

(EUG), and capsicum (CAP) fed with a 45:55 forage:concentrate ratio (DM basis) ration on rumen fermentation. Treatments, including a control (CON), were replicated 3 times over 10 days with 7 days equilibration and 3 days sampling. Essential oils were supplemented at a dosage of 500 mg/L rumen fluid per d. Inoculum was obtained from 2 ruminally cannulated, lactating Holstein dairy cows receiving a 45:55 forage:concentrate ratio (DM basis). Dry matter digestibility did not differ among treatments ( $P = 0.97$ ). Organic matter digestibility tended to be lowest in CIN (36.4%;  $P = 0.06$ ). Digestibility of NDF was highest (37.8%;  $P = 0.04$ ), and ADF digestibility tended to be highest (46.1%;  $P = 0.08$ ), in CAP. Crude protein digestibility was lower in CIN and EUG (44.7% and 49.4%) than in CAP and CON (64.4% and 60.8%;  $P = 0.01$ ). Bacterial nitrogen flow was lower in CIN and EUG (1.1 and 1.2 g/d) than CAP and CON (1.6 and 1.6 g/d;  $P < 0.01$ ). Efficiency of

microbial protein synthesis in CIN tended to be lower (34.6 g bacterial N/kg digested OM;  $P = 0.06$ ) than CON and CAP (40.2 and 39.8 g bacterial N/kg digested OM). Effluent ammonia N tended to be higher in CIN than CON (3.7 vs. 2.5 mg/dL;  $P = 0.06$ ). Total VFA production was unaffected by EO ( $P = 0.16$ ). Supplementation with EUG caused lower production of propionate (103.9 mM/d;  $P < 0.01$ ), higher production of butyrate (59.3 mM/d;  $P < 0.01$ ), and the highest acetate:propionate (1.6;  $P = 0.02$ ) compared to other treatments. Isovalerate production tended to be highest in CAP (1.5 mM/d;  $P = 0.10$ ). Fermenters with CIN or EUG had higher mean pH than CAP and CON (5.9 vs. 5.7;  $P < 0.01$ ), spent fewer hr/d (2.0 and 0.9 vs. 9.6 and 10.5;  $P < 0.01$ ), and had smaller area under the curve (0.1 and 0.1 vs. 0.9 and 1.0;  $P < 0.01$ ) at  $\text{pH} < 5.6$ . Supplementation with CIN or EUG at high dosages may be unfavorable to rumen efficiency.

**Key Words:** dairy nutrition, essential oil, continuous culture

## Graduate Student Paper Competition-CSAS Oral Competition: CSAS Graduate Student Competition 1

**53 Plant-based diets enriched with linseed oil or marine algae and organic selenium modify sperm fertility parameters in broiler breeders over the reproductive cycle.** C. Coss<sup>\*1,2</sup>, C. Brèque<sup>1,2</sup>, R. Gervais<sup>2</sup>, C. Lessard<sup>1,2</sup>, D. Venne<sup>3</sup>, M. R. Lefrançois<sup>2</sup>, P. Y. Chouinard<sup>2</sup>, G. Vandenberg<sup>2</sup>, and J. L. Bailey<sup>1,2</sup>, <sup>1</sup>Centre de recherche en biologie de la reproduction, Québec, QC, Canada, <sup>2</sup>Département des sciences animales, Université Laval, Québec, QC, Canada, <sup>3</sup>Couvoir Scott Ltée, Scott Junction, QC, Canada.

There are indications that plant-based diets and organic (org) Se alter fertility in broiler breeders. We hypothesised that supplementing plant-based diets with n-3 fatty acids (FA), org Se, and vitamin (vit) E improves male reproductive parameters. Individually caged, 23 week old Ross broiler breeders were fed 8 diets (n=15/diet). The control diet contained meat meal + 50 IU/kg vit E, while the others were plant-based: 2.3% of soya oil (rich in C18 n-6 FA) + 50 IU/kg vit E, 2.3% of soya oil + 100 IU/kg vit E, 2.3% of soya oil + 100 IU/kg vit E + 0.3 ppm org Se, 2.3% of linseed oil (rich in C18 n-3 FA) + 100 IU/kg vit E, 2.3% of linseed oil + 100 IU/kg vit E + 0.3 ppm org Se, 2.2% soya oil + 1% of marine algae (42% oil, rich in C22 n-3 FA) + 100 IU/kg vit E, and 2.2% soya oil + 1% of marine algae + 100 IU/kg vit E + 0.3 ppm org Se. Diets were isoproteic and isoenergetic. After 7, 13, and 25 weeks of feeding (corresponding to 33, 38, and 50 weeks of age), semen was evaluated. Data were analysed as a completely randomized design using the SAS MIXED procedure. The Sperm Chromatin Structure Assay showed that the DNA Fragmentation Index (DFI), which reflects the % of sperm with weakened chromatin, increased from 33 to 50 weeks of age for the group fed soya oil + 50 IU/kg vit E ( $P < 0.05$ ), while no effect was observed for the other dietary treatments. DFI standard deviation increased with age ( $P < 0.05$ ). Sperm viability (LIVE/DEAD<sup>®</sup> assay by flow cytometry) decreased with age ( $P < 0.05$ ). Computer Assisted Sperm Analysis revealed that various parameters increased with age (motility, progressive motility, elongation;  $P < 0.05$ ), whereas others decreased (straightness, linearity;  $P < 0.05$ ). These results show that aging had an effect on fertility parameters, whereas dietary treatments had little or no effect.

**Key Words:** broiler breeder, sperm, omega-3

**54 The effect of two calving seasons on cow and calf performance in western Canada.** L. C. Girardin<sup>\*1</sup>, H. A. Lardner<sup>2</sup>, A. D. Iwaasa<sup>3</sup>, S. L. Scott<sup>4</sup>, and S. H. Hendrick<sup>1</sup>, <sup>1</sup>University of Saskatchewan, Saskatoon, SK, Canada, <sup>2</sup>Western Beef Development Centre, Lanigan, SK, Canada, <sup>3</sup>Agriculture and Agri-Food Canada - Semiarid Prairie Agricultural Research Centre, Swift Current, SK, Canada, <sup>4</sup>Agriculture and Agri-Food Canada - Brandon Research Centre, Brandon, MB, Canada.

A 2-yr study was conducted to evaluate the effects of calving season on cow and calf performance. Two calving seasons, Early (March) vs. Late (June), were compared at 3 locations, Lanigan, Saskatchewan (LA), Swift Current (SC), Saskatchewan, and Brandon (BR) Manitoba. One-hundred crossbred cows at LA, 50 crossbred cows at SC and 120 crossbred cows at BR were randomly allocated to 1 of 2 replicated (n=2) calving seasons. Experimental design was a randomized complete block, analyzed using PROC MIXED repeated measures. Cow body weights and condition scores (5-pt scale [1=thin, 5=fat]) were taken at calving, breeding and weaning. Calf body weights were taken at birth, 60 d of age and weaning (205 d). Pregnancy and weaning rates were based on the number of cows exposed at breeding. At BR, cow body weights were not different ( $P > 0.05$ ) between calving seasons, however rump fat of Early-calving cows was greater ( $P < 0.05$ ) than Late-calving cows. Cow body condition at weaning at SC was lower ( $P < 0.05$ ) for Early-calving cows than Late-calving cows. Cow body condition at calving at LA was greater ( $P < 0.05$ ) for Late-calving cows as compared to Early-calving cows. At all locations, birth weights were numerically lower for Early-born calves compared to Late-born calves. Weaning weights were lower ( $P < 0.05$ ) for Late-born calves compared to Early-born calves at all locations (BR, 253 vs. 287 kg(SE=8.58); SC, 239 vs. 270 kg(SE=13.42); LA, 228 vs. 260 kg(SE=7.24)). Calf growth from birth to weaning at BR (SE=0.07), SC (SE=0.06) and LA (SE=0.03) for Early-born and Late-born calves was 1.18, 1.13, 1.09 kg d<sup>-1</sup> and 0.99, 0.95, 0.91 kg d<sup>-1</sup>, respectively. Neither weaning rate nor pregnancy rate was affected by calving season or location. Results indicate that calving season impacts cow performance differently depending on location and may impact calf weaning weights.

**Key Words:** calving season, beef cattle, reproductive traits

**55 Evaluation of swine group-housing systems for breed-to-wean herds using a sow investment model.** M. A. Fynn\*, N. J. Lewis, M. L. Connor, and G. V. Johnson, *University of Manitoba, Winnipeg, MB, Canada.*

With the current trend in the North American swine industry to move away from the use of gestation crates, group-housing systems for gestating sows need careful investigation. The objective of this study was to compare two group-housing systems – one a partial-slatted concrete-floor system (conventional) and the other a straw-based solid-floor system (alternative) – for sows in breed-to-wean operations taking into consideration both animal well-being and economic profitability. Experimental data was collected between March 2006 and March 2009 from two genetically-identical breed-to-wean herds in southern Manitoba. A sample representing average breeding gilts was selected from each barn – 63 in the conventional and 62 in the alternative – with data being collected throughout their productive lives at breeding, 30-days post-breeding, farrowing, weaning, and prior to culling. A dynamic programming model was built using sow condition and production data to determine optimal replacement criteria for breeding sows in each respective housing system. The model used a profit function that optimizes the present value of net revenues. Inherent to this model was the identification of a sow production function. The profit function was estimated using regression analysis, and culling data was analyzed by chi-square analysis. All data analysis was performed in SAS. Production in the alternative system had a higher trend, suggesting increased revenues, as compared to the conventional system. Further, sows in the conventional system were found to be subjected to higher risk of involuntary culling in the first 3 parities than sows in the alternative system ( $P < 0.05$ ) implying improved longevity in the straw-based system. This finding is important since longevity has been shown to be a good indicator of animal well-being. This study suggests that the alternative system favours both higher welfare for the animals and higher production for the farmers. However, a similar model detailing costs for the entire breed-to-wean operation needs to be developed to fully assess the economics.

**Key Words:** economic, sow replacement, housing

**56 Effect of ruminal protozoa on urea-nitrogen recycling in growing lambs fed varying dietary protein concentrations.** D. Kiran\* and T. Mutsvangwa, *University of Saskatchewan, Saskatoon, SK, Canada.*

The objectives were to examine the effects of ruminal protozoa and level of dietary crude protein (CP) on urea-N recycling to the gastrointestinal tract (GIT), microbial protein synthesis and N balance in growing lambs. Four Suffolk ram lambs ( $43.9 \pm 1.4$  kg BW) were used in a  $4 \times 4$  Latin square design with 28-d periods and a  $2 \times 2$  factorial arrangement of treatments. Treatments were: 1) partial defaunation vs. faunation; and 2) 10% (LOW) vs. 15% (HIGH) dietary CP (DM basis). Partial defaunation refers to substantial decreases (up to 85%) in ruminal protozoal counts. Linoleic acid-rich sunflower oil was fed (6% of DM) as an anti-protozoal agent. Nitrogen balance was measured from d 22 to d 26, with concurrent measurements of urea-N kinetics using continuous intra-jugular infusions of [ $^{15}\text{N}^{15}\text{N}$ ]-urea. There were only minor interactions between ruminal protozoal status and level of dietary CP. Feeding sunflower oil decreased ( $P < 0.01$ ) total protozoal counts by 85%, and this was accompanied by a decrease ( $P < 0.01$ ) in ruminal  $\text{NH}_3\text{-N}$  concentrations. Intake of N was lower ( $P = 0.04$ ), and N retention (as a % of N intake) was higher ( $P = 0.05$ ) in partially-defaunated compared to faunated lambs. Endogenous production of urea-N (UER; 26.1 vs. 34.6 g/d) and urea-N loss in urine (UUE; 10.1 vs. 15.7 g/d) were lower ( $P <$

0.01), and urea-N entering the GIT (GER; 16.0 vs. 18.9 g/d) tended to be lower ( $P = 0.06$ ) in partially-defaunated compared to faunated lambs. However, as a proportion of UER, GER was higher ( $P < 0.01$ ) and its anabolic use tended to be higher ( $P = 0.09$ ) in partially-defaunated compared to faunated lambs. Partial defaunation increased ( $P < 0.01$ ) microbial N supply. Endogenous production of urea-N (38.2 vs. 22.5 g/d), GER (20.8 vs. 14.2 g/d), and UUE (17.4 vs. 8.3 g/d) were higher ( $P < 0.01$ ) in lambs fed the HIGH diet compared to those fed the LOW diet. However, as a proportion of UER, GER and its anabolic use were higher ( $P < 0.01$ ) in lambs fed the LOW diet compared to those fed the HIGH diet. In summary, partial defaunation increased urea-N transfer to the GIT, while also increasing microbial N supply.

**Key Words:** dietary protein, ruminal protozoa, urea-N recycling

**57 Comparison of NRC–2001 chemical approach with biological approach (in situ animal study) in the determination of digestible nutrients and energy values of dry distillers grains with solubles in ruminants.** W. G. Nuez Ortin\* and P. Yu, *University of Saskatchewan, Saskatoon, SK, Canada.*

Dry distillers grains with solubles (DDGS) are not natural but man-made feed products from bio-energy production. It is a question whether chemical approach (NRC–2001 formula), which was developed based on natural feeds, can accurately estimate energy values of different types of DDGS based on chemical composition. The objective of this study was to compare the NRC–2001 chemical approach with biological approach (in situ animal study) in the determination of digestible (DE3X) and metabolizable energy (ME3X) at a production level, net energy for lactation (NEL3X), net energy for maintenance (NEm), and net energy for gain (NEg) of DDGS. Corn DDGS, wheat DDGS and blend DDGS (70% wheat: 30% corn) from different batches were obtained during 2007 in Canada. In situ study was used to determine digestible nutrients (tdNFC, tdFA, tdCP, tdNDF) and total digestible nutrients (TDN1X), from which energy values were estimated. Statistical analyses were performed using the Mixed and Correlation procedures of SAS (version 9.1.3). Experimental design was a Completely Randomized Design. The results showed significant differences ( $P < 0.001$ ) in the estimation of energy values as well as nonsignificant correlation ( $P > 0.05$ ) between the NRC–2001 chemical and biological approach. The highest Pearson correlation coefficient found was 0.39 for NEL3X ( $P = 0.229$ ). Compared with the biological approach, NRC–2001 estimated lower values for TDN1x [TDN1x (NRC)–TDN1x (In situ) =  $-18.28\%$  DM], DE3X ( $-0.672$  Mcal/kg DM), ME3X ( $-0.679$  Mcal/kg DM), NEL3X ( $-0.351$  Mcal/kg DM), NEm ( $-0.475$  Mcal/kg DM) and NEg ( $-0.392$  Mcal/kg DM). Energy values of DDGS estimated by the biological approach are not predictable from the chemical approach. Thus, refinement of the NRC-2001 formula is needed in order to more accurately predict energy values in ruminants.

**Key Words:** energy values, dried distillers grains with solubles, NRC–2001 chemical approach

**58 Effect of butyrate absorption on the severity of subacute ruminal acidosis.** G. B. Penner\*<sup>1</sup>, J. R. Aschenbach<sup>2</sup>, G. Gäbel<sup>2</sup>, and M. Oba<sup>1</sup>, <sup>1</sup>University of Alberta, Edmonton, AB, Canada, <sup>2</sup>Universität Leipzig, Leipzig, Germany.

This study aimed to determine the effect of subacute ruminal acidosis (SARA) on the absorption of butyrate across the ruminal epithelia.

Twenty-four German Merino sheep ( $72.3 \pm 10.1$  kg of BW) individually housed and fed a hay diet were assigned to a glucose (GLU;  $n = 17$ ) or control (CON,  $n = 7$ ) treatment. The GLU was designed to induce SARA by administering an orally dosed glucose solution (2.2 M) to supply 5 g glucose/kg BW; whereas, CON sheep received and equal volume of water. Ruminant pH was measured continuously for 3-h following the oral dose. Sheep were euthanized and ruminal epithelia from the ventral sac were collected. Epithelia were mounted in Ussing chambers with separate mucosal and serosal solutions (pH 6.1 and 7.4, respectively). In vitro treatment included Ussing chamber solutions that contained bicarbonate or excluded bicarbonate.  $1\text{-}^{14}\text{C}$ -butyrate was used to determine the apical uptake as a measure for butyrate import into the cell and the mucosal-to-serosal flux as an estimate of butyrate absorption. In vivo data were analyzed as a randomized complete block design and Ussing chamber data as a split-plot design. Means  $\pm$  SEM are presented. Mean ruminal pH was lower ( $5.77 \pm 0.06$  vs.  $6.67 \pm 0.09$ ;  $P < 0.001$ ) and the severity of SARA, indicated by the area that  $\text{pH} < 5.8$ , was higher for GLU than CON sheep ( $27 \pm 5.0$  vs.  $0 \pm 7.8$   $\text{pH} \times \text{min}/180$  min;  $P = 0.009$ ). Total butyrate uptake and flux were not affected by in vivo treatment averaging  $10.23$  nmol/mg protein/min and  $2.83$   $\mu\text{mol}/\text{cm}^2/\text{h}$ , respectively. Bicarbonate-dependent butyrate uptake was lower ( $P < 0.001$ ) than bicarbonate-independent uptake ( $3.06 \pm 0.55$  vs.  $7.23 \pm 0.55$  nmol/mg protein/min) and bicarbonate-dependent butyrate flux was lower than bicarbonate-independent flux ( $1.25 \pm 0.11$  vs.  $1.58 \pm 0.11$   $\mu\text{mol}/\text{cm}^2/\text{h}$ ;  $P = 0.0497$ ). Total butyrate uptake and butyrate flux tended ( $P \leq 0.088$ ) to be negatively related to the severity of ruminal acidosis ( $r^2 = 0.133$  and  $0.127$ , respectively) indicating that efficient absorption of butyrate may ameliorate the severity of SARA.

**Key Words:** butyrate, ruminal acidosis, rumen pH

### 59 Comparison of wheat or corn dried distillers grains with solubles (DDGS) on performance and carcass characteristics of feedlot steers.

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A study was conducted to evaluate performance and carcass quality of cattle fed wheat or corn DDGS. Crossbred steers ( $N=275$ ) weighing  $376 \pm 24$  kg were randomly assigned to one of 25 pens and fed one of 5 treatment rations. The control ration contained 86.6% rolled barley grain, 5.7% supplement and 7.7% barley silage (DM basis) and was formulated to 12% crude protein and 1.95 and 1.30 Mcal/kg  $\text{NE}_m$  and  $\text{NE}_g$ , respectively. The 4 treatments included replacement of barley grain at 20 or 40% of the diet (DM basis) with wheat or corn DDGS. Data was analyzed as a CRD using the mixed model with pen as the experimental unit. Relative to control fed cattle (10.4 kg/d), cattle fed 40% wheat DDGS (10.9 kg/d) had the highest ( $P < 0.0001$ ) DMI while those fed 40% corn DDGS (8.8 kg/d) had the lowest ( $P < 0.0001$ ). No effect ( $P > 0.05$ ) of 20% addition of wheat or corn DDGS on DMI was noted. ADG was not influenced ( $P > 0.1$ ) by DDGS feeding. The cattle fed 40% corn DDGS had a lower ( $P < 0.0001$ ) feed to gain relative to all other treatments (5.2 vs. 6.3). In contrast to the steers fed the control and 20% wheat DDGS treatments, steers fed 40% wheat DDGS had fewer ( $P < 0.05$ ) days on feed. Carcass traits including weight, *l. dorsi* area, grade fat and marbling score were not affected ( $P > 0.05$ ) by treatment, although steers fed the control ration had a lower ( $P < 0.05$ ) dressing % than steers fed 40% wheat DDGS and 20 and 40% corn DDGS. Yield

of boneless boxed beef sub-primals as determined by carcass cutout was not ( $P > 0.05$ ) affected by treatment. The results of this study indicate that replacement of barley grain with corn or wheat DDGS at 40% of the diet DM can lead to superior performance (improved feed efficiency or reduced days on feed, respectively) with no detrimental effect on carcass retail yield or quality grade.

**Key Words:** DDGS, cattle performance, carcass characteristics

### 60 Effect of graded levels of wheat-based dried distillers grains with solubles on rumen fermentation in finishing cattle. R. M. Beliveau<sup>\*1,2</sup> and J. J. McKinnon<sup>2</sup>, <sup>1</sup>Agriculture and Agri-Food Canada, Lethbridge, AB, Canada, <sup>2</sup>University of Saskatchewan, Saskatoon, SK, Canada.

A  $4 \times 4$  Latin square experiment using ruminally cannulated heifers ( $388 \pm 25$  kg) was conducted to evaluate the effects of graded levels of wheat-based dried distiller's grains with solubles (DDGS) on the rumen fermentation characteristics and eating behaviour of finishing cattle fed barley-based diets. Animals were randomly assigned to one of four treatments of 0, 7, 14 or 21% DDGS replacing barley in a finishing ration. Rumen fermentation measurements included in-dwelling 23h pH measurements, total volatile fatty acid (VFA) levels, molar proportions of individual VFA's, osmolality and ammonia nitrogen levels. Mean rumen pH, at the sub-acute and acute acidosis benchmark values of pH 5.8 or less ( $P = 0.02$ ) and 5.5 or less ( $P = 0.004$ ), decreased in a cubic fashion as DDGS inclusion level increased resulting in a theoretical maximum pH at DDGS inclusion levels of 2.5 and 2.6% and theoretical minimum pH at DDGS inclusion level of 14.7% (DM basis). A cubic effect of DDGS inclusion level ( $P = 0.03$ ) was also noted for total time below pH 5.2 where a theoretical minima was found at 2.9% DDGS and a maxima at 15.0% DDGS (DM basis). Ammonia nitrogen ( $P = 0.003$ ) levels and the molar proportions of acetate ( $P = 0.02$ ) and butyrate ( $P = 0.04$ ), as well as the acetate: propionate ratio ( $P = 0.01$ ) increased linearly with DDGS inclusion level. In contrast, propionate decreased ( $P = 0.006$ ) linearly as the level of DDGS increased. Time spent eating increased ( $P = 0.03$ ) linearly with DDGS inclusion level; however, no differences ( $P \geq 0.05$ ) were seen for ruminating, chewing (eating + ruminating), drinking, lying or standing. It was concluded that despite the high fibre, low starch nature of wheat-based DDGS, substitution for barley did not improve the acidic rumen fermentation conditions associated with feeding high grain rations. As such, metabolic disturbances such as sub-acute ruminal acidosis (SARA) are still a concern when feeding wheat-based DDGS as a substitute for barley in finishing rations for feedlot cattle.

**Key Words:** distiller's grains, pH, acidosis

### 61 Impact of feed waste on the nutrition and economics of wintering beef cows. B. J. Yaremcio<sup>\*1</sup>, E. K. Okine<sup>2</sup>, M. Oba<sup>2</sup>, and D. McCartney<sup>3</sup>, <sup>1</sup>Alberta Agriculture and Rural Development, Canada, <sup>2</sup>University of Alberta, Canada, <sup>3</sup>Agriculture and Agri-Food Canada, Canada.

Many cowherds in western Canada are fed forage on snow during winter using extensive feeding systems to reduce feeding costs. Newer technologies claim to be more economical and efficient than other feeding systems. The main objective was to compare two feeding systems, the old bale unroller (BU), and newer bale shredder (BSHR), to determine the amount of feed waste (FW) that occurs when meadow brome alfalfa hay (MBAH) was fed on snow at 1.8% of body weight on a dry matter basis (DMB). The feeding rate was 90% of recommended rates (NRC Beef 2000). The control for this experiment was feeding MBAH into

portable feed bunks (PFB) delivered by BSHR. Four replicates of each treatment were completed, with four samples per replicate were collected. Treatments were blocked by week and analyzed by proc mixed and pdiff (SAS, 2002). The second objective was to calculate the impact of FW on nutrients consumed compared to amounts supplied. The third objective was to calculate the economic impact caused by FW and the amount of additional feed required to replace lost nutrients. FW was 12.1% and 19.2% DMB respectively for BU and BSHR ( $P < 0.0001$ ) when fed on snow. Forage placed into PFB had 0% waste. More fine material (78.5%) was lost ( $P < 0.0001$ ) with the BSHR feeding system than the BU (46%). CP losses were 23.3% and 21.5% compared to physical losses of 12.3% and 19.2% respectively for the BU and BSHR. Losses of Ca, P, Mg, K and Na were also greater than the physical feed loss. Ration CP content was reduced from the delivered feed at 11% DMB to 8.4% and 8.6% when waste was considered with the BU and BSHR respectively. Over a 175 d feeding period, replacing nutrients lost in the FW with additional forage and additional equipment operating time increased winter feed costs by C\$28.52 and C\$56.52 per head for the BU and BSHR respectively.

**Key Words:** snow, feed waste, cows

**62 A temporal characterization of the rumen epithelium response to dramatic shifts in dietary fermentable carbohydrates.** M. A. Steele\*, O. AlZahal, S. E. Hook, S. Greenwood, and B. W. McBride, *University of Guelph, Guelph, ON, Canada.*

The rumen epithelium performs a vital role in whole-animal energy metabolism through the absorption and the metabolism of volatile fatty acids (VFA). In spite of this, very little is known about how the rumen epithelium responds to dramatic shifts in dietary carbohydrates and the resulting microbial products. The first objective of this study was to temporally characterize how shifts in dietary carbohydrates influence rumen pH and epithelial ketogenesis. The second objective was to temporally quantify mRNA expression levels of ketogenic enzymes in rumen papillae. To meet these objectives, four mature, rumen fistulated dairy cattle were utilized to facilitate continuous rumen pH recording on a weekly basis. The cattle were maintained on a control (CON) diet prior to transitioning to an acidosis (AD) diet, which was fed for three weeks (weeks 1-3). The cattle were then switched back to the original CON diet for three additional weeks (weeks 4-6). A mixed model with repeated measures was used to contrast ruminal pH, blood metabolites and mRNA expression data between and within treatments. Mean ruminal pH was depressed ( $P < 0.01$ ) and SARA was diagnosed during the first week of the AD diet however pH was not significantly different from the CON during the second and third week on the AD diet, indicative of improved VFA clearance from the rumen. Plasma BHBA levels were elevated ( $P < 0.01$ ) when cattle were fed the AD compared to the

CON diets, suggesting increased ketogenesis in the rumen epithelium. The expression of HMG-CoA Synthase mRNA increased during the first week of the AD diet ( $P < 0.05$ ) however was down-regulated 2.0-fold  $\pm$  0.08 ( $P < 0.01$ ) by the third week. Acyl-CoA Synthase mRNA expression was also decreased 1.8-fold  $\pm$  0.11 ( $P < 0.01$ ) by the third week of the AD diet. To our knowledge, this is the first in-vivo study to demonstrate that rumen epithelial metabolism adapts to shifts in the form of dietary carbohydrates.

**Key Words:** rumen epithelium, acidosis, ketogenesis

**63 Fertility of Alpine goats following oestrus synchronisation with CIDR and artificial insemination with cryopreserved semen.** M.-E. Marier<sup>\*1,2</sup>, F. Castonguay<sup>3</sup>, M. Theriault<sup>3</sup>, D. Cinq-Mars<sup>2</sup>, C. Lessard<sup>1,2</sup>, and J. L. Bailey<sup>1,2</sup>, <sup>1</sup>Centre de recherche en biologie de la reproduction, <sup>2</sup>Département des sciences animales, Université Laval, Québec City, <sup>3</sup>Dairy & Swine Research and Development Center, AAFC, Lennoxville.

The demand for goat milk by Canada's manufacturing industry far outweighs that produced by its dairy herd. In contrast, France has been proactive in improving the genetic make-up and productivity of their herd using artificial insemination (AI). Our goal is to encourage AI in Canada by developing a protocol based on that used in France but modified for Canada's industry, where sponges are no longer available. A total of 48 female Alpine goats under an artificial photoperiod regime were assigned to 3 treatments (n=16 goats/treatment; 8 adult and 8 yearling) during the non-breeding season (spring): NAT+AI - females were inseminated with frozen semen 12 h after natural oestrus; CIDR+AI - oestrus was synchronized with CIDRs (progesterone-releasing device) and females were inseminated with frozen semen 43 h after CIDR removal; CIDR+buck - oestrus was synchronised with CIDRs and females were placed with bucks 24 h after CIDR removal. For CIDR groups, females were treated with CIDRs on Day 0, injected with eCG+cloprostenol on Day 9, and CIDRs were removed on Day 11. Semen straws from the same lots were used for both AI groups, and sperm parameters (computer-assisted sperm motility, viability, DNA stability, and % acrosome reactions) were analysed to assess the relationship with fertility. Data were analysed by PROC LOGISTIC with SAS. Overall birth rate was 25% for NAT+AI, which was inferior to the 63%, and 100% for CIDR+AI and CIDR+buck, respectively ( $P < 0.05$ ). Female age did not affect fertility. Post-thaw semen analyses were not predictive of fertility. This study demonstrates that AI with frozen semen yields satisfactory fertility in adults and yearlings in the non-breeding season with oestrus being synchronised by a CIDR-based protocol. While natural mating yields the best fertility, the 63% obtained with AI allows a much faster genetic improvement.

**Key Words:** goat, CIDR, AI

## Graduate Student Paper Competition: National ADSA Dairy Foods

**64 Growth of *Lactobacillus casei* at 8°C in Cheddar cheese extract requires supplementation.** W. S. Tan<sup>\*1</sup>, M. F. Budinich<sup>1</sup>, R. Ward<sup>2</sup>, J. R. Broadbent<sup>2</sup>, and J. L. Steele<sup>1</sup>, <sup>1</sup>University of Wisconsin, Madison, <sup>2</sup>Utah State University, Logan.

Flavor development in ripening Cheddar cheese is a complex microbial and biochemical system that is difficult to study in its natural form.

Therefore, we developed a model system, Cheddar cheese extract (CCE), derived from the aqueous phase of ripening Cheddar cheese to study the complex interactions between the cheese microbiota, the conditions present in the cheese (e.g. composition of the microbiota, substrates present, NaCl concentration, temperature, pH, and organic acids) and flavor development. Previous studies in our laboratory have demonstrated that CCE supports the growth of strains of *Lactobacillus casei* at 37°C from