ANIMAL HEALTH SYMPOSIUM I: ANIMAL HEALTH RESEARCH FROM THE PERSPECTIVE OF INFORMATION GAPS

0060 Animal health—From systems biology to translational research. C. Gay*, *USDA-ARS Office of National Programs, Beltsville, MD.*

Genome-enabled technologies are driving fundamental changes in the approaches used to understand mechanisms of disease, selection of animals for beneficial health traits, and discovery of tools to control and mitigate animal diseases. New research strategies using high-throughput gene expression analysis are providing novel platforms for more comprehensive understanding of host–pathogen interactions. In particular regard to application of the findings that result from these new technical capabilities, a systems biology approach has begun, is evolving in focus, and rapidly revolutionizing the analysis of whole genome responses of host and pathogens, which will ultimately lead to a better understanding of disease processes in affected animals. Concurrently, the capabilities facilitate new insights into the mechanisms through which pathogens evade host immunity, the genetic basis of host–pathogen interactions, and ultimately the discovery of novel and highly effective vaccines, drugs, biotherapeutics, and integrated management strategies that ensure the abundance and safety of the food supply while maintaining its economic affordability to all.

Key Words: animal, disease, intervention

0061 Respiratory disease management in livestock—New challenges and knowledge gaps. What is critical on the horizon? A. W. Confer*, *Oklahoma State University, Stillwater.*

Despite availability and use of numerous bovine respiratory pathogen vaccines and new antimicrobial drugs as well as a greater understanding of the pathogenesis of bovine respiratory disease (BRD), pneumonia ranging from subclinical to fatal remains a major cause of morbidity, mortality, and economic loss to the beef and dairy cattle industries. Gaps in our BRD knowledge that could greatly enhance our clinical management schemes mainly fall into 4 general questions. The objective of this presentation is to address briefly each question from the standpoint of general current knowledge and what we need to know to improve management and control of BRD. First, various environmental factors and stressors stimulate potential pathogens that are quiescent in the nasopharynx to replicate and be inhaled, resulting in disease. Can a better understanding of this process translate into improved disease management? Second, currently published studies indicate low heritability for BRD resistance. Can BRD morbidity and mortality be reduced through genomic studies and breeding for genetic resistance. Third, numerous antibiotics are currently available and in use to control and treat BRD. Does in vitro antibiotic resistance and susceptibility of BRD pathogens correctly predict in vivo antimicrobial efficacy? Fourth, in the last 20 yr, we have greatly increased our knowledge base about immunity against BRD pathogens. What has been and can be translated from the research laboratory into improved commercial vaccines?

Key Words: cattle, disease, management

0062 Metabolic and health consequences of heat stress: Knowledge gaps and opportunities. L. H. Baumgard*[1], J. W. Ross[1], N. K. Gabler[1], S. M. Lonergan[1], A. F. Keating[1], J. T. Selsby[1], and R. P. Rhoads[2], [1]*Iowa State University, Ames,* [2]*Virginia Tech, Blacksburg.*

Environmental-induced hyperthermia compromises efficient animal production and jeopardizes animal welfare. Reduced animal agriculture productive output during heat stress was traditionally thought to result from decreased nutrient intake. Our results in ruminants and monogastrics challenge this dogma and indicate heat-stressed animals use homeorhetic strategies to modify metabolic and fuel selection priorities independently of nutrient and energy intake. Systemic shifts in bioenergetics are characterized by increased basal and stimulated circulating insulin. Hepatocyte and myocyte metabolism also show clear differences in glucose production and oxidation during heat stress. Perhaps most intriguing given the energetic shortfall of the heat-stressed animal is the apparent lack of basal adipose tissue mobilization coupled with reduced responsiveness to lipolytic stimuli. The origin of the aforementioned metabolic changes may lie at the gastrointestinal track. For a variety of reasons, heat stress compromises intestinal integrity. Increased permeability to luminal contents results in local and systemic inflammatory responses. Bacterial components might be additional signals influencing insulin secretion during heat stress. For example, in vivo lipopolysaccharide (LPS) IV infusion acutely increases circulating insulin in pigs and cattle, which is paradoxical as endotoxemia is a potent catabolic condition accompanied by severe pyrexia and marked hypophagia. Understanding how and why LPS induces hyperinsulinemia remains to be elucidated, but the practical implications of this phenomenon to animal agriculture are numerous. Consequently, heat-stressed animals are simultaneously confronted with life-threatening hyperthermia and endotoxemia. However, the fields of both environmental metabolism and intestinal integrity are essentially in their infancies (especially in animal agriculture). As a result, there are numerous knowledge gaps that exist and need attention before mitigation strategies can be developed. Of particular relevance to animal agriculture are the tissue- and organ-specific consequences of heat stress. For example, how the liver, muscle, adipose, mammary, and

ovarian systems respond to elevated temperatures, endotoxemia, and LPS-induced inflammation is of obvious interest. Further, determining how these systems are homeostatically and homeorhetically coordinated to prioritize acclimation and survival vs. agriculturally productive purposes would presumably enlighten mechanisms amenable to manipulation. In summary, heat stress is 1 of the primary hurdles to efficient animal production. Defining the physiology and mechanisms that underlie how heat stress jeopardizes animal performance is critical for developing approaches to ameliorate current production issues and a prerequisite for generating future strategies (genetic, managerial, nutritional, and pharmaceutical) to improve animal well-being and performance.

Key Words: heat stress, insulin, intestinal integrity

0063 Ensuring good health and well-being in the aging equine population. K. Malinowski*, R. C. Avenatti, and K. H. McKeever, *Rutgers Equine Science Center, New Brunswick, NJ.*

One of the largest industries in the United States involves horses, a $39.2 billion business associated with 9.2 million animals. The horse industry's contribution to the U.S. gross domestic product is $102 billion, generating more than 1.4 million full-time equivalent jobs across the country. More than 15% of the equine population is > 20 yr old and many of these animals continue to participate in athletic activities. Partly responsible for the increased lifespan of horses is the fact that equine nutritionists have advanced the development of "senior feeds," and that the animal pharmaceutical industry has developed effective anthelmentics for parasite control. However, advancing age in horses is often associated with declining body condition, muscle tone, aerobic capacity, thermoregulatory ability in response to acute exercise, and general well-being. While aging and obesity-related loss of function and diseases have many factors, understanding the underlying imbalance of molecular signaling mediators in metabolically important tissues, such as muscle, to preserve functionality of physiological systems, needs to be addressed. Advanced age in horses is associated with a decline in immune response and is characterized by increased production of pro-inflammatory cytokines, termed inflammageing, which has been linked to obesity. Horses > 20 yr old can improve aerobic performance, reduce body fat, and partially restore changes that occur in the hypothalamic-pituitary-adrenal axis, in response to acute exercise and insulin sensitivity with regular exercise training. Physiological similarities between humans and horses allow for broad implications of equine exercise physiology research in relation to aging and performance. Understanding the molecular mechanisms behind the adaptive response to exercise will aid in the development of exercise conditioning and nutritional strategies meant to preserve the health and well-being of this socioeconomically important species.

Key Words: aging, exercise, horses