was estimated to be 0.30 using a random bred population. Thereafter, distinct lines were produced by genetic selection. Phenotypic variation evaluated with computer-assisted sperm motion analysis, which described motile properties of individual sperm within populations. Motile concentration and straight line velocity (VSL) were used to predict sperm mobility. Specifically, phenotype was a function of the area within the upper tail of a male's VSL distribution. Consequently, the predictive power of the sperm mobility assay depends on a context in which the *consequences* of variation in VSL become manifest in time. The shape of VSL distributions was explicable in terms of mitochondrial function. In this regard, mobile sperm were rendered immobile by a reagent used to induce the mitochondrial permeability transition pore. Consequently phenotypic variation may be related to Ca^{2+} overloading while sperm pass through excurrent ducts of the testis. As such, a sperm mobility measurement may reflect the proportion of disabled sperm within an ejaculate. Three unexpected experimental outcomes included: (1) a model explaining in vivo sperm storage, (2) the relationship between mitochondrial Ca^{2+} cycling and sperm motility, and (3) a new paradigm for artificial semen storage.

Key Words: Sperm Mobility, Sperm Motility, Semen Storage

980 Using the Sperm Quality Analyzer Vt for dosimetry of turkey semen in commercial turkey operations; the potential impact on fertility, and the economic implications of better utilization of sires with superior growth potential. K. K. Krueger*, *Diamond K Research*, *Marshville, NC*.

The Sperm Quality Analyzer Vt (SQA Vt) estimates total (TSC) and motile sperm cell (MSC) concentration in either neat or diluted turkey semen. The device is simple to use and results are returned within 3 minutes. No special calibration, operator training, or sensitive reagents are required. Bench trials have confirmed SQA Vt accuracy and repeatability matches or exceeds other methodologies (i.e., hemocytometer, conventional photo spectroscopy, subjective microscopy). Several field trials and ongoing use in properly managed and supervised commercial turkey operations have shown that when dosimetry is based on motile sperm cell number that ~150 million motile sperm per insemination had no adverse effect on fertility. When insemination doses were prepared on motile sperm cell number, fertility was found to be more stable and often improved during the latter weeks of egg production. Dosimetry based on motile sperm cell numbers has been shown to have a positive impact on fertility, but more importantly it allows sires with superior growth characteristics to be used more efficiently and effectively. Unlike the swine and cattle industries where better superior sire utilization is a primary concern, the commercial turkey industry has failed to recognize the potential impact this concept can have on profitability. Identifying males with superior growth and carcass characteristics, managing them for optimum motile sperm cell production, maximum harvest, and motile sperm cell based dosimetry can have a significant impact on genetic progress and economics in the turkey industry.

Key Words: Sperm, Motility, Fertility

981 Using egg breakout to estimate flock fertility. J. L. Wilson*, *University of Georgia*, *Athens*.

Egg breakout is an excellent tool to estimate flock fertility. This information is used in determining the number of eggs to incubate to meet broiler placements. In addition, egg breakout is a powerful diagnostic tool when flocks are not hatching as expected. It is important to candle eggs between 10-14 days of incubation and open the eggs to determine percentage fertility and early dead embryos. While the end results of low fertility or high numbers of early dead embryos are both low hatchability the causes are distinctly different. Valuable time can be gained in quickly identifying fertility issues and making managerial changes such as spiking the flock to increase fertility. High early embryonic mortality is usually related to egg handling, flock health or chemical exposure. During the candling process other important information can be gathered like the number of eggs in the incubator flat upside down and number of eggs with hairline cracks. Gathering and using egg breakout data to correct low fertility, high embryo mortality, upside down egg placement or loss due to high cracked egg numbers is critical in maximizing chick production.

Key Words: Egg Breakout, Fertility, Candling

Ruminant Nutrition: Nitrogen Digestion/Metabolism

982 Development and establishment of an enzymatic in vitro procedure for estimating intestinal protein digestibility of feedstuffs for ruminants. R. Irshaid[1,2] and K.-H. Suedekum*[2], [1]*University of Kiel*, *Kiel, Germany*, [2]*University of Bonn*, *Bonn, Germany*.

This study utilized forty-nine feed samples to develop and establish a completely laboratory-based, enzymatic in vitro procedure (EIVP) for estimating the intestinal protein digestibility (IPD) of rumen-undegradable protein (RUP) of forages and concentrates. Feed samples encompassed forages with varying crude protein (CP) contents, unprotected or rumen-protected protein supplements and cereal grains representing energy-rich feeds of low to medium CP concentration. The EIVP involved the subsequent digestion of samples with a protease from *Streptomyces griseus*, pepsin-HCl, and pancreatin. The concentration of the *S. griseus* enzyme was related to the true protein content of the feed sample. Briefly, the EIVP started with determination of true protein. Feeds were incubated for 18 h in a buffer solution at a constant ratio (41 U/g) of *S. griseus* protease activity to feed true protein. The dried residues were incubated in pepsin-HCl solution for 1 h and residues from this step were incubated with pancreatin solution for 24 h. Samples had previously been used for IPD estimates using a three-step in situ-in vitro procedure (ISIVP) and mobile-bag technique (MBT). The relationships between IPD values estimated by EIVP and ISIVP or MBT were best described by linear regression equations: IPD_{MBT} (g/kg true protein) = 1.221 IPD_{EIVP} (g/kg true protein) - 165.95 ($n = 38$, $r^2 = 0.666$, $P < 0.0001$) and IPD_{ISIVP} (g/kg true protein) = 1.053 IPD_{EIVP} (g/kg true protein) - 28.14 ($n = 49$, $r^2 = 0.985$, $P < 0.0001$). Results from the EIVP closely resembled those obtained with the ISIVP and thus, the completely laboratory-based, standardized EIVP can replace the more invasive ISIVP for estimating IPD of a wide range of feedstuffs for ruminants.

Key Words: Protein, Digestibility, Small Intestine

983 Evaluation of lysine digestibility in rumen undegraded protein using the precision-fed rooster assay and two *in vitro* methods. S. E. Boucher*[1], C. Pedersen[2], H. H. Stein[3], C. M. Parsons[3], and C. G. Schwab[1], [1]*University of New Hampshire*, *Durham*, [2]*Danisco Animal Nutrition*, *Marlborough, UK*, [3]*University of Illinois*, *Urbana*.

Sixteen feed samples were obtained from the Feed Analysis Consortium, Inc. to evaluate furosine and homoarginine (HA) methods for determining the availability of Lys in rumen undegraded protein (RUP-Lys). Furosine is a secondary product of the initial stages of the Maillard reaction, and HA is formed by the reaction of reactive Lys with O-methylisourea (guanidination reaction). Three samples of soybean meal (SBM), 3 samples of SoyPlus®, 5 samples of dried distillers grains with solubles (DDGS), and 5 samples of fishmeal (FM) were used. Samples were incubated for 16 h *in situ* in the rumen of 4 lactating Holstein cows, averaging (mean ± SD) 48 ± 4 days in milk, fed a 55% forage, 45% concentrate diet. Residues were collected and pooled by feed sample, and portions were crop-intubated to cecectomized roosters. Four birds per sample were intubated with the residue, and endogenous AA excretion was estimated from fasted roosters. Total excreta was collected for 48 h post-intubation and analyzed for Lys content. True digestibility (TD) of RUP-Lys was calculated. In the furosine method, all residues were analyzed for furosine and Lys content; however, only 9 of the 16 samples contained furosine. Percent blocked Lys was calculated. In the HA method all residues were guanidinated for 72 h and analyzed for Lys and HA content. The percent Lys converted to HA was calculated. The results of the experiment showed that percent furosine (n=9), blocked Lys (n=9), and Lys converted to HA (n=16) were correlated to TD of RUP-Lys (R^2 = 0.86 0.94, and 0.90, respectively). In conclusion, it appears that measurements of furosine or HA in rumen digesta residues of SBM, SoyPlus®, DDGS, and FM can be used to predict RUP-Lys digestibility.

Key Words: Lysine Digestibility, Rumen Undegraded Protein, Cecectomized Roosters

984 Amino acid digestibility in rumen undegraded protein estimated in cecectomized roosters and the immobilized digestive enzyme assay (IDEA™). S. E. Boucher*[1], M. Vázquez-Añán[2], J. Wu[2], C. M. Parsons[3], and C. G. Schwab[1], [1]*University of New Hampshire*, *Durham*, [2]*Novus International*, *St. Louis, MO*, [3]*University of Illinois*, *Urbana*.

Sixteen feed samples were obtained from the Feed Analysis Consortium, Inc. to evaluate the immobilized digestive enzyme assay (IDEA™; Novus International, Inc.) as an *in vitro* method to estimate the digestibility of amino acids (AA) in rumen undegraded protein (RUP-AA). Three soybean meal (SBM), 3 SoyPlus®, 5 dried distillers grains with solubles (DDGS), and 5 fishmeal (FM) samples were used. Each sample was incubated for 16 h *in situ* in the rumen of 4 lactating Holstein cows averaging (mean ± SD) 48 ± 4 days in milk, fed a 55% forage, 45% concentrate diet. Residues were collected and pooled by feed sample, and portions analyzed for AA content, crop-intubated to cecectomized roosters, and analyzed via IDEA™. Four birds per sample were used, and endogenous AA excretion was estimated from fasted roosters. Total excreta was collected for 48 h post-intubation and analyzed for AA content. True digestibility (TD) of RUP-AA was calculated. The IDEA™ consisted of 4 steps; sample preparation, dissolution, digestion, and *o*-phthaldialdehyde (OPA) analysis. An IDEA™ value was calculated for each sample based on absorption of the product after the OPA reaction. The IDEA™ values were correlated to TD of RUP-AA measured in the roosters. The IDEA™ values were good predictors of the digestibility of RUP-AA in SBM and SoyPlus® (R^2 = 0.91 and 0.83 for Lys and Met, respectively) and DDGS (R^2 = 0.95 and 0.95 for Lys and Met, respectively). However, the IDEA™ values were not as good predictors of RUP-AA digestibility in FM (R^2 = 0.53 and 0.46 for Lys and Met, respectively) which may be due to a lack of variability in digestibility of RUP-AA among the FM samples. In conclusion, IDEA™ may be a good approach for predicting the digestibility of RUP-AA in SBM and DDGS, and further evaluation of IDEA™ for predicting digestibility of RUP-AA in FM is warranted.

Key Words: Amino Acid Digestibility, Immobilized Digestive Enzyme Assay™, Rumen Undegraded Protein

985 Influence of level of intake upon rumen degradability of protein sources. I. Schadt*[1], G. Azzaro[1], R. Petriglieri[1], P. J. Van Soest[2], K.-H. Südekum[3], and G. Licitra[1,4], [1]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [2]*Cornell University*, *Ithaca, NY*, [3]*University of Bonn*, *Bonn, Germany*, [4]*D.A.C.P.A. University of Catania*, *Catania, Italy*.

Increasing intake pushes rumen turnover, passage and protein escape. The objective of this study was to investigate the effect of turnover on rates of protein degradation. Five protein sources: herring meal, soy flakes, soybean meal, sunflower and brewers grains were incubated in situ for 4, 8, 12, 24, 36, 48 and 72 hours and residual nitrogen measured with six cows, two dry, two midlactation and two at high level of intake and milk production. The TMR′s fed to respective cows were also incubated in situ. The level of DMI (level 1, 2, 3, respectively, range: 9,9 to 25,4 kg DM/d) significantly reduced rates of rumen degradability rates for all protein sources, varying from 12-50% from the lowest to the highest intake, depending on the protein source. Rumen escape protein was calculated using estimated Turnover time (T_{DM}) according to Cannas (PhD thesis, Cornell University, 2000). Kp= $1/T_{DM}$ where T_{DM} = 19.89 - 12.82 * LN (dietary Neutral Detergent Solubles intake as % of body weight). Protein degradabilities were also measured with S. griseus protease at the respective times. Average time required for the S. griseus (1 U/ml) to achieve the extents observed in the in situ bags at predicted T_{DM} were 47h at level 1, 11h at level 2, and 5h at level 3. Ratios of these times with T_{DM} estimate rumen enzymatic activities: 1,9U/ml at level 1, 0,9U/ml at level 2 and 0,5U/ml for level 3. Regression of enzyme time on T_{DM} was y = 2.84 - 23.4x, R^2=0.94, n 6. This is evidence that the differences in the respective digestion of the protein sources with intake are due to varying proteolytic activity in the rumen.

Key Words: Rumen Protein Degradability

986 Balancing diets for rumen microbial protein requirements: 1) effects on animal performance under a deficient rumen available protein scenario. P. J. Guiroy*, D. H. Theuninck, C. B. Calk, and J. N. Pike, *Cargill Inc*, *Minnetonka, MN*.

The objective was to evaluate feedlot performance in diets that provided the same percentage of rumen fermentable carbohydrates but differing in the supply of rumen available protein (**RAP**, sum of degradable intake CP and recycled nitrogen). Diets were formulated

with the Cargill MAX™ system, which utilizes a model to estimate microbial CP (**MCP**) based on type and amount of dietary carbohydrates fermented in the rumen. The trial was conducted with 1806 steers with 3 treatments and 6 pen replications per treatment for 166 d. All diets were isocaloric, and isonitrogenous at 13.3% CP. Diets contained the same inclusion of flaked corn, alfalfa hay, corn silage, fat, and supplement. Treatment supplements contained different sources of protein to meet diet objectives: **Low RAP** diet (RAP deficient by 10% compared to MCP with NPN at 2.50%), **Balanced RAP** diet (compared to MCP with NPN at 3.25%), and **Balanced RAP-High NPN** diet (compared to MCP with NPN at 3.60%). Balanced treatments improved ADG and feed to gain ratio in comparison to Low RAP. Only the Balanced RAP diet resulted in heavier HCW and larger LM in comparison to the Low RAP diet, indicating an advantage in limiting concentration of NPN. DMI was higher during the first 60 d (P< 0.01) when diets were balanced for RAP with a tendency for DMI to be higher for the entire feeding period (P=0.11). Results indicated that meeting MCP requirements with RAP improved DMI and performance. We hypothesize that improved DMI may be due to increasing MCP yield, which results in improved rumen health conditions.

Table 1.

Item	Treatments[1] Low RAP	Balanced RAP	Balanced RAP–High NPN	SEM	P–value
Initial BW, kg	342	343	343	1.54	0.71
Final BW, kg	606[b]	617[a]	613[ab]	2.50	0.02
ADG, kg	1.59[b]	1.65[a]	1.63[a]	0.01	0.01
Daily DMI, kg	9.30	9.52	9.36	0.07	0.11
Feed to Gain ratio	5.85[b]	5.77[a]	5.75[a]	0.019	0.01
HCW, kg	386[b]	394[a]	390[ab]	1.59	0.02
Fat thickness, cm	1.50[b]	1.60[a]	1.58[a]	0.015	<0.01
LM, sq cm	97.4[b]	99.7[a]	98.1[b]	0.45	0.02

[1]Diets were isocaloric (at 1.576 Mcal/kg NEg) and isonitrogenous (at 13.3% CP). [ab]Means differ (P<0.05).

Key Words: Beef, Feedlot, Degradable Intake Protein

987 Balancing diets for rumen microbial protein requirements: 2) effects on animal performance under an excess rumen available protein scenario. J. N. Pike*, P. J. Guiroy, D. H. Theuninck, and C. B. Calk, *Cargill Inc*, *Minnetonka, MN*.

A trial was conducted to evaluate the effect of rumen available protein (**RAP**) relative to microbial CP (**MCP**). The Cargill MAX™ system was used to formulate diets. RAP is the sum of degradable intake protein (**DIP**) and recycled nitrogen while MCP potential is estimated from type and amount of dietary carbohydrate fermented in the rumen. The trial was a 2 x 3 factorial (2 management systems and 3 protein formulations) using mixed breed steers (n=2400, 4 replications). There were no important interactions and only effects of protein formulation will be discussed. Treatments were: **Control**, (13.8% CP, 1.6% NPN, RAP in excess of MCP by 11%); **Balanced** (12.8% CP, .77% NPN, RAP equal MCP), **Hi-Soluble DIP** (13.8% CP, 1.9% NPN, RAP in excess of MCP by 13%). Rations contained 33% steam-flaked corn, 21.5% high-moisture corn, 24% Sweet Bran, 9.5% corn silage, 4.6% tallow and 7.4 % supplement designed to provide desired levels of CP, DIP and NPN. There was a difference in feed conversion (P<0.10) among treatments and a trend for improved ADG for the Balanced diet. There were no differences among treatment groups in HCW or quality grade. The Balanced treatment resulted in lower fat thickness and larger LM than excess RAP diets. Formulating rations to balance RAP with MCP, with no minimum CP, had no negative effects on performance compared with formulating to more typical feedlot crude protein levels. In this trial, balancing RAP with MCP lowered total CP, resulting in reduced feed cost of US$2.81 and US$1.40 per head compared to the Control and Hi-Soluble DIP, respectively.

Table 1.

Item	Treatments[1] Control	Balanced	Hi–Soluble DIP	SEM	P–value
Initial BW, kg[2]	346	343	345	0.94	0.06
Final BW, kg	611	610	610	2.22	0.85
ADG, kg	1.54	1.56	1.51	0.02	0.16
Daily DMI, kg	8.85	8.82	8.84	0.07	0.96
Feed to Gain ratio	5.76[cd]	5.66[c]	5.85[d]	0.06	0.10
HCW, kg	388	387	386	1.24	0.54
Fat thickness, cm	1.35[b]	1.27[a]	1.37[b]	0.02	0.02
LM, sq cm	86.5[b]	91.1[a]	89.5[b]	0.40	0.04

[1]All diets were isocaloric (at 1.62 Mcal/kg NEg). [2]Initial BW did not affect results. [a, b]Means differ (P<0.05). [c, d]Means differ (P<0.10)

Key Words: Beef, Feedlot, Degradable Intake Protein

988 Effect of level of metabolizable protein on milk production and nitrogen utilization in lactating dairy cows. C. Wang*[1], J. X. Liu[1], Z. P. Yuan[1], Y. M. Wu[1], S. W. Zhai[1], and H. W. Ye[2], [1]*Institute of Dairy Sciences, Ministry of Education Key Laboratory of Molecular Animal Nutrition, Zhejiang University*, *Hangzhou 310029, China*, [2]*Hangzhou Zhengxing Animal Industry Company*, *Hangzhou 311301, China*.

The objective of this study was to investigate the effects of levels of metabolizable protein (MP) on milk production and nitrogen utilization in Chinese Holstein dairy cows. Forty multiparous dairy cows (body weigh (BW) =590 kg; days in milk=135; average milk yield=30.2 kg/d) were assigned to treatments randomly within groups based on DIM and milk production. Animals were offered diets with different levels of MP: 8.3 (Diet A), 8.9 (Diet B), 9.7 (Diet C), and 10.4 (Diet D) % of DM. The MP level in Diet A was designed to meet the requirement according to current CNSAPH, while that in Diet D was based on NRC-2001 model. The experiment lasted for seven weeks. Milk yield and milk compositions (fat, protein, and lactose) were recorded, and urea nitrogen concentration in serum, urine, and milk were measured during the experiment. Milk yield and milk protein percentage increased as the MP increased up to 9.7 % of DM, and then leveled off. Concentrations of nitrogen in urine, serum, and milk increased lineally as the MP amount was increased, indicating decreased efficiency of N utilization. Milk lactose percentage and total solid percentage showed no significant differences among four diets. It is concluded that the optimal dietary MP level was at 9.6 % of DM for Chinese Holstein dairy cows producing 30 kg milk per day.

Key Words: Metabolizable Protein, Milk Production, Lactating Cows

989 Nutrient demand affects nitrogen utilization responses to diets containing alfalfa or orchardgrass. J. A. Voelker Linton* and M. S. Allen, *Michigan State University*, *East Lansing*.

Effects of feed intake on relative responses of N intake, digestion, and utilization to alfalfa silage versus orchardgrass silage were evaluated. Eight ruminally and duodenally cannulated Holstein cows were utilized in a crossover design experiment with a 14-d preliminary period and two 15-d treatment periods. Cows were 139 ± 83 (mean ± SD) DIM at the beginning of the preliminary period. During the preliminary period, milk yield ranged from 24.5 to 46.0 kg/d and preliminary voluntary DMI (pVDMI) ranged from 11.4 to 21.0 kg/d. Treatments were a diet with alfalfa silage as the sole forage (AL) and a diet with orchardgrass silage as the sole forage (OG). Alfalfa silage contained 20.5% CP (DM basis) and orchardgrass silage contained 20.4% CP; AL contained 18.3% CP and 5.6% estimated RUP, and OG contained 18.8% CP and 6.3% estimated RUP. Alfalfa silage contained 43% NDF (DM basis) and orchardgrass silage contained 48% NDF; both diets contained 23% forage NDF. Mean N intake was similar between treatments ($P = 0.95$), ruminal N digestibility was greater ($P = 0.03$) for AL than for OG, and whole-tract N digestibility did not differ between treatments ($P = 0.50$). The ability of linear and quadratic factors of pVDMI to predict the difference in responses of individual cows to treatments ($Y_{AL} - Y_{OG}$) was tested by analysis of variance, with treatment sequence as a covariate. With increasing pVDMI, intake and duodenal flow of N increased more for AL than for OG (N intake: $P = 0.01$; duodenal N flow: $P = 0.01$) because of increasingly greater DMI for AL compared to OG as pVDMI increased ($P < 0.01$). However, as pVDMI increased, whole-tract N digestibility tended to decrease for AL relative to OG ($P = 0.07$). When feeding less-filling diets to high-producing cows, reducing dietary N concentration could increase the efficiency of N utilization and reduce the extent to which greater DMI leads to greater N excretion.

Key Words: Grass, Legume, Nitrogen Utilization

990 A comparative review of the flow of nitrogen fractions at the omasal canal and duodenum of dairy cows. I. R. Ipharraguerre*[1], S. M. Reynal[2], P. Huhtanen[3], J. H. Clark[4], G. A. Broderick[2], and S. Ahvenjärvi[5], [1]*Lucta S.A.*, *Barcelona, Spain*, [2]*US Dairy Forage Research Center*, *Madison*, [3]*Cornell University*, *Ithaca*, [4]*University of Illinois*, *Urbana*, [5]*MTT Agrifood Research Finland*, *Jokioinen*.

The objective of this paper was to review and compare published data for the flow of N fractions to the omasal canal and duodenum of lactating dairy cows. Two data sets were created; one with data from 14 studies in which digesta was sampled from the omasal canal (57 means) and the other with data from 67 studies in which digesta was taken from the duodenum (264 means). Mean intakes of DM (DMI 19.7±3.4 kg/d) and N (NI 537±117 g/d) were similar between data sets. Flows (g/d) of nonammonia N (NAN), microbial N (MN), and NAN-non-MN (NANMN), and the ratio NAN/DMI averaged, respectively, 516±128, 342±100, 173±48, and 24.7±3.2 at the omasum; and 508±113, 271±84, 236±87, and 25.9±3.9 at the duodenum. Despite similar mean NAN flows and NAN/DMI between sampling sites (SS), 65% of the reported MN flows to omasum exceeded 300 g/d whereas only 32% of the reported MN flows to duodenum were greater than 300 g/d. As a result, MN represented more than 55% of the postruminal NAN flow in 90% of the cases in which samples were taken from the omasum compared with 39% of the cases in which samples were obtained from the duodenum. Both data sets were combined and subjected to regression analysis using a mixed model approach that included study as a random variable. Dependent variables were NAN, MN, and NANMN flow. Independent variables were SS, NI or DMI and dietary CP %, and all possible two-way interactions. The effect of SS and its interaction with other variables was not significant ($P > 0.25$) for all NAN-flow models. Conversely, the interactions SS x DMI and SS x NI were significant for the MN-flow ($P < 0.06$) and NANMN-flow ($P < 0.01$) models, respectively. These findings suggest that omasal canal and duodenal sampling may result in different estimates of the flow of MN and NANMN. More research is needed to determine the relative accuracy of these estimates and origin of these differences.

991 Essential oil supplementation of a corn silage based diet deficient in rumen undegraded protein fed to lactating Holstein dairy cows. C. A. Crawford, C. G. Schwab, A. B. Conroy, P. S. Erickson, N. L. Whitehouse*, and S. E. Boucher, *University of New Hampshire*, *Durham*.

Thirty multiparous Holstein cows in early lactation were used in a randomized complete block design to determine the efficacy of adding VERTAN, a specific blend of essential oils (EO), at 0 or 0.8% of diet dry matter (DM) to a corn silage based diet on DM intake, milk yield (MY), milk composition, and ruminal N metabolism. The basal diet contained (DM basis) 29.8% corn silage, 14.9% grass silage, 7.2% alfalfa hay, 0.11% grass hay, 21.5% finely-ground corn, 1.6% beet pulp, 1.6% citrus pulp, 4.3% soy hulls, 0.79% molasses, 11.9% soybean meal, 0.43% urea, 0.06% Smartamine M™, 2.5% Megalac™, and 3.4% vitamin and mineral premix. Animals were on treatment from 21 through 105 days in milk. Diets were formulated to meet NRC (2001) requirements for energy and all nutrients except rumen undegraded protein. Cows were fed and milked 3 × daily. Milk and blood samples were collected during wk 4-15 of lactation. There was no effect of VERTAN supplementation on DM intake, MY, milk composition, or blood urea N concentrations. To evaluate the effects of VERTAN on ruminal N metabolism, 2 rumen cannulated multiparous Holstein cows were used in a switchback design (each cow received each treatment twice). Experimental periods were 4 wk; 16 rumen fluid samples were collected during wk 4 of each period. Samples were collected during 2 consecutive days to represent every 2 h in a 24-h period. There was no effect of treatment on ruminal pH. A significant hour by treatment effect was observed for ruminal ammonia-N concentrations; VERTAN supplementation lowered ruminal ammonia-N concentrations at 2, 3, and 4 h post-feeding. These results support the work of others indicating that EO decrease amino acid (AA) deamination in the rumen. More research is needed to determine the interactions of supplementation levels of EO, diet composition, and rumen ammonia-N and free AA concentrations in lactating cows.

Key Words: Lactating Cows, Essential Oils, Corn Silage

992 The effect of rumen undegradable and rumen degradable protein concentration on urea recycling in mid-lactation cows. S. K. Ivan*[1], R. L. Baldwin, VI[2], and R. A. Kohn[1], [1]*University of Maryland*, *College Park*, [2]*USDA-ARS*, *Beltsville, MD*.

This study investigates potential mechanisms for control of urea recycling. We assigned 8 mid-lactation Holstein cows to a repeated 4

× 4 latin square, balanced for carryover effects. The isoenergetic diets contained 16.0, 17.3, 18.8, and 19.5% CP as a percent of DM, and the rumen degradable (RDP) and rumen undegradable protein (RUP) concentrations were arranged in a factorial design (10.0 and 12.5% RDP and 5.6 and 8.1% RUP as a percent of DM). There was no effect (P>0.05) of CP concentration on rate (g/d) of urea recycling, urea transferred to the GIT, or urea returning to the blood from the GIT. Of the urea transferred to the GIT, the proportion utilized by the microbes was also unaffected by CP concentration. Analysis of the RUP and RDP factorial identified tendencies for greater urea transfer (g/d) to the GIT with the low RDP diets (P=0.08), and for greater return of recycled urea to the blood (g/d; P=0.10). The blood urea N (BUN; mg/dL) was lowest for the low RDP diets but low BUN did not decrease transfer of urea to the GIT. As a proportion of urea transferred to the GIT there was more returned to the blood (P=0.05) with the high RUP diets, and a tendency (P=0.11) for more urea utilization by the rumen microbes with the low RUP diets. There was no difference in the liters of blood cleared of urea by the kidney per day per kg body weight indicating that any regulation of recycling is not at the kidney. We did not observe ruminal urea transporter (bUT-B2) expression changes. The rate of transfer of urea across the rumen wall appeared to be independent of rumen and blood urea concentrations, thereby increasing the proportion of BUN and rumen ammonia N (RAN) transferred when low protein diets decrease the BUN and RAN concentrations.

Key Words: Urea Recycling, Rumen Degradable Protein, Rumen Undegradable Protein

993 Nitrogen excretion and utilization efficiency in dairy sheep fed diets with different dietary energy contents. V. Giovanetti[1], M. Decandia[1], F. Boe[2], E. Zerbini[3], A. Cannas[2], and G. Molle*[1], [1]*Istituto Zootecnico e Caseario della Sardegna*, *Olmedo, Sardinia, Italy*, [2]*Dipartimento di Scienze Zootecniche, Università di Sassari*, *Sassari, Sardinia, Italy*, [3]*Cargill Animal Nutrition*, *Spessa, Italy*.

The aim of this study was to evaluate a) the effect of different dietary energy content on fecal N excretion (FNE), urinary N excretion (UNE) and N utilization efficiency (NUE), and b) the relationships between milk urea N (MUN) and the above variables in Sarda dairy ewes. Two experiments were carried out using mid lactating (E1) and late lactating (E2) dairy ewes (n=5 per treatment), kept in metabolic cages and fed 8 pelleted diets with different main ingredients: Corn Meal (CM), Wheat Middlings (WM), Corn Flaked (CF), Barley Meal (BM), Corn Cobs (CC), Beet Pulp (BP), Alfalfa (AA) and Soybean Hulls (SH). The diets ranged from low (1.26-1.53 Mcal/kg DM) to high (1.72-1.84 Mcal/kg DM) NEL contents, and had high CP concentration (on average 18.4 % DM). The lowest energy diet (AA) showed a trend to higher N excretion and MUN and lower NUE (Table 1). Pooling all data, a close positive relationship was found between UNE and MUN (R^2=0.94), while FNE was positively related to NDF and negatively to NFC (R^2=0.82 for both). A negative relationship between MUN and NUE was also found (R^2=0.58). It is concluded that diets with s high energy content can reduce overall N excretion and increase NUE in dairy sheep. In addition, MUN can be effectively used to predict urinary nitrogen excretion and NUE.

Table 1.

Diets		CM	WM	CF	BM	CC	BP	AA	SH
NEL Mcal/kg DM		1.79	1.72	1.84	1.72	1.53	1.76	1.26	1.47
FNE g/d	E1	9.6^{d}	10.8^{cd}	11.5^{cd}	10.9^{cd}	20.3^{ab}	14.5^{bd}	16.4^{bc}	23.8^{a}
	E2	6.1^{c}	nd	8.1^{bc}	12.2^{ab}	18.0^{a}	16.5^{a}	16.5^{a}	16.5^{a}
UNE g/d	E1	16.5^{bc}	17.5^{bc}	14.3^{c}	15.5^{bc}	24.9^{ab}	16.3^{bc}	29.5^{a}	22.2^{ac}
	E2	17.9^{b}	nd	17.8^{b}	22.0^{b}	22.0^{b}	21.4^{b}	38.0^{a}	24.3^{b}
MUN mg/dl	E1	15.6^{c}	18.1^{bc}	15.6^{c}	16.9^{bc}	22.6^{ab}	16.2^{bc}	26.7^{a}	20.3^{ac}
	E2	17.6^{c}	nd	17.9^{c}	21.5^{bc}	21.0^{bc}	18.1^{c}	34.0^{a}	26.2^{b}
NUE %	E1	18.5^{ac}	21.9^{ab}	23.9^{a}	21.7^{ab}	13.8^{cd}	21.3^{ab}	12.6^{d}	16.9^{bd}
	E2	20.3	nd	16.2	16.9	10.7	14.1	9.7	15.1

a, b, c, d: within rows differ (P<0.05).

Key Words: N Utilization, Milk Urea, Sheep

Teaching/Undergraduate & Graduate Education: Swine Teaching

994 Enrollment in swine classes at 49 four-year institutions during academic years 1998-99 to 2005-06. D. E. Reese*, K. M. Eskridge, and D. A. Travnicek, *University of Nebraska*, *Lincoln*.

Concern over enrollment decline in swine classes (SC) at some institutions was discussed at a North Central Region Animal Science department head meeting in 2003. The lack of quantifiable nation-wide enrollment information prompted an effort to collect SC enrollment data from 49, four-year US institutions. Enrollment data was obtained for each institute's SC beginning with the 1998-1999 academic year (AY) though 2005-2006. If no enrollment was reported, follow-up contact was made to discern whether 1) the SC was offered but not taught due to low enrollment (LE), 2) the SC was not offered (NO), 3) the SC was scheduled not to be offered (SNO), or 4) no SC existed. Regression analyses were performed with AY as the independent variable to test if the slope was zero for number of students enrolled, percent of SC that were taught (SCT), percent of institutions experiencing LE, percent of institutions experiencing NO, percent of institutions experiencing SNO, and percent of institutions teaching a SC with < 10 students enrolled. Forty-one institutions had a SC during 1998-99 to 2002-03; forty had a SC from 2003-04. The number of SC ranged from 43 to 46 depending on the AY. Enrollment in SC and the percent of SC that were taught decreased from 1998-99 to 2005-06 (see table). More institutions that had a SC did not offer their SC in 2005-06 vs. 1998-99, while those teaching their SC with < 10 students was stable. These results demonstrate that low enrollment and course offering issues exist with SC at many institutions.