Ingredients That Modify the Immune System.
Elizabeth A. Bobeck1, Iowa State University

Abstract: Companion animal diets have moved beyond providing complete nutrition for growth or maintenance and into functional outcomes that maintain and improve health and longevity. Select dietary ingredients have additional effects, intended or not, on animal physiology and immune function. Many immune-altering nutrients are fats or fat-soluble, including omega-3 fatty acids, essential oils, phytochemical compounds, and Vitamins A, E, and D. Examples of other related ingredients to which the immune system is responsive include phytochemical compounds, zinc, and probiotics. Because composition and inclusion rate of these nutrients impact immune function and physiology, a focused and intentional selection of specific ingredients is one method to alter inflammatory cascades in animals consuming the diet. While work in human, livestock, and companion animal models is working to identify therapeutic inclusion rates for these nutrients and ingredients, it should be noted that physiological alterations are nutrient-specific and are seen in both over and under-inclusion. For example, inclusion above currently recommended levels may optimize immune function and reduce inflammation in the case of vitamin D or omega-3 PUFA, while for zinc, additional pharmacological supplementation above requirements may inhibit immune function. Probiotics need to be specifically selected and included continuously for maximal benefit. When choosing to formulate an anti-inflammatory diet for long-lived animals, it must also be considered that important “background” functions of the immune system, including monitoring for and clearing pathogenic microbial populations, may be downregulated due to a general reduction in immune reactivity. Continued work to understand how diet and nutrition impact immunity, and how to balance inflammation through nutrition, is an area of active research and will inform downstream users how to best use data to impact consumers of that feed in desirable ways.

Age-Dependent Intestinal Barrier Repair in Suckling Pigs: A Comparative Model to Improve Neonatal Gastrointestinal Health Across Species.
Amanda L. Ziegler1, North Carolina State University

Abstract: As in porcine epidemic diarrhea virus, strangulating equine colic or necrotizing enterocolitis in human infants, intestinal diseases involving ischemic injury cause mucosal barrier damage and are associated with poorer survival in neonates. The cause of age-dependent outcomes in afflicted individuals has not been fully explained and therefore novel preventatives and treatments are lacking. While traditional rodent models have not demonstrated age-dependent differences in intestinal recovery, our translational pig model is the first to demonstrate an age-dependent intestinal barrier repair defect. We have shown that, while weaned pigs recover rapidly after ischemic intestinal injury, barrier repair is markedly impaired in suckling pigs, due to complete failure of epithelial restitution. Importantly, we found that the restitution defect in suckling pigs can be rescued by the direct application of homogenized mucosa from ischemia-injured small intestine from weaned pigs. Identifying reasons for this age-dependent defect in restitution and the components of the more mature pig mucosal tissues responsible for rescue will inform novel treatment interventions for neonates suffering with intestinal injury. Our lab has associated this age-dependent defect in barrier repair with an underdeveloped enteric glial cell (EGC) network, a postnatally developing component of the enteric nervous system known to regulate the intestinal barrier. We have found sub-epithelial EGC are reduced in neonates, neonatal epithelium in co-culture with EGC reconstitute more efficiently in vitro, and EGC inhibition ex vivo blocks restitution in juveniles recreating the neonatal phenotype. Further, as this EGC network is known to mature postnatally in response to the microbial colonization, we have found postnatal microbiota modulation with dietary prebiotic fiber supplementation exerts important effects on EGC network development and activity, and on EGC-epithelial pro-restitution crosstalk in vitro. Ongoing work to understand the roles of diet, microbiota, and the enteric nervous system on postnatal development of epithelial barrier repair can inform novel preventative and interventions to improve intestinal health in vulnerable neonates.

Keywords: pigs, intestinal barrier, enteric nervous system