606 Evaluation of factors affecting phosphorus solubility in feces of lactating cows. T. D. Nennich*[1], J. H. Harrison[1], Z. Dou[2], L. Johnson VanWieringen[1], R. L. Kincaid[3], and D. L. Davidson[1], [1]*Washington State University, Puyallup,* [2]*University of Pennsylvania, Kennet Square,* [3]*Washington State University, Pullman.*

Solubility of fecal P is associated with potential movement of P to surface waters after field application. The objective of this study was to evaluate factors affecting total and soluble P excretion by lactating dairy cows. Fecal samples (n = 121) were from total collection metabolism studies that used multiparous Holstein cows. These samples were analyzed for water soluble P by extraction (0.3 g + 100 ml deionized water) and P soluble in dilute acid (0.3 g + 100 ml 0.1% HCl). Variables evaluated in regression equations included P intake, dietary P concentration, Ca:P ratio, Ca intake, and other animal and dietary factors. Regression analysis performed using the PROC MIXED procedure of SAS included study as a random variable. Total P and HCl soluble P excretion were predicted using dietary P concentration, whereas dietary P concentration was not a significant variable for predicting water soluble P. Water-soluble P in the feces was affected by P intake and the concentration of Ca in the diet. Increased ratios of dietary Ca:P decreased soluble and total P excretion. Equations developed to predict water or HCl soluble fecal P (g/kg) using Ca:P ratio as the independent variable were y = -0.75 (±0.16) x Ca:P (g) + 4.32(±0.40) and y = -0.51(±0.40) x Ca:P (g) + 7.56 (±1.07), respectively. Dietary or animal factors in several of the studies evaluated affected total and soluble P excretion. In one study on maturity of corn silage, cow diets that contained 37% corn silage (DM basis) resulted in an average P balance of -32 g and had greater total P and HCl-soluble P excretion than other studies at similar dietary P concentrations. A better understanding of dietary factors that contribute to greater soluble P excretion in feces will aid in formulating diets to help lower the excretion of soluble P in feces.

Key Words: Phosphorus, Calcium, Feces

607 Separated drinking water from liquid manure for swine. J. Morris*, R. Fleming, and M. MacAlpine, *Ridgetown College, University of Guelph, Guelph, ON, Canada.*

The efficacy of separated clean water from liquid swine manure as a source of drinking water for starter pigs was completed. The objectives of the study were to evaluate the impact of separated clean water as a source of drinking water on the quality of water, the growth performance and the health status of starter pigs. Water was recovered from liquid manure using the Vibratory Shearing Enhanced Processing (VSEP) unit which was fitted with an reverse osmosis (RO) filter pack. The quality of the recovered water (permeate) was assessed and provided for drinking water to young pigs. Three water treatments (A-regular barn water, B-half barn water and VSEP permeate, and C-VSEP permeate) were prepared and given to the pigs. A total of 54 pigs were allocated to 9 pens of 6 pigs each (3 barrows and 3 gilts). All pigs were fed ad libitum a pelleted corn-soybean meal based pig starter ration. The pigs were subjected to the water treatments for 28 days (12 - 26 Kg liveweight). Performance data was subjected to statistical analysis using the GLM procedure of SAS. Results showed that the VSEP unit produced permeate (separated water) from liquid manure at a quality level acceptable to pigs. No significant treatment effects were found for ADFI - 1.20, 1.18, and 1.23kg/d; se = 0.04; p=0.755, ADG - 0.50, 0.52 and 0.51kg/d; se=0.009; p=0.579, Feed-to-Gain conversion - 2.38, 2.20, and 2.40; se=0.095 and daily water intake - 5.2, 4.3, and 6.1 l/d; se=0.492; p=0.099, for water treatments A, B and C respectively. There were no negative health effects resulting from the treatments during the study. It appeared that the recovered water from liquid manure under the conditions of this study was satisfactory as a source of drinking water for starter pigs.

Key Words: Swine, Water, Liquid Manure

608 Environmental impact of integrating crop and sylvan systems with swine. C. W. Talbott*[1], G. B. Reddy[1], C. Raczkowski[1], T. Barrios[1], M. Matlapudi[1], A. Coffee[2], and J. Andrews[2], [1]*North Carolina A&T State University, Greensboro,* [2]*USDA/CSREES Forestry, NC Division of Forest Resources, Raleigh, NC.*

Many species of swine evolved in sylvan environments where natural canopies provide cooler temperatures and thereby aid in thermoregulation during the warm seasons. During cooler seasons, farmers may be able to develop organic soils by utilizing the rooting behavior of the hogs to incorporate manure and mulch into compost. Forty-eight gestating sows were randomly assigned to one of six 25m x 90m wooded plots or one of four 40m x 30m dirt-lots for warm season application (April through September). Five, 10 m radius areas were surveyed (inches diameter breast high, basal area, % canopy) for species variation and prevalence after two, six-month seasons with swine; timber growth response was adjusted for animal stocking rate. During the cool season (October through March), animals were rotated to eight, 20m x 20m lots with or without leaf mulch. Soil samples were collected in years 2000 and 2001 at planting and at harvest at depth increments of 0-15 cm, 15-30 cm and 30-60 cm. Samples were analyzed for soil NO3–N, inorganic N, PO4, total P, organic matter, total C, total N, C:N, and CEC. Integrated plots with pigs had significant increases in NO3–N, inorganic N and PO4 concentrations. Results suggest that sylvo-pastoral systems with swine may improve hardwood stands by reducing softwood competition.

Key Words: Integrated Systems, Sylvo-Pastoral, Swine

Ruminant Nutrition: Dairy - Additives, Vitamins & Models

609 Effects of Aspergillus oryzae (Amaferm®) on production and metabolic parameters in Holstein cattle during the transition period. L. H. Baumgard*[1], M. E. Dwyer[1], C. Davis[1], C. E. Moore[1], H. C. Hafliger III[1], O. B. Mendivil[1], H. Jensen[2], B. Christie[2], and M. J. VanBaale[1], [1]*The University of Arizona, Tucson,* [2]*BioZyme Inc., St. Joseph, MO.*

Holstein cattle (n=33; 22 multiparous and 11 primiparous) were assigned to a TMR with or without an Aspergillus oryzae (AO) extract (Amaferm®; BioZyme Inc., St. Joseph, MO) from -21 to 60 d relative to calving. Alfalfa hay was the main forage source and steam-flaked corn the primary concentrate. AO (15 g/cow/d) was top-dressed daily at 0600 h. Cows were balanced by previous 305 ME and heifers randomly assigned to treatment, all animals were blocked by calving date and milked at 0600 and 1800 h, yield was recorded daily, and milk and blood samples were obtained 1, 7, 14, 21, 28 and 35 DIM. Body weights (BW) were recorded weekly until 60 DIM. There was no overall effect of treatment or treatment by week interaction on DMI prepartum (18.3 kg/d) or postpartum (39.7 kg/d), and this was independent of parity. BW loss did not differ between treatments (51.9 kg), but AO tended (P<0.1) to reduce week of BW nadir (5.0 vs. 6.2 wk). There were no interactions between parity and treatment on BW change, but overall, heifers lost less BW (31.8 vs. 71.8 kg) and tended (P<0.1) to reach BW nadir earlier than cows (4.9 vs. 6.2 wk). Feeding AO through the transition increased (P<0.05) milk yield (35.0 vs. 37.7 kg/d). The overall treatment effect was attributed to the enhanced milk yield of cows (40.8 vs. 44.7 kg/d) as heifers had similar milk yields between treatments. Peak yield was achieved earlier (wk 3) in AO compared to control fed cows (wk 5-6) and this resulted in a milk differential of 4.5 kg during wks 3 and 4 of lactation. AO tended (P<0.15) to increase milk fat content (6%) and decrease milk lactose percentage (3%). Plasma glucose concentrations were not altered by treatment. Despite increased milk yield without a corresponding increase in feed intake, plasma NEFA levels tended (P<0.12) to be reduced (14%) by AO. Feeding an AO extract through the transition appeared to increase dietary energy availability and improve production.

610 The effects of feeding yeast culture during the transition from cool to hot weather to Holstein cows on animal performance. J. D. Ward*[1], T. R. Smith[2], L. Zeringue[1], R. J. Williams[2], J. Crouch[2], R. Walz[1], T. Nueefch[2], and H. M. Wilson[2], [1]*LSU AgCenter, Southeast Research Station, Franklinton, LA,* [2]*Department of Animal and Dairy Sciences, Mississippi State University, Mississippi State.*

Forty-two mid to late lactation Holstein cows at two locations were used to determine the effects of feeding yeast culture during the transition from cool to hot weather on dry matter intake (DMI), milk production (MP), blood glucose, body condition score (BCS) and body weight

(BW). Cows were housed at the Mississippi State University dairy (MS; n=23) and the LSU AgCenter Southeast Research Station dairy (LA; n=19). Both groups of cows were housed in free stall barns and individually fed using Calan gates (American Calan, Northwood, NH). The cows at MS were fed a totally mixed ration while those at LA were component fed with forage and grain offered separately. Cows received yeast culture as a top dress on their feed (113 g/d). Milk production and DMI were recorded daily. Blood samples were taken weekly for plasma glucose analysis. Body weight and BCS were recorded at the beginning and end of the eight week study. Milk production and DMI data were averaged within week before statistical analysis. There was a treatment by parity interaction for MP with yeast supplementation decreasing MP in primiparous cows ($P < 0.08$; 31.1 vs 26.4 kg/d) but increasing MP in second and later lactation cows ($P < 0.08$; 29.7 vs 25.1 kg/d). There was also a treatment by parity interaction for DMI with yeast supplementation decreasing DMI in primiparous cows ($P < 0.08$; 20.5 vs 22.1 kg/d) but increasing DMI in third lactation cows ($P < 0.10$; 23.4 vs 20.0 kg/d). Dietary treatment had no effect on plasma glucose, BW, BCS, nor changes in BW and BCS. The results of this research indicate that feeding yeast culture during the transition from cool to hot weather can improve animal performance in second and later lactation cows but may be detrimental to primiparous cows. Further research is needed to determine why primiparous cows respond differently than older cows to yeast supplementation.

Key Words: Yeast Culture, Heat Stress, Milk Production

611 Effects of feeding yeast culture on milk yield during heat stress conditions. F. Y. Bernal*, J. S. Britt, J. W. Tako, and N. C. Speer, *Western Kentucky University, Bowling Green*.

Effects of feeding yeast culture on milk yield during heat stress conditions. F.Y. Bernal, J.S. Britt*, J.W.Tako, N.C. Speer, Western Kentucky University
The objective of this study was to evaluate the effect on milk yield of dietary yeast 2x-2-2-5 fed to lactating dairy cows during heat stress conditions. Sixteen cows per group paired by breed (Jersey and Holstein), lactation number and days in milk were assigned to CONTROL (no yeast) or YEAST 2X-2-2-5 PLUS (2oz - 2-2-5 western yeast) group. Both groups were fed a total mixed ration consisting of corn silage, alfalfa haylage, alfalfa hay, grain mix including whole cottonseed and also had controlled access to alfalfa pasture. The trial ran between August 6 and September 16. Dry matter content of the TMR fed and the refusal was measured to calculate dry matter consumption. Cows were weighed 3 times during the trial. Body temperatures were taken at each weighing. Milk weights were captured at each milking using electronic weigh meters, which download into a computer. Data was analyzed using Microsoft Excel and 7-day average milk weights were used in the analysis. Both groups were subject to the same heat stress conditions. Individual animal milk fat and protein percent was determined by laboratory analysis three times during the trial. During the trial 1 cow from each group had to be removed for health reasons. The matching paired cow from the other group was removed so the final results were based on 14 cows per group. Milk yield, butterfat %, butterfat yield, protein yield, fat corrected and energy corrected milk were not statistically but were biologically higher, FCM 4.78 lbs/day and ECM 4.15 lbs/day, in the YEAST 2X-2-2-5 PLUS group than the CONTROL group. At $13/CWTtherewasa0.54$ economical advantage daily to the YEAST 2X-2-2-5 PLUS group. The YEAST 2X-2-2-5 PLUS group did have an advantage over the CONTROL group in faster recovery from a drop in milk production following an increase in ambient temperature.

Key Words: Yeast, Milk Yield, Heat Stress

612 Improving the fermentation and aerobic stability of bermudagrass with molasses or a combination of bacteria and enzymes. A. T. Adesogan*, N. A. Krueger, D. B. Dean, M. B. Salawu, and C. R. Staples, *University of Florida, Gainesville*.

This study determined the effectiveness for improving the fermentation and aerobic stability of bermudagrass, of an inoculant (BB), molasses, or a mixture of either BB and molasses (BBM) or BB and fibrolytic enzymes (BBE). A five-week regrowth of Tifton 85 bermudagrass was conserved in quadruplicate in mini-silos alone, or after treatment application. The inoculant contained a mixture of *Pediococcus pentosaceus*12455, 1 x 10^5 cfu/g of fresh forage and *Lactobacillus buchneri* 40788, 4 x 10^5 of fresh forage and beta-glucanase, alpha-amylase and xylanase. BBE contained similar enzymes as BB, but greater enzyme activities. Chemical composition was quantified after 2, 4, 7, 30 and 60 d of ensiling and microbial composition and aerobic stability were measured after 60 days of ensiling. After 60 d of ensiling, the pH of additive-treated silages was consistently lower ($P < 0.05$) and DM recovery was higher ($P < 0.01$) than in untreated silages. BB, BBM and molasses-treated silages had less ($P < 0.01$) ammonia N than untreated silages. BB, BBM, and BBE-treated silages had less ($P < 0.01$) residual WSC than untreated silages. All silages had high acetic acid (47.5 g/kg DM) and low lactic acid (1.7 g/kg DM) concentrations. However, untreated and BBE-treated silages had more ($P < 0.05$) butyric acid and ammonia N, suggesting that a clostridial fermentation had occurred. These butyric forages were more ($P < 0.05$) aerobically stable (27 d), but less desirable for feeding than those ensiled with BB or molasses, which were stable for 6.9 d. In conclusion, BB and molasses treatments improved the digestibility and fermentation of bermudagrass and produced higher quality silages that were stable for 6.9 days. Mixing BB with molasses or the enzyme tested was not more beneficial than BB or molasses alone.

Key Words: *Lactobacillus buchneri*, Silage, Inoculant

613 Use of exogenous proteolytic enzymes to improve lactational performance of dairy cows. J.-S. Eun* and K. Beauchemin, *Agriculture and Agri-Food Canada, Lethbridge, AB, Canada*.

The effects of exogenous proteolytic enzymes (EPE) on digestibility and lactational performance were determined using 8 lactating Holstein cows in a double 4×4 Latin square experiment with a 2×2 factorial arrangement of treatments. Diets based on barley silage and alfalfa hay as the primary forage sources were formulated to obtain two forage to concentrate ratios (60:40 vs. 34:66, DM basis) using steam-rolled barley concentrate. Four dietary treatments were tested: HF-EPE = high forage without EPE, HF+EPE = high forage with EPE, LF-EPE = low forage without EPE, and LF+EPE = low forage with EPE. The EPE contained protease activity, but no measurable xylanase or endoglucanase activity. The EPE was added to the concentrate portion of the diets after pelleting at a rate of 1.25 mL/kg DMI. Data were analyzed using the PROC MIXED function of SAS. Increasing the forage proportion or adding EPE decreased intakes of DM and nutrients ($P < 0.01$). However, total tract digestibilities of DM and fiber were increased by decreasing the forage proportion or adding EPE ($P < 0.01$). Increases in digestibilities due to enzymes were highest with the LF+EPE diet. Digestibilities of DM, NDF, and ADF increased by 6.3%, 14.8%, and 23.6%, respectively. Feeding a LF diet increased digestible DMI ($P < 0.01$), but EPE did not influence digestible DMI because of the drop in DMI. Milk yield increased with feeding a LF diet (46.8 vs. 42.1 kg/d, $P < 0.01$), but decreased with adding EPE (43.4 vs. 45.5 kg/d, $P < 0.01$). Adding EPE to the LF diet increased milk fat percentage ($P < 0.01$), but not as much as increasing the forage proportion. Milk protein concentration was decreased when EPE was added to the LF diet ($P < 0.01$). Dairy efficiency calculated as milk/DMI was highest for the LF+EPE diet. Addition of EPE decreased nitrogen utilization for milk production for both the HF and LF diets ($P < 0.01$). Addition of EPE resulted in considerable improvement in the digestibility of nutrients, but the negative effects on intake offset these benefits.

Key Words: Exogenous Proteolytic Enzyme, Digestibility, Milk Yield

614 Effects of mixture enzymes on hydrolysis and rate of fermentation of alfalfa in vitro. A. A. Naserian* and S. Ghasemi, *Animal Science Department of Ferdowsi University, Mashhad, Iran*.

The use of enzymes as additives in ruminant diets has received considerable research interest and recently following positive responses observed in feeding trials, the objective of present study was to determine the effects of mixture enzymes on rate of fermentation of alfalfa in vitro. The gas production system consisted of 64 gas serum bottle (100mL) and one incubation chamber ($39\pm1c^{\circ}$) were used to hold the 64 serum bottle and bottle were continuously shaken with an orbital shaker. 0.2g of ground alfalfa (four replicate for one time) were weighted in to each bottle. The enzyme mixture (Natuzyme, Bioproton PTY. LTD., AU) was applied at 4 levels (0, 2, 4, 8 g/kg alfalfa, air dry basis), then 20mL of rumen fluid and 10mL of buffer were added to each bottle and initial volume of each bottle was 30mL, gas production was measured for 96

hours (0, 2, 4, 6, 8, 12, 24, 48, 72, 96), the values corrected for the gas released from blank(rumen fluid+ buffer) and initial volume. Data were analyzed Using General Linear models procedures of SAS V6.12 for ANOVA to evaluate differences among experimental groups, means were compared with Duncan test. Enzyme had significant effect on gas production ($P \leq 0.05$),(Table1). values for each treatment were averaged across replicates and equation p=a+b (1-e^{-ct}) was employed to fit data, gas production rate and cumulative gas production were affected by enzyme supplementation ($P \leq 0.05$), (Table 1). In conclusion, adding of a fibrolytic enzyme mixture increased the rate of gas production.

Table 1.

Treatment	Control	1x	2x	4x	SEM
Gas production (mL)	29.3^{c}	29.96^{b}	30.27^{a}	29.75^{b}	0.051
a+b (mL)	47.8^{c}	48.5^{b}	48.9^{a}	47.7^{d}	0.001
C (h^{-1})	0.102^{d}	0.1039^{b}	0.1035^{c}	0.1055^{a}	0.0001

Key Words: Mixture Enzyme, Fermentation, Gas Production

615 Effect of fibrolytic enzymes on the fermentation characteristics, aerobic stability and digestibility of bermudagrass silage.

D. B. Dean*, A. T. Adesogan, N. Krueger, and R. C. Littell, *University of Florida, Gainesville.*

This study determined the effectiveness for improving the nutritive value and aerobic stability (AE) of bermudagrass (Cynodon dactylon) silage, of applying four proprietary cellulase/hemicellulase enzymes. A five-week regrowth of Tifton 85 bermudagrass was conserved alone, or after treatment with Promote (Pr), Biocellulase X-20 (X20), Cattle-Ase (CA) or Biocellulase A-20 (A20). The enzymes were applied at 0, 0.5, 1x and 2x the rates recommended by the manufacturers. Six replicates of 1 kg of chopped (5 cm) forage were ensiled for 145 days in 2.8 l mini silos. Three silos per treatment were used for chemical analysis and three to measure aerobic stability (4 x 3 factorial design). The silage juice was analyzed for organic acids, pH, water soluble carbohydrates (WSC), ammonia-N and soluble N. Freeze-dried samples were analyzed for crude protein (CP), NDF and ADF. In vitro digestibility of DM (IVDMD), NDF (IVNDFD) and ADF (IVADFD) were calculated after digesting the silages in buffered rumen fluid for 6 or 48 h in two ANKOMII Daisy Incubators. The following results are based on comparing treated to untreated samples. DM losses and pH were significantly reduced by Pr ($P<0.01$). Ammonia-N was increased linearly ($P<0.05$) by X20, but decreased linearly and quadratically by CA ($P<0.05$) and A20 ($P<0.05$) respectively. Residual WSC concentration was increased by Pr ($P<0.01$) and CA ($P<0.05$). NDF and ADF concentration were reduced ($P<0.05$) by X20, CA and A20. Additive-treated silages had less ($P<0.05$) acetic acid than untreated silages, but aerobic stability was unaffected by treatment. The 6 h, IVDMD was increased ($P<0.01$) by Pr and A20, however only Pr increased ($P<0.01$) 48 h IVDMD and 48 h IVNDFD. Pr ($P<0.05$), CA ($P<0.05$) and A20 ($P<0.05$) also increased ($P<0.05$) 48 h IVADFD. These results show that fibrolytic enzymes can improve the nutritive value of bermudagrass silage, and Promote was the most promising enzyme in this respect.

Key Words: Enzymes, Silage, Nutritive Value

616 Development and use of an assay to test enzymatic activity of rumen microflora in calves.

B. J. Suarez*, S. Fiardo, A. H. M Cornelissen, P. Van Wikselaar, and W. J. J. Gerrits, *Wageningen University Unit Research, Wageningen, The Netherlands.*

The objective of this study was to develop an assay to quantify cellulase activity in rumen contents of calves fed different diets. Eighteen male calves (45 ± 0.2 kg) were individually housed and fed diets differing in carbohydrate composition: a Pectin rich diet (> 90% Sugar beet pulp), a NDF rich diet (> 90% soy hulls + maize bran), a Starch rich diet (> 90% barley + maize). Diets were offered to a maximum of 750 g/d on top of a milk replacer. Calves were slaughtered at 12 weeks of age and rumen samples were stored (-20°C). Intra and extra-cellular enzymes and enzymes attached to rumen particles were extracted by a combination of methods: freezing/thawing, sonication and osmotic shock. After thawing, samples were sonified in a 50 mM NaAc buffer (pH 5) including 2 M NaCl and 0.01% NaN3. Subsequently feed particles and lysed bacteria were removed (centrifugation: 22.5 min, 20000g, 4 °C) and the enzyme cocktail obtained was dialyzed against a 50 mM NaAc buffer (18 h; 4 °C) to remove dissolved sugars and NaCl. Enzyme activity was determined by the release of reducing sugars after incubation of the enzyme cocktail at 39 °C (120 mM NaAc buffer) with each of 3 substrates: Carboxymethylcellulose (CMC), soybean hulls (SBH) and crystalline cellulose (Avicel), and expressed as μmol reducing sugars (RS) released per minute per kg dry matter (DM) in the rumen. Reducing sugar end-groups were measured by Nelson Somogyi method. Avicel was hardly degraded by the enzyme cocktail (1μmol of RS/h/kg DM), while CMC and SBH were well degraded (48.7 and 51.6 μmol RS/h/kg DM respectively; P=0.05). CMC- and SBH-ase activities of rumen contents decreased from 61, 48.5 to 41 μmol RS/h/kg DM for calves fed the NDF, Pectin and Starch diet, respectively (P=0.1). Results show that differences in enzyme activity between rumen contents can be detected using this assay. By using different substrates, the degrading capacity of others enzyme systems can be evaluated.

Key Words: Calves Rumen Contents, Microbial Enzyme Activity, Cellulase

617 Effects of feeding increasing levels of vitamin E on milk production variables, plasma fatty acid composition, and milk fatty acid profiles in Holstein cows experiencing diet induced milk fat depression.

H. C. Hafliger III*, C. E. Moore, S. R. Sanders, and L. H. Baumgard, *The University of Arizona, Tucson.*

Recent research indicates feeding high levels of vitamin E (VitE) may alleviate milk fat depression (MFD) by altering rumen polyunsaturated fatty acid biohydrogenation pathways. Objectives were to evaluate the effects of extremely high VitE doses on production variables, milk, and plasma fatty acid profiles (a proxy for rumen biohydrogenation) on diet induced (4% corn oil, 45% forage) MFD. Multiparous Holstein cows (283 ±15 DIM; 136 ±15 d pregnant; n=6) were randomly assigned to an unbalanced 4x4 Latin square design consisting of a control (0 additional IU/d VitE) and VitE top dressed (4000, 8000, and 16000 additional IU/d). Milk and blood samples were obtained on d 1 and at the end of treatment periods (d 14). A 7-d washout period was provided between periods. Orthogonal contrasts were used to characterize linear, cubic and quadratic effects of VitE dose. As a result of the MFD diet, milk fat content was reduced ($P<0.02$) by 18% (3.5 to 2.8%) and milk total trans $C_{18:1}$ and CLA increased ($P<0.01$; 29.4 vs. 62.0 mg/g and 5.4 vs. 14.4 mg/g, respectively). VitE had no effect on DMI (24 kg/d), milk yield (32 kg/d), milk protein (1.1 kg/d), milk lactose (1.6 kg/d), SNF (3.0 kg/d), and SCC (269,855) or the content of these components. There was no effect on milk fat yield, however, VitE linearly increased ($P<0.01$) milk fat content (2.83, 2.93, 3.05, and 3.12% for 0, 4000, 8000, and 16000 IU/d, respectively). Changes in fatty acids associated with MFD including *t*-10 and *t*-11 $C_{18:1}$ as well as *c*-9, *t*-11 and *t*-10, *c*-12 CLA did not differ in milk or plasma as a result of VitE supplementation. Although the milk fat Δ^9-desaturase index did not differ, VitE decreased ($P<0.05$) specific Δ^9-desaturase product to substrate ratios ($C_{14:1}/C_{14:0}$, $C_{18:1}/C_{18:0}$, and *c*-9, *t*-11 CLA/*t*-11 $C_{18:1}$ by 18, 13, and 13%, respectively). Although only slightly, VitE linearly increased milk fat content but this effect was not reflected in plasma or milk fatty acid changes. Milk Fat Depression, Vitamin E, CLA

Key Words: Milk Fat Depression, Vitamin E, CLA

618 Effects of dietary forage and non-fiber carbohydrate concentrations on B-vitamin intake and duodenal flow in dairy cows.

E. C. Schwab*[1], C. G. Schwab*[2], C. L. Girard[3], R. D. Shaver[1], D. E. Putnam[4], and N. L. Whitehouse[2], [1]*University of Wisconsin, Madison,* [2]*University of New Hampshire, Durham,* [3]*Dairy and Swine R&D Center, AAC, Lennoxville, QC, Canada,* [4]*Balchem Encapsulates, New Hampton, NY.*

Eight Holstein cows (four primiparous, four multiparous) were fitted with ruminal and duodenal cannulas to test the effects of dietary forage (F) and NFC concentrations on intake and duodenal flow of B-vitamins in lactating cattle. Cows were used in a replicated 4×4 Latin square design balanced for carryover effects with a 2×2 factorial arrangement of treatments. Each square contained two multiparous and two primiparous cows and periods were 21 d in length. Experimental diets with 35 or 60% (DM basis) forage (corn silage, alfalfa hay, grass hay) were formulated to contain either 30 or 40% NFC (DM basis). The concentrate portion of the diets was composed of varying proportions of

soybean hulls, beet pulp, corn grain, rolled barley, soybean meal, blood meal, Smartamine-M®, vitamins, and minerals. B-vitamin intakes and flows presented below are expressed as mg/d. There was a significant F effect for all measurments except for folic acid and B_{12} intake and pyridoxine (PYR) flow. Intakes of DM, thiamin, pyridoxamine (PAM), and pyridoxal (PAL) and flows of B_{12} and PAM were affected by NFC. A F×NFC interaction was observed for thiamin and PYR flow. Overall, there was a greater influence of dietary F content than NFC concentration on B-vitamin intake and flow.

	Diets					Effect (P <)[5]		
Item	3530	3540	6030	6040	SEM	F	NFC	F×NFC
DMI, kg/d	21	22	18	20	1	<0.01	0.05	NS
Thiamin intake	37	47	27	37	2	<0.01	<0.01	NS
Thiamin flow	107	101	75	90	7	<0.01	NS	0.04
Folic acid intake	13	12	12	12	1	NS	NS	NS
Folic acid flow	33	35	27	31	3	<0.01	NS	NS
B_{12} intake	0.4	0.3	0.3	0.3	0.02	NS	NS	0.2
B_{12} flow	118	84	83	63	6	<0.01	<0.01	NS
PAM intake	9	15	8	13	1	<0.01	<0.01	NS
PAM flow	57	61	47	56	4	<0.01	0.05	NS
PAL intake	28	24	17	13	1	<0.01	<0.01	NS
PAL flow	34	39	23	28	3	<0.01	NS	NS
PYR intake	31	30	35	35	2	<0.01	NS	NS
PYR flow	11	6	6	9	1	NS	NS	0.01

[5]NS=not significant (P>0.05)

Key Words: B-Vitamin, Duodenal Flow, Cow

619 Effect of feeding malic acid on performance of lactating Holstein cows. R. J. Grant*[1], C. S. Ballard[1], M. P. Carter[1], K. W. Cotanch[1], P. Mandebvu[1], C. J. Sniffen[2], M. Suekawa[5], S. A. Martin[3], T. K. Miller-Webster[4], and W. H. Hoover[4], [1]*W.H. Miner Agricultural Research Institute, Chazy, NY,* [2]*Fencrest LLC, Holderness, NH,* [3]*University of Georgia, Athens,* [4]*West Virginia University, Morgantown,* [5]*Zen-Noh National Federation of Agricultural Co-operative Associations, Tokyo, Japan.*

Limitations on feeding ruminant proteins to cattle necessitate using alternative feeds to supply amino acids such as lysine, or stimulating ruminal microbial growth to increase supply of amino acids for the host animal. In continuous culture, DL-malate (50 g/d) improved microbial growth and efficiency, resulting in an increase in metabolizable protein of 426g/d. The objective of this study was to determine the effect of feeding malic acid (MA; Harcros Chemicals Inc., Kansas City, KS) at a rate of 50 g/d on the performance of mid-lactation dairy cows. Forty cows (70-276 days in milk) were blocked and assigned randomly to control or MA diets in a crossover design with two 28-d periods. Total mixed ration included corn silage, alfalfa-grass silage, alfalfa hay, ground corn, whole cottonseed, and a commercial protein supplement. Cows fed the ration containing MA had greater yield of milk ($P = 0.012$) and true protein ($P = 0.035$) compared with cows fed the control ration. There was no effect of MA on body weight, body condition score change, or total tract digestion of nutrients ($P > 0.05$).

	Control	MA	SE	P
Milk Yield avg[1], kg/d	36.8	38.3	0.4	0.012
Milk yield[2], kg/d	37.6	39.3	0.5	0.022
3.5% FCM, kg/d	39.2	40.5	0.5	0.097
Milk fat				
%	3.79	3.70	0.04	0.117
kg/d	1.42	1.45	0.02	0.288
Milk true protein				
%	3.08	3.08	0.01	0.830
kg/d	1.15	1.21	0.02	0.035
Total tract digestibility, %				
OM	68.1	67.7	0.4	0.440
CP	62.3	62.9	0.6	0.471
ADF	47.4	47.9	0.9	0.697
NDF	46.7	46.2	1.1	0.758

[1]Seven day average milk yield.[2]Sample day milk yield from which milk component yields are calculated.

Key Words: Malic Acid, Dairy Cows, Microbial Growth

620 Further validation of the fat sub-model in CPM-Dairy. P. J. Moate*, R. C. Boston, and W. Chalupa, *School of Veterinary Medicine, University of Pennsylvania, Kennett Square.*

CPM-Dairy contains a fat sub-model (Anim. Feed Sci. Tech. 112:79) that describes dietary intake, ruminal lipolysis, ruminal biohydrogenation, ruminal denovo production and intestinal absorption of 10 major long chain fatty acids (LCFA) and total LCFA (TLCFA) in dairy cows. The previous validation of intestinal digestion (duodenum - feces) mainly involved young (250 kg) non-lactating cattle. We now report on the ability of the model to predict, in lactating dairy cows, the apparent absorption (intake feces) of TLCFA. Data used were from 43 diverse diets in ten published feeding experiments that reported intakes and fecal output of TLCFA (g/cow/day). Additional data were with 15 diets from three experiments in which different types of LCFA supplements were infused into the abomasum. In the table, the mean and STD of the measured (X) absorbed TLCFA (g/cow/d) is tabulated and the regression (forced through the origin) between the predicted absorbed TLCFA (Y) and X is given by B (slope) ∗X. For both the feeding and infusion experiments, the slopes and Lins concordance correlation coefficient indicate a high degree of concordance between measured and predicted absorbed TLCFA. We conclude the fat sub-model in CPM-Dairy accurately predicts the apparent absorption of TLCFA in lactating dairy cows.

TLCFA (Y)	X (mean± STD)	B (±Std Error)	Concordance
Feeding expts.	833 ± 266	0.99 ± 0.011	0.974
Infusion expts.	757 ± 120	1.03 ± 0.016	0.923

†Lin's concordance correlation coefficient

Key Words: Cattle, Long-Chain Fatty Acids, Apparent Absorption

621 Sensitivity analysis of the 2001 Dairy NRC and CNCPS protein fractionation systems. C. Lanzas*, L. O. Tedeschi, and D. G. Fox, *Cornell University, Ithaca, NY.*

Feeding diets not properly balanced for protein decreases its utilization efficiency. Sensitivity analyses of the NRC and the CNCPS protein fractionation systems were conducted to assess the influence of the uncertainty in feed inputs on the model predictions.Two lactating dairy-cow diets either with corn (CS) and alfalfa silages (diet 1) or grass hay and CS (diet 2) plus corn meal and supplements (soybean meal (SBM), canola meal (CM), whole cottonseed (WC), wet brewers (WB) and distillers (DG) grains) were used. A feed database provided by Dairy One lab was used to obtain the distributions and correlations of the variables. Monte Carlo technique was conducted in spreadsheet versions of the models. For each diet, 3 simulations were carried out. In simulation 1 (CNCPS1), CP, Soluble protein, NPN, NDICP, and ADICP were varied. In simulation 2 (CNCPS2), the inputs for protein pools (CNCPS1) and the corresponding digestion rates (kd) were varied. In simulation 3 (NRC), CP, in situ A and C fractions and kd for in situ B fraction were varied. The maximal impact on MP, Lys and Met allowable milk (kg/day) is summarized below.Both models behaved similarly

when variation in kd was taken into account. For the NRC model, the ranking of critical inputs was, for diet 1, SBM kd (r=-0.5), CS A fraction (r=-0.34), and dried corn kd (r=-0.25), for diet 2, SBM kd (r=-0.55), grass hay CP (r=0.32), and dried corn kd (r=-0.31). For the CNCPS, the ranking was, for diet 1, SBM kd of B2 pool (r=-0.5), dried corn kd (r=-0.26), and WB CP (r=0.26), for diet 2, SBM kd (r=-0.52), grass hay CP (r=0.36), and dried corn kd (r=-0.35). One SD increase (1.5 %/h) in SBM kd resulted in a 0.5 SD decrease in MP from RUP (Diet 1 SD= 153 g, Diet 2 SD=208 g), while for the CNCPS model, 1 SD increase (4 %/h) in kd for SBM B2 kd resulted in a $>$ 0.5 SD decrease (Diet 1 SD=136 g, Diet 2 SD=177 g). Because of the intrinsic variation in kd measurements and the sensitivity of the current models, research is needed to improve the methodology used to obtain kd.

	Diet 1			Diet 2		
	CNCPS1	CNCPS2	NRC	CNCPS1	CNCPS2	NRC
MP milk from RUP	1.9	2.8	3.1	2.2	3.6	4.2
MP milk from Met in RUP	2.2	2.9	1.8	2.3	3.0	4.2
MP milk from Lys in RUP	1.4	2.2	2.4	1.3	2.6	2.7

Key Words: Nutritional Models, Monte Carlo, Digestion Rates

Ruminant Nutrition: Dairy - Fats

622 Effect of rumen protected conjugated linoleic acid on energy metabolism of dairy cows during early to mid-lactation. K. J. Shingfield*[1], D. E. Beever[1], C. K. Reynolds[1], S. K. Gulati[2,3], D. J. Humphries[1], B. Lupoli[1], G. Hervas[1], and M. J. Griinari[4], [1]*Centre for Dairy Research, University of Reading, Reading, UK,* [2]*University of Sydney, Sydney, Australia,* [3]*Rumentek Pty Limited, Australia,* [4]*University of Helsinki, Helsinki, Finland.*

Trans-10, cis-12 conjugated linoleic acid (CLA) inhibits milk fat synthesis and reduces milk energy content. Controlled decreases in milk energy secretion could be used to improve energy balance of the dairy cow during early lactation. Twelve multi-parous Holstein-British Friesian cows were used in a randomized block study to evaluate the effects of rumen protected CLA (RCLA) on energy metabolism in early lactation. Supplements were prepared by casein-formaldehyde treatment of CLA methyl esters containing equal amounts of cis-9, trans-11 and trans-10, cis-12. At calving, cows were paired and allocated at random to a control diet (C) or the same diet supplemented with 110 g of RCLA that supplied 14.3 g trans-10, cis-12 CLA/d. Energy balance (MJ/d) was estimated during weeks 3, 7, 11 and 15 of lactation using 6d excreta collection and respiration calorimetry. On average, RCLA reduced milk fat content (34.9 vs. 19.2 g/kg; P<0.001) and milk fat yield (1395 vs. 901 g/d; P<0.001), increased (P<0.05) milk yield (40.3 vs. 47.4 kg/d) and milk protein output (1.25 vs. 1.42 kg/d) and tended to increase DMI (22.2 vs. 24.6 kg/d; P=0.06) and BW (614 vs. 661 kg; P=0.11). The effects on DMI and production occurred within one week of lactation. RCLA increased (P=0.08) energy intake (389 vs. 434, for C vs. RCLA, respectively), but had no effect (P>0.10) on estimated heat energy (155 vs. 169), milk energy (112 vs. 103) or energy excreted in methane (25.0 vs. 26.0), urine (11.1 vs. 11.0) or feces (108 vs. 119). However, RCLA improved (P<0.05) tissue energy balance (-17.1, 8.5, 6.6 and 24.4 at weeks 3, 7, 11 and 15 of lactation, respectively) compared with C (-53.1, -19.3, -8.2 and -6.5). In conclusion, RCLA decreased milk fat content, increased milk production and improved tissue energy balance of dairy cows during the first 15 weeks of lactation, with evidence of improved tissue N retention (19 vs. 42 g/d; P = 0.05). In contrast to the effects in growing mice, heat energy/BW.75 was not affected (1.26 vs. 1.30).

Key Words: Conjugated Linoleic Acid, Energy Metabolism, Dairy Cows

623 Effects of dietary CLA on production parameters and milk fatty acid variables in Holstein and Brown Swiss cows during heat stress. C. E. Moore*, H. C. Hafliger III, O. B. Mendivil, R. J. Collier, and L. H. Baumgard, *University of Arizona, Tucson.*

Heat stressed dairy cattle are bioenergetically similar to transition cows in that dietary intake may be inadequate to support maximum milk and component synthesis. Objectives were to evaluate whether CLA induced milk fat depression (MFD) during heat stress would allow for increased milk production and component synthesis. In addition, CLA effects on production variables, MFD and milk composition were compared between Holstein and Brown Swiss cows. Multiparous cows (n = 8, Holstein; n = 5, Brown Swiss) averaging 97 ± 17 DIM were used in a crossover design during the summer (mean THI = 75.7). Treatment period lengths were 21 d with a 7 d acclimation period prior to and between periods. During acclimation periods all cows received EnerGII® (a supplement of palm fatty acid distilla; Bioproducts Inc., Fairlawn, OH). Dietary treatment consisted of either 250 g/d of CLA (Bioproducts Inc.) or EnerGII. The CLA supplement contained a variety of CLA isomers (5.4% trans-8, cis-10; 6.3% cis-9, trans-11; 7.9% trans-10, cis-12; and 8.2% cis-11, trans-13 CLA). Treatment was applied 2x/d with half of the supplement top dressed at 0600 h and the remaining at 1800 h. There was no overall treatment effect on DMI (23.9 kg/d), milk yield (40.0 kg/d), SCC (305,000), protein% (2.86) or lactose% (4.52) or yield of these milk components. CLA supplementation decreased (P < 0.01) overall milk fat content and yield by 21 and 24%, irrespective of breed. The reduction of milk fat content and yield was greater on d 21 (28 and 37%, respectively). Energy balance was improved (P < 0.01) by 3.1 Mcal/d for the CLA group (-1.1 vs. 2.03 Mcal/d, respectively). Respiration rate (78 breaths/min) and skin temperature (35.4°C) were not affected by treatment. The CLA supplemented group had higher total milk fat CLA concentrations (8.3 vs. 4.8 mg/g). CLA supplementation caused MFD similarly between breeds and improved energy balance during heat stress, but had no effect on production parameters under these conditions.

Key Words: CLA, Milk Fat, Heat Stress

624 Effects of source and level of dietary lipid on in vitro production of conjugated linoleic acid and trans vaccenic acid. X. Qiu*[1], K. E. Griswold[2], G. A. Apgar[1], D. W. Murdach[1], E. D. Frantz[1], D. L. Hastings[1], and B. N. Jacobson[1], [1]*Southern Illinois University, Carbondale,* [2]*Penn State University Extension, Lancaster.*

Two in vitro experiments were conducted to investigate the effects of source and level of lipid on biohydrogenation (BH) and the production of conjugated linoleic acid (CLA) and trans vaccenic acid (TVA). Exp. 1 examined the effect of partial (50%) or complete replacement of 4% yellow grease with each of the following three plant oils: soybean oil, corn oil, and sunflower oil (SUO), respectively. Based on the results of Exp 1, Exp 2 with a total of six treatments was designed to investigate the effect of four other plant oil sources, olive oil, peanut oil, canola oil, and safflower oil (SAO), as compared to yellow grease and SUO at 4% of dietary DM. Diets were composed of corn silage, alfalfa hay, soybean meal, and contained 18.4% CP and 32.4% NDF on average. The incubation periods were 0, 8, 12, or 16 h for Exp 1 and 0, 12, 18, and 24 h for Exp. 2. Three samples were incubated per treatment per time point. Fatty acid data were analyzed using the MIXED procedure of SAS with repeated measures. Rate of BH was estimated by linear regression. In Exp. 1, source of lipid did not affect the production of TVA but affected (P < 0.05) the production of CLA isomers and total CLA, with SUO producing the largest increase in TVA and CLA yields; elevated level of plant oil increased the production of TVA (P < 0.05), total CLA (P < 0.01) and CLA isomers (P < 0.01). In Exp. 2, SUO and SAO were similarly effective (P < 0.01) in increasing TVA production compared to other plant oils. However, SAO was more effective (P < 0.01) than SUO in increasing CLA production and SUO (P < 0.01) was more effective than the other oils. In addition, combined information from both experiments showed that, within the range of 4% of dietary DM, rate of BH was not affected by lipid source but slightly increased as oil level increased; production of CLA peaked between 12 and 18 h, whereas the peak for TVA occurred later, around 24 h.

Key Words: Conjugated Linoleic Acid, Vaccenic Acid, In Vitro