T222 Effects of feeding time and forage to concentrate ratio on water intake and drinking behavior of dairy cows. J. Plaizier*, D. Fulawka, A. Nikkhah, and A. Kennedy, *University of Manitoba*, *Winnipeg, MB, Canada*.

Effects of time of feeding (TF) and forage to concentrate ratio (F:C) on drinking behavior were determined in eight lactating Holstein cows housed in individual tie stalls. Cows had unlimited access to fresh water only through their own water bowl. A four by four Latin square with experimental periods of 2 wk adaptation and 1 wk of data collection was used. Data were analyzed using the SAS Mixed procedure with TF and diet as fixed factors. Cow and period were random factors. Cows received a total mixed ration (TMR) with a F:C of 38:62 or a TMR with a F:C of 49:51. Fresh TMR was provided either at 9 am or at 9 pm. Water consumption was determined by continuous measurement of the flow of water through each water bowl. Drinking bouts were defined as the combination of drinking events that were less that 4 min apart. The number of drinking bouts and water consumption during each 3 h period were determined. Dry matter intake and milk yield were not affected by diet and TF and were 20.6 kg/d and 37.0 kg/d across treatments, respectively. Both diet and TF did not affect total water consumption, the water consumption per bout, the duration of drinking bouts and the drinking rate. Averages for these parameters across treatments were 73.7 L/d, 2.9 L, 3.3 min, and 1.07 L/min, respectively. Drinking behavior varied significantly among cows. Diet did not affect the number of drinking bouts per day, the total time spent drinking, and the distribution of drinking throughout the day. Cows fed at 9 am had more drinking bouts per day (28.3 vs. 25.6) and spent more time drinking (94.4 vs. 81.7 min/d) than cows fed at 9 pm. More drinking bouts and more water consumption were found for cows fed at 9 am during all 3 h periods from 9 am to 9 pm. Thereafter, the number of drinking bouts and water consumption were greater in cows fed at 9 pm (9 pm to 12 pm; 6 am to 9 am) or similar (12 pm to 3 am; 3 am to 6 am) for the two TF treatments. Results show that TF affects distribution of drinking bouts throughout the day.

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Key Words: Drinking Behavior, Time of Feeding, Dairy Cows

Ruminant Nutrition: Methodology and Modeling

T223 Influence of fermentation method on NDF degradation parameter estimates. D. Bossen[1], D. R. Mertens*[2], and M. R. Weisbjerg[1], [1]*Danish Institute of Agricultural Sciences*, *Foulum, Denmark*, [2]*US Dairy Forage Reseach Center*, *Madison, WI*.

Effect of three methods of fermentation on degradation parameters was studied using feeds ground to different sizes. Corn silage (CS), grass silage (GS), barley grain (B), sugar beet pulp (BP), and rape seed cake (RSC) were ground using a shear mill. Silages were ground through 8, 4, 2 or 1-mm screens (G8, G4, G2, G1, respectively) and concentrates through 4, 2 or 1-mm screens, except RSC that was ground through 2 or 1-mm screens. Materials were incubated twice for 0, 6, 12, 24, 48 and 96 h either in situ (IS) in four lactating cows, in vitro (IVn) with media pH of 6.8, or in vitro (IVa) with media pH adjusted to 6.0 using citric acid. Inoculum for IVn and IVa was prepared as a composite from the same four cows used for IS. Feeds and residues were analysed using the amylase-treated NDF method. Potentially degradable aNDF (D_0, g kg^{-1} DM), indegradable aNDF (I, g kg^{-1} DM), discrete lag time (L, h) and fractional rate of aNDF degradation (k_d, h^{-1}) were estimated using NLIN in SAS. Differences within each feed were determined using GLM in SAS. Initial aNDF was 399, 431, 197, 480 and 251 g kg^{-1} DM for CS, GS, B, BP, and RSC, respectively, for G1, but increased with increasing screen size. Grinding screen size affected k_d for CS and B, and D_0 for B, possibly due to incomplete extraction of starch for G4 and G8. Fermentation method affected all degradation parameters for all feeds except RSC, where method only affected D_0 and k_d. Higher D_0 were obtained using IVn compared to IVa, but the difference was significant only for CS. The D_0 was higher for IVn than IS for B, CS and GS, but not BP. Method IVa gave highest I for all feeds except RSC. Method IVn obtained higher k_d than IVa, and especially IS. Average k_d were .06, .10, and .17 for G1 and G2 of all feeds, using methods IS, IVa and IVn, respectively. However, the differences were much larger for BP than for CS. Method IVa gave markedly higher L compared to IVn and IS for all feeds except B. The results demonstrate a marked effect of method on parameter estimates, and indicate that low pH increases lag time and decreases fractional rate of aNDF degradation.

Key Words: Degradation, NDF, Kinetics

T224 The application of a novel, wireless, automated system for determining the fermentation gas production kinetics of feeds. A. Adesogan*[1], S. Kim[1,2], and N. Krueger[1], [1]*University of Florida*, *Gainesville*, [2]*Gyeongsang National University*, *Jinju, South Korea*.

This study describes a novel automated method of measuring the fermentation gas production kinetics of feeds that intermittently measures and relays the pressure arising from the fermentation of feeds in culture bottles to a server using a wireless, radio frequency (RF) signal. The fermentation parameters of three ground (1 mm) feeds (corn, citrus pulp and Pensacola bahiagrass hay, Experiment 1) or esterase enzyme-treated (0, 1 and 2 g/100 g DM) bermudagrass hay (Experiment 2) were determined using the RF sensors and compared to those determined with a digital manometer. Feed samples were incubated in buffered, rumen fluid in quadruplicate (Experiment 1) or triplicate (Experiment 2) in 250 ml, gas-tight, culture bottles at 39 °C. Pressure sensors mounted on each culture bottle were set to take hourly pressure measurements for 96 h and a digital manometer was used to take pressure readings after 0, 2, 4, 6, 8, 12, 24, 48, 60, 72 and 96 h of incubation. An exponential model was fitted to the fermentation gas production data from the sensors and the digital manometer. The fermentation parameters were compared using a 3 x 2 factorial (Experiment 1) and a completely randomized design (Experiment 2). In both experiments, the method of gas pressure measurement did not affect ($P>0.05$) fermentation parameters and there was no method x feed interaction ($P>0.05$). In Experiment 1 the concentrates had greater ($P<0.001$) gas pool size, a faster fermentation rate and a slower lag phase than the hay; and the corn had a longer ($P<0.05$) lag phase, a similar ($P>0.05$) fermentation rate and a greater ($P<0.01$) gas pool size than the citrus pulp. In Experiment 2, increasing esterase enzyme application did not affect the fermentation rate ($P>0.05$), but increased the lag phase ($P<0.05$) and tended ($P=0.063$) to increase the gas pool size. There was a good relationship between RF sensor and manometer-based estimates of gas pool size ($r^2 = 92$), fermentation rate ($r^2 = 83$), and lag phase ($r^2 = 60$). This study demonstrates the potential of the new RF sensor technique for differentiating between the fermentation kinetics of feeds.

Key Words: Gas Production, Kinetics, Fermentation

T225 Comparison of two molecular methods to assess the shift in bacterial population in continuous culture receiving fresh alfalfa or hay with different concentrations of sucrose. C. Ribeiro*, S. Karnati, J. Sylvester, Z. Yu, and M. Eastridge, *The Ohio State University*, *Columbus*.

Identifying shifts in rumen bacterial populations while also measuring nutrient digestibility and the disappearance of unsaturated fatty acids will improve our understanding of the contribution of specific bacterial species to the overall biohydrogenation (BH) process. Denaturing gradient gel electrophoresis (DGGE) and ribosomal intergenic spacer length polymorphism (RIS-LP) were used to determine the effect of forage conservation and sucrose addition on bacterial populations. Four continuous culture fermenters were used in a 4 X 4 Latin square design. The treatments were: 1) fresh alfalfa, 2) alfalfa hay, 3) alfalfa hay plus 4% sucrose, and 4) alfalfa hay plus 8% sucrose. Effluent and bacterial

samples were frozen, lyophilized, and stored at -20 °C. For DGGE, the V3 hypervariable region of the 16S rRNA gene was amplified from extracted DNA using PCR with a universal bacterial primer set. Amplicons were separated on a 6.5% acrylamide gel with a 40 to 60% denaturing gradient. For RIS-LP, extracted DNA was amplified using PCR with primers S926f and L189r. Amplicons containing the complete RIS and parts of the flanking rRNA genes were separated on a 4% polyacrylamide gel. Banding profiles of DGGE and RIS-LP were analyzed using Bionumerics. Digestibility data were analyzed by PROC MIXED of SAS. Cluster analysis of the banding profiles grouped the sucrose treatments together for both methods suggesting that sucrose altered the bacterial populations. As reported previously [J. Dairy Sci. 87(Suppl. 1):38], addition of sucrose linearly ($P < 0.05$) decreased BH. Alfalfa hay with 8% sucrose resulted in 14% lower NDF digestibility than alfalfa hay alone. Digestibilities of fiber fractions were higher ($P < 0.05$) for fresh alfalfa than hay. Future research will identify individual bands and try to identify the bacteria that may be responsible for treatment-induced changes in BH.

Key Words: Fresh Alfalfa, Biohydrogenation, RIS Analysis

T226 Measurement of volatile fatty acid interconversion as a means to study the role of thermodynamics in the control of fermentation. E. Ungerfeld*, B. Bequette, S. Owens, and R. Kohn, *University of Maryland*, *College Park*.

The molar ratios of volatile fatty acids (VFA) observed in the rumen may result in part from thermodynamic constraints on rumen fermentation. If certain pathway branches become infeasible because of the buildup of end products, fermentation may shift momentarily to other pathways, keeping the profile of end products in equilibrium. Because similar bidirectional pathways are used for VFA interconversion as for VFA production, thermodynamic control of VFA production would result in a similar rate of conversion from one VFA to another as the reverse rate of conversion. A method was developed to measure VFA interconversion under different fermentation conditions to determine when thermodynamics may play a role in the control of VFA and gas profiles. VFA interconversion flows were measured by infusing ^{13}C-labeled VFA into ruminal batch cultures that had been incubated for 2 or 8 h with alfalfa hay. VFA were infused in a 73:16:11 molar ratio mixture of acetate, propionate and butyrate, a different one of which was ^{13}C-labeled in each incubation. Samples were taken over 10 h for the incubations that were dosed after 2 h of the fermentation, and over 13 h for the incubations dosed after 8 h of fermentation. VFA production rates increased initially and then declined over the course of the incubation. Rates of conversion of the different VFA into other VFA increased and decreased in parallel with fermentation rates, as expected because the same enzymes are involved. On average throughout the incubation period, rate of conversion of acetate to propionate was similar to the reverse conversion rate, suggesting flows were close to equilibrium. Rate of conversion of two acetate to butyrate was greater than the reverse rate in the first half hour of measurement, but later the forward and reverse rates were similar. The method enabled us to measure non-steady state VFA interconversion rates, and can be used to study the return to equilibrium when fermentation is perturbed under different conditions.

Key Words: Rumen, Thermodynamics, Fermentation

T227 Dry matter determination by conventional oven drying and by semi-automatic halogen moisture analyzer methods. C. T. Kadzere*, Z. Liu, and H. Krebs, *North Carolina A&T State University*, *Greensboro*.

Determining dry matter (DM) is a basic analytical procedure that facilitates the comparison of nutrient content in feed, food, fecal, and other samples on a common denominator. Therefore, an accurate DM is important in compositional analysis of feed samples and is pivotal to ration formulation for precise animal nutrition. The DM of 43 fecal samples from two digestibility studies DSI and DSII were determined in duplicate by the conventional oven drying (OD) method and also by the semi-automatic halogen moisture analyzer (HMA) method. Samples were pre-dried at 55°C for 66 hrs and ground through a 1 mm sieve for DSI. DSII samples were pre-dried as for DSI and ground through a 2 mm sieve. In the OD method, 2 g of the samples were weighed into an aluminum dish and oven dried at 102°C for 24 hrs. The dried residue was cooled in a dessicator and weighed again to determine DM. In the HMA method, a 0.5-1 g sample was weighed into an aluminum sample pan and heated by the internal halogen dryer unit. The HMA determined DM to a constant value. DM was determined by the two methods for DSI and DSII samples. The two-sample t-significance test was used to compare DM data generated from the OD and that from the HMA methods. In DSI, there was no difference ($p \geq 0.05$) in 11 out of the 12 samples between DM determined by the OD and that by the HMA methods. However, in DSII 20 out of 31 samples had higher ($p \leq 0.05$) DM by 0.4 to 2.8 percentage points when DM determined by the HMA method was compared to that determined by the OD method. The variation in these data sets suggests the need to carefully evaluate basic analytical procedures as modern electronic methods are adopted and replace conventional analytical methods in animal nutrition labs. This is important if accurate compositional analysis of feed, food, fecal, and other samples is to be achieved, and if data generated from different analytical procedures are to be interpreted and comparatively used.

Key Words: Dry Matter, Oven Dry, Moisture Anlyzer

T228 A cordless system for continuous ruminal pH recording in dairy cows. O. Alzahal*, B. Rustomo, T. F. Duffield, and B. W. McBride, *University of Guelph*, *Guelph, Ontario, Canada.*

The use of continuous pH recording in dairy cows provides more accurate measurements than spot-sampling technique and better explains the daily diurnal variation in ruminal pH. The existing system, however, uses an indwelling pH sensor that is connected to a remote personal computer via a cable, thus, restricting the movement of the cow. The use of a cordless system has numerous advantages. It provides researchers with a tool to record pH in a free-stall setting as well as during the grazing season. It also allows the experimental animal an access to exercise. The cordless system is compromised of three major components: a sensor, a data logger, and software. The sensor (PHE-7352, Omega Engineering Inc., Stamford, Connecticut, USA) is a heavy-duty sensor designed to assure low maintenance and has the capability of measuring pH under any angle orientation. The sensor connects to a light-weight portable data logger (pHTemp101, Monarch Instrument, Amherst, NH, USA) that is situated in a water-proof box mounted on the animal back. The software (Monarch Instruments Data Recording Software v 2.0) loaded to a personal computer or a PDA allows users to collect, display, analyze, and synchronize data from different loggers. The new system was used to monitor ruminal pH of a dry cow fed *ad-libitum* alfalfa hay for three days. Rumen fluid was sampled and measured using a hand-held pH meter (pH 310, Oakton Instruments, Vernon Hills, IL, USA) four times per day and pH readings were compared against the pH readings obtained at the same time from the continuous system. Readings obtained by the continuous system were not significantly different from those obtained by point-sampling, but tended to be numerically lower. This technique will expand the ability of researchers to study ruminal pH of dairy cows under practical management circumstances such as free-stall housing or during grazing.

	Technique Continuous	Spot-Sampling	SE	*P* value
pH	6.59	6.64	0.03	0.09

Key Words: Dairy Cattle, Ruminal pH, Continuous Recording.

T229 Effect of sampling time on blood metabolites to dairy cows given amino acids, starch and glucose infusions. I. Schei*[1,2], I. A. Boman[1], L. T. Mydland[1], and H. Volden[1,2], [1]*Norwegian University of Life Sciences*, *Aas, Norway*, [2]*TINE BA*, *Aas, Norway*.

Eight multiparous lactating dairy cows were used to evaluate diurnal variation related to time of feeding on blood metabolites to abomasal or intravenous infusion of a mixture of amino acids, wheat starch and glucose. Each cow was assigned to an uncompleted replicated run 4x4 Latin square with 14 d periods, where the last 7 days were for infusions. Infusions were: 1) starch in the abomasum (SP), 2) glucose in the blood (GB), 3) amino acids in the abomasum (AP), 4) amino acids in the blood (AB). The experiment was conducted in early lactation (start 56 ± 7 d postpartum; milk yield 33.4 ± 1.7 kg) and repeated with the same animals and treatments in late lactation (start 159 ± 4 d postpartum; milk yield 22.5 ± 1.1 kg). Daily amounts infused were 400, 446 and 400 g in early lactation and 300, 335 and 300 g in late lactation for starch, glucose and amino acids, respectively. Cows were fed a basal diet of a concentrate mixture and grass silage at a ratio of 55:45 on DM basis and fixed to 95% of the energy requirement receiving 18.6 and 14.0 kg DM d^{-1} in early and late lactation, respectively. Feed was offered three times daily, at 0600, 1400 and 2200. Blood samples from the jugular vein were drawn at 0500, 0800 and 1200. Sampling time showed an effect on glucose, NEFA, urea, insulin and growth hormone ($P < 0.05$), but not on glucagon and IGF-1. Interactions between sampling time, infusions and lactation stage were observed for urea, glucose and insulin. In early lactation, highest glucose concentrations were observed for SP and GB at 0500 and 0800 and for AB at all sampling times in late lactation. In early lactation, insulin were elevated in GB at 0800. However, in late lactation, AB showed the highest post-feeding insulin concentration. From this study it is concluded that glucose and insulin concentrations are not only dependent of time after feeding, but also to substrate supplementation and stage of lactation.

Key Words: Dairy Cows, Insulin, Glucose

T230 Estimating methane emissions from grazing dairy cattle using the SF6 tracer technique. S. Cooper*[1], M. Main[1], C. Benchaar[1,2], D. Lynch[3], and A. H. Fredeen[1], [1]*Nova Scotia Agricultural College*, *Truro, Nova Scotia, Canada*, [2]*Agriculture and Agri-Food Canada, Dairy and Swine R&D Centre*, *Lennoxville, Quebec, Canada*, [3]*Organic Agriculture Centre of Canada*, *Truro, Nova Scotia, Canada*.

The SF6 tracer method for measuring CH_4 emission from lactating dairy cows was compared to that of a respiration chamber under real and simulated grazing conditions. Four Holstein cows were used in a 2 x 2 cross-over design. The cattle were housed under either confinement conditions (respiration chamber) or grazing pasture throughout the study. The chambers (n=2) were 3.5 m deep x 2.6 m wide x 2.6 m tall. In order to simulate grazing within the chamber, fresh pasture was clipped and hand fed twice daily. Additionally, the SF6 collection devices were attached to the cows within chambers to more accurately compare the chamber and the tracer technique in terms of CH_4 emissions. Gas samples were taken for four consecutive days and CH_4 concentration was analyzed using Fournier transformed infrared spectroscopy. SF6 concentration in gas samples was analyzed by gas chromatography. Data were analyzed using the GLM procedure of SAS. The respiration chambers accounted for a higher level of total CH_4 production than the SF6 tracer technique under simulated grazing (347.6 vs. 275 g/d; $P< 0.01$) . However, no difference in total CH_4 emission was observed between the chambers and SF6 method on pasture (349.4 g/d; $P>0.05$) . Results from this study indicate that the SF6 tracer technique can be used to qauntify CH_4 emissions from lactating dairy cows grazing pasture.

Key Words: Dairy Cattle, Methane, Measurment Techniques

T231 Development and evaluation of empirical equations to predict feed passage rate in cattle. S. Seo*[1], L. O. Tedeschi[1], C. G. Schwab[2], and D. G. Fox[1], [1]*Cornell University*, *Ithaca, NY*, [2]*University of New Hampshire*, *Durham*.

The 2001 Dairy NRC database was used to develop empirical equations that can more accurately predict feed passage rate (Kp) in cattle, using a meta-analysis technique. The database was comprised of studies that used external markers, and included wide ranges in BW, DMI and physiological stages (post weaning growth, lactating and dry) of cattle. The selection of significant input variables was done using a random coefficients model that used each study effect as a random variable. The equations developed are: kp forage = 2.365 + 0.214 FpBW + 0.734 CpBW + 0.069 FDMI (n = 553); kp concentrate = 1.169 + 1.375 FpBW + 1.721 CpBW (n = 195); and kp liquid = 4.524 + 0.223 FpBW + 2.046 CpBW + 0.344 FDMI (n = 766), where kp is passage rate, %/h; FpBW is forage DMI as a percentage of BW, %; CpBW is concentrate DMI as a percentage of BW, %; and FDMI is forage DMI, kg. These passage rate equations for forage, concentrate and liquid explained 87%, 95% and 94%, respectively of the variation in passage rates in the data base used in equation development after adjustment for random study effect. These equations and other published equations (2001 dairy NRC, CNCPS cattle, Cannas and Van Soest, Lescoat and Sauvant, Owens and Goetsch and Evans) were evaluated with an independent database. The present equations predicted more accurately than the published equations. The increase in R squared between observed and model-predicted values ranged from 1 to 19%, 1 to 14%, and 4 to 16% and the decrease in the mean square error of prediction varied from 6.7 to 39.2%, 3.3 to 54.4%, and 8.1 to 52.7% in the prediction of kp of forage, concentrate and liquid, respectively. When the present equations were implemented, the CNCPS cattle prediction resulted in up to 1.5 kg lower MP allowable milk. We concluded these empirical equations are suitable for predicting passage rate in cattle. However, because more than half of the variation resulted from the random effect, which was unaccounted for, the development of a mechanistic model that accounts for more of the biologically important variables and their interactions is required to predict passage rate more accurately.

Key Words: Cattle, Passage Rate, CNCPS

T232 Potential of NIR spectroscopy to predict grain vitreousness using whole-plant corn samples. J. Goeser*[1,2], B. A. L. Justen[3], J. Coors[1], and R. Shaver[1], [1]*University of Wisconsin*, *Madison*, [2]*U.S. Dairy Forage Research Center*, *Madison, WI*.

Vitreousness, a measure of corn grain hardness, is an indirect measure of starch degradability in the rumen. Vitreousness can be predicted using near infrared spectroscopy (NIRS) from grain samples. Our objective was to determine whether vitreousness can be determined from whole-plant samples using NIRS, which would simplify evaluating starch degradability in silage trials by eliminating the need for a separate grain evaluation. Nearly 300 whole-plant corn samples were collected from silage evaluation trials from the University of Wisconsin silage breeding program. The trial involved 50 hybrids planted in two-row plots in six replications, with one row harvested for whole-plant silage, and one for grain vitreousness. Vitreousness was determined using a light box technique on ears from 10 plants. Samples ranged in vitreousness from approximately 70-95%, a typical range for commercial hybrid varieties. Vitreousness, based on grain samples, varied significantly (p=.05) among hybrids. Whole-plant silage samples were scanned using a FOSS NIR system Model 6500 scanning monochrometer with a spectral range between 400-2498 nm. Approximately 2 g of ground sample was used for scanning. The Infrasoft International NIRS version 3.0 software program CALIBRATE with the modified partial least squares regression option was used for analysis. Thirty-one NIRS math treatments were applied to the data, and 20% of the samples were randomly selected for cross validation. The highest R^2-value relating predicted to observed data points was 0.22 when using a 4,1,2,1 math treatment, which was not satisfactory. The poor NIRS predictions are likely the result of dilution of the grain portion by the stover. Determination of grain vitreousness by NIRS should be limited to using ground grain samples as opposed to whole-plant samples.

Key Words: Corn, Starch, Vitreousness

T233 A comparison of three techniques for determining the physical effectiveness factor for use in calculating physically effective NDF. K. W. Cotanch*[1], J. W. Darrah[1], H. M. Dann[1], R. J. Grant[1], and J. Audy[2], [1]*W.H. Miner Agricultural Research Institute*, *Chazy, NY*, [2]*Feed Commodities International*, *Vergennes, VT*.

The physically effective NDF content of a feed is determined by multiplying the NDF content of the feed by a physical effectiveness factor (pef). The pef is determined analytically as the proportion of dry matter greater than 1.18-mm using dry sieving with a Ro-Tap Sieve Shaker (Ro-Tap). The Penn State Particle Separator (PSPS) has been proposed as a method to determine pef on farm quickly and inexpensively. The objective of this study was to compare pef values from the Ro-Tap method to pef values from 2 PSPS methods. Samples of corn silage (n=20) and hay crop silage (n=21) were collected from 15 commercial dairy farms in Vermont. Particle size distribution was determined for all samples using the Ro-Tap and the PSPS. The pef was determined as 1) the proportion of dry forage greater than 1.18-mm using a Ro-Tap ($pef_{Ro\text{-}Tap}$), 2) the proportion of as-fed forage greater than 1.18-mm PSPS (pef_{PSPS}), and 3) the proportion of as-fed forage remaining on the 19 and 8-mm sieves plus 50% of the amount remaining on the 1.18-mm sieve and pan using the PSPS ($pef_{PSPSmod}$). Data were analyzed using the CORR and REG procedures of SAS. For corn silage, there were positive correlations between $pef_{Ro\text{-}Tap}$ and pef_{PSPS} (r=0.82; $P<0.001$) and $pef_{Ro\text{-}Tap}$ and $pef_{PSPSmod}$ (r=0.82; $P<0.001$). Compared to Ro-Tap (x), PSPS (y_1) over predicted pef ($y_1=0.31x+0.71$) and PSPSmod (y_2) under predicted pef ($y_2=1.71x-0.68$). For hay crop silage, there was no correlation between $pef_{Ro\text{-}Tap}$ and pef_{PSPS} (r=0.17; $P=0.45$) and a weak correlation between $pef_{Ro\text{-}Tap}$ and $pef_{PSPSmod}$ (r=0.45; $P=0.04$). Compared to Ro-Tap (x), PSPSmod (y_3) over predicted pef ($y_3=0.26x + 0.65$). Though a limited sample set and range of pef values, the PSPS and modified PSPS systems did not accurately measure pef as defined by standard dry sieving. If on-farm measurement of pef is needed, then a new method or sieving tool needs to be developed.

Key Words: peNDF, Dry Sieving, Penn State Particle Separator

T234 Pool size and flux of vaccenic acid during in vitro incubation of fresh alfalfa modeled by SAAM II. C. Ribeiro*, M. Eastridge, and D. Palmquist, *The Ohio State University*, *Columbus*.

The concentration of vaccenic acid (VA) during ruminal biohydrogenation (BH) is important because it is the major source of conjugated linoleic acid in milk from cows. We developed multicompartmental models to estimate pool size and flux of VA during BH of FA in fresh alfalfa. Alfalfa was harvested and immersed immediately in liquid nitrogen. Approximately 0.5 g of the frozen alfalfa was inoculated with rumen fluid using two buffers: a strong buffer (SB; 0.4 *M* $NaHCO_3$) and a weak buffer (WB, 0.2 *M*; 50:50 $NaHCO_3$/NaCl, wt/wt). Samples were incubated for 0, 1, 2, 3, 4, 6, 9, and 12 h. At each sample time, pH was measured and the tubes were immediately put in ice and stored at -20 °C until freeze-drying. Fatty acids (FA) were transesterified and measured using GLC. Average concentration of VA during incubation was estimated by PROC MIXED of SAS. The temporal change in the size of the VA pool and BH of VA were estimated by SAAM II. Precision of measuring the VA pool size was estimated from the CV for each time point in each buffer solution. There was no difference ($P > 0.05$) in the rate of BH of VA between SB (13.0%/h) and WB (11.7%/h). The VA concentration did not differ ($P > 0.05$) between buffers; however, the CV for pool size for SB and WB were 2.5% and 3.45%, respectively. Appearance of VA was greater than disappearance until ca. 6 and 9 h for SB and WB, respectively (see table). These represent the times that VA concentration peaked for each buffer. Because SAAM II estimates fluxes, as well as mass of the VA pools, it generates more information from the data than using SAS alone and is therefore a useful tool to model ruminal BH.

Flux (mg/h) of vaccenic acid appearance and disappearance

Time (h)	SB App.	SB Disapp.	WB App.	WB Disapp.
0	0.000	0.056	0.000	0.043
1	0.202	0.070	0.146	0.051
2	0.278	0.098	0.219	0.070
3	0.286	0.126	0.247	0.091
4	0.264	0.150	0.247	0.112
6	0.191	0.175	0.209	0.142
9	0.098	0.173	0.134	0.156
12	0.047	0.146	0.077	0.146

Key Words: Vaccenic Acid, Biohydrogenation, Fresh Alfalfa

T235 Rate of disappearance of linoleic and linolenic acids from fresh alfalfa during in vitro incubations estimated by SAAM II. C. Ribeiro*, M. Eastridge, and D. Palmquist, *The Ohio State University*, *Columbus*.

We used kinetic analysis (SAAM II) of disappearance rates (DR) of unsaturated fatty acids (FA) to study dietary and ruminal factors affecting biohydrogenation (BH) and formation of *trans* FA in fresh alfalfa. Alfalfa samples were harvested and immersed immediately in liquid N, then freeze-dried, ground to 1 mm, and stored at -20 °C. Approximately 0.5 g of frozen alfalfa was inoculated with rumen fluid using two buffers: a strong buffer (SB; 0.4 *M* $NaHCO_3$) and a weak buffer (WB, 0.2 *M*; 50:50 $NaHCO_3$/NaCl, wt/wt). Samples were incubated for 0, 1, 2, 3, 4, 6, 9, and 12 h; pH was measured and tubes were put in ice and stored at -20 °C until freeze-drying. The FA were transmethylated and measured by GLC. The DR (h^{-1}) of 18:2 and 18:3 were estimated by PROC NLIN of SAS and by SAAM II. Comparison of the two methods was performed by paired *t*-Test of the DR from each FA in each buffer. The average pH for the SB and WB were 6.7 and 6.2, respectively. The DR was lower ($P < 0.05$) for 18:2 and 18:3 in WB and did not differ ($P > 0.05$) between methods of estimation. The SE of the DR were very similar between methods. SAAM II is a superior approach to model the dynamics of FA metabolism in BH.

Disappearance rates (h^{-1}) of 18:2 and 18:3

Methods	18:2 SB	18:2 WB	18:3 SB	18:3 WB
SAS	0.281	0.245	0.440	0.308
SAAM II	0.275	0.236	0.438	0.303
Probability (*t*-Test)	0.27	0.27	0.41	0.24

Key Words: Biohydrogenation, Fresh Alfalfa, Kinetics

T236 Modeling nutrient supply to ruminants using NRC-2001 with inputs based on in situ and mobile bag techniques measurements. P. Yu*, *University of Saskatchewan*, *Saskatoon, SK, Canada*.

The objectives of this study were to use the NRC-2001 model with inputs based on in situ and mobile bag techniques measurements to predict the potential nutrient supply to dairy cows using an exampled feedstuff - lupin seeds that were systematically pressure-toasted and to determine how pressure-toasting effects (which shifted degradation of protein from rumen to small intestine without changing intestinal digestion) could be quantitatively measured by the model. The quantitative predictions were made in terms of: 1) rumen undegraded (RUP)

and 2) degraded rumen protein (RDP), 3) truly absorbed undegraded protein (ARUP), 4) microbial protein (MCP) synthesized in the rumen from rumen available protein or 5) from total digestible nutrients (TDN), 6) truly absorbed rumen synthesized microbial protein (AMCP), 7) truly absorbed rumen endogenous protein (AECP), 8) total metabolizable protein (MP), as well as 9) the protein degradation balance (PDB). The results show using NRC-2001 with inputs based on in situ and mobile bag techniques measurements, the protein degradation balance and total metabolizable protein supply to dairy cattle could be quantifiably predicted. However, the results differed from that published with the DVE/OEB system (which is a non-TDN based model) although the two models had significant correlations with high R square (> 0.99) values. Using the NRC model, the overall mean for the total absorbed protein in the small intestine was higher (+10 g/kg DM), but the protein degradation protein balance values were lower (-12 g/kg DM) in comparison to that predicted by the non-TDN based model. These differences are due to considerably different factors used in calculations in the two models, although both are based on similar principles. This indicates that a further refinement is needed for a modern protein evaluation and prediction system

Key Words: Modeling Nutrient Supply, Ruminants, NRC and DVE/OEB

T237 Comparison between nylon bag method and gas production method in determination of feedstuff nutritive value. A. Nikkhah* and A. Mahdavi, *University of Tehran*, *Karaj, Tehran, Iran*.

This investigation was conducted to determine dry matter digestibility (DMD), crude protein degradability (CPD), neutral detergent fiber (NDF), acid detergent fiber (ADF) and gas production of some feedstuffs with different methods. Six cannulated bulls (Holstein and Sistani bulls) in a complete randomized design with two replicates were used. The amounts of gas production at 0, 2, 4, 6, 8, 12, 24, 48, 72 and 96 hours and feedstuffs degradation by nylon bag at 0, 4, 8, 16, 24, 48, 72 and 96 hours were measured. The feedstuffs that were used in this study included: alfalfa hay, wheat straw, corn silage, concentrate and cottonseed, which consumed at maintenance level by experimental animals. Dry matter degradability at 96 hours for alfalfa hay, wheat straw and corn silage were 71.52%, 51.02% and 77.89% and at 48 hours for concentrate and cottonseed were 80.59% and 53.51% and the dry matter degradability for these feedstuffs at 24 hours were 66.93%, 33.57%, 68.24%, 79.83% and 48.71%, respectively. The amount of gas production at 96 hours of incubation for alfalfa hay, wheat straw and corn silage were 51, 45, and 75.5 mL/h and for concentrate and cottonseed at 48 hours of incubation were 81 and 58.5 mL/h, respectively. Correlation coefficient between dry matter degradation and gas production for these feedstuffs were 0.99, 0.99, 0.99, 0.96 and 0.99, and correlation coefficient between crude protein degradation and amount of gas production were 0.97, 0.99, 0.99, 0.99 and 0.98 respectively. Due to high correlation coefficient between dry matter degradation, crude protein degradation, ADF degradation, NDF degradation and gas production, regression equations between these parameters and gas production were calculated to estimate amount of these parameters from amount of gas production without doing digestion experiments. The calculated regression equation between alfalfa dry matter degradation and its gas productions was: Y=35.724+0.714X, so for 51 mL gas production for alfalfa at 96 hours, this equation estimate 72.14% degradation for alfalfa dry matter that is in a good agreement with 71.52% from digestion experiments.

Key Words: Feedstuff, Gas Production, Nutritive Value

Ruminant Nutrition: Small Ruminants

T238 Effect of dietary copper supplementation on fatty acid profile of muscle, mesenteric, and subcutaneous adipose tissue in goat kids. E. Ellis[1], W. Bergen[1], S. Solaiman[2], and K. Cummins*[1], [1]*Auburn University*, *Auburn*, [2]*Tuskegee University*, *Tuskegee, AL.*

A feeding trial was conducted to evaluate the effect of dietary copper (Cu) supplementation at 0, 100 and 200 mg/d above basal intake on relative amounts of fatty acids in various tissue depots of goats (n=5/treatment). Copper was given daily in gelatin capsules. Goats were slaughtered at 98 days of the experimental protocol. Samples of longissimus dorsi muscle and subcutaneous and mesenteric adipose tissue were taken after slaughter and flash frozen and kept at -80 degrees C until analysis. Total lipids were extracted with cholorform:methanol (2:1), fatty acid methyl esters were prepared and analyzed using gas chromatography and mass spectrometry. Data are expressed as percent of the total lipids. Dietary Cu supplementation elicited a variable effect depending on the tissue. In muscle C15:0 increased linearly with increasing Cu (P<.05; 0.08, 0.17, 0.17 for 0, 100 and 200 mg/d dietary Cu, respectively). Dietary Cu supplementation resulted in an linear decrease in C14:0 (P<.03; 3.96, 3.22, 2.63 for the 0, 100, and 200 mg/d Cu, respectively) and C16:0 (P<.02; 25.56, 23.76, and 23.86 percent for 0, 100 and 200 mg/d Cu) in subcutaneous adipose. In mesenteric adipose C18:2 trans, trans isomer tended to increase P<.06; 0.05, 0.1, and 0.07 percent for the 0, 100 and 200 mg/d Cu) with increasing Cu. Ten other hydrophobic, methylated compounds for which standards were not available were identified in mesenteric adipose tissue, based on melting point in the GC, linear retention time, and mass, as being altered in relative concentration by dietary Cu supplementation. Two other compounds, one in each of subcutaneous adipose and muscle tissue, were altered by dietary Cu supplementation. Dietary Cu supplementation altered the fatty acid profile of various tissues in the goat kid. The effect varied with tissue and affected different fatty acids in different tissues. The effect on odd-chain fatty acids observed in muscle may indicate an effect of dietary Cu on rumen microorganisms. Dietary Cu supplementation may offer a means of altering carcass lipid profile as well as content.

Key Words: Copper, Goat, Lipid

T239 The effect of dietary n-6/n-3 fatty acid ratio on feed intake, digestibility, and fatty acid profiles in muscle of growing lambs. S. C. Kim*[1,2], A. T. Adesogan[1], C. R. Staples[1], and L. Badinga[1], [1]*University of Florida*, *Gainesville*, [2]*Gyeongsang National University*, *Jinju, Gyeongsangnam-do, Korea.*

This study investigated the effect of modifying the n-6/n-3 ratio of dietary oil supplements on apparent digestibility, growth performance and foreshank fatty acid profile of growing lambs. Forty individually housed, Katadhin cross lambs (average of 20.0 kg initial BW) were fed bermudagrass hay (10.5% CP and 1.25% EE) in ad libitum amounts and were supplemented with a concentrate (18.7% CP and 7.7% EE) containing corn, soybean meal and oil (72:24:4) at 3.7% of BW. The lambs were blocked by BW and randomly assigned to four dietary oil supplement treatments containing n-6/n-3 ratios of 2:1, 10:1, 16:1 and 20:1 by mixing linseed oil, cottonseed oil, and soybean oil. At the end of the 28-d trial, samples of blood, rumen fluid and foreshank tissue were collected at slaughter. Increasing the n-6/n-3 fatty acid ratio of the supplemental oils did not affect DM intake (960 g/d), apparent digestibility of DM (74.1%), CP (49.4%), or EE (82.6%), ruminal fluid concentrations of acetate (32.8 molar %), propionate (37.8 molar %) and ammonia (30.6 mg/100 ml) or BW gain (0.26 kg/d). Plasma concentrations of IGF-1 and insulin tended to increase linearly with increasing n6/n3 ratio (P=0.15). Increasing the n-6/n-3 fatty acid ratio of the supplemental oils linearly changed the fatty acid concentration of the foreshank lipid (% of lipid) as follows: C18:2 (17.0, 20.3, 22.9, and 28.8%), trans-10,cis-12 CLA (0.01, 0.04, 0.06, and 0.04%), C20:4 n-6 (8.9, 10.7,13.1, and 14.7%), and total polyunsaturated fatty acids (31.2, 34.6, 39.9, and 47.9%) increased linearly whereas the n6/n3 ratio increased in a quadratic fashion (5.5, 9.9, 10.6, and 10.6). Alternatively, concentrations of C14:0, C16:0, C16:1, C18:1, C18:3, cis-9,trans-11 CLA, saturated fatty acids, and monounsaturated fatty acids decreased in either a linear or quadratic fashion as the n6:n3 ratio increased. Feeding oils to young lambs can change the fatty acid profile of muscle lipid fractions.

Key Words: Lamb, Digestibility, Fatty Acid Profiles