of Georgia, College of Veterinary Medicine, Department of Population Health, Athens.

As part of a trial at a university bull test station, data were collected from 101 animals 7 to 10 mo of age including daily weight gain, scrotal circumference, and body frame score. In the process of measuring scrotal circumference, technicians observed that teats of 2 bulls were swollen and leaking a thick pus-like fluid. Upon subsequent culture by university personnel 2 mo later, 14 of 58 bulls sampled (24.1%) were observed to have abnormal, swollen teats, and an examination of teat skin surfaces revealed the presence of scabs and abrasions typical of those caused by horn flies. The culture of teat skin scabs revealed numerous coagulase-negative staphylococcal (CNS) species. No systemic clinical signs were observed, but affected bulls exhibited expressible mammary secretions ranging from a clear, serum-like fluid to a viscous, pus-like secretion. A total of 19 mammary secretion samples were collected for culture, plated on blood agar, and identified following procedures recommended for the diagnosis of mastitis in dairy cows. Results demonstrated the following distribution: Uninfected- 26.3%, *Arcanobacterium pyogenes*- 52.6%, gram-negative rods- 10.5%, CNS- 5.3%, and dual infections with CNS/environmental streptococci- 5.3%. Approximately 1 mo later, 21 of 97 bulls (21.6%) were found to have mastitis, and 26 mammary secretion samples were collected with the following distribution: Uninfected- 11.2%, *A. pyogenes*- 57.7%, gram-negative rods- 7.7%, CNS- 7.7%, *Staphylococcus aureus*- 7.7%, and environmental streptococci- 8%. Although a limited number of *A. pyogenes* infections was treated, teat infusions with a cephalosporin-based nonlactating cow product was ineffective, but infusion of 2% chlorhexidine digluconate resulted in a cure in one bull. Because *A. pyogenes* mastitis is known to be initiated by horn flies in dairy cows and heifers, greater control of these insect vectors may be necessary to manage this form of mastitis in beef bulls.

Key Words: *Arcanobacterium pyogenes*, beef bulls, mastitis

Ruminant Nutrition: Dairy 3

789 Short-term changes in forage dry matter affect milk production responses in dairy cows. D. R. Mertens*[1] and P. Berzaghi[2], [1]*US Dairy Forage Research Center, Madison, WI*, [2]*University of Padua, Italy*.

Our goal was to quantify the effect of one-day changes in forage DM on ration imprecision and milk responses. Forty eight cows (days of lactation = 121 ±52d; BW = 591 ±63 kg) were blocked in 12 groups for parity and milk production and two were assigned to a control (CON) or treatment (TRT) group. The TRT consisted of changing forage DM to simulate a rain event on a bunker silo and feeding an imprecise ration based on as-fed ratios of ingredients for one day of each week. The CON ration was adjusted to maintain DM ratios of ingredients on that day. Each period consisted of three days for baseline, one day (d4) with ration differences, and three days of recovery. The ration changes were repeated 5 times by changing DM of corn silage or alfalfa silage or both by 8%-units. Production was recorded and samples were taken at each milking (2 ×/d) between days 2 and 6 of each period. Milk production and composition during days 4 to 6 were expressed as difference from those of the baseline period. Forages, TMR and refusals were sampled daily and concentrates were samples weekly. Chemical composition (DM, CP, NDF) of samples were determined by NIR after updating in-house calibrations with 58 samples from the experiment. Data were analyzed using Proc Mix of SAS with cow-within-block and TRT group as random variables. The DMI of TRT was reduced ($P<0.01$) on d4 (-2.2 kg) compared to the baseline, but cows returned to baseline level during recovery. Overall DMI was similar between CON and TRT (25 kg/d). Compared to baseline, milk production, but not composition, of TRT was affected ($P<0.001$) in the two days following d4 (-0.86 kg/d) compared to an increase ($P<0.05$) of 0.43 kg/d in the CON group. On d5, TRT milk depression averaged 1 kg and remained depressed (-0.7 kg) on d6. Using DMI change as a covariate ($P<0.001$), the loss of one kg of DMI on d4 resulted in 0.57kg/d less milk in each of the following two days. We concluded that improving ration precision by adjusting rations for forage DM changes enhances DMI and milk production.

Key Words: dry matter, intake, precision feeding

790 Meta-analysis of influence of dietary NDF on energy partitioning in dairy cows. D. Sauvant*[1], O. Martin[1], and D. Mertens[2], [1]*Agroparistech-INRA, Paris, France*, [2]*US Dairy Forage Center, Madison, WI*.

The objective of this study was to evaluate the influence of dietary NDF on dairy cow energy intake and partitioning. A database of 88 published experiments (nexp) with 219 treatments (n) where dietary NDF was the factor (34.9 ±8.6, min = 28.8, max = 40.0%DM) was compiled. Experiments were selected that measured diet organic matter digestibility (OMD = 70.7 ±5.9, min = 54.6, Max = 83.6%) to predict as accurately as possible dietary metabolizable energy intake (MEI). Milk yield ranged from 9.2 to 45.2 kg/d (27.6 ±7.8). Milk fat content ranged from 2.1 to 5.1% (3.7 ±0.6). Energy secreted in milk (Emilk) and in milk lactose (Elact), protein (Eprot) and fat (Efat) was calculated using 4.0, 5.6 and 9.3 Mcal/kg, respectively. Data were analyzed using GLM to separate inter- and intra-experiment variances. Daily MEI (48.7 ±9.9 Mcal/d) was negatively linked to the dietary NDF (MEI = 72.3 – 0.693 NDF, n = 219, nexp = 88, R2 = 0.90, RMSE = 15.3). Energy secreted as lactose was linearly linked to MEI (Elact = 2.40 + 0.0665 MEI, n = 80, nexp = 34, R2 = 0.98, RMSE = 0.22), and the regression was similar for Eprot (Eprot = 1.18 + 0.074 MEI, n = 197, nexp = 78, R2 = 0.98, RMSE = 0.23). The global and inter-experiment regressions were not statistically different, thus, the marginal efficiency of MEI transformation to Elact and Eprot is of 6.7 and 7.4% respectively. For energy secreted as fat, the relationship was curvilinear (Efat = – 3.20 + 0.45 MEI – 0.0038 MEI2, n = 219, nexp = 88, R2 = 0.95, RMSE = 0.59). Marginal efficiency of MEI to Efat decreased from 26% (MEI = 25) to – 8% (MEI = 70). Therefore the milk energy response was curvilinear (Emilk = 2.49 + 0.48 MEI – 0.0027 MEI2, n = 219, nexp = 88, R2 = 0.98, RMSE = 0.78). Energy balance (EB) was also curvilinearly related to MEI (EB = –3.3 – 0.23 MEI + 0.0062 MEI2, n = 219, nexp = 88, R2 = 0.94, RMSE = 1.09), and EB of zero was achieved for MEI = 50 Mcal/j. In conclusion, dietary NDF strongly influences energy partitioning in dairy cows through its impact on MEI.

Key Words: NDF, milk energy, energy partitioning

791 Effect of feeding low-starch, low-forage diets to mid-lactation dairy cows on lactational performance and ruminal characteristics. E. R. Myers*[1], H. M. Dann[2], K. W. Cotanch[2], C. S. Mooney[2], R. J. Grant[2], A. L. Lock[1], and K. Yagi[3], [1]*University of Vermont, Burlington*, [2]*William H. Miner Agricultural Research Institute, Chazy, NY*, [3]*ZEN-NOH National Federation of Agriculture Co-Operative Associations, Tokyo, Japan*.

We have shown that corn grain can be replaced with byproduct feeds in lactating cow diets resulting in a low-starch [18% of dry matter (DM)] diet without adverse effects on ruminal fermentation and lactational performance. Previous research has not addressed how little forage can be fed with a low-starch diet. Sixteen lactating Holstein cows (116 ± 5 days in milk; 8 ruminally fistulated) were used in a replicated 4×4 Latin square design study with 21-d periods (9-d collection) to determine the effect of feeding diets containing low-starch (19% of DM) and different amounts of forage (52, 47, 43, and 39% of DM) on lactational performance and ruminal characteristics. The primary ingredients (DM basis) in the 52 to 39% forage diets were corn silage (37 to 28%), alfalfa-grass silage (14 to 1%), wheat straw (0 to 10%), beet pulp (6.2%), distillers dried grains with solubles (11 to 9%), soybean meal (11 to 12%), wheat middlings (7 to 19%), and corn meal (5 to 6%). Data were analyzed as a replicated Latin square design using the MIXED procedure of SAS. Diet affected ($P \leq 0.05$) dry matter intake [DMI, % of body weight (BW)], feed efficiency, total tract digestibility (TTD) of organic matter (OM) and neutral detergent fiber (NDF), and ruminal turnover rate (RTR) of OM and NDF. Diet did not affect ($P > 0.10$) milk yield, milk composition (fat = 3.60 ± 0.09%; protein = 3.02 ± 0.04%), mean ruminal pH (6.07 ± 0.07), microbial N yield (450 ± 17 g/d), ruminal digesta mass (95.1 ± 8.3 kg), or ruminal pool size (OM = 12.2 ± 1.1 kg; NDF = 8.4 ± 0.7 kg). For high producing cows the limit to decreasing forage in low-starch diets appears to be between 39 and 43% forage.

Table 1.

Item	52% forage	47% forage	43% forage	39% forage	SEM	P
DMI, kg/d	22.8	23.4	23.4	24.1	0.5	0.07
DMI, % BW/d	3.47^{b}	3.55^{ab}	3.54^{ab}	3.67^{a}	0.1	0.03
Milk, kg/d	42.5	42.6	42.8	42.6	1.3	0.99
Milk/DMI, kg/kg	1.87^{a}	1.82^{ab}	1.84^{ab}	1.77^{b}	0.04	0.02
TTD of OM, %	64.5^{a}	63.3^{ab}	62.0^{bc}	61.0^{c}	0.7	<0.01
TTD of NDF, %	39.4^{a}	35.9^{ab}	34.0^{b}	29.1^{c}	1.3	<0.01
RTR of OM, %/h	7.0^{b}	7.5^{bc}	8.1^{a}	8.0^{a}	0.5	0.01
RTR of NDF, %/h	4.0^{b}	4.4^{ab}	4.6^{a}	4.5^{ab}	0.3	0.03

^{abc} $P \leq 0.05$

Key Words: starch, forage, dairy cow

792 Assessment of dietary ratios of red clover and corn silages on milk production and milk quality in dairy cows. J. M. Moorby*, N. M. Ellis, D. W. R. Davies, and D. R. Davies, *Institute of Biological, Environmental and Rural Sciences, Aberystwyth, UK*.

Twenty-four multiparous Holstein-Friesian dairy cows at 106 (± 16.1) DIM were used in a replicated 3×3 Latin square changeover design experiment to test the effects of changing from corn silage to red clover silage in graded proportions on feed intake, milk production and milk quality, and whole-body partitioning of N and P. The 3 dietary treatments comprised ad libitum access to 1 of 3 forage mixtures plus 4 kg dairy concentrates/d. The 3 forage mixtures (on a DM basis) were: 1) 90% corn silage:10% red clover silage, 2) 50% corn silage:50% red clover silage, and 3) 10% corn silage:90% red clover silage. In each of 3 experimental periods there were 21 d for adaptation to diets and 7 d for measurements. Results were analyzed by ANOVA with polynomial contrasts and are given in order of diets 1, 2 and 3. Diet CP intakes increased, and starch intakes decreased, as the silage mixture changed from 90% corn to 90% red clover. Highest total DM intakes (19.6, 20.5, and 19.5 kg/d; SED = 0.32; $P_{quad} < 0.001$) and milk yields (26.1, 27.3, and 25.7 kg/d; SED = 0.54; $P_{quad} < 0.01$) were achieved on the 1:1 silage mix. Although milk fat concentrations were unaffected by diet, milk protein concentrations decreased as the proportion of red clover silage in the diet increased (3.09, 3.06, and 2.99%; SED = 0.024; $P_{lin} < 0.001$). Apparent secretion of dietary N into milk (33, 28, and 25%; SED = 1.1; $P_{lin} < 0.001$) decreased, while apparent urinary excretion of dietary N (19, 23, and 31%; SED = 1.3; $P_{lin} < 0.001$) and urinary allantoin excretion (408, 440, and 481 mmol/d; SED = 28.5; $P_{lin} = 0.04$) increased, with more red clover in the diet. There was no treatment effect on whole body N balance, although P balance was greatest on the 1:1 forage mix (10, 17, and 12 g P/d; SED = 1.6; $P_{quad} = 0.03$). In conclusion, optimum feed intakes and milk yields were achieved on a diet that contained a 1:1 DM mixture of corn and red clover silages.

Key Words: red clover silage, corn silage, N use efficiency

793 Determining fiber requirements in dairy cows by modeling digestive responses to dietary physically effective NDF. Q. Zebeli*[1,2], D. Mansmann[1,2], H. Steingass[2], W. Drochner[2], and B. N. Ametaj[1], [1]*University of Alberta, Edmonton, AB, Canada*, [2]*University of Hohenheim, Stuttgart, Germany*.

Predicting requirements for dietary fiber is crucial in optimizing digestion and preventing occurrence of sub-acute ruminal acidosis (SARA). The aim of the study was to determine requirements of physically effective fiber in dairy cows by modeling its effects on digestive responses using a meta-analytical approach. A database was compiled from 65 recently published studies (n=242 dietary treatments) with lactating Holstein cows (112 DIM, 33.7 kg milk/d) fed TMR (35.1% NDF and 25.0% starch in DM). The content of $peNDF_{>8}$ was calculated by amount of DM retained on 2 sieves (19 and 8mm) of PSPS multiplied by dietary NDF. Average amounts of dietary particles retained on screens 19 and 8 mm were 12.8 and 37.1%, respectively, while average content of $peNDF_{>8}$ was 16.9±5.5%. Digestive response variables modeled included rumen pH, chewing activities, passage rate, and fiber digestibility. Results showed that total chewing time increased linearly with increasing dietary $peNDF_{>8}$ (R^2=0.40). The analysis revealed a curvilinear response of rumination time (RT) to dietary $peNDF_{>8}$ [RT (min/d)=512-243$e^{-0.077*peNDF_{>8}}$; R^2=0.42]. Increasing the content of dietary $peNDF_{>8}$ quadratically decreased chewing time per unit of $peNDF_{>8}$ ingested with the latter reaching a plateau at 160 min/kg $peNDF_{>8}$. Interestingly, results showed a linear response of rumen pH to diet $peNDF_{>8}$ (pH=5.57+0.034*$peNDF_{>8}$; RSME=0.12; R^2=0.62) up to a content of 18.5% (95% CI: 16.4 to 20.6% $peNDF_{>8}$). The latter threshold of $peNDF_{>8}$ corresponded to plateau values of 6.22 for daily mean rumen pH and <1 h/d for duration in which rumen pH was <5.8. Both pH-variables and passage rate out of reticulorumen were accurate predictors of NDF and ADF digestibility (R^2=0.47 to 0.62). In summary, results suggested that a minimum of 16.4% $peNDF_{>8}$ in diet DM is required to maintain chewing activities, prevent SARA, and optimize fiber digestion in dairy cows.

Key Words: dairy cow, physically effective fiber, meta analysis

794 Nutritional value of bahiagrass, bahiagrass-alfalfa, or brown mid rib sorghum baleage for lactating Holstein cows. M. E. McCormick*[1], V. R. Moreira[1], D. C. Blouin[2], and K. J. Han[1], [1]*Louisiana State University Agricultural Center, Southeast Research Station, Franklinton*, [2]*Louisiana State University Department of Experimental Statistics, Baton Rouge*.

Forty eight Holstein cows were stratified according to lactation number, days in milk (115 ± 17), and daily milk yield (34.3 ± 7.2 kg) and randomly assigned to the following forage treatments:1) bahiagrass baleage, 2) bahiagrass-alfalfa (78%:22%) baleage, 3) brown mid rib (BMR) sorghum baleage, or 4) corn silage. The first objective of the 56-day feeding study was to assess the feeding value of a bahiagrass-alfalfa baleage derived by interseeding 'Amerigraze 702' alfalfa in 30 cm rows into an existing stand of 'Argentine' bahiagrass relative to the feeding value of baleage from a pure stand of similar bahiagrass. A second objective was to evaluate the nutritional value of 'BMR 106' forage sorghum (vegetative, 1.4m ht) stored as baleage compared to corn silage. Baleage crops were ground with a flail-type hay processor. All forages were incorporated into total mixed rations (TMR) and individually fed once daily. Lactation performance data were statistically analyzed using Proc Mixed of SAS with data from a 7-day standard feeding period used as covariables. Forage dry matter, pH, CP, ADF, NDF, water soluble carbohydrate, and IVTD means were 57.2%, 5.69, 10.1%, 38.4%, 69.5%, 2.2% and 67.8%; 52.6%, 5.42, 11.4%, 37.6%, 64.8%, 3.7% and 71.0%; 35.2%, 4.54, 12.9%, 38.8%, 61.7%, 8.0% and 79.8%; 29.2%, 3.8, 8.6%, 24.0%, 41.4%, 10.3%, and 80.6% for treatment 1-4, respectively. The TMR dry matter intake (DMI) was similar between diets 1 and 2 (20.3 vs 22.1 kg/d), but milk yield (26.1 vs 28.5 kg/d) tended ($P < 0.10$) to favor the bahiagrass-alfalfa mixture, presumably due to improved forage nutritive value. The TMR DMI and daily milk yield were lower ($P < .05$) for diet 3 than 4 (21.3 and 30.6 kg/d vs 25.7 and 33.1 kg/d, respectively). Milk composition, rumen pH, body weights, and body condition scores were not affected by diet. The data indicate that modest concentrations of alfalfa in bahiagrass baleage may improve lactation performance of Holstein cows. The BMR sorghum baleage failed to generate as much milk as corn silage due to lower TMR DMI.

Key Words: baleage, nutrition, Holstein

795 Diurnal patterns of rumen pH and function in dairy cows on high quality temperate pastures of the South Island of New Zealand. J. Gibbs* and J. Laporte, *Lincoln University, Canterbury, New Zealand*.

This experiment was undertaken to describe the diurnal patterns of rumen, urinary and faecal pH, SCFA and ammonia in dairy cows under a specific grazing management typical of the new, large herd systems of the South Island of NZ, and to compare these to accepted patterns of rumen function in traditional, lower intensity grass based dairy systems. For a 48h period in mid-spring, six high production (425 kg MS/ yr), ruminally fistulated, lactating Holstein Friesian cows free-grazing very high quality ryegrass pasture in a typical NZ large herd scenario had indwelling rumen pH and temperature probes recording to a datalogger every 15s and were also manually sampled for rumen fluid, faeces and urine every 2h. Samples obtained were analysed for: rumen - SCFA and ammonia; faeces - pH, SCFA and ammonia; urine - pH and ammonia. Cow grazing behaviour was recorded every 15min over the 48h. Results showed a consistent, marked diurnal wax and wane pattern of rumen, faecal and urinary pH, SCFA and ammonia associated with grazing behaviour. Rumen pH varied from 5.1-7.0, faecal pH from 6.2-7.1, and urinary pH from 7.0-8.5. Total rumen SCFA concentrations varied from 84-223mmol/L, lactic acid was absent or below 10mmol/L, and ammonia varied from 35-528mg/L. Faecal total SCFA concentrations varied from 15-50mmol/L, and ammonia from 47-325mg/L, and urinary ammonia from 5-102mg/L. The results suggest grazing behaviour under intensive pasture management conditions typical of the South island in NZ produces an atypical rumen function of extreme diurnal variation in metabolic activity. However, this previously undescribed pattern in rumen, faecal and urinary pH and metabolites does not appear inimical to either rumen function or milk production, suggesting physiological adaptation.

Key Words: rumen pH, pasture grazing, grazing management

796 Effect of pre-grazing herbage mass and daily herbage allowance on rumen, plasma and milk fatty acids. R. A. Palladino[1], M. O'Donovan[2], J. J. Murphy[2], M. McEvoy[1,2], and D. A. Kenny*[1], [1]*University College Dublin, Belfield, Dublin, Ireland*, [2]*Teagasc, Fermoy, Co. Cork, Ireland*.

Conjugated linoleic acid (CLA) in milk is dictated by intake of dietary precursors and the extent of ruminal biohydrogenation. Grazing management may change both precursor intake and biohydrogenation through its influence on pasture composition. This study evaluated the effect of two levels of pre-grazing herbage mass (HM; 1700 and 2500 kg/ha) and two levels of daily herbage allowance (DHA; 16 and 20 kg/cow/d) on the fatty acid (FA) composition of rumen fluid, plasma and milk in grazing dairy cows. Four rumen fistulated Holstein dairy cows were randomly allocated to four treatments (high HM, high DHA; high HM, low DHA; low HM, high DHA; low HM, low DHA). Rumen (0700, 1100, 1500 and 2000 h), plasma (0700 and 1500 h) and milk (pm milking) samples were collected during each of four periods from June to August in a Latin square design. Samples were analyzed for FA by gas chromatography. Data were analyzed by mixed model ANOVA with cow as a random effect. The model included terms for HM, DHA, period and the interaction HM x DHA. For rumen and plasma samples, time of sampling was included as well as the interaction of HM x time, DHA x time and HM x DHA x time. No CLA was detected in either rumen or plasma samples. The milk CLA concentration was in agreement with previous reports under grazing conditions (12.8 × 2.20 g/kg of total FA) but was not affected by treatment ($P>0.05$). Rumen concentration of vaccenic acid (VA) was highest in cows grazing the low HM, high DHA pasture (17.0 g/kg of total FA; $P<0.05$). Additionally, rumen VA concentration increased from 0700 to 2000 h (from 13.1 to 14.7 g/kg of total FA; $P<0.01$). Concentrations of VA in plasma were not affected by treatment or time of sampling ($P>0.05$). Milk VA was higher in cows grazing low HM ($P<0.01$). Linolenic acid (LNA) in plasma or rumen fluid was not affected by time ($P>0.05$). However, milk LNA was higher for cows grazing low HM (3.6 vs. 5.6 g/kg of total FA for high and low HM respectively). In conclusion, under the conditions of the present study, there was little effect of grazing management on the concentration of health promoting FA in milk.

Key Words: conjugated linoleic acid, herbage mass, daily herbage allowance

797 Comparison of energy expenditure, physical activity and feeding behavior in dairy cows grazing pasture grass or fed the same grass indoors. L. D. Kaufmann[1], A. Münger[1], M. Rérat[1], P. Junghans[2], S. Görs[2], C. C. Metges[2], and F. Dohme*[1], [1]*Agroscope Liebefeld-Posieux,*

Research Station ALP, Posieux, FR, Switzerland, [2]*Research Institute for the Biology of Farm Animals (FBN), Dummerstorf, Germany.*

The objectives of the study were to compare energy expenditure (EE) of dairy cows fed grass either on pasture or in the barn and to evaluate the influence of physical activity on EE. Fourteen dairy cows (BW: 658 ± 64.3 kg; milk yield: 45.5 ± 1.78 kg/d) were randomly assigned to a cross over study, with two 2-wk experimental periods consisting of an adaptation and a data collection period of 1 wk each. Cows either grazed on pasture or had ad libitum access to grass from the same paddock, fed in a free-stall barn. All cows were supplemented with a cereal-based concentrate. Milk yield and milk components were recorded daily. In the collection period EE of each cow was determined on 1 d from 0700 to 1300 h using the ^{13}C bicarbonate dilution technique. After administration of the tracer (0.7 mg $NaH^{13}CO_3$ /kg BW) into the jugular vein, blood was sampled either manually in the barn or with an automatic blood sampling system on pasture. During the same time cow′s physical activity was recorded with a pedometer and feeding behavior was investigated using a behavior recorder. Milk (42.8 kg/d), fat (1.58 kg/d) and protein yield (1.31 kg/d) did not differ ($P > 0.05$) between treatments. Within the 6-h measurement period, cows on pasture produced more ($P < 0.01$) CO_2 and consequently expended more energy ($P < 0.01$) than cows fed grass in the barn (251 vs. 204 kJ/kg $BW^{0.75}$). Number of steps was higher ($P < 0.001$) and the proportion of time spent walking (28 vs. 9%) increased ($P < 0.001$) for cows on pasture compared to those in the barn, which, conversely, spent more ($P < 0.01$) time standing (37 vs. 48%). Feeding behavior of the treatment groups changed in such a manner that the proportion of time spent eating (47 vs. 37%) was higher ($P < 0.001$) and that of time spent ruminating (22 vs. 29%) lower ($P < 0.01$) for grazing cows compared to cows fed grass in the barn. In conclusion, positive correlations ($P < 0.01$) between EE and walking (r = 0.63) and eating time (r = 0.59) suggest that higher physical activity accounts for a considerable part of the higher energy requirements of cows on pasture.

Key Words: dairy cows, energy expenditure, pasture

798 Relationship between milk fat and nutrition in lactating Holstein cows. M. Vazirigohar*, A. Nejati Javaremi, and A. Nikkhah, *University of Tehran, Karaj, Tehran, Iran.*

The objective of this study was to evaluate production and nutritional factors that influence milk fat (MF) and milk fat depression (MFD) in lactating Holstein dairy herds. Production data were obtained from the Iranian Dairy Herd Improvement Center (n=33540), which in 2005 and 2006. Programmed total mixed ration (731 herd-month rations) on milk test day were collected from 3 large dairy herds. Diets were evaluated for nutrient composition using CPM Dairy. Milk fat: protein ratio was divided into four different categories (<0.8, 0.8 to 1, 1 to 1.2 and >1.2), which the ratios less than 1 defined as MFD. Data were analyzed with univariate and multivariate regression models. Significant negative ($p<0.01$; estimate= -0.018) relationship was found between MF concentration and milk yield; MF levels were lower during the summer months and increased as lactation progressed. Milk fat was increased ($p<0.01$) with dietary levels of forage neutral detergent fiber, effective neutral detergent fiber and sugar contents; it was decreased ($p<0.01$) with non forage neutral detergent fiber, rumen undegradable protein, and linoleic acid contents. In the ratios lower than 0.8, least squares means of effective neutral detergent fiber, soluble fiber and forage neutral detergent fiber were in the lowest levels (20.81±0.009, 10.43±0.01 and 17.58±0.04 respect.; as %DM), non fibrous carbohydrate, non forage neutral detergent fiber, crude protein, rumen undegradable protein, linoleic acid and dry matter intake were in the greatest levels (40.58±0.01, 15.35±0.02, 15.69±0.02, 5.99±0.009, 1.62±0.003; as %DM, and 22.41±0.04; as kg of DM). In the ratios of lower than 0.8, least Squares means of milk yield was in the greatest (31.47±0.1 kg) and milk fat percentage was in the lowest (2.15±0.007%) level.This study showed that DMI and linoeleic acid were the main factors that influence milk fat depression.

Key Words: milk fat depression, nutrition, dairy cows

799 Profitability and milk yield response to protein supplementation in mid-lactation dairy cows. A. E. O. Malau-Aduli* and J. C. Beattie, *School of Agricultural Science, University of Tasmania, Hobart, Tasmania, Australia.*

This study utilized 120 Holstein-Friesian dairy cows in mid-lactation in a randomized block experimental design. The aim was to evaluate milk yield and composition responses to protein supplementation and profitability over an eight-week lactation period. The cows were blocked according to milk yield, days in milk and parity before being randomly assigned to three treatment groups: Control, 15% and 30% protein supplementation. Weekly average daily milk yield (WMY), total milk yield (TMY), income from milk sales, profitability, fat and protein percentages were subjected to statistical analyses to test the effects of treatment, block, parity, week and their second order interactions fitting days in milk as a random effect in mixed model procedures. Multiple regressions with quadratic contrasts were fitted to predict income and profitability from total ration fed and days in milk. The 30% protein supplemented cows gave the highest milk responses (WMY, 27.1 ± 0.80; TMY, 1479.9 ± 38.01litres), fat percentage (2.6 ± 0.3%), total income ($597.4 ± 40.23) and profitability ($54.4 ± 5.04 per cow), while the control group gave the least responses and incurred a loss of -$24.30 ± 4.95. Third parity cows also gave the highest milk yield responses (WMY, 28.1 ± 0.51; TMY 1562.1 ± 28.24 litres) and profitability ($65.7 ± 15.37). Residual phenotypic correlations (r) between milk yield, composition and profitability were almost all highly significant (P<001) with the highest positive r=0.96 between WMY and TMY. Total ration and days in milk within treatment group alone were very poor predictors of profitability (r^2=0.02-0.12) compared to within parity groups (r^2=0.14-0.90) for income, WMY and TMY. It was concluded that even though a positive profit margin was evident, long-term feeding of mid-lactation cows with 30% protein supplement is unrealistic because of the prohibitive cost of protein. Furthermore, protein requirements for milk synthesis at this stage of lactation can be adequately met by a 16-17% protein diet since energy would be the most limiting nutrient.

Key Words: protein supplementation, milk yield response, profitability

800 Pigeon peas as a supplement for lactating dairy cows fed corn silage based diets. V. A. Corriher*[1], G. M. Hill[1], J. K. Bernard[1], T. Jenkins[2], and B. G. Mullinix[1], [1]*University of Georgia, Tifton,* [2]*Clemson University, Anderson, SC.*

Holstein rumen canulated cows (n=7; initial BW 640.56 ±71.43 kg) were fed a corn silage basal diet with one of three concentrates (C=control; P10=10% pigeon peas; P20=20% pigeon peas). Cows were randomly assigned to treatments in a replicated 3 × 3 Latin square design and individually fed using Calan®gates. Each experimental period was 21 d with 7 d for adaption and 14 d for sample collection. Ruminal fluid samples were taken the last day of each experimental period and analyzed for

pH, ammonia, long chain fatty acids (LCFA) and VFA. Consecutive a.m. and p.m. milk samples were taken from each cow during last 2 wk of 21-d period and analyzed for fat, protein, LCFA and somatic cell count (SCC). Dietary DMI (kg/d) was lower during second period and higher for the 10% pigeon pea diet ($P < 0.05$). Milk protein was higher for cows fed the 20% pigeon pea diet compared with 10% diet ($P < 0.05$). Milk ECM was higher for cows fed control diet compared with 10% pigeon peas ($P < 0.05$). Treatment had no effect on milk yield ($P > 0.10$). Diets did not affect ruminal fluid pH ($P > 0.10$); however, pH was different for sampling periods ($P < 0.01$). Ruminal ammonia decreased until 8h post-feeding at which time it peaked consistent with changes in ammonia concentrations that usually peak 3-5h post-feeding on diets high in plant proteins. Dietary treatments altered ruminal fluid VFA with lower concentrations of acetate and higher concentrations of propionate for the control diet, resulting in lower acetate: propionate ratio ($P < 0.05$). The P10 diet resulted in higher ruminal isovalerate ($P < 0.05$). Ruminal cis 9, trans 11 and trans 10, cis 12 conjugated linoleic acid (CLA) isomers were not affected by dietary treatments ($P > 0.10$). The P10 diet had highest ruminal synthesis of c9, t11, but control cows had highest ruminal synthesis of t10, c12 ($P > 0.10$). Milk CLA isomers were similar ($P > 0.10$) among treatments. Trends were observed for greater ($P > 0.10$) c9, t11 and t10, c12 for P10 diet. Pigeon peas may be used as a protein supplement in dairy diets without affecting milk production, DMI or ruminal environment when they replace corn and soybean meal.

Key Words: dairy, forage, fatty acids

Ruminant Nutrition: Research Methods

801 Everting the omasum into the reticulum to identify the sensory receptors in the omasum of the sheep. W. L. Grovum*, *Department of Biomedical Sciences, Ontario Veterinary College, University of Guelph, Guelph, Ontario, Canada*.

The purpose of this work was to expose the inner surface of the omasum to identify its sensory receptors. Such work has been precluded to date because there was no technique for displaying its epithelia while keeping their circulation and vagal innervation intact. The main problem has been the location of the omasum under the liver, caudal to the diaphragm between the cranial sac of the rumen and the ribs on the right. Also, the reticulo-omasal orifice is nearly closed whereas the bean-shaped omasum is approximately 16 cm in diameter. To evert the omasum, sheep were anesthesized with sodium pentobarbital, intubated and placed on a ventilation pump to first remove 7 ribs (6-12) along with associated tissues on the left and thus expose the reticulum. Then, it was incised from its apex upwards on its left and right sides between major blood vessels and opened like a clam-shell, care being taken to prevent contamination of the thoracic and abdominal cavities with digesta. The cut edges of the reticulum and the skin incision were clipped together to close the large opening in the animal. The reticulo-omasal orifice thus exposed was stretched to 4 - 5 cm in diameter to elute the omasal contents between the leaves into the reticulum by pumping warm normal saline through a 2 mm ID copper tube while dislodging the particles with 2 fingers. The much shrunken omasum was then gently pushed from behind and pulled into the reticulum. The omasal leaves now projected outwards from the omasal body and were easily manipulated to identify neuronal receptors sensitive to stretch and tactile stimulation.

Key Words: omasum, sensory function, sheep

802 Standardization of an in vitro method using *Streptomyces griseus* enzyme to predict rumen undegraded protein. I. Schadt*[1], P. J. Van Soest[2], and G. Licitra[1,3], [1]*CoRFiLaC, Regione Siciliana, Ragusa, Italy*, [2]*Cornell University, Ithaca, NY*, [3]*D.A.C.P.A. University of Catania, Italy*.

In situ rumen protein degradation might change relative to feed intake and production. Incubation times of an in vitro method to achieve equal extents should be adapted, consequently. However, a continuous change of enzyme time is not practical for laboratory use. The purpose of the present study was the development and validation of a calibration curve to predict undegraded protein (UP) at any necessary enzyme time from one measurement at a single incubation time of 18 hours (1T). UP of 32 feeds was determined using *S. griseus* enzyme (40.6 U per gram true protein) at 4, 8, 12, 18, 24, 36 and 48 hours. The feeds were divided into 18 calibration and 14 validation feeds. UP of calibration feeds at incubation times was subtracted from UP at 18 hours and mean deviations at individual times were calculated. Deviations were plotted upon the natural logarithm of respective times to obtain the calibration curve. UP of validation feeds at 4, 8, 12, 24, 36 and 48 hours was predicted from the measured residue at 18 hours. The 1T method was validated against methods using two incubation times of 18 and 36 hours (2T) and all seven incubation times (7T). Individual calibration curves for all 32 feeds were generated by plotting UP either after 18 and 36 hours (2T) or after all seven incubation times (7T) upon the natural logarithms of the respective times. All three methods were examined for predictive capacity by plotting measured values upon predicted values and by calculating proportional deviations (PD) of calculated from measured values. Calculated and measured UP was generally highly correlated with $R^2 = 0.96$ ($n = 98$), $R^2 = 0.96$ ($n = 224$), and $R^2 = 0.99$ ($n = 224$), at 1T, 2T, and 7T, respectively. PD was decreasing ($p < 0.01$) with values of $0.066 > 0.049 > 0.030$ at 1T, 2T, and 7T, respectively. PD was highest at 48 hours using 1T and 7T. Elimination of times longer than 36 hours decreases PD at 1T to 0.054 being not different from PD at 2T.

Key Words: in vitro method, rumen protein degradation

803 Methodology to improve the sensitivity and repeatability of in vitro gas production. D. R. Mertens*, *US Dairy Forage Research Center, Madison, WI.*

The goal of this research was to improve the measurement of in vitro gas production during early fermentation and reduce variability among runs. Eleven forages (immature and mature grasses and legumes) were used in four in vitro runs over a six week period. Ruminal contents were collected from four lactating cows, and inoculum preparation was initiated within 20 min after collection. Ruminal fluid was separated from solids by squeezing through two layers of cheesecloth. Solids weighing one-half of the required ruminal fluid was blended for 60 s with twice their weight of CO_2-purged, reduced and warmed media. Ruminal fluid and blended solids were combined and squeezed through four layers of cheesecloth. Inoculum was kept warm using a jacketed beaker with circulating water at 39°C and purged with CO_2. Bottles (50 ml) containing samples and 6 ml of buffered media were purged with CO_2, reduced and warmed in a waterbath. Each bottle was inoculated with 4 ml of blended inoculum, closed with a septum and crimp