Discover Conference 35 recap—Stress effects on health and production. M. A. Ballou*1 and B. J. Bradford2, 1Department of Veterinary Sciences, Texas Tech University, Lubbock, TX; 2Department of Animal Sciences and Industry, Kansas State University, Manhattan, KS.

Many factors, including stress, contribute to the increased risk for disease during certain periods of life in dairy cattle, and factors that contribute to disease vary dramatically between herds. The immune system of cattle may become dysfunctional and increase the likelihood of infectious diseases, many of which are caused by environmental microorganisms. The stress response is essential for the physiological adaptation to change; however, prolonged stress or a maladaptation is in the etiology of immune dysfunction and increased disease. Stress affects the immune system of animals both through direct and indirect mechanisms. Direct impacts are mediated through catecholamine and glucocorticoid pathways, whereas indirect mechanisms are largely directed through altered digestive and metabolic functions. A few examples of indirect mechanisms that were presented include (1) dietary changes, either during weaning or the transition period, alters microbial ecology and/or increases total gastrointestinal permeability, (2) excessive lipolysis during early lactation causes macrophage infiltration into adipose tissue that further exacerbates the negative effects of body condition loss, (3) maladaptation of the homeorhetic calcium system can impair leukocyte function and increase the risk for disease, and (4) long-term, even trans-generational, consequences of disease sequelae on reproduction. Inflammation was discussed in many contexts, both positive and negative. Inflammation is an essential adaptation mechanism, but also contributes to pathological disruption of normal tissue function. An activated immune response, initiated through an inflammatory response, is metabolically expensive and diverts nutrients and energy away from milk synthesis and reproduction toward immune defense and tissue repair. Further, the severity of an infectious disease in many cases is directly related to the degree of inflammation in a tissue. Improved ability of animals to adapt to physiological changes, tolerance to pathogens, early diagnosis, and quick interventions were discussed as key strategies to improve health and limit the negative impacts of disease.

Key Words: health, inflammation, stress

Male dairy calf morbidity and mortality after long-distance transportation. D. Wilson*, J. Stojkov, and D. Fraser, University of British Columbia, Vancouver, BC, Canada.

Many male dairy calves are sold and transported to grower facilities at a young age when they are vulnerable to health and welfare problems. Our aim was to describe the age, weight, and health of male dairy calves before long distance transport. Second, we evaluated whether these factors related to early morbidity and mortality at a grower facility. From October 2017 to March 2018, calves (n = 373) from 11 dairy farms in British Columbia were assessed by a veterinarian within 24 h before shipping. Health measures included calf attitude (based on depression, willingness to rise), respiratory and enteric health, navel and joint inflammation, and body temperature. Serum total protein was measured, taking a cut-off value of <5.2 g/dL as an indicator of failure of transfer of passive immunity (FTPI). Chest girth circumference was used to estimate weight, and calf age was recorded. Calves were then transported for approximately 1,100 km to one of 2 calf growers and monitored for 2 weeks during which time disease treatments and mortal-

Evaluating health and welfare in veal and dairy beef facilities.

M. A. Ballou*1 and B. J. Bradford2, 1Department of Veterinary Sciences, Texas Tech University, Lubbock, TX; 2Department of Animal Sciences and Industry, Kansas State University, Manhattan, KS.

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Key Words: health, inflammation, stress

Assessing the utility of leukocyte differential cell counts for predicting mortality risk in neonatal Holstein calves upon arrival and 72 hours post-arrival at calf rearing facilities. T. E. von Koningslow*, D. L. Renaud, T. F. Duffield, C. B. Winder, V. Higginson, and D. F. Kelton, University of Guelph, Guelph, ON, Canada.

Advances in the understanding of risk factors and biomarkers in calves entering rearing facilities show promise for identifying high-risk calves upon arrival at veal and dairy beef operations. Rapid, on farm machine leukocyte differential cell counts (DCC) may be a good addition to calf risk identification protocols for implementing selective antimicrobial therapy strategies upon arrival. The objective of this study was to assess the utility of DCC taken at the time of arrival to a calf rearing facility and 72-h post arrival for determining mortality risk during the production cycle. From June to July 2018, blood samples collected in EDTA anticoagulant from 233 calves upon arrival and a subset of 158 calves 72 h post arrival to a veal research facility in Ontario, Canada were evaluated by the qScout BLD test for leukocyte differential cell counts (Advanced Animal Diagnostic, Morrisville, NC). Over the production cycle, 39/233 calves died including 30/158 calves in the 72-h post arrival subset. All calves received a risk assessment upon arrival to the facility using a standardized screening protocol and a blood sample was collected to evaluate serum total protein (TP). Preliminary unvariable survival analysis using Cox proportional hazards models suggest that on the day of arrival every 1 g/dL increase in TP lowers the risk of mortality (hazard ratio (HR) = 0.38; P < 0.001). At 72 h post-arrival, it was found that for every 10° cells/L increase in neutrophils the risk of mortality increased (HR = 1.12; P = 0.007). Of the 30 calves that died from the 72 h post arrival subset, only 15 received antibiotic treatment in the first 3 d of life. Machine DCC taken 72 h after the stress of transport has potential for use in selective antimicrobial therapy protocols with the purpose of reducing antimicrobial use without sacrifice to animal health and welfare in veal and dairy beef facilities.

Key Words: male dairy calf, leukocyte, biomarker

Effects of a bovine nonspecific immune stimulant on health of Jersey and Jersey-cross heifer calves in the first month of life. B. Omontese*1, M. Celestino2, D. Paiva1, A. Garcia-Muñoz1, A. Masic4, V. Machado2, and L. Caixeta1, 1Department of Veterinary Population Medicine, University of Minnesota, St. Paul, MN, 2Department of Veterinary Sciences, Texas Tech University, Lubbock, TX.

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Key Words: health, inflammation, stress

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Health and performance of pre-weaned dairy calves have great influence on adult life performance. Among the diseases that affect young dairy calves, diarrhea and pneumonia are the most prevalent and economically important. This study evaluated the effects of a non-specific immune stimulant (IS; Amplimmune, NovaVive Inc., Canada) on the health of Jersey and Jersey-cross heifer calves within their first month of life. We hypothesized that calves receiving IS would have lower weekly health scores (HS) and decreased disease treatment hazard. Newborn heifer calves (5 ± 2d) in a large well-managed dairy were randomly allocated to receive either 1mL of saline (CON; n = 458) or 1mL of IS (BTIS; n = 449) at nursery before transport to grower (~18h from Minnesota to New Mexico), or 1mL of IS immediately after transport to grower (ATIS; n = 453). All treatments were administered subcutaneously and blood samples were collected for analysis of serum total solids. Calves were health scored weekly based on nasal/ocular discharge, coughing, ear position, temperature, attitude and fecal consistency. Interval to disease treatment was analyzed using Cox proportional hazards regression and HS by logistic regression. For all analysis, CON was set as reference and non-significant variables were removed from the models using backward stepwise elimination. The number of disease treatment events was lower than the national average. A total of 155 calves were treated at least once and 14 calves died within the first month of life. The proportion of calves treated for any disease was 9.8, 11.2 and 13.1%; whereas mortality was 1.1, 1.6 and 2.4% for BTIS, ATIS and CON groups, respectively. Weekly HS did not differ between BTIS and ATIS calves versus CON calves. Calves that received IS before transport had reduced hazard of treatment for pneumonia when compared with CON (HR: 0.54; 95% CI: 0.31–0.94; P = 0.03). In conclusion, the administration of IS did not influence weekly HS but IS administration before transport reduced the number of calves treated for pneumonia within the first 30 d of life.

Key Words: calf, health, immune stimulant

454 Withdrawn

455 Association between hoof lesions and milk yield in dairy cows. B. O. Omontese1, R. Bellet-Elias1, A. M. Argüello1, G. D. Catandi1, R. Casagrande1, Z. Rodríguez1, R. S. Bisinotto2, and G. Cramer1. 1Department of Veterinary Population Medicine, University of Minnesota, St. Paul, MN. 2Department of Large Animal Clinical Sciences, University of Florida, Gainesville, FL.

The objective of this study was to evaluate the association between specific hoof lesion (HL) and milk yield in dairy cows. Jerseys were enrolled at 20 ± 3 DIM (d20), evaluated for HL and body condition (BCS). At 120 ± 3 DIM (d120), cows were reexamined for HL and BCS. At the end of lactation, test day milk yield data for each cow was retrieved. According to HL category at d20, cows were grouped as healthy (n = 1,171), hemorrhage (n = 278), noninfectious (n = 103), and infectious HL (n = 34). To assess the relationship of HL development with milk yield, cows were grouped as healthy (no HL at d20 and d120; n = 308), cured (with HL at d20 and no HL at d120; n = 72), new (no HL at d20 but with HL at d120; n = 587), and chronic (with HL at d20 and d120; n = 208). Separate repeated measures linear mixed models were built using test day milk yield as outcome. Variables of interest offered to the model included the fixed effects of HL status, test day number (1–10+), interaction between HL status and test number, parity (1, 2, >3), BCS and calving season. A total of 1,584 cows comprising 13,655 test day milk yield records were used in the final analyses. Of all the HL diagnosed at d20, hemorrhage (69% of HL) was the most common, followed by other noninfectious HL (24%) and infectious HL (7%). Overall, the average test day milk yield was 20.8 kg (95% CI: 20.2 to 21.4 kg). Cows with HL at d20 had reduced milk yield beginning from the 3rd test day with the greatest losses of up to 1.78 kg (95% Confidence Interval [CI]); −2.7 to −0.9 kg) by the eighth test day. Cows with noninfectious HL at d20 had reduced milk yield with the greatest losses of up to 4.7 kg at the eighth test day compared with healthy herdmates (95% Confidence Interval [CI]); −6.3 to −3.1 kg). Cows that developed new HL produced more milk from the second to fifth test days compared with healthy cows with the greatest milk yield of 1.8 kg (95% CI; 0.9 to 2.8 kg) at the fourth test day of lactation. We conclude that having a lesion in early lactation has a negative impact on productivity and that higher milk production was risk factor for HL development.

Key Words: lameness, milk yield, Jersey

456 Predicting the next life event including disease by applying deep learning on sequential and pictorial data. A. Liseune1, D. Van den Poel1, B. Van Ranst2, and M. Hostens*2,3. 1Faculty of Economics and Business Administration, Ghent University, Ghent, Belgium. 2Faculty of Veterinary Medicine, Ghent University, Merelbeke, Belgium. 3Faculty of Veterinary Medicine, University of Utrecht, Utrecht, the Netherlands.

The common currency in developing solutions to sustainable dairy production are often focusing on increased animal production efficiency through improved animal health. In particular, the use of data driven technologies for early disease detection has shown a lot of promise. In this study, we show how systematically recording fertility and disease events from herd management systems can be helpful in improving existing animal monitoring systems. Moreover, while previous research focused primarily on detecting single outcomes such as mastitis lameness and insemination outcomes, we propose a multiclass prediction model which forecasts a probability distribution over 12 possible life events. Traditional techniques such as Markov for discrimination models can use historical sequences of disease and fertility records to predict a cow’s future state. Additionally, we investigated whether more advanced recurrent neural network algorithms are better able to uncover the complex data patterns hidden in the event sequences. Finally, we examined if augmenting a cow’s history of events with pictures take can enhance the predictive performance even further by making use of convolutional neural network models. While most picture studies are conducted as experimental designs using complex video camera setups and expensive equipment such as thermal scanners, we worked with pictures taken by the farmers and personel their smartphones, which to our most recent knowledge, has not yet been applied in the context of animal monitoring systems. While the Markov for discrimination models their percentage correctly classified (PCC) and Top-3 PCC ranged from 67% to 68% and from 87% to 88% respectively, the neural network models achieved a PCC of 75% and a Top-3 PCC of 95%. Results show that an ensemble model incorporating sequential as well pictorial information performs best and that the model is able to accurately predict future states such as calving, mastitis, pregnancy and death with an accuracy of 97%. The framework presented in this research can be used to enhance current animal monitoring systems with better animal health and higher sustainability for the dairy industry as a result.

Key Words: artificial intelligence, disease classification, animal monitoring
457 Impact of metabolic, digestive and postpartum disorders on milk yield. G. Pérez-Hernández*, J. G. García-Muñiz†, H. A. Ramírez-Ramírez‡, and A. Ruiz-Flores§, 1Universidad Autónoma Chapingo, Chapingo, México, 2Iowa State University, Ames, IA.

Milk yield (MY) is influenced by DIM, calving season, weather, cow age, physiological state, dry period length, nutrition and health status. A lactation curve model is a useful tool to separate the continuous components of environmental changes and estimate real MY. This study aimed at quantifying the impact of the postpartum incidence of metabolic and digestive disorders on subsequent MY. Daily individual records of MY and health disorders during all lactation were recorded on a commercial dairy farm in the northern region of Mexico. The data set was comprised of 93,580 daily records of 220 Holstein cows representing 382 lactations. Data were obtained from the AFIMILK software from January 2016 to July 2017. The health disorders evaluated during the complete lactation were diarrhea, hypocalcemia, ketosis, laminitis and mastitis. The test-date records of each cow included in the analysis were expanded using the EXPAND procedure of SAS to homogenize the length of lactation to 305 d. To describe the lactation curves of individual cows, Legendre polynomials were fitted using the SAS MIXED procedure. The fitted model included the fixed effects of a high order interaction (test-date, year and month of calving, lactation number and sex of the offspring generated the modeled lactation), health disorder, as well as random and fixed ninth degree Legendre polynomials of DIM. Prevalence disorder was obtained with PROC UNIVARIATE procedure. The proposed modeling estimated losses in daily MY on the day of diagnosis and prevalence for, diarrhea (1.68 kg/d; 0.18), hypocalcemia (6.42 kg/d; 0.05), ketosis (0.67 kg/d; 0.20), laminitis (2.60 kg/d; 0.06) and mastitis (0.73 kg/d; 0.28). There were cumulative decreases in MY during the whole lactation ranging from 219 to 1927 kg per cow after the incidence of diarrhea (504 kg/cow), low calcium concentration (1927 kg/cow), ketosis (202 kg/cow), hock injuries (781 kg/cow), and udder damages (219 kg/cow). These results demonstrate that reduction in milk yield brought on by health challenges may be substantial throughout the lactation and, that country- or region-specific models are needed to better characterize the impact on metabolic disorders on cow productivity and farm profitability.

Key Words: random regression model, lactation curve, Legendre polynomial

458 Impaired blood neutrophil function under ketotic conditions in peripartal dairy cows revealed through an ex vivo LPS challenge. N. Carpinell†, J. Halfen‡, F. Rosa§, and J. Osorio||, 1South Dakota State University, Brookings, SD, 2Universidade Federal de Pelotas, Pelotas, Rio Grande do Sul, Brazil.

Ketosis is an important metabolic disease associated with the negative energy balance commonly experienced by dairy cows soon after calving, and such condition can have ramifications in the immune system of dairy cows in early lactation. The objective of this study was to evaluate blood neutrophil function under ketotic conditions in early lactation cows via an ex vivo LPS challenge. Fourteen Holstein dairy cows (n = 7/group) were monitored during the peripartal period. Blood BHB was measured with the Precision Xtra at 1, 3, 5, 7, 9, and 11 d postpartum. Cows were classified as subclinically ketotic (KET; > 1.4 mM/L) or non-ketotic (NONKET; < 1.4 mM/L). Blood samples were collected on d 5 postpartum for an ex vivo LPS challenge conducted at 0 (control), 0.01 (low dose), and 5 μg of LPS/mL (high dose) for 3.5h. Immediately after oxidative burst, neutrophil %, and selectin L were measured via flow cytometry. Additional blood on d 5 was collected for phagocytosis and neutrophil isolation for gene expression. The MIXED procedure of SAS was used to analyze the data. A priori contrasts statements were used to determine a linear effect based on the LPS challenge. As expected, a Group × Day (P < 0.01) was observed in BHB, where BHB increased at a greater rate in KET cows and was reflected in greater (P < 0.01) BHB in KET cows than NONKET. A trend (P = 0.06) for a Group × LPS interaction was observed in oxidative burst increasing linearly (P < 0.01) in NONKET cows as LPS was increased from 0 to 5 μg, while no change (P = 0.89) was observed in KET cows. Selectin L decreased linearly (P = 0.02) in NONKET cows while no change (P = 0.22) was observed in KET cows. Blood neutrophil concentration was not affected by either ketosis (P = 0.27) or LPS challenge (P = 0.31). These results suggest that neutrophils from cows undergoing a ketosis condition will have a lower ability to detect inflammation sites and lower killing capacity based on the lack of response in oxidative burst and selectin L, respectively when facing a further inflammatory or stress conditions.

Key Words: ketosis, lipopolysaccharide, neutrophils

459 Plasma alpha-1-acid glycoprotein is negatively associated with dry matter intake in postpartum dairy cows. W. E. Brown§, M. Garcia†, L. K. Mamedova‡, M. G. Zenobi§, C. R. Staples§, B. M. Leno§, T. R. Overton†, B. K. Whitlock§, J. A. Danieli§, and B. J. Bradford§, 1Kansas State University, Manhattan, KS, 2University of Florida, Gainesville, FL, 3Cornell University, Ithaca, NY, 4University of Tennessee, Knoxville, TN, 5Berry College, Mount Berry, GA.

Alpha-1-acid glycoprotein (AGP) is an acute-phase protein that may suppress DMI by acting on the leptin receptor in the hypothalamus. Our objective was to characterize plasma AGP concentration and associations with DMI during the transition period. Plasma samples (n = 2,086) from 434 Holstein cows in 6 studies were analyzed on d −21, −12 ± 3, −3, 1, 3, 7 ± 1, 14 ± 1, and 21 ± 1 relative to parturition. Bivariate analysis was used to assess the relationship between AGP and DMI. For significant associations, treatment(study) was added to the model and quadratic associations were included in the model, if significant. Mean plasma AGP concentration (±SEM) was 273 ± 70 μg/mL prepartum, and postpartum was 468 ± 66 μg/mL (d 3), 568 ± 66 μg/mL (d 7), 532 ± 65 μg/mL (d 14), and 457 ± 66 μg/mL (d 21). On d −12, AGP was negatively associated with wk −2 DMI (P < 0.05) and wk 1 DMI (P < 0.05). On d 3, AGP was associated negatively with DMI in a quadratic manner for wk 1 (P < 0.001) and wk 2 (P < 0.05) and linearly for wk 3 (P < 0.001). Day 7 AGP was associated negatively with DMI in a quadratic manner for wk 2 (P < 0.05) and linearly for wk 3 (P < 0.001). Similarly, d 14 AGP was negatively associated with DMI for wk 3 (P < 0.001) and wk 4 (P < 0.01). As d 3 AGP concentration increased over the interquartile range, there was a calculated 1.4 (7.8%), 0.5 (2.8%) and 0.4 (1.9%) kg/d reduction in predicted DMI during wk 1, 2, and 3, respectively. Using bivariate analysis, d 3 AGP explained 15.4% of the variation in DMI during wk 1. Finally, we explored the clinical utility of d 3 AGP to diagnose low DMI, defined as wk 1 DMI more than 1 standard deviation below the mean. Receiver operating characteristic analysis identified a threshold of 480.9 μg/mL providing 76% specificity and 48% sensitivity (AUC = 0.60). These results demonstrate a negative association between plasma AGP concentration and DMI in early postpartum dairy cows, although its diagnostic performance was marginal. Further investigation into whether AGP directly suppresses DMI in dairy cattle is warranted.

Key Words: acute-phase protein

This proof-of-concept study evaluated the effects of the anti-inflammatory drug meloxicam on markers of systemic inflammation and energy metabolism, neutrophil function, and endometritis. Cows received meloxicam (0.5 mg/kg SC (MEL) n = 20) once/d for 4 d (10–13 DIM) or were untreated (CON; n = 22). Blood samples were collected −7, 1, 3, 5, 7, 10, 11, 12, 13, 14, 18, 21, 28, and 35 DIM to measure serum haptoglobin (Hp), albumin, total protein, urea, hepatic enzymes (AST, GGT, GLDH), BHB, NEFA, Ca, glucose, and IGF-1. Neutrophil phagocytosis and oxidative burst were measured at 5, 10, 14, and 21, and endometrial cytology at 5, 10, 14, 21, 28 and 35 DIM. The effect of treatment was assessed with mixed linear regression models. MEL had lower Hp at 11, 12, and 13 DIM (0.2 ± 0.2, 0.3 ± 0.2, and 0.4 ± 0.2 g/L vs. CON 0.8 ± 0.3, 1.2 ± 0.4, and 1.1 ± 0.3 g/L, respectively; P < 0.05). BHB was lower in MEL at 11, 12, 13, and 14 DIM (0.6 ± 0.1, 0.7 ± 0.1, 0.5 ± 0.1, and 0.6 ± 0.1 mmol/L vs. CON 0.9 ± 0.2, 0.9 ± 0.2, 1.0 ± 0.4, and 0.8 ± 0.2 mmol/L; P < 0.05). Serum IGF-1 was greater in MEL during treatment (0.84 ± 0.09, 0.81 ± 0.10, 0.83 ± 0.08, and 0.83 ± 0.09 μg/L vs. 0.76 ± 0.10, 0.67 ± 0.09, 0.65 ± 0.08, and 0.72 ± 0.07 μg/L; P < 0.03) and glucose was greater in MEL at 13 DIM (3.50 ± 0.10 vs. 3.01 ± 0.17 mmol/L; P = 0.04). Phagocytic activity (fluorescence intensity) was 27% greater (P = 0.04) in MEL at 14 DIM. Other metabolites and markers of inflammation were not different between treatments. The proportion of endometrial neutrophils was not different at 5, 10, 14, 21, 28, or 35 DIM (MEL 21 ± 5, 40 ± 6, 50 ± 6, 40 ± 7, 26 ± 8, and 15 ± 5%; CON 15 ± 5, 46 ± 7, 52 ± 6, 45 ± 6, 22 ± 5, and 14 ± 5%; P > 0.3). MEL attenuated systemic inflammation and improved indicators of energy balance but did not affect uterine inflammation.

Key Words: transition period, neutrophil function, endometritis