
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 \( y = -0.75 (\pm 0.16) \times \) Ca:P (g) + 4.32 (\pm 0.40) and \( y = -0.51 (\pm 0.40) \times \) Ca:P (g) + 7.56 (\pm 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 P and HCl-soluble P concentrations 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, Ridgeway 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


Many species of swine evolved in swiney 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 foster nutrient movement and establishment of hardwoods. Forty-eight gestating sows were randomly assigned to one of six 25m x 90m woodlots 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 sylvopastoral systems with swine may improve hardwood stands by reducing softwood competition.

Key Words: Integrated Systems, Sylvo-Pastoral, Swine

Ruminant Nutrition: Dairy - Additives, Vitamins & Models


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 (6.1 vs. 7.18 kg) and regained BW faster (10.9 vs. 6.2 kg) than 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 weeks 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.


Forty-two mid to late lactation Holstein cows at two locations were used to determine the effects of feeding yeast culture (VSEP) 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. Cows treated with yeast culture with molasses or a combination of bac- terial enzymes (BBE) increased 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 supplemen- tation 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


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 (2ox - 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 t-distribution 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 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/CWTtherwas aston 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


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 bermuda- grass was conserved in quadruplicate in mini-silos alone, or after treatment application. The inoculant contained a mixture of *Pedoscorus pennisetaceus* 12455, 1 x 10^8 cfu/g of fresh forage and *Lactobacillus bucher- neri* 40788, 4 x 10^6 of fresh forage and beta-glucanase, alpha-amylase and xylanase. BBE contained similar enzymes as BB, but greater en- zyme 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 re- covered 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 digestion and fermentation of bermudagrass and pro- duced 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. Beuchemin, *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 x 4 Latin square experiment with a 2 x 2 factorial arrange- ment. Treatments. Diets based on haylage silage and alfalfa haylage. The primary forage sources were formulated to obtain two forage to concentra- tion ratios (40:40 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 pellet- ing at a rate of 1.25 mL/kg DM. 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. 43.5 kg/d, $P < 0.01$). Adding EPE to the LF diet increased milk fat content ($P < 0.01$), 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 consider- able 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 hydrolysis rate of fermentation of alfalfa in vitro. The gas production system consisted of 64 gas serum bottle (100mL) and one incubation chamber (39±1°C) 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 (Nautosyme, Bioproton PTY. LTD, AU) was applied at 4 levels (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 < 0.05). Ammonia was not affected by diet (P > 0.05). Results show that differences in enzyme activity between rumen contents can be detected using this assay. By using different substrates, the degrading capacity of enzymes 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 polymonomerized fatty acid biohydrogenation pathways. Objectives were to evaluate the effects of feeding extremely high VitE levels on production and composition of 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 C18:1 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 DM (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 (260,855) or the content of these components. There was no effect on milk fat yield, however, VitE linearly increased milk fat content (2.8, 2.93, 3.05, and 3.12% for 0, 4000, 8000, and 16000 IU/d, respectively). Changes in fatty acids associated with MFD included increased (P<0.01) CLA and trans C18:1 (120 mM NaAc buffer) with each of 3 treatments decreased from 61, 48.5 to 41 h IVDFD: Pr, 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 enzymes systems can be evaluated.

Key Words: Enzymes, Silage, Nutritive Value


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 centrifuged at 50,000 g (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 (1 µmol of RS/kg DM), while CMC and SBH were well degraded (48.7 and 51.6 µmol RS/kg DM respectively; P<0.05). CMC- and SBHase activities of rumen contents decreased from 61, 48.5 and 56 µmol RS/kg DM for calves fed the NDF, Pectin and Starch diet, respectively (P<0.01). Results show that differences in enzyme activity between rumen contents can be detected using this assay. By using different substrates, the degrading capacity of enzymes systems can be evaluated.

Key Words: Mixtures Enzyme, Fermentation, Gas Production


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 replications 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 anaerobic 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 (IVADF) were calculated after digesting the silages in buffered rumen fluid for 6 or 48 h in two ANKOM® 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<0.01). Intra and extracellular enzymes attached to rumen particles were extracted by a combination of methods: freezing/thawing, sonication and osmotic shock. After thawing, samples were centrifuged at 50,000 g (pH 5) including 2 M NaCl and 0.01% NaN3. Enzyme activity of rumen contents 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 (1 µmol of RS/kg DM), while CMC and SBH were well degraded (48.7 and 51.6 µmol RS/kg DM respectively; P<0.05). CMC- and SBHase activities of rumen contents decreased from 61, 48.5 and 56 µmol RS/kg DM for calves fed the NDF, Pectin and Starch diet, respectively (P<0.01). Results show that differences in enzyme activity between rumen contents can be detected using this assay. By using different substrates, the degrading capacity of enzymes systems can be evaluated.

Key Words: Enzymes, Silage, Nutritive Value


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 4x4 Latin square design balanced for carryover effects with a 2x2 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 measurements except for folic acid and B₁₂ intake and pyridoxine (PYR) flow. Intakes of DM, thiamin, pyridoxamine (PAM), and pyridoxal (PAL) and flows of B₁₂ 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 <)³

<table>
<thead>
<tr>
<th>Item</th>
<th>Control</th>
<th>MA</th>
<th>SE</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk Yield avg²</td>
<td>36.8</td>
<td>38.3</td>
<td>0.4</td>
<td>0.012</td>
</tr>
<tr>
<td>Milk yield²</td>
<td>37.6</td>
<td>39.3</td>
<td>0.5</td>
<td>0.022</td>
</tr>
<tr>
<td>3.5% FCM, kg/d</td>
<td>39.2</td>
<td>40.5</td>
<td>0.5</td>
<td>0.097</td>
</tr>
<tr>
<td>Milk fat %</td>
<td>3.79</td>
<td>3.70</td>
<td>0.04</td>
<td>0.117</td>
</tr>
<tr>
<td>Milk true protein</td>
<td>3.08</td>
<td>3.08</td>
<td>0.01</td>
<td>0.830</td>
</tr>
<tr>
<td>kg/d</td>
<td>1.42</td>
<td>1.45</td>
<td>0.02</td>
<td>0.288</td>
</tr>
<tr>
<td>NDF</td>
<td>46.7</td>
<td>46.2</td>
<td>1.1</td>
<td>0.758</td>
</tr>
</tbody>
</table>

³Seven day average milk yield.²Sample 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 from 15 diets from three experiments in which different types of TLCFA supplements were infused into the abomasum. In the table, the mean and STD of the measured (X) absorbed TLCFA (g/cow/day) 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

⁵Lin'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 cows 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 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.
622 Effect of rumen protected conjugated linoleic acid on energy metabolism of dairy cows during early to mid-lactation. K. J. Shingfield, D. E. Beever, C. K. Reynolds, S. K. Gulati, J. J. Koohmaraie, R. L. Waters, and M. J. Grinnari. 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 multiparous Holstein 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 yield (1395 vs. 901 g/d; P<0.001), increased milk protein 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 g; 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 (25.9 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 reduced milk fat content, increased milk production and improved 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


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 EnerGI (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). 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 (23.4 vs. 23.9 kg/d), milk yield (40.8 vs. 40.0 kg/d), SCC (305,000 vs. 305,000), protein% (2.86 vs. 2.86) or lactose% (4.52 vs. 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 reducing effect of milk fat content and yield were greatest (28% and 37%, respectively). Energy balance was improved (P<0.01) by 3.1 Mcal/d for the CLA group (1.1 vs. 2.0 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


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% yeast culture 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, 6, 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