Animal Health Symposium: Understanding and reducing the impact of various stressors on immune responses and health of cattle

249 Understanding what stresses a dairy cow and the effect on immunity. Michael A. Ballou*, *Texas Tech University, Department of Animal and Food Sciences, Lubbock, TX.*

Dairy cows experience stress at many times in their life and these stressful events increase the risk for negative health and productive outcomes. A better understanding of what causes stress and the impacts on the immune system will aid in developing management strategies that either reduce stress or attenuate the risk for disease. Cows are creatures of habit and this consistency gives her control. Take away this control and the more stressed she becomes. Stress generally suppresses many inflammatory leukocyte, neutrophil, and lymphocyte responses that create holes in the immune system, which microorganisms capitalize on to cause disease. An early lactating dairy cow is a great example of homeorhesis, whereas she is able to adapt to a new physiological state and environmental conditions. However, when that change is abrupt and/or dramatic, such as parturition and initiation of lactation, the cow can become stressed because the adaptation lags. The metabolic demands during the initiation of lactation play a major role in the dysfunctional immune system, and the effects are likely both direct and indirect. Direct effects are considered if nutrient demands of leukocyte responses are not met / prioritized or an increase in a metabolite, such as NEFA or BHBA, inhibits leukocyte function. Another example of a direct effect would be the negative effect of hypocalcemia on neutrophil function. The indirect effects are considered the physiological adaptations that need to occur in the cow that causes stress because they are a significant deviation and happen abruptly. Since some of the stress during the transition period is unavoidable, the focus should be to limit microbial exposure and any additional stressors that may have additional negative effects on immunity. Some factors that can contribute to additional stress include: high stocking density, poor cow comfort, dirty environment, comingling cows and heifers, and poor feed and bunk management. It is called the transition period because many changes are occurring and this increases the risk for stress. The stressors are multifactorial; therefore, a systematic approach to improving transition cow health is required.

Key Words: dairy, health, stress

250 Stress, immunity, and management of calves. Lindsey E. Hulbert* and Sonia J. Moisá, *Department of Animal Sciences and Industry, Kansas State University, Manhattan, KS.*

Despite many advances in management and housing of dairy calves, 1 in 10 US dairy heifers die before weaning. A better understanding of the internal and external stimuli that contribute to the calf's physiological and behavioral responses to stressors is needed to reduce the risk of morbidity and mortality. Feeding calves their first meal is crucial, as successful passive transfer reduces mortality by 60%. There appears to be sexually dimorphic immune and stress responses in young cattle, but more research is needed to determine if this is caused by human-bias for female calves. After that first feeding, 1 in 10 heifers and most bull-calves in the US are transported to specialized calf-raising facilities, yet there is a lack of information of the newborn calf stress response during transit and handling. Whether calves are raised off-site or at a calf-ranch, individual housing systems are commonly used in the US to reduce the risk of pathogen exposure and provide individual feeding and healthcare. However, there may be health, growth, and social benefits for calves in alternative systems that have increased space-allowance or group housing. Disbudding and castration are typically performed at an early age for dairy calves, during the pre-wean stage. These stressors often take place when the calf has decreased passive-transfer Ig and immunity is developing. There is limited availability of pain-mitigation through anesthetics and analgesics, but there is evidence that analgesics attenuate supressed leukocyte function during these procedures. Milk replacer (MR) and milk quality may alter immunity. Solid-feed intake is a primary measure for determining "weaning-readiness," but some MR formulas may influence the calf's oral behaviors before weaning, therefore alternate weaning-methods may need to coincide with alternate MR formulas. The calf's behavioral and stress response at weaning may influence its immunity during the transition from individual to group housing (commingling). Alternate commingling strategies and nutritional supplements may help with this transition, but more research is needed to explore feasible alternatives. Optimizing the calf's health and well-being at these early-stages may improve its long-term health and behavioral strategies.

Key Words: calves, stress, immunity

251 Effects of late-gestation heat stress on immunity and performance of calves. Geoffrey Dahl*[1], Ana Monteiro[2], and Sha Tao[2], *[1]University of Florida, Gainesville, FL, [2]University of Georgia, Tifton, GA.*

Heat stress effects during lactation are well characterized and include reductions in dry matter intake, milk yield and metabolic shifts that reduce the efficiency of milk production. Similarly, when dry cows are heat stressed they experience lower intake, reduced mammary growth and compromised immune function that ultimately results in a poorer transition into lactation and lower milk yield. Recently, we have focused on the effects of late gestation heat stress on calf survival and performance, with a series of studies examining preweaning growth and health, and later reproductive and productive responses, in an attempt to quantify acute and persistent effects of in utero stress. Calves born to dams heat stressed when dry have lower body weight at birth, are shorter at weaning, and do not achieve the same level of weight or height accumulation to 12 mo of age observed in calves from dams that are cooled when dry. Some of the reduced growth may result from the lower immune status observed in calves heat stressed in utero, which begins with poorer apparent efficiency of immunoglobulin absorption and extends to lower survival rates through puberty. However, heat stressed calves also have permanent shifts in metabolism that may lead to greater peripheral accumulation of energy and less lean growth relative to those from cooled dams. Comparing reproductive performance in calves heat stressed versus those cooled in utero, we observe that the cooled heifers require fewer services to attain pregnancy and become pregnant at an earlier age. Tracking the milk production in calves that were heat stressed in utero versus those cooled in late gestation revealed a significant reduction of yield in the first lactation, approximately 5 kg/d through 35 weeks of lactation, despite similar bodyweight and condition score at calving. These observations indicate that a relatively brief period of heat stress in late gestation dramatically alters the health, growth, and ultimate performance of dairy calves. Thus, it is critical to effectively manage heat stress of dry cows to avoid negative effects on the calf.

Key Words: in utero heat stress, growth, health

252 Social stressors and their effects on immunity and health of periparturient dairy cows. Ricardo C. Chebel*[1,2], Paula R. B. Silva[2], Karen Luchterhand[2], and Marcia Endres[2], *[1]University of Florida, Gainesville, FL, [2]University of Minnesota, St. Paul, MN.*

Management practices during the periparturient period have been the focus of much research recently because during this period immune function, metabolism and health of cows are severely challenged. Responses to stress are often classified as behavioral, immunological, neuroendocrine, and autonomic. In production systems, understanding all facets of stress response is important to correctly predict the consequences of stressors to the health and performance of animals and to prevent costly managerial changes that have minimal impact on animal well-being and performance. Common stressors faced by periparturient animals are: regrouping, stocking density, and, for nulliparous animals, commingling with parous animals. In conventional dairies, feeding strategies during the periparturient period often require several group changes during the most challenging period of an animal's life. Traditional weekly regrouping of prepartum cows increases competitive behavior at the feed bunk but it does not affect innate and adaptive immunity, metabolic parameters, health and production, as long as stocking density is not overwhelming and nulliparous and parous animals are housed separately. Stocking density of prepartum animals is often overlooked because these are non-productive animals. Although severe overstocking (200% of feeding space) of commingled nulliparous and parous pregnant animals produces important neuroendocrine and metabolic changes, when prepartum nulliparous and parous animals are housed separately, stocking densities of up to 100% of feed space do not seem to affect innate and adaptive immunity, metabolic parameters, and performance. In recent experiments, when animals were ranked based on feed bunk displacement, submissive animals were more likely to be diagnosed with metritis than dominant animals despite not presenting significant differences in metabolic parameters. With the advent of new technologies that monitor rumination, activity, and lying behavior, it may be possible to more easily identify submissive animals and create strategies to prevent diseases.

253 Metabolic and physiological stressors during the periparturient period and effects on immunity and health of dairy cows. José E. P. Santos*, Eduardo S. Ribeiro, and Natalia Martinez, *University of Florida, Gainesville, FL.*

During early postpartum, high-producing dairy cows undergo a period of extensive tissue catabolism because of negative nutrient balance. Homeorrhetic controls assure that nutrients are partitioned to favor lactation at the same time that homeostasis secures survival. However, unrestrained metabolic disturbances often lead to diseases which, in turn, dramatically decrease both productive and reproductive performance. In early lactation, dairy cows are more susceptible to diseases, particularly those that affect the uterus, such as metritis, and the mammary gland, such as mastitis. It is thought that calving and the increase in nutrient demands with the onset of lactation affect the immune system causing a temporary dysregulation in immune function. Humoral and cellular immunity are usually depressed at the same time that inflammation is enhanced with parturition. Negative nutrient balance has been associated with compromised immune function in dairy cows, and low concentrations of glucose, insulin, and insulin-like growth factor (IGF)-1 associated with elevated concentrations of nonesterified fatty acids and ketone bodies can have disruptive and detrimental effects on immune cells. Reductions in blood concentrations of Ca and antioxidant vitamins that typically occur around parturition are also linked with impaired immune competence and increased risk of uterine diseases. Nevertheless, experimentally-induced negative nutrient balance alone have minor effects on the leukocyte function, does not seem to affect the clinical symptoms associated with an intramammary endotoxin infusion, and have minor effects on immunocompetence of cows challenged to develop mastitis. The disagreement between experimental models that use nutrient restriction to study negative nutrient balance and immunity and the observations of immunosuppression in periparturient dairy cows suggests that changes in immune function are complex; they likely involve nutritional imbalances associated with the physiological and endocrine state of the cow that leads to the dysregulation of the immune system and increased risk of diseases.

Key Words: dairy cow, health, immunity