diets would increase saturated fatty acids and modify sensory characteristics and volatile aroma compounds of loin chops. A completely randomized design study using Rambouillet wether lambs (n = 48) consisted of 2 feeding periods: Period 1 = fed a 70% concentrate (consisting mainly of 40% dried distillers grains with solubles, DDGS; 21.7% sorghum grain) diet from d 0 to 27 d and Period 2 = fed an 86% concentrate (consisting mainly of 40% DDGS and 37.5% sorghum grain) diet from d 28 to 57. In each feeding period, lambs were individually fed 6 diets that differed only by roughage source: cottonseed hulls (CSH; control) or ground wood consisting of either redberry (RED), blueberry (BLUE), or one-seed juniper (ONE), eastern red cedar (ERC), or mesquite (MESQ). After humanely harvesting the lambs and chilling the carcasses for at 48°C for 48 h, five chops, 2.54-cm thick, were cut starting from the posterior end of the LM; the first chop was designated the analysis of fatty acid composition, cut to straighten the LM face, vacuum-packaged separately, and stored at −80°C until analyzed. Subsequently, four, 2.54-cm-thick chops were serially cut for sensory and GC/MS/Olfactory analysis, labeled, vacuum packaged separately, and stored at −10°C until analyzed. Chops from lambs fed MESQ tended (P = 0.07) to have less total saturated fatty acids compared to chops from lambs fed either RED or ONE. No other fatty acids were affected (P > 0.10) by roughage source. Neither sensory traits nor cook loss percentage were affected (P > 0.17) by roughage source. A total of 95 aroma chemical compounds were detected by GC/MS/Olfactory methods and included alkanes, alcohols, aldehydes, acids, ketones, sulfur-compounds, and pyrazines. The CSH had greater (P < 0.05) amounts of 1-pentanol (bread or cereal aroma) compared to BLUE, ERC, or MESQ. Heptanal (medicinal aroma), pentanal (bread aroma), 1-(1H-pyrol-2yl)-ethanone, 2-heptanone (fruity aroma), and 2-pentyl furan (caramel aroma) amounts were greater (P < 0.05) in CSH than all other roughages. We conclude that woody plants can be included in feedlot rations of lambs with no adverse affects on fatty acid profile, sensory traits, or aromatic compounds.

Key Words: carcass, lamb, sensory

1680 Feeding behavior of grazing lambs in a silvopastoral system. F. de Oliveira Scarpino van Cleef[*1,2], T. Silva do Nascimento[1], L. Ariel Tosi[1], D. J. A. Santos[1], and A. C. Ruggieri[1,2], *[1]Sao Paulo State University, Jaboticabal, Brazil, [2]CNPq, Brasilia, Brazil.*

Silvopastoral systems may contribute to the reduction of the effects caused by climate change in grazing animals. The aim of this study was to evaluate the presence of trees (*Eucalyptus urophylla* × *Eucalyptus grandis*) on the behavior of grazing finishing lambs in Massai grass (*Panicum maximum* × *Panicum infestum*). Twenty-four crossbred lambs (27 ± 3.3 kg BW and approximately 90 d old) were blocked by initial BW and assigned into three experimental treatments: TA = unshaded Massai grass pasture; TB = Massai grass pasture with eucalyptus trees spaced 12 × 2m; TC = Massai grass pasture with eucalyptus trees spaced 6 × 2m. Light interception was the criteria for starting grazing period and the residual pasture height was fixed in 20 cm. Animals were observed over 9 consecutive days (3 d of occupation in each of 3 paddocks) to assess the grazing activities: feeding (FE), lying ruminating (LR), standing ruminating (SR), lying (LY), standing still (SS), searching for food (SF), and other activities (OT). Three trained observers recorded the behavioral activities, every 10 min, for 12 h (from 0700 to 1900 h). Data were submitted to analysis of variance and F test at 5% significance, using the GLM procedure of the statistical package SAS, and the treatments' means were compared using Tukey test at 5% significance. They were included in the model the treatment, block, day of occupation, day of occupation nested within the treatment, and interactions of treatment × block, and treatment × day of occupation. Animals in TA spent more time on FE (TA = 59%, TB = 53%, TC = 50%, P < 0.0001), with no differences observed between treatments with trees. Time of LR was greater for TB (TA = 25.7%, TB = 30%, and TC = 23%, P < 0.0001), and the interaction was observed between TB and day of occupation (P = 0.02), with animals spending more time on this activity at second and third occupational d. On the other hand, animals in TC stayed more time on LY (TA = 5.7%, TB = 7.7%, and TC = 11.8%,P < 0.0001), SS (TA = 2.5%, TB = 3,01%, and TC = 4,2%, P = 0.0001), and having other activities (TA = 0.7%, TB = 0.6%, and TC = 2.9%, P < 0.0001) than animals in TA and TB. The activities SR and SF did not differ among treatments (P = 0.08 and P = 0.14, respectively). Because of the greater availability of shade, the silvopastoral system improved the state of welfare of the lambs, shown by the greatest time spent on ruminating.

Key Words: eucalyptus, silvopastoral, sheep

Table 1681.

Table 1. Digestibility and performance of hair sheep lambs fed with ammoniated cotton gin trash treated with exogenous fibrolytic enzymes (EFE).

Variables	EFE					CV (%)	Regression		R^2
	Control	0%	2%	4%	6%				
DM	39.1	40.2	45.3*	48.2*	50.7*	8.2	$\hat{Y}$= 40.948 + 1.718x		0.97
OM	40.7	42.3	45.7	48.3	50.1	9.2	$\hat{Y}$= 42.708 + 1.299x		0.98
CP	45.5	40.8	48.3	46.1	48.8	16.7	$\hat{Y}$= 46.0		-
EE	44.4	44.5	44.7	45.1	45.3	18.0	$\hat{Y}$= 44.9		-
NDF	45.3	40.1	39.9	39.1*	38.4*	9.3	$\hat{Y}$= 40.262 - 0.295x		0.95
ADF	44.4	39.6	38.0	37.3*	36.5*	10.6	$\hat{Y}$= 39.354 - 0.505x		0.96
FC	42.0	37.1	36.8	35.6*	35.0*	8.1	$\hat{Y}$= 37.252 - 0.375x		0.95
NCF	26.2	51.5*	54.4*	56.3*	59.0*	23.6	$\hat{Y}$= 51.642 + 1.223x		0.99
TDN	41.1	45.6	48.7*	50.6*	53.2*	11.5	$\hat{Y}$= 45.814 + 1.240x		0.99
								Males	Female
IW (kg)	20.0	20.7	20.6	21.2	21.2	8.7	$\hat{Y}$= 20.9	20.3 a	21.2 a
FW (kg)	30.7	33.1	33.6	34.5	34.8	7.2	$\hat{Y}$= 34.0	35.5 a	31.2 b
TG (kg)	10.7	12.4	13.0	13.3	13.6	15.8	$\hat{Y}$= 13.1	15.2 a	10.0 b
DLG (g d^{-1})	170.1	196.2	206.0	210.9	215.1	15.8	$\hat{Y}$= 207.0	240.9 a	158.4 b
FCR (kg/kg)	15.3	15.9	14.8	15.0	15.1	18.5	$\hat{Y}$= 15.2	16.2 a	14.2 a

R^2 = coefficient of determination. C.V. (%) = coefficient of variation. IW = initial weight. FW = final weight. TG = total gain. DLG = daily liveweight gain. FCR = feed conversion ratio. Mean followed by same letters are not significantly different by F test (5%). * P< .05

1681 Intake, digestibility, and performance of hair sheep lambs fed with ammoniated cotton gin trash treated with exogenous fibrolytic enzymes. D. G. Quadros*, *Bahia State University, Barreiras, Brazil.*

This study was performed to evaluate intake, digestibility, and performance of Santa Ines lambs fed with diets containing ammoniated cotton gin trash (CGT) treated with exogenous fibrolytic enzymes (EFE). CGT was pre-treated with 6% urea (25% of moisture for 80 d) according previous studies. Treatments were 0, 2, 4, and 6% of EFE (75% cellulase and 25% hemicellulase), applied 24h before feeding. In addition, there was a control group fed with non-ammoniated and untreated CGT. The experiment was a completely randomized block design with five treatments and six replications (animals), with three males and three females per treatment, from February to May 2014 in Animal Science Center at UESB, in Vitoria da Conquista, Bahia, Brazil. Isonitrogenous and isocaloric diets were balanced according to NRC for 20 kg animals, liveweight gain of 200 g with estimated intake of 4.5% of bodyweight (61% TDN and 15% CP). Concentrate contained corn, soybean meal, and minerals, fed in a concentrate:roughage ratio of 50:50. The lambs were feedlotted for 84 d, being the first 21 d of adaptation and three periods of data collection of five consecutive days in each 16 d. For evaluating intake and digestibility, feed, orts, and feces were collected, using NDFi as an internal marker. There was no effect of EFE on intake, with the average values of 1311.4, 1189.9, 254.1, 748.9, and 810.0 g per day for DM, OM, CP, NDF, and TDN, respectively. EFE increased NFC intake ($P < 0.05$), by 17.0% units for each 1% of EFE. There were no differences on apparent digestibility of CP and EE ($P > 0.05$) with EFE application; however, digestibility of DM, OM, NDF, ADF, FC, NFC, and TDN were increased linearly ($P < 0.05$). Males (240 g) gained daily more weight than females (158.4 g) ($P < 0.05$), although there was no effect of EFE ($P > 0.05$). Despite the benefits of ammonization and EFE on digestibility and intake of CGT, there was no significant effect on performance.

Key Words: cellulase, feedlot, hemicellulase, ruminants.

1682 Effects of forage quality and breed on rumination time in goats. S. N. LeShure*, T. A. Gipson, A. L. Goetsch, R. Puchala, and T. Sahlu, *American Institute for Goat Research, Langston University, Langston, OK.*

Rumination time is one of the many key factors in determining animal wellbeing. The objective was to investigate effects of forage quality and breed on rumination time in goats. The experiment was 2 simultaneous 4 × 4 Latin squares having a 2 × 4 factorial treatment arrangement with 2 breeds (Alpine and Spanish) and 4 treatments [24 h fasting (FAST), low-quality hay (LOW; mixed grass), LOW plus concentrate (CONC; 80% corn and 20% soybean meal at 1% BW(DM)), and high-quality hay (HIGH; alfalfa)]. Twelve mature does of each breed were placed in individual metabolic crates and given free access to hay unless fasting. There were 4 periods of 72 h with 3 rotations of 8 does/day (24 h × 3 d). Does were digitally recorded for 24 h, then observations were encoded for ruminating bouts and bout duration. Data were analyzed using a mixed model consisting of DMI as a covariate, treatment, breed, and treatment x breed as fixed effects and animal within square as a random effect. Feed intake relative to $BW^{0.75}$ was 0, 17, 28, and 21 g/kg $BW^{0.75}$ for FAST, LOW, CONC, and HIGH, respectively (SEM = 1.6) and 17 and 16 g/kg $BW^{0.75}$for Alpine and Spanish, respectively (SEM = 1.4).

Total rumination duration was affected by breed ($P < 0.01$) and treatment ($P < 0.01$). Alpine goats ruminated longer ($P < 0.01$) than Spanish (310 vs. 249 min, respectively; SEM = 12.8) and rumination duration while fasting was lower ($P < 0.01$) than for other treatments (229, 313, 282, and 295 min for FAST, LOW, CONC, and HIGH, respectively; SEM = 17.6). Treatment did not affect ($P > 0.10$) the number of rumination bouts; however, Alpines had a greater ($P < 0.01$) number of bouts than Spanish (29 vs. 20 bouts, respectively; SEM = 1.9). Average bout duration was affected by both treatment ($P < 0.01$) and breed ($P < 0.01$). Average bout while fasting was shorter ($P < 0.01$) than for other treatments (10, 13, 13, and 15 min for FAST, LOW, CONC, and HIGH, respectively; SEM = 0.9). Spanish had longer ($P = 0.03$) rumination bouts than Alpine (14 vs. 11 min, respectively; SEM = 0.8). In conclusion, similar dry matter intake among non-fasting treatments may have prevented effects on rumination, although greater differences between breeds and fasting state had marked influences.

Key Words: forage quality, goats, rumination

1683 Genome-wide association analysis of residual feed intake and milk yield in dairy goats.

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Interest in both dairy and meat goat production in the US has been increasing, and there is tremendous opportunity for genetic progress in traits that are easy to measure (e.g., milk yield) and those that are more difficult (e.g., residual feed intake, RFI). However, there is little research or infrastructure within the goat industry for implementation of large-scale genetic evaluation. The objective of this study was to conduct a genome-wide association study (GWAS) for RFI and total milk yield in dairy goats. Forty-eight Alpine females (56.4 ± 7.15 kg BW; 423 ± 146.1 kg milk; 225 ± 20.9 d in milk; 16 primiparous) were used. Data in mid- to late lactation were used to calculate RFI. Milk yield and components were collected over a 12-wk period in mid- to late lactation and were used to calculate energy-corrected milk yield (ECMY). ECMY DMI, and BW from the same period were used to calculate RFI, which ranged from −794 to 594 g. DNA was collected via venipuncture and stored on Whatman FTA cards. Genotypes were assayed using the Illumina 52K goat SNP chip. SNPs with a minor allelic frequency < .01 were removed, resulting in 48,632 SNPs available for analysis. Missing genotypes were imputed using BEAGLE and SNP effects were estimated using GenSel on the iPlant platform. For RFI, the posterior mean of the residual variance was 47,934 and the posterior mean of genetic variance was 14,428, giving an estimated heritability of 0.23. For total milk yield, the posterior mean of the residual variance was 10,141 and the posterior mean of genetic variance was 9826, giving an estimated heritability of 0.49. The 100 SNP with the greatest effects contributed 3.1% and 3.3% of the total genetic variance for RFI and total milk yield, respectively. Although the sample size in this study is very small and the ideal usage of genomic information would be to supplement large-scale genetic evaluation programs, it illustrates the potential of utilizing genomic selection with phenotypes on large populations of dairy goats to make genetic improvement. Genetic selection for RFI and milk yield in dairy goats may be expedited by selection programs that incorporate genomic information, particularly in the absence of large, nationwide breeding value prediction programs.

Key Words: dairy goats, residual feed intake, SNP

1684 Effect of Narasin on nutrient intake and digestibility in wethers fed high-forage diets.

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The objectives in this trial were to determine the effects of adding increased levels of narasin on nutrient intake and digestibility in wethers fed low quality forage. Five White Dorper x Santa Inês wethers (BW 68.7 ± 2.1 kg), cannulated in the rumen, were used in a 5 × 5 Latin square design. Animal were fed daily and diet was composed of coastcross bermudagrass hay (91.0% DM; 67.2% NDF; 32.1% ADF; 6.8% CP; 3.2% EE; 17.3% NFC; 5.5% ash). Narasin was offered twice a day and levels were 0 (control, N0), 8 (N8), 16 (N16), 24 (N24), or 32 (N32) mg/kg DM, corresponding to 0, 80, 160, 240, and 320 mg of Zimprova 100®. The delivery vehicle of narasin was 20 g of ground corn containing the set dosage of narasin in 1 kg of DM. Every experimental period lasted 20 d. The first 15 d were used to adapt the wethers with the experimental diets. Daily feed intake and fecal output were determined on Days 16, 17, 18, and 19 of each period. For total collection of feces, harnesses with collection bags were used to avoid contamination of feces by urine. Data were analyzed using the MIXED procedure (SAS Inst. Inc.) and the LSMEANS option was used to generate individual means. The effect of narasin levels were evaluated using linear and quadratic orthogonal contrasts. The effects were considered significant when $P < 0.10$. Increasing levels of narasin did not affect dry matter (1.1 ± 0.2 kg; $P = 0.70$), organic matter (1.0 ± 0.2 kg; $P = 0.69$), NDF (0.7 ± 0.1 kg; $P = 0.69$), and ADF (0.3 ± 0.01 kg; $P = 0.68$) intakes. Experimental diets did not affect DM (50.5 ± 2.6%; $P = 0.57$) and OM (50.9 ± 2.6%; $P = 0.63$) digestibilities. However, narasin increased linearly NDF digestibility (N0: 50.4%; N8: 53.7%; N16: 51.8%; N24: 55.0%; N32: 55.2%; $P = 0.06$). ADF digestibility tended to differ with increased levels of narasin (N0: 49.1; N8: 51.1; N16: 49.2; N24:

53.4; N32: 53.0%; $P = 0.15$). Levels of narasin improve NDF digestibility in wethers fed a low quality forage diet without affecting nutrient intake.

Key Words: intake, ionophore, narasin.

1685 Effects of different levels of zilpaterol hydrochloride on feedlot performance and carcass characteristics of hair-breed ram lambs.

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Twenty-four Dorper × Pelibuey ram lambs initially weighing 30.73 ± 1.04 kg were used in a randomized complete block experimental design to evaluate effects of different levels of zilpaterol hydrochloride (ZH; 0, 0.1, 0.2, and 0.3 mg/kg BW) on feedlot performance and carcass characteristics of ram lambs. After a 30-d feeding period, all lambs were harvested. All data collected were analyzed with analysis of variance using the MIXED procedure of SAS (SAS Inst. Inc., Cary, NC). Means were separated with a PDIFF STDERR statement. Significance was declared at $P \leq 0.05$ and tendency when $0.05 < P \leq 0.10$. The doses of ZH improved ($P < 0.05$) feed intake, water consumption, ADG, and G:F. Carcass characteristics as HCW, CCW, KPH, dressing %, LM area, LM pH at 24 h, leg perimeter were not affected ($P > 0.05$) by ZH level supplementation. Inclusion of different levels of ZH in feedlot finishing diets improve feedlot performance; without affecting carcass characteristics.

Key Words: β-adrenergic agonist, carcass characteristics, feedlot sheep, growth rate

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1686 Performance of lambs fed high concentrate-diets containing monensin or narasin.

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The objective in this trial was to determine the effect of ionophore inclusion (monensin or doses of narasin) on performance of lambs fed high-concentrate diet. Forty-five (30 males and 15 females) Dorper x Santa Inês lambs were assigned to a randomized complete block design, defined by age (90.5 ± 0.8 d old), sex, and initial BW (25.3 ± 0.5 kg). Lambs were housed in "tie stalls" and fed a TMR composed of 90% concentrate. Diets were isonitrogenous (15.5% CP, DM basis) and treatments were Control (without ionophore), monensin (25 mg/kg DM), and three doses of narasin (5, 10 or 15 mg/kg DM), corresponding to the experimental diets C, M, N5, N10, and N15, respectively. Feed ingredients (ground corn, ground hay, soybean meal, limestone, mineral salt, urea, and ammonium chloride) and ionophores were mixed using a horizontal mixer. The experiment lasted 56 d and lambs were weighted after a fasting period of 14 h on Days 0, 14, 28, 42, and 56. Average daily gain (ADG), dry matter intake (DMI), and feed efficiency (FE) were determined in each period. Data were analyzed using the MIXED procedure (SAS Inst. Inc.). There were two contrasts previously defined (I: control vs. ionophores; II: monensin vs. narasin). The effects of levels of narasin (control, N5, N10, and N15) were evaluated using linear and quadratic orthogonal contrasts. The effects were considered significant when $P < 0.10$. Inclusion of ionophores did not affect BW 14d after start receiving the experimental diets. However, on d 28 animals fed the diets containing narasin (5, 10, or 15 mg/kg) were heavier ($P = 0.01$) than those fed monensin (C: 32.7; M: 31.3; N5: 32.2; N10: 33.2; N15: 33.2 kg). On d 42 there was an increased linear effect ($P = 0.04$) for levels of narasin and animals fed monensin were lighter than animals fed narasin (C: 36.8; M: 36.1; N5: 36.1; N10: 38.0; N15: 37.8 kg; $P = 0.07$). There was an increased linear effect ($P = 0.02$) on final BW (d56) and animals fed narasin were heavier than those fed monensin (C: 40.9; M: 40.2; N5: 40.5; N10: 42.4; N15: 42.5 kg; $P = 0.02$). There was no effect ($P = 0.40$) on DMI (1.09 ± 0.04 kg/d). Narasin increased ($P = 0.04$) feed efficiency (C: 0.25; M: 0.25; N5: 0.25 N10: 0.26; N15: 0.27). Narasin improved lamb performance compared to a monensin dosage of 25 mg/kg.

Key Words: feed efficiency, ionophore, narasin.

1687 Effects of high concentrations of crude glycerin on blood parameters of energy metabolism in finishing lambs.

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Forty crossbred (Santa Ines × Dorper) ram lambs (21.7 ± 2.7 kg BW, 90 d old) were used to evaluate the effects of high concentrations of crude glycerin on some blood parameters of energy metabolism. Lambs were assigned to a complete randomized block design (initial BW) and fed four isonitrogenous (18.4% CP) and isocaloric (2.7 Kcal ME/kg) experimental diets containing corn silage (40%), and concentrate (60%) composed of soybean hulls, soybean meal, mineral premix, and crude glycerin replacing 0 (G0), 10 (G10), 20 (G20), or 30% (G30) corn cracked grain, on a DM basis. Crude glycerin totally replaced corn grain in G30 and it was composed of 83% glycerol, 95% DM, 6% salt, and less than

0.01% methanol. The feedlot period lasted 66 d (21 d adaptation [three step-up diets] and 45 d finishing period). Animals were fed twice daily (0700 and 1900 h). Blood samples were collected from the jugular by venipuncture on the d 0 and d 45 of finishing period (day effect), before morning feeding and 4 h after feeding (prandial effect). Serum total cholesterol (TC), serum triglycerides (TG), blood glucose (BG), serum HDL-cholesterol (HDL), serum LDL-cholesterol (LDL), and serum VLDL-cholesterol (VLDL) were evaluated. Data were analyzed using a linear mixed model with Kenward-Rogers adjustment for calculation of degrees of freedom. Whenever the F-test was significant, contrast analyses were performed and differences of least squares means were determined using the pairwise Tukey–Kramer multiple test. Crude glycerin did not change BG concentrations, but a day effect was observed ($P < 0.001$) for this variable. A linear decrease in TC was observed with increasing concentrations of crude glycerin in the diets ($P = 0.02$). A prandial effect was observed for TG ($P = 0.001$) and for VLDL ($P < 0.0001$), while HDL concentrations linearly decreased ($P < 0.001$), and showed a day effect ($P < 0.001$) and a prandial effect ($P = 0.02$). The concentration of LDL linearly decreased with crude glycerin inclusion, and showed a significant day effect ($P < 0.001$). The average values (mg/dL) observed for treatments G0, G10, G20, and G30 were, respectively: TC = 41.0, 41.2, 36.4, 36.1; TG = 12.5, 13.2, 12.1, 15.3; BG = 83.6, 85.7, 82.1, 87.2; HDL = 13.3, 12.7, 11.4, 10.7; LDL = 25.2, 22.9, 23.8, 22.3; VLDL = 2.5, 2.6, 2.4, 3.1. Feeding crossbred finishing lambs up to 30% crude glycerin can decrease the concentration of some blood parameters of energy metabolism, such as total cholesterol, HDL and LDL.

Key Words: blood, glycerol, sheep

1688 Effect of diets rich in starch or digestible fiber on glucose metabolism of ewes and goats in mid-lactation. M. F. Lunesu*[1], G. C. Bomboi[2], M. Decandia[3], G. Molle[3], G. Gaspa[1], A. S. Atzori[1], L. S. Knupp[4], and A. Cannas[1], *[1]Dipartimento di Agraria, University of Sassari, Sassari, Italy, [2]Dipartimento di Medicina Veterinaria, University of Sassari, Sassari, Italy, [3]Dipartimento per la Ricerca nelle Produzioni Animali, Agris Sardegna, Sassari, Italy, [4]Departamento de Zootecnia, Universidade Federal de Vicosa, Vicosa, Brazil.*

This study evaluated if dietary carbohydrate type (starch vs. fiber) can modulate glucose metabolism in ewes and goats in mid-lactation. At c.a. 95 d in milk (DIM), 20 ewes and 20 goats were subdivided into two groups. The first one (10 sheep and 10 goats) received a high-starch diet (HS; 24.1% starch, 36.4% NDF, 15.4% CP, DM basis) and the other (10 sheep and 10 goats) a highly-digestible fiber diet (HF; 10.5% starch, 46.8% NDF, 15.4% CP, DM basis), obtained by replacing corn and barley meal with soybean hulls. At 153 DIM, glucose tolerance tests (GTT) were performed on 10 sheep and 10 goats selected from each group. Diet was withdrawn in the afternoon of the day before the test. One mL of a 50% glucose solution per kg of BW was injected into the jugular vein of each animal. Blood samples were collected 15 min before and at 5, 10, 15, 30, 45, and 90 min after glucose injection. At 165 DIM, all the animals were subjected to blood postprandial sampling at 30, 60, 120, 180, and 240 min post feeding. Blood glucose was assayed by an enzymatic-colorimetric method. Blood glucose concentration data were analyzed by the PROC MIXED of SAS with repeated measurements. For GTT the incremental area under the curve (AUC), the fractional turnover rate (k), and the half-life were calculated and data were analyzed with a two-factor (diet within species and species) ANOVA. The −15-min glucose concentration was higher in sheep than goats (73.5 vs. 53.6 mg/dl; $P < 0.005$) but was not affected by diet. During the GTT, the mean blood glucose concentration was greater in sheep than goats (228.1 vs. 209.2 mg/dl; $P < 0.05$) and in HS goats than HF goats (217.9 vs. 198.6 mg/dl $P < 0.01$), whereas it did not differ between HS sheep and HF sheep. The values of AUC, k and half-life were not affected by species or diet. Regarding the postprandial sampling, mean blood glucose concentration was higher in sheep than goats (60.3 vs. 50.3 mg/dl; $P < 0.001$) and in HS goats than HF goats (52.2 vs. 48.1 mg/dl; $P < 0.001$), whereas it did not differ between HS sheep and HF sheep. In conclusion, it seems that the source of carbohydrates modulated blood glucose metabolism in goats but not in sheep.

Key Words: fiber, glycemia, goats, sheep, starch

1689 Reproductive parameters of Dorper ewes in south Texas. E. C. Taylor*[1], J. A. Reyes[1], M. R. Garcia[1], and R. Stanko[2], *[1]Texas A&M University-Kingsville, Kingsville, [2]Texas A&M University-Kingsville, Texas A&M AgriLife Research, Kingsville.*

The overall objectives of two studies were to determine reproductive characteristics of Dorper ewes in south Texas and their potential use in accelerated mating. The initial study characterized month of puberty and subsequent anestrus in 16 spring-born, pre-pubertal ewe lambs (34.9 ± 0.43 kg). Lambs were monitored over a 13-mo period (September to October). Lambs were housed together and fed commercial pellets (2% BW, DM basis) and ad libitum hay. The second study determined the effect of a 9-d controlled vaginal insert (CIDR; 0.3 g progesterone) administered on d 0 of a 30-d anestrus breeding season (June). Thirteen non-lactating, postpartum (90 ± 4.5 d) ewes of second parity were randomly allocated into one of two treatment groups. All ewes were bled weekly for serum progesterone analysis to confirm anestrous, ovulation, and pregnancy. Ewes were continuously exposed to a fertile ram during the 30-d anestrous breeding season. Six ewes received a CIDR on d 0 to 9 (CT) and were housed separately and away from seven control ewes (CON). Two additional ewes were

housed in isolation and served as anestrous sentinels. Rams were alternated between CT and CON on d 16. Cumulative percentage of spring-born ewe lambs attaining puberty by September and December was 25% and 100%, respectively. Lambs had a mean BW of 39.1 ± 0.72 kg at 100% pubertal. During January, 62.5% of ewe lambs became anestrous and all were in anestrous by the seventh day of March. Resumption of estrous cycles began in May (6.25%) and continued through September (100%). Postpartum, CT ewes had a reduced ($P <$ 0.02) ram introduction to lambing interval (152.8 ± 3.2 d) as compared to CON ewes (165.7 ± 3.0 d). Ram introduction to lambing interval for CT ewes which conceived first service was further reduced as compared to CON ewes conceiving at first service (149.3 ± 1.3 d vs. 160.7 ± 1.5 d; $P < 0.01$). However, CT and CON ewes had similar conception rate (83.3% vs. 87.7%), days to conception (5.0 ± 4.5 vs. 14.7 ± 4.1), and lambs per ewe (1.4 ± 0.3 vs. 2.0 ± 0.3). We conclude that Dorper ewe lambs are sexually mature during the first fall-breeding season and enter anestrus as yearlings (March to May). Ram exposure alone is as effective as progesterone co-treatment to induce breeding of 90-d, postpartum Dorper ewes during the late anestrus season.

Key Words: anestrus, CIDR, Dorper

1690 Comparison of linear model and artificial neural network using antler beam diameter and beam length of white-tailed deer (*Odocoileus virginianus*).

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A thirty-one-year (1977–2008) record of field-dressed weight (FDW), antler diameter (AD), and beam length (BL) of male white-tailed deer (WTD) harvested at Berry College Wildlife Management Area (WMA), Mount Berry, Georgia, was analyzed using linear model and Artificial Neural Network (ANN). A total of 3564 male WTD were harvested at the WMA during the period under study. Of the total deer harvested, 63.95% were 1.5 yr old and 22.42%, 8.64%, 3.87%, and 0.67% for 2.5, 3.5, 4.5, and 5.5 yr old, respectively. The mean FDW of deer was 32.33 kg. Linear model and ANN were used to predict antler diameter and beam length of WTD. Linear model used to analyze AD and BL of deer includes the factors of year and month of harvest, and the covariates of age and FDW. For ANN, the two-layer feed-forward perceptron, also called single hidden layer feed-forward neural network was used to estimate AD and BL of deer. In the training phase of ANN, year, month of harvest, age, and FDW were linearly combined with a vector of weights. The resulting linear score was then transformed using an activation function to produce the output of the single hidden neuron. The estimates of correlation coefficients between FDW and AD, FDW and BL, and AD and BL were 0.75, 0.77, and 0.85 ($P < 0.01$), respectively. The estimates of regression coefficients indicated that FDW of the deer affected ($P < 0.05$) AD (0.92 ± .03) and BL (0.74 ± .02). Correlation coefficients between observed and predicted values of AD and BL from linear model are 0.81 and 0.83. However, ANN results in higher correlation coefficients (0.94 and 0.86) between observed and predicted values of AD and BL than linear model. This result demonstrates the utility of ANN in multidimensional data analysis.

Key Words: linear model, neural network, white-tailed deer

1691 Induction of sexual activity in Dorper ewes: Effect of two intramuscular doses of progesterone vs. progesterone vaginal sponges + eCG.

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The use of intravaginal sponges is a high-cost treatment which requires trained personnel while can generate reproductive problems in the animals. Therefore, the use of intramuscular (im) progesterone (P4) could be an alternative to avoid such a scenario. The reproductive outcomes of Dorper anestrus ewes using different im doses of P4 regarding the use of P4-intravaginal sponges + eCG, was evaluated. The study was carried-out in northern Mexico during the anestrus season (26°N, February). Anestrus ewes (n = 52, 3–5 yr old) similar body weight (BW) and body condition score (BCS) were subjected to two transrectal ultrasound screenings on Days 14 and 7 prior to the onset of the experimental treatments to confirm the absence of functional corpora lutea. Thereafter, ewes were randomly distributed to three experimental groups: 1) IMG1 (n = 21; 41.7 ± 4.0 kg BW, 2.1 ± 0.2 BCS) receiving 30 mg-im of P4 on Days 5 and 2 prior to eCG administration, 2) IMG2 (n = 17; 41 ± 7 kg BW, 2.0 ± 0.6 BCS) receiving 20 mg-im of P4 on Days 5 and 2 prior to eCG application, and 3) IVS (n = 14; 41.5 ± 3.0 kg BW, 2.0 ± 0.2 BCS), receiving an intravaginal sponge Chronogest® during 6 d and removed 24 h prior to eCG application (d 0). The three groups received a single dose of 300 IU eCG im on d 0. Estrus activity was recorded after exposure to one sexually active male during 15 min twice per day (0800 and 1800 h) × 5 d. On Day 10, the percentage of ovulations across treatments was determined by detecting the presence of corpora lutea throughout ultrasonographic scanning (USS). Then, on Day 45, another transrectal-USS was performed to determine pregnancy rate. Estrus activity,

ovarian activity and pregnancy were evaluated among treatments thru X^2considering the daily and cumulative proportions of these variables (MYSTAT 12 X2 program). The percentage of estrus were different ($P < 0.05$) between all the groups (43% IMG1, 35% IMG2, and 100% IVS). The largest ovulation percentage and gestation rate ($P < 0.05$) were observed in IVS group (93% and 79%, respectively), and similar ($P > 0.05$) for both IMG groups (62% IMG1 and 59% IMG2 for ovulation percentage, and 24% for gestation rate in both groups). Results demonstrated a better reproductive performance of previously anestrus Dorper ewes treated with intravaginal P4-sponges + eCG with respect to those receiving the im administration of P4. In conclusion, the synchronization protocol using two injections of progesterone had less sexual response compared to the use of vaginal sponges.

Key Words: anestrus, ewes, progesterone

1692 Effect of supplementation with antioxidants in goats and their newborns evaluated during the transition period. B. Barcelos*[1], F. R. B. Ribeiro[2], S. K. Lewis[2], W. B. Foxworth[2], L. C. Nuti[2], G. R. Newton[2], V. F. P. Ríspoli[3], L. B. Correa[1], and A. Saran Netto[1], *[1]School of Animal Science and Food Engineering, University of Sao Paulo, Pirassununga, Brazil, [2]Prairie View A&M University, Prairie View, TX, [3]School of Veterinary Medicine and Animal Science, University of Sao Paulo, Sao Paulo, Brazil.*

The objective of this study was to evaluate hematological parameters of dam and newborn goats of the does that were supplemented with Selenium and Vitamin E. Also, the amount of Selenium and Vitamin E of the serum and milk was measured for evaluation of amount that was transferred from dam to newborns. Fifteen Saanen does that were supplemented starting on the fourth month of pregnancy until the end of the experiment and twenty-one kids from these does were used. The does and the newborns were divided into three groups based on the dam treatments: Control and Control milk (base diet with 50% forage and 50% concentrate); Se and Se milk (2.5 mg of Se/Kg Dm added to the diet) and Sev and Sev milk (2.5 mg of Se/Kg DM and 1000 IU/day of Vitamin E/kg DM), for does and kids, respectively. The kids started receiving ad libitum access to feed from 7 d postpartum. The experiment continued for 56 d. Blood samples were collected from dam before the supplementation, during the partum and 2, 7, 14, and 28 d postpartum. Milk was collected during partum and 28 d postpartum. Blood samples were collected from newborns before ingesting of colostrum and 2, 7, 14, and 28 d postpartum. Blood samples were analyzed for Selenium, Vitamim E, Erythrocyte (red blood cell- RBC- 10^6/mm^3), Hemoglobin (Hb-g/dL), Hematocrit (Hct-%), Mean Corpuscular Volume (MCV-μ^3), Mean Corpuscular Hemoglobin (MCH-pg), Mean Corpuscular Hemoglobin Concentration (MCHC-%), Red Cell Distribution Width (RDW-%). Milk samples were analyzed for Selenium and Vitamin E. Kids were weighed at birth and 7, 14, 21, and 28 after birth. The experimental design was a complete randomized design with repeated measures, with replications. Data were analyzed by analysis of variance and the means were compared by Tukey test ($P \leq 0.05$). There was no significant effect of treatment ($P > 0.05$) for all hematological parameters, Vitamin E for dam and newborns nor for weight of the kids. For Se the results showed significant increase ($P < 0.05$) of the transfer from dam to the kids with values of 0.20, 0.17, and 0.08 mg/kg of dam serum; 0.49, 0.25, and 0.062 mg/kg of dam milk and 0.15, 0.18, and 0.057 mg/kg of kids serum of treatments Sev, Se, and control, respectively

Key Words: birth, nutrition, selenium, vitamin E

1693 Effects of feeding varying levels of deoiled distillers dried grains with solubles on fatty acid composition of subcutaneous adipose tissue in meat goats. K. C. Camareno*[1], A. T. Sukumaran[1], J. Scott[2], N. Gurung[2], T. T. N. Dinh[1], and D. D. Burnett[1], *[1]Mississippi State University, Department of Animal and Dairy Sciences, Mississippi State, [2]Tuskegee University, Tuskegee, AL.*

Deoiled distillers dried grains with solubles (D-DDGS), a by-product of the fuel ethanol industry, have increasingly been used as ingredients in livestock feed. These D-DDGSs have a reduced fat content and increased protein content making them attractive ingredients, however, feeding D-DDGS can affect carcass composition. The objective of this study was to investigate the effect of D-DDGS on fatty acid (FA) composition of subcutaneous (s.c.) adipose tissues in goats. Four experimental diets containing 50% Bermuda grass hay plus 50% concentrate mix containing 0 (CON), 10, 20, or 30% D-DDGS (D-DDGS10, D-DDGS20, or D-DDGS30, respectively) in the diet were randomly assigned to twenty-four castrated male Kiko goats ($n = 6$ per treatment). The goats were slaughtered at 84 d and s.c. fat was collected from directly over the sternum of the carcass, and were then pulverized, and stored at −80°C. The fat samples were directly derivatized for fatty acid identification and quantification on a gas chromatography system (Agilent Technologies, Santa Clara, CA) using internal standard calibration. Fatty acid methyl ester concentrations were used to calculate fatty acid concentrations and percentages. Statistical analysis was performed using the GLIMMIX procedure of SAS 9.4 (SAS Institute Inc., Cary, NC.) and statistical significance was determined at $P \leq 0.05$. D-DDGS did not affect total FA content ($P \leq 0.395$) of adipose tissues, however, their inclusion changed concentrations and percentages of important FA ($P < 0.038$). Concentrations of 18:1 t, 18:2 n6c, 20:1 n9c, and polyunsaturated (PUFA) of s.c. fat from D-DDGS30 goat were 16.26, 16.29, 9.35, and 19.74 mg/g, respectively, which were greater than those from D-DDGS10 and CON

goats ($P < 0.026$). Because of the similar total FA content, the percentages of 18:1 t, 18:2 n6c, 20:1 n9c, and PUFA (2.12, 2.11, 1.25, and 2.56%, respectively) were also greater in s.c. fat of D-DDGS30 goats than those of D-DDGS10 and CON goats. Although concentration of 20:4 n6c was similar among CON and D-DDGS treatments ($P = 0.408$), its percentage was greater in s.c. fat of D-DDGS30 goats than that of CON goats ($P = 0.018$). These data indicate that feeding D-DDGS30 increased the percentages of unsaturated fatty acids in the s.c. depot of the meat goats in the current study and may be used to alter carcass fat composition.

Key Words: adipose tissue, distillers, goat

1694 Dietary effects of grass hay and alfalfa hay on the digestive microbiome of the alpaca. C. Carroll*, K. D. Olsen, J. M. Chaston, and T. F. Robinson, *Brigham Young University, Provo, UT.*

The purpose of this study is to identify the effects of a grass hay diet (GH) and an alfalfa hay diet (AH) on the digestive microbiome of the alpaca. Ten adult male alpacas were randomly selected for the study and divided into two groups; each group was fed a different diet (GH or AH) for thirty days. Both groups were fed once daily ad libitum. At the end of the feeding period, digesta samples were taken from the first stomach compartment (C1), duodenum, jejunum, ileum, cecum, and large intestine of each alpaca. Bacterial DNA was isolated from each sample and sequenced to identify operational taxonomic units, or bacterial taxa. All data were analyzed using QIIME software. Comparisons of the microbial composition of samples from grass-fed and alfalfa-fed alpacas at each digestive tract sample site showed that the microbiome at any single body site differed with diet ($P < 0.05$). Among the differences noted in the microbiomes of alpacas fed AH include a shift toward a higher proportion of phylum *Euryarchaeota* and a lower proportion of phylum *Actinobacteria* in the duodenum, ileum, and jejunum; and a higher proportion of phylum *Euryarchaeota* with a lower proportion of phylum *Bacteroidetes* in the cecum and large intestine. Analyses of the microbial composition of each body site revealed the presence of three different microbiomes per diet treatment group ($P < 0.05$); that of C1, the small intestine (duodenum, jejunum, and ileum), and the distal intestine (cecum and large intestine). The predominant phyla were *Firmicutes* (all sites), *Bacteroidetes* (C1, cecum, and large intestine), *Actinobacteria* (duodenum, jejunum, and ileum), and *Euryarchaeota* (duodenum, jejunum, and ileum). These data demonstrate that, in alpacas, forage type does affect the predominant microbes and though taxa are similar between tract sites, there are shifts in the populations.

Key Words: alpaca, forage, microbiome

1695 Sunflower and palm cake as supplemental fatty acid sources to feedlot lambs. J. G. de Souza[*1,2], P. G. Cirqueira[2], J. P. I. S. Monnerat[3], and C. V. D. M. Ribeiro[2], *[1]Penn State University, University Park, [2]Federal University of Bahia, Salvador, Brazil, [3]Federal University of Pernambuco Rural, Recife, Brazil.*

The sunflower cake and palm cake are two by-products of the biodiesel industry with different profiles of fatty acids (FA). The sunflower cake has 60% of unsaturated FA and the palm cake is rich in medium-chain fatty acids (MCFA). Feeding both sources to ruminants may increase FA digestibility and improve energy intake. Therefore, the objective of this study was to evaluate the interaction of the dietary supplementation of sunflower cake and palm cake on DMI and blood parameters of feedlot lambs. Twenty non-castrated lambs [23.81 ± 4.3 kg] were individually penned and used in a completely randomized design. The animals were fed 40% Tifton hay plus 60% concentrate, with 5% of supplemental FA (% DM). The treatment diets consisted of the contribution of each fat source to the total FA supplementation, as follows: 1) 100% of supplemental FA from sunflower cake; 2) 66% from sunflower cake and 33% from palm cake; 3) 33% from sunflower cake and 66% from palm cake; and 4) 100% of supplemental FA from palm cake. The collection period started on the 35th d of the feedlot period and lasted for 5 d, when the DMI was determined. Blood parameters were taken on the 36th d at 0, 3, 6, and 9 h after the morning feeding. Data were compared by orthogonal polynomial contrasts to determine linear and quadratic effects of the substitution of sunflower cake by palm cake, and significance was declared at 5%. No effect was observed for the daily average serum concentrations of AST (199.80, 197.51, 196.78, 185.56 UI/L), ALT (36.07, 45.21, 41.96, 38.09 UI/L), urea (39.31, 43.55, 48.96, 47.11 mg/dL), triglycerides (18.35, 18.53, 16.16, 17.05 mg/L), and NEFA (1.01, 1.15, 1.17, 1.31 mmol/L) as sunflower cake was substituted by palm cake. A treatment by time interaction ($P < 0.05$) was observed only for triglycerides and NEFA. There was a linear effect ($P < 0.05$) for DMI (1.266, 1.017, 1.177, 0.902 kg/d) and ether extract intake (0.09, 0.05, 0.05, 0.03 kg/d) as sunflower cake was substituted by palm cake. In conclusion, replacement of sunflower cake by palm cake decrease DMI without affecting blood metabolites.

Key Words: blood parameters, sheep, supplemental fatty acids

Table 1697.

Table 1. Reproductive response of Alpine goats receiving 20 mg of progesterone and 100 IU eCG, treated with 4 mg GnRH i.m. or non-GnRH treated in Northern Mexico[1]

	GnRH Group	Control Group
Estrus latency (h)	**44.6±3.7ª**	**52.0±3.7ª**
Estrus response (%)	14/14, 100%	12/12, 100%
Ovulation rate (%)	**12/14, 85.7%**	**10/12, 83.3%**
Pregnancy rate (%)	7/14, 50%	8/12, 67%

[1] No differences occurred for any variable between treatments

1696 Ground chevon as influenced by different concentrations of rosemary extracts. M. Y. Muñoz[1], J. H. Lee[2], C. D. Santos[1], X. Ma[2], A. Discua[*2], and B. Kouakou[2], *[1]Universidad Nacional de Agricultura, Catacamas, Honduras, [2]Fort Valley State University, Fort Valley, GA.*

Rosemary extracts (RE), containing high concentrations of polyphenol compounds that have antioxidant and antimicrobial properties, which could increase the shelf-life of fresh meat. Numerous studies have been conducted to enhance the quality of fresh meat from ruminants by feeding dietary supplements containing high amounts of polyphenol compounds. However, limited information is available on the effectiveness of RE on shelf-life of ground chevon (goat meat). The aim of this study was to determine the effect of different concentrations of RE on the physicochemical and microbial properties of ground chevon stored under retail display conditions. Ground chevon was prepared with shoulder and leg cuts from Kiko crossbred (8 mo old, BW = 39.7 ± 2.55 kg) male goats, treated with four different concentrations of RE (0, 0.02, 0.1, or 0.25%). Each batch of RE treated ground chevon (3/RE; 8.0 kg/batch) was placed on high barrier polypropylene trays and sealed with lidding films (30 trays/batch), and stored in a display case at 4°C over a 15-d period. Six packages (250 g/package) from each RE treatment (30 packages/RE) were analyzed for color properties (CIE L*a*b* values), lipid stabilities (thiobarbituric acid-reactive substances, TBARS), and bacterial counts (total aerobic bacteria, coliforms, *Escherichia coli*, yeasts, and molds) after 1, 4, 8, 12, 15 d of storage. All data were analyzed as a randomized block design, blocked by batch, with a 4 × 5 factorial treatment arrangement using the MIXED procedure of SAS. Ground chevon that contained 0.1 or 0.25% RE had higher ($P < 0.01$) CIE L*(lightness) values than that contained 0% RE. The CIE a* (redness) and b* (yellowness) values of ground chevon significantly decreased after 12-d of storage. Ground chevon containing 0.1 or 0.25% RE had lower ($P < 0.01$) total aerobic bacteria than that containing 0.02 or 0% RE. Furthermore, total aerobic bacteria counts increased ($P < 0.01$; 2.32 to 4.39 ± 0.073 log CFU/g) with storage time in ground chevon containing all different concentrations of RE. This trend was also found in the yeast and mold counts in the ground chevon. The TBARS values varied for all RE treated groups and remained lower than 1.0 mg MAD/kg over the storage period. The results indicated that higher concentrations of rosemary extracts in ground chevon might inhibit the growth of aerobic bacteria. However, the lipid stability of ground chevon was not enhanced by the inclusion of rosemary extracts.

Key Words: ground chevon, rosemary extracts, shelf-life

1697 Post-estrus GnRH administration does not improve fertility in Alpine goats in northern Mexico. Z. Santos[*1], C. A. Meza-Herrera[2], J. M. Guillen[1], F. Arellano[1], R. Rodriguez[1], and F. G. Véliz-Deras[1], *[1]Universidad Autonoma Agraria Antonio Narro, Torreon, Mexico, [2]Universidad Autónoma Chapingo, Unidad Regional Universitaria de Zonas Áridas, Bermejillo, Mexico.*

The aim of this study was to evaluate the possible effect of GnRH administration during the implantation process in Alpine goats in northern Mexico (26° 23 'N). The study included sexually active bucks ($n = 4$) and multiparous anestrus Alpine goats ($n = 26$). Early in May, goats with homogeneous body condition score (3.0 ± 0.11) were treated with 20 mg of progesterone i.m (d0) and 24 h later (d1) received 100 IU of eCG. Thereafter, on d-13 post-estrus, goats were randomly distributed into the following experimental groups: 1) the GG group ($n = 14$) received 4 mg of GnRH i.m. (synthetic analog) and 2) the GC ($n = 12$) served as a control, receiving saline. Estrus activity was confirmed every 12 h for 5 min using an aproned male from d 0 to d 15. Once in standing estrus, goats were bred by a sexually active male. Then, on d45, a transrectal ultrasonographic scanning (USS; HS-2000, Honda Electronics Co, LTD) was performed to determine pregnancy rate. The response variables estrus response (ER), ovulation (OR) and pregnancy (PR) rates were analyzed by X^2 and estrus latency (EL) with a t-student test (SYSTAT 12, Evanston, IL, USA). None of the response variables EL, ER, OR, and PR differed ($P > 0.05$) between experimental groups. Administration of GnRH on d-13 post-estrus did not improved fertility in Alpine goats from northern Mexico.

Key Words: GnRH, progesterone, synchronization

Table 1699.

Table 1. Reproductive performance of anovulatory goats exposed to males previously treated with estrogenized females either changed every 12 h (GR) or not-changed (GN) and males with control saline-treated females (GC) under the anestrus season (Feb-Mar) and natural photoperiod at 26°N

	GR	GN	GC
Goats (n)	(24)	(24)	(24)
Estrus response (n)	19/24[a]	19/24[a]	0/24[b]
	80%	80%	0%
Estrus latency (h)	89.68±5.8[a]	106.74±5.4[a]	0[b]
Pregnancy rates (n)	14/24[a]	14/24[a]	0/24[b]
	58%	58%	0%

[ab] Means with different superscripts differ (p=0.05)

1698 Quality of chevon chops as influenced by different packaging atmospheres. C. D. Santos[1], J. H. Lee[2], M. Y. Muñoz[1], A. Discua[2], X. Ma[2], D. Kafle[*2], and B. Kouakou[2], *[1]Universidad Nacional de Agricultura, Catacamas, Honduras, [2]Fort Valley State University, Fort Valley, GA.*

Vacuum and modified atmosphere packaging (MAP) techniques are used to extend the display life of fresh meat. The aim of this work was to evaluate the microbial and physicochemical properties of goat meat (chevon) cuts packaged under different atmospheres. Chevon chops from Kiko crossbred (8 mo. old, BW = 39.7 ± 2.55 kg) male goats were packaged under high carbon dioxide (CO_2; 80%), nitrogen (N_2; 80%), vacuum (VAC), or ambient air (AIR) atmospheres (30 packages/atmosphere) using an MAP tray sealer. All treated packages were stored at 4°C under 1700 lux of fluorescent lighting for 15 d. Six packages (4 chops/package) from each packaging treatment (6 packages/d) were analyzed for color properties (CIE L*a*b* values), lipid stabilities (thiobarbituric acid-reactive substances, TBARS), and bacterial counts (total aerobic bacteria, coliforms, *Escherichia coli*, yeasts, and molds) after 1, 4, 8, 12, 15-d of storage. All data were analyzed as a completely randomized design with a 4 × 5 factorial treatment arrangement using MIXED procedure of SAS. Chevon chops from high N_2 packages had higher ($P < 0.01$) CIE a*(redness) and lower b* (yellowness) values than those from VAC packages. The CIE a* and b* values of chevon chops significantly decreased with storage time; however, the CIE L* (lightness) values increased ($P < 0.01$) with storage time with some variations. No significant differences were found in the bacterial counts in chevon cuts from vacuum and high-CO_2 and-N_2 packages. Coliforms (1.26 to 5.11 ± 0.158 log CFU/g), *E. coli* (1.26 to 5.11 ± 0.073 log CFU/g) yeasts (1.02 to 3.06 ± 0.085 log CFU/g) and molds (1.72 to 5.55 ± 0.135 log CFU/g), and total aerobic bacterial (2.08 to 5.42 ± 0.243 log CFU/g) counts increased ($P < 0.01$) with storage time in chevon chops from all packaging treatments. The TBARS values of chevon chops varied for all packaging treatments and increased ($P < 0.01$) as the storage time progressed (0.13 to 0.31 ± 0.026 mg MAD/kg). The results indicated that high nitrogen atmosphere packaging might improve the color property of fresh chevon cuts. However, neither vacuum nor modified atmosphere packaging methods might significantly inhibit the lipid oxidation and microbial growth in fresh chevon cuts during 15 d storage.

Key Words: chevon chops, packaging atmospheres, shelf-life

1699 Reproductive performance of anovulatory goats stimulated by bucks previously exposed to estrogenized does. J. M. Guillen[*1], C. A. Meza-Herrera[2], Z. Santos[1], and F. G. Véliz-Deras[1], *[1]Universidad Autonoma Agraria Antonio Narro, Torreon, Mexico, [2]Universidad Autónoma Chapingo, Unidad Regional Universitaria de Zonas Áridas, Bermejillo, Mexico.*

The aim of this study was to evaluate the effectiveness to induce estrus response of cross-mix dairy anovulatory goats by the stimulus of either sexually active bucks or estrogenized does. Bucks (n = 12) were randomly allotted to three experimental groups (n = 4 per group): A) (GR) males in contact with 2 estrogenized females (EF) for 12 h, and then changed for 2 different EF for 12 h: B) (GN), males were exposed to 2 EF for 12 h, separated 1 h and returning the same goats for 12 h, C) (GC) males were exposed 12 h to 2 anestrous does treated with saline, separated 1 h and returning the same goats for 12 h. While the EF received 2 mg of estradiol cyprionate × 3 d, control females received 1 mL of saline × 3 d. On May 15, 72 cross-mix dairy multiparous females were distributed in 3 homogeneous groups (24 goats each) according to body condition (3.0 ± 0.11 units), and exposed to the previously treated males (GR, GN, GC). Females goats were checked every 12 h × 5 min with a male; on estrus manifestation, females were bred. On Day 45, a transrectal ultrasound scanning was performed to determine pregnancy rate. The estrus response, ovulation, and pregnancy rates were analyzed by X^2while estrus latency considered a t-student test (SYSTAT 12, Evanston, IL, USA). The reproductive response of treated goats is presented in Table 1. Results demonstrate that induction of males with estrogenized females is an effective method to induce out-of-season reproductive function in northern Mexico.

Key Words: buck effect, estrogenized goats, estrus induction

1700 Effect of dried distillers grains on diet digestibility, body weight gain, and carcass composition of lambs.
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Dried corn distillers grains with solubles (DDGS) can partially replace grains and forages in diets for ruminants. Therefore, the objective of this study was to evaluate the effect of diets with or without DDGS on DM, NDF and ADF digestibility, DM intake, ADG, and carcass composition of lambs. The experimental design was completely randomized with four treatments: 1) control, 0.0% DDGS, 2) 15% DDGS, 3) 30% DDGS, and 4) 45% DDGS. Thirty-two Criollo lambs (28.56 ± 2.19 kg initial BW) housed in individual metabolic cages were used in this experiment during 60 d (n = 8). Data were analyzed with PROC MIXED of SAS and treatments means were compared using Tukey test ($P < 0.05$). As compared to control, DDGS increased DM intake (1.7 kg vs. 1.4 kg control), ADG only for lambs fed 15% DDGS (288 g d^{-1} vs. 238 g d^{-1}control), and decreased DM digestibility (7.0%) in lambs fed 45% DDGS ($P < 0.05$). Lambs fed diets with DDGS showed higher weight (8.0%) and yield (2.0%) of hot and cold carcass, but rib eye area was lower for lambs fed 15% DDGS ($P < 0.05$), and no differences were found for back fat ($P > 0.05$). Therefore, the inclusion of DDGS in diets for lambs increased DM intake and improved carcass weight and yield, without affecting back fat.

Key Words: DDGS, lambs, performance.

1701 Effect of high concentrations of crude glycerin on feed intake and growth of feedlot ram lambs.
M. Almeida[*1,2], J. M. Bertocco Ezequiel[3], J. R. Paschoaloto[3], H. L. Perez[1,2], V. B. Carvalho[3], E. S. Castro Filho[3], and E. H. C. B. Van Cleef[2,3], *[1]São Paulo State University, Jaboticabal, Brazil, [2]FAPESP, São Paulo, Brazil, [3]Unesp, São Paulo State University, Department of Animal Science, Jaboticabal, Brazil.*

The objective of this study was to evaluate the effects of high concentrations of crude glycerin (CG) on feed intake and growth of finishing lambs. Forty crossbred (Santa Ines × Dorper) ram lambs (21.7 ± 2.7 kg BW and approximately 90 d old) were assigned to a complete randomized block design and fed four isonitrogenous (18.4% CP) and isocaloric (2.7 Kcal ME/kg) experimental diets containing 0, 10, 20, or 30% of CG (83% glycerol), on a dry matter basis. In the diet containing 30% CG, the by-product totally replaced corn grain. The experimental diets were formulated with 30% corn silage and 70% concentrate (corn grain [except the diet with 30% CG], soybean hulls, soybean meal, urea, minerals, and crude glycerin [except the control treatment]). Lambs were housed in a naturally ventilated barn with individual pens, and fed ad libitum twice daily. Animals were weighed at 14-d intervals and were harvested when they reached approximately 35 kg BW. Feed intake and growth were evaluated during the initial (d 0 to d 14), intermediate (d 14 to d 28), and cumulative feedlot period. Data were analyzed using a MIXED procedure, with treatment included as fixed effect and block as random effect. The increasing inclusion of CG in the diets linearly increased days on feed ($P = 0.02$). Dry matter intake (DMI) during the initial feedlot period was decreased with CG inclusion (Linear, $P = 0.03$), while during the intermediate feedlot period, a tendency was observed for DMI to reduce when animals were fed CG (Linear $P = 0.09$). Regarding the cumulative feedlot period, a quadratic effect was observed on DMI ($P = 0.04$), with greater intakes for animals fed treatment containing 10% CG. There was a tendency for reduced average daily gain (ADG) in animals fed CG during initial feedlot period (Linear, $P = 0.08$). The CG also decreased ADG during intermediate feedlot period ($P = 0.02$), and during the cumulative finishing period (Linear, $P = 0.003$). When all treatments with CG were compared with controls, there was a tendency for reduced ADG during intermediate and cumulative periods ($P = 0.07$, $P = 0.09$, respectively). There was also a tendency for reduced cumulative feed efficiency (Linear, $P = 0.07$), when CG was added to the diets. In conclusion, adding up to 10% of CG in diets for crossbred finishing lambs improves feed intake and animal growth.

Key Words: by-product, glycerol, sheep

1702 Conditions to evaluate differences among individual sheep and goats in resilience to restricted drinking water availability.
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Thirty-six yearling Boer goat (BOE), Katahdin sheep (KAT), and Spanish goat wethers (SPA) were used to study appropriate conditions to evaluate resilience to restricted drinking water availability. Moderate quality grass hay was consumed ad libitum with concentrate (80% corn, 20% soybean meal) supplemented at 0.5% BW. Baseline conditions were determined in the last 2 wk of a 3-wk period (i.e., 100% level). Thereafter, water availability was decreased by 10% every 1 (1X) or 2 wk (2X) to 40% of baseline intake (i.e., 90, 80, 70, 60, 50, and 40% levels), but also with 2 wk at 40% for the 1X restriction

treatment. There was an interaction (P < 0.001) between animal type and restriction level in hay DMI, with values of 346, 360, 358, 276, 286, 235, and 176 g/d for BOE, 656, 592, 592, 469, 522, 407, and 307 g/d for KAT, and 392, 390, 368, 273, 298, 298, and 219 g/d for SPA at levels of 100, 90, 80, 70, 60, 50, and 40%, respectively (SE = 29.1). Moreover, hay DMI by 2X wethers was much lower in wk 2 vs. 1 at the 40% level (week × level interaction, P = 0.008; 409, 369, 345, 377, 336, and 276 g/d in wk 1 and 428, 398, 312, 352, 310, and 203 g/d in wk 2 at 90, 80, 70, 60, 50, and 40% levels, respectively; SE = 23.4). Restriction level affected (P < 0.001) plasma cortisol concentration in 2X wethers on the last day at each level (12.4, 14.0, 23.3, 26.4, and 32.6 nmol/l for 100, 70, 60, 50, and 40% levels, respectively; SE = 3.62). Plasma vasopressin concentration in 2X wethers at the end of each week at 60, 50, and 40% levels was affected by an interaction (P = 0.006) between week and restriction level (3.98, 5.61, and 7.84 in wk 1 and 6.40, 7.22, and 7.06 pmol/l in wk 2, respectively; SE = 0.564). In conclusion, there was some indication that DMI by KAT was more subject to adverse effects of very low water availability but not mild restriction compared with goats. Based on vasopressin concentration, a length of at least 2 wk rather than 1 with a set level(s) of restricted water availability seems desirable, which might also increase meaningfulness of measures such as BW. Results for DMI and cortisol concentration suggest appropriateness of a maximum restriction level of 50%.

Key Words: goats, sheep, water

1703 High concentrations of crude glycerin change ruminal in vitro greenhouse gas emissions in feedlot sheep.

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The objective of this study was to evaluate the effects of high concentrations of crude glycerin (CG) on in vitro greenhouse gas emissions in feedlot sheep. Eight crossbred (Santa Ines × Dorper) ruminally cannulated male sheep (64.5 ± 8.5 kg BW) were distributed in a replicated 4 × 4 Latin square design. Treatments consisted of isonitrogenous (18.4% CP) and isocaloric (2.7 Kcal ME/kg) diets containing 0, 10, 20, or 30% CG, on diets' dry matter basis. In the diet with 30% CG, corn grain was totally replaced. The experimental diets contained 30% corn silage and 70% concentrate (corn grain [except the diet with 30% CG], soybean hulls, soybean meal, urea, minerals, and crude glycerin [except the control treatment]). The animals were housed in semi-covered individual pens and fed ad libitum twice daily. After 21-d adaptation period, rumen content was sampled to serve as inoculum for in vitro incubations. Approximately 200 mg (DM basis) of each diet and buffered rumen fluid (20 mL McDougall's buffer and 10 mL rumen fluid) were placed into 60-mL penicillin glass bottles, purged with helium gas and sealed. The gas production (mL/g DM and mL/g DM disappeared), terminal pH, and DM disappearance were evaluated after 24-h incubation at 39°C. DM disappearance was obtained filtering and drying incubation residues. Gas production was estimated using a digital pressure meter and a transducer, while CH_4 and CO_2concentrations were obtained using gas chromatography. Data were analyzed using MIXED procedure, with fixed effects of diet and period, and random effects of sheep (diet). Orthogonal contrasts were used to determine the linear and quadratic effects of CG. Total gas production was linearly increased with inclusion of CG to the diets ($P = 0.04$), while CO_2 production tended to decrease ($P = 0.10$), decreasing proportion of CH_4 in total gas. DM disappearance was not affected by treatments (average = 46.7%), and when this parameter was taken into account in the gas production calculation, the same effect was observed for total gas production ($P = 0.04$), and CO_2 production linearly decreased ($P = 0.03$). The increasing inclusion of CG in the diets linearly increased terminal pH ($P = 0.02$). In conclusion, high concentrations of crude glycerin have no effect on diets' DM disappearance, but increase in vitro total gas production, decreasing proportion of CH_4 and increasing terminal pH.

Key Words: by-product, glycerol, methane

1704 Factors influencing estimates of energy used for activity by grazing meat goats.

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Ten yearling Boer goat wethers (45.4 ± 0.92 kg) consuming fresh Sudangrass ad libitum while grazing (GRA) a 0.8-ha pasture or individually confined (CON) were used in a crossover experiment with 3-wk periods to evaluate factors influencing estimates of energy used for activity (AEC) when grazing. Fresh forage offered to CON wethers was 15.9 and 13.4% CP and 65.0 and 67.4% NDF in periods 1 and 2, respectively. Based on forage and fecal AIA, forage DE concentration for CON averaged 67.9 and 56.5% in periods 1 and 2, respectively. From these values and fecal DM, least squares means of ME intake were 405 and 484 kJ/kg $BW^{0.75}$ for CON and GRA, respectively (SE = 15.4). Heat energy (HE) determined from heart rate (HR) measured over 1 d and the ratio of HE to HR estimated earlier was less (P < 0.001) for CON than for GRA (482 and 642 kJ/kg $BW^{0.75}$; SE = 17.2). To estimate the AEC from total HE and the partitioning of its sources, a ME requirement for maintenance of 427 kJ/kg $BW^{0.75}$) was assumed; HE expended for tissue energy gain was determined from recovered energy (RE) when greater than 0 and an efficiency of ME use for gain of 0.40 ± 0.009 ([0.0423 × forage ME in MJ/kg DM] + 0.006); and, when RE was less than 0,

the efficiency of use for maintenance of energy from forage and mobilized tissue was 0.68 ± 0.004 ([0.019 × forage ME in MJ/kg DM] + 0.503). The resultant AEC was 39 and 213 kJ/kg $BW^{0.75}$ for CON and GRA, respectively (SE = 21.9). Assuming that mobilized tissue energy was used for maintenance more efficiently (i.e., 0.80) than forage ME yielded slightly greater AEC of 57 and 241 kJ/kg $BW^{0.75}$ for CON and GRA, respectively (SE = 23.9). The former AEC value for GRA and that determined from the difference between GRA and CON HE were much greater than AEC based on time spent in different activities (i.e., lying, standing, grazing, and walking) multiplied by corresponding HE and assuming that AEC resulted from HE when standing, grazing, and walking (217 ± 19.7, 165 ± 19.3, and 46 ± 4.85 kJ/kg $BW^{0.75}$, respectively). In conclusion, determining the AEC of meat goats while grazing by subtraction of other sources of HE is influenced by specific assumptions of energy requirements and efficiencies of use for different physiological functions.

Key Words: activity, energy, goats, grazing

1705 The response to artificial infection with *Haemonchus contortus* and growth performance of sheep and goat progeny of selected parents in a central performance test.

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Fifteen Katahdin (KS-A; 4.0 mo old, 38 kg), 5 Katahdin (KS-B; 3.0 mo, 20 kg), 16 Dorper (DS; 3.4 mo, 25 kg), and 17 St. Croix sheep (CS; 4.2 mo, 18 kg) and 20 Kiko (KG; 3.9 mo, 19 kg), 16 Boer (BG; 4.4 mo, 16 kg), and 18 Spanish goat (SG; 4.3 mo, 18 kg) males from 5 commercial farms in KS, MO, and AR and Langston University (LU) were used to investigate growth performance and response to artificial infection with *Haemonchus contortus* in year 3 of a central test at LU. Animals tested were progeny of dams (based on on-farm data) and sires classified as Resistant and Moderate in year 2. The test entailed an adjustment period of 2 wk followed by 8 wk of data collection. Animal groups were housed separately in adjacent pens with automated feeders allowing free-choice access to a 15% CP diet. During adaptation, anthelmintic treatment resulted in low fecal egg count (FEC; < 600 eggs/g), after which 10,000 larvae were administered orally. Packed cell volume (PCV) was measured weekly and FEC was determined 5 times in wk 5-9. The cubic clustering criterion of SAS® categorized resistance classes. The GLM procedure included animal group and resistance classification, initial BW, PCV, and FEC were covariates, and the logarithmic transformation ln(x+100) was used for mean FEC. Animal group affected (P < 0.01) ADG (308, 264, 321, 254, 139, 243, and 147 g; SEM = 14.6), DMI (2.34, 1.65, 1.65, 1.32, 0.79, 1.28, and 0.94 kg/d; SEM = 0.069), and PCV (25.4, 24.3, 28.6, 29.3, 25.8, 22.9, and 25.7% for KS-A, KS-B, DS, CS, KG, BG, and SG, respectively; SEM = 0.65). The resistant males had highest (P = 0.04) ADG (256, 237, and 225 g for Resistant, Moderate, and Susceptible, respectively; SEM = 8.8). There was an animal group × resistance classification interaction (P = 0.04) on FEC (270, 2346, and 4633 with KS-A, 1088, 5272, and 8263 with KS-B, 442, 1140, and 2370 with DS, 209, 870, and 2368 with CS, 248, 994, and 2431 with KG, 1182, 2164, and 4523 with BG, and 215, 1203, and 3132 eggs/g (untransformed) with SG for Resistant, Moderate, and Susceptible classes, respectively; SEM = 295.0). The correlation coefficient between sire and progeny FEC was 0.27 (P = 0.004) and that of PCV was 0.44 (P < 0.001). In conclusion, selection for resistance did not adversely affect performance of males, and there were moderate relationships between indices of parasite infection of sires and progeny.

Key Words: goats, internal parasitism, sheep

1706 Species and breed differences of small ruminants in response to experimental infection with *Haemonchus contortus* and growth performance in a centralized performance test.

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The response to experimental infection with *Haemonchus contortus* and growth performance of small ruminant males were compared in a central performance test at Langston University (LU). Seventy-five Boer (3.8 mo of initial age, 19 kg), 51 Kiko (3.7 mo, 19 kg), and 50 Spanish goats (3.9 mo, 18 kg) and 43 Dorper (3.9 mo, 29 kg), 75 Katahdin (3.7 mo, 28 kg), and 42 St. Croix sheep (4.2 mo, 20 kg) from 8 commercial farms in AR, KS, MO, and OK and LU were housed separately in adjacent pens with automated feeders allowing free-choice access to a 15% CP (DM) and 50% concentrate pelletized diet. The test entailed an adjustment period of 2 wk followed by 8 wk of data collection. Body weight was determined weekly. During adaptation, anthelmintic treatment resulted in low fecal egg count (initial FEC = 64 eggs/g; SEM = 7.0), after which a dose of 10,000 larvae was administered orally. After the infection, packed cell volume (PCV) was measured weekly and FEC was determined 5 times in wk 5-9. Data were analyzed using the GLM procedure of SAS® with fixed effects of species and breed within species. Initial BW, PCV, and FEC were covariates and the logarithmic transformation was used for individual mean FEC. Species differed in ADG (P < 0.01; 176 and 305 g; SEM = 4.1), DMI (P < 0.01; 1.14 and 1.81 kg/d; SEM = 0.032), FEC (P = 0.02; 1897 and 1488 eggs/g in untransformed scale; SEM = 135.1), and PCV (P < 0.01; 26.7 and 29.1% for goat and sheep; SEM = 0.20). Dorper and Katahdin had greatest (P < 0.01) ADG (231, 154, 144, 329, 316, and 270 g; SEM = 6.8) and DMI (1.37, 0.94, 1.11, 1.98, 1.94, and 1.51 kg/d

for Boer, Kiko, Spanish, Dorper, Katahdin, and St. Croix, respectively; SEM = 0.054). St. Croix had the lowest ($P < 0.05$) FEC (1701, 2548, 1442, 1957, 1587, and 921 eggs/g; SEM = 233.9) and highest ($P < 0.01$) PCV (25.8, 27.8, 26.5, 29.0, 27.7, and 30.7% for Boer, Kiko, Spanish, Dorper, Katahdin, and St. Croix, respectively; SEM = 0.34). In conclusion, there was considerable variability between species, among breeds, and within breeds in resistance to internal parasite based on FEC and PCV after an artificial challenge with *H. contortus* larvae in a standardized environment.

Key Words: goat, internal parasite, sheep

1707 Effects of adding water to total mixed ration on water consumption, nutrient digestibility, wool cortisol, and blood indices in Corriedale ewes under hot and humid conditions.

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The objective of this study was to determine the effect of adding water to total mixed ration (TMR) on water consumption, nutrient digestibility, wool cortisol, and blood indices in Corriedale ewes under hot and humid conditions. Nine Corriedale ewes (ave. BW = 41 ± 3.5 kg) were individually fed diets based on maintenance requirements in metabolic crates. Sheep were assigned to three treatment groups according to a 3 × 3 Latin square design for 3 periods of 21 days duration each (9 sheep per treatment). Treatments were TMR moisture for 40%, 50%, and 60%. No differences were found in body weight gain among all treatment groups ($P > 0.05$). Nitrogen balance including digestible N, retained N, and urinary and fecal N showed no change among the treatment groups ($P > 0.05$). Water consumption was the lowest in 50% TMR moisture group than the other groups ($P < 0.05$). Other than ether extract which was higher in 60% TMR moisture group ($P < 0.05$) the differences among nutrient digestibilities including CP, crude fiber, OM, DM, NDF, ADF, and NFC were not significant ($P > 0.05$). No significant difference was observed for serum protein, BUN, glucose, and TG among the treatment groups ($P > 0.05$). Wool and blood cortisol were not different among the treatment groups ($P > 0.05$). Blood hematology including RBC, WBC, hemoglobin, hematocrit, basophils, and eosinophils were not different among the treatment groups ($P > 0.05$). It is concluded that the increase of TMR moisture at 40%, 50% and 60% had no effects on water consumption, N balance parameters, and nutrient digestibilities except for the ether extract under hot and humid environmental conditions. Additionally there were no effects on stress conditions (chronically known as wool cortisol levels), as well as blood cortisol levels, and immune functions of ewes.

Key Words: blood parameters, Corriedale ewes, digestibility, stress, TMR moisture, wool cortisol

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1708 Effects of pasture access regimen on grazing behavior and energy utilization by Alpine goats.

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Twenty-eight Alpine goats (initially 53.2 ± 1.80 kg BW and 26 ± 2.5 days in milk; 11 primiparous) were used to evaluate effects of different pasture access regimens on grazing behavior and energy utilization in a 16-wk experiment with 4-wk periods. Treatments were access to grass and(or) legume pasture from 0800 h, after the morning milking at 0700 h, to 1600 h (SET); continually other than during milking (CG); from the time of no moisture on leaf surfaces until milking at 1600 h (ND-M); and from the time of no leaf surface moisture until sunset (ND-D). The SET, CG, and ND-M goats were supplemented with 1.5% BW (DM) of concentrate immediately after the afternoon milking, whereas ND-D goats were supplemented at sunset. The ND-M and ND-D goats were fed alfalfa hay when length of pasture access was less than 6 h, with the level based on length of pasture access. Digestibility of OM determined each period from fecal DM and AIA in feedstuffs and feces was 77.0, 79.1, 81.3, and 77.8%, respectively (SE = 1.46), and ADG was similar among treatments (−12, −15, 2, and −6 g for CG, ND-D, ND-M, and SET, respectively; SE = 10.9). Neither fecal egg count nor FAMACHA score was affected by treatment ($P > 0.05$). Based on data from GPS collars and leg activity monitors, treatment affected ($P < 0.05$) time spent grazing (7.43, 6.93, 5.86, and 6.18 h, respectively; SE = 0.343), resting while lying (8.48, 8.82, 10.63, and 9.11 h, respectively; SE = 0.480) and standing (6.33, 7.29, 6.85, and 7.82 h, respectively; SE = 0.338), and walking (1.75, 0.95, 0.66, and 0.90 h for CG, ND-D, ND-M, and SET, respectively; SE = 0.093). Intake of ME was similar among regimens ($P > 0.05$; 26.73, 24.54, 26.25, and 22.37 MJ/d, respectively; SE = 1.522), although heat energy determined from heart rate and heat energy per heart beat was greatest for CG ($P < 0.05$; 14.41, 13.11, 12.90, and 13.03 MJ/d for CG, ND-D, ND-M, and SET, respectively; SE = 0.392). Milk energy yield was similar among treatments (5.41, 5.06, 5.34, and 5.55 MJ/d, respectively; SE = 0.35), but milk energy:ME intake was greatest ($P < 0.05$) for SET (0.228, 0.219, 0.220, and 0.275 for CG, ND-D, ND-M, and SET, respectively; SE = 0.0104). In conclusion, restricting time of pasture access from the morning to afternoon milking appeared to favorably affect efficiency of energy utilization for lactation, not relating to

Table 1709.

Table 1. Equations used to predict energy requirements for maintenance and gain in indigenous goats.

Equation[1]	Parameter estimates		SE	σ^2_e	P-value
Maintenance					
[1] HP, kJ/kgEBW$^{0.75}$ =β_0×e$^{(\beta 1 \times MEI)}$	β_0	344.1	14.6	2052.9	<0.01
	β_1	0.000883	0.000042		<0.01
[2] Retained CP, g/kg EBW$^{0.75}$=β_2+ β_3×CP intake	β_2	1.091	0.435	0.439	0.041
	β_3	0.282	0.0369		<0.01
Gain					
[3] Energy, MJ=β_4×EBW$^{\beta 5}$	β_4	8.63	1.94	346.0	<0.01
	β_5	1.01	0.0801		<0.01
[4] Protein, g=β_6×EBW$^{\beta 7}$	β_6	134.5	16.1	33514	<0.01
	β_7	1.14	0.0423		<0.01

[1]The empty BW (EBW) was computed as the BW at slaughter minus the weight of the contents of the digestive tract, bladder, and biliary vesicle; Linear equations and Nonlinear equations were fitted using PROC MIXED and NLMIXED of SAS (v. 9.4, SAS Institute Inc., Cary, NC), respectively.

internal parasitism, but rather by limiting time spent and heat energy associated with grazing.

Key Words: dairy goats, energy, grazing

1709 Energy and protein requirements of indigenous goats. A. K. Almeida*[1], K. T. Resende[1], I. A. M. A. Teixeira[1], S. D. A. Ribeiro[2], M. T. Rodrigues[3], and J. A. Garcia[3], *[1]UNESP, Univ. Estadual Paulista, Department of Animal Science, Jaboticabal, Brazil, [2]Capritec, Espirito Santo do Pinhal, Brazil, [3]Universidade Federal de Vicosa, Vicosa, Brazil.*

The objective of this study was to estimate energy requirements of indigenous goats weighing from 5 to 25 kg of body weight (BW). Goats were weaned at 79 ± 4.4 days after the beginning of experiment. Milk and solid diet intake were recorded daily. Total ration had 11.0 MJ/kg ME and 144 g/kg CP (DM basis). To determine energy maintenance requirements, 33 goats weighing 4.90 ± 0.302 kg of initial BW were used. Ten goats were slaughtered to estimate body energy and protein at the beginning of the experiment, then retained energy. The remaining goats were randomly assigned to two DM intake levels: ad libitum and restricted-fed (1.20X maintenance). Heat production was calculated as the difference between ME intake and retained energy (RE, kJ/kgEBW$^{0.75}$). Net energy requirement for maintenance (NE_m) was estimated as β_0 of relationship between HP and MEI (Table 1, Eq.[1]). Metabolizable energy required for maintenance (ME_m) was calculated iteratively, when HP = MEI. Efficiency of energy utilization for maintenance (k_m) was calculated as NE_m/ME_m. A linear regression of retained CP on CP intake (g CP/kg EBW$^{0.75}$) was used to calculate net protein requirements for maintenance (NP_m). The intercept of regression (Table 1, Eq.[2]) was assumed to be the endogenous and metabolic losses of N×6.25, which represented the NP_m. Net energy and protein requirement for gain (NE_g and NP_g, respectively) were obtained using 26 goats fed ad libitum randomly slaughtered at 5.40 ± 0.484 kg BW (n = 10), 15.8 ± 0.655 kg BW (n = 10), and 26.3 ± 1.27 kg BW (n = 6). The first derivative of allometric equation (used to calculate energy and protein contents in the EBW; Table 1, Eq. [3] and [4]) with respect to EBW yielded estimates of the NE_g and NP_g. A Monte Carlo-based method was used to simulate variation of NE_g and NP_g. Estimated NE_m was 344.1 ± 14.6 kJ/kgEBW$^{0.75}$, resulting in 568.4 kJ/kgEBW$^{0.75}$ ME_m, thus k_m was 0.605. The NP_m was 1.091 ± 0.435 g CP/kgEBW$^{0.75}$·at NI = 0. The CP intake required for maintenance, at which retained CP = 0, was 3.87 g CP/kgEBW$^{0.75}$. The growth phase, NE_g ranged from 8.59 ± 0.555 to 8.75 ± 0.821 MJ/kg and NP_g increased increased from 186.6 ± 5.25 to 230.8 ± 10.4 g CP/kg of empty weight gain in indigenous goats weighing from 5 to 25 kg BW. It is expected that indigenous goats are later maturing animals. That would explain the lack of significant increase in NE_g as BW increased. We thank FAPESP for financial support (grant No. 2014/14939-0, 2014/14734-9, 2015/26000-5).

Key Words: comparative slaughter, gain, maintenance.

1710 Nutrient content of crop residues selected by grazing goats. J. Mendoza*[1], L. Gaytan[1], M. Mellado[2], O. Angel[1], and I. Chavarria[1], *[1]Autonomous Agrarian University Antonio Narro, Torreon, Coahuila, Mexico, [2]Autonomous Agrarian University Antonio Narro, Saltillo, Coahuila, Mexico.*

In Mexico, the majority of goats are exploited extensively, so their diet depends on native vegetation on rangelands, and occasionally crop residues. There is no information on the nutritional quality of different crop residues used by goats. Therefore, the objective of this study was to determine the nutrient content of two crop residues: alfalfa roots (goats grazed in a plowed crop of alfalfa) and oats (straw), selected by mixed breed goats (crossbred dairy goats) grazing in these crop fields. The collection of forage selected by goats was carried out by 10 multiparous goats, which carried a plastic

rope (1.5 m long and 0.5 cm in diameter) tied around their neck. Forage was collected directly from their oral cavity by separating the jaws with the hands, without impeding their grazing activity. Goats were restrained momentarily by holding them with the rope attached to their neck. This procedure was repeated about every 10 min for 3 hours a day, collecting approximately 300 g of forage (green matter) during 5 days (collections were made by one person per goat). A portion of this material was washed immediately with distilled water and was used for the determination of minerals. The data analysis was performed using analysis of variance (ANOVA) using the PROC GLM procedure of SAS. Ash content of goat diets grazing the alfalfa residue was higher ($P < 0.01$) (14.6 ± 1.7 vs. 11.0 ± 0.8) than goats grazing oat residues. NDF was higher ($P < 0.05$) in the alfalfa forage (predominantly roots) selected by goats (57.0 ± 1.9 vs. 53.6 ± 3.9) compared with diets of goats grazing oat residues. The protein content was higher ($P < 0.05$) in forage selected by goats on the oat residues (9.4 ± 1.0) compared to alfalfa residues (8.0 ± 1.2). The Ca, Cu, Mn, and Fe concentrations were higher ($P < 0.01$) in the goat diets grazing on alfalfa residues compared to oat residues. It was concluded that goats grazing on oat residues select diets higher in nutrients compared to diets selected on plowed alfalfa (high root consumption). However, goats ingesting alfalfa residues, mainly roots, had access to higher levels of minerals.

Key Words: alfalfa, NDF, nutritional quality, oats, protein

1711 Genomic evaluation and population structure of eleven Russian sheep breeds. T. E. Deniskova[1], A. V. Dotsev[1], K. Wimmers[2], H. Reyer[2], V. R. Kharzinova*[1], E. A. Gladyr[1], G. Brem[1,3], and N. A. Zinovieva[3], *[1]L.K. Ernst Institute of Animal Husbandry, Moscow, Russian Federation, [2]Genome Biology, Leibniz Institute for Farm Animal Biology (FBN), Dummerstorf, Germany, [3]Institute of Animal Breeding and Genetics, VMU, Vienna, Austria.*

Availability of high-density SNP arrays created an opportunity to understand current genetic structure and differentiation of sheep breeds and to find ways for their improving via whole genome analysis. A wide range of sheep breeds including wool, meat, milk types, and dual- and multi-purpose breeds was established in Russia. Although the breeds have unique gene pool and are a part of national heritage, they have not been genotyped yet and there is no information of their polymorphism at genome level. In this regard, our aim was to evaluate genetic diversity and population structure of some Russian sheep breeds. We used OvineSNP50K BeadChip to genotype 141 sheep of 11 breeds including Romanov (ROM, n = 22), Baikal fine-fleeced (ZBL, n = 12), Tuvan short fat tailed (TUV, n = 16), Kuibyshev (KUI, n = 11), Soviet Merino (SVM, n = 10), Kuchugur (KCH, n = 12), Karakul (KAR, n = 16), North Caucasian merino (NCM, n = 11), Russian long haired (RLH, n = 11), Stavropol (STA, n = 10), and Manych merino (MAN, n = 10). Quality control (QC) of SNPs and summary statistics were performed in PLINK v1.07. R v3.2.3 was used to create input files and visualize the data. After QC overall 48,842 SNPs (90%) were involved in the further analysis, 47,980 (or 98.3% from detected) were polymorphic. The highest polymorphism level among the breeds was identified in ZBL (97.4%), whereas KCH, RLH, STA were characterized by 93.4, 93.7, and 93.8% of polymorphic loci, respectively. Observed heterozygosity was 0.370 ranging from 0.361 in ROM to 0.398 in ZBL. All breeds were characterized by heterozygote excess ranging from 0.84 in ROM to 9.78% in KCH. The minor allele frequency was 0.305 overall for all breeds. The MDS analysis showed pattern corresponding breeds productivity type. Merino breeds (STA, SVM, MAN, ZBL) with close NCM group and semi-fine fleeced clade of RLH and KUI clustered separately from KAR and TUV with coarse wool. Multi-purpose KCH occupied an equidistant position. The most remote group was ROM, probably, due to their unique genetic traits such as extremely high prolificacy and adaptability to any conditions of keeping and feeding. Our study represents the initial phase of large-scale SNP genotyping of Russian sheep breeds. The research was conducted under financial support of Russian Scientific Foundation (project N° 14-36-00039).

Key Words: genetic diversity, sheep breeds, whole-genome studies

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1712 Plate waste and artificial rearing of orphaned lambs versus ewe reared lambs. A. DiPastina* and D. J. R. Cherney*, Cornell University, Ithaca, NY.*

In this study, our objective was to determine the possible use of breakfast plate waste from a university dining hall as a supplement to lamb creep feed other than as compost and to evaluate gain of artificially versus ewe reared lambs. Twelve ewes bearing twins were selected. Twins were given 177 mL of ewe's colostrum each on day 0 immediately after birth and again 4 hours later, and then were randomly assigned to groups. Groups consisted of 12 lambs reared with their dams (NR), 12 artificially reared on milk replacer (AR). Half of each set of lambs were fed a standard creep feed (SC). The other lambs were fed a creep feed containing about 15% plate waste, which replaced some of corn and soybean meal of the standard creep (PW). Both creep feeds contained the same amount of crude protein, neutral detergent fiber, and total digestible nutrients (20.8 ± 3.11%, 23.9 ± 6.22%, and 79 ± 2.12% TDN, respectively). A 2 x 2 factorial was used to compare rearing methods and creep feed treatments for all 24 lambs. The AR lambs were housed in 0.9 x 0.9 meter pens in pairs. The NR lambs were housed with their dams in 1.5 x 1.5 m pens with access to a 0.6 x 1.5 m creep area. Lambs

were weighed daily from days 0 to 30. Lambs weighed 3.76 ± 0.712 kg at birth. Creep feed was offered starting at 10 d of age. Creep feed was weighed 3x daily, and more added if necessary. Creep feed intake did not differ between AR and NR lambs, but AR lambs grew at a greater rate (0.28 kg/d) versus NR lambs (0.27 kg/d; $P < 0.05$). Lambs offered SC consumed more (20.24 ± 11.17 g/d) than lambs offered PW feed (8.83 ± 8.21 g/d; $P < 0.05$). Artificially grown lambs fed SC grew faster ($P < 0.01$) but consumed less milk replacer per day (1.75 ± 0.75 L/day) than PW fed lambs (2.93 ± 1.14 L/day). Lambs fed PW consumed feed at a more accelerated rate past 20 d than what lambs consumed on SC, suggesting possible acceptability issues that decreased over time with the PW. Results indicate that AR lambs can have growth rates greater than or similar to NR lambs, but intensive management is required. In addition, PW produced acceptable growth rates in lambs pre-weaning, but PW use needs continued research to assess issues such as acceptability.

Key Words: orphan lambs, plate waste

1713 Effects of corn silage levels on methane emissions and blood metabolite concentrations of drying-off Xinong Saanen dairy goats. P. Wang[*1], Y. Xue[2], G. Ma[1], and J. Luo[1], *[1]Alltech-NWAFU Animal Science Research Alliance, College of Animal Science and Technology, Northwest A&F University, Yangling, China, [2]Alltech, Lexington, KY.*

The objective of this study was to determine the effects of increasing corn silage level in drying-off Xinong Saanen dairy goats on methane emissions and blood metabolites concentrations. Twenty-one drying-off Xinong Saanen dairy goats (3.36 ± 0.95 yr old; BW = 64 ± 9.19 kg) were randomly allocated to 3 treatments with 7 goats per treatment (one goat of MS treatment got fever and excluded) and were fed 3 levels of corn silage with 2 7-d periods: 0.33 kg/d for LS, 0.47 kg/d for MS, 0.55 kg/d for HS (DM basis), respectively. Goats were fed twice daily by pens. Concentrate, corn silage, and alfalfa hay were provided separately. Concentrates were offered at 0.58 kg/goat daily, and alfalfa hay was ad libitum. Methane emissions were measured on 2 7-d periods using 3 polymethyl methacrylate chambers (length × width × height = 1.2 m × 0.6 m × 1.0 m; bottom is open). One of 7 goats for each treatment was placed in the chamber for 30 min (1200 h-1230 h) during gas sampling day, and temperature was recorded simultaneously. Daily methane emission rates were estimated based on the emission rate of 1200 h-1230 h and the percentage of 1200 h-1230 h methane production in daily methane production. Blood serum samples were collected once on the last day of the experiment to analyze concentrations of blood urea nitrogen (BUN), glucose (GLU), total protein (TP), β-hydroxybutyrate (BOHA), NEFA, and triglyceride (TG). Data were analyzed by GLM and treatment means were compared by LSD test ($P \leq 0.05$). Methane emission rate ranged from 9.90-11.89 g/d, 452.37-508.51 mg/d per kg metabolic body weight (MBW), 7.55-8.52 g/kg DMI. Increasing corn silage intake showed the potential to reduce methane emission rate (9.90 ± 4.00 g/d for HS, 10.58 ± 1.84 g/d for MS, and 11.89 ± 2.03 g/d for LS), although no significant differences were found. The relatively higher methane emission of LS was in accordance with higher hay intakes (0.50 ± 0.06 kg/goat for LS vs. 0.19 ± 0.09 kg/goat for HS, 0.20 ± 0.09 kg/goat for MS). Serum concentrations of BUN, GLU, TP, BOHA, and NEFA were not affected by corn silage intake, whereas serum TG concentration increased with increasing corn silage level ($P < 0.05$). These results indicated that increasing corn silage level potentially reduced methane emissions with accordingly decreased hay intakes.

Key Words: corn silage, dairy goat, methane

1714 Inclusion of a by-product of *Myrtus communis* in the diet of lactating sheep: Performance and health. A. Nudda[*1], G. Battacone[1], P. Nicolussi[2], F. Correddu[1], G. Pulina[1], and P. Bonelli[2], *[1]Dipartimento di Agraria, University of Sassari, Sassari, Italy, [2]Istituto Zooprofilatico Sperimentale della Sardegna, Sassari, Italy.*

By-product resulting from myrtle liqueur preparation of *Myrtus communis* berries could represent a suitable source of polyphenolic compounds. The present study aimed to investigate the effect of dietary supplementation of exhausted berries of *Myrtus communis* (EBM) on milk production and composition, blood metabolic profile and the efficiency of nitrogen utilization in lactating dairy ewes. Thirty Sarda dairy ewes were randomly assigned to 3 dietary treatments consisting of a control diet (CON), a diet supplemented with 50 g/d per head of EMB (EMB50), or a diet supplemented with 100 g/d per head of EMB (EMB100). The study lasted 13 wk, with a 2 wk adaptation period and an 11 wk experimental period. Milk yield was measured and milk samples were collected weekly and analyzed for fat, protein, and milk urea content (MU). Blood samples were collected on d 0, 15, 30, 45, and 60 of the experiment and analyzed for hematological parameters, albumin, alkaline phosphatase (ALP), bilirubin, creatinine, gamma glutamyltransferase (GGT), aspartate aminotransferase (AST), alanine aminotransferase (ALT), protein, blood urea (BU), and serum protein fractions. The urinary N excretion was estimated. Dietary treatments did not affect milk yield and composition, except for MU, which decreased as the dose of EMB in the diet increased (41.5, 37.6, 32.4, respectively; $P < 0.05$). Diet influenced blood urea content (BU), which decreased with the inclusion of EMB in the diet (72.4, 61.3, 59.0, respectively; $P < 0.05$). The urinary N excretion was reduced by the EMB supplementation (19.9, 17.8, 14.9, respectively; $P < 0.05$). The reduction in MU, BU, and estimated urinary excretion suggests that the use of EMB might reduce N emissions. The results on milk production

and composition and hematological parameters suggests that EMB can be included in the diet of dairy ewes without adverse effects on performance and health status.

Key Words: blood parameters, by-product, lactating sheep

1715 Genetic parameter estimates for productivity of the Katahdin and Hampshire ewe and its components. J. G. Pérez-Álvarez, F. A. Rodríguez-Almeida*, and J. Domínguez-Viveros, *Universidad Autónoma de Chihuahua, Chihuahua, Mexico.*

Productivity of the ewe is one of the most important economic traits in lamb production, and predicted as a biological index could facilitate selection decisions for genetic improvement if not negatively related to any of its components. In order to estimate genetic parameters for total weight of lamb weaned at 75 d per lambing ewe (TWW) and its components [average weaning weight (AWW), number of lambs born (NLB), and number of lambs weaned (NLW)] in two distinct breeds, 4439 and 1076 records from 3166 Katahdin (KT) and 646 Hampshire (HS) ewes with progeny from 556 and 72 sires in 91 and 10 flocks in México, respectively, were analyzed. Because NLB and NLW were about the same in HS, NLW was not analyzed for this breed. Weaning weights were adjusted to a female equivalent base for each breed by type of birth and region, prior to the calculation of TWW and AWW. Heritability and genetic correlations were estimated by bi- and tri-variate analyses with the MTDFREML software. The models included the fixed effects of contemporary group-season-year-flock and the linear and quadratic covariate age of the ewe at lambing, and the direct additive genetic and permanent environment random effects of the ewe. For TWW and AWW, also the random effect of sire of mating was included, as well as the fixed effects of NLB and NLW for AWW. Parameter estimates were very similar for both breeds. Heritability estimates for TWW, AWW, NLB, and NLW ranged from 0.13 to 0.18, 0.15 to 0.18, 0.10 to 0.16, and 0.14 to 0.16, respectively. The average estimates of r_g of the component traits with TWW in KT and HS were 0.87 and 0.67 for AWW, 0.83 and 0.70 for NLB, and 0.98 for NLW, and between components in KT were 0.98 for NLW and NLB, 0.35 (tri-) and 0.65 (bi-variate) for AWW and NLW, and around 0 for AWW and NLB in both breeds. Variance for sire of mating random effects as proportion of phenotypic variance were consistently moderate (0.16 and 0.25 for TWW and AWW, respectively) only for the HS breed. In conclusion, a moderate genetic response to selection is expected for the KT and HS ewe productivity without adverse effects in any of its component traits.

Key Words: ewe productivity, genetic correlation, heritability

1716 Effects of protected methionine supplementation during dry period of seasonally synchronized goats on blood parameters and the subsequent lactation. *F*. Piccioli-Cappelli[1], A. Minuti*, M. Maiocchi, M. Mezzetti, and E. Trevisi, *Università Cattolica del Sacro Cuore, Piacenza, Italy.*

At the end of pregnancy, goats experience a marked body fat mobilization and inflammatory events that may increase the risks of ketosis and oxidative stress and impair health. It is recognized that methionine (Met), often deficient in the diet of ruminants, acts as a donor of thiol groups, which are essential in alleviating the negative effects of stress and inflammation. The aim was to study the effects of feeding protected Met (Timet®, Vetagro, RE, Italy) during the dry period to double its content in metabolizable protein. Fourteen Saanen goats were divided into 2 groups of 7 goats each. During the last month of pregnancy the control (CTRL) group received 320 g of soya meal (Met = 0.2% DM) and the treatment (TRAT) group received 300 g of a protein supplement containing Timet® (Met = 0.4% DM). Both groups were fed hay ad libitum and the supplement resulted in a diet with the same energy content (1.4 Mcal/kg DM) and protein (CP 14.2% DM). Blood samples were collected every 7 d and milk samples on 7th and 14th d of lactation. Data were analyzed using Proc. Mixed of SAS. Before kidding, at blood level TRAT compared with CTRL goats had lower concentrations of urea, NEFA (0.22 vs. 0.37 mmol/L, $P < 0.10$), indicating a lower mobilization of body reserves and lower BHB (0.34 vs. 0.48 mmol/L, $P < 0.07$), indicating lower ketogenesis. Altogether these data indicate a higher availability of glucose in TRAT goats. TRAT compared to CTRL goats had a better liver metabolism (i.e., higher concentrations of albumin 35.4 vs. 33.9 g/L, $P < 0.10$), and this could result in a more favorable condition concerning both inflammatory status (lower levels of haptoglobin, 0.13 vs. 0.41 g/L) and oxidative stress (lower levels of reactive oxygen metabolites, 16.7 vs. 19.0 mg H_2O_2/dL) resulted numerically, although not statistically, different. During the first two weeks of lactation these responses likely allowed the TRAT group to yield more milk (2.83 vs. 2.18 kg/d, $P < 0.12$) and lactose (137 vs. 98 g/d, $P < 0.05$); moreover, milk from TRAT treated goats had a significantly lower somatic cells count (2.72 vs. 3.13 logN/mL, $P < 0.05$). Thus, the data indicate that supplementation of Met in late gestation can help goats to mitigate the frequent adverse metabolic and inflammatory conditions that characterize this physiological phase, and to improve the beginning of the lactation cycle.

Key Words: goat, inflammation, metionine, pregnancy

1717 Responses of hair sheep breeds to high heat load index conditions. D. Tadesse*, R. Puchala, T. A. Gipson, Y. Tsukahara, and A. L. Goetsch, *American Institute for Goat Research, Langston University, Langston, OK.*

Fourteen Dorper (D; 59 ± 3.2 kg), 13 Katahdin (K; 58 ± 2.5 kg), and 8 St. Croix (SC; 50 ± 3.0 kg) female sheep (> 1.5 yr) were used to evaluate responses to high heat load index (HLI) conditions. After 4 wk of thermoneutral conditions (70 HLI), in sequential 2-wk periods daytime HLI was regulated near 85, 90, and 95 and that at night was 70, 77, and 81, respectively. Data were analyzed with a mixed model containing breed, week within period, measurement time (0700, 1300, and 1700 h), three-way interactions, and baseline covariates. Rectal temperature (RT) at 1300 and 1700 h was lowest for SC (38.36, 38.87, and 38.96 for D, 38.31, 38.85, and 38.87 for K, and 38.29, 38.64, and 38.66 °C for SC at 0700, 1300, and 1700 h, respectively; SE = 0.046). A similar interaction ($P = 0.052$) occurred for panting score (PS, 0-4.5; 0.10, 0.64, and 0.54 for D, 0.09, 0.70, and 0.58 for K, 0.02, 0.42, and 0.40 for SC at 0700, 1300, and 1700 h, respectively; SE = 0.064). Breed differences in PS resulted from highest HLI in period 3 (0.07, 0.17, and 1.03 for D, 0.08, 0.15, and 1.14 for K, 0.04, 0.06, and 0.73 for SC in period 1, 2, and 3, respectively; SE = 0.080). Period, week, and time interacted ($P < 0.001$) in respiration rate (RR) (period 1: 41, 102, and 97 in wk 1, 50, 124, and 115 in wk 2; period 2: 56, 158, and 124 in wk 1, 65, 160, and 134 in wk 2; period 3: 76, 219, and 161 in wk 1, 130, 164, and 148 in wk 2 at 0700, 1300, and 1700 h, respectively; SE = 6.6). There was a corresponding interaction ($P < 0.001$) in RR:RT as an index of energy expended to minimize RT (period 1: 0.40, 1.00, and 0.96 in wk 1, 0.05, 1.22, and 1.14 in wk 2; period 2: 0.57, 1.55, and 1.22 in wk 1, 0.66, 1.58, and 1.31 in wk 2; period 3: 0.75, 2.14, and 1.58 in wk 1, 1.28, 1.61, and 1.44 in wk 2 at 0700, 1300, and 1700 h, respectively; SE = 0.064). In conclusion, some measures suggest higher tolerance of high HLI by SC than D or K. There appeared to be considerable adaptation in RR from wk 1 to 2 of period 3 to minimize RT in the early afternoon, which was at least partially facilitated by higher RR in the early morning before HLI increased.

Key Words: hair sheep, heat, temperature

1718 In vitro efficacy of three novel compounds on development and survival of gastrointestinal nematode larvae in feces of sheep. J. E. Miller*[1], V. Kelly[2], and J. M. Burke[3], *[1]Louisiana State University, Baton Rouge, [2]Louisiana State University School of Veterinary Medicine, Baton Rouge, [3]USDA-ARS, Booneville, AR.*

Gastrointestinal nematode (GIN) parasites are a major constraint to profitable sheep production. The long-term use of anthelmintics has resulted in GIN populations developing resistance to those available. The objective of this study was to determine the efficacy of three novel compounds on development and survival of GIN larvae in feces of sheep. Feces were collected directly from the rectum of 10 lambs and combined to make one large sample. This sample was homogenized by thorough mixing by hand and five 2-g subsamples were randomly selected for determination of fecal egg count (FEC) using the McMaster technique. Fifty 5-g subsamples were then randomly selected and individual fecal cultures were made by mixing with an equivalent volume of vermiculite and adding water to make a soft crumbly culture composition. Three novel synthetic compounds (Bedoukian Research, Inc.) similar to natural flavor/fragrance application compounds were diluted 1:10, 1:1,000, and 1:10,000. Five mL of water (control) and each dilution of the compounds were thoroughly mixed with a culture, making 5 replicates/dilution. Cultures were incubated at 27°C for 2 wk, after which, they were processed by a baermann procedure to recover infective larvae (L3). The number of L3 were counted to estimate L3/g of feces. The mean FEC (3530 ± 231) indicated that the GIN eggs were evenly distributed in the homogenized fecal mass, so all subsamples were considered to have equivalent FEC. The control larval recovery was 814 L3/g, and recovery for all the dilutions of the 3 compounds was < 10 L3/g. This indicated very high efficacy of L3 reduction (over 98.7%, $P < 0.05$). These novel compounds may be a viable treatment to aid in the control of GIN infection by reducing development and survival of larvae in feces, thus reducing pasture infectivity.

Key Words: control, nematodes, sheep

1719 Recovery of fibroblast cells up to 65 d of postmortem storage of sheep ear skin at 4°C. M. Singh* and X. Ma, *Fort Valley State University, Fort Valley, GA.*

Animal cloning technology has renewed interest in tissue storage, since these tissues can be used to reintroduce lost genetics back into the breeding pool in animal agriculture, preserve genetic diversity, and revive endangered species. Several studies have demonstrated that cell survival decreases with increasing postmortem tissue storage. However, the limits of time interval within which live cells can be recovered

from animal tissues postmortem have not been adequately studied. The objective of this study was to evaluate the time limits of cell survival in sheep skin tissues stored at 4°C after the death of the animal. Outgrowth of cells around small tissue explants in cultures was used as a measure of cell recovery. Ear skin was procured from the university slaughter house from six random but healthy animals and stored at 4°C in the lab. We cultured 2–3 mm^2explants (n = 60) after 0, 10, 20, 27, 30, 35, 38, 41, 45, 50, 55, 60, 65, and 70 d of tissue storage. DMEM media supplemented with 10% FBS and 50 units/mL of penicillin and 50 µg/mL of streptomycin was used. Twelve dishes (60 mm) for each time point were used. After 10 d of culture in a CO_2incubator, outgrowth of fibroblast-like cells around the explants was scored. Out of 481 explants that adhered to dish surface, 374 exhibited outgrowth. Our results showed outgrowth of cells up to 65 d of postmortem storage. In general, the number of outgrowing cells decreased with increasing postmortem storage time. To test the differences between cell cultures obtained from postmortem fresh and stored tissues, we established secondary cultures from primary cells of 0-dpm and 65-dpm time points from selected cell lines and studied their growth profile (p5 level) which showed similar morphology and growth curves. The karyotype analysis of 65 dpm tissue derived cells revealed a normal female karyotype without any genetic aberrations. Both cultures have been passaged up to 33 times which exhibit similar morphology; however, they grew very slowly. These results suggest that live cells can be recovered from skin tissues of sheep and perhaps other animals for more than 2 mo after their death with comparable growth profiles.

Key Words: cell culture, fibroblast cells, postmortem tissue storage, sheep, skin

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1720 Morphometric measurements and body weight affected by breed, age, and sex in the Sindh goat breed populations of Pakistan. M. Moaeen-ud-Din[*1], G. Bilal[1], J. M. Reecy[2], M. S. Khan[3], and S. Razzaq[1], *[1]PMAS-Arid Agriculture University, Rawalpindi, Pakistan, [2]Iowa State University, Ames, [3]University of Agriculture, Faisalabad, Pakistan.*

Sindh province is harbor of maximum goat breeds in Pakistan. However, there is scarcity of information regarding the indigenous goat breeds of Sindh province on morphometric measurements and weight. Therefore, the current study was designed to study the effects of age, sex, and breed on body weight and body measurements of ten goat breeds in their respective breeding tracts. A survey was performed in breeding tracts of ten goat breeds of Sindh viz. Kamori, Tapri, Bugi-Turi, Pateri, Kachan, Jattan, Lohri, Chappar, Barri, and Thari. During the current study HyderAbad, Matiyari, Hala, Methi, Umer kot, Tharparkar, Thatha, Badin, Dadu, and Mirpur Khas districts of Sindh province were visited. Data were collected and arranged according to age class (class 1: 1–6 mo, class 2: 7–12months, class 3: 13–18 mo, class 4: 19–24 mo, class 5: 25–36 mo, class 6; 37–48 mo, class 7: 49–60 mo, class 8: > 60 mo), sex, and breed. Data were analyzed using Mixed Procedure by REML methodology in SAS (Version 9.2) to investigate the effect of breed, age, and sex on body weight and body measurements. Overall breeds did differ for live body weight, heart girth, length, height, and chest length ($P < 0.05$). However, there was no difference among breeds in term of pubic bone length ($P < 0.05$). Kamori had mean body weight of 67.58 ± 1.41 kg, followed by Pateri (50.01 ± 1.50kg), Bugi-Turi (44.13 ± 1.33kg), Barri (43.50 ± 1.60kg), Kachan (42.50 ± 1.60kg), Tapri (39.33 ± 1.55kg), Jattan (38.63 ± 1.51kg), Chappar (38.03 ± 1.49kg), Lohri (35.41 ± 1.60kg), and Thari (33.94 ± 1.45kg). There was significant difference among age class for all the body measurement and body weight ($P < 0.05$) except for pubic bone length. Overall male goats showed higher body weight and height. The present study revealed variations in body measurements and body weight across age, sex, and breed in Sindh for the first time. As goats are mainly raised for meat production in the area, Kamori goat showed highest body weight followed by Pateri, Bugi-Turi, Barri, Kachan, Tapri, Jattan, Chappar, Lohri, and Thari. Moreover, if breeds are to selected for mutton based on body weight, then Kamori are followed by Pateri, Bugi-Turi, Barri, Kachan, Tapri, Jattan, Chappar, Lohri, and Thari. This could be useful information if a selection program is to be launched in the future to improve meat production in the province.

Key Words: AJK, goat breeds, body measurements, body weight

1721 Effects of supplementing olive pomace as a feed additive on weight gain in *Capris aegagrus hircus*. P. Urso*, M. M. Beverly, S. F. Kelley, M. J. Anderson, J. L. Leatherwood, K. J. Stutts, and S. Nair, *Sam Houston State University, Huntsville, TX.*

In the livestock industry, feed is one of the highest variables affecting the cost of production. A producer's goal is to find the least costly feedstuff that is effective in meeting nutrient requirements of livestock, particularly during winter months. Olive pomace is a by-product of the olive oil industry and could be considered as a potential livestock feedstuff to be used as an energy supplement due to its high fat content (15%). The objective of our study was to determine if olive pomace could be used as an acceptable low cost feedstuff to maintain weight during the colder winter months. To accomplish this 28 Spanish influence goats were fed (2% of body weight, BW) varying amounts of fermented pomace with a protein pellet to meet maintenance requirements. The four test groups (n = 7) consisted of a 3:1, 1:1, and 1:3 olive pomace to concentrate ratio (O:C) as well as a control containing no pomace. All groups received molasses at 0.5% BW

to improve the palatability of the feed and to further homogenize the ration to discourage selective eating of the mixture. Does were fed in herring bone style runs every morning for 49 d. The average daily gain (ADG) for the 1:3, 1:1, 3:1, and control groups were 0.0370, 0.0166, 0.0119, and 0.0262 kg/day, respectively, with no difference detected between groups ($P > 0.88$). The similar ADG across groups suggests that pomace can be an effective feed additive to reduce feed costs. A difference ($P < 0.01$) in consumption rates was detected between treatments with the 3:1 group consuming more feed with an average of 0.785 kg/day compared to the control at 0.694 kg/day. Additionally, olive pomace may be considered as a cost effective supplement to reduce costs for maintenance rations. Using ANOVA, cost efficiency of the test groups were compared. Rations costs were calculated at \$0.153/g for the 3:1 ration compared to \$0.6386/kg for the pelleted control ration. On average, this difference in input cost can reduce a producer's cost of feed by \$13.53/hd over a 49 d maintenance feeding period ($P < 0.01$) by feeding olive pomace. While further research is needed to determine the optimum levels of olive pomace feeding, it remains a viable alterative to high cost feedstuffs.

Key Words: goats, olive, pomace

1722 Genetic and non-genetic effects on performance traits in a U.S. population of dairy sheep.

T. W. Murphy*[1], M. Baldin[2], Y. M. Berger[3], R. L. Burgett[4], P. W. Holman[3], and D. L. Thomas[1], *[1]University of Wisconsin-Madison, Department of Animal Sciences, Madison, [2]Pennsylvania State University, Department of Animal Science, University Park, [3]University of Wisconsin-Madison, Spooner Agricultural Research Station, Spooner, [4]National Sheep Improvement Program, Ames, IA.*

There are relatively few dairy sheep operations in the U.S., but the industry is growing. Genetic improvement in dairy flocks has come through "breeding-up" ewes of common meat and wool breeds to European dairy breeds with imported rams and semen. This process has led to a crossbred domestic dairy sheep population consisting of East Friesian (EF), Lacaune (LA), and non-dairy (Meat) breeds. The objectives of this research were to: 1) determine the non-genetic factors affecting ewe performance, 2) estimate genetic parameters of and among traits, and 3) evaluate the genetic trends in traits of economic importance. Data were obtained from flock records collected at the Spooner Ag Research Station, University of Wisconsin-Madison from 1995–2015. There were 5438 records on number of lambs born per ewe lambing (NLB) and 4763 records on 180-d adjusted milk (MY), fat (FY), and protein (PY) yield, and percentage fat (%F) and protein (%P). There were 1969 and 1688 ewes with NLB and lactation records, respectively. The two multiple trait repeatability models jointly analyzed NLB, MY, FY, and PY or NLB, MY, %F, and %P. The significant fixed effects were trait dependent but included a proportion of EF and LA breeding, EFxLA and LAxMeat specific retained heterosis coefficients, age of ewe at lambing, and production year. The estimated heritabilities were 0.08 ± 0.02, 0.30 ± 0.04, 0.26 ± 0.04, 0.29 ± 0.04, 0.53 ± 0.04, and 0.61 ± 0.04 for NLB, MY, FY, PY, %F, and %P, respectively. NLB had a negative genetic correlation with %F (-0.25 ± 0.12). However, all other estimates of genetic correlations between NLB and lactation traits were low. The yield traits had high genetic correlations with each other (0.90 ± 0.02 between MY and FY, 0.96 ± 0.01 between MY and PY, and 0.93 ± 0.01 between FY and PY). There were unfavorable genetic correlations of -0.29 ± 0.08 between MY and %F and -0.35 ± 0.08 between MY and %P. The genetic correlation between %F and %P was high (0.60 ± 0.05). The regression of MY predicted breeding value on ewe year of birth revealed an average genetic improvement of 2.60 ± 0.12 kg yr^{-1} from 1995 to 2014 in this population. Due to the current restrictions and difficulties surrounding importation of foreign germplasm, a national dairy sheep genetic evaluation program is key to the continued improvement of U.S. flocks.

Key Words: crossbreeding, dairy sheep, genetic parameters

1723 Effects of high concentrations of crude glycerin on feed intake and ruminal parameters of sheep.

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Eight ruminally-cannulated crossbred (Santa Ines × Dorper) male sheep (64.5 ± 8.5 kg) were used to evaluate the effects of high concentrations of crude glycerin on dry matter intake, and ruminal parameters. Animals were assigned to a replicated 4 × 4 Latin square design and, in pairs, were fed one of the four experimental diets. Isonitrogenous (18.4% CP) and isoenergetic (2.7 Mcal ME/kg DM) diets were composed of corn silage, soybean hulls, soybean meal, mineral premix, and crude glycerin replacing 0 (G0), 10 (G10), 20 (G20), or 30% (G30) corn cracked grain (DM basis), in a roughage:concentrate ratio of 40:60. Crude glycerin totally replaced corn grain in G30, and contained 83% glycerol, 95% DM, 6% salt, and less than 0.01% methanol. Each experimental period lasted 21 d (14 d adaptation and 7 d data collection). Animals were fed twice daily (0700 and 1900 h), and feed delivered and refused were weighed every morning to assess DMI. Ruminal pH, ammonia nitrogen (NH_3–N), and short-chain fatty acids (SCFA; acetate [C2], propionate [C3], butyrate, isobutyrate, valerate, and isovalerate) were evaluated at 0, 2, 4, 8, 10, and 12 h after feeding. No interaction time of observation × treatments was observed. The DM intake tended to show a quadratic effect ($P = 0.09$), with greater values observed for

G10 and G20 (1375 and 1336 g/d, respectively). Ruminal pH tended to linearly increase ($P = 0.07$), with values from 6.0 (G0) to 6.2 (G30). A tendency for a quadratic effect of ruminal concentrations of NH_3–N ($P = 0.06$) was observed, with lesser values for treatments with intermediate levels of crude glycerin (9.6 and 10.2 mg/dL, respectively for G10 and G20). Crude glycerin inclusion linearly decreased total SCFA ($P < 0.0001$), acetic acid ($P < 0.0001$), butyric acid ($P = 0.0004$), isobutyric acid ($P = 0.0007$), isovaleric acid ($P = 0.003$), and C2:C3 ratio ($P < 0.0001$). The production of propionic and valeric acids were not influenced by treatments (average = 8.7 and 0.5 mg/dL); however, the proportion of propionate linearly increased from 21 to 34% of total SCFA produced. The inclusion of up to 30% crude glycerin in diets for crossbred sheep promotes quadratic effect on DM intake and ruminal concentrations of NH_3–N, changes SCFA profiles and increases ruminal pH.

Key Words: glycerol, rumen, sheep

1724 Serum anti-mullerian hormone as an indicator of fertility in Katahdin ewes. M. Acharya[*1], J. M. Burke[2], E. Smyth[2], L. Ngere[2,3], and R. W. Rorie[1], *[1]Department of Animal Science, Division of Agriculture, University of Arkansas, Fayetteville, [2]USDA-ARS, Booneville, AR, [3]Oak Ridge Institute for Science and Education, Oak Ridge, TN.*

Individual ewes vary in reproductive performance parameters, such as age at first lambing, twinning rate, and ability to breed during off-season. Previous studies indicate that anti-mullerian hormone (AMH) in circulation reflects the total pool of follicles within the ovaries, and is positively correlated with fertility. In this study, retrospective analysis was used to determine if AMH could serve as an indicator of ewe fecundity. Serum samples were collected from 152 Katahdin ewes ranging from 0.5 to 7 yr of age, their pregnancy and lambing rate recorded, and estimated breeding values obtained from the National Sheep Improvement Program. Anti-mullerian hormone was analyzed using an equine and ovine AMH enzyme-linked immunosorbent assay (ELISA) kit. Continuous variables were analyzed by ANOVA and categorical data by chi-squared, using JMP® (SAS institute) software. Serum AMH ranged from 0.04 to 0.39 ng/mL, with mean of 0.17 ng/mL. Mean serum AMH was similar ($P = 0.37$) across all ewe age groups (< 1, 1 to 2, 2 to 3, and > 4 yr). The distribution of AMH concentrations was divided into quartiles (AMH Q1 through Q4, with the Q1 lowest and Q4 the highest). There was no relationship (fall; $P = 0.65$; summer; $P = 0.11$) between AMH quartile and mean number of lambs born (NLB) from fall and summer breeding. No correlation ($P = 0.39$) was found between individual estimated breeding value for NLB and serum AMH concentration. A significant correlation ($P < 0.01$; $r = 0.411$) existed between mean NLB per individual ewe during summer (0.79) and fall (1.44). Overall pregnancy rate was higher ($P < 0.01$) for fall (79%) than summer (48%) breeding. It was noted that 25/68 (36.8%) of ewes < 2 yr of age fell into the lowest AMH quartile (Q1) as compared with 13/84 (15.5%) for older ewes. Similarity of AMH among different ewe age groups and a lower percentage of older ewes in AMH Q1 could reflect particular selection criteria.

Key Words: anti-mullerian hormone, ewes, reproductive performance

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1725 Fatty acid composition of different fat depots from hair and wool x hair crossbred lambs supplemented with highly digestible fiber containing agro-byproducts on pasture. C. Tripp[*1], J. H. Lee[1], S. Wildeus[2], A. Discua[1], and D. Kafle[1], *[1]Fort Valley State University, Fort Valley, GA, [2]Virginia State University, Petersburg.*

Agro-byproducts such as soy hull and corn gluten have been recognized as economical sources of feeds for small ruminants because they can provide supplemental nutrients for small ruminants with highly digestible fiber. However, their effect on the fatty acid profile of different fat depots in lambs has not been completely studied. This study was conducted to determine the fatty acid composition of different fat depots from grazing lambs supplemented with highly digestible fiber containing agro-byproducts. Thirty-six 7.5-mo-old purebred hair (Barbados Blackbelly and St. Croix) and crossbred wool (Dorset) x hair lambs grazed predominantly Jesup tall fescue pasture. Lambs were randomly assigned to a pasture-only, or a soy hull (SH) or corn gluten feed (CGF) supplemented group balanced by breed type. Supplement was provided at 2% of BW daily at individual feeding stations. After 77 d of grazing, lambs were slaughtered using standard procedures. Intramuscular, subcutaneous, and kidney fats were obtained from each carcass. Total lipids from each fat depot sample were extracted by the chloroform-methanol method. Extracted lipids were prepared for the fatty acid methyl esters (FAME) and then analyzed by a gas chromatography. All data were analyzed as a completely randomized design with a 2 × 3 factorial treatment arrangement: breed type (pure- or cross-bred) and diet (pasture-only, pasture plus SH or CGF) as main effects. The fatty acid profiles of different fat depots from lambs were significantly influenced by supplementation. Compared with lambs supplemented with SH or CGF, pasture-only fed lambs had higher concentrations of γ-linolenic (C18:3n6; 0.50 or 0.52 vs. 0.64%), arachidonic (C20:4n6; 2.10 or 2.06 vs. 3.31%), eicosapentaenoic (C20:5n3; 0.46 or 0.36 vs. 1.06%), and docosahexaenoic (C22:6n3; 0.55 or 0.52 vs. 1.27%) acids, but lower ($P < 0.05$) concentrations of palmitic (C16:0; 17.0 or 18.1 vs. 15.9%) and oleic (C18:1n9; 33.8 or 32.8 vs. 29.1%) acids in intramuscular fat; higher ($P < 0.05$) concentrations of myristoleic (C14:1n5), palmitoleic

(C16:1n7), α-linolenic (C18:3n3; 1.80 or 1.24 vs. 2.84%), and C18:3n6 (0.83 or 0.65 vs. 2.66%) acids, but a lower ($P < 0.01$) concentration of C18:1n9 in subcutaneous fat; and a higher ($P < 0.01$) concentration of C14:1n5, but a lower concentration of C18:1n9 in kidney fat. The results indicate that fresh lamb from pasture only fed-lambs might have healthier fatty acid profiles compared with that from lambs supplemented with soy hull or corn gluten feed.

Key Words: agro-byproduct, fatty acid, lamb

SMALL RUMINANT SYMPOSIUM: ENHANCING SMALL RUMINANT PROFITABILITY

1726 Profitability of small ruminant production systems.

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The prolonged decline in U.S. sheep numbers is well documented. Well known reasons for the decline include dwindling U.S. demand for lamb, relative prices for competing meats, the rise of man-made fibers competing with wool, discontinuation of the U.S. Wool Incentive payment program, grazing allotment policies for public lands, and restrictions on predator control. Another critically important force behind falling U.S. sheep numbers has been rising costs resulting in unprofitable conditions, forcing producers to reduce the size of their flocks or exit the industry. Using extension sheep production budgets, this study examines and compares sheep production costs across various states representing conventional sheep production based on an average flock size with costs and returns on a per ewe basis. The weighted total variable cost was $124.44 per ewe in 2015 and ranged from $148 per ewe in Kentucky to $118 per ewe in Wyoming. Receipts were the highest in the Eastern region at $179 per ewe and were the lowest in Texas at $98 per ewe. Net returns ranged from a-$41 to $21 per ewe in Texas and Kentucky, respectively. Costs between regions reflected significant differences in production systems. For example, feed made up just over 50% of total variable costs in Texas and 22% of total variable costs in Wyoming. Hired labor made up 37% of total variable costs in Wyoming or $44 per ewe. Predator control costs were $10.50 per ewe in Texas but only $1-$2 in the other regions. The results highlight the variable nature of the cost of sheep production and the range of production systems across the country. Policy changes that affect hired labor costs, for example, affect Wyoming and Western region production more than smaller flocks in the East with little, if any, hired labor. New technologies or predator control systems would be likely to see the greatest returns in Texas and the Southwest or in the Mountain West. Changes in public land grazing policies would have the biggest effect in the West. Positive returns in Kentucky indicate opportunities for industry expansion in the Eastern half of the U.S.

Key Words: cost of production, net returns, production systems, sheep

1727 Contribution of hair sheep to small ruminant profitability.

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Hair sheep numbers in the United States have increased dramatically in the past twenty years as documented by breed registry data. Characteristics promoted by hair sheep producers include: moderate or small framed, easy care, parasite resistant, twinning, productivity in extensive systems, aseasonal breeders, and adapted to heat and humidity. These descriptors suggest that hair sheep have the potential to add to the profitability of small ruminant production in the USA. Two hair sheep breeds rank among the top six breeds for numbers of sheep registered in the USA from 2002 to 2015 (Table 1 for 2003–2015). The increase in hair sheep registrations occurred while the vast majority of wool sheep registries experienced declines of 25–75% in their registration numbers from 1990 to 2015. Research results from three research stations will be discussed since they document productivity of hair sheep and hair sheep crosses. These stations include USDA ARS Meat Animal Research Center in Nebraska, USDA ARS Small Farm Research Center in Arkansas, and Texas A&M Agrilife Research Center in San Angelo, Texas. Data from these stations and other university studies find that the weights of weaned and finished hair sheep lambs are well suited to markets and regions of the country that reward the non-traditional or light lamb market. In the Nebraska and Arkansas production systems, hair sheep genetics produced 150–200% lamb crops in forage-based systems compared to annual NASS reports of 110% for the United States. In west Texas, research results indicate that lamb markets differentially impact hair sheep (Dorper) and wool sheep (Rambouillet) producers based on corn prices and weather (Sheep and Goat Research Journal, In Press). During drought years, Dorpers wean significantly more lambs. When corn prices are high, Dorpers bring premium prices for the light lamb, non-traditional markets. When corn prices are low, wool feeder lambs bring premium prices. A significant percentage of the hair sheep operations, using breed association membership, are located in regions of the country where sheep numbers have traditionally been low, especially the Southeastern region. It is suggested that lack of shearers, decreased quality and quantify of wool, resistance to parasites (documented by Virginia Tech, LSU, USDA Booneville, among others) and adapted to heat and humidity help with popularity of these breeds in this region.

Key Words: breed registry, hair, sheep