

Small Ruminant: Nutrition

M372 Effect of breed and sex on fatty acid composition of fat-tailed and tailed lambs. A. Yousefi,* H. Kohram, A. Z. Shahneh, M. Sadeghi, and M. Poorhamdollah, *University of Tehran, Karaj, Tehran, Iran.*

The objective of this study was to compare fatty acid profile of longissimus dorsi (LD) between fat-tailed Chall (14 male and 15 female) and tailed Zel lambs (15 male and 15 female). All of lambs were pastured with average age of 10–12 mo and BW of 36.5 ± 1.6 (Kg). LD muscles were dissected 24h after slaughtering to evaluation fatty acid composition. Data of fatty acid profile and intramuscular fat of LD muscle were analyzed by SAS 9.2 software and GLM procedure where HCW was used as covariate and breed and sex were used as fixed effect. Results showed (Table 1) that Zel and female stored more intramuscular fat than Chall ($P < 0.001$) and male lambs ($P < 0.0001$), respectively. Oleic (C18:1) acid was lower ($P < 0.001$) and linolenic acid (C18:3n-3) was higher ($P < 0.01$) in Chall compared with Zel lambs. Although percentage of linoleic acid (C18:2n-6) and SFA were not significant ($P > 0.05$) between breeds, LD muscle of Chall contained more percentage of PUFA and PUFA/SFA ratio ($P < 0.05$) rather than Zel lambs. LD muscle of male lambs showed higher percentage of PUFA ($P < 0.05$) and lower proportion of n-6/n-3PUFA ($P < 0.001$). Considering n-6/n-3PUFA, LD muscle of Chall lambs showed lower ratio ($P < 0.01$) than Zel lambs whereas sex did not show significant difference ($P > 0.05$). In conclusion, results indicated that meat produced by Fat-tailed and male lambs was more close to recommended nutritional quality for human.

Table 1. Mean \pm SE fatty acid and chemical components analysis

| Trait (mg/100g) | Breed | | | Sex | | | Effect | |
|-------------------|-------|------|-----------|------|--------|-----------|--------|-----|
| | Chall | Zel | SEM \pm | Male | Female | SEM \pm | Breed | Sex |
| C16:0 | 26.3 | 26.6 | 0.47 | 25.3 | 26.91 | 0.47 | NS | NS |
| C18:1 | 36.9 | 40.2 | 0.64 | 38.7 | 38.41 | 0.65 | *** | NS |
| C18:3n-3 | 0.05 | 0.53 | 0.05 | 0.65 | 0.60 | 0.05 | ** | NS |
| C18:2n-6 | 5.98 | 5.47 | 0.24 | 6.25 | 5.20 | 0.24 | NS | ** |
| PUFA | 9.33 | 7.61 | 0.46 | 9.24 | 7.70 | 0.46 | * | * |
| PUFA/SFA | 0.19 | 0.16 | 0.01 | 0.20 | 0.15 | 0.01 | * | ** |
| n-6/n-3PUFA | 4.77 | 6.12 | 0.35 | 5.37 | 5.52 | 0.34 | ** | NS |
| Intramuscular fat | 1.82 | 2.83 | 0.24 | 1.98 | 2.97 | 0.21 | ** | *** |

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$; NS = not significant.

Key Words: fatty acid composition, fat-tailed lamb, tailed lamb

M373 The energetic efficiency of growing lambs fed high-concentrate diets with different roughages. D. B. Galvani¹, A. V. Pires², I. Susin², V. N. Gouvea², A. Berndt³, L. J. Chagas², J. R. R. Dórea², A. L. Abdalla⁴, and L. O. Tedeschi⁵, ¹EMBRAPA Goats and Sheep, Sobral, CE, Brazil, ²University of São Paulo, "Luiz de Queiroz" College of Agriculture, Piracicaba, SP, Brazil, ³EMBRAPA Southeast Livestock, São Carlos, SP, Brazil, ⁴University of São Paulo, Center for Nuclear Energy in Agriculture, Piracicaba, SP, Brazil, ⁵Texas A&M University, Department of Animal Science, College Station.

Poor quality roughages have been widely used as fiber source in high-concentrate diets for ruminants. Because roughage quality is associated with the efficiency of energy use in high-forage diets, the objective of this study was to determine whether using roughages with different quality in high-concentrate diets could change the energy requirements of growing lambs. Eighty-two Dorper \times Santa Ines ram lambs (18.0 ± 3.3

kg BW) were individually penned and divided into 2 groups according to the diet roughage quality: low quality (sugarcane bagasse; SCB) or good quality [coastcross hay (*Cynodon* sp.)]. Diets were formulated to be isonitrogenous (2.6% N) and to meet the minimum requirement of physically effective NDF (peNDF = 20%). After a 10-d ad libitum adaptation period, 7 animals from each group were randomly selected and slaughtered (baseline). Twenty one animals in each group were fed ad libitum and slaughtered at 25, 35, or 45 kg BW. The remaining 28 lambs were submitted to one of 2 levels of feed restriction: 70 or 50% of the ad libitum intake. Retentions of body fat, N, and energy were determined. Additionally, 6 ram lambs (52.3 ± 6.9 kg BW) were kept in cages to estimate diet ME content. There was no effect of intake level on diet ME content, but it was greater in the SCB diet than in the hay diet (3.18 vs. 2.94 Mcal/kg, respectively; $P < 0.01$). Animals fed the SCB diet had greater body fat and energy concentrations as a response of a larger visceral fat deposition ($P < 0.05$). Using poor quality roughage in high-concentrate diet for growing lambs did not change NE_m and the efficiency of ME use for maintenance, which averaged 72.9 kcal/kg^{0.75} BW and 0.64, respectively. On the other hand, the greater ME content of the SCB diet resulted in a 17% better efficiency of ME use for gain ($k_g = 0.41$ vs. 0.35; $P < 0.05$), which was associated with a greater partial efficiency of ME retention as fat ($k_f = 0.73$ vs. 0.58; $P < 0.01$). In a meat production scenario, however, this increased nutritional efficiency should be viewed with caution because it is related to visceral fat deposition, a non edible tissue.

Key Words: efficiency of gain, energy retention, visceral fat

M374 Intake and feeding behavior of Morada Nova lambs fed different energy levels. D. A. Camilo¹, E. S. Pereira¹, P. G. Pimentel¹, M. S. S. Carneiro¹, I. Y. Mizubuti², M. R. G. F. Costa¹, G. M. B. Moreno¹, and J. N. Rocha Junior¹, ¹Federal University of Ceara, Fortaleza, Ceara, Brazil, ²State University of Londrina, Londrina, Parana, Brazil.

The eating behavior of ruminants, such as feed intake, ruminating time and number of chews, varies by feed type and physical characteristics and has an important effect on the digestive physiology of the ruminant. The objectives of this study were to evaluate the effects of ME levels on nutrient intake and ingestive behavior of Morada Nova lambs. Forty Morada Nova lambs were used with an initial BW of 12.2 ± 2.05 kg. Five treatments were defined according to the ME levels (0.96, 1.28, 1.72, 2.18 and 2.62 Mcal/kg DM). Diets were composed of Tifton 85 hay as roughage and concentrates based on corn grain, soybean meal, urea, sodium chloride, calcium carbonate, dicalcium phosphate and mineral premix and offered as a total mixed ration. The experimental model was a randomized block design. Regression equation was adjusted when 0.05 significance was observed, using PROC REG SAS (9.0). Linear effect ($P < 0.0001$) of ME levels was determined for DMI, OM, CP, total carbohydrates (TC), non-fibrous carbohydrates (NFC) and TDN in g/day. Quadratic effect was determined for neutral NDF ($P < 0.017$) and non fibrous carbohydrate intake ($P < 0.003$). Eating, ruminating and total chewing times, expressed in h/d, decreased linearly ($P < 0.0001$) with the energy levels of experimental diets. Idle time increased linearly ($P < 0.0001$) with the increase of energy levels of the rations. Feeding and rumination efficiencies were influenced by the energy levels ($P < 0.0001$) when expressed in g of DM/h. The number of ruminal boluses, number of chews and chews per ruminal bolus were not affected by the levels of ME. However, the time spent chewing per ruminal bolus

was influenced ($P < 0.0014$). Increase in ME levels of diets influences nutrient intake and feeding behavior of Morada Nova lambs during the growing period.

Key Words: eating time, feeding level, rumination time

M375 Different supplement treatments for lactating meat goat does grazing grass/forb pastures. A. L. Goetsch,* G. D. Detweiler, Z. Wang, J. Hayes, K. Tesfai, and T. A. Gipson, *Langston University, Langston, OK*.

Lactating meat goats grazing 0.4-ha grass/forb pastures were used to determine effects on performance of different supplement treatments. Boer does (32) with 1 or 2 kids were used in a study with 4 4-wk periods (PR) starting 22 ± 2.0 d after birth. Two groups were subjected to treatments of no supplementation (CO), access to a 20% CP supplement block (SB), and placement in a supplement pasture with mimosa (*Albizia julibrissin*) trees for 6 h 1 d/wk ($1\times$) or twice weekly for 3 h/d ($2\times$). All groups received access to the same mineral-vitamin supplement. Available forage DM in non-supplement pastures averaged 3,477, 3,448, 3,353, 2,802, and 2,423 kg/ha initially and after PR 1, 2, 3, and 4, respectively; hand-plucked forage samples averaged 15 and 67% CP and NDF, respectively. Treatment did not affect doe ADG ($-23, -42, -23$, and -15 g; SE = 11.5), FAMACHA score, or fecal egg count, although kid ADG in the first 3 PR differed ($P < 0.05$) between type of supplement and frequency of supplement pasture access (121, 111, 120, and 134 g for CO, SB, $1\times$, and $2\times$, respectively; SE = 3.3). Spanish does (32) nursing 2 kids were used in a study with three 4-wk PR starting 66 ± 0.8 d after kidding. The same CO and SB treatments were employed, but access to supplement pastures was for 24 h 1 d/wk ($1\times$) or 2 d for 6 h/d ($2\times$). Forage DM averaged 1,530, 842, 791, and 750 kg/ha initially and after PR 1, 2, and 3, respectively), and 0.6 kg/d (as fed) per doe of grass hay (7 and 67% CP and NDF, respectively) was fed after PR 1. Hand-plucked forage samples averaged 14 and 64% CP and NDF, respectively. Treatment did not affect doe or kid FAMACHA score. Kid ADG in PR 1 and 2 was not affected by treatment. Doe ADG was affected by supplementation ($P < 0.05$) and supplement type ($P < 0.09$; $-44, -33, -23$, and -12 g; SE = 5.5), which resulted from effects ($P < 0.05$) in PR 3 after weaning ($-87, -69, -16$, and -2 g for CO, SB, $1\times$, and $2\times$, respectively; SE = 14.3). In conclusion, use of the SB was not beneficial, and infrequent access to supplement pastures had relatively small effects on ADG perhaps because forage availability and nutritive value were not severely limiting.

Key Words: goats, grazing, supplementation

M376 Effects of level and length of supplementation on BW and harvest characteristics of yearling Boer and Spanish wethers. R. C. Merkel, T. A. Gipson,* Z. Wang, and A. L. Goetsch, *Langston University, Langston, OK*.

Spanish (S; 28 - 40 wk of age) and Boer (B; 33 - 46 wk) wethers were used to determine effects of level (SL) and length of supplementation on BW and harvest characteristics. The experiment started in January, with wethers residing in 4 pastures primarily with warm season grasses. Alfalfa hay was given free-choice, and a pelleted diet (16% CP and 60% TDN) was group supplemented at 0.5 or 1.5% BW (DM basis; L and H, respectively). Five S and 6 B were harvested initially, and 12 per breed (BR) and SL were harvested after 110 and 218 d (PR 1 and 2, respectively). Data were analyzed by GLM procedures. There were BR differences ($P \leq 0.06$) in initial BW (33.3 and 23.7 kg), carcass weight

(15.4 and 10.9 kg), and mass of noncarcass components (NCC; 11.7 and 9.2 kg for B and S, respectively) but not in mass of NCC relative to empty BW (EBW). The ADG was greatest ($P < 0.05$) among PR-BR treatments for PR 1-B (139, 74, 63, and 56 g for PR 1-B, PR 1-S, PR 2-B, and PR 2-S, respectively; SEM = 5.23). The BW was affected ($P < 0.05$) by SL (48.2 and 43.1 kg for H and L), BR (53.1 and 38.2 kg for B and S), and PR (41.8 and 49.3 kg in 1 and 2, respectively). There were corresponding differences ($P < 0.05$) in weight of the carcass (23.6 and 20.4 kg for H and L; 25.5 and 18.5 kg for B and S; 20.3 and 23.8 kg for PR 1 and 2, respectively) and NCC (16.9 and 15.0 kg for H and L; 18.4 and 13.5 kg for B and S; 15.1 and 16.8 kg for PR 1 and 2, respectively). Digestive tract mass was similar between BR and lowest ($P < 0.05$) among SL-PR treatments for PR 2-H (7.21, 7.19, 6.31, and 7.51% EBW for PR 1-H, PR 1-L, PR 2-H, and PR 2-L, respectively). Liver mass was similar between BR and less ($P < 0.05$) for H than for L (2.15 and 2.30% EBW) and for PR 2 vs. 1 (2.11 and 2.34% EBW). Mass of internal fat was greatest ($P < 0.05$) among SL-PR treatments for PR 2-H (6.72, 6.36, 8.61, and 5.95% EBW for PR 1-H, PR 1-L, PR 2-H, and PR 2-L, respectively). In summary, advantages of B in BW and carcass weight were similar after PR 1 and 2, BR had little effect on NCC mass relative to EBW, and H increased mass of internal fat after PR 2 but not PR 1.

Key Words: meat goat, breed, supplement

M377 Energy requirements for growth of male and female Saanen goat kids. M. H. M. R. Fernandes,* O. Boaventura Neto, A. N. Mendonca, S. F. Souza, D. Oliveira, T. F. V. Bompadre, T. R. Delphino, K. T. Resende, and I. A. M. A. Teixeira, *UNESP/Sao Paulo State University, Jaboticabal, Sao Paulo, Brazil*.

Nutritional requirements could be affected by several factors, including sex. However, studies evaluating the effect of sex on body composition and nutritional requirements in goats are scarce. The aim of this study was to evaluate the effect of sex on energy requirement for maintenance and gain of Saanen goat kids, using comparative slaughter technique. A total of 66 animals (24 non-castrated males, 18 castrated males and 24 females) with initial BW of 4.93 ± 0.1 kg were used. Six non-castrated males and 6 females were slaughtered at beginning of the experiment (baseline animals) and 18 randomly selected kids (6 of each sex) were slaughtered when they reached 10 kg BW (intermediate slaughter). The remainder was randomly allocated into 12 groups (blocks) of 3 animals of the same sex, subjected to 0, 25 and 50% of feed restriction. A group was slaughtered when the animal set in the 0% restriction reached 15 kg BW. Initial body composition was determined using equations developed from the energy composition of the baseline kids. The energy maintenance requirement was estimated using the animals subjected to feed restriction (0, 25, and 50% of feed restriction). Animals fed ad libitum (baseline, intermediate and 0% of feed restriction) were used to estimate body composition and requirements for gain. There was no effect of sex on the energy requirements for maintenance and gain. The overall NE_m calculated was $56.3 \text{ kcal/kg}^{0.75} \text{ EBW}$ ($47.3 \text{ kcal/kg}^{0.75} \text{ BW}$). The overall ME_m for maintenance ($88.05 \text{ kcal/kg}^{0.75} \text{ EBW}$) was calculated by iteration assuming heat produced is equal to ME intake at maintenance. Therefore, the partial efficiency of use of ME to NE for maintenance was 0.64. Net energy (NE_g) requirements for gain ranged from 2.07 to 2.30 Mcal/kg empty weight gain (EWG) for kids weighting 5 and 15 kg BW, respectively. These findings suggested that sex did not influence energy requirements of Saanen goat kids at early growth stages. (FAPESP project number 2008/58351-5)

Key Words: gain, sex, maintenance

M378 Influence of reducing starch and increasing digestible fiber on glucose tolerance test of lactating ewes. R. S. Gentil¹, I. Susin¹, A. V. Pires¹, E. M. Ferreira¹, A. Cannas², D. Eysink¹, M. V. Biehl¹, and C. P. Nolli¹, ¹Universidade de São Paulo/ESALQ, Piracicaba, São Paulo, Brazil, ²Università degli Studi di Sassari, Sassari, Sardegna, Italy.

Thirty-three lactating Santa Ines ewes (68 ± 3 initial BW and 13.2 ± 3 DIM; mean \pm SD), assigned to a randomized complete block design, were used to define an optimal combination between carbohydrates sources (starch and high digestible fiber) that can favor energy partitioning toward milk production at different lactation stages. Ewes were housed individually for a period of 10 wks from the second wk of lactation. Animals were fed a 60:40 (concentrate:roughage ratio). Soybean hull (SH) replaced corn by 0, 20 or 40% (DM basis). At the end of the lactation trial, 9 ewes (3 animals/treatment) were used for the glucose tolerance test (GTT). Prior to GTT, ewes were removed from feed and weighed 24 h before glucose infusion (0.25 g of glucose/kg of BW, delivered in a 50% dextrose solution). Fasting values of glucose and insulin were determined at 0 min before administration of the glucose bolus. Additional blood samples were collected at 5, 10, 20, 40 and 80 min after the glucose infusion. A colorimetric assay was used to determine plasma glucose concentrations. Plasma insulin concentrations were measured using RIA. Glucose disappearance rate was calculated by regression of glucose concentration over time from 5 to 80 min post glucose infusion. Incremental area under the curve (AUC) for glucose (transformed logarithmically, Ln) was determined using a trapezoidal summation method. Data were analyzed by the PROC MIXED (SAS, 2002). Both, insulin and glucose concentrations showed effect ($P < 0.01$) on the time post glucose infusion. Fasting glucose (53.2; 57.7; 60.4 mg/dL) and insulin (1.4; 3.0; 5.3 μ IU/mL) concentrations and peak insulin increased (22.4; 25.9; 35.1 μ IU/mL) ($P < 0.05$) with inclusion of the SH. Additionally, peak glucose (247.5; 236.3; 184.7 mg/dL) and glucose clearance rate (2.04; 1.44; 1.11 mg/dL.min) decreased ($P < 0.05$) in the animals fed more SH. Glucose tolerance (measured as glucose AUC) was not affected ($P > 0.05$) by replacing corn by SH. Sheep fed more corn demonstrated greater ability to decrease the concentration of glucose.

Key Words: insulin, ovine, soybean hulls

M379 Soybean meal supplementation of lambs grazing native pastures in the summer-fall season. L. Piaggio¹, M. L. delPino¹, H. Deschenaux¹, and M. de J. Marichal², ¹Secretariado Uruguayo de la Lana, Montevideo, Uruguay, ²Facultad de Agronomía, Universidad de la República, Montevideo, Uruguay.

The objective of this study was to evaluate the effect of soybean meal (SBM) supplementation on growth rate of lambs grazing natural pastures in the summer-fall season. The experiment was conducted at Research Center (S 33° 52', W 55° 34') of the Secretariado Uruguayo de la Lana from January 17 to April 27 (15 d of adaptation period plus 85 d of measurements). Thirty-six 3-mo-old weaned Corriedale lambs were divided into 12 homogenous groups according to sex and live weight. Animals were allocated in one paddock of natural pastures (10 lambs ha⁻¹, 1864 kg of initial available DM ha⁻¹; 8.8 and 70.4% CP and NDF, respectively) and assigned (3 groups of lambs/treatment) to one of the following treatments: continuous grazing (T0), Control + SBM (150 g lamb⁻¹d⁻¹; 46.7 and 20.9% CP and NDF, respectively; T1), Control + SBM (250 g lamb⁻¹d⁻¹; T2), Control + SBM (350g lamb⁻¹d⁻¹; T3). Lambs were weighed at the beginning of the experiment (average 17.8 \pm 2 kg), and at every 15 d thereafter. Initial and final BW, and ADG, were analyzed (PROC GLM, SAS) in a completely randomized design (Tukey test), considering the group of lambs by replicate as

the experimental unit. Treatment effects ($P = 0.02$) were registered in final weights (FW). Greater ($P = 0.04$) FW was registered in T3 than T0 (22.7 and 28.6 kg, respectively), presenting T1 and T2 intermediate and with similar ($P = 0.19$) values (24.5 and 26.4 kg, respectively). No differences ($P = 0.14$) among treatments were observed for the ADG of lambs at d 14 after the beginning of the measurement period (56, 65, 71 and 109 g lamb⁻¹d⁻¹ for T0, T1, T2 and T3, respectively). Differences ($P = 0.25$) in ADG were first registered on d 28, presenting lambs in T3 greater ($P = 0.004$) in ADG than T0 (126 and 57 g d⁻¹, respectively), and T2 and T3 having similar ($P = 0.16$) values (78 and 101g d⁻¹, for T1 and T2, respectively). These differences were maintained from this point forward. In the overall measurement period, ADG were 56, 78, 101, and 127 g lamb⁻¹d⁻¹, for T0, T1, T2 and T3 ($P < 0.05$). Soybean meal supplementation appeared as an effective supplement to improve growth in lambs grazing natural pastures.

Key Words: lambs, soybean meal supplementation, grazing

M380 Nutritional quality, intake, and apparent digestibility of mulberry (*Morus alba*) and star grass (*Cynodon nlemfuensis*) in goats. J. A. Elizondo-Salazar* and J. Rodríguez-Zamora, *Estación Experimental Alfredo Volio Mata, Facultad de Ciencias Agroalimentarias, Universidad de Costa Rica, Costa Rica.*

The objective of the study was to evaluate the quality, intake, and apparent digestibility of mulberry and star grass offered to goats in fresh or partially dehydrated form. The experiment was carried out at the "Alfredo Volio Mata" Experiment Station of the University of Costa Rica. Forage was fed to 12 Saanen, Toggenburg, and Lamancha nonlactating and non-pregnant goats with an average live weight of 37 \pm 5 kg. A 2x2 factorial design was used with 2 forage species (star grass and mulberry) and 2 moisture levels (fresh and partially dehydrated). Thus, treatments were fresh star grass, partially dehydrated star grass, fresh mulberry, and partially dehydrated mulberry. Forage was offered chopped to the animals. The GLM procedure of SAS was used to analyze the data. There were some nutritional differences among treatments. Dry matter content was different ($P < 0.05$) between treatments (28.2, 37.5, 36.7, and 43.1%, respectively). Mulberry had the lowest NDF content (65.7%) but also had the highest lignin concentration (13.0%). Daily DMI was not different when considering water concentration within forages but it was different ($P < 0.05$) for forage type. The levels of intake were 0.93, 0.76, 1.17, and 1.12 kg/animal for fresh star grass, partially dehydrated star grass, fresh mulberry, and partially dehydrated mulberry, respectively. This represented 2.62, 2.09, 3.17, and 3.13% of BW. Crude protein intake was lower for partially dehydrated star grass and greater for fresh mulberry (75.2 vs. 135.4 g/d). Apparent digestibility was not different between treatments and averaged 49.2% for DM, 59.8% for CP, 57.8% for NDF, and 55.3% for ADF. This study demonstrated that forage species significantly affected voluntary DMI in goats; however, DM content of the forages used in this study did not affect DM intake.

Key Words: intake, dry matter, digestibility

M381 Effect of dietary supplementation of ferrous sulfate on performance and carcass characteristics of meat sheep. G. Abdelrahim¹, J. Khatiwada², and A. Gueyec³, ¹Alabama A&M University, Huntsville, ²North Carolina A&T State University, Greensboro, ³Mount Ida College, Newton, MA.

The overall objective of this study was to gain a thorough understanding of the impact of increasing the concentration of FeSO₄ in meat sheep diets. The specific objective was to investigate the effects of elevated

levels of FeSO₄ inclusion on DMI, growth, and carcass characteristics of meat sheep. Twenty-four Gulf Coast wether lambs (26.3 ± 3.63 kg initial BW, and 8 to 9 mo of age) were blocked by BW and were randomly assigned within block to 1 of the 3 dietary treatments, giving 8 lambs per treatment. Animals were grouped in 2 pens (replicates) per treatment (4 lambs/pen) with pen serving as the experimental unit. Lambs were fed dietary treatments containing 0, 75, or 150 mg/kg of DM (as-fed basis) supplemental FeSO₄. Control diets contained dry-rolled corn, SBM, and fescue/bermudagrass hay. The concentrate mixes were formulated to be isonitrogenous and isocaloric and to meet or exceed the NRC requirements of a finishing lamb. Lambs were slaughtered, and data were collected after a 48-h chill. Both growth and carcass quality data were analyzed using the GLM procedures of SAS. Dry matter intake, final BW, and ADG were not different among treatments ($P = 0.5$, 0.9 , and 0.7 , respectively). Also, no differences were observed in HCW ($P = 0.9$), cold carcass weight ($P = 0.8$), body wall fat ($P = 0.6$), 12th rib fat ($P = 0.9$), K&P fat ($P = 0.9$) and REA ($P = 0.7$) among treatments. These results support our hypothesis that the addition of 75 or 150 mg FeSO₄/kg in finishing lamb diets do not affect DMI, growth rate, and carcass characteristics of meat sheep.

Key Words: iron, meat sheep, growth

M382 Effects of diets with different qualities of roughage on fatty acids metabolism in mammary glands of lactating dairy goats. L. W. Song¹, C. J. Ao^{*1}, K. Khas-Erdene¹, H. Zhang¹, Y. X. Wu², and S. W. Liu¹, ¹*Department of Animal Science, Inner Mongolia Agricultural University, Huhhot, Inner Mongolia, China*, ²*Key Laboratory of Grass and Herbivores of Chongqing, College of Animal Science and Technology, Southwest University, Chongqing, China*.

The objectives of this study were to determine the effects of diets with different qualities of roughage on milk-fat percentage, daily yield of milk fat and fatty acids metabolism in mammary gland. Eight multiparous lactating GuanZhong dairy goats (BW = 45.6 ± 2.5 kg, DIM = 90 ± 12 d) fitted with external pudendal artery (EPA) and subskin abdominal vein (SAV) intubation were assigned to 2 treatments in a crossover design. Animals received same concentrate and different roughage, concentrate-roughage ratio was 40:60. Treatments were: 1) hay (30%), corn silage (20%) and alfalfa (10%) (HCA; CP: 10.6%, NDF: 50.4% and ME: 2.24 Mcal/kg); 2) hay (30%), corn straw (30%) (HCS; CP: 14.2%, NDF: 39.7% and ME: 2.39 Mcal/kg)(DM basis). Each period lasted for 3-wk. At the last 3 d of each period, milk and blood samples from EPA and SAV were collected for FA analysis. Data were analyzed by the PROC MIXED procedure of SAS 9.0. The milk fat percentage of HCA was greater than HCS (3.04 vs. 2.84%; $P = 0.01$), while daily yields of milk fat were not affected (15.3 vs. 14.5 g/d). Compared with HCS, HCA tended to increase total percentage of long-chain FA (>16c) which known as major precursor of de novo milk fat synthesis in mammary gland (35.0 vs. 33.0%, $P = 0.16$); the concentration and profile of FAs in the blood of EPA, SAV and milk were not affected. However, percentage of total milk SFA by HCA was statistically lower than HCS (71.7% vs. 73.4, $P = 0.15$); percentage of milk UFA by HCA was higher than HCS (28.29 vs. 26.59%, $P = 0.15$). Compared with HCS, HCA tended to increase EPA plasma concentration of total FA (0.73 vs. 0.57, $P = 0.32$), and increased SAV plasma concentration of total FA (0.62 vs. 0.44, $P = 0.02$), especially the concentration of C18:0 and C18:2c6 (0.1 vs. 0.08, $P = 0.12$; 0.12 vs. 0.09, $P = 0.11$). No differences were found on the extraction rate of specific FA in 2 groups. Compared with HCS, HCA increased plasma concentration of long-chain FA in EPA and SAV, which might result in higher milk fat percentage.

Key Words: milk fat concentration, FA composition, dairy goat

M383 Effects of diets with different forage profiles on the gene expression of enzymes related to fatty acid synthesis in the mammary gland of lactating dairy goats. H. Zhang, C. J. Ao,^{*} K. Khas-Erdene, L. W. Song, and X. F. Zhang, *Department of Animal Science, Inner Mongolia Agricultural University, Huhhot, Inner Mongolia, China*.

The objective was to determine the effects of 2 diets with different forage profiles on the key gene expression of enzymes related to fatty acid synthesis in the mammary gland of GuanZhong dairy goats. Analysis of mRNA expression for acetyl-coenzyme A carboxylase- α (ACACA), fatty acid synthesis (FASN), stearyl coA desaturase (SCD), and lipoprotein lipase (LPL) were performed. Eight multiparous lactating goats (BW = 45.6 ± 2.5 kg, DIM = 90 ± 12 d) were assigned to 2 treatments in a crossover design. Animals were fed diets with different forage profiles, the concentrate-roughage ratio in the treatments were 40:60. Diets were: 1) hay (30%), corn silage (20%) and alfalfa (10%) with additional 40% of concentrate (HCA; CP: 10.6%, NDF: 50.4% and ME: 2.24Mcal/kg); 2) hay (30%), corn straw (30%) with additional 40% of concentrate (HCS; CP: 14.2%, NDF: 39.7% and ME: 2.39Mcal/kg), on DM base. Mammary gland biopsies were performed after milking on the last day of each period. The mammary tissue biopsy (50 mg/animal) was immediately frozen in liquid nitrogen and stored at -80°C until RNA isolation. Samples of total RNA were reverse transcribed to cDNA to determine the expression of key genes for fatty acid synthesis by the method of RT-PCR. Statistical analysis was performed using a paired *t*-test on the difference between treatments. Compared with HCS, in HCA animals mammary mRNA abundance of LPL, which is involved in fatty acid uptake was increased by 39% ($P < 0.01$); ACACA and FASN, which are involved in de novo fatty acid synthesis were increased by 18, and 20%, respectively ($P < 0.01$); SCD, which is involved in fatty acid desaturation was increased by 50% ($P < 0.01$). The data demonstrated that diet with high quality roughage (HCA) can increase the gene expression of enzymes that are related to milk fat synthesis in the mammary gland of dairy goats.

Key Words: mammary gland, milk fatty acid, dairy goat

M384 Performance of Ile de France lambs fed with diets containing different percentages of mulberry hay. L. G. A. Cirne,^{*} A. G. Silva Sobrinho, V. T. Santana, R. Takahashi, N. M. B. L. Zeola, F. A. Almeida, G. M. Manzi, and F. U. Silva, *São Paulo State University, Jaboticabal, São Paulo, Brazil*.

Among the concentrated feeds most used in ruminant feeding, stand out the corn and the soybean meal, and the high cost of this feeds limit their use. Efforts have been made in the search for alternative feeds among them the mulberry hay, being fundamental to evaluate the performance of lamb fed with such feeds. The objective of this study was to evaluate the performance of lambs fed with diets containing different percentages of mulberry hay. A total of 20 4 lambs, Ile de France breed, with 25 kg of BW, 3 mo old were used and kept in individual stalls, in a completely randomized design, with 3 treatments and 8 repetitions, in which the data were analyzed using SISVAR statistical software, and when statistical differences were observed, a mean comparison was done using the Tukey test. The treatments were: T1: sugarcane + concentrate with 0% mulberry hay; T2: sugarcane + concentrate with 25% mulberry hay; T3: sugarcane + concentrate with 50% mulberry hay. The sugarcane used was the forage variety IAC 86-2480, and the total diet had forage:concentrate ratio of 50:50 given ad libitum. The remains of the diets were collected, weighed and subtracted from the total provided to quantify the feed consumed by the animals individually. The ADG (0.26 kg/d), DMI (0.82 kg/d), feed conversion (3.21 kg

DM/kg BW), feed efficiency (0.31 kg BW/kg DM) and feedlot period (66 d) were not affected ($P > 0.05$) by different percentages of mulberry hay in the concentrate. The use of mulberry hay partially substituting the concentrate did not affect the performance of feedlot lambs. This research is in progress (Fapesp process number 2011/18362-0).

Table 1. Initial body weight (IBW), final body weight (FBW), daily weight gain (DWG), dry matter intake (DMI), feed conversion (FC), feed efficiency (FE) and days of feedlot (DF) of lambs fed with diets containing different percentages of mulberry hay

| Item | T1 | T2 | T3 | CV (%) |
|------------------|------|------|------|--------|
| IBW (kg) | 15.5 | 15.5 | 15.5 | 0.50 |
| FBW (kg) | 32.1 | 32.1 | 32.3 | 1.69 |
| DWG (kg/day) | 0.26 | 0.25 | 0.25 | 6.53 |
| DMI (kg/day) | 0.83 | 0.80 | 0.82 | 9.88 |
| FC (kg DM/kg BW) | 3.21 | 3.21 | 3.22 | 7.99 |
| FE (kg BW/kg DM) | 0.31 | 0.31 | 0.31 | 7.22 |
| DF | 64.8 | 66.8 | 66.4 | 7.14 |

Key Words: feedlot, feed conversion, weight gain

M385 Effect of metabolizable protein supplementation to ewes during late gestation on wether offspring feedlot performance, carcass characteristics, and nitrogen balance. M. L. Van Emon^{*1,2}, K. A. Vonnahme², P. T. Berg², K. R. Maddock Carlin², and C. S. Schauer¹, ¹Hettinger Research Extension Center, North Dakota State University, Hettinger, ²Department of Animal Sciences, North Dakota State University, Fargo.

Our objective was to determine the effect of metabolizable protein (MP) supplementation to ewes during late gestation on wether offspring nitrogen (N) balance, feedlot performance, and carcass characteristics. Maternal dietary treatments were isocaloric and contained 60% (60), 100% (100), and 140% (140) of MP requirements for ewes bearing twins during the last 50 d of gestation. Feedlot (28 ± 7 kg) and N balance wethers (29 ± 3 kg) were fed a common feedlot ration (84.7% whole corn, 15.3% commercial market lamb pellet). The N balance trial was 21 d in length and consisted of an adaptation period on d 1 through 14 and on d 15 through 21 feed, orts, urine, feces, and blood samples were collected and composited by lamb. Statistical analysis was accomplished utilizing the MIXED procedures of SAS. Maternal dietary treatment did not affect ($P \geq 0.36$) initial and final BW, ADG or G:F of wether offspring. Hot carcass weight, dressing percentage, longissimus muscle area, 12th rib fat depth, body wall thickness, leg score, conformation score, flank streaking, USDA quality grade, yield grade, and percent boneless, closely trimmed retail cuts were not different ($P \geq 0.40$) due to maternal dietary treatment. For the N balance trial, daily DMI, daily NDF intake, daily N intake, total tract digestibility of DM, NDF, and N, daily N excretion in the feces and urine, daily N balance, daily digested N retained, and serum urea-N concentrations were not different ($P \geq 0.46$) due to maternal dietary treatment. There was a day effect ($P = 0.02$) for serum urea-N concentrations. Days 15 and 17 of the collection period had increased serum urea-N concentrations compared with d 20 ($P = 0.001$ and $P = 0.02$, respectively) and 21 ($P = 0.004$ and $P = 0.04$, respectively); and d 15 also had increased ($P = 0.04$) concentrations compared with d 18. Maternal MP restriction or excess during late gestation did not affect wether offspring performance in the feedlot, carcass characteristics, or N retention.

Key Words: metabolizable protein, performance, wethers

M386 Effects of sources of oil on intake, performance and carcass characteristics of feedlot sheep. F. B. O. Scarpino^{*1,2}, J. M. B. Ezequiel¹, E. H. C. B. van Cleef^{1,3}, A. P. D'Aurea^{1,3}, M. T. C. Almeida¹, and H. L. Perez¹, ¹São Paulo State University, Jaboticabal, São Paulo, Brazil, ²CNPq, ³FAPESP.

Crossbred uncastrated male lambs (Santa Inês \times Dorper, $n = 24$, 24.9 ± 2.4 kg BW) were used to evaluate intake, feedlot performance and carcass characteristics when fed diets containing supplementary oil sources. Treatments (3 diets) consisted of a control diet containing 40% corn silage, 10.8% corn grain, 9.8% soybean hulls, 37.45% sunflower meal, 0.55% urea, 0.4% limestone, and 1% supplement, and 2 diets containing additional 6% soybean oil or 6% residual soybean frying oil (DM basis). Lambs were vaccinated against common viral and clostridial diseases, weighed and assigned randomly to 24 individual feedlot pens (8/treatment). Over a period of 21 d, lambs were transitioned from diets containing 20% concentrate to their respective 60% concentrate finishing diets, using 3 step-up diets that contained, progressively, greater proportions of concentrate. Final diets provided 18.5% CP, 2.6 kcal ME/kg, 0.85% Ca, and 0.60% P, and the animals were harvested when reached 35 kg BW. Data analysis was performed as a completely randomized block design (initial BW as block), using GLM procedure of SAS, and the contrasts control vs. oil treatments and soybean oil vs. frying oil were evaluated. Adding oil sources decreased DMI ($P \leq 0.01$), and the decrease were more severe in animals fed frying oil ($P = 0.02$). This oil source also promoted lower ADG ($P \leq 0.01$) and increased days on feed ($P = 0.05$), compared with other treatments. However, the addition of both sources of oil increased G:F ($P = 0.02$). Carcass weight were unaffected ($P > 0.05$) by diets, but dressing percentage were lower in treatment with soybean oil ($P \leq 0.01$). LM area and BF thickness were not affected by oil addition ($P > 0.05$). Including supplementary oil to sheep diets decreased DMI and improved feed efficiency but when the source of oil is residual frying oil, it decreased performance, by increasing days on feed.

Key Words: by-products, lambs, frying oil

M387 Lipid sources in diets for feedlot sheep: Blood parameters. F. B. O. Scarpino^{*1,2}, J. M. B. Ezequiel¹, D. A. V. Silva^{1,3}, and E. H. C. B. van Cleef^{1,3}, ¹São Paulo State University, Jaboticabal, São Paulo, Brazil, ²CNPq, ³FAPESP.

Twenty-four crossbred uncastrated male lambs (Santa Inês \times Dorper, 24.9 ± 2.4 kg BW), were used to evaluate the effects of adding lipid sources (soybean oil or residual frying soybean oil) on blood parameters. Lambs were vaccinated against common viral and clostridial diseases, weighed and assigned randomly to 24 individual feedlot pens (8/treatment). Over a period of 21 d, lambs were transitioned from diets containing 20% concentrate to their respective 60% concentrate finishing diets, using 3 step-up diets that contained, progressively, greater proportions of concentrate. Corn silage was the roughage, and concentrate was composed of corn grain, soybean hulls, sunflower meal, urea, mineral supplement, antioxidant, soybean oil or residual frying oil and diets provided 18.5% CP, 2.6 Mcal ME/kg, 0.85% Ca, and 0.60% P. Treatments were labeled as 1 - Control, without added oil, 2 - Soybean, with 6% added soybean oil, and 3 - Frying, with 6% added used frying oil. The animals were kept in a feedlot barn, equipped with individual pens for up to 105 d. Blood sampling was performed with jugular vein puncture on d 59 and serum glucose, triglycerides, cholesterol, total protein, and liver enzymes AST (aspartate aminotransferase), GGT (gamma glutamyltransferase) and ALP (alkaline phosphatase) were determined. Data analysis were performed as a completely randomized block design (initial BW as block), using GLM procedure of SAS, and

the contrasts control vs. oil treatments and soybean oil vs. frying oil were evaluated. The addition of oil increased cholesterol ($P < 0.01$) and AST ($P \leq 0.01$). When the residual frying oil was used it was observed a tendency to increase ALP ($P = 0.06$). Serum glucose, triglycerides and total protein were unaffected by the diets ($P > 0.05$). Addition of 6% soybean oil or residual frying oil in feedlot sheep diet increases concentrations of serum liver enzymes, suggesting over activity of the organ. However, such changes, observed to this feedlot period, are not sufficient to cause damage to animal health.

Key Words: frying oil, lambs, liver enzymes

M388 Relationship between phosphorus fluids concentration and phosphorus flows in growing ruminants. R. M. Patiño*¹, T. Soares da Silva³, J. C. da Silva Filho², D. M. S. S. Vitti³, J. A. Moreira⁴, and E. H. van Cleef⁵, ¹University of Sucre, Sincelejo, Colombia, ²Federal University of Lavras, Lavras, MG, Brazil, ³Nuclear Energy Center for Agriculture, Piracicaba, SP, Brazil, ⁴Federal University of Rio Grande do Norte, Natal, RN, Brazil, ⁵State University of São Paulo, Jaboticabal, SP, Brazil.

The objective of this work was to study the relationship between phosphorus (P) concentration in body fluids and the flows between plasma and organs, and P concentration in liver and bone, in growing sheep fed diets with increasing levels of P. An experiment was carried out using 24 male sheep, initial BW of 33.6 ± 1.6 kg, assigned to 4 treatments (0, 2, 4 and 6 g/d of supplementary P). The animals were injected with 7.4 MBq of ³²P and slaughtered 168 h later. The flows were quantified using isotopic dilution technique and applied a compartmental model, to define the flows between the digestive tract and plasma (F₂₁), plasma and digestive tract (F₁₂), plasma and bone (F₄₂), bone and plasma (F₂₄), plasma and soft tissues (F₃₂) and soft tissue and plasma (F₂₃). P concentration in plasma, saliva, ruminal fluid, feces, urine, liver, and bone were determined. Principal components and regression analysis were used. In all cases the first component explained more than 80% of the variation, indicating the effect of P intake on P concentration in fluids and P kinetics, principally when P supplementation exceeded 4 g. F₁₂ and F₂₁ flows were correlated ($P = 0.002$), as well as the flows F₂₃, F₃₂, F₂₄ and F₄₂ ($P < 0.05$), however, no correlation was observed ($P > 0.05$) between the 2 groups of variables. The concentration of P in plasma, saliva and urine was related to the flows between compartments, with the exception of F₂₁ and F₁₂, however, P concentration in urine (PU) was the better predictor ($P < 0.003$) [F₂₃ (g/d) = $5.75 + 0.31 \times$ PU (mg/100 mL) ($R^2 = 0.42$); F₃₂ (g/d) = $5.65 + 0.28 \times$ PU (mg/100 mL) ($R^2 = 0.34$); F₄₂ (g/d) = $1.58 + 0.06 \times$ PU (mg/100 mL) ($R^2 = 0.47$) and F₂₄ (g/d) = $0.79 + 0.05 \times$ PU (mg/100 mL) ($R^2 = 0.44$)]. The equation, P liver (% DM) = $9.87 + 3.36 \times$ P saliva (mg/100 mL) ($R^2 = 0.26$; $P = 0.01$), explained the relation between P concentration in urine and liver. It is concluded that the increase in P intake affects P kinetics in growing sheep. P concentration in plasma, saliva, and urine predicts the flows between organs, principally urine, with the exception of flows between plasma and digestive tract, and vice versa.

Key Words: metabolism, mineral, lamb

M389 Mineral requirements for gain in Saanen goats of different sexes. A. N. Mendonca,* C. J. Härter, I. A. M. A. Teixeira, O. Boaventura Neto, S. F. Souza, and D. Oliveira, UNESP/Sao Paulo State University, Jaboticabal, Sao Paulo, Brazil.

There is evidence that sex plays an important role on body composition and requirements of animals; however, there are few studies evaluating

the effect of sex on the mineral requirements of goats, thus the objective of this study was to estimate the net calcium (Ca), phosphorus (P) and magnesium (Mg) requirements for growth of Saanen goat kids, using the comparative slaughter technique. A total of 48 Saanen animals, 18 females, 18 males, and 12 castrated males with BW ranging from 5 to 15 kg were used. At the beginning of the experiment 6 intact males and 6 females with approximately 5 kg BW were slaughtered. No castrated males were slaughtered with 5 kg BW, because castration occurred when they were about 15 d old, then the males slaughtered at 5 kg BW were considered for the construction of the equations of both, castrated and intact males. The remainder of the kids, from each sex, were randomly assigned to 2 treatment groups (slaughter weight; 10 and 15 kg BW). The experiment was conducted in a completely randomized design in a factorial scheme (3×2). Body composition was estimated using the logarithmized allometric equation ($\log y = a + b \log x$). The equations ($P < 0.0001$) for estimating Ca and Mg body composition were different for males and females (Table 1). There was no sex effect on P body composition (Table 1). The net Ca and Mg requirements for weight gain were influenced by the sex of goats in the early growth phase. On the other hand, kids of different sex had similar net P requirement. FAPESP project number 2011/05176-4.

Table 1. Allometric equations to estimate Ca, Mg, and P body composition of female, intact, and castrated male goat kids

| | 5 kg | 10 kg | 15 kg | Equation | RMSE |
|------------------|------|-------|-------|-----------------------------------|-------|
| Ca (g/kg) | | | | | |
| Males | 1.74 | 2.07 | 2.27 | $\log Ca = 0.99 + 1.19 \log EBW$ | 0.071 |
| Females | 1.83 | 2.06 | 2.20 | $\log Ca = 1.31 + 0.83 \log EBW$ | 0.071 |
| Castrated | 1.74 | 2.08 | 2.29 | $\log Ca = 0.94 + 1.26 \log EBW$ | 0.071 |
| Mg (g/kg) | | | | | |
| Males | 0.28 | 0.64 | 0.86 | $\log Mg = -0.53 + 1.29 \log EBW$ | 0.057 |
| Females | 0.36 | 0.62 | 0.78 | $\log Mg = -0.24 + 0.95 \log EBW$ | 0.057 |
| Castrated | 0.27 | 0.65 | 0.87 | $\log Mg = -0.58 + 1.35 \log EBW$ | 0.057 |
| P (g/kg) | 1.64 | 1.95 | 2.15 | $\log P = 0.91 + 1.15 \log EBW$ | 0.051 |

Key Words: goats, growth requirements, major minerals

M390 Effect of chromium supplementation on ruminal parameters of Mahabadi goat kids. A. Emami, A. Zali, M. Ganjkanlou,* A. Hojabri, and A. Akbari, University of Tehran, Tehran, Iran.

The objective of this study was to evaluate the possible effects of supplementing chromium-methionine (Cr-Met) on different ruminal parameters in growing kids. Thirty-two male kids (BW = 22 ± 2 kg, 4mo) were used in a completely randomized design to one of 4 treatments: 1) control (without Cr), 2) 0.5, 3) 1.0 and 4) 1.5 mg Cr as Cr-Met/animal/d. Diets were formulated for NRC requirements with forage (alfalfa and corn silage):concentrate ratio of 30:70 in TMR form. Diets were the same, except for top-dress addition of Cr-Met fed in 2 equal meals (0800 and 1600 h). Animals were kept in individual pens with self-mangers for 90 d. Ruminal fluid samples were taken from the rumen at 3 h after the morning meal the last day of the experiment to determine rumen concentration of ammonia nitrogen (NH₃-N) and VFA. Rumen contents were sampled 5 times during the trial to measure ruminal protozoa and pH. Protozoa counts were determined using light microscopic numeration with a hemacytometer. Protozoa and pH data were analyzed by MIXED MODEL procedure and rumen NH₃-N and VFA with GLM MODEL procedure and adjusted Tukey-Kramer (SAS 9.1). Cr supplementation increased rumen pH ($P = 0.03$). Treatment failed to have statistically significant effects on rumen NH₃-N and VFA ($P > 0.05$), but there was a higher butyrate concentration in kids

receiving 1 mg Cr as Cr-Met/animal/d compared with other groups ($P = 0.009$). There was a negative relationship between Cr supplementation and protozoa count ($P = 0.0079$). These results indicate that supplementation of goat kid diets with chromium-methionine decreased protozoa, and increased pH and butyrate concentration without altering other VFAs.

Table 1. Characteristics of ruminal parameter in kid fed chromium-methionine

| Trait | Treatment, mg of Cr | | | | SEM |
|--------------------------------|---------------------|-------------------|-------------------|-------------------|------|
| | Control (0.0) | 0.5 | 1.0 | 1.5 | |
| pH | 6.23 ^b | 6.16 ^b | 6.45 ^a | 6.22 ^b | 0.07 |
| Total VFA, mmol/L | 48.3 | 39.7 | 48.1 | 60.0 | 6.25 |
| Acetate, mmol/L | 25.7 | 19.4 | 24.4 | 32.1 | 4.68 |
| Propionate+Isobutyrate, mmol/L | 15.0 | 14.4 | 12.5 | 15.3 | 2.81 |
| Butyrate, mmol/L | 5.77 ^b | 4.76 ^b | 8.77 ^a | 4.72 ^b | 0.76 |
| Valerate, mmol/L | 1.15 | 0.36 | 0.75 | 5.3 | 2.36 |
| Protozoa count (10^4) | 70.0 ^a | 67.0 ^a | 54.0 ^b | 65.2 ^a | 3.55 |

^{a,b}Means in each row with different superscripts were statistically different ($P > 0.05$).

Key Words: goat kids, chromium-methionine, ruminal VFA

M391 Effect of feeding tannin-containing pine bark on performance, parasite load and blood metabolites in goats. E. A. Wilson^{*1}, S. Solaiman¹, B. R. Min¹, N. Gurung¹, W. McElhenny¹, and J. Miller², ¹Tuskegee University, Tuskegee Institute, AL, ²Louisiana State University, Baton Rouge.

The objective of this study was to assess animal performance, parasite load and blood parameters of goats fed condensed tannin (CT)-containing pine bark (PB) diet. Pine bark is one of the abundant forest by-products in Southern US and contains 11–13% CT on a DM basis. Thirty-two Kiko-cross meat goats (*Capra hircus*; BW = 28.0 ± 1.0 kg) were randomly assigned to 2 experimental diets: 1) 0% PB and 30% wheat straw (WS) and 2) 30% PB and 0% WS. Grain mixes were fed at 85% with the remaining 15% provided as bermudagrass hay. Animals were strategically dewormed and one half of each diet group was inoculated with 5000 infective stage (L3) *Haemonchus contortus* larvae ($n = 8$). Feed intake, refusals, and performance were monitored for 87 d. Blood samples were taken twice, once at the beginning and once at the end of the experiment. Fecal egg counts (FEC) were determined approximately every 2 wk. At the end of the experimental period, goats were slaughtered and carcass characteristics were determined. Total stomach worms were identified and counted. Overall, there were no differences ($P > 0.10$) in DMI, animal performance and carcass characteristics among diet groups or inoculation groups, but ADG (76.8 vs. 97 g/d), G:F (0.05 vs. 0.07), HCW (14.2 vs. 15.8 kg), and cold carcass weight (13.3 vs. 14.8 kg) tended to increase ($P = 0.15$ to 0.18) with PB supplementation compared with WS diet within artificially inoculated groups, respectively. The LM area was lower ($P = 0.02$) for inoculated groups. Goats fed PB had greater ($P = 0.001$) blood urea nitrogen and lower serum triglyceride and cholesterol ($P = 0.03$). Mean red blood cells, hemoglobin, and hematocrit (packed cell volume) were greater ($P = 0.03$) for goats fed PB diets. Mean FEC, coccidia counts, and total worm counts were lower ($P < 0.05$) for goats that were fed PB diet. The results indicated that ground PB as a feed ingredient has the potential to decrease internal parasite infection, and worm burdens while

improving animal performance by altering feed efficiency, especially in parasitized goats.

Key Words: goats, internal parasites, pine bark

M392 Lamb performance feeding diets with different crude protein level. P. Meda Alducin, J. Maldonado Jaquez, I. Tovar Luna,^{*} and J. Jaimes Jaimes, *Universidad Autonoma Chapingo, URUZA, Bermejillo, Mexico.*

Thirty 6-mo old Dorset × Rambouillet lambs with 21.3 ± 4.48 kg BW were used to study the effect of CP level in the diet on feed intake, DM digestibility, ADG, feed efficiency, and water intake during a 50 d feeding period. Lambs were stratified by BW and randomly assigned to one of 3 levels of CP in the diet (12, 14 or 16% with 2.59 Mcal ME/kg DM). After the 50 d feeding period, digestibility of DM was determined with 5 lambs per treatment in metabolic cages. An economic balance was performed including only the feed cost of the total diet consumed. Data was analyzed as a completely randomized design of treatments using the GLM procedure of SAS. No significant differences were detected in DM intake among treatments neither during the pen feeding phase (3.8, 4.2, and 4.2%; 88, 98, and 96 g/kg metabolic BW, respectively), nor when fed in cages (3.1, 3.0, and 3.3%; 75, 76, and 82 g/kg metabolic BW, respectively). Water intake was not affected ($P > 0.05$) by CP level in both phases (pen: 3.21, 3.10, and 3.16 g water/g DM; metabolic cages: 3.22, 3.80, and 3.47 g water/g DM, respectively). Dry matter digestibility was similar among CP levels (74, 72, and 74%, respectively). Feed conversion (6.83, 6.67, and 5.33) and ADG (214, 291, and 276 g/anim/d) were not significantly different among CP levels. Results of this study indicated that even though lambs fed the diets with 14 and 16% CP had numerically higher ADG, there were no differences among CP levels for the variables studied. The economic balance showed that lambs fed the 14% CP diet had the greatest return.

Key Words: lambs, crude protein

M393 Effect of copper and zinc on nutrient digestibility and growth performance in goats. R. R. Rojo,^{*} A. Z. M. Salem, J. F. Vázquez, and B. Albarrán, *Centro Universitario UAEM Temascaltepec, Temascaltepec, Estado de México, México.*

Copper (Cu) and zinc (Zn) are elements that have specific health functions in animal production; they play an indispensable role in physiological processes. In this study, a growth assay was conducted to evaluate the addition of copper and zinc to a total mixed ration (TMR) for improving of nutrient digestibility and performance of goat. Sixteen Boer crossbred male goats were randomly assigned to the following treatments (mg/kg DM): Cu-Zn (860.7–224.1); Cu (860.7); Zn (224.1) and control (no added trace minerals). Data were analyzed as a completely randomized design. Cu and Zn improved ($P < 0.01$) DM, OM, CP and ADF digestibility. DMI (g/d) was not affected ($P = 0.216$) by the micro-minerals addition. Animals on Cu-Zn treatment presented the highest ($P < 0.01$) ADG (g/d), Cu and Zn, with intermediate values while the control group had the lowest response. Feed conversion ratio was greater ($P = 0.023$) in the diet where Cu-Zn were added. Ruminal pH was not affected by treatments ($P = 0.435$). Copper and Zinc addition improved the nutrient digestibility and performance of growing male goats.

Table 1. Nutrients digestibility (g/kg DM) and growth performance of male goats consumed a total mixed ration supplemented with copper and zinc

| Item | Cu + Zn | Cu | Zn | Control | SEM | P-value |
|---------------|--------------------|--------------------|--------------------|--------------------|-------|---------|
| Digestibility | | | | | | |
| DM | 702.9 ^a | 697.9 ^a | 705.6 ^a | 675.6 ^b | 5.89 | 0.001 |
| OM | 716.1 ^a | 714.8 ^a | 720.1 ^a | 692.6 ^b | 6.28 | 0.03 |
| CP | 670.8 ^a | 682.9 ^a | 685.1 ^a | 597 ^b | 10.39 | 0.01 |
| ADF | 374.7 ^a | 363.3 ^a | 387.3 ^a | 277.9 ^b | 9.09 | 0.01 |
| AVG (g/d) | 104.2 ^a | 81.7 ^b | 80.9 ^b | 57.5 ^c | 2.10 | 0.01 |
| FCR | 8.0 ^a | 11.2 ^{ab} | 10.5 ^{ab} | 13.6 ^b | 0.69 | 0.02 |
| | 6.1 | 6.3 | 6.1 | 6.2 | 0.21 | 0.43 |

^{a,b}Mean values within each row for micromineral addition with different letters differ ($P < 0.05$).

Key Words: copper, zinc, performance of male goats

M394 Growth and carcass characteristics of lambs fed high-concentrate diets containing increasing levels of crude glycerin. D. M. Polizel,* R. S. Gentil, E. M. Ferreira, M. O. Maia, C. P. Nolli, D. Eysink, A. V. Pires, and I. Susin, *Escola Superior de Agricultura Luiz de Queiroz (ESALQ)/University of São Paulo (USP), Piracicaba, São Paulo, Brazil.*

Crude glycerin is a co-product of biodiesel production with a high concentration of glycerol. Due to the high production of biodiesel, there is a wide availability of crude glycerin and it is becoming an interesting ingredient in animal nutrition. The objectives of this trial were to determine the effects of partial replacement of corn by crude glycerin on growth and carcass characteristics of lambs fed high-concentrate diets. Forty Santa Inês ram lambs (initial BW 24.1 ± 0.6 kg and 97 ± 2 d old) were used in a randomized complete block design according to initial BW and age. Lambs were penned individually during 56 d and fed an isonitrogenous (15% CP, DM basis) total mixed ration composed of 90% concentrate and 10% coastcross hay. Levels of crude glycerin (89.7% glycerol, DM basis) were 0, 5, 10, or 15% in experimental diets G0, G5, G10 and G15, respectively. There was a quadratic response for DMI, ($P < 0.04$) and ADG, ($P < 0.06$) with no effect on G:F. Dry matter intake was 1.03, 1.18, 1.12 and 1.09 kg/d while ADG was 250, 293, 294 and 272 g for G0, G5, G10 and G15, respectively. Carcass characteristics (dressing percentage, LM area, backfat thickness and body wall thickness) were unaffected by experimental diets. Dietary crude glycerin up to 10% increases DMI and ADG in feedlot lambs.

Key Words: co-product, glycerol, sheep

M395 Ruminal fermentation, kinetics and digestibility of hair lambs supplemented with cull pinto bean. F. Castillo, G. Villalobos,* D. Domínguez, J. A. Ortega, and L. Cortés, *Universidad Autónoma de Chihuahua, Chihuahua, Chihuahua, México.*

Cull pinto bean (*Phaseolus vulgaris*) is an ingredient used in ovine feeding in northern Mexico. The objective was to evaluate the effect of 3 levels of cull pinto bean (CPB) on feed intake, ruminal fermentation, kinetics, and nutrient digestibility of hair lambs. Six crossbred (Dorper × Pelibuey and Charolais × Pelibuey) rumen fistulated lambs averaging 56.6 ± 3.8 kg were used. Lambs were randomly assigned to 1 of 3 treatments. Treatments were (DM basis): 1) 0% of CPB of the supplement (CON); 2) 25% of CPB of the supplement (F25); and 40% of CPB of the supplement (F40). Dry matter intake, ruminal pH, ruminal NH₃ and VFA, methane production, Kp, MRT, DMD, CPD, and NDFD were evaluated. Data were analyzed with the MIXED procedure of SAS in a

Latin square design 3 × 3 repeated in line. Estimates used for Kp, and MRT were obtained by a non linear regression model (PROC NLIN, SAS). There was a difference in DMI (kg; $P \leq 0.05$) among treatments, F25 (1.62 ± 0.08) and F40 (1.62 ± 0.08) were lower probably due to anti-nutritional factors in CPB. Ruminal pH and NH₃ (mg/100 mL of ruminal fluid) were not different ($P \geq 0.05$) among treatments. Differences were found ($P \leq 0.03$) for ruminal VFA (mM) concentration (CON: 60.4 ± 2.1; F25: 68.4 ± 2.1; F40: 64.2 ± 2.1). Higher DMI of CON did not affect total VFA. The higher value in F40 could be due to its greater oligosaccharide content. Acetate: propionate ratio was greater ($P \leq 0.0001$) for F40 (CON: 2.34 ± 0.073; F25: 2.2 ± 0.07; F40: 2.9 ± 0.07). CH₄ production (mM/ml) was different ($P \leq 0.03$) among treatments (CON: 29.1 ± 0.75; F25: 27.6 ± 0.75; F40: 32.9 ± 0.75). Kp (%/h) (CON: 3.6 ± 1.9; F25: 2.9 ± 1.9; F40: 5.9 ± 1.9%) and MRT (h) (CON: 36.3 ± 13.7; F25: 57.7 ± 13.7; F40: 36.2 ± 13.7 h) were similar ($P \geq 0.42$) among treatments. Digestibility of DM, CP, and NDF was similar ($P \geq 0.26$) among treatments. Cull pinto bean reduced DMI, although it did not affect ruminal pH and NH₃ production. The inclusion of 25% of CPB in the diet of hair lambs allowed having an appropriate nutrient digestibility without affecting Kp and MRT, and this increased the molar proportion of VFA without increasing methane production maintaining acetate:propionate ratio.

Key Words: cull pinto bean, hair lamb, ruminal fermentation and kinetics

M396 Effect of clinoptilolite (zeolite) substituting for soybean meal on apparent digestibility and energy concentration of feed in growing Pelibuey sheep. A. Estrada-Angulo,* S. A. Serrano-Ceberos, V. Martinez-Cruz, J. Cazarez-Rocha, A. Rubio-Angulo, B. I. Castro-Perez, H. Davila-Ramos, J. C. Robles, and F. G. Ríos, *FMVZ-UAS, Culiacan, Sinaloa, Mexico.*

To determine the effect of clinoptilolite (zeolite) substituting for soybean meal on apparent digestibility and energy concentration of feed in growing Pelibuey sheep, 6 male Pelibuey sheep (BW = 25.0 ± 1.1kg) were used in a Cross Over design with the following diets: 1) 3 animals received control treatment (without zeolite) 18.0% CP and 3.68 Mcal DE/kg, and contained 10.0% sudan hay, 49.0% cracked corn grain, 14.0% soybean meal, 14% DDGS, 8.0% sugarcane molasses, 2.5% animal fat, and 2.5% mineral premix; 2) like control, 3 animals received diet with zeolite, had 17.2% CP and 3.60 Mcal of DE/kg, but contained 1.5% zeolite and 12.5% soybean meal. Dry matter intake was adjusted at 1000 g/day/head (500 g am and 500 g pm). Total collection of feces was used in 2 periods under crossover experimental design. Data were analyzed with ANOVA. The OM excreted in feces was greater ($P < 0.05$) in control treatments (86.4 vs. 83.1%) in comparison with zeolite treatment. The apparent digestibility of OM for control and zeolite treatments was similar ($P > 0.05$) with 85.5 and 84.0%, respectively. Ashes excreted in feces were greater ($P < 0.05$) in sheep with zeolite treatment in respect to control (16.9 vs. 13.6%, respectively). N excreted in feces was minor 12.7% in zeolite treatment. There was no difference in DE concentration of diet ($P > 0.05$) between treatments (3.5 vs. 3.4 Mcal/kg of DM) for control and zeolite treatment, respectively. The observed/expected DE ratio was similar for treatments (0.95 and 0.94 for control and zeolite treatments, respectively). It is concluded that clinoptilolite (zeolite) can substitute soybean meal at 1.5% of the diet increasing the apparent digestibility of OM and without effect on energy concentration in diets for growing Pelibuey sheep. Further, zeolite can diminish the N excreted in feces when it is included in diets for growing hair sheep.

Key Words: clinoptilolite, apparent digestibility, pelibuey sheep

M397 Influence of level of protein and energy on growth performance and tissue composition of feedlot hair lambs. F. G. Rios¹, H. Davila-Ramos*¹, A. Estrada-Angulo¹, A. Plascencia², J. J. Portillo¹, and J. C. Robles¹, ¹FMVZ-UAS, Culiacan, Sinaloa, Mexico, ²IICV-UABC, Mexicali, BC, Mexico.

Forty-eight Pelibuey × Katahdin (23.9 ± 2.84 kg) crossbred male lambs were used in a 84-d feeding trial (6 pens per treatment in a randomized complete block design) to evaluate the influence of protein and energy supplementation level on growth performance and tissue composition. Lambs were fed with cracked corn-based finishing diet. Treatments were HPHE: 18% CP/2.99 Mcal ME/kg DM; HPLE: 18% CP/2.79 Mcal ME/kg DM; LPHE: 15% CP/2.99 Mcal ME/kg DM, and LPLE: 15% PC/2.79 Mcal ME/kg DM. Final live weight (FLW), DMI, ADG, G:F, slaughter weight (SW), HCW, dressing percentage (DP), LM area, Fat thickness (FT), kidney-pelvic fat (KPF), primal performance and carcass tissue composition were determined. The values were analyzed by ANOVA for

a complete block design with 2 × 2 factorial arrangement; for carcass traits, slaughter live weight was used as a covariate. The means were compared using Tukey-Kramer test. FLW was greater ($P < 0.05$) in HPLE by the effect of protein level (49.8 vs. 48.0 kg), DMI was lower ($P < 0.05$) in HPHE and LPHE by the effect of energy level (1.15 vs. 1.27 kg); ADG (0.29 kg/d) and (G:F) (4.27) was not affected ($P > 0.05$) by treatments. SW was greater ($P < 0.04$) in HPHE (46.6 vs. 45.1) due to the protein level, KPF was higher ($P < 0.05$) for HPHE by the effect of energy level (1.03 vs. 0.79 kg). Carcass tissue composition was not modified by the effect of protein and energy level, nor by the factor's interaction. The results of this experiment suggested that 15% protein in the diet is sufficient to optimize the carcass traits of the finishing lambs with high energy diets, on the other hand providing higher levels of protein, does not improve carcass dressing percentage and carcass traits.

Key Words: protein level, hair lambs, carcass composition