

Small Ruminant I

M452 Chemical composition and quality of fresh lamb from rationally grazed hair and wool x hair sheep lambs as influenced by soy hull supplementation. Beruk B. Lemma^{*1}, Jung Hoon Lee¹, Stephan A. Wildeus², Govind Kannan¹, and Brou Kouakou¹, ¹Fort Valley State University, Fort Valley, GA, ²Virginia State University, Petersburg, VA.

This study was conducted to evaluate the effects of soy hull supplementation on the quality characteristics of fresh lamb from hair and wool x hair sheep lambs. Forty-seven lambs (5-mo old), 23 purebred hair sheep (Barbados Blackbelly or BB, BW = 16.2 ± 1.9 kg; St. Croix or SC, BW = 19.5 ± 2.0 kg) and 24 crossbred wool (Dorset, D) x hair (BB; BW = 21.7 ± 2.3 kg or SC; BW = 21.7 ± 2.9 kg) sheep lambs of both sexes rotationally grazed predominately tall fescue with or without soy hull supplementation during summer. Soy hull was provided at 2.0% of BW at individual feeding stations. After 90 d of grazing, lambs were harvested using standard procedures. After 24 h cooler storage (2°C), longissimus muscle (LM) pH was measured in individual carcasses. Each carcass was fabricated to obtained 2.5-cm thick loin chops for meat quality analysis. All data were analyzed as a completely randomized design with a 2 x 2 x 2 factorial treatment arrangement: breed type (pure- or cross-bred), supplement (with or without soy hull), and sex (male or female). The CIE L* (lightness), a* (redness), and b* (yellowness) values of lamb chops were significantly influenced by supplementation, sex, and their interaction. Chops from supplemented lambs had higher ($P < 0.001$) CIE a* values than those from grazed-only lambs. The LM from supplemented lambs had higher ($P < 0.001$) protein (22.4 vs 21.4%) and fat contents (2.88 vs 2.47%) than that from grazed-only lambs. The percent metmyoglobin and thiobarbituric acid reactive substances (TBARS) values of LM from lamb chops were significantly affected by sex, breed type, and breed type x sex. The LM from purebred lambs had a higher ($P < 0.05$) level of TBARS (0.32 vs 0.27 mg MDA/kg) than that of crossbred lambs. Chops from supplemented lambs had lower ($P < 0.01$) shear values than those from grazed-only lambs. The results indicate that soy hull supplementation can improve color and texture property of fresh hair sheep lambs grazing fescue pasture regardless of breed type.

Key Words: hair and wool sheep, meat quality, soy hull

M453 Effects of feeding entrapped fish oil in a chemically treated protein matrix on milk composition of lactating goats. Jung Hoon Lee^{*1}, Christina R. Alfred¹, Beruk B. Lemma¹, Brou Kouakou¹, and Byung J. Min², ¹Fort Valley State University, Fort Valley, GA, ²Tuskegee University, Tuskegee, AL.

Because of the potential benefit to human health, there is considerable interest in increasing omega-3 fatty acid contents in milk fat. However, efforts to increase the levels of eicosapentaenoic (EPA; C20:5n-3) and docosahexaenoic (DHA; C22:6n-3) acids had limited success because they undergo biohydrogenation in rumen. This study investigated the effect of entrapped fish oil (EFO) containing EPA and DHA acids on milk and milk fat compositions of lactating goats. The EFO were prepared with fish oil, defatted soy flour, and acetaldehyde. Nine Saanen lactating goats (4 yr old; BW = 48.3 ± 2.26 kg) were divided into groups of 3 and randomly assigned to 3 diets using a 3 x 3 Latin square design with 14-d periods. The 3 diets consisted of 95% basal diet containing alfalfa meal, yellow corn and soybean meal, plus 5.0% lipid from either poultry fat (PF), fish oil (FO) or EFO. Each period consisted of a 10-d adjustment

to assigned diets followed by 4-d of milking collection. The designated diet was provided once daily ad libitum at individual feed stations. The collected milk samples from each goat were analyzed for basic nutrient, α -tocopherol and fatty acid composition. All data were analyzed as a 3 x 3 Latin square design. Lactating goats fed a PF containing diet had a higher ($P < 0.01$) content of milk fat compared with goats fed either a FO- or an EFO-containing diet (3.98 vs 3.34 or 3.22%). No significant differences were found in the amount of α -tocopherol (0.87–0.90 μ g/mL) in the milk samples from the 3 different diets. Compared with lactating goats fed PF-diet, goats fed either FO- or EFO- diets had higher ($P < 0.01$) concentrations of EPA (C20:5n-3, 0.30 vs. 0.81 or 1.66%), docosapentaenoic (C22:5n-3, 0.24 vs. 0.77 or 0.98%), and DHA (C22:6n-3, 0.32 vs. 1.21 or 1.86%) in milk. Furthermore, the concentration of EPA in milk from goats fed EFO-diet was higher ($P < 0.01$) than that from goats fed a FO-diet. The results indicate that feeding lactating goats with entrapped fish oil in a chemically treated protein matrix might increase the deposition of omega-3 fatty acids in their milk.

Key Words: lactating goat, milk fat, eicosapentaenoic and docosahexaenoic acids

M454 Fatty acid composition and α -tocopherol content of blood serum from lactation goats fed entrapped fish oil in a chemically treated protein matrix. Christina R. Alfred^{*1}, Jung Hoon Lee¹, Beruk B. Lemma¹, Brou Kouakou¹, and Byung J. Min², ¹Fort Valley State University, Fort Valley, GA, ²Tuskegee University, Tuskegee, AL.

This study evaluated the effects of feeding entrapped fish oil containing eicosapentaenoic (EPA; C20:5n-3) and docosahexaenoic (DHA; C22:6n-3) acids in chemically treated protein on fatty acid compositions and α -tocopherol concentrations of blood serum in lactating goats. The entrapped fish oil (EFO) were prepared with fish oil, defatted soy flour, and acetaldehyde. Nine Saanen lactating goats (4 yr old; BW = 48.3 ± 2.26 kg) were divided into groups of 3 and randomly assigned to 3 diets using a 3 x 3 Latin square design with 3 14-d periods. Experimental diets consisted of 95% basal diet, containing alfalfa meal, yellow corn and soybean meal, with 5.0% of oil/fat from either poultry fat (PF), fish oil (FO) or EFO. The designated diet was provided once daily ad libitum at individual feed stations. Blood samples were collected from individual goats at the end of each feeding period which were analyzed for α -tocopherol and fatty acid composition. All data were analyzed as a 3 x 3 Latin square design. Average daily intake of diet containing EFO was lower ($P < 0.01$) than diets containing either PF or FO (1.04 vs 2.56 or 1.90 ± 0.300 kg). Consequently, the ADG of goats fed EFO diet was lower ($P < 0.05$) than the other 2 diets. The blood serum from goats fed EFO diet tended ($P = 0.08$) to have a higher amount of α -tocopherol (2.31 vs 1.89 or 1.90 μ g/mL) than did those from goats fed either PF or FO diet. Compared with goats fed PF-diet, goats fed either FO- or EFO- diet had higher ($P < 0.01$) concentrations of EPA (C20:5n-3, 1.76 vs 10.57 or 13.23%), docosapentaenoic (C22:5n-3, 1.32 vs 2.02 or 1.93%), and DHA (C22:6n-3, 1.95 vs 4.58 or 5.38%) acids in blood serums. Furthermore, the concentrations of EPA and DHA in blood serums from either EFO- or FO-diet fed goats were similar even with a limited intake of EFO-diet. Thus, feeding lactating goats with entrapped fish oil in chemically treated protein might protect n-3 fatty

acids and α -tocopherols from ruminal degradation and subsequently increased those contents in the blood serum of lactating goats.

Key Words: lactating goat, blood serum, eicosapentaenoic and docosahexaenoic acids

M455 Fatty acid composition of different fat depots from meat goats supplemented with tannin-rich pine bark. Beruk B. Lemma*¹, Jung Hoon Lee¹, Byeng R. Min², Govind Kannan¹, and Brou Kouakou¹, ¹Fort Valley State University, Fort Valley, GA, ²Tuskegee University, Tuskegee, AL.

This research assessed the effect of feeding ground pine bark (PB, *Pinus* spp.), containing up to 13% condensed tannins (CT) on a DM basis, on different fat depots in meat goats. Twenty-four intact male Kiko goats (8 mo of age; BW = 39.7 ± 2.55 kg) were grazed in a winter rye grass-dominant pasture, and supplemented either bermudagrass hay (BG) or PB pellet. Each supplementation (n = 12 goats/treatment) consisted of alfalfa pellet (16.9% CP, 3.30% ether extract or EE, 48.7% NDF), molasses, and mineral mixtures with either BG (20.5% CP, 4.44% EE, 40.9% NDF) or PB powder (9.10% CP, 3.35% EE, 59.0% NDF), which was provided at 1.5% of BW at individual feeding stations. After 50 d grazing, goats were harvested. 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. Palmitic (C16:0), stearic (C18:0), oleic (C18:1n9), and linoleic (C18:2n6) acids were the major fatty acids in the intramuscular fats from goats supplemented with either BG-hay or PB-pellet (85.9 vs 86.0% of total fatty acid). The subcutaneous and kidney fats consisted mainly of myristic (C14:0), C16:0, C18:0, and C18:1n9 acids, which accounted for 79.1 and 81.9% vs 85.3 and 84.7% of total fatty acids in the BG-hay and PB-pellet supplemented goats, respectively. No significant differences were found in these major fatty acids in the 3 different fat depots from goats fed either BG-hay or PB-pellet. However, compared with goats fed BG-hay, goats fed PB-pellet had lower ($P < 0.05$) concentrations of margaric (C17:0), margaroleic (C17:1n9), and conjugated linoleic (C18:2, CLA) acids in intramuscular fats; a higher ($P < 0.05$) concentration of eicosapentaenoic (C20:5n3) acid in subcutaneous and kidney fats. The results indicate that the supplementation of PB did not change the major fatty acids in the different fat depots in meat goats.

Key Words: goat, pine bark, fatty acid profile

M456 Influence of dietary condensed tannins from pine bark and/or sericea lespedeza on chemical composition and quality of goat meat. Travet Witherspoon¹, Jung Hoon Lee*², Beruk B. Lemma¹, Byeng R. Min³, Govind Kannan², and Brou Kouakou², ¹Thomasville High School, Thomasville, GA, ²Fort Valley State University, Fort Valley, GA, ³Tuskegee University, Tuskegee, AL.

Even though pine bark (PB) and sericea lespedeza (SL) contain a high amount of condensed tannins (CT), they have been recognized as an economical source of nutrients for goats. Yet their effect on the quality of goat meat (chevon) has not been intensively studied. This study was conducted to determine the quality characteristics of chevon from meat goats fed CT-containing PB and/or SL diets. Twenty-four Kiko × Boer male goats (8 mo of age; BW = 37.3 ± 2.56 kg) were randomly assigned to a feeding trial. Goats were randomly divided into 4 groups with 6 goats in each group. Each group was assigned randomly 1 of 4

diets: 30% bermudagrass (BG) hay (control, BG-diet); 30% PB pellet (PB-diet); 30% SL pellet (SL-diet); and 15% PB + 15% SL pellet (PS-diet) with the remainder of each diet made up of 70% alfalfa pellets mixed with a commercial molasses-based sweet feed. After a 50 d feeding trial, goats were slaughtered using standard procedures. After 24 h cooler storage (2°C), longissimus muscle (LM) pH was measured from individual carcasses and each carcass was fabricated to obtain 2.5-cm thick loin chops for meat quality analysis. All data were analyzed as a completely randomized design. The LM pH values of goats fed the 4 different diets were not significantly different. Chops from goats fed a PB-diet had higher ($P < 0.05$) CIE L* (lightness) and a* (redness) values than those from goats fed the other 3 different diets. The LM from goats fed a PS-diet had higher ($P < 0.05$) moisture and ash contents than that from goats fed a PB- and a BG-diet, respectively. Furthermore, the LM from goats fed a PB-diet had higher ($P < 0.05$) percent metmyoglobin and thiobarbituric acid reactive substances (TBARS) values than that from goats fed the other diets. Compared with goats fed BG-diet, goat fed either a SL- or a PB-diet had lower ($P < 0.05$) shear values (3.74 vs 3.26 or 3.03 ± 0.13 kg) in cooked loin chops. The results indicate that a diet containing higher amounts of dietary tannins from PB might improve the texture property and color of goat meat, whereas the resulting chevon might be more susceptible to the lipid oxidation.

Key Words: chevon quality, pine bark, sericea lespedeza

M457 Fatty acid composition of different fat depots from meat goats supplemented with either tannin-rich pine bark and sericea lespedeza alone or in combination. Christina R. Alfred¹, Jung Hoon Lee*¹, Travet Witherspoon², Beruk B. Lemma¹, Byeng R. Min³, Govind Kannan¹, and Brou Kouakou¹, ¹Fort Valley State University, Fort Valley, GA, ²Thomasville High School, Thomasville, GA, ³Tuskegee University, Tuskegee, AL.

In vitro studies showed that dietary tannins inhibit the growth of microorganisms that are responsible for ruminal biohydrogenation of fatty acids. Both pine bark (PB) and sericea lespedeza (SL) contain high amounts of condensed tannins (CT). However, their effect on the fatty acid profile of different fat depots in meat goats has not been studied. This study was conducted to determine the fatty acid composition of different fat depots from meat goats fed CT-containing either PB and SL alone or in combination diets. Twenty-four crossbred (Kiko × Boer) goats (BW = 37.3 ± 2.56 kg) were randomly assigned to one of 4 diets: 30% bermudagrass (BG) hay (control, BG-diet); 30% PB pellet (PB-diet); 30% SL pellet (SL-diet); and 15% PB + 15% SL pellet (PS-diet) with the remainder of each diet made up of 70% alfalfa pellets mixed with a commercial molasses-based sweet feed. After 50 d feeding, goats were harvested. Intramuscular, subcutaneous, and kidney fats were obtained from each carcass. Total lipids from each fat sample were extracted, and prepared for the fatty acid methyl esters (FAME). The FAME were analyzed by a gas chromatography. All data were analyzed as a completely randomized design. Compared with goats fed BG-diet, goats fed either PB- and SL-diet had a lower ($P < 0.05$) concentration of stearic (C18:0) acid (16.93 vs 14.93 or 15.01%) in intramuscular fat. Goats fed PB-diet had higher concentrations of linoleic (C18:2n-6; 5.55 vs 8.21%) and linolenic (C18:3n-3; 0.57 vs 0.91%) acids in intramuscular fat compared with goat fed BG-diet. In kidney fat, goats fed either PB- or SL-diet had a lower ($P < 0.05$) concentration of margaroleic (C17:1n-9) acid (0.45 vs 0.33 or 0.36%), but goats fed PB-diet had higher a concentration of C18:2n-6 (2.50 vs 5.48%) acid compared with goats fed BG-diet. Goats fed PS-diet had a higher concentration of C18:2n-6 acid (1.48 vs 2.75%) in subcutaneous fat compared with those fed BG-diet. The

results indicated that goats fed PB might increase the deposition of C18 polyunsaturated fatty acids in fresh goat meats.

Key Words: pine bark, sericea lespedeza, fatty acid profile of goat

M458 Influence of reproductive stage and breed on the hemogram of sheep. Leilson R. Bezerra*^{1,2}, Jacira N. C. Torreão¹, Carlo A. T. Marques¹, Marcos J. Araujo¹, and Ronaldo L. Oliveira², ¹Federal University of Piauí, Bom Jesus, Piauí, Brazil, ²Federal University of Bahia, Salvador, Bahia, Brazil.

The objective with this study was to evaluate the influence of reproductive stages (pregnancy, puerperium) and breed (Santa Inês and Morada Nova) on the hemogram. We used 20 Santa Inês sheep and 20 Morada Nova sheep diagnosed with positive pregnancy and distributed in a completely randomized design, factorial arrangement 2 × 2 (reproductive stage × breed) in a split-plot arrangement over time (blood collection). During the experimental period, the animals were kept in paddocks containing *Andropogon gayanus*, which was enclosed in the late afternoon for supplementation consisting of cracked corn (70%), soybean meal (25%) and mineral supplement (5%), based on the dry matter. Blood samples were collected by jugular venipuncture every 14 d in the morning before the animals were released to pasture, starting from 1st day of gestation up to the 90th day of lactation (when the lambs were weaned). The hemogram analysis consisted of global erythrocyte counts, packed cell volume or hematocrit, hemoglobin, mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), total plasma proteins (TPP) and total leukocyte counts. The means were compared with the Student-Newman-Keuls test, and was considered significant effect when $P < 0.05$. There was no influence of breed in erythrocyte count ($P = 0.4718$) and TPP ($P = 0.2609$). The Morada Nova breed showed higher hemoglobin ($P < 0.0001$) and hematocrit ($P = 0.0024$) and total leukocyte count ($P < 0.0001$) than Santa Inês breed. There was increased in global erythrocyte counts ($P < 0.0001$) in pregnancy and a reestablishment during the puerperium period. The pregnancy period reduced hemoglobin ($P < 0.0001$), hematocrit ($P = 0.0024$), MCV ($P < 0.0001$) and MCHC ($P < 0.0001$) and puerperium period increased hematocrit ($P = 0.0356$) and total leukocyte count ($P = 0.0243$). The TPP also increased ($P < 0.0001$) during pregnancy period to compensate for the high nutritional requirements of the fetus, and these levels remained high until the end of the puerperium phase when the lambs were weaned. There is recuperation of blood values such as TPP in puerperium, which increase during this period to compensate for the high nutritional demands of the fetus in pregnancy.

Key Words: hemoglobin, indigenous sheep, parturition

M459 Production and chemical composition of milk from goats fed different levels of buriti oil. Leilson R. Bezerra*^{1,3}, Jasiel S. Morais^{1,2}, Ronaldo L. Oliveira³, Aderbal M. A. Silva², and Ricardo L. Edvan¹, ¹Federal University of Piauí, Bom Jesus, Piauí, Brazil, ²Federal University of Campina Grande, Patos, Paraíba, Brazil, ³Federal University of Bahia, Salvador, Bahia, Brazil.

Buriti (*Mauritia flexuosa*) oil can be a great energy source for goats in lactation. This study aimed to determine the most effective level of buriti oil to use in supplements for lactating goats. Eight Anglo-Nubian crossbreed goats in 50 d of lactation were grouped into 2 4 × 4 double simultaneous Latin squares being 4 experimental periods of 21 d each, with 16 adaptation days and 5 d data collection. The treatments were 4 diets containing 0–15, 30 or 45 g·kg⁻¹ of buriti oil in the total diet. The diets, a total mixed ration, were composed of corn silage and con-

centrate made with: corn, soybean, mineral supplement and buriti oil and were formulated according to NRC (2007) recommendations to lactating goats with production of 2 kg⁻¹·goat⁻¹·day⁻¹ and 4% milk fat. Animals were fed twice a day immediately after milking, at 8:00 and 16:00 h. The data were submitted to ANOVA and regression, using the MIXED model procedure from the statistics program SAS 9.1.2. The dry matter intake was reduced linearly ($Y = -0.16x + 2.1$, $r^2 = 0.914$) by the addition of buriti oil ($P < 0.05$). The milk production and milk production corrected for 4% of fat were not affected by the addition of buriti oil, but the corrected milk production of total solids ($Y = 0.033x + 1.152$, $r^2 = 0.898$) were increased linearly ($P = 0.0378$). In regards to milk constituents, the fat milk ($Y = 0.237x + 4.465$, $r^2 = 0.985$) was increased linearly ($P < 0.0001$) by the buriti oil levels in the total diet. The mean concentrations of total protein (37.63 g·day⁻¹) casein (31.80 g·day⁻¹) lactose (45.09 g·day⁻¹) and urea (18.74 mg·dL⁻¹) were not affected by the addition of buriti oil in diet ($P > 0.05$). The inclusion of buriti oil at 45 g·kg⁻¹ in a total mixed ration increases corrected milk production of total solids and milk fat of Anglo-Nubian crossbreed goats.

Key Words: fat milk, nutrition, palm tree

M460 The effects of administering a fibrolytic probiotic made from moose rumen bacteria to neonatal lambs. Suzanne L. Ishaq*¹, Christina J. Kim¹, and André-Denis G. Wright², ¹University of Vermont, Burlington, VT, ²University of Arizona, Tucson, AZ.

The present study investigated the effect of a fibrolytic probiotic using bacteria isolated from the rumen of the North American moose (*Alces alces*). Bacteria from moose were chosen for their ability to digest a variety of plant polysaccharides and lignin. Twenty 5-d old lambs (mean 5.9 ± 0.2 kg) were divided into probiotic and control groups, with probiotic receiving 5 bacterial isolates orally through weaning (9 wk), after which the lambs were put on pasture. Neither weight gain nor wool quality was improved in lambs given a probiotic, however, dietary efficiency was increased as evidenced by the reduced feed intake (and rearing costs) without a loss to weight gain. Total VFAs were not significantly different between groups. Acetate, propionate, butyrate, and ethanol were significantly ($P < 0.05$) higher in experimental lambs at certain weeks. The acetate to propionate ratio was statistically lower in the experimental group at wk 9, 11, and 15, which was previously shown to indicate increased dietary efficiency. Sampling coverage decreased over time, while Shannon, Inverse Simpson, CHAO, and ACE increased over time, which is a function of the increasing diversity of microbiota as the rumen develops. The experimental group had a higher diversity at the beginning of the experiment. Bacteroidetes was the most prevalent phylum (38–73% of total sequences) in both groups for the duration of the study, with the exception of the first sampling of the control group. Firmicutes was the second most prevalent (23–59%). In the control group, Bacteroidetes increased while Firmicutes decreased for the first 3 sampling points, while the experimental had a general trend of decreasing Bacteroidetes and increasing Firmicutes over time. *Prevotella* was the most prevalent genus, followed by *Butyrivibrio* and *Ruminococcus*. Protozoal densities increased over time and stabilized, but methanogen densities varied greatly in the first 6 mo of life for lambs. This is likely due to the changing diet and bacterial populations in the rumen.

Key Words: lamb, probiotic, moose

M461 Factors affecting feed efficiency in dairy goats. Tadeu Silva de Oliveira*¹, Ricardo Augusto Mendonça Vieira¹, Danielle Ferreira Baffa², Aberto Magno Fernandes¹, and José Carlos Pereira², ¹Universidade Estadual do Norte Fluminense-Darcy Ribeiro, Rio

de Janeiro, Brazil, ²Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil.

The objective of this study was to present some factors affecting feed efficiency in dairy goats. For our study, individual and average data from performance experiments with lactating goats were used. The following variables were evaluated: gross feed efficiency, adjusted feed efficiency, dry matter intake, milk-yield, 3.5% fat-corrected milk yield, dry matter digestibility, dietary neutral detergent fiber content, different roughage-to-concentrate ratios and body weight. The statistical analyses involved the application of descriptive and dispersion measures besides Pearson correlation coefficient PROC CORR and linear regression analysis PROC MIXED of SAS. However, because average daily gain (ADG) and dry matter intake (DMI) are variables of normal distribution, and because their division generates a Cauchy distribution variable it is more appropriate to generate a normal distribution variable from the transformation of the 2 variables according PROC TRANSREG of SAS. The analyzed variables were highly correlated with feed efficiency. The dry matter intake, dietary NDF content, roughage to-concentrate ratio and live weight had a negative correlation ($P < 0.05$) with feed efficiency, indicating that increase in these variables inversely affecting FE, reducing it. In contrast, milk yield, 3.5% fat-corrected milk yield and dry matter digestibility positively affected ($P < 0.05$) FE. Fat corrected milk yield was positively correlated with FE ($R = 0.89$; $P < 0.001$) as was milk yield ($R = 0.83$; $P < 0.001$). Feed efficiency (FE) increased by 0.061 points with every 1-L increase in milk yield. Fat corrected milk is a better indicator of feed efficiency because of the difference in energy represented by milk fat percentage. In conclusion, among these factors, standardization of the milk fat appeared to be the most efficient in describing the feed efficiency in lactating goats. Funded by FAPERJ, CAPES, and CNPq.

Key Words: dry matter intake, goat, milk yield

M462 Variation of masses of body fat and protein and visceral organs of alpine goats in the first eight weeks of lactation. Tadeu Silva de Oliveira^{*1}, Ricardo Augusto Mendonça Vieira¹, Marcelo Teixeira Rodrigues², Aberto Magno Fernandes¹, and Danielle Ferreira Baffa², ¹Universidade Estadual do Norte Fluminense-Darcy Ribeiro, Rio de Janeiro, Brazil, ²Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil.

The use constant values to represent the loss of energy due to mobilization of fat and protein as considered by INRA (1989), AFRC (1993) and Morand-Fehr and Hervieu (1999) does not reflect in a reliable dynamic mobilization. It should be considered that most data used for that inference were based on short-term calorimetric studies. Thus, it is essential to quantitatively know low body energy reserves are transformed into milk energy, and low energy mobilized and consumed concur for energy balance in the lactation course. This study aimed to measure changes of body fat and protein masses, and also quantify mass-changes of visceral organs of Swiss Alpine does throughout the first 8 weeks of lactation. Fifty-one multiparous does were allotted in a completely randomized design with 6 replications and 8 treatments (weeks of lactation). Animals were slaughtered sequentially to measure the mass of fat and protein retained in the body, as well as the weight of the visceral organs. The data were analyzed by using the MIXED procedure of SAS, in which 2 covariance structures (homogeneous and heterogeneous variances) and the likelihood of linear, quadratic, and cubic models were evaluated. The empty body weight (EBW) decreased ($P < 0.05$) over the 8 weeks of lactation (from 56.8 to 35.6 kg) and carcass fat also decreased ($P < 0.05$) from 5.16 to 2.10 kg and from 9.1 to 5.9% of EBW. Body fat reduced from 24.13 to 13.51%, as well as protein (from 14.18 to

14.75%), mostly because of the mobilization of noncarcass fat (from 28.58 to 15.73%) and protein (from 12.42 to 13.20%). The visceral fat mass was mobilized with greater intensity from the third to the eighth week of lactation, i.e., 4.33 kg reduced to 1.40 kg in the period or 7.57% reduced to 3.01% of EBW. There was no effect ($P > 0.05$) on liver mass, rumen, omasum, abomasum, small intestine, and large intestine during the first 8 weeks of lactation, but there was a decrease ($P < 0.05$) in the uterus (from 1.63 to 0.14 kg) and mammary gland masses (from 2.84 to 1.48 kg). In conclusion, Swiss Alpine does in early lactation mobilized energy reserves not only from carcass and internal fat but also from visceral organs. Funded by FAPERJ, CAPES and CNPq.

Key Words: adipose tissue, goats, mobilization

M463 Meat composition and yield of carcass and non-carcass components in crossbred lambs fed frying soybean oil. F. O. Scarpino-van Cleef*, E. H. C. B. van Cleef, M. T. C. Almeida, A. P. D' Aurea, H. L. Perez, and J. M. B. Ezequiel, São Paulo State University, Jaboticabal, São Paulo, Brazil.

Twenty-four crossbred uncastrated male Santa Ines × Dorper lambs (24.9 ± 2.4 kg BW) were used to evaluate meat composition and yield of carcass and non-carcass components when fed diets containing supplementary oil sources. Treatments consisted of a control diet (CON) containing 40% corn silage, 10.8% corn grain, 9.8% soybean hulls, 37.45% sunflower meal, 0.55% urea, 1.4% mineral premix, and 2 diets containing additional 6% soybean oil (SOY) or 6% residual soybean frying oil (FRY). Lambs were blocked by initial body weight (BW), and randomly assigned to 24 individual feedlot pens. Animals were harvested when they reached 35 kg BW. Carcass and edible non-carcass components were separated and weighed. Total edible non-carcass components yield (TENC) was obtained as the sum of weights of blood, tongue, lungs + trachea, liver + gall bladder, heart, kidneys, gastrointestinal tract (reticulum, rumen, omasum, abomasum and intestines), and abdominal and kidney fats. Total yield of usable products (TUP) was calculated as the sum of hot carcass weight and TENC. A sample of *Longissimus* muscle was collected between 12th and 13th ribs, and evaluated for moisture, crude protein, ether extract and ash contents. Data were analyzed as a randomized block design using a mixed model, and the contrasts control × oil treatments and soybean oil × frying oil were evaluated. TENC values were 6.62, 6.56, and 6.35 kg; and TUP values were 22.27, 21.58, and 22.19 kg for CON, SOY and FRY, respectively ($P > 0.10$). The weight of the liver of oil-fed lambs was greater than the ones fed CON ($P = 0.04$). The weight of the spleen tended to be greater in lambs fed FRY ($P = 0.06$), while the other individual non-carcass components were not affected by treatments. The ether extract of meat tended to be greater in lambs fed diets containing oil, regardless the source ($P = 0.07$). The meat moisture, mineral matter, or crude protein contents were unaffected by dietary oil supplementation. Data indicate soybean-frying oil is a potential alternative energy ingredient in diets for feedlot lambs and that the inclusion of 6% of this oil does not depreciate carcass and edible non-carcass components yields, and it increases meat intramuscular fat slightly.

Key Words: byproduct, lipid, non-carcass component

M464 Milk production, quality, and components measured in lactating dairy goats supplemented with OmniGen-AF. Angela D. Rowson^{*1}, Shelby A. Armstrong¹, Lane O. Ely², and Derek J. McLean¹, ¹Phibro Animal Health Corporation, Quincy, IL, ²University of Georgia, Athens, GA.

OmniGen-AF (OG) is a nutritional supplement that supports immune function in ruminant species. Forty-four, second parity lactating dairy goats were used to determine the effects of feeding OG on milk production, quality and components. Goats (63.5 ± 4.8 kg BW) were housed on a commercial goat dairy in Wisconsin. Does were randomly assigned to 1 of 2 diets: 1) Control (CT; n = 22), and 2) OG (n = 22). CT does were fed a complete commercially available feed pellet (dry pellet: CP 14%, fat 3%, fiber 11.2%; lactating pellet: CP 16%, fat 3.4%, fiber 8.1%) twice a day and had ad libitum access to alfalfa hay. OG does were fed the same diet but with 6 g/h/d of OG added to the pellet. Both diets met the nutrient requirements of the does including the diet without OG. Diets were initiated at dry-off (67–94 d prepartum) and continued for the entire lactation. Does were crossbreds (Saanan, Nubian, Alpine and LaMancha) with all breeds equally represented in both groups. DHIA milk testing was performed every 28 d during lactation, resulting in a total of 10 tests. Milk production, % fat, % protein, fat corrected milk (FCM), energy corrected milk (ECM), SCC, and somatic cell score (SCS) data were collected at each test. Mean milk produced per day was significantly greater ($P < 0.05$) for OG does than CT does (3.65 vs. 3.3 kg/h/d, respectively). Mean FCM was 3.59 kg/h/d for OG goats vs. 3.15 kg/h/d for CT goats ($P < 0.01$). Mean ECM was 3.82 kg/h/d for OG goats and 3.39 kg/h/d for CT goats ($P < 0.02$). Mean milk % fat was significantly greater ($P < 0.05$) for OG does (3.93%) compared with CT does (3.66%). The mean SCC for OG does was 847,060 mL⁻¹ vs. 1,167,100 mL⁻¹ for CT does ($P < 0.1$). Further analysis of the last 2 test dates (mean days in milk = 239.7 and 266.8) indicated OG does had lower SCC [1,348,090 mL⁻¹ ($P < 0.1$) and 2,003,630 mL⁻¹ ($P < 0.05$)] than CT does (2,471,090 mL⁻¹ and 5,057,630 mL⁻¹). There were no differences ($P > 0.1$) in mean % protein or mean SCS between the 2 groups. These results, including improved milk production, quality and select components, suggest enhanced mammary health in lactating dairy goats supplemented with OG.

Key Words: goat, milk, OmniGen-AF

M465 Effect of increasing levels of concentrate on nutrient digestibility and growth performance in lambs. Michelle de Oliveira Maia Parente¹, Ruan Mourão da Silva Gomes*¹, Wesclley Jesus dos Santos Sodré¹, Henrique Nunes Parente¹, Miguel Arcaño Moreira Filho¹, Nágila Maria de Carvalho Almeida¹, Rosane Cláudia Rodrigues¹, Jocélio dos Santos Araújo¹, and Daniel Louçana da Costa Araújo², ¹Universidade Federal do Maranhão, Chapadinha, Maranhão, Brazil, ²Universidade Federal do Piauí, Teresina, Piauí, Brazil.

Quality and quantity of feed are the major factors in increasing ruminant productivity under tropical conditions. Increase in energy density in diets by providing larger quantities of concentrate feeds may improve feed efficiency and animal performance contributing to higher overall efficiency of utilization of dietary energy for body weight gain. Therefore, the objectives were to determine the effects increasing levels of concentrate on performance, intake and digestibility of lambs. Fifteen crossbred lambs (initial BW of 18.2 ± 3.2 kg and 100 d old) were used in a randomized complete block design according to initial BW and age. Lambs were penned individually during 45 d and fed an isonitrogenous (16.6 ± 0.55 CP, DM basis) diet. Increasing levels of concentrate were 40, 60, or 80% corresponding to the experimental diets C40, C60 and C80, respectively. Data were analyzed using SAS PROC Mixed procedure and means compared by Tukey Test. Effects were declared significant at $P \leq 0.05$. No effect were observed on Dry matter (DM) intake (0.76, 0.87 and 0.85 kg/d for C40, C60 and C80) and crude protein (CP) intake (0.14, 0.16 and 0.15 kg/d for C40, C60 and C80). The DM digestibility was greater ($P \leq 0.01$) for lambs fed C60 and C80 diets (80.18, 87.53

and 88.16% for C40, C60 and C80, respectively), while CP digestibility was unaffected ($P \geq 0.05$) by concentrate levels (91.03, 92.21 and 91.56% for C40, C60 and C80, respectively). The Neutral Detergent Fiber (NDF) intake decreased for lambs fed C80 diet ($P \leq 0.05$) while NDF digestibility was unaffected ($P \geq 0.05$). ADG and G:F were greater ($P \leq 0.01$) with increasing concentrate levels. Average daily gain was 60.1, 126.1 and 232.6 g/d while G:F was 0.08, 0.14 and 0.23 for C40, C60 and C80, respectively. It is concluded that supplementation of concentrate between 60 to 80% improves DM digestibility and performance of crossbred lambs without affect DM intake.

Key Words: average daily gain, energy density, feed efficiency

M466 Feeding behavior of lambs fed increasing levels of concentrate in the diet. Michelle de Oliveira Maia Parente¹, Wesclley Jesus dos Santos Sodré¹, Ruan Mourão da Silva Gomes*¹, Miguel Arcaño Moreira Filho¹, Grazieli Silva Oliveira¹, Alayne Andrade Cutrim¹, Arnaud Azevêdo Alves², and Viviany Lúcia Fernandes dos Santos³, ¹Universidade Federal do Maranhão, Chapadinha, Maranhão, Brazil, ²Universidade Federal do Piauí, Teresina, Piauí, Brazil, ³Universidade Federal do Rio Grande do Norte, Natal, Rio Grande do Norte.

The study of ingestive behavior is a highly important tool in the evaluation of diets, because through it is possible to acquire knowledge of the possible relationships existing between foods and animal, allowing us to adjust the feeding management of animals to obtain better productive performance. The objective of this trial was to determine the effects increasing levels of concentrate on feeding behavior of lambs. Fifteen crossbred lambs (initial BW of 18.2 ± 3.2 kg and 100 d old) were used in a randomized complete block design according to initial BW and age. Lambs were penned individually during 45 d and fed an isonitrogenous (16.6 ± 0.55 CP, DM basis) diet. Increasing levels of concentrate were 40, 60, or 80% corresponding to the experimental diets C40, C60 and C80, respectively. Animals were monitored every 5 min during 24 h, on the 23th day of the experiment, according to the activities: eating, rumination, idle and other activities. The feed and rumination efficiencies, expressed as g DM/hour were obtained by dividing the average daily intake of dry matter by the total time spent eating and/or ruminating in 24 h, respectively. Orthogonal polynomials for diet responses were determined by linear and quadratic effects. Effects were declared significant at $P \leq 0.05$. There was a quadratic response ($P \leq 0.05$) for time spent in eating. The levels of concentrate did not affect ($P \geq 0.05$) the eating efficiency (149.3, 182.3 and 226.1 g DM/h for C40, C60 and C80), time spent in idle (505.0, 493.0 and 589.0 min/d for C40, C60 and C80) and water intake (1.8, 2.5 and 2.5 kg/d for C40, C60 and C80). The time spent in other activities (133.0, 185.0 and 220.0 min/d for C40, C60 and C80) and rumination efficiency (92.4, 116.5 and 132.4 g DM/h for C40, C60 and C80) tended to linearly increase ($P = 0.07$) with high concentrate levels. However, the time spent in rumination (495.0, 462.0 and 391.0 min/d for C40, C60 and C80) tended to linearly decrease ($P = 0.06$) with high concentrate levels. It is concluded that high concentrate levels (C80) changed the feeding behavior of lambs, especially for time spent for eating

Key Words: eating efficiency, idle, rumination efficiency

M467 Efficacy of Rumatel (morantel tartrate) against gastrointestinal nematode infections in lactating dairy goats. Angela D. Rowson*¹, Shelby A. Armstrong¹, Brian P. Schnell², and Lane O. Ely³, ¹Phibro Animal Health Corporation, Quincy, IL, ²University of Wisconsin, Madison, WI, ³University of Georgia, Athens, GA.

Rumatel (morantel tartrate) is an FDA-approved anthelmintic safe for use in goats and has no milk withhold. The objective of this study was to evaluate the efficacy of Rumatel on the removal of gastrointestinal nematodes (GIN) in lactating dairy goats. Twenty second-lactation crossbreed does (59–68 kg; mean days in milk = 128.5) from a south-central Wisconsin commercial herd were used in this study. Goats were housed in a pole barn with roll-up curtain sides on a bedded pack with continual access to pasture. A complete feed pellet was provided to the does twice a day and alfalfa hay was fed ad libitum. Goats had not been dewormed for 7 mo. Fecal pellets were collected from the rectum of each doe at 2 different time points, once immediately before the administration of Rumatel and again 14 d later. Fecal samples were analyzed for GIN using the McMaster's technique for fecal egg counts. Eligible samples [≥ 25 *Trichostrongyle* spp. eggs/gram of feces (EPG)] were further analyzed using the Peanut Agglutination test. Conjunctional examinations were conducted on all does using the FAMACHA card as a color reference (scored 1–5) at each fecal collection. Goats were dewormed once using Manna Pro Positive Pellet Goat Dewormer (morantel tartrate: 880 g/ton) immediately following the first fecal collection. Does were group-fed the product with enough pellet provided for each goat to consume 0.68 kg (0.66 g of morantel tartrate). Means were compared with a Student's *t*-test. Feeding Rumatel resulted in significantly lower ($P < 0.01$) EPG of total nematodes, *Trichostrongyle* spp., and *Haemonchus contortus*. Fecal egg counts were 176.3, 167.5, and 166.1 EPG, respectively, before deworming and 20.0, 20.0, and 14.7 EPG after deworming. Rumatel treatment also lowered the percentage of goats with *H. contortus* infections from 74.7% to 29.6% ($P = 0.001$) and decreased FAMACHA scores from 3.5 to 2.65 ($P = 0.001$). Results indicate that Rumatel is an efficacious anthelmintic for lactating dairy goats for GIN like *Trichostrongyle* spp., including *H. contortus*.

Key Words: goats, *Haemonchus contortus*, Rumatel

M468 Determining the critical time to measure fasting heat production of Saanen goats. Ana Rebeca Castro Lima*, Kleber Tomás de Resende, Márcia Helena Machado da Rocha Fernandes, Izabelle Auxiliadora Molina de Almeida Teixeira, Thiago Henrique Borghi, José Mauricio dos Santos Neto, and Carolina Isabel Soriano Oporto, *Unesp, Jaboticabal, São Paulo, Brazil*.

The objective of this study was to establish the physiological parameters of Saanen goats at absorptive and post absorptive statuses, to determine the required period of fasting for these animals. Gas exchange was recorded by an open-circuit face-mask respirometry. Six nonlactating and non-pregnant Saanen (49.2 \pm 3.2 kg) goats were used in this experiment, allocated to individual pens and fed the same total mixed ration (19.5% of crude protein, 10 MJ per kg DM of metabolizable energy, ME). Gas exchange was measured in groups of 3 animals each and each data collection period lasted 6 d. During feeding period (3 d), each group was submitted to a double Latin square (3 \times 3) with 3 animals and 3 h window in the morning (7.00–9.00h; 9.00–11.00h; 11.00–13.00h) and evening (13.00–15.00h; 15.00–17.00h; 17.00–19.00h). After the 3-d feeding period, animals were subjected to fasting (no feed, only water) and gas exchange measurement was performed for 30 min periods at 12, 20, 36, 44, 60, and 68 h after fasting. To evaluate the decay of methane during fasting, methane production was fitted to a nonlinear logistic model. The critical time to reach the asymptote, or to measure fast heat production (FHP), was obtained when the upper limit of the standard error of mean of minimum methane produced and when CH₄ production became equivalent. During the feeding period, Saanen goats drank 3.34 \pm 0.53 L/d of fresh water and consumed 848.6 \pm 40.2 g/d of dry matter, the daily heat production, averaged 557.4 \pm 38.7 kJ/kg^{0.75} BW and their

FHP was 236.0 \pm 19.7 kJ/kg^{0.75} BW. After fasting, methane production decreased exponentially and the critical time to measure FHP was 47 h of fasting for Saanen goats when methane production was statistically equal to zero. Taken together, our results suggest that the ideal period to measure FHP should be between 40 and 60 h of fasting for goats fed at maintenance levels. The results presented herein are relevant for future energy metabolism studies in goats.

Key Words: heat production, indirect calorimetry, methane

M469 Calcium and phosphorus accretion rate in Saanen goat kids of different genders. José Mauricio dos Santos Neto*, Kléber Tomás de Resende, Márcia Helena Machado da Rocha Fernandes, Izabelle Auxiliadora Molina de Almeida Teixeira, Julian André Castillo Vargas, Ana Rebeca Castro Lima, Fernanda Oliveira de Miranda Figueiredo, Rafael Fernandes Leite, Paula Fernanda Varella dos Santos, and Carolina Isabel Soriano Oporto, *São Paulo State University (Unesp), Jaboticabal, São Paulo, Brazil*.

Calcium (Ca) and phosphorus (P) constitute an essential part of goat diets, being necessary for adequate growth and physiological function; however, studies about their accretion rate in goats are still scant, especially regarding the differences among genders. In this sense, we evaluated and compared the Ca and P accretion rate in intact males, castrated males and females, weighting from 15 to 30 kg of body weight (BW). We used 58 Saanen goat kids (20 intact males, 20 castrated males and 18 females) fed ad libitum and housed in individual pens, with an initial BW of 15.85 \pm 0.11 kg. The diet consisted of 45% forage (dehydrated corn plant) and 55% concentrate. The animals of different genders were assigned in a completely randomized design and slaughtered at 16.6 \pm 0.40 kg BW, 23.1 \pm 1.33 kg and 31.2 \pm 0.58 kg BW. Allometric equations used to calculate the relationships between macromineral quantities and empty body weight (EBW) were generated and compared among genders by NLINMIX procedure (SAS Institute Inc., Cary, NC 9.4). The Ca and P accretion rate were estimated by the first derivative of these allometric equations. The Ca and P accretion rate did not differ among genders ($P > 0.05$) and decreased from 11.04 to 11.01 g of Ca and from 6.96 to 5.98 g P per kg of EBW gain, when kids grown from 15 to 30 kg BW, respectively. Because Ca and P mostly concentrate in skeletal tissue, absence of difference may indicate that bone development in Saanen goats are similar among genders, and presumably, those animals have reached bone maturity early in life.

Key Words: body composition, comparative slaughter, macromineral

M470 Effects of milk replacer feeding time on growth performance, nutrient digestibility and serum profiles in early-weaned lambs. Jian-min Chai, Hai-chao Wang, Qi-yu Diao, Tao Ma, Min-li Qi, Yan Tu, and Nai-feng Zhang*, *Feed Research Institute, Chinese Academy of Agricultural Sciences, Key Laboratory of Feed Biotechnology of the Ministry of Agriculture, Beijing, China*.

This study was conducted to evaluate the effect of milk replacer feeding time on growth performance, nutrient digestibility and serum profiles in early-weaned lambs. Forty-eight newborn Hu lambs (2.53 \pm 0.13 kg; 24 male and 24 female) were divided into 4 treatments: ewe-reared (ER) or weaned at 10, 20, or 30 d post birth (EW10, EW20, and EW30) and fed milk replacer (MR). All liquid feed were eliminated at 60 d of age (d 60). Creep feed was offered ad libitum to all lambs from d 15 to 90. Lambs were weighed on d 60 and 90. The data of liveweight (LWT), average daily gain (ADG), feed (including creep and MR) intake, nutrient utilization and serum parameters were analyzed as completely

randomized design using one-way ANOVA. Duncan's method for multiple comparisons was used if the overall F test for the measurement was significant ($P < 0.05$). The results indicated that lambs of EW10, EW 20, and EW 30 had higher LWT (22.1, 21.4, and 20.2 vs 18.5 g), ADG (225.1, 219.6, and 208.6 vs 177.6 g/d), and creep feed intake (512.9, 412.1, and 413.0 vs 370.3 g/d) ($P < 0.001$) than those in ER group. There were no differences between treatments in the apparent digestibility of dry matter (DM), organic matter (OM), nitrogen (N), phosphorus (P) ($P > 0.05$) from d 50 to 60. The apparent digestibility of DM, OM, N and P of EW20 and EW30 groups were significantly higher ($P < 0.05$) than that of EW10 and ER groups from d 80 to 90. Lambs in the EW10 group had higher concentration of albumin, serum urea nitrogen, and immunoglobulin G than those of other groups ($P < 0.05$). In conclusion, early weaning could improve creep intake, growth performance, and nutrient utilization of Hu lambs. Time of early weaning significantly increased the growth of lambs.

Key Words: early weaning, milk replacer, lamb

M471 Seasonal weight loss tolerance biomarkers to in dairy goats: An approach for breed selection. Mariana Palma¹, Lorenzo Hernández-Castellano^{2,3}, Noemi Castro², Anastasio Argüello², Juan Capote⁴, Manolis Matzapetakis¹, and Andre M. de Almeida*⁵, ¹Instituto de Tecnologia Química e Biológica António Xavier, Universidade Nova de Lisboa, Oeiras, Portugal, ²Department of Animal Science, Universidad de Las Palmas de Gran Canaria, Arucas, Canary Islands, Spain, ³Veterinary Physiology, Vetsuisse Faculty, University of Bern, Bern, Switzerland, ⁴Instituto Canario de Investigaciones Agrarias, Valle Guerra, Canary Islands, Spain, ⁵Instituto de Biologia Experimental e Tecnológica, Oeiras, Portugal.

Goat milk and dairy products are an important nutritional and economic resource in Tropics. However, the yearly production of milk is affected by the scarcity of pastures during the dry season, which leads to seasonal weight loss (SWL) in ruminants. The aim of the work is to identify physiological markers indicative of SWL tolerance in 2 dairy goat breeds, with different SWL tolerance levels. The results will help to define breed selection strategies in drought prone regions. Nuclear magnetic resonance (NMR) was used to compare the observable metabolome present in aqueous extracts of mammary glands and milk serum from 2 dairy goat breeds; tolerant to dry environment (Majorera) and susceptible (Palmera). Ten Palmera and 9 Majorera dairy goats in mid lactation were used in this study. Animals were divided in 4 experimental groups (Majorera control, Palmera control, Majorera restricted and Palmera restricted). Milk samples were collected daily, after milking from the whole available milk, and mammary gland biopsies were collected after 23 d. Aqueous fractions were obtained by tissue aqueous/organic extraction and milk serum was obtained by ultra-centrifugation. We collected ¹H NMR spectra (1D-NOESY and CPMG) from the aqueous extract of the mammary gland, and the milk serum. ¹H NMR Spectrum deconvolution was used for metabolite profiling analysis and has led to the identification of 47 compounds in the aqueous fraction of mammary gland extracts. Lactose, glutamate, glycine, lactate and glucose were found to be the most abundant. Statistical evaluation using principal component analysis (PCA) and partial least squares (PLS) revealed differences between control and restricted animals, although no differences between breeds were observed. Preliminary profiling analysis of milk serum samples resulted in the identification of 20 metabolites.

Key Words: goat, undernutrition, nuclear magnetic resonance metabolomics

M472 An NGS-based gene expression profile study in the goat mammary gland: Effect of undernutrition in two breeds with different levels of adaptation to nutritional stress. José Parreira^{1,2}, Joana R. Lérias¹, Lorenzo E. Hernández-Castellano^{3,4}, Mariana Palma², Noemi Castro⁴, Anastasio Argüello⁴, Juan Capote⁵, Susana S. Araújo^{1,2}, and André M. de Almeida*¹, ¹Instituto de Biologia Experimental Tecnológica, Oeiras, Portugal, ²Instituto de Tecnologia Química e Biológica (I.T.Q.B.), Universidade Nova de Lisboa, Oeiras, Portugal, ³Veterinary Physiology, Vetsuisse Faculty, University of Bern, Bern, Switzerland, ⁴Department of Animal Science, Universidad de Las Palmas de Gran Canaria, Arucas, Canary Islands, Spain, ⁵Instituto Canario de Investigaciones Agrarias, Valle Guerra, Canary Islands, Spain.

Goat milk has a high relevance worldwide, particularly in the tropics. Consequently, dairy goat productivity performance is very important for animal production and the dairy industry. Undernutrition during the dry season causes Seasonal Weight Loss (SWL), a relevant constraint for animal production. Knowledge on the genetic factors regulating milk production is limited and the impact of feed restriction, in this mechanism has been poorly addressed. A Systems Biology approach can provide a new and comprehensive insight on the molecular mechanisms underlying milk production, under feed restriction, as well as the regulation of the several biological processes involved. With such strategy, the identification of specific biomarkers and metabolic pathways involved could be used to develop new strategies to overcome this constraint. The objective of this work is to understand the molecular mechanisms by which goat breeds are adapted to SWL. We report a preliminary study of a quantitative differential analysis of mammary glands transcriptome using the Illumina high-throughput transcriptome sequencing (RNA-Seq). Two Canary Island (Spain) goat breeds were used; Majorera (SWL tolerant) and Palmera (SWL susceptible), with different productivity performances. We studied the impact of nutritional restriction on the transcriptome of mammary gland secretory tissue. Results show that a concerted reprogramming of genes expression occurs as result of the stress imposed, irrespective to the breed. Also suggesting a different behavior of both breeds in response to the treatment applied. Moreover, an enrichment analysis of the differentially expressed genes provided some insight into what biological processes are related with the response to SWL during lactation. Finally, a validation of the RNA-Seq assay using RT-qPCR was performed on candidate genes differentially expressed, for instance glycerol kinase (GK) and adrenoreceptor β 2 (ADRB2). The knowledge obtained through this project will be useful to release new genomic resources as well as shed some light into the genes and regulatory networks underlying milk production under nutritional stress.

Key Words: dairy goat, undernutrition, transcriptomics

M473 Digestibility of diets containing calcium salts of fatty acids in Saanen goats. Bruna Susan de Labio Molina, Claudete Regina Alcalde*, Bruna Hygino, Ludmila Couto Gomes, Caroline Isabela da Silva, Ana Paula Silva Possamai, and Rodrigo de Souza, Universidade Estadual de Maringá, Maringá, Paraná, Brazil.

According on the fat source included in the diets for goats, the availability of nutrients can be improved. The objective was to evaluate the inclusion of calcium salts of fatty acids (CSFA) in diets of Saanen goats on the digestibility of dry matter and nutrients. Five Saanen goats (63.23 \pm 9.08 kg body weight and \pm 105 d of lactation) were distributed in a Latin square design (5 \times 5). The treatments were diets: control (without CSFA) and the other with: 6.25, 12.50, 18.75, and 25.0 g of CSFA g/kg DM, respectively. The ingredients that were: ground corn, soybean meal, protected fat (calcium salt linked with long chain fatty acids containing

1,760 g/kg total digestible nutrients, 820 g/kg ether extract, 100 g/kg calcium, 260 g/kg oleic acid, and 420 g/kg linoleic acid), and mineral-vitamin supplement. The oat hay was utilized in a proportion of 570 g/kg DM for all the treatments. The rations were adjusted to provide 700 g of total digestible nutrients/kg DM and 155 g of crude protein/kg DM. The internal marker used to estimate the digestibility was the indigestible acid detergent fiber. After 15 d for the animals to adapt to the diets, samples of feces from the exit of the rectum were collected during 6 consecutive days to obtain a composite sample per animal for each period. Calcium salts of fatty acids showed a quadratic effect on digestibility of dry matter; organic matter; neutral detergent fiber and total carbohydrate with improvement from the minimum points of 13.2; 13.3; 16.9 and 14.6 g of CSFA/kg of dry matter, respectively. Crude protein digestibility and non-fiber carbohydrates digestibility were not influenced by treatments, however, for the ether extract digestibility there was a positive linear response as function of the calcium salts of fatty acids in diets. A quadratic effect was observed on total digestible nutrients with the minimum point of 9.8 g of CSFA/kg DM. In conclusion, the inclusion of 25.0 g calcium salts of fatty acids/kg DM in diets of Saanen goats shows a better response for the total digestible nutrients.

Key Words: digestion, goat, indigestible ADF

M474 Loin characteristics of feedlot lambs fed different sources of non-protein nitrogen and carbohydrate. Ricardo D. Kliemann*, Jean C. S. Lourenço, Larissa Goltz, Juliana M. Lima, Dayanna Pastal, Tiago M. Santos, Sergio R. Fernandes, and Américo F. Garcez Neto, *Federal University of Paraná, Palotina, Paraná, Brazil.*

The formulation of balanced diets has been a way to optimize the nutrient use by different animals and to get carcasses with high proportion of muscles and proper fat content to attract potential consumer markets. The proportion of these tissues in the carcass can be estimated by measurements in the *Longissimus dorsi* (*L. dorsi*) muscle. Characteristics of *L. dorsi* in feedlot lambs fed different sources of carbohydrates (CHO) and non-protein nitrogen (NPN) were evaluated. It was used 20 non-castrated crossbred lambs with 4 mo of age and 26 kg of body weight. The diets were composed by 57% of grass hay (*Brachiaria* hybrid) and 43% of concentrate. The hay was harvested at late mature stage with high (72.4%) neutral detergent fiber and low (4.9%) crude protein. Four concentrates were formulated from the combination of 2 CHO (ground corn: starch; whey permeate: lactose) and 2 NPN (fast and slow release urea) sources. After cooling, loin of the left half of carcasses was separated and measurements in the *L. dorsi* were made. The measurements were loin eye width (LEW), loin eye depth (LED), loin eye area (LEA), minimum fat thickness (MinFT), maximum fat thickness (MaxFT). The LEW:LED ratio was also calculated. It was used a completely randomized design with 4 treatments and 5 replicates. Data were analyzed by ANOVA following a 2 × 2 factorial scheme. LED (2.57 ± 0.06 cm), LEA (10.37 ± 0.31 cm²), MinFT (0.76 ± 0.09 mm), MaxFT (1.69 ± 0.12 mm) and LEW:LED ratio (2.12 ± 0.06) were not ($P > 0.05$) affected by the diets. It was found an interaction ($P < 0.05$) between CHO and NPN for LEW. The LEW was smaller ($P < 0.05$) for feedlot lambs fed whey permeate and fast release urea (4.98 cm) than for those fed whey permeate and slow release urea (5.78 cm). The mean LEW was 5.39 ± 0.10 cm. Differences in the LEW did not change the LEA, which may be inferred that the association of whey permeate with slow and fast release urea resulted in the same muscle development. The association of CHO and NPN with concentrates of closest potential degradation

rates does not influence the proportions of muscle and fat of lambs fed low quality forage at finishing.

Key Words: fat, muscle, sheep

M475 Blood metabolites of feedlot lambs fed different sources of non-protein nitrogen and carbohydrate. Ricardo D. Kliemann*, Larissa Goltz, Jean C. S. Lourenço, Eduardo M. Nascimento, Dayanna Pastal, Tiago M. Santos, Sergio R. Fernandes, and Américo F. Garcez Neto, *Federal University of Paraná, Palotina, Paraná, Brazil.*

The levels of blood metabolites of feedlot lambs fed low quality forage and different sources of carbohydrate (CHO) and non-protein nitrogen (NPN) in the concentrate feed was evaluated. Twelve non-castrated male lambs with 4 mo of age and 23.5 kg BW were used. The experimental design was 4 × 3 incomplete Latin square replicated 3 times, with 4 treatments (diets) and 3 periods of 21 d. The diets were composed by 57% of grass hay (*Brachiaria* hybrid) and 43% of concentrate. The hay was harvested at late mature stage with high fiber (72.4% NDF) and low protein (4.9% CP). Four concentrate feeds were formulated from the combination of 2 CHO (ground corn: starch; whey permeate: lactose) and 2 NPN (fast and slow release urea) sources. The diets were isoenergetic (2.32 Mcal/kg ME) and isoproteic (11% CP), and fed at 1.5 times the ME requirement. At the end of each period, blood samples were collected after fasting (feed for 14 h) to assess the serum levels of total proteins (TP), albumin (Alb), creatinine (Creat), urea, glucose (Glu), cholesterol (Chol), triglycerides (TG) and β-hydroxybutyrate (BHBA). Data were analyzed by ANOVA and means were compared by LSD test ($P < 0.05$). Serum levels of TP (61.7 g/L), Alb (31 g/L), Creat (0.91 mg/dL), Glu (64 mg/dL) and BHBA (0.12 mg/dL) were not affected by the diets. Serum urea was higher in lambs fed corn and fast release urea (29.9 mg/dL), and lower in those fed whey permeate independent from NPN source (25.4 mg/dL). High levels of serum urea can be related to high production of ammonia in the rumen due to the differences in degradation rates between corn and fast release urea, and by the higher CP of corn (9%) compared with whey permeate (3%). Maybe the whey permeate was fermented faster than corn resulting in greater MP production and less ammonia in the rumen. Serum levels of Chol and TG were higher in lambs fed corn (45.2 and 24.6 mg/dL) compared with those fed whey (34.6 and 17.1 mg/dL), which was caused by the lipid fraction of corn (5.4%). The inclusion of corn or whey permeate in the concentrate feed affects the protein and energy metabolism of lambs fed low quality forage.

Key Words: cholesterol, metabolism, urea

M476 Multi-scale straightness index analysis of goat behavior. Terry A. Gipson*¹, Kenneth M. Andries², Terry Hutchens², and Myron E. Evans³, ¹American Institute for Goat Research, Langston University, Langston, OK, ²Kentucky State University, Frankfort, KY, ³University of Kentucky Cooperative Extension, Grayson, KY.

Multi-scale straightness index (MSSI) has been proposed for determining behavioral states such as resting, grazing, or commuting in wildlife but its suitability in livestock is not known. Therefore, the objective of this study was to apply MSSI to a herd of grazing goats. On a random sample of 13 mature Boer-cross females from a herd of 120, GPS collars that recorded a fix every 5 min were fitted for 3 consecutive days in August, 2012. The study area was a 40-ha unimproved hill pasture. The fix records were post-processed and imported into ArcMap. Boundaries of the pasture, including a 7-m external buffer, were constructed as shapefiles. Only fixes (average of 804 ± 15.2 fixes/goat) within the

boundary and buffer shape-files were exported to a spreadsheet for the calculation of MSSSI using granularity (g) from 1 to 12 and window (w) from 1 to 36 with the constraint that w/g must be an integer, yielding a total of 110 g-w combinations. Within daytime (D) and nighttime (N) periods, MSSSI were calculated for each g-w combination yielding 868,707 MSSSI for D and 541,599 MSSSI for N. LSmeans for each g-w combination were estimated using mixed model analysis with collar as random effect and day (1, 2, or 3) as repeated measure. A linear-linear-linear grafted polynomial analysis was conducted to ascertain ridge points for g-w combinations (between 2 break points). The first linear segment for both D and N represented targeted travel and accounted for 11% of the MSSSI; however, the g/w ratio was 1 so this was straight line travel between 2 points. The last linear segment represented highly tortuous travel indicating most probably grazing or resting. This segment was 81% and 85% of the MSSSI with an average MSSSI of 0.17 ± 0.083 and 0.08 ± 0.050 for D and N, respectively. The middle linear segment represented targeted travel and accounted for 8% and 4% of the MSSSI with an average MSSSI of 0.53 ± 0.108 and 0.41 ± 0.119 for D and N, respectively. For the targeted travel segment, g averaged 1 for both D and N and w averaged 5 and 3 for D and N, respectively. Even in a herd of goats familiar with the terrain, targeted travel account for a small percentage of behavior and was only for a short duration.

Key Words: goat, GPS, multi-scale straightness index (MSSSI)

M477 Effects of high heat load on BW, DMI, rectal temperature, and respiration rate of Katahdin sheep and Boer and Spanish goat wethers. Mengistu Urge^{1,2}, Ryszard Puchala¹, Terry A. Gipson¹, Tilahun Sahlu¹, and Arthur L. Goetsch^{*1}, ¹*American Institute for Goat Research, Langston University, Langston, OK*, ²*School of Animal and Range Sciences, Haramaya University, Dire Dawa, Ethiopia*.

Thirty-three yearling Katahdin sheep (K) and Boer (B) and Spanish (S) goat wethers were used to determine conditions such as an appropriate heat load index (HLI) for a method of evaluating differences in resilience to high HLI among different small ruminant species, breeds, ecotypes, and individuals. Grass hay was consumed ad libitum with concentrate (80% corn, 20% soybean meal) at 0.5% BW. After a baseline period (1) with thermo-neutral conditions, target HLI were 80, 90, 95, and 100 (e.g., 42.0°C, 40% relative humidity) during the day and 70, 77, 81, and 85 at night in subsequent 1-wk periods (2–5). Actual values averaged 66, 80, 92, 97, and 101 during day (0700 to 1900 h) and 66, 75, 84, 86, and 89 at night in periods 1–5, respectively. Final period BW was not markedly affected by HLI (100.2, 99.7, 103.1, and 101.3% of baseline; SE = 0.74), and hay DMI also was generally similar to the baseline (95.0, 72.4, 93.6, and 96.4% in periods 2–5, respectively; SE = 3.69). Rectal temperature at 0600, 1300, and 1700 h was lowest for Katahdin in periods 3 (39.4, 39.2, and 39.6°C) and 4 (39.9, 39.6, and 40.0°C for Boer, Katahdin, and Spanish, respectively; SE = 0.07) but similar at other times. There was an interaction in respiration rate between animal type and period (71, 105, and 105 in period 2, 93, 101, and 104 in period 3, 121, 139, and 129 in period 4, and 105, 126, and 109 breaths/min in period 5 for B, K, and S, respectively; SE = 4.75). Rectal temperature and respiration rate were much lower at 0600 (38.7, 38.9, and 38.8°C and 34, 77, and 56 breaths/min) than at 1300 (39.7, 39.6, and 39.9°C and 127, 137, and 135 breaths/min) and 1700 h (40.1, 39.7, and 40.2°C, SE = 0.07, and 131, 139, and 144 breaths/min for B, K, and S, respectively, SE = 4.4). In conclusion, in some periods K exhibited greater ability than B and S to increase respiration rate and minimize rectal temperature at high HLI; periods longer than 1 wk at high HLI are required for evaluating changes in BW and DMI; and variables such as rectal temperature

and respiration rate may be more meaningful when measured in the afternoon than morning.

Key Words: goat, sheep, heat load

M478 Effects of mixing different breeds to evaluate electric fence strand additions to barbed wire fence to contain growing meat goat kids. Yoko Tsukahara*, Terry A. Gipson, Jerry Hayes, Ryszard Puchala, Tilahun Sahl, and Arthur L. Goetsch, *American Institute for Goat Research, Langston University, Langston, OK*.

A method of evaluating electric fence strand addition to cattle barbed wire fence for goat containment would be useful to promote co-grazing. Therefore, 38 Boer (B) wethers (6.3 mo of age and 22.1 kg BW initially), 41 B doelings (6.3 mo and 21.4 kg), 40 Spanish (S) wethers (6.7 mo and 17.8 kg), and 40 S doelings (6.8 mo and 18.4 kg), were used to evaluate effects of grouping, single breed (SGL) and breeds combined (COM), on behavior (e.g., pen exit and shock) when exposed to barbed wire fence with different electric strand additions. Five 2.4 × 3.7 m evaluation pens had 1 side of barb wire strands at 30, 56, 81, 107, and 132 cm from the ground. Fence treatments (FT) were electrified strands (6 kV) at 15 and 43 (LH), 15 and 23 (LM), 15 (L), 23 (M), and 43 cm (H). For adaptation, kids were exposed in evaluation pens to no electric strands (NES), NES, LH at 0 kV, LH at 6 kV, and NES in wk 1, 2, 3, 4, and 5, respectively. Then kids were divided into 2 replication sets per grouping (2 B-SGL, 2 S-SGL, 2 B-COM, and 2 S-COM); each of the 5 pens consisted of 4 or 3 animals for 1 h exposure to FT while observing behavior visually and with video surveillance. There were no main effects of grouping. Fence treatment affected ($P < 0.01$) the percentage of animals receiving a shock (59.4, 44.5, 34.4, 22.8, and 6.2%; SE = 8.53), exiting with shock (37.5, 35.8, 31.3, 19.6, and 3.1%; SE = 7.63), and exiting without shock (0.0, 14.9, 50.0, 67.7, and 76.3% for LH, LM, L, M, H, respectively; SE = 7.56). There was an interaction ($P = 0.01$) between FT and grouping in pen exit (50.0, 25.0, 75.0, 85.7, and 42.9% with B-COM, 12.5, 77.8, 87.5, 75.0, and 100% with B-SGL, 62.5, 62.5, 75.0, 87.5, and 75.0% with S-COM, and 25.0, 37.5, 87.5, 100.0, and 100.0% with S-SGL for LH, LM, L, M, and H, respectively; SE = 14.83). In conclusion, in contrast to previous findings with mature does, these results do not provide clear evidence supporting notable effect of method of grouping growing meat goat kids for evaluating effectiveness of various electric strand additions to barbed wire fence for goat containment, indicating appropriateness of either method.

Key Words: behavior, fence, goat

M479 Diet selection patterns and ingestive behavior of feedlot lambs fed different sources of non-protein nitrogen and carbohydrate. Jean C. S. Lourenço*, Ricardo D. Kliemann, Larissa Goltz, Caroline Dell'Agnolo, Dayanna Pastal, Tiago M. Santos, Sergio R. Fernandes, and Américo F. Garcez Neto, *Federal University of Paraná, Palotina, Paraná, Brazil*.

The mixture of carbohydrates (CHO) and non-protein nitrogen (NPN) with different ruminal degradation may affect the feeding behavior and feed selection by ruminants. This study was carried out to evaluate the ingestive behavior and diet selection by feedlot lambs fed different sources of CHO and NPN. It was used 20 non-castrated crossbred lambs with 4 mo of age and 26 kg of body weight. The diets were composed by 57% of grass hay (*Brachiaria* hybrid) and 43% of concentrate. The hay was harvested at late mature stage with high (72.4%) neutral detergent fiber and low (4.9%) crude protein content. Four concentrate feeds were formulated from the combination of 2 CHO (ground corn:

starch; whey permeate: lactose) and 2 NPN (fast and slow release urea) sources. Orts samples were taken to determine the proportion of leaves (LVS), stems (STS) and leaf:stem ratio, and activities of eating (EAT), ruminating (RUM) and resting (RES) were recorded. The efficiency of rumination (RE) and dry matter intake (IE) were also calculated. It was used a completely randomized design with 4 diets and 5 replicates. Data were analyzed by ANOVA following a 2×2 factorial scheme. LVS ($56.2 \pm 2.7\%$), STS ($43.8 \pm 2.7\%$), leaf:stem ratio (1.60 ± 0.16), EAT (318 ± 8 min), RUM (537 ± 11 min), RES (585 ± 14 min), RE (1.82 ± 0.06 g DM/min) and IE (3.10 ± 0.11 g DM/min) were not affected ($P > 0.05$) by diets. The mixture of CHO and NPN with more distinct potential degradation rates (ground corn + fast release urea; dry whey permeate + fast release urea) did not increase ($P > 0.05$) the selection of LVS, neither the mixture of sources with closest potential degradation rates (ground corn + slow release urea; dry whey permeate + fast release urea) reduced the RUM. It is possible that these results were not effective to increase the ruminal degradation of low quality forage. Such hypothesis is supported by the similarity of RE values between diets. In the present study the association of CHO and NPN with similar or distinct degradation rates does not influence the diet selection and the ingestive behavior.

Key Words: degradation rate, rumination, sheep

M480 Carcass characteristics of feedlot lambs fed different sources of non-protein nitrogen and carbohydrate. Jean C. S. Lourenço*, Larissa Goltz, Ricardo D. Kliemann, Douglas Bloedorn, Dayanna Pastal, Tiago M. Santos, Sergio R. Fernandes, and Américo F. Garcez Neto, *Federal University of Paraná, Palotina, Paraná, Brazil.*

A balanced supply of nutrients can be regarded a way to support an increase of body weight and a tool to improve the carcass grade at slaughter. In that context carcass weight, yield and fat covering can be changed by the quality of different diets affecting not only the carcass parameters but also the meat value of the lambs. The carcass grade and weight at slaughtering and its parameters were evaluated on feedlot lambs fed different sources of non-protein nitrogen (NPN) and carbohydrates (CHO). It was used 20 non-castrated lambs with 4 mo of age and 26 kg of body weight. Lambs were fed ad libitum for 45 d. The diets were composed by 57% of grass hay (*Brachiaria* hybrid) and 43% of concentrate. The hay was harvested at late mature stage with high (72.4%) neutral detergent fiber and low (4.9%) crude protein. Four concentrates were formulated from the combination of 2 CHO (ground corn: starch; whey permeate: lactose) and 2 NPN (fast and slow release urea) sources. Slaughter weight (SW), body condition score (BCS), hot carcass weight (HCW), cold carcass weight (CCW), fat thickness (FT), hot carcass yield (HCY), cold carcass yield (CCY) and chilling losses (CL) were measured. A completely randomized design was used with 4 diets and 5 replicates. Data were analyzed by ANOVA following a 2×2 factorial scheme. SW was higher ($P < 0.05$) for lambs fed corn (31.3 kg) than for those fed whey (29.4 kg) suggesting that the starch intake was more effective in improving low quality forage degradation than lactose. However, BCS (3.0 ± 0.1), HCW (12.34 ± 0.41 kg), CCW (11.87 ± 0.37 kg), HCY ($40.7 \pm 0.5\%$), CCY ($39.2 \pm 0.5\%$), FT (1.23 ± 0.10 mm) were not influenced ($P > 0.05$) by diets. CL was higher ($P < 0.05$) for diets with slow release urea (4.01%) compared with those with fast release urea (3.65%) suggesting higher muscle water retention for diets with urea of faster degradation. For this reason, we can recommend the use of a concentrate diet composed of fast release urea

and corn for finishing lambs. Because these feed ingredients are usually cheaper, this will also reduce the cost of fattening.

Key Words: fattening, sheep, slaughter weight

M481 Weight and cutting yield of feedlot lambs fed different sources of non-protein nitrogen and carbohydrate. Larissa Goltz, Jean C. S. Lourenço, Ricardo D. Kliemann, Bruna N. Zuffo, Dayanna Pastal, Tiago M. Santos, Sergio R. Fernandes, and Américo F. Garcez Neto*, *Federal University of Paraná, Palotina, Paraná, Brazil.*

Diets formulated with feed of different ruminal degradation rates can affect the performance and feed efficiency of lambs. In that condition is expected that the carcass weight and its cuts are also influenced changing the potential income for farmers. This work was carried out to evaluate the weights and yield of carcass cuttings of feedlot lambs fed diets of different carbohydrate (CHO) and non-protein nitrogen (NPN) sources. It was used 20 non-castrated crossbred lambs with 4 mo of age and 26 kg of body weight. The diets were composed by 57% of grass hay (*Brachiaria* hybrid) and 43% of concentrate. The hay was harvested at late mature stage with high (72.4%) neutral detergent fiber and low (4.9%) crude protein. Four concentrate feeds were formulated from the combination of 2 CHO (ground corn: starch; whey permeate: lactose) and 2 NPN (fast and slow release urea) sources. The diets were isoenergetic (2.32 Mcal/kg ME) and isoproteic (11% CP). The lambs were slaughtered at the end of trial after 45 d with a mean body weight of 30.4 ± 1.0 kg. After cooling, the left half of carcasses was separated into 6 commercial cuts of meat: neck, breast, ribs, shoulder, loin and leg. It was recorded the weight of each cut and its proportion in relation to the half carcass. A completely randomized design was used with 4 treatments and 5 replicates. Data were analyzed by ANOVA following a 2×2 factorial scheme between CHO and NPN. The weights of neck (0.57 ± 0.02 kg), breast (0.63 ± 0.02 kg), ribs (0.85 ± 0.03 kg), shoulder (1.19 ± 0.04 kg), loin (0.64 ± 0.02 kg) and leg (2.05 ± 0.07 kg) were not influenced ($P > 0.05$) by the treatments. The same pattern was found to the yield of neck (9.7 \pm 0.2%) breast (10.6 \pm 0.3%), ribs (14.3 \pm 0.2%), shoulder (20.1 \pm 0.2%), loin (10.8 \pm 0.2%) and leg (34.6 \pm 0.3%). The association of CHO and NPN with concentrates of closest degradation rates (whey permeate + fast release urea; ground corn + slow release urea) do not increase ($P > 0.05$) the weight neither change the yield of cuts of meat in the lamb carcass when low quality forage is added to the diet during the finishing.

Key Words: slow release urea, sheep, whey permeate

M482 Effect of *Acacia mearnsii* tannin extract on intake and digestibility by sheep fed a tropical grass hay plus concentrate. S. C. Avila*¹, G. V. Kozloski¹, T. Orlandi¹, M. P. Mezzomo¹, and D. L. Harmon², ¹*Universidade Federal de Santa Maria, Santa Maria, Rio Grande do Sul, Brazil,* ²*University of Kentucky, Lexington, Kentucky.*

Tannins are plant polyphenols with the capacity to form complexes mainly with proteins reducing their degradation in the rumen and, thus, have the potential to increase the metabolizable protein supply and/or to decrease the urinary N losses by ruminants. However, tannins might also decrease feed intake and digestibility. Moreover, the nutritional effect of tannins is dependent on the tannin source. Six Texel wethers (67.0 \pm 6.53 kg) fed ad libitum Tifton hay (*Cynodon* sp.) and 12 g/kg body weight (dry matter (DM) basis) of concentrate were used in a crossover design with 2 21 d periods to evaluate the effect of dietary inclusion of a tannin extract from *Acacia mearnsii* on feed intake, digestibility and N excre-

tion. The concentrate was composed of cracked corn grain (0.36), wheat bran (0.36) and soybean meal (0.28) with or without 10 g/kg DM of tannin extract of *Acacia mearnsii*. Total feed, refusals, feces and urinary excretion were measured during the last 7 d of each experimental period. The concentrate represented in average 0.40 of total DM intake. Total intake (g/day) of organic matter (OM, 1720 ± 132.0), neutral detergent fiber (NDF, 1039 ± 78.8) and N (38.2 ± 3.29), as well as the apparent digestibility of OM (0.77 ± 0.031), N compounds (0.82 ± 0.020) and NDF (0.72 ± 0.038) and urinary N excretion (21.4 ± 2.33 g/day) were not affected by tannin extract inclusion. Tannin extract reduced ($P < 0.05$) the proportion of fecal N from endogenous origin (0.81 vs 0.76) and the true digestibility of N compounds (0.97 vs 0.95). These results indicate that tannin inclusion can affect N digestion. Further studies are needed to optimize the amount of tannin for each diet.

Key Words: consumption, digestion, nitrogen compound

M483 Probiotic supplementation affects resilience to parasites in goats. Mulumebet Worku*, Kingsley Ekwemalour, Emmanuel Asiama, Hamid Ismail, and Sara Adjei-Fremah, *North Carolina A&T State University, Greensboro, NC.*

The objective of this study was to evaluate resistance and resilience to gastrointestinal parasites in goats following supplementation with probiotics. Improving resistance and resilience to gastro-intestinal parasites is essential to combating the threat to the small ruminant industry from anthelmintic resistance. Following initial screening for infection, female SpanishXBoer goats were assigned to 4 groups of 4 ($n = 16$), one week post weaning. Goats were drenched daily with 10 mL sterile water containing recommended doses of either CorPET (treatment I)-a probiotic from the mushroom *Coriolus versicolor* (Mycology Research Laboratories, Ltd., Netherlands), Fastrak microbial pack (treatment II) or ruminant gel (treatment III) (Conklin Company, Inc. Shakopee, MN). A control group of age-matched goats received sterile water (treatment IV) for an 8 week period. Samples were collected weekly. Body weight, Body condition and FAMACHA scores were evaluated. Fecal samples were used for Hemonchus and coccidia egg counts to evaluate resistance. Blood samples were used to measure Packed cell volume (PCV) and for isolation of total RNA using Tri-reagent. The Nanodrop spectrophotometer was used to evaluate RNA concentration and purity. Data were analyzed using SAS PROC MIXED for repeated measures analyses. The effect of treatment on fecal egg count was variable. Treatment with commercial probiotics significantly increased body weight in wk 8, improved FAMACHA scores in wk 7, PCV was improved by treatments II and III in wk 5 ($P < 0.05$). There was no effect on body condition score. Transcription of total RNA in blood increased during periods of high parasite egg output and were not affected by treatment ($P > 0.05$). Thus probiotic supplementation may affect resilience to parasite infection in goats in a time and marker specific manner.

Key Words: goat, probiotic, resilience

M484 Determination of the grazing activity energy cost in Boer goat wethers using a portable indirect calorimetry method. Marie E. Brassard^{1,2}, Ryszard Puchala*¹, Tilahun Sahlul¹, and Arthur L. Goetsch¹, ¹American Institute for Goat Research, Langston University, Langston, OK, ²Université Laval, Québec, QC, Canada.

Heat energy (HE) of small ruminants in free-moving settings such as grazing is often measured indirectly from heart rate (HR) and the ratio of HE to HR determined when situated once or periodically in a stationary

calorimetry system. Therefore, feasibility of use of a portable indirect calorimetry system with goats while grazing, for a direct estimate of HE based on gas exchange without reliance on HR, was investigated in this experiment. Ten yearling Boer goat wethers (44.4 ± 0.95 kg) were used to determine HE and the grazing activity energy cost (GAEC) while standing or grazing Sudangrass pasture with a portable indirect calorimetry system. The method entailed use of a partial face mask that allowed unrestricted grazing to measure oxygen consumption and carbon dioxide emission for 30 min while restrained in a stanchion near the grazing area, followed by 60 min of grazing with other members of the group. The face mask was attached to a 15-m tether along with a corrugated plastic hose through which exhaled air was passed to a FlowKit Mass Flow Generator and FoxBox Respirometry System (Sable System, Las Vegas, NV) that were carried by a researcher who allowed unrestricted goat movement. Prior to measurements, animals were trained to become accustomed to presence of personnel and use of the equipment, with observed grazing behavior similar among all animals of the group. Measurement periods were during morning and afternoon grazing bouts. Heat energy while restrained was 18.7 kJ/kg BW^{0.75}/h or 446 ± 10.7 kJ/kg BW^{0.75}/d. Grazing HE increased to 35.1 kJ/kg BW^{0.75}/h or 843 ± 39.3 kJ/kg BW^{0.75}/d, implying that the GAEC was 16.4 kJ/kg BW^{0.75}/h. Goats spent 8.5 h/d grazing; therefore, the daily GAEC was 138 ± 17.3 kJ/kg BW^{0.75}. A very similar GAEC of (165 ± 10.4 kJ/kg BW^{0.75}/d) was determined from the difference in HE estimated indirectly from HR between times when grazing a 0.8-ha pasture and confined in nearby 1.2×1.2 m pens and fed fresh forage. In conclusion, this method offers promise for relatively simple and direct estimates of the sizable fraction of total HE comprised by GAEC.

Key Words: goat, grazing, heat energy

M485 Effects of two heart rate-based methods of estimating the grazing activity energy cost of Boer goat wethers. Marie E. Brassard^{1,2}, Ryszard Puchala*¹, Terry A. Gipson¹, Tilahun Sahlul¹, and Arthur L. Goetsch¹, ¹American Institute for Goat Research, Langston University, Langston, OK, ²Université Laval, Québec, QC, Canada.

There are different methods to estimate the grazing activity energy cost (GAEC) of ruminants from heart rate (HR), regarding both treatment differences and contribution to total heat energy (HE). The primary objective of this experiment was to investigate differences between 2 such methods. Ten yearling Boer goat wethers (44.4 ± 0.95 kg) consuming fresh Sudangrass ad libitum while grazing a 0.8-ha pasture or confined in nearby 1.2×1.2 m pens were used in a crossover. Heart rate measured over 24 h in 5-min intervals and the ratio of HE to HR previously determined for each animal with a stationary calorimetry system for 24 h while consuming grass hay was used to estimate HE. A GPS collar and leg activity monitor were used when HR was measured to determine HE while resting-lying (L), resting-standing (S), grazing (G), and walking (W); behavior in confinement was L or S. The grazing activity method (GAM) was based on time spent in the different activities multiplied by corresponding HE values, with GAEC assumed the sum of differences between S, G, and W relative to L. The confinement method (COM) entailed subtracting total HE while confined from that when grazing. There were differences ($P < 0.01$) in percentage of the day spent in the 4 activities (33.8, 53.9, 11.4, and 0.9%; SE = 2.44) and the associated daily HE (241, 322, 75, and 6 kJ/kg BW^{0.75}; SE = 17.9), although HE per unit time only tended ($P = 0.099$) to vary (707, 598, 472, and 636 kJ/kg BW^{0.75} on a daily basis for G, L, S, and W, respectively; SE = 65.8). Total daily HE (642 and 482 kJ/kg BW^{0.75}; SE = 17.2) and

HE while lying (598 and 450 kJ/kg BW^{0.75}; SE = 18.1) were greater when grazing than confined ($P < 0.01$). Daily GAEC was considerably greater ($P < 0.01$) for the COM vs. GAM expressed in kJ/kg BW^{0.75} (165 and 46; SE = 14.0) and relative to HE when confined for COM and of L on a daily basis for GAM (35 and 8%; SE = 3.5). In conclusion, method of estimation can have substantial effect on GAEC. Greater L HE per unit time when grazing than confined may contribute to lower GAEC for GAM than for COM, although factors such as dietary and environmental conditions will influence accuracy of COM.

Key Words: activity, energy, goat

M486 The effects of variation in birth weight of littermates on lamb performance. Jennifer L. Juengel¹, George H. Davis¹, Roger Wheeler², and Peter D. Johnstone¹, ¹*AgResearch, Invermay Agricultural Centre, Mosgiel, New Zealand*, ²*AgResearch, Woodlands Research Station, Invercargill, New Zealand*.

The objective of this study was to assess the relative importance of lamb birth weight (BW) and variation between BW of littermates (VAR) on lamb performance. Records from lambs born into twin ($n = 4160$) or triplet ($n = 1279$) litters from 1988 to 2005 were analyzed. Data collected for each lamb included dam, sire, sex, BW, birth date, lamb fate, and weaning weight and date. Data were analyzed with REML with BW and VAR grouped into classes (BW (kg): ≤ 2 , $>2-3$, $>3-3.5$, $>3.5-4$, $>4-5$, >5 ; VAR (kg): $0-0.1$, $>0.1-0.35$, $>0.35-0.5$, $>0.5-0.75$, $>0.75-1.00$, >-1.3 , >1.3). The model included BW, VAR, sex and year of birth as fixed effects with sire of lamb included as a random effect. Overall, 85.3% of twins and 74.7% of triplet lambs survived to weaning. For both twin and triplet lambs, BW was associated with survival ($P < 0.001$) with lambs < 2 kg having very low survival rates ($< 40\%$). For triplets and the larger of twin lambs, VAR was not associated with survival. However, VAR did affect survival of the smallest lamb in twin litters ($P < 0.001$) with lambs with VAR > 1.3 kg being less apt to survive (67.8% compared with those from litters of smaller VAR (range 80.4–86.2% survival). Growth rate of twin and triplet lambs was affected by BW ($P < 0.001$). As BW increased, growth rate also increased. For triplet born and raised lambs, VAR did not affect growth of the lamb. Surprisingly, twin lambs from litters with high VAR had slightly greater growth rate than those from lambs of low VAR ($P < 0.05$). Given the strong effect of BW on lamb performance, the large data set of twins was examined to determine whether variation in ovulation rate or pattern influenced BW. While year born, lamb birth date and sex and ewe age and weight before mating affected BW of the lamb ($P < 0.001$), neither ovulation rate nor pattern (i.e., both ova released from one ovary or one from each) were associated with BW of the lambs. In summary, the BW was strongly associated with survival and growth of the lamb. The litter VAR had little or no effect on survival and did not negatively affect growth of the lamb. Thus, birth weight, but not variability in birth weight within a litter, appears to be a major driver of lamb performance.

Key Words: sheep, lamb survival, lamb growth

M487 Effect of different rearing systems on growth, nutrient utilization and serum indices of early weaned Hu twin lambs. Hai-chao Wang, Jian-min Chai, Yan Tu, Nai-feng Zhang, Tao Ma, Bo Wang, and Qi-yu Diao*, *Feed Research Institute of Chinese Academy of Agricultural Sciences, Key Laboratory of Feed Biotechnology of the Ministry of Agriculture, Beijing, China*.

This experiment was conducted to study the effect of different rearing systems on growth, nutrient utilization and serum indices of early weaned Hu twin lambs. Twenty-four pairs of newborn Hu male twin lambs were equally divided into 2 groups according to paired experiment design. In each pair, one lamb was artificially reared (AR) with milk replacer, while the other one was ewe reared (ER). Body weight was recorded and blood samples were collected every 10 d. Two digestion trials were undertaken during d 45 to 55 and d 75 to 85 with 4 pairs of lambs from each group. On d 60 and 90, another 3 pairs of lambs from each group at each time point were euthanized for weighing gastrointestinal organs. The data of body weight and serum indices (total protein, cholesterol, glucose, triglyceride, albumin, blood urea nitrogen, alkaline phosphatase activity, and immunoglobulin) were analyzed using PROC ANOVA with repeated measure, while the others were analyzed using PROC paired *t*-test of SAS 9.1. The results showed that the BW of lambs in ER group was higher than that in AR group on d 30 ($P < 0.05$). No difference was observed in the final BW of AR group and ER group (21.02 vs 21.92 kg, $P > 0.05$) or the overall average daily gain (205.97 vs 217.01 g/d, $P > 0.05$). On d 60, the proportion of the rumen to 4 stomachs (weight basis) of lambs in AR group was higher ($P < 0.05$) while that of omasum and abomasum were lower ($P < 0.05$) than those in ER group. The proportion of small intestine was higher in AR group than that in ER group ($P < 0.05$). There was no difference in the nutrient digestibility ($P > 0.05$) or the serum concentration of total protein, cholesterol, glucose, triglyceride, albumin, blood urea nitrogen, alkaline phosphatase activity, and immunoglobulin (G, A, and M) ($P > 0.05$). In general, lambs reared with milk replacer achieved the same growth performance as their ewe-reared counterparts.

Key Words: lamb, milk replacer, growth performance

M488 Preliminary results of the feedlot performance of South African Boer goats. Tertius S. Brand^{1,2}, Daniel A. van der Merwe², Louw C. Hoffman², and Emiliano Raffrenato², ¹*Directorate: Animal Sciences, Department of Agriculture, Western Cape Government, Elsenburg, South Africa*, ²*Department of Animal Sciences, Stellenbosch University, Stellenbosch, South Africa*.

Goats are more commonly reared in extensive production systems in South Africa and are directly marketed from the farm at a weight of less than 30 kg. This study was performed to determine the effect of dietary energy content on the production of South African Boer goats in a feedlot system to be able to increase marketing weight. In this trial, 53 Boer goats were randomly divided into 3 dietary treatments that varied in energy content, giving a low, 11.3 MJ ME/kg feed (18 goats), medium, 12.0 MJ ME/kg feed (16 goats) and high energy diets, 12.7 MJ ME/kg feed (19 goats). The diets were equal in terms of crude protein (17.0%), calcium (0.86%) and phosphorus (0.36%). These goats were reared in individual pens for a period of 8 weeks, where the trial diets were fed on an ad libitum basis and growth and feed intake were monitored. Initial body weight was 22.4 kg and after 8 weeks the goats on the medium diet had gained the most weight, weighing 34.6 kg followed by the low energy (33.4 kg) and the high-energy diets (31.4 kg). The difference between the 3 treatments were significant at $P = 0.01$. The average daily gains differed significantly ($P = 0.036$) with goats on the medium energy diet attaining the highest ADG of 0.253 kg/day, while goats on the high-energy diet had the lowest ADG of 0.183 kg/day. This suggests that the energy content of the medium energy diet is probably close to the energy requirements of the goats, while the low diet does not contain sufficient energy to maintain higher growth rates. Goats are also not adapted to digest feeds with high-energy contents

and therefore can probably not use the excess energy for growth. Feed intake differed between the 3 treatments ($P < 0.001$) with the goats on the low energy diet having the highest DMI of 1.456 kg/day which decreased with an increase in dietary energy content (1.112 kg/d for the high energy diet). The feed intake for the medium energy group was intermediate at 1.284 kg/d. The feed conversion ratio (FCR) did not differ significantly for the 3 treatments and was calculated to be 6.61

kg feed/kg weight gain. Goats fed the medium energy diet displayed the best growth at a moderate feed intake, even though the FCR between the diets did not differ significantly.

Key Words: Boer goat, dietary energy, feed intake