

Graduate Student Paper Competition: National ADSA Production Division PhD Oral Competition

84 Expression of inducible nitric oxide synthase is up-regulated by production of 1,25-dihydroxyvitamin D₃ in bovine monocytes in response to toll-like receptor signaling. C. D. Nelson^{*1,2}, D. C. Beitz¹, T. A. Reinhardt², and J. D. Lippolis², ¹*Iowa State University, Ames*, ²*National Animal Disease Center, United States Department of Agriculture, Ames, IA*.

In the endocrine pathway of vitamin D signaling 1,25-dihydroxyvitamin D₃ (1,25(OH)₂D₃) is produced from 25-hydroxyvitamin D₃ (25(OH)D₃) by the enzyme CYP27B1 in the kidney. Production of 1,25(OH)₂D₃ in the kidney functions to regulate gene expression systemically. However, recent studies have shown that human monocytes express CYP27B1 and produce 1,25(OH)₂D₃ in response to toll-like receptor recognition of bacterial cell wall components. Activation of 25(OH)D₃ by CYP27B1 in human monocytes improves antimicrobial activity via an autocrine pathway. The purpose of this study was to determine if 1,25(OH)₂D₃ is produced by CYP27B1 in bovine monocytes upon TLR signaling and if 1,25(OH)₂D₃ production in bovine monocytes increases expression of antimicrobial genes. Monocytes were isolated from peripheral blood of six lactating Holstein cows and cultured in media containing 10% FBS. Monocyte cultures were treated with 0 - 75 ng/mL 25(OH)D₃ or 0 - 4 ng/mL 1,25(OH)₂D₃ and stimulated for 24 hours with lipopolysaccharide (LPS) a tripalmitoylated lipopeptide (Pam3CSK4) or peptidoglycan (PGN). Relative expression of CYP27B1, cathelicidin 4 (CATH4), CATH5, CATH6 and inducible nitric oxide synthase (iNOS) mRNA in monocytes was measured using quantitative real-time PCR. CYP27B1 expression in monocyte cultures was induced by stimulation with LPS, Pam3CSK4 or PGN ($p < 0.05$). Treatment of stimulated monocyte cultures with 25(OH)D₃ or 1,25(OH)₂D₃ increased iNOS expression ($p < 0.05$). Treatment of unstimulated monocyte cultures with 1,25(OH)₂D₃, but not 25(OH)D₃, increased iNOS expression. Expression of CATH4, CATH5 and CATH6 genes in stimulated monocytes was not affected by 25(OH)D₃ or 1,25(OH)₂D₃ treatment. In conclusion, bovine monocytes convert 25(OH)D₃ to 1,25(OH)₂D₃ in response to TLR signaling and 1,25(OH)₂D₃ production up-regulates iNOS expression. This study is the first to show that an autocrine pathway of vitamin D signaling has an impact on the innate immune response in cattle.

Key Words: iNOS, vitamin D, toll-like receptor

85 Regulation of bovine pyruvate carboxylase mRNA and promoter expression by heat stress. H. M. White^{*}, S. L. Koser, and S. S. Donkin, *Purdue University, West Lafayette, IN*.

Pyruvate carboxylase (PC) catalyzes a rate limiting step in gluconeogenesis and TCA cycle flux. Bovine PC is the product of a gene containing three promoter regions (P3, P2, and P1, 5' to 3') and is responsive to physiological and nutritional stressors. The objectives of this study were to investigate the effects of heat exposure (42°C) on PC expression in bovine hepatocyte monolayer cultures and in rat hepatoma (H4IIE) cells. Hepatocytes were isolated from three Holstein calves less than 7 d of age and used to prepare monolayer cultures. Rat hepatoma cells were obtained from American Type Culture Collection and utilized by eight passage. Cells from both lines were maintained in 10% FBS for 24 h following plating, and treatments were applied in triplicate in three independent groups of cells or three primary hepatocyte preparations. Expression of PC mRNA relative to 18S mRNA (arbitrary units) increased ($P \leq 0.1$) with 24h exposure to heat (1.31 vs. 2.79, control vs. heat). Conversely, endogenous PC mRNA expression decreased

($P \leq 0.1$) in H4IIE cells (0.47 vs. 0.30, control vs. heat). There was an interaction of cell type and PC mRNA expression with heat exposure ($P \leq 0.05$). There were no changes in phosphoenolpyruvate carboxykinase (PEPCK) mRNA expression in either cell types. To further investigate the regulation of PC, H4IIE cells were transiently transfected with bovine promoter-luciferase constructs containing either P1, P2, or P3 and exposed to heat for 23 h. Activity of P1 was suppressed (arbitrary units of luciferase activity; $P \leq 0.05$) with heat exposure (5.85 vs. 1.25, control vs. heat) but P3 activity was enhanced ($P \leq 0.1$; 0.34 vs. 2.57, control vs. heat). These data indicate that there is a cell type interaction of PC expression with heat exposure. Furthermore, induction of gene expression by heat stress appears specific to bovine PC compared with PEPCK. The promoter response data indicate unique characteristics of bovine PC promoters that may be part of the physiological response to heat stress.

Key Words: pyruvate carboxylase, heat, bovine hepatocytes

86 Activation of AMP-activated protein kinase (AMPK) inhibits *de novo* fatty acid synthesis in bovine mammary epithelial cells. J. W. McFadden^{*} and B. A. Corl, *Virginia Polytechnic Institute and State University, Blacksburg*.

Activation of AMP-activated protein kinase (AMPK), a heterotrimeric energy-sensing protein, decreases lipid synthesis in liver tissue of various species; however, little is known about the role of AMPK in the regulation of lipid synthesis in bovine mammary epithelial cells. Our objectives were to identify the presence of AMPK in bovine mammary tissue and a bovine mammary epithelial cell line (MAC-T) and determine the effect of AMPK activation on *de novo* fatty acid synthesis in MAC-T. Expression of AMPK subunits ($\alpha 1$, $\alpha 2$, $\beta 1$, $\beta 2$, $\gamma 1$, $\gamma 2$, and $\gamma 3$) was determined using real-time PCR. The α , β , and γ subunits of AMPK were found in mammary tissue and MAC-T; however, the $\alpha 2$ isoform was not expressed in MAC-T nor was the $\gamma 3$ isoform found in mammary tissue or MAC-T. Treatment of MAC-T with the AMPK activator AICAR for 4 h (acute) or 24 h (chronic) resulted in 85 and 92% decreases ($P < 0.05$) in radiolabeled-acetate incorporation into fatty acids, respectively. Treatment of MAC-T with AICAR for 1 h increased the ratio of inactive acetyl-CoA carboxylase (ACC) to total ACC by 959% ($P < 0.0001$). Chronic treatment of MAC-T with AICAR decreased the mRNA expression of glycerol phosphate acyltransferase, lipoprotein lipase, and peroxisome proliferator-activated receptor- γ by 44-80% ($P < 0.05$). Chronic AICAR increased the mRNA expression of fatty acid binding protein-3, fatty acid synthase, and sterol regulatory element binding protein-1 by 39-65% ($P < 0.01$). Expression of ACC mRNA was unaffected by AICAR. AMP-activated protein kinase is sensitive to decreases in energy supply. Incubating MAC-T without glucose for 4 h resulted in a 251% increase in the ratio of inactive ACC to total ACC ($P < 0.0001$). Ionomycin is a potential activator of Ca²⁺/calmodulin-dependent kinase kinase, an AMPK kinase. Treatment of MAC-T with ionomycin for 1 h resulted in a 308% increase in the ratio of inactive ACC to total ACC ($P < 0.0001$). Results confirm that AMPK activation dramatically decreases *de novo* fatty acid synthesis in MAC-T. Therefore, in the lactating mammary gland, AMPK may sense energy availability and regulate milk fat synthesis to control energy utilization.

Key Words: ACC, AMPK, fatty acid

87 Evaluation of effects of fibrolytic enzyme application on the digestibility of corn silage, alfalfa hay, and two concentrates and complete diets under simulated ruminal and preruminal conditions. K. G. Arriola* and A. T. Adesogan, *University of Florida, Gainesville.*

Previous work showed that when added to the TMR prior to feeding, a fibrolytic enzyme containing 880 U/ml of endoglucanase activity, 3633 U/ml of xylanase activity, and 0.1 $\mu\text{mol}/\text{mg}/\text{minute}$ of esterase activity improved DM (DMD) and NDF digestibility (NDFD) and the level and efficiency of milk production by dairy cows. This study determined if the enzyme exerts its hydrolytic effect on different dietary substrates preruminally or ruminally. Substrates evaluated included corn silage (CS), alfalfa hay (AH), low (LC) and high (HC) -energy concentrates (22 and 37% corn meal) and low- (33%) and high-(48%) concentrate TMRs (TMRL and TMRH). The enzyme was diluted in 1 ml of citrate phosphate buffer (pH 6.0) and applied to six replicates of 0.5 g of each substrate within 250 ml culture bottles in each of 2 runs. Twenty-four h later, 40 ml of either distilled water (W) or buffered-rumen fluid (RF) was added to the substrates. Samples were incubated at 39°C for 24 h after which, residues were analyzed for DM and NDF, and digestibility of DM and NDF were calculated. Substrates incubated in RF had greater ($P < 0.01$) DMD than those incubated in W except for AH, which had greater DMD in water and TMRH which, had similar DMD in both media. On average, DMD in RF was 5.5% greater than DMD in W. Due to a substrate \times medium interaction; AH had the greatest ($P < 0.01$) DMD in W and CS had the lowest ($P < 0.01$) DMD, whereas, LC had the greatest DMD in RF and TMRH had the lowest DMD. All substrates except AH had greater ($P < 0.001$) NDFD when incubated in RF than in W. On average, NDFD in rumen fluid was 74% greater than NDFD in W. Due to a substrate \times medium interaction, AH had the greatest NDFD in W and CS had the lowest, whereas TMRL had the greatest NDFD in RF and AH had the lowest. The fibrolytic enzyme hydrolyzed the substrates in the presence and absence of rumen fluid suggesting that it can improve digestion both preruminally and ruminally.

Key Words: fibrolytic enzymes, digestibility, diet

88 Comparison of a controlled-energy high-fiber diet fed throughout the dry period to a two-stage far-off and close-up dietary strategy. B. F. Richards*¹, N. A. Janovick¹, K. M. Moyes¹, D. E. Beever², and J. K. Drackley¹, ¹*University of Illinois, Urbana,* ²*Richard Keenan & Co., County Carlow, Ireland.*

Our objective was to determine if a controlled-energy, high-fiber diet fed during the dry period improves metabolic status and production of dairy cows compared with a higher-energy diet or a two-stage system (controlled energy far-off and higher energy close-up to calving). Twenty-five Holstein cows (10 primiparous) were assigned to 1 of 3 treatments at 60 d before expected calving. Treatment LE was a controlled-energy diet (1.32 Mcal $\text{NE}_L/\text{kg DM}$; 12.3% CP) to meet but not exceed NRC recommendations at ad libitum intake from dry-off until calving. The diet included wheat straw (42% of the DM) processed directly into the TMR using Keenan Klassik mixer wagon technology. Treatment HE was a moderate-energy diet (1.61 Mcal $\text{NE}_L/\text{kg DM}$; 12.7% CP) fed ad libitum from dry-off until calving. For the LEHE treatment, the LE diet was fed ad libitum from dry-off until 21 d prepartum, followed by the HE diet until parturition. After parturition all cows were fed the same lactation diet (1.66 Mcal $\text{NE}_L/\text{kg DM}$; 18% CP) mixed in a Calan Data Ranger through 63 d postpartum. The DMI and BW were greater for HE cows prepartum ($P < 0.01$, $P < 0.01$), but not postpartum ($P = 0.47$, $P = 0.59$). Cows fed HE had greater gain of body condition score (BCS)

before calving ($P < 0.01$) but lost more BCS postpartum ($P = 0.06$). Milk production did not differ across treatments ($P = 0.80$). Milk fat (kg/d) was higher for HE ($P < 0.01$); milk protein (kg/d) did not differ ($P = 0.38$). The LE cows had lower serum NEFA ($P < 0.01$), serum β -hydroxybutyrate ($P < 0.01$) and liver total lipid ($P < 0.01$) postpartum than HE cows and lower liver total lipid ($P < 0.05$) than LEHE cows. Serum glucose ($P < 0.01$) and insulin ($P = 0.02$) were lower for LE than HE and LEHE prepartum; insulin was lower for LE than LEHE postpartum ($P < 0.01$). Controlling energy intake to near requirements during the dry period by use of a high-straw diet improved metabolic status with no adverse effects on production. A two-stage feeding strategy provided little benefit over the single-group controlled-energy diet.

Key Words: dry period, transition cow, energy balance

89 Effects of addition of live bacterial inoculants and glycerol to the diet of lactating dairy cows on apparent efficiency and milk yield during heat stress. J. Boyd*¹, J. W. West¹, J. Bernard¹, J. Lofton², and D. R. Ware², ¹*University of Georgia, Tifton,* ²*Nutrition Physiology Corporation, St. Cloud, MN.*

A study was conducted to evaluate the effects of a live bacterial inoculant and dietary glycerol on milk yield, efficiency of yield, and nutrient digestibility during hot weather. Sixty Holstein cows averaging 120 DIM and 36.2 kg/d of milk were used. The study was conducted from June through Sept. 2008. Cows were fed a common diet during the 2 wk standardization period and then divided into 4 groups of 15 by parity, milk yield, ECM, and DIM and randomly assigned to 1 of 4 treatments for 10 wks. Experimental design was a randomized complete block with a 2x2 factorial treatment arrangement. Treatments included control (C), Bovamine[®] (B), Bovamine[®] w/ 400g h/d glycerol (BG), and control w/ 400g h/d glycerol (G). Bovamine[®] contained 4×10^9 CFU/h/d of a combination of *Lactobacillus acidophilus NP51* and *Propionibacterium freudenreichii NP24*. Diets were based on corn and ryegrass silages and balanced to be iso-caloric and iso-nitrogenous. DMI ($P < 0.52$) was 23.0, 22.2, 23.3, and 22.8 kg/d (treatments C, B, BG, and G respectively). Milk yield ($P < 0.52$) was 32.5, 32.8, 34.5, and 32.4 kg/d (treatments C, B, BG, and G respectively). A trend for improved milk yield with BG versus G of 2.1 kg/d was noted. No effect was noted for milk fat percentage or ECM among diets. A decrease in milk protein percentage was noted ($P < 0.06$) for cows offered G (2.72 ± 0.02) compared with C (2.8 ± 0.02). No effect on respiratory rate, skin temperature, body temperature or concentration of serum glucose or urea N was noted. An increase in efficiency ($P < 0.02$) defined as milk yield/DMI was noted with G (1.51 ± 0.02) and BG (1.54 ± 0.02) compared with C (1.42 ± 0.02). Also, improved efficiency ($P < 0.06$) for B (1.5 ± 0.02) versus C (1.42 ± 0.02) was noted. The addition of Bovamine[®] alone and with glycerol had a positive effect on apparent efficiency compared with C. Results suggest that the addition of Bovamine[®], glycerol or a combination of both may improve yield efficiency for cows subject to heat stress.

Key Words: bacterial inoculant, glycerol, heat stress

90 Subacute ruminal acidosis decreases acetate absorption across the isolated ruminal epithelia. G. B. Penner*¹, J. R. Aschenbach², G. Gäbel², and M. Oba¹, ¹*University of Alberta, Edmonton, AB, Canada,* ²*Universität Leipzig, Leipzig, Germany.*

This study aimed to determine the effect of subacute ruminal acidosis (SARA) on the absorption of acetate across ruminal epithelia. Twenty-four German Merino sheep (72.3 ± 10.1 kg of BW), fed a hay diet,

were assigned to the glucose (GLU; n = 17) or control (CON, n = 7) treatments. The GLU sheep were orally dosed with a 2.2 M glucose solution to supply 5 g glucose/kg BW; whereas, CON sheep received an equal volume of water. Ruminal pH was measured for 48 h prior to and extending for 3 h after the oral dose. Following the 3 h challenge period, sheep were euthanized and ruminal epithelia from the ventral sac were collected. Epithelia were mounted in Ussing chambers with isolated mucosal and serosal solutions buffered at pH 6.1 and 7.4, respectively. In vitro treatment was Ussing chamber buffer solutions that 1) contained bicarbonate, 2) excluded bicarbonate, or 3) excluded bicarbonate and included nitrate. ^3H -acetate was used to determine the mucosal-to-serosal flux of acetate in order to estimate absorption. This allowed for the calculation of total, bicarbonate-dependent, bicarbonate-independent, and bicarbonate-independent and nitrate-sensitive absorption of acetate. Data were analyzed as a split-plot design with the main-plot factors of in vivo treatment and the sub-plot factors of in vitro treatment. The severity of SARA, as indicated by area that ruminal pH < 5.8, was greater ($P = 0.009$) for GLU than CON sheep (27 vs. 0 pH \times min/180 min) during the 3 h challenge. Inducing SARA decreased acetate absorption ($P = 0.037$), where total absorption was reduced by 37% for epithelia from GLU compared to CON sheep (0.64 vs. 0.43 $\mu\text{mol}/\text{cm}^2/\text{h}$). Correlation analysis revealed that as the severity of SARA increased, the bicarbonate-dependent absorption of acetate decreased ($r^2 = 0.263$; $P = 0.035$). This study indicates that SARA decreases acetate absorption across the ruminal epithelia primarily due to a reduction in bicarbonate-dependent absorption.

Key Words: acetate, ruminal acidosis, ruminal epithelia

91 Effect of feed bin stocking density on the feeding and standing behavior of postpartum dairy cows. P. D. Krawczel^{1,2}, D. M. Weary³, R. J. Grant¹, and M. A. G. von Keyserlingk³, ¹William H. Miner Agricultural Research Institute, Chazy, NY, ²The University of Vermont, Burlington, ³University of British Columbia, Vancouver, BC, Canada.

There are limited data on the effect of overcrowding feed bins, within a range that is representative of on-farm conditions, on the behavior of dairy cows during the postpartum period. The objective of this study was to determine the effects of feed bin stocking densities of 100% (1:1, bin:cow), 133% (1:1.33), 150% (1:1.5), and 200% (1:2) on the behavior of cows during 21 d following parturition. Two groups of multiparous, Holstein cows (n = 24) were housed sequentially in a pen containing 36 freestalls (freestall stocking density was 67%) and 18 feed bins. To keep stocking density constant, the pen was managed as a dynamic group. Dry matter intake, water intake, feeding rate, and total feeding time were recorded on a daily basis and used to assess feeding behavior. Standing behavior was quantified by daily standing time and daily standing bouts, which were averaged for each of the 3 wk. Data were analyzed as a randomized design using the mixed procedure of SAS. The model included day as the repeated measure for feeding behavior and week as the repeated measure for standing behavior. Dry matter and water intake increased ($P < 0.001$) from 1 d to 21 d (13.9 ± 0.4 kg/d to 22.1 ± 0.4 kg/d and from 64.8 ± 2.5 kg/d to 102.4 ± 2.5 kg/d, respectively), but were not affected by treatment ($P < 0.20$) or treatment by day interaction ($P < 0.10$). Feeding rate tended ($P = 0.06$) to increase with treatment (from 1.6 ± 0.1 g/s at 100% to 2.0 ± 0.1 g/s at 200%). Time spent feeding was affected ($P < 0.001$) by day and there was a trend ($P = 0.08$) for a treatment by day interaction. Standing time (14.0 ± 0.6 h/d) was not affected by treatment ($P = 0.40$) or week ($P = 0.87$). Although standing bouts decreased ($P = 0.02$) during the trial (from 9.4 ± 0.4 during wk 1 to 8.7 ± 0.4 during wk 3), no treatment by week interaction ($P = 0.99$)

occurred. In absence of freestall overcrowding, feed bin stocking density did not affect dry matter intake, water intake, or standing behavior. Trends for increased feeding rate and altered feeding time suggest that overstocking feed bins may alter feeding behavior.

Key Words: dairy cow, behavior, competition

92 Evaluation of NEFA and β -hydroxybutyrate (BHB) as predictors of clinical disease, milk production and reproductive performance in dairy cattle. P. A. Ospina*, D. V. Nycham, T. Stokol, and T. R. Overton, Cornell University, Ithaca, NY.

Data from 100 freestall, TMR-fed herds in the Northeastern U.S. were used in a prospective cohort study to establish cow-level critical thresholds for non-esterified fatty acids (NEFA) mEq/L and β -hydroxybutyrate (BHB) mg/dL as predictors of disease outcomes, milk production and reproductive performance. Blood samples were collected from two different sets of 15 pre- and 15 post-partum transition animals in each herd and a total of 2758 cows were analyzed. The outcomes of interest were: diseases (DA, clinical ketosis, and metritis or retained placenta); milk production (estimated by ME 305 kg at 120 DIM), and reproductive performance (time to conception within 70 d post-voluntary waiting period). NEFA was measured in the pre-partum group while both NEFA and BHB were measured post-partum. ROC- curve analysis and multivariable models were used to evaluate NEFA and BHB as predictors of disease. Mixed effect models were used to predict milk production with herd as a random effect. Reproductive performance was evaluated using time to event analysis. There was a significant change in risk of disease ($p < 0.05$), the risk doubled when pre-partum NEFA levels were ≥ 0.29 quadrupled when post-partum NEFA ≥ 0.57 , and increased by 4% when BHB levels were ≥ 10 . ME 305 was decreased by 616 kg in all animals when pre-partum NEFA was ≥ 0.33 ($p < 0.05$) and by 662 kg when post-partum NEFA was ≥ 0.72 ($p < 0.05$) and 328 kg when BHB was ≥ 10 in cows ($p = 0.09$). ME 305 was increased by 482 kg when post-partum NEFA was ≥ 0.57 ($p < 0.05$) and by 381 when BHB was ≥ 9 in heifers ($p = 0.05$). The probability of pregnancy within 70 d post-VWP was reduced by 20% when pre-partum NEFA was ≥ 0.27 ($p = 0.01$) and 16% when post-partum NEFA was ≥ 0.72 ($p = 0.05$). Similar results were seen when BHB was ≥ 10 ($p = 0.1$). This study indicates that increased levels of NEFA and BHB increased the risk of developing disease, and had detrimental effects on reproductive performance and milk production. However, further investigation about homeorhesis in heifers is warranted.

Key Words: transition cow, nonesterified fatty acids, ketosis

93 Heterogeneous relationship between milk production and reproduction in dairy cows: Preliminary evidence. N. M. Bello*, R. J. Erskine, and R. J. Tempelman, Michigan State University, East Lansing.

Although it is generally perceived that an antagonistic relationship exists between dairy cow milk yield and fertility, some recent studies have suggested otherwise. We hypothesize that the relationship between milk production and reproductive performance in dairy cows is thereby heterogeneous and depends upon various herd-related and management factors. In this study, we provide preliminary ad-hoc evidence for heterogeneity in the correlation between 305-d milk yield (305Milk) and projected calving interval (ProjCI) in dairy cows. Dairy Herd Improvement data for 776,957 lactation records from 1,033 Michigan

herds recorded from 1998 to 2007 were used to jointly estimate residual (cow-level) (co)variances for 305Milk and ProjCI for each herd-year using a bivariate restricted maximum likelihood approach. (Co)variance estimates were then used to compute the cow-level correlation for each herd-year. The distribution of the estimated 305Milk-ProjCI correlation was symmetrical, centered at 0.26 and ranged from highly positive to negative values (i.e., unfavorable to favorable relationships between milk production and reproductive performance, respectively). A total of 16 selected herd performance indicators and management factors were evaluated as potential sources of correlation heterogeneity using stepwise model selection based on Bayesian Information Criteria. The final model indicated that the cow-level correlation between 305Milk and ProjCI was greater in herds with 2X versus 3+X milking frequency ($P < 0.01$) and was lower in herds that used bST compared to those that did not ($P < 0.01$). Also, the 305Milk-ProjCI correlation increased in herds undergoing expansion ($P < 0.01$) but was not associated with herd size ($P = 0.08$). The correlation between 305Milk and ProjCI increased linearly over the 10-year period considered ($P < 0.01$). In summary, this study provides preliminary evidence for heterogeneity in the relationship between milk production and reproductive performance of dairy cows, as a function of herd-related and management factors.

Key Words: dairy production, heterogeneous correlation, management

94 Effects of maternal lineage on production and fertility traits of Holstein cattle. C. N. Vierhout*, S. P. Washburn, R. L. McCraw, and E. J. Eisen, *North Carolina State University, Raleigh.*

The objective of this study was to determine effect maternal lineage has on production and fertility in Holstein cattle. Data included Holstein historical lactation records dating from 1980 to August 2005 from 13 states obtained from Animal Improvement Laboratory of USDA. Cows were included from historical records dating back to birth year of 1980 or 1981 as the foundation cows. Historical records included cows calving and completing lactations through August, 2005. Cows were then put in maternal family groups using dam identification within herd. A family value was calculated by averaging the first and second lactations across parity by degree of relationship to the individual (free of progeny information) for generations one through four. Each family was entered into top, middle, and bottom groups based on average deviations for milk production, pregnancy rate, or by combining pregnancy rate and milk into a selection index. Analyses were performed on fifth generation cows to determine if milk production and pregnancy rates were significantly associated with historical performance of the respective cow families. After adjustments for sire predicted transmitting ability (PTA), maternal-grand sire PTA, and family group for milk in the model the effect of maternal cow family was significant for pregnancy rate (P

< 0.05 ; -1.05 percentage units) and milk production ($P < 0.05$; +913 kg) in an inverse relationship. When using deviations of pregnancy rate, the effect of maternal cow family was significant for both pregnancy rate ($P < 0.05$; +7.73 percentage units) and milk production ($P < 0.05$; -128 kg). A selection index with equal weights for milk and pregnancy rate resulted in an effect of maternal cow family for milk ($P < 0.05$; +133 kg) but not for pregnancy rate ($P > 0.05$; -0.22 percentage units). Although pregnancy rate and milk production have an antagonistic relationship, simultaneous consideration of both traits could allow for moderate genetic gain in production without adversely affecting reproduction. Consideration of maternal family history for pregnancy rate may be useful when selecting future bull dams.

Key Words: milk yield, pregnancy rate, selection index

95 Use of acaricides and gastrointestinal anthelmintics in developing countries: A case study among livestock farmers in Ghana. W. Addah*¹, J. Baah², and E. K. Okine¹, ¹*University of Alberta, Edmonton, Alberta, Canada,* ²*Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, Alberta, Canada.*

Logistical constraints facing regulatory agencies in developing countries limit their capacity to enforce laws on importation, packaging and appropriate use of agro-parasiticides. A survey of 100 ruminant livestock farmers was conducted to assess their knowledge and administration of acaricides and gastrointestinal anthelmintics to ruminant livestock in the Sissala East district of the Upper West region of Ghana. Respondents were interviewed with a semi-structured questionnaire and data analyzed using Statistical Package for Social Sciences (SPSS 11). Inspection of labels of acaricides and anthelmintics showed that 4% and 30% respectively were not certified by the Foods and Drugs Boards of Ghana. Only 10% of farmers ($P < 0.05$) used anthelmintics at the recommended rate. Majority of respondents (72%; $P < 0.05$) reported underdosing of anthelmintics while overdosing of acaricides was 18% ($P > 0.05$). Administration of both parasiticides was not done by the livestock owners themselves (30%), hired herdsmen (50%); none of whom were literate in the English language nor had any formal training in the use of agro-parasiticides, veterinary personnel (9%) and community-based livestock health workers (11%). Most farmers (35%; $P < 0.05$) did not practice parasiticide withdrawal prior to slaughter or sale of livestock. Thirty eight percent ($P < 0.05$) of anthelmintics had no expiry dates on their labels. The commonest place for storage of both parasiticides was under the bed in the bedrooms of farmers (43%; $P < 0.05$). Animals that did not respond to treatment were slaughtered and consumed in the household (65%; $P < 0.05$). The study found that inappropriate handling and use of livestock parasiticides were prevalent and raised serious public health and food safety concerns in the region.

Key Words: anthelmintics, acaricides, livestock

Nonruminant Nutrition: Feed Ingredients

96 A comparative evaluation of a new dried cheese and milk product (Gold Star Milk) versus other milk protein sources for weaning pigs. G. L. Cromwell*, M. C. Ulery, Y. L. Ma, I. F. Hung, and M. D. Lindemann, *University of Kentucky, Lexington.*

Gold Star Milk (International Ingredient Corp., St. Louis, MO) is a product resulting from the blending of dried cheese powder and specialty dairy powders such as dried milk and whey protein concentrate. It has a pleasant cheese aroma and an attractive dairy flavor. The product typically contains 24% CP, 15% fat, and 38% lactose. A 21-d experi-

ment involving 90 pigs weaned at 21 d and averaging 7.6 kg BW was conducted to compare Gold Star Milk with 3 other sources of milk protein in Phase I (7 d) and Phase II (14 d) diets. There were 4 replications of 4 or 5 pigs/pen. Treatments were (1) basal diet with no milk protein, and 4 diets with 1.82% milk protein provided by (2) dried skim milk, (3) whey protein concentrate, (4) Gold Star Milk, or (5) casein. The 4 milk protein sources analyzed 35.9, 35.2, 23.1, and 88.7% CP, respectively. In addition, the Gold Star Milk product analyzed 96.1% DM, 17.1% fat, 35.6% lactose, 0.42% Ca, 0.57% P, and 1.92% lysine.