

Ruminant Nutrition: Feeding, Ruminal Fermentation, and Efficiency of Production I

T40 Effects of restricted versus conventional dietary adaptation over periods of 6 and 9 days on rumen papillae of feedlot Nellore cattle. A. Perdigão^{1,3}, M. D. B. Arrigoni¹, D. D. Millen^{*2}, C. L. Martins¹, R. S. Barducci¹, M. T. Cesar¹, D. D. Estevam², T. V. B. Carrara², D. V. F. Vicari², and R. F. Pessin¹, ¹São Paulo State University (UNESP), Botucatu, São Paulo, Brazil, ²São Paulo State University (UNESP), Dracena, São Paulo, Brazil, ³Supported by FAPESP, São Paulo, São Paulo, Brazil.

This study was designed to determine effects of restricting DMI of the final finishing diet (REST) as a means of dietary adaptation compared with diets increasing in concentrate (STEP) over periods of 6-d and 9-d on morphological parameters of rumen papillae of feedlot cattle. The experiment was designed as a completely randomized block with a 2 × 2 factorial arrangement with repeated measures over time, replicated 6 times (5 bullocks/pen), in which 120 22-mo-old yearling Nellore bulls (352.03 ± 19.61 kg) were fed in 24 pens for 84-d according to the treatments: STEP for 6-d, STEP for 9-d, REST for 6-d, and REST for 9-d. The STEP program consisted of ad libitum feeding of two adaptation diets over periods of 6-d or 9-d with concentrate level increasing from 61% to 85% of diet DM. After adaptation one animal per pen (n = 24) was slaughtered for rumen papillae evaluations. The remaining 96 animals were harvested after 84-d on feeding. At harvest, rumenitis incidence (RUM) was determined, on the entire washed rumen, using a scale of 0 (no lesions noted) to 10 (severe ulcerative RUM). Likewise, a 1-cm² fragment of each rumen was collected from cranial sac. Manually, the number of papillae per cm² of rumen wall (NOP) was determined and 12 papillae were randomly collected from each fragment; scanned, and mean papillae area (MPA) was measured by software for image analysis. The rumen wall absorptive surface area (RASA) in cm² was calculated as follows: 1 + (NOP × MPA) – (NOP × 0.002). No significant ($P > 0.10$) main effects or interactions were observed for NOP and RASA. A significant ($P = 0.03$) interaction between protocol and days was observed, in which animals adapted for 9-d in STEP protocol and for 6-d in REST protocol had lesser RUM. Moreover, a significant ($P = 0.04$) interaction between days and harvesting dates was observed, in which animals adapted for 9-d at the end of adaption period had smaller MPA (0.35 cm²) than animals adapted for: (1) 9-d after finishing (0.48 cm²), (2) 6-d after adaptation (0.51 cm²), and (3) 6-d after finishing (0.52 cm²). For adaptation during 6-d and 9-d, a REST and STEP protocols, respectively, should be used.

Key Words: rumenitis, Zebu

T41 Effects of restricted versus conventional dietary adaptation over periods of 9 or 14 days on total tract digestibility of NDF and TDN of feedlot Nellore cattle. D. H. M. Watanabe², A. L. N. Rigueiro², R. S. Barducci¹, C. L. Martins¹, M. D. B. Arrigoni¹, M. C. S. Pereira², J. Silva², T. V. B. Carrara¹, F. Perna Junior³, M. C. S. Franzói¹, and D. D. Millen^{*2}, ¹São Paulo State University (UNESP), Botucatu, São Paulo, Brazil, ²São Paulo State University (UNESP), Dracena, São Paulo, Brazil, ³University of São Paulo (USP), Pirassununga, São Paulo, Brazil.

This study, conducted at the São Paulo State University feedlot, Botucatu Campus, Brazil, had the objective to evaluate step up (STEP) and restriction (REST) protocols to high concentrate diets over periods of 9 or 14 days on total tract digestibility of NDF and TDN of Nellore

cattle finished in feedlot. The experiment was designed as a completely randomized block with 2 × 2 factorial arrangement, replicated 6 times (5 bullocks/pen), in which 120 22-mo-old yearling Nellore bulls (361.3±30.2 kg) were fed in 24 pens for 84 days according to the treatments: STEP for 9 days and 14 days, REST for 9 days and 14 days. Measures over time were taken on days 5, 10, 15, and 20 of experimental period. The STEP program consisted of ad libitum feeding of 3 adaptation diets over periods of 9 or 14 days with concentrate level increasing from 55% to 85% of diet DM. The REST program consisted of restricted intake of the final diet (85% concentrate) with programmed increases in feed offered until yearling bulls reached ad libitum access over periods of 9 or 14 days. Fecal samples were collected just before morning (0800) and afternoon (1500) meals, and a composite sample per pen in each day was made. For the NDF and TDN digestibility, it was observed ($P < 0.05$) interaction between protocols, length of protocols and days. Yearling bulls adapted for 14 days had greater NDF digestibility on the first day of the finishing period (day 15: STEP in 14 days = 70.44%, REST in 14 days = 61.54%) than those adapted for 9 days (day 10: STEP in 9 days = 58.28%, REST in 9 days = 35.04%); however no differences ($P > 0.10$) between treatments were observed on day 15. Likewise, yearling bulls adapted for 14 days had greater TDN digestibility on the first day of the finishing period (day 15: STEP in 14 days = 78.81%, REST in 14 days = 81.38%) than those adapted for 9 days (day 10: STEP in 9 days = 69.66%, REST in 9 days = 72.33%); however, no differences ($P > 0.10$) between treatments were observed on day 15. Thus, according to the present data, yearling Nellore bulls should be adapted in 14 days, regardless of the protocol.

Key Words: adaptation, NDF, TDN

T42 Potential proteolytic bacteria adherent to soybean meal in the rumen revealed by PCR-DGGE. D. Jin², J. Q. Wang^{*1,2}, D. P. Bu², and S. G. Zhao², ¹Agronomy College of Heilongjiang August First Land Reclamation University, Da qing, Heilongjiang, China, ²Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China.

Rumen bacteria metabolize dietary protein to provide enough N for animal health and production. Soybean meal is widely used as protein source in ruminant feeds and protein degradation by the adherent bacteria is the first essential step for rumen N metabolism. In order to get the information of bacteria involved in protein degradation, denaturing gradient gel electrophoresis (DGGE) was used to reveal the potential proteolytic bacteria adherent to soybean meal in the rumen of Holstein dairy cows. Three healthy Chinese Holstein dairy cows fitted with rumen cannula and similar body weight were selected (n = 3). Soybean meals were placed into nylon bags and then incubated in the rumen for 0, 12, 24, 48 h. Rumen degradability of DM was estimated, and N concentration was determined by Kjeldahl N apparatus. Bacteria adherent to soybean meal were eluted with phosphate buffer saline. Patterns of bacterial composition were compared by DGGE profiling and some special bands from different incubation time were selected and sequenced. Results showed that DM was degraded at 55.5, 70.1, and 96.3%, whereas CP was degraded at 36.9, 58.4, and 95.7%, respectively, after incubation for 12, 24, and 48 h. The DGGE profiles showed the number and intensity of bands from varying samples were different, and the dendrogram of the PCR-DGGE fingerprint showed that they were

assigned to different clusters by different incubation time. The amounts and types of special strains increased significantly after incubating for 12 h and these may be closely related to protein degradation. Shannon-Wiener index of different time differed ($P < 0.01$). Sequencing results derived from 16S rDNA analysis for the DGGE bands showed that most of them belonged to *Prevotella* sp. and uncultured bacteria. The results showed that more proteolytic bacteria were from uncultured bacteria. In future, metagenomic analysis should be applied to these uncultured bacteria for key proteolytic enzyme exploration.

Key Words: PCR-DGGE, rumen bacteria, soybean meal

T43 Effect of changing ratios of corn silage and alfalfa on ruminal fiber digestion in high producing lactating cows. F. Lopes*, D. E. Cook, and D. K. Combs, *Department of Dairy Science, University of Wisconsin, Madison.*

The aim of this study was to compare ruminal fiber digestion and passage of alfalfa and corn silage in lactating cows. Alfalfa silage and corn silage with similar NDF content (33.2%) and in vitro 48-h NDF digestibilities of 44.2 and 38.4% respectively, were used. Eight rumen-cannulated dairy cows (110 ± 5 d in milk) were utilized in a 4×4 Latin square design with 21 d period to test 4 rations of corn silage:alfalfa silage; 100:0 (A), 66:33 (B), 0:100 (C) or 33:66 (D). Total mixed rations contained approximately 55% of DMI as forage, with 28.8, 29.1, 32.9 and 29.7% of NDF for ration A, B, C and D, respectively. Intake and milk production were measured during d 14 to 21. Ruminal contents were evacuated manually 4h after and 2 h before feeding on d 20 and 21 to evaluate rumen nutrient pool sizes and turnover. Ruminal contents were analyzed for OM, NDF and iNDF content. Data were analyzed with MIXED-SAS with fixed effect of square, diet, period, and cow within square was the random effect. Milk production was 39.2, 37.6, 36.9 and 37.7 kg/d for A, B, C, and D, respectively, with significantly ($P < 0.05$) higher yield for ration A. Dry matter and NDF intake were lower ($P < 0.05$) for diet D than other treatments. Indigestible NDF intake was greater for diets C and D than diets A and B (Table 1). Ruminal digesta volume did not differ by treatment; but ruminal mass was greater for diets with more corn silage compared to alfalfa silage. Rumen pools and turnover of NDF and iNDF were affected by different rations of corn:alfalfa silage. Fiber turnover rates increased as more alfalfa was included in the diets.

Table 1.

Item	CS:ALF				SEM
	A (100:0)	B (66:33)	C (0:100)	D (33:66)	
DMI, kg/d	28.62 ^a	28.39 ^a	25.24 ^b	28.39 ^a	1.13
NDF, kg/d	8.11 ^{ab}	7.82 ^{ab}	7.33 ^b	8.50 ^a	0.37
Indigestible NDF intake, kg/d	2.09 ^b	2.26 ^b	2.49 ^a	2.47 ^a	0.10
Digesta mass, kg	80.56 ^a	80.55 ^a	74.17 ^b	76.75 ^{ab}	2.51
Ruminal pool, kg					
DM	11.07 ^a	11.39 ^a	10.00 ^b	10.29 ^{ab}	0.45
NDF	5.87 ^a	5.72 ^a	4.75 ^b	5.38 ^{ab}	0.25
iNDF	3.20	3.30	3.18	3.26	0.19
Ruminal turnover rate, %/h					
DM	11.11 ^{ab}	9.25 ^b	10.85 ^{ab}	12.67 ^a	0.73
NDF	5.81 ^{ab}	5.24 ^b	6.69 ^a	7.08 ^a	0.38
iNDF	3.17 ^{ab}	2.69 ^b	2.97 ^{ab}	3.46 ^a	0.27

^{ab} $P < 0.05$.

Key Words: corn silage, fiber digestion, turnover

T44 Dry matter intake and nutrient intake of crossbred cattle $\frac{3}{4}$ Zebu x $\frac{1}{4}$ Holstein fed different levels of calcium and phosphorus in the diet. L. F. Prados*, S. C. Valadares Filho, S. A. Santos, D. Zanetti, A. N. Nunes, L. D. S. Mariz, F. C. Rodrigues, P. M. Amaral, A. S. F. Veiga, E. Detmann, and F. A. S. Silva, *Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil.*

This study aimed to evaluate the intake of dry matter and nutrient intake of crossbred bulls. A total of 36 $\frac{3}{4}$ Zebu \times $\frac{1}{4}$ Holstein crossbred bulls with an initial weight of 214 ± 4 kg and a mean age of 11 ± 0.2 mo were used in the study. The animals were fed ad libitum and distributed in a completely randomized design with a 3×3 factorial arrangement for treatments, with 3 levels of calcium and phosphorus and 3 periods of feedlot (56, 112 or 168 d). The 3 levels of calcium and phosphorus were: low = 0.18 and 0.22%, medium = 0.30 and 0.24%, normal = 0.42 and 0.26%, respectively for calcium and phosphorus on a dry matter basis. The diets were isonitrogenous (12.6%) and consisted of corn silage and concentrate (60:40). The amount of feed supply was recorded daily, and samples were collected from corn silage and orts of each animal. Samples of feed and orts were measured for dry matter (DM), mineral matter (MM), crude protein (CP), neutral detergent fiber (NDF), ether extract (EE), calcium (Ca) and phosphorus (P). Intake of DM was not affected ($P > 0.05$) by the level of Ca and P in the diet. Intake of DM, CP, EE, organic matter (OM) and non-fiber carbohydrates, when expressed as kg/d, were higher ($P < 0.05$) for animals in feedlot for longer periods. Intake of DM as a function of body weight (BW) decreased ($P < 0.05$) in animals confined for longer periods. This decrease in the ratio of intake of DM to BW can be explained by the reduction in maintenance requirements because of a decrease in organ tissue as a proportion of overall BW. Differences were observed ($P < 0.05$) in Ca intake with increasing levels of Ca in the diet and for different feedlot periods. There were no significant differences in P intake ($P > 0.05$) by the level of Ca and P in the diet. We observed higher intake of Ca and P ($P < 0.05$) for animals in feedlot for longer periods this can be explained by a higher intake of DM of these animals. It was concluded that reductions in the levels of Ca and P in cattle diets did not change DMI and nutrient intake of animals, and the periods of feedlot influenced DMI.

Key Words: calcium, nutrient intake, phosphorus

T45 Relationship of residual feed intake with heart rate and heat production in Nellore steers. A. S. Chaves*¹, M. L. Nascimento¹, R. R. Tullio², M. M. Alencar², A. N. Rosa³, and D. P. D. Lanna¹, ¹University of Sao Paulo/ESALQ, Piracicaba, SP, Brazil, ²Embrapa Cattle Southeast, Sao Carlos, SP, Brazil, ³Embrapa Beef Cattle, Campo Grande, MS, Brazil.

The objective of this work was to examine the relationship between RFI, heart rate (HR) and heat production (HP) of Nellore steers. The animals ($n = 39$) were individually fed twice daily with 5% of orts, for 84 days. BW was measured at 14-d intervals. HR was recorded during a 4 day period with measurements at 60 seconds intervals. HR and O_2 consumption (VO_2) were collected at the same time during 15 minutes using a face mask open-circuit respiratory system (Exhalyzer). These measurements were used to calibrate the volume of O_2 per heart beat. O_2 Pulse (O_2P) was calculated as the VO_2 per beat. Daily HP (kcal/kg^{0.75}) was calculated multiplying O_2P by the average HR obtained during the 4 days, assuming 4.89 kcal/L de O_2 . Daily gain (DG) was estimated by slope of the individual regression between BW and days on feed. RFI was obtained using mixed models in which metabolic BW and DG were included to predict the feed

intake. The animals were classified as low, medium and high RFI (mean \pm 0.5 SD), and then high and low RFI classes were compared using Proc GLIMMIX (SAS). During oxygen calibration, HR was similar to the daily average measurement when the animals were in the stalls, 101 ± 6.2 and 102 ± 2.7 bpm, respectively. This suggests animals were not stressed and O_2P values probably are not biased. Furthermore, HR was 19.4% lower ($P = 0.019$), and the average daily HR tended to be lower for efficient animals ($P = 0.092$). O_2P did not differ between classes ($P > 0.05$), but there was a trend ($P = 0.0956$) toward higher VO_2 in efficient animals. These results suggest that efficient animals, have a slower heartbeat, and maybe able to pump a greater amount of oxygen per heart beat. No significant relationships were observed between RFI and HP in efficient and inefficient animals ($P > 0.05$).

Key Words: energy expenditure, feed efficiency

T46 Does the processing method affect cell wall and dry matter degradability of wheat grain. H. Karkhaneh*, K. Rezayazdi, M. Dehghan-Banadaki, and A. Zali, *University of Tehran, Tehran, Iran.*

Four Holstein cattle with rumen fistula were used according to a Latin square design with 4 treatments and 4 periods of 21 days and 4 cows. Treatments include ground wheat (control), dry rolled wheat, steam flaked wheat and wheat processed with formaldehyde 0/4 percent. Cell wall and dry matter degradability of processed wheat were measured at 2, 4, 8, 12, 24 and 48 hours according to the method of Vanzant et al. (1998). Effective degradability of dry matter of different treatments in passage rate $r = 0.05$, respectively, 87/62, 87/95, 76/50 and 80/62 percent were significantly different ($P < 0.05$). Also effective degradability of cell walls of wheat grain processed with different methods in passage rate $r = 0.05$, respectively, 64/30, 68/25, 52/85 and 53/97% of which were also significant differences between them. So it can be concluded that treating with formaldehyde and steam rolling can cause a significant reduction in dry matter and cell wall degradability of wheat.

Key Words: processed wheat grain, dry matter degradability, cell wall degradability

T47 The effect of three different dietary starch concentration on some reproductive parameters in lactating dairy cows. G. Y. Mecitoglu¹, E. Karakaya¹, I. Cetin², C. Kara², A. Orman³, H. Gencoglu^{*2}, A. Keskin¹, A. Gumen¹, and I. Turkmen², ¹*Department of Obstetrics and Gynecology, Faculty of Veterinary Medicine University of Uludag, Bursa, Turkey,* ²*Department of Animal Nutrition and Nutritional Diseases, Faculty of Veterinary Medicine, University of Uludag, Bursa, Turkey,* ³*Department of Zootecnics, Faculty of Veterinary Medicine University of Uludag, Bursa, Turkey.*

The aim of this study was to determine the effect of three different dietary starch concentrations on first postpartum (PP) and following induced estrous ovulation times, follicular and luteal size in dairy cows. Primiparous dairy cows ($n = 22$) were randomly assigned to 1 of the 3 treatment groups at PP 6 d. Cows were fed with low (LS, 16.2% starch, $n = 8$), medium (MS, 19.8% starch, $n = 6$) or high-starch (HS, 24.1% starch, $n = 8$) diets as TMR (DM basis). To determine the time of PP first ovulation, all cows were scanned three times a week until PP 50 d. In order to detect ovulation time after estrus, cows were synchronized. Cows received GnRH and intravaginal progesterone device (CIDR) at PP 60 d and 7 d later CIDR was removed and $PGF_{2\alpha}$ was administered. Cows were scanned 8 h apart as from 48 h after $PGF_{2\alpha}$ administration to determination of ovulation. Furthermore, cows were also scanned 7 d after ovulation to detect luteal size. Data were analyzed according mixed models procedure. Times of

PP first ovulations were did not differ among the groups (19.9 ± 5.04 d in LS, 26.3 ± 5.81 d MS and 24.3 ± 4.84 d HS). The size of ovulatory follicle before PP first ovulation was lower ($P = 0.05$) in LS (13.31 ± 1.10) than in HS (14.83 ± 0.51) but did not differ from MS group (14.62 ± 1.91). In addition ovulation time after induced estrous tended to be shorter ($P = 0.09$) in MS group (75.33 ± 13.68 h) than in HS (100.33 ± 4.88 h) and LS (100.17 ± 12.96 h) groups. Ovulatory follicle size tended to be lower ($P = 0.08$) in LS (14.70 ± 0.62 mm) than MS (16.67 ± 1.20 mm) and HS (16.25 ± 0.42 mm). Luteal size measured 7 d after ovulation was lower ($P = 0.04$) in LS group (21.92 ± 1.12 mm) than MS (27.67 ± 1.88 mm) and HS (26.33 ± 1.34 mm) groups. Thus, although the ovulation times in both first PP and following induced estrous did not differ among the groups, follicular size in synchronized estrous and luteal size were lower in LS than MS and HS groups.

Key Words: cow, reproductive parameter, starch

T48 Use of simple static models to estimate in vitro methane production. A. Woldeghebriel*, A. Duncan, and M. Worku, *North Carolina A&T State University, Greensboro.*

A two-stage static model developed for ruminant animals was used to determine the amount of carbon dioxide (CO_2) and methane (CH_4) produced in the study. Concentration of CO_2 calculated in the first-stage was then used to determine concentration of CH_4 in the second-phase. Molar concentration of the three VFAs (acetate, propionate and butyrate) used in the model was determined by GC. Feed grab samples from a TMR was oven-dried, coarsely pulverized in a regular kitchen blender for one minute, and separated into three particle-sizes (PS; 0.85, 1.00 and 1.40 mm). The experimental design was a 3×4 factorial (3 PS and 4 feed additives at 1:4 feed ratios). The treatments used were: (1) feed only, as control (CON); (2) CON+ nitrate; (3) CON + fumarate; (4) CON + a 50/50 nitrate-fumarate mix. A 4-g sample from each particle-size for each treatment was weighed in triplicates and transferred into a pre-labeled 500 ml flask. Each flask received 400 mL of rumen fluid-buffer mixture according to the Tilley and Terry procedures and CH_4 gas in the over-head space of each flask was directly measured using the G2301Picarro Gas Analyzer (Picarro, CA). While the VFA data obtained from the study was used in the model to estimate CO_2 and CH_4 production, the direct measurements of CH_4 by the Picarro Gas Analyzer were used for comparison using the t-test statistics at 5% probability. Results obtained show that the model underestimated ($P < 0.05$) the amount of CH_4 produced for all PS and feed additive by as much as 15%. However, CH_4 gas concentration data obtained from the model seem to closely follow the same patterns as the direct measurements of the gas by the Picarro Gas Analyzer. It seems therefore the model can appropriately be used to estimate production of methane using VFA data.

Key Words: methane, nitrate, model

T49 Development of equations to estimate microbial contamination in ruminal incubation residues of tropical forage using ^{15}N as a marker. P. A. S. Machado, S. A. Santos, S. C. V. Filho, E. Detmann, L. F. Prados, P. M. Amaral*, L. F. C. Silva, A. C. B. Menezes, F. A. C. Villadiego, and P. P. Rotta, *Universidade Federal de Vicosa, Vicosa, MG, Brazil.*

The objective was to use ^{15}N to label microbial cells to allow development of equations for estimating the contamination in ruminal incubation residues of tropical forage. A total of 24 forages were divided into 3 groups, and each group was incubated in a different steer per period, in a 3×3 Latin square design. Ruminal bacteria were labeled with ^{15}N by continuous infusion 60 h before the first incubation and continued until

the end of incubation period. The digesta was collected for the isolation of bacteria before the first infusion of ^{15}N and after the infusion of ^{15}N . Three collections were made on each day, being the first before feeding and two at an interval of 4 h. To determine the contaminated fractions of CP degradation, the restricted model was compared with the full model using the model identity test. Values of the corrected fraction "A" (ACPC) were estimated from its values without correction (ACPWC) by the equation: $\text{ACPC} = 1.99286 + 0.98256 \times \text{ACPWC}$. The corrected fraction "B" was estimated from its value without correction (WC) and from CP, NDF, neutral detergent insoluble protein (NDIP), and indigestible NDF (iNDF) using the equation $\text{BCPC} = -17.2181 - 0.0344 \times \text{BCPWC} + 0.65433 \times \text{CP} + 1.03787 \times \text{NDF} + 2.66010 \times \text{NDIP} - 0.85979 \times \text{iNDF}$, where BCPC = the potentially degradable B fraction of CP corrected for microbial contamination and BCPWC = the fraction WC. The corrected "kd" (kdCPC) was estimated using the equation $\text{kdCPC} = 0.04667 + 0.35139 \times \text{kdCPWC} + 0.0020 \times \text{CP} - 0.00055839 \times \text{NDF} - 0.00336 \times \text{NDIP} + 0.00075089 \times \text{iNDF}$, where kdCPWC = the rate of degradation without correction. The equation obtained to estimate the contamination (C) using CP of the feeds was: $\%C = 79.21 \times (1 - e^{-0.0555 \times t}) \times e^{-0.0874 \times \text{CP}}$, where: t = incubation time. It was concluded that A and B fractions and kd of CP would be biased by microbial CP contamination, thus these corrected values could replace the use of microbial markers. The contamination and the corrected apparent degradability of CP could be obtained from values of CP and time of incubation for each feed, which could reduce cost involved when using ^{15}N .

Key Words: degradability, protein fraction

T50 Influence of offering hay free-choice concurrently with total mixed ration on residual feed intake rank differences of beef bulls.

E. El-Haroun^{1,3}, M. Abo-Ismaïl^{*3}, H. Salim², G. Vander Voort³, M. McMorris¹, and S. Miller³, ¹Beef Improvement Opportunities, Guelph, Ontario, Canada, ²Department of Animal and Poultry Science, Cairo University, Giza, Egypt, ³Centre for Genetic Improvement of Livestock, Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario, Canada.

Individual feed intake data has been collected on growing bulls on a moderate energy pelleted diet, while the bulls had free access to chopped hay as a roughage source, where the hay was not recorded. The objectives of this study were to offer bulls hay free choice in addition to a moderate energy total mixed ration (TMR) and determine if measurement of the hay influenced the bulls ranking for residual feed intake (RFI). The study collected feed intake and BW data from 102 crossbred bulls on a post-weaning growth test over a 2-yr period where individual feed intake was measured using the Insentec Roughage Intake Control (RIC) system. The RFI was calculated using different models, which included ADG, mid-metabolic BW, marbling and backfat. The principal RFI determination in this study RFI_{Koch} was calculated as the residuals from the regression of total DMI ($\text{DMI}_{\text{hay}} + \text{DMI}_{\text{TMR}}$) on BW and ADG. The RFI_{hay} and RFI_{TMR} were calculated as the residual from the regression of DMI_{hay} and DMI_{TMR} , respectively on BW and ADG. The RFI_{Koch} had the lowest coefficient of determination (R^2 ; 0.75), and highest, less desirable, Bayesian information criterion (BIC; 286.4). The RFI_{TMR} had the highest R^2 (0.87) and the best BIC (230.1) among the other models, while, RFI_{hay} had a moderate R^2 (0.77) and BIC (283.6). The RFI including carcass traits had the same R^2 (0.76) and BIC (285.6 and 283.6) for marbling and backfat, respectively. The rank correlations among the RFI calculated from different models were obtained. The RFI_{Koch} was highly correlated with RFI_{hay} 0.97%, indicating that the 2 RFI were similar and the relative re-rankings of the bulls were similar regardless of the model used. The rank correlation between RFI_{Koch} and RFI_{TMR} was 74%, thus, the 2 RFI were somewhat

different and bulls ranked differently when hay intake was accounted for RFI_{Koch} , compared to when hay intake was not included RFI_{TMR} . These results suggest that when measuring feed intake in young growing bulls, it is important to measure all sources of energy consumption, including hay that has been overlooked in previous studies and test designs.

Key Words: beef, reranking, residual feed intake

T51 Model for estimating enteric methane emissions from black goat. Y. Na*, W. Jeong, O. Yi, S. Hwang, and S Lee, Department of Animal Science and Technology, Konkuk University, Seoul, Republic of Korea.

The objective was to develop mathematical models for estimating enteric CH_4 emissions from black goats. Methane production and digestibility of diets were measured using respiration-metabolism chamber with different feeding conditions: different concentrate to roughage ratio (40:60, 50:50, and 60:40), oil sources (soybean oil, coconut oil and palm oil) and roughage sources (timothy, rice straw, corn silage, alfalfa pellet and tall fescue). One hundred and thirty-five observations from these experiments were used for the estimation of model parameters. Dry matter intake, OM intake (OMI), CP intake (CPI), NDF intake (NDFI), digested DMI (DDMI), digested OMI (DOMI), digested CPI (DCPI) and digested NDF intake (DNDFI) were considered for the development of models. Cook's distance tests were performed to identify outliers and SAS PROC REG was used for the calculation of single and multiple simple linear regressions. Root mean square prediction error (RMSPE) and R^2 were used as a measure of prediction accuracy. For the simple linear regression, an equation using OMI as an independent variable most accurately predicted CH_4 emission: $\text{CH}_4, \text{L/d} = 0.1092 + 0.0414 \times \text{OMI}, \text{g/d}$ (RMSPE = 5.49, $R^2 = 0.44$) among equations using nutritional intake as an independent variable. An equation using DOMI as an independent variable was the most accurate: $\text{CH}_4, \text{L/d} = 4.5051 + 0.0410 \times \text{DOMI}, \text{g/d}$ (RMSPE = 5.11, $R^2 = 0.52$) among equations using digested nutritional intake as an independent variable. For the multiple linear regression, an equation using nutritional intake as independent variables $\text{CH}_4, \text{L/d} = 1.1605 + 0.0078 \times \text{DMI}, \text{g/d} + 0.0250 \times \text{OMI}, \text{g/d} + 0.0167 \times \text{CPI}, \text{g/d} + 0.0037 \times \text{NDFI}, \text{g/d}$ resulted in the lowest RMSPE value (5.55) and the highest R^2 value (0.45). And an equation using digested nutritional intake as independent variables, $\text{CH}_4, \text{L/d} = 9.2184 - 0.0081 \times \text{DDMI}, \text{g/d} + 0.0133 \times \text{DOMI}, \text{g/d} + 0.0057 \times \text{DCPI}, \text{g/d} + 0.0227 \times \text{DNDFI}, \text{g/d}$ resulted in the lowest RMSPE value (5.01) and the highest R^2 value (0.55). Therefore, digested nutritional intake (DDMI, DOMI, DCPI, and DNDFI) is better independent variables than nutritional intake (DMI, OMI, CPI, and OMI) for the prediction of CH_4 emissions.

Key Words: black goat, methane, modeling

T52 Effects of forage sources on the gene expression related to milk protein synthesis in the mammary gland of lactating Holstein cows. X. Zhang¹, C. Ao^{*1}, M. Gao², E. Khas¹, H. Zhang¹, L. Song¹, and R. Du², ¹Inner Mongolia Agricultural University, Hohhot, Inner Mongolia, China, ²Inner Mongolia Academy of Agricultural & Animal Husbandry Sciences, Hohhot, Inner Mongolia, China.

The objective of this study was to determine the effects of forage sources on gene expression related to milk protein synthesis in the mammary gland of lactating cows. Twenty multiparous Holstein cows (BW = 566 ± 19.6 kg, DIM = 95 ± 24 d) were assigned to a single factor block design with 30 d period. Cows were fed diets with different forage. Diets (on DM base) were: (1) corn straw (35%) and 65% of concentrate (CS; CP: 17.14%, NDF: 41.58% and NEL: 1.58 Mcal/kg); (2) hay (4%), corn silage (27%) and alfalfa (23%) with additional 46% of concentrate (MF; CP: 17.45%, NDF:

38.33% and NEL: 1.6 Mcal/kg). Nutrient level in the two diets were similar. Mammary gland tissue (500 mg/animal) biopsies were randomly performed for half numbers of cows in each group after milking on the last day of experiment. Statistical analysis was performed using the PROC MIXED procedure of SAS 9.0. We hypothesized that forage sources will affect gene expressions in three aspects: (1) milk protein synthesis (CSN1S1 CSN3); (2) hormone receptors in the cytomembrane of mammary epithelial cells (PRLR GHR1A); and (3) the cell signal regulators involved in milk protein synthesis (mTOR JAK2 STAT5). Results showed that the level of CSN1S1 CSN3 PRLR GHR1A and mTOR mRNA were significantly increased ($P < 0.05$) by the MF treatment, but the mRNA expression of JAK2 and STAT5 were not significantly affected by treatment ($P > 0.05$). In conclusion, forage quality affects the efficiency of milk protein synthesis in lactating Holstein cows. High quality forage can promote PRLR GHR1A and mTOR genes expression, resulting in increased milk protein synthesis.

Key Words: mammary gland, protein synthesis, gene expression

T53 Relationship of flight speed, rectal temperature and infrared thermography of eye with feed efficiency of Nellore beef cattle. A. M. Mobiglia¹, F. R. Camilo¹, V. R. M. Couto¹, E. G. Moraes², H. F. Oliveira¹, L. F. N. Souza², J. T. Neves Neto¹, T. S. Almeida¹, J. C. Pimenta¹, and J. J. R. Fernandes^{*1,2}, ¹Escola de Veterinária e Zootecnia da UFG, Goiânia, Goiás, Brazil, ²Nelore Qualitas, Goiânia, Goiás, Brazil.

The objective of this study was to correlate flight speed (FS), rectal temperature (RT) and eye temperature (ET), measured by infrared thermography, with residual feed intake (RFI), feed efficiency (FE), and feed conversion (FC) of Nellore beef cattle. The bulls ($n = 120$, 393.04 ± 47.3 kg of BW), with an average of 20 mo of age, were housed outdoors in individual pens and weighted at beginning and end of trial. All the animals were fed sorghum silage (27%), sugarcane bagasse (10%) and concentrate (63%). Animals were classified as follows: high RFI (SD > 0.42 - less efficient; $n = 32$), medium RFI (SD ± 0.42 ; $n = 52$), and low RFI (SD < 0.42 - more efficient; $n = 36$). We evaluated eye temperature using an infrared portable camera (FLIR I7 of Flir Systems Inc.). In all photographs, we considered a specific shape (circle) in order to keep a constant sub-area (eye surface), and the average was computed. We measured RT and ET simultaneously with a digital thermometer. We measured FS by infrared sensors placed in exit of the crush. The data were analyzed by Pearson using statistical software R (2010). Mean ET and RT were $35.63 \pm 1.60^\circ\text{C}$ and $38.39 \pm 0.61^\circ\text{C}$, respectively, ranging between 39.30°C and 31.50°C for ET, and 40.30°C and 37.20°C for RT. In addition, the values of FS were 2.78 ± 1.53 m/s (BFS, beginning of feedlot), 1.75 ± 0.6 m/s (EFS, end of feedlot) and -1.02 ± 1.68 m/s (DFS, difference between BFS and EFS). The data of correlation are showed in Table 1 ($*P < 0.05$). Therefore, the RT, ET, and FS did not correlate with feed efficiency. However, the ET showed medium correlation with RT of Nellore beef cattle.

Table 1. Correlation among variables.

	RFI	FE	FC	BFS	EFS	DFS	RT	ET
RFI	—							
FE	-0.38*	—						
FC	0.36*	-0.88*	—					
BFS	-0.11	-0.13	0.06	—				
EFS	0.04	0.11	-0.09	-0.52	—			
DFS	0.12	0.16	-0.09	-0.93*	0.41*	—		
RT	0.06	-0.09	0.11	0.15	0.18*	-0.07	—	
ET	0.01	0.04	-0.04	0.17	0.08	-0.12	0.53*	—

Key Words: efficiency, feedlot, temperature

T54 Bone morphometry and densitometry of goats of different genders subjected to feed restriction. N. C. D. Silva^{*1}, K. T. Resende¹, M. H. M. R. Fernandes¹, H. C. Bonfá², D. C. Soares¹, R. F. Leite¹, F. O. M. Figueiredo¹, M. M. Freire³, B. R. S. M. Oliveira⁴, and I. A. M. A. Teixeira¹, ¹Unesp Univ Estadual Paulista, Jaboticabal, São Paulo, Brazil, ²Universidade Federal de Viçosa, Viçosa, Minas Gerais, Brazil, ³Universidade Federal de Alagoas, Maceió, Alagoas, Brazil, ⁴Unesp Univ Estadual Paulista, Araçatuba, São Paulo, Brazil.

The objective of this study was to evaluate the effect of gender and feed restriction on bone morphometry and bone mineral densitometry (BMD) of 54 Saanen goat kids (18 intact males, 18 castrated males and 18 females) with initial BW of 15 kg. The animals of the same gender were randomly distributed into 6 groups (blocks) of 3 animals subjected to different levels of feed restriction (ad libitum or 0%, 25% and 50% of feed restriction). Then in total there were 18 blocks. A whole group was slaughtered when the kid subjected to 0% of feed restriction reached 30 kg BW. After slaughter and evisceration, the carcasses were weighed and femur of the right leg of each animal was removed for subsequent analyses. Morphometric evaluations were accomplished by measuring femur weight, total length (TL), perimeter proximal epiphysis (PEP) and distal (PED), perimeter of diaphysis (PD), breadth of diaphysis-laterolateral position (LDLL) and craniocaudal position (LDCC). The evaluation of BMD was performed by image generated by X-rays of femur using Lunar DPX equipment. Data were analyzed as a randomized complete block design with a 3×3 factorial arrangement, using mixed model of SAS. Gender did not affect TL, PD, LDLL and LDCC, but, femur weight, PEP and PED were lower ($P < 0.05$) in females (100.9 ± 2.6 g, 11.8 ± 0.1 cm and 15.2 ± 0.2 cm, respectively) than intact males (109.4 ± 4.0 g, 11.5 ± 0.1 cm and 15.9 ± 0.2 cm, respectively) and castrated males (116.7 ± 2.3 g, 12.4 ± 0.1 cm and 16.1 ± 0.2 cm, respectively). Regarding feed restriction level, animals subjected to 50% feed restriction showed lower values ($P < 0.05$) of all morphometric variables compared to the kids subjected to 0% and 25% feed restriction. Bone mineral densitometry was higher ($P < 0.05$) for females fed ad libitum (0.644 ± 0.04 g/cm²) compared to intact males and castrated fed ad libitum. We concluded that bone morphometry was influenced by gender and feed restriction. Bone mineral densitometry and bone morphometry can be important tools for understanding bone mineral metabolism in goats.

Key Words: bone metabolism, density, nutrition

T55 The National Animal Nutrition Program (NANP): Modeling Subcommittee goals and progress. M. D. Hanigan^{*1}, C. R. Angel², C. F. M. de Lange³, E. Kebreab⁴, J. P. McNamara⁵, L. O. Tedeschi⁶, N. L. Trotter⁷, and M. J. VandeHaar⁷, ¹Virginia Tech, Blacksburg, ²University of Maryland, College Park, ³University of Guelph, Guelph, ON, Canada, ⁴University of California, Davis, ⁵Washington State University, Pullman, ⁶Texas A&M, College Station, ⁷Michigan State University, East Lansing.

The NANP is a research-support activity established as National Research Support Project 9 (NRSP-9; <http://www.ca.uky.edu/nrsp-9/index.htm>). The NRSP are funded from Hatch funds administered by the U.S. Department of Agriculture and drawn from federal allocations prior to formula distribution to experiment stations. The objective of the NANP Modeling subcommittee is to facilitate the use of predictive technologies, tools, and platforms, and to support the efforts of the National Research Council (NRC). The goals are to provide maintenance of the nutrient requirement models and software between NRC releases, to collect user feedback, to provide guidelines and tools for scientists and instructors using modeling to address nutrition problems, and to facilitate knowledge development and dissemination. Two calculation errors in the 2001 Dairy NRC model

were corrected and the installation program was recompiled to support 64-bit Windows installations. We also created an installation program to allow the 2000 Beef NRC to be operated on modern Windows based computers. Both are available on the website. We are working to develop a review of techniques used to evaluate models, an article listing guidelines for reporting dietary information in publications, and an article describing a software platform that could be used across NRC species requirement models. We are also developing a database to store observational data collected by the NRC committees which can be downloaded and used for model development. Future work includes development of a web based mechanism to provide access to the model source code for use by the animal nutrition research community, collection of feedback from model users to help identify software problems and prediction problems, summarization of evaluations of the current NRC models, and an assessment of supply and requirement model subcomponents that could be used across species. These changes will facilitate the use of NRC models in diet formulation, update NRC models more rapidly as new information becomes available and at lower cost, and improve efficiency of feed use and sustainability in animal agriculture.

Key Words: NRC, nutrient requirements, nutrition model

T56 Effects of stage of gestation and diet on maternal fat deposition. P. P. Rotta^{*1}, S. C. Valadares Filho¹, T. R. Santos¹, L. F. Costa e Silva¹, M. I. Marcondes¹, B. C. Carvalho², A. A. G. Lobo¹, J. V. F. Souza¹, M. A. S. Novaes¹, M. F. L. Ferreira¹, and J. S. A. A. Santos¹, ¹Universidade Federal de Vicosa, Vicosa, Brazil, ²Empresa Brasileira de Pesquisa Agropecuaria, Brazil.

The objectives were to evaluate the maternal nutrient intake and stage of gestation on mesentery, kidney, pelvic and heart (KPH) fat and fat thickness growth rate in Holstein × Gyr cows. Sixty-two multiparous cows were inseminated with the same Gyr semen and in the d 30 the gestation was confirmed in 44 cows. Six cows non-pregnant were previously slaughtered as reference group. The 44 pregnant cows were randomly distributed in four time of gestation: 140, 200, 240 and 270 days. Thus, 11 cows were slaughtered in each time. These eleven cows were randomly allocated in two different diets: maintenance level (n = 6; 1.1% of body weight) and ad libitum (n = 5). The cows that achieved the time of gestation were slaughtered and necropsied. The mesentery was removed of the viscera and weighted. The KPH fat was removed and weighted. The fat thickness was measured using an electronic caliper rule 18 h after the slaughter. The values are given in function of final body weight. Data were analyzed using MIXED procedure of SAS. Data of non-pregnant cows were used considering as initial time. The growth rate of mesentery for cows fed ad libitum was exponential and the estimated equation was: $y = 2.7808 + 3.9181 \times [1 - \exp(-0.00726 \times \text{days})]$. However, the growth rate of mesentery for cows fed at maintenance level was linear and the estimated equation was: $y = 2.8351 + (0.00484 \times \text{days})$. In the same way, the KPH fat was exponential to cows fed ad libitum: $y = 1.0812 + 6.5984 \times [1 - \exp(-0.00172 \times \text{days})]$ while the estimated equation to cows fed at maintenance level was linear: $y = 1.1236 + (0.002572 \times \text{days})$. The fat thickness was also exponential to cows fed ad libitum: $y = 0.8033 + 0.0111 \times [\exp(0.0186 \times \text{days})]$ in comparison to cows fed at maintenance level, which estimated equation was linear: $y = 0.757 + (0.002986 \times \text{days})$. Thus, cows fed ad libitum present exponential growth rate of fat deposition, while cows fed at maintenance level present linear growth rate. This can be explained by the high dry matter intake observed to this group and the higher average daily gain. In this way, the excess of energy and protein are being deposited as fat.

Key Words: fat thickness, KPH fat, mesentery

T57 Effects of different diets on the gene expression of enzymes related to fatty acid synthesis in the mammary gland of lactating dairy cows. H. Zhang, C. Ao^{*}, L. Song, E. Khas, and X. Zhang, Department of Animal Science of Inner Mongolia Agricultural University, Huhhot, Inner Mongolia, China.

The objectives of this study were to determine the effects of three different diets on the genes expression of key enzymes involved in fatty acid synthesis in the mammary gland of dairy cows. Thirty multiparous Holstein cows (BW = 566 ± 19.6 kg, DIM = 95 ± 24d) were assigned to a single factor block design with 30 d period. Animals were fed diets with different roughage and same concentrate profiles, the concentrate-roughage ratio in the treatments were different. Diets (on DM base) were: (1) hay (4%), corn silage (27%) and alfalfa (23%) with additional 46% of concentrate (MF; CP: 17.45%, NDF: 38.33% and NEL: 1.6 Mcal/kg); (2) corn straw (35%) and 65% of concentrate (CSA; CP: 17.14%, NDF: 41.58% and NEL: 1.58Mcal/kg); (3) corn straw (54%) and 46% of concentrate (CSB; CP: 13.80%, NDF: 55.59% and NEL: 1.36 Mcal/kg). Mammary gland tissue (500 mg/animal) biopsies were randomly performed for half numbers of cows in each group after milking on the last day of experiment. Gene expressions for key enzymes involved in fatty acids synthesis were determined by RT-PCR. Statistical analysis was performed using the PROC MIXED procedure of SAS 9.0. Results showed that mRNA abundance for ACACA and FASN which involve in de novo fatty acid synthesis was higher ($P < 0.05$) in MF compared to CSA and CSB. Gene expression for fatty acid desaturase SCD was significantly increased ($P < 0.01$) by MF treatment and gene expression for fatty acid uptake and intracellular trafficking enzymes LPL, ACSL1 and CD36 were increased ($P < 0.05$) also by MF. However, no effects were observed for milk fat synthesis regulator genes PPARA, PPARG, SREBF1 ($P > 0.05$). No effects on the gene expressions for all above enzymes and regulators between CSA and CSB were found. The data indicated that diet with high quality roughage and the same concentrate-roughage can increase the gene expression of enzymes related to fatty acid synthesis and desaturation, but with the same roughage and different concentrate-roughage ratio had no effect on milk fat synthesis key genes in the mammary gland of dairy cows.

Key Words: dairy cow, mammary gland, fatty acid synthesis

T58 Effects of stage of gestation and diet on dairy cow placentomes. P. P. Rotta^{*1}, S. C. Valadares Filho¹, T. R. Santos¹, L. F. Costa e Silva¹, M. I. Marcondes¹, M. M. Campos², F. A. S. Silva¹, J. R. Oliveira¹, A. C. B. Menezes¹, E. C. Martins¹, and F. A. C. Villadiego¹, ¹Universidade Federal de Vicosa, Vicosa, Brazil, ²Empresa Brasileira de Pesquisa Agropecuaria, Brazil.

The objectives were to evaluate the maternal nutrient intake and stage of gestation on caruncular, cotyledon and placentoma growth and number rate in Holstein × Gyr cows. Sixty-two multiparous cows were inseminated with the same Gyr semen and in the d 30 the gestation was confirmed in 44 cows. Six cows non-pregnant were previously slaughtered as reference group. The 44 pregnant cows were randomly distributed in four time of gestation: 140, 200, 240 and 270 days. Thus, 11 cows were slaughtered in each time. These eleven cows were randomly allocated in two different diets: maintenance level (n = 6; 1.1% of body weight) and ad libitum (n = 5). The cows that achieved the time of gestation were slaughtered and necropsied. The gravid uterus was removed and the uterus was separated from placenta. In the uterus, all carunculars were removed, counted and weighted. In the placenta, all cotyledons were removed, counted and weighted. Except for placentomas number, that consider 140 days of pregnancy at minimum, the

other equations consider the time 0 to time of pregnancy. Data were analyzed using MIXED procedure of SAS. Data of non-pregnant cows were used considering as initial time. For all parameters evaluated, the growth rate observed was exponential, except to placentomas number, which was linear. The weight of caruncular was similar ($P > 0.05$) between diets and the estimated equation was: $y = -0.5018 + 0.3992 \times \exp(0.008658 \times \text{days})$. However, the higher ($P = 0.0007$) value to cotyledons weight was observed to cows fed at maintenance level: $y = -0.0698 + 0.07697 \times \exp(0.01249 \times \text{days})$ in comparison to cows fed ad libitum: $y = -0.0698 + 0.07697 \times \exp(0.01115 \times \text{days})$. Placentomas weight were higher ($P = 0.0144$) to cows fed at maintenance level: $y = -0.568 + 0.4597 \times \exp(0.009739 \times \text{days})$ in comparison to cows fed ad libitum: $y = -0.568 + 0.4597 \times \exp(0.009303 \times \text{days})$. The number of placentomas was linear and higher ($P < 0.0001$) to cows fed at maintenance level. The estimated equation to maintenance was: $y = -53.8325 + (1.219 \times \text{days})$ and to cows fed ad libitum: $y = -53.8325 + (0.9717 \times \text{days})$.

Key Words: caruncular, cotyledon

T59 Rumen epithelial adaptation during the transition period is associated with structural changes and transcriptomic signatures. M. A. Steele^{*1}, O. AlZahal¹, C. Zettler¹, J. C. Matthews², and B. W. McBride¹, ¹University of Guelph, Guelph, Ontario, Canada, ²University of Kentucky, Lexington.

The structural and functional adaptations of the rumen epithelium during the transition period are largely undescribed. To characterize the adaptations of the rumen epithelium during transition, multiparous dairy cattle ($n = 12$) fed a low energy dry cow diet (1.45 Mcal/kg NE_L) were transitioned abruptly to a high-energy lactating cow diet (1.60 Mcal/kg NE_L) immediately after parturition. Dry matter intake and ruminal pH were monitored at -3 wk, +1 wk, and +6 wk relative to calving. To uncover changes in the ruminal epithelial structure and function, rumen papillae were biopsied at -3 wk, +1 wk, and +6 wk relative to calving. Histomorphometrics of rumen epithelial structure was examined under a light microscope and mRNA profiling was performed using Affymetrix GeneChip. Data pre-processing was conducted using Robust Multichip Average method and detection of significant genes was conducted using ANOVA. Dry matter intake was 13.1 ± 0.84 kg/d at -3 wk and 12.8 ± 0.84 kg/d at +1 wk, and increased ($P < 0.05$) to 21.0 ± 0.84 kg/d at +6 wk. Ruminal pH was reduced ($P < 0.05$) during the onset of lactation from 6.38 ± 0.07 at -3 wk to 5.81 ± 0.07 and 5.85 ± 0.07 at +1 and +6 wk, respectively. Microscopic examination of rumen papillae revealed an increase in epithelial sloughing during early lactation as sloughing scores increased ($P < 0.05$) from 1.7 ± 0.2 at -3 wk to 4.1 ± 0.3 and 3.4 ± 0.2 at +1 and +6 wk, respectively. A total of 1,144 and 535 differentially expressed genes (False discovery rate of 0.01, $P < 0.01$) were uncovered from -3 wk to +1 wk and +6 wk relative to parturition, respectively. Analysis of microarray results using Ingenuity Pathway Analysis revealed that metabolic and transport genes were regulated during early lactation, including mitochondrial dysfunction being the top pathway identified ($P < 0.01$) between -3 wk and +1 wk and +6 wk. These results suggest that the structure and function of the rumen epithelium is altered during early lactation and is associated with the differential expression of genes involved with metabolic functions.

Key Words: transition cow, rumen, epithelium

T60 Effects of stage of gestation and diet on maternal and fetal growth in dairy cows. P. P. Rotta^{*1}, S. C. Valadares Filho¹, T. R. Santos¹,

L. F. Costa e Silva¹, M. I. Marcondes¹, F. S. Machado², L. H. R. Silva¹, B. C. Silva¹, F. A. C. Villadiego¹, M. V. Pacheco¹, D. E. C. Marquez¹, and R. H. M. Ortega¹, ¹Universidade Federal de Vicosa, Vicosa, Brazil, ²Empresa Brasileira de Pesquisa Agropecuaria, Brazil.

The objectives were to evaluate the maternal nutrient intake and stage of gestation on gravid uterus, uterus, fetus and placenta growth rate in Holstein \times Gyr cows. Sixty-two multiparous cows were inseminated with the same Gyr semen and in the d 30 the gestation was confirmed in 44 cows. Six cows non-pregnant were previously slaughtered as reference group. The 44 pregnant cows were randomly distributed in four time of gestation: 140, 200, 240 and 270 days. Thus, 11 cows were slaughtered in each time. These eleven cows were randomly allocated in two different diets: maintenance level ($n = 6$; 1.1% of body weight) and ad libitum ($n = 5$). The diet was based on corn silage and concentrate at 93:7. The cows that achieved the time of gestation were slaughtered and necropsied. The gravid uterus was removed and weighted. After the opening of gravid uterus, uterus, placenta and fetus were removed and weighted separately. Data were analyzed using MIXED procedure of SAS. Data of non-pregnant cows were used considering as initial time. For all parameters evaluated, the growth rates observed were exponential. The gravid uterus presented a similar ($P > 0.05$) growth rate to cows fed ad libitum or at maintenance. The estimate equation was: $y = -1.104 + 1.7406 \times \exp(0.0132 \times \text{days})$. In the same way, the growth rate of uterus was similar ($P > 0.05$) between diets. The estimated equation was: $y = -0.591 + 0.9817 \times \exp(0.008836 \times \text{days})$. The growth rate of fetus was similar ($P > 0.05$) between diets and the equation was: $y = -1.2426 + 0.4939 \times \exp(0.01589 \times \text{days})$. However, the growth rate of placenta was higher ($P = 0.0125$) to cows fed at maintenance level: $y = -0.1324 + 0.1665 \times \exp(0.0118 \times \text{days})$ in comparison to ad libitum: $y = -0.1324 + 0.1665 \times \exp(0.01144 \times \text{days})$. Placenta is the organ most related to gestation and its growth rate is positively affected by maintenance level. This suggests that the organism tried to develop mechanisms to be more efficient in nutrient transfer to cows fed at maintenance level. In conclusion, the effect of stage of gestation is exponential and cows fed at maintenance level present higher growth rate to placenta.

Key Words: fetus, gravid uterus, placenta

T61 Determination of particle size distribution and physically effective fiber in total mixed ration from 14 dairy farms in the Comarca Lagunera, Mexico. P. A. Robles Trillo^{*1}, E. Vazquez-Martínez¹, F. G. Veliz-Deras¹, C. A. Meza-Herrera², and P. Cano-Ríos¹, ¹Universidad Autónoma Agraria Antonio Narro, Torreón, Coahuila, Mexico, ²Unidad Universitaria de Zonas Áridas. Universidad Autónoma de Chapingo., Bermejillo, Durango, Mexico.

In order to determine the particle size distribution (PSD) and physical effectiveness factor (PEF) in totally mixed ration (TMR) in dairy cattle farms, a cross-sectional study was conducted in 14 stables from the Comarca Lagunera, Mexico (25°N, 103°W). Farms were randomly selected and visited in summer in order to collect two freshly served samples of TMR; both the PSD and PEF were determined by the Penn State Particle Separator technique. The amount of PSD and PEF differed among farms ($P < 0.05$). In nine farms and using a 19 mm-sieve (S) PSD ranged from 4.85 to 8.86%, the remainder ranged from 12 to 23%. Above a S-8 mm the PSD ranged among 32 to 54%, although seven stables had lesser than 40%. Regarding PSD using S 1.18 mm, the variation between farms was 16% (30 to 46%). When analyzing the plastic bottom pan, four farms had less than 10% of food collected while the rest ranged from 12-19%. The PEF 8 mm showed great variation, ranging from 38 to 61%, although eight stables were above 50%. Finally, with the PEF1.18 mm, the range was 81 to 93% for all the stables. In

conclusion, both the PSD and PEF showed differences between farms; moreover the PSD and PEF were in line with some research reports, which can cause variations in DMI, milk production and composition.

Key Words: dairy, feeding, fiber

T62 Relation between ultrasound and carcass measurements in Girolando steers fed spineless cactus. R. A. S. Pessoa*¹, J. R. C. Silva¹, A. S. C. Veras¹, M. A. Ferreira¹, I. Ferraz², and P. C. Vasconcelos¹, ¹Universidade Federal Rural de Pernambuco, Recife, Pernambuco, Brazil, ²Instituto Agrono de Pernambuco, Recife, Pernambuco, Brazil.

The objective of this study was to evaluate the correlations between the measurements obtained by ultrasound and from the carcass of the ribeye and back fat thickness in Girolando steers (5/8 Holstein-Zebu). Eighteen animals, no castrated, with average initial body weight of 320 kg and 24 mo of age were used, kept in feedlot system and assigned to a randomized block design, established in accordance with the weight of animals, being 3 treatments and 4 blocks. The experimental period lasted 84 d divided into 3 periods of 28 d. The treatments were 3 urea levels (0.0, 1.5 and 3.0%) in substitution of cottonseed meal (23.0, 11.5 and 0.0%) in diets based on spineless cactus with approximately 12.0% of crude protein and 65.0% of total digestible nutrients. The control diet was composed of 60.0% of spineless cactus, 15.0% of sorghum silage, 0.0% of urea:ammonium sulfate mixture (9:1), 23.0% of cottonseed meal and 2.0% of mineral mixture, in dry matter basis. The animals were slaughtered at 84 d of feedlot. The measurements taken by ultrasound when the steers reached the slaughter point and from the carcass after the slaughter were ribeye and back fat thickness. The fat thickness was evaluated using a paquimeter and the ribeye was evaluated by using a quadrant grade ruler. The data were submitted to ANOVA and correlation of Pearson using the SAS. The replacement of cottonseed meal by urea did not alter the ribeye and back fat thickness ($P > 0.05$) (average of 58.25 and 2.65, respectively). The correlations measured by ultrasound and from the carcass were 0.72 for ribeye and 0.60 for back fat thickness. The characteristics of the measurements taken by ultrasound correlated well with measurements at the time of slaughter in Girolando steers. FACEPE process number: 2008/0979.

Key Words: nitrogen, *Opuntia ficus indica*, ribeye

T63 Effects of grain source and alfalfa hay particle size on feed sorting, feeding behavior, and chewing activity in mid-lactation Holstein dairy cows. S. M. Nasrollahi¹, G. R. Ghorbani¹, M. Khorvash¹, W. Z. Yang², and Z. He*², ¹Isfahan University of Technology, Department of Animal Sciences, Isfahan University of Technology, Isfahan, Iran, ²Lethbridge, Agriculture and Agri-Food Canada, Research Centre, Lethbridge, AB, Canada.

This study investigated the effects of grain source and alfalfa hay (AH) particle length on feed sorting, feeding behavior, and chewing activity of lactating dairy cows. Eight Holstein dairy cows (175 ± 21 DIM) were used in a replicated 4 × 4 Latin square design with four 21-d periods. The experiment was a 2 × 2 factorial arrangement of treatments with 2 grain sources (barley grain alone or equal blend of barley and corn grains) combined with 2 particle lengths of alfalfa hay (short = 15 mm and long = 30 mm). Diets were fed ad libitum as TMR with a concentrate to forage ratio of 60:40. The TMR and orts were sampled at 0, 1.5, 3, 6, and 24 h post morning feeding for determining particle size distribution. Data were analyzed using Mixed Procedures of SAS with linear models consisting of fixed period, grain source, hay particle size, and grain source × hay particle size effects, plus cow and residuals random effects. Interactions between grain source and AH particle length on feed particle distributions, sorting index, chewing activity, and milk production were minimal ($P > 0.05$). Partially replacing barley grain with corn in the diet generally did not change diurnal distributions of particles retained on the sieves of Penn State Particle Separator ($P > 0.05$) but reduced the proportion of particles on 1.18-sieve and increased that of particles on pan ($P < 0.05$). Grain source did not affect feed sorting index and chewing activity ($P > 0.05$). However, feeding long AH increased intakes of long particles (i.e., 19- and 8-mm), prolonged eating time, and lowered eating rate ($P < 0.05$). Interestingly, cows fed with long AH ate more coarse particle during critical-early time after feeding (i.e., 1.5 h after feeding), which increased eating time and decreased eating rate in the similar moment ($P < 0.05$). The increased eating time as well as decreased eating rate with marginally increasing AH particle length would be beneficial to improve ruminal pH and milk composition because of any undesirable effect on feed sorting.

Key Words: alfalfa hay particle length, dairy cow, feeding behavior