

## Animal Health III

**152 Stress and Immunity: Implications on animal health and production.** J. A. Carroll<sup>\*1</sup>, T. H. Elsasser<sup>2</sup>, J. C. Laurenz<sup>3</sup>, R. D. Randel<sup>4</sup>, J. L. Sartin<sup>5</sup>, and T. H. Welsh, Jr.<sup>6</sup>, <sup>1</sup>*Livestock Issues Research Unit, USDA-ARS, Lubbock, TX*, <sup>2</sup>*Growth Biology Laboratory, USDA-ARS, Beltsville, MD*, <sup>3</sup>*Department of Animal and Wildlife Science, College of Agriculture, Natural Resources and Human Sciences, Texas A&M University System, Kingsville, TX*, <sup>4</sup>*Texas AgriLife Research and Extension Center, Texas A&M System, Overton, TX*, <sup>5</sup>*Department of Anatomy, Physiology & Pharmacology, College of Veterinary Medicine, Auburn University, Auburn, AL*, <sup>6</sup>*Departments of Animal Science and Veterinary Integrative Biosciences, Texas AgriLife Research, Texas A&M System, College Station, TX*.

Throughout their production cycle, domestic livestock experience various stressors and varying magnitudes of stress that inhibit health and productivity. As researchers have continued to explore the complex interactions between stress and production parameters such as growth, reproduction, and health, multidisciplinary efforts emerged that have led to a greater understanding of homeostatic regulation. Based upon these efforts, our knowledge has extended beyond the “all or none” biological activity strictly associated with the “fight or flight” response. For instance, researchers have demonstrated that the combined immunological effects of glucocorticoids and catecholamines result in a well-orchestrated biological event designed to prevent over-stimulation of innate immunity and the production of proinflammatory cytokines while simultaneously priming the humoral immune response in an effort to provide adequate immunological protection. The perception of stress in domestic animals has evolved as well, now including indices such as environmental stress, nutritional stress, social stress and prenatal stress. Animal stress is now identified as a unique event that elicits a specific behavioral, physiological, neuroendocrine, endocrine, and/or immune response that may be as unique as the stressful event itself. Additionally, there has been an increased effort to elucidate the interactions between stress responsiveness and immunological parameters in animals that may be either predisposed to or resistant to the detrimental effects of stress due to genetic programming and/or prior experiences. Of particular interest are animals that demonstrate differential stress and immunological responses due to previous exposure to various managerial, environmental, nutritional, or pathogenic stressors or due to varying temperaments within a genetically similar group of animals. Continued research efforts into these complex interactions may allow the implementation of alternative management practices, improved selection programs, and/or implementation of various nutritional strategies to prevent or overcome significant production losses and animal health care costs for livestock producers.

**Key Words:** Stress, Immunity, Health

**153 Neck rails improve udder and stall hygiene but increase risk of lameness.** F. Bernardi<sup>\*1,2</sup>, J. Fregonesi<sup>1,3</sup>, C. Winkler<sup>2</sup>, D. M. Veira<sup>4</sup>, M. A. G. von Keyserlingk<sup>1</sup>, and D. M. Weary<sup>1</sup>, <sup>1</sup>*University of British Columbia, Vancouver, BC, Canada*, <sup>2</sup>*University of Natural Resources and Applied Life Sciences, Vienna, Austria*, <sup>3</sup>*Universidade Estadual de Londrina, Londrina, PR, Brazil*, <sup>4</sup>*Agriculture and Agri-Food Canada, Agassiz, BC, Canada*.

Housing conditions for dairy cows are thought to affect lameness but almost no experimental work has addressed this link. The aim of the

current study was to assess the effect of one feature of free stall design, the position of the neck rail, testing the prediction that cows housed in pens with neck rails would spend less time standing inside the stall and have reduced gait scores relative to cows housed in pens without neck rails. Cows (n = 32) were housed in 8 pens. Treatments were tested using a crossover design; treatments were allocated alternately to pen at the beginning of the experiment and switched half way through the 10-wk experiment. Cows spent approximately 30 min /d standing with all 4 hooves in stalls without neck rails, but almost never performed this behavior when neck rails were present. Instead, cows in pens with neck rails spent more time spent standing with only the front 2 hooves in the stall. Over the 5 weeks on each treatment, gait scores worsened for cows kept in pens with the neck rail compared to pens without. Of 13 new cases of lameness 11 occurred in pens with neck rails. Similarly, of the 16 new cases of sole lesions, 15 occurred during the period when cows were housed in with neck rails. Stalls without neck rails were 9 fold more likely to be contaminated with fecal matter and urine, and cows using those stalls had 30% dirtier udders and 15% longer teat cleaning times. This study provides the first experimental evidence that aspects of stall design can reduce the risk of lameness and hoof disease. The results also illustrate that changes in design that result in improvements in cow comfort and hoof health can come at the expense of cow and stall cleanliness.

**Key Words:** Lameness, Udder Hygiene, Stall Design

**154 Cytokine secretion in periparturient dairy cows naturally infected with *Mycobacterium avium* subsp. *paratuberculosis*.** E. L. Karcher<sup>\*1</sup>, D. C. Beitz<sup>1</sup>, and J. R. Stabel<sup>2</sup>, <sup>1</sup>*Iowa State University, Ames*, <sup>2</sup>*ARS-USDA, National Animal Disease Center, Ames, IA*.

Johne's disease, caused by *Mycobacterium avium* subsp. *paratuberculosis* (MAP), has a devastating impact on the dairy industry. Cows typically are infected as neonates, and stressors, such as parturition, may induce the transition from the subclinical to a more clinical stage of disease. The objective of this study was to characterize cytokine secretion in periparturient dairy cows naturally infected with MAP. Twenty-five Holstein cows were classified according to infection status into three groups consisting of 8 noninfected healthy cows, 10 subclinical cows, and 7 clinical cows. Peripheral blood mononuclear cells (PBMCs) were isolated and cultured at  $1.4 \times 10^6$  cells/mL with either medium alone (nonstimulated, NS), concanavalin A (ConA), or MAP whole cell sonicate (MPS). Culture supernatants were removed and analyzed by ELISA to detect the secretion of IFN- $\gamma$ , IL-4, IL-10, and TGF- $\beta$ . Production of IFN- $\gamma$  by MPS-stimulated PBMCs was greater ( $P < 0.01$ ) in subclinical cows compared with control cows and tended to be greater ( $P < 0.11$ ) than in clinical cows. Similarly, when PBMCs were stimulated with either ConA or MPS, IL-10 secretion was greater ( $P < 0.04$ ) in subclinical cows compared with controls. In contrast, secretion of IL-4 by MPS-stimulated PBMCs was greater in clinical cows compared with control ( $P < 0.004$ ) and subclinical cows ( $P < 0.04$ ). There was a tendency for NS PBMCs from infected cows to have increased secretion of TGF- $\beta$  compared with the control, but secretion of TGF- $\beta$  by ConA and MPS-stimulated PBMCs was not affected by infection group. Parturition evoked significant effects on cytokine secretion with observed increases in IFN- $\gamma$ , IL-10, IL-4, and TGF- $\beta$ , depending upon infection status of the cows and the in vitro stimulant used. Results of this study indicate that in dairy cows the secretion of

many key cytokines is modulated by natural infection with MAP and by the periparturient period.

**Key Words:** Cytokines, Periparturient, *Mycobacterium avium* subsp. *paratuberculosis*

**155 A clinical trial evaluating MorindaMax™ Calf® immune-supplement on health and performance of preweaned, Holstein, heifer calves.** V. J. Brooks<sup>1</sup>, T. J. Paulus<sup>1</sup>, T. DeWolfe<sup>1</sup>, R. G. Godbee<sup>2</sup>, S. F. Peek<sup>1</sup>, S. M. McGuirk<sup>1</sup>, and B. J. Darien\*<sup>1</sup>, <sup>1</sup>University Wisconsin, Madison, <sup>2</sup>University Nevada, Reno.

Neonatal calves are at high risk for disease as their immune system is developmentally immature and incapable of mounting an adequate response to infectious pathogens. While adequate colostrum intake and properly used antibiotics can provide much protection for the neonate, increased antibiotic scrutiny and consumer demand for organic products has prompted investigations of natural immunomodulators for enhancing calf health and production. The objective of this clinical trial was to evaluate the effects of MorindaMax™ Calf® on health and performance of preweaned, Holstein heifer calves on a commercial calf-raising farm. MorindaMax™ Calf® is a commercially-available supplement for bovine neonates made from the *Morinda citrifolia* (noni) fruit. Noni is a natural product that has a broad range of immune-enhancing effects including: antibacterial, anti-inflammatory, anti-tumorigenesis, anti-oxidant and anti-fatigue activity. Two formulas (A and B; n=143) were tested against a control group of newborn calves (n=73). Calves received 0, 15 or 30 ml q 12 hr of either formula for the first 3 weeks of life. The effect of formula type on weaning age, weight gain, morbidity and mortality were analyzed through weaning (~5-8 weeks). Calf health was evaluated through daily physical exams which were recorded as health scores and dictated whether the calf required medical treatment or not. Results demonstrated a significant increase in number of calves weaned by 6 weeks of age that had received 15 ml q 12 hr of formula A relative to control calves. Additionally, calves receiving 30 ml q 12 hr of formula B had a significant reduction in respiratory, gastrointestinal and total medical treatments required relative to control calves. Early weaning and fewer required antibiotic treatments may result in monetary savings for the farmer through the production of healthier animals that require less time and treatments in the preweaning stage.

**Key Words:** MorindaMax, Immune-supplement, Calves

**156 Effect of weaning strategy on immunological, hematological and physiological responses of beef calves.** E. M. Lynch\*<sup>1,2</sup>, B. Earley<sup>1</sup>, M. McGee<sup>1</sup>, and S. Doyle<sup>2</sup>, <sup>1</sup>Teagasc, Grange Beef Research Centre, Dunsany, Co. Meath, Ireland, <sup>2</sup>National University of Ireland, Maynooth, Co. Kildare, Ireland.

The effect of weaning strategy on immunological, hematological and physiological responses was determined using 36 beef calves (276, s.d. 37.0 kg). Following abrupt weaning, calves were either 1) housed (WH) immediately in a slatted floor shed and offered grass silage *ad libitum* and supplementary concentrates or 2) remained at pasture (WP) and housed on day 35 post-weaning. Blood samples were collected by jugular venipuncture at weaning (day (d) 0) and on d 2, 7, 14, 21, 28, 35 (housing), 37, 42, 49 and 56. Plasma fibrinogen and haptoglobin concentration, in vitro interferon- $\gamma$  (IFN- $\gamma$ ) production, plasma cortisol

and dehydroepiandrosterone (DHEA) concentration, total leukocyte number and subsets were determined. Plasma fibrinogen and haptoglobin increased ( $P < 0.05$ ) in WH and WP calves for 21 d post-weaning. Post-housing, fibrinogen decreased ( $P < 0.05$ ) and haptoglobin was unchanged ( $P > 0.05$ ) in WP calves. IFN- $\gamma$  production decreased ( $P < 0.01$ ) in WH calves post-weaning, whereas no change ( $P > 0.05$ ) was observed for WP calves post-weaning or -housing. Total leukocyte number decreased ( $P < 0.05$ ) by d 7 post-weaning in WH calves and did not return ( $P < 0.001$ ) to pre-weaning baseline, whereas in WP calves, it increased ( $P < 0.01$ ) until d 21 post-weaning and subsequently decreased ( $P < 0.02$ ) post-housing. Neutrophil number in WP calves increased ( $P < 0.02$ ) on d 2 and d 7, whereas lymphocyte number was unchanged from d 0 to d 7. Neutrophil number in WH calves decreased ( $P < 0.05$ ) on d 14 until d 56 whereas lymphocyte number increased ( $P < 0.05$ ) on d 21 to d 56. Plasma cortisol increased ( $P < 0.05$ ) from pre-weaning baseline to d 21 in WH and WP calves, but was unchanged ( $P > 0.05$ ) in WH and WP calves from d 28 to d 56. Plasma DHEA was unchanged ( $P > 0.05$ ) throughout the study. In conclusion, abrupt weaning altered leukocyte populations and acute phase protein profiles in WH and WP calves. The lower circulating leukocyte count and reduced IFN- $\gamma$  response observed for WH calves suggests that abrupt weaning may be exacerbated by immediate housing.

**Key Words:** Weaning, Immunity, Cortisol

**157 Dietary Colicin E1 prevents experimentally induced post-weaning diarrhea but does not provide a growth promoting effect.** S. A. Cutler<sup>1</sup>, N. A. Cornick<sup>1</sup>, S. M. Lonergan<sup>1</sup>, and C. H. Stahl\*<sup>2</sup>, <sup>1</sup>Iowa State University, Ames, <sup>2</sup>North Carolina State University, Raleigh.

Post-weaning diarrhea (PWD) causes significant economic losses to the U.S. swine industry despite the use of antibiotic prophylaxis. While the dietary addition of sub-therapeutic levels of antibiotics is used for disease prevention, it has also been suggested to have an independent growth promoting effect. In a proof of concept study, we have demonstrated that dietary inclusion of Colicin E1 is effective in preventing PWD. In the current study, we examined the efficacy of dietary supplementation with Colicin E1 in preventing PWD using a seeder pig model as well as in promoting growth independently of a disease challenge. Eight pigs were orally inoculated with  $10^9$  CFU of an ETEC strain isolated from piglets with PWD. Two animals (paired by body weight) that exhibited severe diarrhea two days post-inoculation were placed into pens of piglets that were either fed a basal diet or the basal diet plus 20 mg Colicin E1/kg. An additional group of littermates were fed the same diets, in the absence of the ETEC challenge to investigate the effect of dietary inclusion of Colicin E1 alone. In the first week of exposure to the seeder animal, the challenged control animals gained less weight ( $P < 0.05$ ) than the Colicin E1 treated pigs. A trend existed for lower body weight in the challenged control animals as compared to the Colicin E1 fed pigs at weeks 2, 3, and 4 ( $P < 0.1$ ). No significant differences in body weight between the control and Colicin E1 fed non-challenged pigs were seen at any point in the study, nor were there differences in body weight between the challenged Colicin E1 fed animals and the non-challenged animals. In the first week after the seeder challenge, 4 of the control animals lost weight and two of those pigs lost more than 10% of their initial body weight. In total, over 75% of the control pigs had PWD by the end of the first week of the study, compared with 30% of the Colicin E1 fed pigs. Dietary addition of Colicin E1 is effective in preventing PWD under industry relevant conditions; however, no

growth promoting effect in the absence of a disease challenge was seen in this experiment.

**Key Words:** Post-weaning Diarrhea, Pig, Bacteriocin

**158 Effects of PCV2 vaccine on growth performance and mortality rate of pigs in a PCV2-positive commercial swine herd.** J. Y. Jacela\*, S. S. Dritz, M. D. Tokach, J. M. DeRouchey, R. D. Goodband, J. L. Nelssen, R. C. Sulabo, and J. R. Bergstrom, *Kansas State University, Manhattan*.

A total of 1,470 pigs (8.8 kg) were used in a swine farm with a history of Porcine Circovirus Disease (PCVD) to evaluate the effects of two commercial Porcine Circovirus Type 2 (PCV2) vaccines on growth and mortality rates. The first vaccine was administered a week after weaning (1-dose; Suvaxyn™ PCV2 One Dose, Fort Dodge®) while the second was administered at weaning and three wk later (2-dose; Circuvent™ PCV, Intervet®). A group of unvaccinated pigs served as a control group. Individual weights were taken at d 0 (weaning), 113, 143, and 152 (off-test). Pigs commingled during the growing period. A subsample of necropsied pigs had histopathologic lesions associated with PCVD. On d 113, the 2-dose group was heavier ( $P < 0.05$ ) than the control group (86.5 vs 82.5 kg) with the 1-dose group intermediate (85.4 kg). At d 143, both the 1-dose and the 2-dose pigs were heavier than the control pigs by 3.4 and 4.6 kg ( $P < 0.05$ ), respectively, with the two vaccinated groups not significantly different. The 2-dose group was heavier ( $P < 0.05$ ) than the controls (120.2 vs 116.4 kg) while the 1-dose group was intermediate (118.8 kg) at off test. Weight gap between vaccinates and controls were smaller at off-test compared to d 143 due to a wider on-test days variability as a result of multiple marketing days. The 1-dose and 2-dose groups had greater ADG ( $P < 0.05$ ) compared to the controls from d 0 to 113 (676 and 689 vs 653 g), d 0 to 143 (717 and 726 vs 694 g), and at off-test (726 and 735 vs 703 g). From d 113 to 143 and off test, ADG between groups were not different suggesting that the increase in growth rate in vaccinated pigs occurred from d 0 to 113. No significant difference in mortality rates between treatments were observed but each vaccinated group had numerically lower mortality than control pigs (7.8 and 7.7 vs 11.0%). Both vaccines in this trial were effective in mitigating the effects of PCV2 virus on growth performance of pigs in a PCV2-positive herd.

**Key Words:** PCVD, PCV2, Vaccine

**159 Effect of feeding *Mucuna pruriens* to sheep on helminth parasite infestation in lambs.** C. M. Huisden\*, A. T. Adesogan, J. M. Gaskin, C. H. Courtney, A. M. Raji, and T. Kang, *University of Florida, Gainesville*.

*Mucuna pruriens* is a tropical legume anecdotally reputed to have anthelmintic properties. The aim of this study was to determine if ingestion of *Mucuna* seeds reduces helminth parasite infestation in lambs. Thirty-six Dorper x Katahdin ram lambs ( $\pm$  6 months old, 28.8  $\pm$  5 kg body weight) were dewormed subcutaneously with levamisole (2 ml/45.4 kg), balanced for fecal egg counts and body weight, and randomly allocated to 3 treatment groups. The 12 lambs in each treatment group were randomly assigned to 4 pens, each containing 3 lambs. All lambs were fed ad libitum amounts of an isonitrogenous (14% CP), isocaloric (64% TDN) total mixed ration in which the main protein supplement was cotton seed

meal or *Mucuna*. Treatments consisted of a control diet, a diet in which *Mucuna* replaced cotton seed meal and a further treatment that involved administering levamisole (2 ml/45.4 kg) to lambs fed the control diet. Lambs were adapted to diets for 2 wk and trickle infected three times per wk by gavage with infectious *Haemonchus contortus* larvae (2000 larvae/lamb) for 3 wk. Subsequently, 2 lambs per pen were necropsied and the third lamb was grazed on bahiagrass pasture for 14 d and then necropsied. Levamisole treatment decreased fecal egg counts by 87% (58 vs. 445 eggs/g) and abomasal worm counts by 83% (1170 vs. 202 worms/lamb). *Mucuna* intake did not affect fecal egg counts (412 vs. 445 eggs/g) or abomasal worm counts (958 vs. 1170 total worms), though a numerical ( $P \geq 0.10$ ) reduction was evident. Neither levamisole nor *Mucuna* treatment affected anemia indicators [FAMACHA (2), packed cell volume (32.4%) and blood protein (6 g/dl)], daily feed intake (2.5 kg), final body weight (37.9 kg), average daily gain (0.31 kg/d) and dressing (48.8%). *Mucuna* intake did not reduce infection in lambs fed a high quality diet. Pathological signs of infection were obscured, most likely by a combination of well balanced rations and lambs of breeding known to be at least somewhat inherently resistant to this parasite as compared to highly improved breeds. Future studies should examine if *Mucuna* exhibits anthelmintic properties in more susceptible lambs fed poorer quality diets.

**Key Words:** *Mucuna*, *Haemonchus*, Anthelmintic

**160 The effect of the synthetic glucocorticoid dexamethasone on clock gene expression in bovine neutrophils.** S. J. Nebzdoski\*, L. M. Nemeč, and T. F. Gressley, *University of Delaware, Newark*.

Glucocorticoid induced suppression of neutrophil function contributes to cattle disease. Although circadian rhythms drive immune function in other species, the role of circadian rhythms on bovine neutrophil function is unknown. A study was conducted to determine the influence of the synthetic glucocorticoid dexamethasone (dex) on circadian rhythms of gene expression in bovine neutrophils. Six Holstein steers averaging 225 kg were injected with either saline (control) or dex (0.1 mg/kg BW). One wk later the opposite treatments were administered. Photoperiod was controlled with lights on at 0700h and off at 1700h which roughly coincided with the natural sunrise and sunset. Neutrophils were collected from blood sampled by jugular catheters at 0, 4, 8, 12, 16, 20 and 24h following administration of treatment. Quantitative real-time PCR was used to determine mRNA expression of *L-selectin* and multiple clock genes including *Bmal1*, *Clock*, *Per1*, *Rev-erba* and *CK1ε* relative to the expression of the housekeeping genes *RPS9* and  $\beta$ -*actin*. A mixed model was used to quantify the effects of treatment (dex vs. control), time (0, 4, 8, 12, 16, 20, 24h) and their interaction on gene expression. Treatment affected expression of *L-selectin*, *Clock*, *Per1* and *Rev-erba* ( $P < 0.001$ ) and tended to affect *Bmal1* ( $P = 0.07$ ). Relative to the control treatment, dex decreased expression of *L-selectin* 2-fold, *Bmal1* by 14%, *Clock* by 79% and *Rev-erba* by 47%. Expression of *Per1* increased 26-fold. Time affected *Clock*, *Per1*, *Rev-erba* and *CK1ε* ( $P < 0.01$ ). Expression of *Clock*, *Per1* and *CK1ε* peaked at 4h and reached a nadir at 24h. *Rev-erba* expression peaked at 4h and was lowest at 16h. An interaction between treatment and time was found for *Clock* and *CK1ε* ( $P \leq 0.001$ ). Relative to the saline treatment, dex depressed *Clock* expression at all times with the greatest difference at 8h and the least difference at 20h. Additionally, *CK1ε* expression increased at 4 and 8h but decreased at 20h after dex treatment ( $P \leq 0.05$ ). Glucocorticoid induced changes in circadian rhythms of gene expression may be important in regulating the functionality of bovine neutrophils.

**Key Words:** Clock Genes, Dexamethasone, Neutrophils