

Undergraduate Student Competition:

ADSA-SAD Undergraduate Competition: Original Research

255 Leptospirosis and erythrocyte patterns: An exploration through nonlinear dynamics. C. A. Comyn*¹, S. P. Washburn¹, and V. Cortese², ¹North Carolina State University Department of Animal Science, Raleigh, ²Zoetis, Cattle-Equine Immunology and Biologics, Simpsonville, KY.

Leptospirosis, a bacterial disease of worldwide distribution and significance, has long had a correlation to erythrocytes, platelet counts, and hemoglobin levels in various mammalian species. However, documentation of these phenomena has been rare in cattle. Using the principles of physiological nonlinear dynamics, the study objective was to compare erythrocyte fluctuation patterns in healthy cattle versus patterns in cattle testing positive for *Leptospira* spp. with the expectation that cows testing positive for *Leptospira* spp. would have fewer fluctuations from the linear trend. Experimental and control groups were established by testing cattle for *Leptospira* spp. using urine samples followed by real-time PCR to identify bacterial isolates in the urine. Nine visibly healthy Holstein cows from one dairy herd in Virginia were used in this study; 4 tested positive for *Leptospira* spp., and 5 tested negative for *Leptospira* spp. Blood samples were collected at 24-h intervals for 12 d. The blood samples were submitted for complete blood counts at the Antech Diagnostic Laboratory in Manakin, VA. Mean red blood cell (RBC) counts were similar for the 2 groups of cows across the 12-d period. A linear trend line for RBC counts was calculated for each cow and then average fluctuation from the linear trend was calculated using the mathematical technique of detrended fluctuation analysis (DFA). Cattle testing positive for *Leptospira* spp. had numerically lower fluctuation in RBC counts compared with cattle testing negative for *Leptospira* spp., but the difference was not significant (0.29 ± 0.045 vs. 0.45 ± 0.115 ; $P = 0.26$). It should be noted that the group observed was relatively small; with a larger study group, results may have been more significant. Further, because animals observed in this study were asymptomatic, it may be possible that cattle experiencing an acute infection would maintain a lower DFA value for RBC counts. However, more research will need to be done to corroborate this.

Key Words: leptospirosis, nonlinear dynamics

256 Effect of milk feeding frequency and weaning age on growth and intake of dairy calves. S. A. McCullough*¹, T. S. Dennis¹, S. E. Fraley¹, B. Houin², and T. D. Nennich¹, ¹Purdue University, West Lafayette, IN, ²Homestead Dairy, Plymouth, IN.

The objective of this study was to determine the effects of milk feeding frequency and weaning age on growth, intake, and feed efficiency of dairy calves on a commercial dairy. In this randomized complete block design with a 3×2 factorial arrangement of treatments, 162 Holstein heifers (BW = 40.5 ± 5.18 kg) were blocked in groups of 6 by birth date and hutch type. Heifers were assigned to either 2 (2 \times), 3 (3 \times), or 4 (4 \times) times per day milk feeding and either 7 (7WK) or 9 wk (9WK) weaning times. Calves were fed whole milk and allowed ad libitum access to starter. Calves received the same amount of milk per treatment at 3.8 L/d of milk for 14 d, 6.7 L/d from d 15 to 21, and 7.6 L/d from d 22 to 1 wk before weaning when calves were reduced to 3.8 L of milk once per day. Calves were weighed at birth and measured every 2 wk for weight, hip and withers height, heart girth circumference (HGC), and hip width. Data were analyzed as repeated measures using the Proc Mixed procedure of SAS. There were no interactions between feeding

frequency and weaning age. Body weight at wk 10 was the greatest for 4 \times with calves weighing 95.6, 93.5, and 91.4 kg for 4 \times , 3 \times , and 2 \times , respectively ($P < 0.001$). Average daily gain (ADG) was greater ($P < 0.01$) for 4 \times calves than 2 \times calves with 3 \times being intermediate (0.79, 0.73, and 0.76 kg/d, respectively). At wk 10, calves fed 4 \times were taller at the hip ($P < 0.008$) and withers ($P < 0.01$) than 2 \times . The HGC was greater ($P < 0.01$) for 4 \times and 3 \times calves than for 2 \times (93.2, 92.8, and 91.9 cm, respectively). Starter intakes were similar for milk treatment, but calves weaned at 7WK had greater starter intake ($P < 0.01$) from 6 to 8 wk of age than 9WK. Calves weaned at 9WK were heavier at the end of the study than those weaned at 7WK (95.0 and 92.0 kg, respectively; $P < 0.001$), and overall ADG was greater for 9WK calves at 0.78 kg/d as compared with 0.74 kg/d for 7WK ($P < 0.02$). Calves weaned at 9WK had greater HGC ($P < 0.05$) and hip widths ($P < 0.001$), and were taller at the hip ($P < 0.001$) at the end of the study. Feeding calves milk 4 times per day improved calf growth as compared with feeding milk 2 times per day.

Key Words: dairy calf, milk, weaning

257 Characterization of quarter milking pulsation and take-off in a conventional milking parlor. S. M. Smith*, J. M. Bewley, K. J. McQuerry, and C. L. Wood, University of Kentucky, Lexington.

Overmilking may increase teat end hyperkeratosis and contribute to mastitis incidence. The objectives of this study were (1) to characterize the frequency of individual quarter milking using the Milpro P4C (Milkline, Gariga di Podenzano, Italy) and to describe the anatomical features that contribute to uneven milkout. The Milpro P4C system stops milking individual quarters using an individual quarter pulsation milking system with 4 independent pulsation channels per cluster instead of 2. The study was conducted at the University of Kentucky Coldstream Dairy during January 2013. The exact times when the partial take-off feature was employed were collected recorded by the milking system. Udder and teat characteristics were scored subjectively 3 times to create composite scores. Teat length and udder tilt were scored using the Holstein Association Linear Scoring System. Teat shape was scored according to the system described by Hickman (1985). Teat end shape was scored using the system described by Seykora and McDaniel (1985). Teat end callosity was scored according to Mein (2001). Milk weights were collected from the Milkline System. Cow demographic data (DIM and parity) were collected from PCDart. The partial takeoff procedure was not recorded for 5 of the 8 milking units due to equipment error or failure. For the 3 milking units functioning properly, the partial takeoff feature of the milking system was employed in 55% of 1263 valid milkings. The LOGISTIC procedure of SAS (Cary, NC) was used to develop a model to predict the likelihood of uneven milkout. Udder tilt, teat shape, teat end shape, and teat callosity were significant predictors of uneven milkout ($P < 0.05$) while milk yield (kg) was not ($P = 0.14$). These results demonstrate that a quarter based pulsation system may be beneficial for cows with varying udder and teat shapes. The partial takeoff feature was employed in over half of valid milkings indicating potential improved milkout and reduced risk of overmilking with this type of milking system.

Key Words: quarter milking, udder trait, pulsation

258 Variation in milk production within dairy herds. S. K. Finney*, M. L. Eastridge, W. P. Weiss, and N. R. St-Pierre, *The Ohio State University, Columbus*.

Understanding the variation of milk yield on dairy farms may assist dairy farmers in improving profitability. This study was conducted to determine the variation among farms with different levels of rolling herd average (RHA) for annual milk yield. Data from Dairy Herd Improvement were collected yearly from 2003 through 2011. The data included yearly RHA for milk, fat, and protein for each herd in Ohio and the annual production of milk, fat, and protein by individual cows having completed a lactation within the respective year for each herd. Dairy farms having at least 50 cows of either Holstein or Jersey were used, and individual cows must have completed a lactation of over 290 d in milk. Cows either above or below 3 standard deviations from the average milk yield for a herd were eliminated. The individual cow data were analyzed with SAS to calculate the herd average and standard deviation (SD) for yields of milk, fat, and protein. These data were then merged with the RHA data by herd. Quartiles within each year were determined using PROC Univariate within SAS and were then used to classify herds into categories for yields of milk, fat, and protein. For Holstein herds, the SD within each quartile RHA class was (low to high RHA milk) 1515, 1594, 1676, and 1801 kg and coefficients of variation (CV) were 17.5, 16.6, 16.1, and 15.0%, respectively. The SD for Jersey herds was 1060, 1239, 1262, and 1378 kg and CV of 17.4, 17.5, 16.6, and 16.7%, respectively. Variation within herds increased ($P < 0.01$) as the RHA increased, but the CV decreased ($P < 0.01$). Variation in milk yield within herds also was affected by year. Further analysis of this variation may provide evidence for recommendations to minimize the variation of milk yield on dairy farms.

Key Words: RHA milk, milk yield variation, yield variation within herd

259 Choosing appropriate temperature-humidity indices to predict the incidence of heat stress in lactating dairy cattle by analyzing local weather data for central Iowa. E. Hodges*, P. J. Berger, and G. Takle, *Iowa State University, Ames*.

Heat stress is known to cause a depression in milk yield and reduce reproductive success in dairy cattle. Few areas in the United States have been evaluated to compare temperature-humidity index (THI) values to milk yield and reproductive success. The objective of this research was to determine if weather conditions in central Iowa could be expected to cause heat stress in dairy cattle. Hourly weather data was obtained over a period of 5 years (2008–2011) from 2 local weather stations. The data were used to calculate hourly, daily, and monthly values for 7 temperature-humidity indices (THI) previously applied in dairy cattle. Each THI was a different weighted function of temperature and humidity. Six additional indices were calculated to incorporate wind speed and solar radiation. These indices had previously been applied in beef cattle feedlot settings. THI values from other states were matched against those in central Iowa, with the incorporation of wind speed and solar radiation. The former have been ignored in comparison of indices with regard to dairy cattle. The incorporation of wind speed and solar radiation relationships from beef feedlot trials in Nebraska matched an existing THI formula established from Georgia work. The onset of heat stress in beef cattle was established by visual observation. The onset of heat stress in dairy cattle was established by analysis of reproduction and lactation data. This research confirmed the existence of heat waves in the summer months with sufficient magnitude to facilitate the discovery of depressed milk yield and reproductive success.

Key Words: temperature-humidity indices, solar radiation, wind speed

260 Correlations among nutritional status of the dairy cow during early gestation and subsequent growth and cardiac measurements of her offspring. D. K. Hardin*, B. E. Voelz, H. M. Kerr, K. A. Barton, C. O. Lemley, and J. E. Larson, *Mississippi State University, Mississippi State*.

The potential of calves to become productive cows may be related to characteristics of growth and cardiac function early in life. The objective of this experiment was to determine whether nutritional status of the dam, as determined by concentrations of glucose and β -hydroxybutyrate (BHBA) and milk production during early gestation, was correlated with measurements of the calf at birth and at 1 mo of age. From parturition until 90 d pregnant, blood samples were collected every 14 d in Holstein cows. Plasma was later assayed for concentrations of glucose and BHBA. Calves ($n = 26$) born from these cows were measured for blood pressure, heart girth, hip and wither height as well as carotid artery hemodynamics measured via Doppler ultrasonography (pulsatility index (PI), resistance index (RI), and vessel diameter). Mean arterial pressure (MAP), pulse pressure (PP), and blood flow (BF) were then calculated. The CORR procedures of SAS were used to analyze data; means (\pm SD) are presented. In calves at birth, mean milk production of dams during early gestation (89.2 ± 18.3 kg) was positively correlated ($P < 0.05$) with heart girth (77.0 ± 4.3 cm). As expected, length of gestation was also positively correlated with heart girth of calves at birth ($P < 0.05$) and at 1 mo of age ($P < 0.01$). There tended to be a positive correlation between mean concentration of glucose in dams ($P = 0.07$; 3.48 ± 0.6 mmol/L) and MAP in calves at birth (80.1 ± 8.8 mmHg) and a negative correlation between mean concentration of BHBA in dams ($P = 0.06$; 905.3 ± 505.2 μ mol/L) and PP in calves at birth (42.8 ± 7.0 mmHg). Mean concentration of glucose in dams was positively ($P < 0.05$) correlated with wither height in calves at 1 mo of age. Length of gestation was negatively ($P < 0.01$) correlated with RI in calves at 1 mo of age. Milk production in the dam was positively correlated ($P < 0.10$) with hip and wither height, and PI but negatively correlated with MAP in 1 mo old calves. These correlations lead to speculation that early gestational environment may affect growth and hemodynamic parameters in young calves.

Key Words: cattle, dairy, Doppler

261 High moisture corn increased hepatic gene expression for anapleurotic and gluconeogenic enzymes compared with dry corn for Holstein cows in the postpartum period. C. M. Ylloja*, R. J. Rockwell, and M. S. Allen, *Michigan State University, East Lansing*.

Holstein cows ($n = 48$) were used in a randomized block design experiment to determine hepatic gene expression responses to dietary starch source in the postpartum period (PP). Treatments were dry corn (DC) or high moisture corn (HMC) fed from parturition until 28 ± 3 d PP. HMC increased milk yield 3.4 kg/d compared with DC (42.6 vs. 39.2 kg/d, $P = 0.02$), but did not affect 3.5% fat-corrected milk (FCM, $P = 0.11$) or dry matter intake (DMI, $P = 0.52$) during the treatment period. Sustained effects of treatment were detected when cows were offered a common diet from 29 ± 3 d to 84 ± 3 d PP; HMC increased DMI and FCM compared with DC but effects diminished over time (interaction $P < 0.03$). HMC increased plasma glucagon concentration over time during the treatment period compared with DC both before ($P = 0.001$) and after ($P = 0.04$) feeding. Liver tissue obtained by biopsy at 7 ± 3 d prepartum and 14 ± 3 d PP was analyzed by qRT-PCR for relative mRNA abundance of genes related to metabolism. HMC allowed increased anapleurosis compared with DC by increasing gene expression for pyruvate carboxylase (1.44 fold, $P = 0.01$), propionyl CoA synthetase (1.19 fold, $P = 0.05$), propionyl-CoA carboxylase α (1.16 fold, P

= 0.05), and increasing expression for methylmalonyl CoA epimerase more over time (pre- vs. postpartum) for HMC than DC (1.30 vs. 1.03 fold, $P = 0.03$). Gene expression for carnitine palmitoyl transferase 1 α tended ($P = 0.11$) to decrease more over time for HMC (0.77 fold) than DC, which was relatively unchanged (0.97 fold). HMC also increased expression for citrate synthase compared with DC (1.15 fold, $P = 0.07$). Expression for phosphoenolpyruvate carboxykinase (PCK1) was not affected by treatment ($P > 0.15$) but HMC increased glyceraldehyde 3-phosphate dehydrogenase (1.13 fold, $P = 0.02$), and tended to increase glucose 6-phosphatase (1.17 fold, $P = 0.10$), consistent with increased gluconeogenesis. Effects of treatment on plasma glucagon concentration and hepatic gene expression are consistent with increased milk yield for HMC compared with DC.

Key Words: starch fermentability, glucagon, gene expression

262 The association of telomere length and body weight in lactating Holsteins. I. W. Haagen*, C. D. Dechow, and D. E. Brown, Penn State University, University Park.

Telomeres are a repetitive TTAGGG DNA sequence on the end of chromosomes that protect the integrity of the chromosome and are reported to become shorter following cell division. The objective of this study was to evaluate the association between telomere length and body weight (BW) in lactating Holstein dairy cows. A total of 132 cows with 273 BW observations from 11 commercial herds and 88 cows with 46,020 observations from the Penn State Dairy Research Center herd were used in this study. BW in commercial herds was estimated using heart girth circumference measurements taken up to 4 times per lactation from 2008 to 2009. BW is electronically recorded daily at the Penn State Dairy Research Center as cows exit the milking parlor and BW from lactations 1 to 3 were considered. DNA was extracted from whole blood and telomere length estimated with quantitative PCR by comparing relative expression of a 79 base pair telomere product to a 144 base pair reference gene product. Cows ranged in age from 22 mo to 121 mo at the time of blood collection. Cows were stratified into high (TH) and low telomere (TL) length groups of equal size. BW was evaluated separately for commercial herd cows and PSU cows with a model that included effects of telomere group, lactation, stage of lactation, contemporary group, and the random effect of cow. Telomere group had a significant association with BW ($P < 0.05$) in both the commercial and PSU populations. The least-squares-means (LSM) estimate of BW in commercial herd TH was 737.5 kg compared with 685.9 kg in TL. The TH at PSU had a LSM estimate of 661.6 kg, whereas cows in TL had a

LSM estimate of 639.6 kg. The results of this study suggest that a positive association may exist between telomere length and BW. However, telomere length was available at different ages. A controlled study with telomere length determined at the same age for all cows is required to more fully describe the relationship between telomere length and BW.

Key Words: telomere, body weight

263 The effects of corn silage inclusion in pre-weaned calf diets. S. Retz*¹, S. I. Kehoe¹, K. McFarland², and G. Suen², ¹University of Wisconsin-River Falls, River Falls, ²University of Wisconsin-Madison, Madison.

Dairy calves should receive feed that will stimulate rumen development and allow for healthy growth. However, calf grain starters can be expensive and some farmers feed corn silage instead. Corn silage may not provide enough rumen stimulation and energy substrate for healthy papillae development. The objective of this trial was to assess the effects of starter feed on calves over the course of their developmental cycle by quantifying rumen morphology. Thirty 6 heifer calves and 9 bull calves were reared in blocks of 15 at the US Dairy Forage Research farm where they were individually housed in hutches. All treatments were fed pasteurized milk with either all calf starter (C; 18% crude protein), 40% corn silage and 60% calf starter (CC), or all corn silage (CS). Nine bull calves, one from each treatment during each block, were slaughtered at 8 wk of age. Rumens were collected and 3 samples from 4 areas within the rumen were taken; left side caudal dorsal sac (LB), right side caudal dorsal sac (RB), right side cranial ventral sac (RD) and left side cranial ventral sac (LD). Twelve papillae per sample were randomly measured for length and width. The Mixed procedure of SAS (2010) was used with block as a random effect to analyze for treatment differences. No significant differences were found for papillae length for region LB (8.1 ± 1.5 , 3.9 ± 1.9 , and 6.4 ± 1.5 for treatments C, CC, and CS, respectively) and RB (10.2 ± 3.2 , 4.4 ± 2.4 , and 7.9 ± 2.4 for treatments C, CC, and CS, respectively). There were significant differences between treatments for regions LD (11.7 ± 1.2 , 5.3 ± 1.2 , and 10.1 ± 1.2 for treatments C, CC, and CS, respectively) and RD (8.7 ± 1.1 , 2.8 ± 1.1 , and 5.7 ± 1.1 for treatments C, CC, and CS, respectively). There were no significant differences between treatments for papillae width. This data indicates that corn silage added to calf starter may not result in as much rumen development for some areas of the rumen as calf starter or only corn silage. Data collected for calf health and growth parameters is currently being analyzed.

Key Words: calf, corn silage, rumen development