The Growth and Development Symposium titled “Understanding and mitigating the impacts of inflammation on animal growth and development” was held at the Joint Annual Meeting of the American Society of Animal Science and the American Dairy Science Association in New Orleans, LA, July 10 to 14, 2011. The goals of the symposium were to highlight advances in the study of the complex processes of inflammation as it relates to growth and development of agricultural species, and to identify potential targets amenable to mitigation and prevention of production losses due to chronic inflammation. Under normal physiological circumstances, inflammation serves to protect tissues from infection, irritation, or injury, which is critical to maintain homeostasis and support animal survival. However, sustained stimulation of the inflammatory response impairs normal growth and development, and limits productivity by preventing an animal from attaining its full genetic potential. For instance, direct interactions between pro-inflammatory molecules with myofibers, adipocytes, and mammary and intestinal epithelial cells recently have been described that result in modifications of their metabolic and anabolic functions. Modified anabolic responses of these cells can reduce production efficiency, leading to significant economic losses in animal production agriculture. A more thorough understanding of the complex interactions of the immune system with productive tissues can assist in the development of means to reduce and prevent these economic losses due to chronic inflammation. The symposium provided a general overview of inflammation and the effects of anti-inflammatory compounds on animal growth and health, followed by more specific discussions of the effects of inflammation on growth of beef cattle and carcass merit, intestinal function as it relates to growth in swine, production losses of dairy cattle during mastitis, and overall efficiency of nutrient use in production animals.

Inflammation is a normal and necessary response to infection and tissue injury. However, prolonged or excessive inflammation can impair growth and development, as well as limit animal productivity. The first speaker of the symposium, Theo Niewold (Universiteit Leuven, Heverlee, Belgium), discussed mechanisms inducing the negative impacts of inflammation on animal growth and potential action of antimicrobial growth promoters as direct inhibitors of intestinal inflammation (Niewold, 2011). Use and effectiveness of anti-inflammatory compounds and anti-inflammatory feeds were identified as future areas of investigation.

As the second speaker of the symposium, Clint Krehbiel (Oklahoma State University, Stillwater) discussed the economic impacts of bovine respiratory disease (BRD) on growth performance and carcass characteristics of feedlot cattle (Gifford et al., 2012). In addition, the physiological mechanisms involved in the immune response that may contribute to these negative effects on production were highlighted. For example, BRD is the primary cause of cattle death in U.S. feedlots, costing an average of $12.60/animal for treatment (USDA-APHIS, 2001). Production losses associated with BRD result from reduced DMI, which negatively impacts ADG and G:F, and may have long-term negative consequences, such as poor carcass quality (e.g., reduced marbling and LM area) and reduced retail yield. The authors suggest that factors associated with
the immune response, including increased production of acute-phase proteins by the liver and cytokine effects on hepatic carbohydrate and fatty acid metabolism may reduce the availability of critical substrates needed for muscle and adipose tissue accretion. Molecular aspects of muscle atrophy associated with chronic inflammation also were discussed.

The third speaker, Nicholas Gabler (Iowa State University, Ames) provided an overview of the role of bacterial endotoxins in the immune response and their associated impacts on production performance of livestock species. In particular, the absorption of endotoxin and its deactivation in the context of the intestinal epithelium were discussed (Mani et al., 2012). The gastrointestinal tract is highly populated with Gram negative bacteria that produce endotoxin. As a result, paracellular transport of endotoxin from the gut into circulation through tight junctions, or transcellular transport via Toll-like receptor 4, can stimulate inflammation, causing nutrients to be partitioned away from growth and other productive processes to support an immune response. It was suggested that factors, such as dietary fat or environmental and metabolic stressors, play major roles in the intestinal absorption and detoxification of endotoxin, and that research is needed on how to mitigate these effects to improve animal metabolism and energetics.

Similarly, the fourth speaker, Michael Ballou (Texas Tech University, Lubbock), reviewed potential strategies to improve animal health and performance during clinical mastitis by modulating inflammatory responses, particularly in the periparturient dairy cow (Ballou, 2012). Inflammatory mediators, including cytokines, are a critical component of the innate immune system necessary for the effective elimination of mastitis-causing pathogens. However, it appears that dairy cows are particularly responsive to inflammatory stimuli during the periparturient period, contributing to increased incidence and severity of mastitis during this stage of the lactation cycle. The inflammatory mediators have both local effects within the infected mammary quarter, as well as peripheral tissue effects, impacting lactation performance and overall health of the cow. The author suggested multiple strategies to optimize or mitigate the level of inflammation including: 1) improving antioxidant status of the cow; 2) attenuating the inflammatory response through vaccination or use of pharmacological (e.g., non-steroidal anti-inflammatory drugs) or nutritional supplements (e.g., omega-3 fatty acids) that reduce production of inflammatory mediators; and 3) use of bovine GH to enhance recovery of the mammary gland.

The final symposium speaker, Kirk Klasing (University of California, Davis), provided a review of metabolic inefficiencies resulting from inflammation caused by pathogens or trauma (Klasing, 2011). Because inflammation causes reduced DMI, reduced nutrient absorption, and impaired nutrient metabolism, some improvements to feed efficiency and growth can be achieved through nutritional manipulation. However, the author suggested that the greatest benefits are achieved by reducing the frequency and magnitude of the inflammatory response through better animal management (e.g., improved sanitation and proper vaccination programs) and the prophylactic feeding of antimicrobial agents.

Persistent or unchecked inflammation can have detrimental effects on animal production efficiency. The Growth and Development Symposium on “Understanding and mitigating the impacts of inflammation on animal growth and development” provided an overview of how inflammation can negatively impact growth and carcass merit of beef cattle, growth performance of swine, lactation performance and health of dairy cows, and decrease overall metabolic efficiency of poultry and livestock. Furthermore, the symposium facilitated identification and discussion of novel management approaches to mitigate the negative aspects of inflammation on animal production performance, growth, and development.

LITERATURE CITED


