

# Graduate Student Competition: ADSA Production Division Graduate Student Poster Competition, MS

**M129 Transcriptome profiling of pituitary gland from pre- and post-pubertal beef heifers.** Robmay Garcia\*, Dianelys Gonzalez-Pena, Bruce R. Southey, and Sandra L. Rodriguez-Zas, *University of Illinois at Urbana Champaign, Urbana, IL.*

Onset of puberty is a key component of animal production and reproductive efficiency. The pituitary gland plays a major role in reproductive readiness. A comprehensive understanding of the associated transcriptome changes during peripuberty will aid in the development of treatments and management practices to improve reproductive performance. The objective of this study was to gain understanding of the transcriptome associated with changes pre- and post-puberty. The transcriptome of pituitary tissue from 4 pre-pubertal beef heifers was compared with that of 4 different post-pubertal beef heifers using individual RNA-seq libraries. Single-end reads were mapped to the *Bos taurus* reference genome (Btau\_4.6.1) using Tophat v2.0.12. In total, 10,489 isoform transcripts pertaining to 10,234 genes were identified and 1,162 isoform transcripts pertaining to 1,149 genes were differentially expressed between post-puberty and pre-puberty pituitary tissue (False Discovery Rate-adjusted  $P$ -value  $< 0.05$ ) using Cufflinks v2.2.1. Among the most relevant and significant (false discovery rate adjusted  $P$ -value  $< 0.03$ ) genes associated with reproductive maturation were leptin receptor (*LEPR*) and vasoactive intestinal peptide (*VIP*), and endothelin 1 (*EDN1*). Increments in leptin receptors encoded by *LEPR* are associated with gonad maturation, the advent of reproductive maturity and fertility. *VIP* encodes the VIP neuropeptide that among other roles, participates in ovarian development and stimulation of prolactin release under the influence of estrogen. *EDN1* encodes the EDN1 neuropeptide that is involved in mechanisms controlling the gonadotropins and prolactin secretion, also inhibiting synthesis of progesterone and premature luteinization of granulosa cells. Functional analysis of the differentially expressed genes using DAVID identified 4 enriched functional category clusters (enrichment score  $> 2$ ): blood vessels and vasculature development, collagen fibrin and extracellular organization, carbohydrate and hyaluronic acid binding, and transforming growth factor  $\beta$  receptor signaling pathway. These categories confirm a wide range of changes associated with beef heifers transitioning from pre- to post-puberty and suggest potential pharmacological targets.

**Key Words:** transcriptome, puberty, pituitary

**M130 Prepartum supplementation of niacin increases colostral immunoglobulin G content in dairy cows.** Kayla M. Aragona\*, Colleen E. Chapman, André B.D. Pereira, and Peter S. Erickson, *University of New Hampshire, Durham, NH.*

In the US, 60% of colostrum fails to meet the minimum standard of 50g/L of immunoglobulin G (IgG). High quality colostrum is essential for the survival and future production of dairy heifers. Previous studies have shown that niacin (N) may increase vasodilation and in dairy cows, prepartum N supplementation may increase blood flow and potentially Ig flow, to the mammary gland. The objective of this study was to determine if feeding 48g/d of supplemental N to prepartum dairy cows effects colostrum quality. The experiment used 26 multiparous Holstein cows housed in a tie-stall barn. Cows were blocked by expected calving date and randomly assigned to 1 of 2 treatments 4wk prepartum: (1) 48g/d N (Lonza) or (2) 0g/d N (C), both with 52g/d of corn meal as a carrier. Total mixed ration amounts fed and refused were measured

daily at 0800h to determine dry matter intake (DMI). Within 90min of parturition, colostrum was collected and weighed. IgG concentration was analyzed using a radial immunodiffusion (RID) assay (Triple J Farms). Calves were removed from their dams immediately and weighed. Calves received 3 bags of a lacteal based colostrum replacer (180g IgG, Saskatoon Colostrum Co.), fed within 2 h of birth. Blood samples were collected from calves via jugular vein at 0 and 24 h of age and analyzed for IgG concentration and apparent efficiency of absorption (AEA). No differences were observed for DMI [15.7 kg/d (C), 14.3 kg/d (N);  $P = 0.13$ ], IgG yield [748.87 g (C), 773.67 g (N);  $P = 0.83$ ], colostrum yield [10.64 L (C), 9.45 L (N);  $P = 0.19$ ], fat % [5.5% (C), 4.72% (N);  $P = 0.45$ ] and solids nonfat % [23.9% (C), 22.9% (N);  $P = 0.7$ ]. No differences were observed for 24-h calf serum IgG concentration [15.9 g/L (C), 15.5 g/L (N);  $P = 0.8$ ] or AEA [32.46% (C), 30.92% (N);  $P = 0.5$ ]. Niacin tended to increase colostrum protein percent (14.6% (C), 17.9% (N);  $P = 0.09$ ). Niacin increased IgG concentration in colostrum from 73.8 g/L (C) to 86.8 g/L (N) ( $P < 0.05$ ). These results indicate that supplementing N (48 g/d) during the prepartum period improves colostrum quality.

**Key Words:** niacin, IgG, colostrum

**M131 Innate immune cells may be involved in bovine mammary development.** Kirsten. L. Beaudry\*<sup>1</sup>, Cathy. L. Parsons<sup>1</sup>, Adam. J. Geiger<sup>1</sup>, Steven. E. Ellis<sup>2</sup>, and Robert M. Akers<sup>1</sup>, <sup>1</sup>*Department of Dairy Science, Virginia Polytechnic Institute and State University, Blacksburg, VA,* <sup>2</sup>*Department of Animal and Veterinary Sciences, Clemson University, Clemson, SC.*

Bovine mammary development begins before puberty with the elongation and branching of ducts and stromal remodeling. This process is highly regulated, and in mice impacted by the presence of innate immune cells which cluster near developing ductal structures. For the first time, we studied the presence, location and changes in numbers of eosinophils, mast cells and macrophages in prepubertal bovine mammary tissue. Chemical stains and immunofluorescence were used to identify the 3 cell types in formalin fixed, paraffin embedded mammary tissue from prepubertal female calves in archived sets. The first set (ONT) included samples ( $n = 4$  per week) from birth to 6 wk of age. A second set (OVX) allowed for examination of the potential influence of ovaries on innate immune cells. It included samples from 19 animals who were either intact or ovariectomized 30 d before sample collection. These animals were 90, 120 or 150 d old at examination. The third set (EST) allowed for examination of the potential influence of exogenous estrogen on innate immune cells in the mammary gland. This set included samples from 10 calves given estrogen implants ( $n = 6$ ) or placebo ( $n = 4$ ) at 56 d of age. Calves were sampled at 70 d of age. Eosinophils were identified via LUNA staining, mast cells by May-Grunewald Giemsa staining, and macrophages with immunofluorescence. Stroma was examined in 20 images from each animal of the NEAR ( $< 100 \mu\text{m}$ ) and FAR ( $> 100 \mu\text{m}$ ) locations relative to the epithelial ducts. Results were expressed as cells/mm<sup>2</sup>. More eosinophils and mast cells were observed in NEAR compared with FAR stroma in the ONT ( $P < 0.001$ ) and OVX ( $P < 0.05$ ) but not EST. More macrophages were also observed in NEAR compared with FAR in ONT ( $P < 0.001$ ). Treatment (age, ovariectomy or estrogen) had no impact on stromal eosinophils. Age tended to affect mast cell numbers in ONT, with the most mast cells observed at 14 d

of age. In summary, we show for the first time that innate immune cells are present in prepubertal bovine mammary tissue and that abundance is related to the epithelial structure and physiological state of development. We suggest there may be a role for these cells in control of bovine mammary development.

**Key Words:** mammary, immune cell, development

**M132 An evaluation of precision dairy farming technologies monitoring rumination, feeding, and lying behaviors.** Matthew R. Borchers\*, I-Ching Tsai, Barbara A. Wadsworth, and Jeffrey M. Bewley, *University of Kentucky, Lexington, KY.*

The objective of this study was to evaluate commercially available precision dairy farming technologies against direct visual observations for feeding, rumination, and lying behaviors. Primiparous ( $n = 24$ ) and multiparous ( $n = 24$ ) lactating Holstein dairy cattle (mean  $\pm$  SD;  $223.4 \pm 117.8$  d in milk, producing  $29.2 \pm 8.2$  kg milk/d) were fitted with 6 triaxial accelerometer technologies to evaluate cow behavior. Technologies recording feeding behavior were the CowManager SensOor (Agis, Harmelen, Netherlands) and the Track a Cow (ENGS, Israel). Technologies recording rumination behavior were the CowManager SensOor and the Smartbow (MKW electronics GmbH, Jutogasse, Austria). Lying behavior was recorded by the AfiAct Pedometer Plus (Afirmilk, Kibbutz Afikim, Israel), HOBO Data Logger (HOBO Pendant G Acceleration Data Logger, Onset Computer Corporation, Pocasset, MA), CowAlert IceQube (IceRobotics Ltd., Edinburgh, UK), and Track a Cow. Over 8 d in October 2014, 6 cows per day were visually observed for feeding, rumination, and lying behavior for 2 h after morning and evening milking. The CORR procedure of SAS Version 9.3 (SAS Institute Inc., Cary, NC) was used to evaluate agreement between visual observations and technology-recorded behaviors. Visually recorded feeding behavior was strongly correlated with CowManager SensOor ( $r = 0.97$ ;  $P = 0.03$ ) and Track a Cow ( $r = 0.91$ ;  $P = 0.09$ ). Between the CowManager SensOor and Track a Cow, a strong correlation ( $r = 0.91$ ;  $P = 0.09$ ) was found. Visually recorded rumination was strongly correlated with the Smartbow ( $r = 0.99$ ;  $P < 0.01$ ) and CowManager SensOor ( $r = 0.96$ ;  $P < 0.01$ ). Between the Smartbow and CowManager SensOor, a strong correlation ( $r = 0.94$ ;  $P = 0.06$ ) was found. Visually recorded lying behavior was highly correlated with the AfiAct Pedometer Plus ( $r = 0.97$ ;  $P < 0.01$ ), HOBO Data Loggers ( $r = 0.98$ ;  $P < 0.01$ ), CowAlert IceQube ( $r = 0.99$ ;  $P < 0.01$ ), and Track a Cow ( $r = 0.99$ ;  $P < 0.01$ ). Results indicate these precision dairy farming technologies to be accurate dairy cattle behavioral monitors.

**Key Words:** precision dairy farming technologies, dairy cow behavioral monitoring, accuracy evaluation

**M133 The effect of estrus expression on target genes in the endometrium, conceptus and corpus luteum of cows.** Saeideh Davoodi\*<sup>1</sup>, Reinaldo F. Cooke<sup>2</sup>, Arthur C. C. Fernandes<sup>1</sup>, Bruno I. Cappellozza<sup>2</sup>, Jose L. M. Vasconcelos<sup>3</sup>, and Ronaldo L. A. Cerri<sup>1</sup>, <sup>1</sup>*Faculty of Land and Food Systems, University of British Columbia, Vancouver, BC, Canada*, <sup>2</sup>*Eastern Oregon Agricultural Research Center, Oregon State University, Burns, OR*, <sup>3</sup>*Faculdade de Medicina Veterinária e Zootecnia, UNESP – Botucatu, SP, Brazil.*

The aim of this study was to test the effect of estrus expression at artificial insemination (AI) on the endometrium, conceptus and corpus luteum (CL) gene expression. Twenty-three multiparous nonlactating Nelore cows were enrolled on a estradiol and progesterone (P4) based timed-AI protocol (AI = d 0), then slaughtered for endometrium, CL

and conceptus collection on d 19. Body condition score (BCS), blood samples for analysis of P4 and ultrasound examination was performed on d 0, 7 and 18 of the experiment. RNA extraction and qRT-PCR analysis of 58 target genes were analyzed on tissues. Data were checked for normality and analyzed by ANOVA for repeated measures using proc GLM, MIXED and UNIVARIATE. Estrous expression had no correlation with parameters such as BCS, pre-ovulatory follicle and CL diameter, P4 concentration in plasma on d 7 and 18 after AI and IFN-tau concentration in the uterine flushing ( $P > 0.05$ ); however, a significant increase was observed in conceptus size ( $P = 0.02$ ;  $38.3 \pm 2.8$  vs.  $28.2 \pm 2.9$ ). The majority of transcripts affected by estrous expression in the endometrium belong to the immune system and adhesion molecule family (MX1, MX2, MYL12A, MMP19, CXCL10, IGLL10 and SLPI;  $P \leq 0.05$ ). Genes related to apoptosis, P4 synthesis and prostaglandin receptor were downregulated (CYP11A, BAX and PGR;  $P < 0.05$ ) in the CL tissue of cows in estrus. In addition, 4 genes were identified as differentially expressed in the 19 old conceptus from cows observed in estrus (ISG15, PLA2, BMP15 and EEF1A1;  $P < 0.05$ ). There was an interaction ( $P < 0.05$ ) between estrus expression and P4 concentration on d 7 which mainly affected genes involved in immune system (MX1, MX2, TRD, SLPI and IGLL1). This study demonstrated that estrous expression at the time of AI, in spite of ovulation being induced by estradiol, can alter the gene expression profile in reproductive tissues during the preimplantation phase. These effects seem to be more pronounced in endometrium during the time of dynamic remodeling to prepare a receptive uterus for embryo implantation.

**Key Words:** conceptus, corpus luteum, endometrium

**M134 Accuracy and intensity of heat detection with activity monitoring systems for lactating dairy cows.** Craig LeRoy\* and Stephen LeBlanc, *Department of Population Medicine, University of Guelph, Guelph, ON.*

Activity monitors are becoming a widely used tool for estrus detection in dairy cows. The objective of this study is to assess the intensity and accuracy of estrus detection with automated activity monitoring systems. Three commercial dairy farms with an activity monitoring system (Heatime SCR Inc., or Afi Pedometer Plus, Afikim) that was used for essentially all inseminations between 50 and 80 d in milk (DIM) were enrolled in this observational study. Herds were visited once weekly. Blood samples were collected at wk 5, 7, and 9 postpartum and from a subset of cows on the day of insemination, to measure serum progesterone concentration. Cows were examined at wk 5 for purulent vaginal discharge (PVD). Lameness and body condition were scored at wk 7. Cows were classified as anovular if all 3 blood samples from wk 5, 7, and 9 had progesterone  $< 1$  ng/mL. Overall, 6.7% of cows were anovular (range of 3.6% to 8.2% among farms). Of these cows, 39% had a lameness score of 3 or above (1 to 5 scale) and 29% had PVD. Among cows that reached 80 DIM ( $n = 419$ ), 14% had not been inseminated by 80 DIM; of these, 12% were anovular, 23% were lame, 21% had PVD and 4% had a BCS of  $< 2.5$ . Among 352 blood samples taken on the day of insemination (all services; 212 signaled by the activity system and 140 by Ovsynch), 8% and 3% had progesterone  $> 1$  ng/mL; that is, the cows were not in estrus. In this sample, the accuracy of detection of estrus by AAM was high, but a subset of cows would likely require intervention for timely first AI and only a fraction of these were truly not cyclic.

**Key Words:** activity monitor, anovular, progesterone

**M135 Extruded flaxseed products improve the fatty acid profile of bovine milk.** Janna Moats<sup>\*1,2</sup>, Timothy Mutsvangwa<sup>2</sup>, and David Christensen<sup>2</sup>, <sup>1</sup>O&T Farms Ltd., Regina, SK, Canada, <sup>2</sup>University of Saskatchewan, Saskatoon, SK, Canada.

There is interest in increasing the content of omega-3 (n-3) fatty acids in bovine milk, primarily because of their beneficial effects on human health. This study investigated the effects of extrusion and the inclusion of condensed tannins (CT) in a flaxseed product on rumen fermentation characteristics, animal performance and milk fatty acid composition in dairy cows. Eight Holstein cows were used in a replicated 4 × 4 Latin Square with 28-d periods (20 d for dietary adaptation and 8 d for collection). Four cows in one Latin square were ruminally-cannulated. Cows were fed either a control diet (CTL) or one of 3 treatment diets that consisted of the daily substitution of 3 kg of the CTL concentrate pellet with 3 kg of either a non-extruded flaxseed and pea product (55% flaxseed, 36% peas, 8% alfalfa, 1% antioxidant; designated RAW), an extruded flaxseed and pea product (55% flaxseed, 36% peas, 8% alfalfa, 1% antioxidant; designated LPR), or an extruded flaxseed and high-tannin fava bean product (55% flaxseed, 36% fava beans, 8% alfalfa, 1% antioxidant; designated LPF). Diets were fed twice daily as total mixed rations. Dry matter intake was lower for cows fed LPR compared with those fed CTL ( $P < 0.05$ ). Milk yield was unaffected by dietary treatment ( $P > 0.05$ ). Rumen pH was not affected by dietary treatment ( $P > 0.05$ ). Rumen ammonia concentration was lower in animals fed CTL compared with those fed RAW, LPR or LPF ( $P = 0.04$ ). Propionate concentrations were higher for animals fed LPR compared with those fed RAW ( $P = 0.04$ ), while acetate concentrations did not differ between dietary treatments ( $P > 0.05$ ). Total n-3 and CLA milk contents were higher in cows fed LPR and LPF compared with those fed RAW and CTL ( $P < 0.01$ ). Milk fat content was lower for cows fed LPF compared with those fed CTL ( $P = 0.03$ ); however, milk fat yield was unaffected by dietary treatment ( $P > 0.05$ ). The use of extruded flaxseed products is an effective strategy for increasing the n-3 and CLA concentrations of bovine milk without negatively affecting rumen fermentation or animal production; however, the inclusion of CT in the extruded product had no additional benefit.

**Key Words:** omega-3, flaxseed, milk

**M136 Probiotic supplementation influences feed intake, body weight gain, and adaptive immunity in Holstein heifer calves during commingling.** Caleigh E. Payne<sup>\*</sup>, Luis G. D. Mendonça, Sonia J. Moisés, Sophia C. Trombetta, Lucas D. S. Rocha, Suzy Q. Fowler, Juan C. Gordienko, and Lindsey E. Hulbert, Kansas State University, Manhattan, KS.

After weaning, the transition from individual housing to group housing (commingling) is stressful for calves and increases the risk of respiratory disease during this period. Probiotics can include mannan-oligosaccharide (MOS) and b-glucan (BG) which may help improve calf health and performance. Therefore, the objectives of this study were to determine if a daily bolus dose of oral probiotics (20% MOS; 10% BG) influence feed intake, body weight gain, or adaptive immunity in Holstein heifer calves ( $n = 60$ ) during the transition from individual hutches to pens of 3. One week before commingling, calves (age  $52 \pm 4.0$  SD d; body weight  $83 \pm 14.92$  SD kg) were randomly assigned to daily treatments of either 4 g of probiotic (Preb) dissolved in 15 mL of molasses or control (Con; 15 mL of molasses only) for 7 weeks. Calves were fed ad libitum TMR top-dressed with 9 pounds of 18% CP calf starter once per day with refusals collected and measured daily. Calves were weighed and measured weekly. All calves were administered an innocuous protein

injection, ovalbumin (OVA; subQ; 0.5 mg/mL), at commingling and 4 weeks after commingling. Blood was collected 2 weeks after OVA to measure primary and secondary OVA-specific IgG and IgA responses. Prebiotic-fed calves ate more than control-fed calves 2 weeks after commingling ( $3.18$  vs.  $3.06 \pm 0.034$  kg/d;  $P = 0.015$ ). Prebiotic calves also gained more weight 3 weeks (ADG  $0.90$  vs.  $0.86 \pm 0.060$  kg/d;  $P = 0.037$ ) and 6 weeks post-commingling (ADG  $1.08$  vs.  $0.96 \pm 0.060$  kg/d;  $P = 0.025$ ). In addition, the interaction between treatment and week affected F:G ( $P = 0.044$ ) with preb-calves having lower F:G 1, 3, and 6 weeks post-commingling. The Preb-calves had a greater primary IgA response to OVA than Con-calves ( $P = 0.0315$ ), but no differences were observed for IgG ( $P = 0.8289$ ). Prebiotic supplementation may improve calf performance and adaptive immunity in the transition to group-housing situations post weaning.

**Key Words:** prebiotic, bovine, performance

**M137 Supplementation of conjugated linoleic acid during the transition to lactation period increased milk production in a commercial dairy.** Tawny L. Chandler<sup>\*1</sup>, Robert T. Fugate<sup>1</sup>, Arnulf H. A. Troescher<sup>3</sup>, Joshua A. Jendza<sup>2</sup>, and Heather M. White<sup>1</sup>, <sup>1</sup>University of Wisconsin-Madison, Madison, WI, <sup>2</sup>BASF Corporation, Florham Park, NJ, <sup>3</sup>BASF Corporation, Lampertheim, Germany.

*Trans*-10, *cis*-12 conjugated linoleic acid (CLA), a bioactive fatty acid, has the potential to alter energy partitioning in lactating cows by marginally reducing milk fat synthesis in the mammary gland. The objective of this study was to determine the effects of pre- and postpartum CLA supplementation on lactation performance in a commercial dairy setting. Holstein cows in a robotic milking system were blocked by multiparous (mp) or primiparous (pp), and expected calving date, and randomly assigned to either a CLA group (mp  $n = 100$ ; pp  $n = 39$ ) or control group (mp  $n = 98$ ; pp  $n = 38$ ). Cows were supplemented with 100g of lipid encapsulated CLA methyl esters (Lutrell Pure, BASF, Germany) mixed 50:50 with soybean meal to provide 10g each of *trans*-10, *cis*-12 CLA and *cis*-9, *trans*-11 CLA via a robot mineral supplement unit. Supplementation was from -21d precalving through 30d in milk (DIM) for mp or 70 DIM for pp. Milk yield, fat, and protein concentration were recorded daily and averaged by wk for the first 100 DIM. Data were analyzed using the MIXED procedure of SAS 9.4 with repeated measures. Treatment, wk, and treatment × wk were fixed effects with random effects of (cow)group. Means were considered different when  $P \leq 0.1$  and tended to differ when  $P \leq 0.15$ . Daily milk yield over 100d was increased with CLA supplementation (100d mean mp:  $49.7$  vs.  $51.3 \pm 0.6$  kg/d,  $P = 0.07$ ; pp:  $30.3$  vs.  $32.0 \pm 0.7$  kg/d  $P = 0.09$ ) with the greatest increase in milk production being 3.0 kg/d for mp (wk 5;  $P = 0.007$ ) and 3.9 kg/d for pp (wk 14;  $P = 0.001$ ) cows. Supplementation with CLA did not alter milk fat concentration ( $P > 0.15$ ) or yield ( $P > 0.15$ ) over the 100 d period. Milk protein concentration was reduced ( $P = 0.05$ ) with CLA supplementation in mp ( $3.18$  vs.  $3.12 \pm 0.02\%$ , control vs. CLA) but not changed ( $P > 0.15$ ) in pp ( $3.27$  vs.  $3.22 \pm 0.04\%$ , control vs. CLA) cows; however milk protein yield was unaffected ( $P > 0.15$ ). These results suggest that CLA supplementation during the transition to lactation period altered energy partitioning to increase milk production during the first 100 DIM.

**Key Words:** conjugated linoleic acid, transition cow, energy partitioning

**M138 Effects of plane of nutrition on glucose tolerance test kinetics pre- and postweaning in Holstein calves fed twice daily.**

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Feeding an elevated plane of nutrition to dairy calves preweaning is becoming more popular as it has been linked to higher growth rates, earlier onset of puberty, and increased milk production. Providing these feeding schemes in 2 meals is thought to impair glucose clearance and insulin responsiveness in young calves, but whether or not there is a carryover effect postweaning remains unclear. The objective of this study was to investigate this using a glucose tolerance test (GTT). A total of 12 female Holstein calves were selected and blocked by cow parity and colostrum intake, then assigned to an elevated plane (EP; 8 L/d) or a low plane (LP; 4 L/d) of nutrition. Calves received 4 L of colostrum provided in 2 meals (1h and 6h after birth), and were stepped-down from milk by 50% during wk 7 then weaned on wk 8. All calves had ad libitum access to pelleted calf starter, chopped wheat straw, and water. Milk replacer consisted of 24% CP and 18% CF and was fed at 150g/L. The GTT (glucose 30%) was conducted at 4, 7 and 10 weeks of age by infusing 540 mg of glucose per kg of metabolic bodyweight at the time of the morning feeding after a 12 h fast. Blood samples were collected at -15, 0, 5, 10, 20, 30, 45, 60, 120, 180, and 240 min via a jugular catheter. Changes in glucose concentration (mmol/L), clearance rate (%/min), and area under the curve (AUC<sub>240</sub>) were calculated. Preliminary data from a Hemocue blood glucose analyzer indicates that the increase in glucose (C<sub>max</sub>; mmol/L) was similar ( $P = 0.31$ ) between treatment groups and no differences between ages (pre- and postweaning) were detected. The time to reach the peak concentration (T<sub>max</sub>; minutes) was similar across treatments and age ( $P = 0.29$ ). Area under the curve was significantly affected by calf age ( $P = 0.005$ ) with AUC<sub>240</sub> increasing with age, and a trend for interaction with treatment was observed, where EP calves tended ( $P = 0.07$ ) to have a greater AUC at 10 weeks of age. The results show that the rate of glucose clearance following a tolerance test was not affected ( $P = 0.14$ ) by plane of nutrition or age when calves were fed milk replacer in 2 meals per day.

**Key Words:** glucose, glucose tolerance test, calf nutrition

**M139 Metabolic characteristics of protein, nutrient supply and feed milk value of the newly developed AAFC yellow and brown carinata lines for dairy cattle in comparison with commercial canola seeds.** Yajing Ban\*, David A. Christensen, John J. McKinnon, and Peiqiang Yu, *Department of Animal and Poultry Science, College of Agricultural and Bioresources, University of Saskatchewan, Canada.*

New lines of *Brassica carinata*, which were developed recently as oil crops for bio-fuel production in the dry western Canadian prairie, could also be regarded as a potential new feed source for animals. To our knowledge, there is little research on metabolic characteristics of protein in the new yellow and brown lines of carinata seeds. The objective of this study was to determine the differences in metabolic characteristics of protein from the new lines of carinata seeds in yellow and brown coats for dairy cows compared with commercial canola seeds. The new carinata lines were bred by Agriculture and Agri-Food Canada (AAFC). The experiment of rumen and intestinal digestion was carried out in U of S dairy research facility. Four cannulated lactating dairy cows were used for rumen degradation trial. The nutrient supply to dairy cattle and feed milk value (FMV) were determined based on the DVE/OEB system

with data from rumen and intestinal digestion experiments. Statistical analyses were performed using PROC MIXED procedure of SAS 9.3 with significance declared at  $P < 0.05$ . The results showed that yellow carinata seed line had higher ( $P < 0.05$ ) rumen undegraded feed crude protein (RUP) and effective degradability of crude protein (EDCP) compared with canola seeds. From in vitro intestinal digestion results, carinata seeds had higher total digestible protein (TDP) than canola seeds ( $P < 0.05$ ). Based on the DVE/OEB system, carinata seeds had higher truly absorbed rumen-synthesized microbial protein, total truly digested protein (DVE) in small intestine and feed milk value (FMV) than canola seeds ( $P < 0.05$ ). Yellow carinata seed line had higher protein supply than the brown seed line. In conclusion, the new lines of carinata seeds could be regarded as a potential feed protein supplement for dairy cows, and yellow carinata seed line had greater protein digestibility than brown carinata seeds.

**Key Words:** carinata seed, metabolic characteristics of protein, DVE/OEB system

**M140 Responses of neonatal goats (kids) to different concentrations of carbon dioxide gas.** Isabelle C. Withrock\*, Paul J. Plummer, Timothy A. Shepherd, Anna Johnson, Hongwei Xin, Johann F. Coetzee, and Suzanne T. Millman, *Iowa State University, Ames, IA.*

The dairy goat industry faces challenges for kid euthanasia. The methods approved by the AVMA are barbiturate overdose, gunshot, and captive bolt. The disadvantages of these methods range from cost to operator safety. Currently, there is no published research on inhalant euthanasia methods for neonatal ruminants. The objective of this study was to evaluate carbon dioxide (CO<sub>2</sub>) for kid euthanasia. A preference testing device was custom made to hold 2 connected chambers at static atmospheric concentrations. One chamber maintained ambient conditions, and the other designated CO<sub>2</sub> levels (treatment). A total of 7 mixed-breed dairy kids were enrolled in the study. Six males and 1 female were enrolled, and body weights ranged from 3.18 to 4.17 kg. Kids were individually trained for 5 consecutive days to enter the treatment chamber from the ambient chamber to access a milk ration (32oz). During training both chambers were set at ambient air concentrations. Kids were held in the ambient chamber for 5 min, after which the sliding door was opened to provide access to the treatment chamber. Kids were provided 10 min access to the treatment chamber after which they were removed and returned to their home pen. After training, testing began with the treatment chamber set at one of 3 CO<sub>2</sub> levels: 10%, 20% or 25%, while the ambient chamber was maintained at 1% CO<sub>2</sub>. Kids were randomly assigned 10% or 20% as the first treatment and received 25% CO<sub>2</sub> last. Kids experienced all 3 CO<sub>2</sub> treatments, with a 2-d wash-out (ambient CO<sub>2</sub>) between tests. Outcomes were collected using continuous sampling, and included latency to enter and exit treatment chamber to measure aversion, loss of muscle control (ataxia), and loss of posture. Five kids (71%) tolerated 10% CO<sub>2</sub> for 10 min. One kid left at 8.5 min after consuming his full ration. One kid lost posture at 289 s. At 20 and 25% CO<sub>2</sub>, a total of 100% of the kids became ataxic, and posture loss ranged from 93 to 215 s. All kids continued to consume milk before and during ataxia and reentered the treatment chamber on wash out days. In conclusion, kids did not display aversion to CO<sub>2</sub> and therefore, CO<sub>2</sub> has merit for goat euthanasia.

**Key Words:** carbon dioxide, euthanasia, goat

**M141 Analyzing udder efficiency of Brown Swiss cattle using data envelopment analysis.** Keith D. Gibson\* and Chad D. Dechow, *The Pennsylvania State University, State College, PA.*

Udder conformation traits such as udder depth are favorably associated with somatic cell score (SCS) and mastitis resistance, but unfavorably associated with yield, resulting in unclear selection aims. Data envelopment analysis (DEA) is an approach to characterize the efficiency of different units based on inputs and outputs. The objective of this research was to use DEA to create an efficiency trait for udders of Brown Swiss cattle, which we termed udder efficiency, and to evaluate the genetic relationship of udder efficiency with yield, fitness, and udder conformation. The lone input was identified as milking speed and the outputs were milk, fat, and protein yield, and the inverse of SCS. A SAS DEA macro was used to determine udder efficiency relative to herd mates, with the most desirable cows milking quickly, producing large volumes of milk, fat, and protein with a low SCS. Values for the trait ranged from 0.03 (very inefficient cows) to 1.0 (efficient cows). There were 105,164 first through fifth lactation yield and SCS records from 45,464 cows born in 2000 or later. There were 41,704 milking speed records with a high

score corresponding to faster milking speed. From these, 40,960 udder efficiency records were derived. These data were analyzed using a series of 3 trait models in ASREML that included fixed effects for lactation, age, and herd-calving cluster. Random effects were animal, permanent environment, and residual. The heritability of udder efficiency was  $0.23 \pm 0.0133$ . Genetic correlations with udder efficiency were moderate and positive for yield (0.40 to 0.42), favorable with SCS (-0.21), and strongly positive for milking speed (0.86). Udder efficiency was also strongly correlated with productive life (0.69). Of the udder traits, rear udder height (0.30), teat length (-0.28), fore udder attachment (0.25), and rear udder attachment (0.21) were most favorably correlated to udder efficiency. The correlation of udder depth with udder efficiency was 0.16. Based on these findings, DEA could be a useful and novel method for evaluating udder efficiency, helping to identify traits that enable selection for mastitis resistance without compromising yield.

**Key Words:** Brown Swiss, udder efficiency, data envelopment analysis