Lemen Swine Conference

High Soy for Improved Health

Speaker: Ryan N. Dilger, University of Illinois
Presentation title: Mechanistic insights into key soy-derived bioactives (isoflavones, saponins): Modulating immunity and improving disease resilience in swine

Abstract
Introduction: Swine respiratory disease (SRD) involves complex interactions between host immunity and a range of viral and bacterial pathogens. Nutritional interventions that target immune modulation represent a promising approach to improve resilience and reduce reliance on therapeutic agents. Soybean meal, long used as a protein source in swine diets, also contains bioactive compounds (most notably isoflavones and saponins) that are proven to exert immunomodulatory, anti-inflammatory, and antiviral effects. These compounds offer mechanistic potential for mitigating the pathophysiological impacts of SRD.

Methods: Evidence was synthesized from *in vivo* and *in vitro* studies in swine and model systems to evaluate biological pathways influenced by soy-derived isoflavones and saponins. Emphasis was placed on immunological, molecular, and physiological endpoints relevant to respiratory disease pathogenesis, including cytokine signaling, epithelial barrier integrity, oxidative stress, and adaptive immune cell profiles.

Results: Isoflavones, particularly genistein and daidzein, inhibit NF-κB activation and downstream pro-inflammatory cytokines such as TNF-α and IL-6. These effects are associated with reduced immune-mediated tissue damage and improved systemic resilience during pathogen challenge. Saponins, owing to their amphiphilic structure, influence mucosal immunity and barrier function, potentially reducing pathogen entry and secondary bacterial complications. Both compound classes have demonstrated antioxidant activity and the ability to modulate acute-phase responses and hematological parameters. Although bioavailability varies across soy processing methods, strategic inclusion of soy protein sources or concentrated bioactive fractions can support immune homeostasis during respiratory infection.

Conclusions: Soy-derived isoflavones and saponins exert complementary effects on host immune function through suppression of inflammatory signaling, maintenance of epithelial integrity, and modulation of cellular immune responses. These mechanisms are relevant across diverse SRD pathogens and support the broader use of soy-based functional ingredients as part of an integrated strategy for disease resilience in swine production.