Gut Health and Coccidiosis

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Introduction

In poultry, the gastrointestinal tract accounts for twenty percent of the energy expenditure of the whole body (Choct, 2009). This energy requirement is variable and dependent on numerous factors influencing the highly dynamic nature of the intestinal environment. The intestinal environment including the mucosal structure and function is influenced by many factors including environmental management, embryonic incubation, dietary ingredients, protein level, composition, and quality among others. The health of the intestinal tract is extremely important as nutrient digestion and assimilation for growth occur here. Intestinal integrity is based on the system functioning properly for digestion, absorption, secretion, and immunity. Subsequently, when disruption of this system occurs, major consequences in terms of bird health and growth follow. In order to understand the factors that may influence intestinal health, it is important to appreciate the normal structure and function of the intestine in order to be able to recognize when the equilibrium of the system has been disrupted. Maintaining intestinal integrity is a daily challenge in today's poultry industry, and it will likely become even more challenging with increasing environmental considerations, changing feed ingredients, and reduced medication usage. These increasing constraints demand the industry continually seek new opportunities or reconsider adopted strategies for maintaining a healthy and optimally functional intestinal mucosa.

Common Intestinal Challenges for Disruption of Intestinal Integrity: Eimeria and Necrotic Enteritis

If homeostasis in the intestinal bacterial community in commercial poultry is disrupted, over proliferation of indigenous bacteria can cause diseases, such as necrotic enteritis (NE) (Van Immerseel et al., 2004). *C. perfringens,* the bacteria responsible for NE*,* are naturally occurring in the intestines of chickens; however, its presence alone is not a determining factor for disease development. In situations of impaired intestinal function, a shift in commensal intestinal microflora is thought to result in rapid proliferation of *C. perfringens* bacteria, which in turn produce extracellular toxins that damage the intestinal wall and lead to development of necrotic lesions. When intestinal conditions are not favorable, even highly virulent *C. perfringens* strains fail to produce disease. However, there are some intestinal physiopathological circumstances that favor the development of NE, such as intestinal stasis, crude protein level and source (Drew et al., 2004), changes in gastrointestinal pH, and damage to the intestinal mucosa such as occurs with coccidiosis (Williams, 2005; Cooper and Songer, 2009). Pre-disposing factors for NE development are

extremely important, given that *C. perfringens* is a naturally occurring bacterium in the intestinal tract of poultry.

One of the precursors to NE occurrence can be infection by *Eimeria* resulting in coccidiosis**.** Available options for control of coccidia in the commercial poultry industry include dietary anticoccidial drugs, vaccination, or natural (non-antibiotic) dietary products. Historically, dietary anticoccidials have provided effective strategies of control; however, *Eimeria* has the ability to become resistant to these products and efficacy declines. As a result of this development of resistance, alternative strategies are being sought for management and prevention of the intestinal damage from this disease. Vaccination is one option for treatment, but there can be challenges associated with this approach. In order to generate complete immunity from vaccination, the vaccine must contain live oocysts to induce infection. The infection then results in intestinal damage and potential impacts on performance prior to establishment of immunity. Evaluating strategies to preserve intestinal integrity during the response to vaccination are critical to optimal vaccine usage.

Both coccidiosis and NE, independently or in combination, result in mild to extensive damage to the intestinal mucosa and intestinal function. Sub-clinical cases of these diseases may be as detrimental to commercial poultry production as more severe occurrences due to daily losses in bird performance that aren't attributed to a particular cause. With more producers considering alternatives to the use of in feed antibiotics, controlling these two diseases are central to the maintenance of intestinal integrity.

Dietary Approaches to Maintenance of Intestinal Health

While general improvements in gut integrity and immune competency may be achievable through improved embryonic incubation conditions, more focused research on the daily contribution of management factors to intestinal integrity and the host-pathogen interaction with specific diseases is necessary to decrease their impact on bird productivity and industry profits. The poultry industry is increasingly in need of non-antibiotic alternatives to improve gut health or decrease enteric pathogen impacts in commercial broilers. Options being investigated include among many, enzymes, and prebiotics and probiotics. Additionally, there may be numerous opportunities to preserve a healthy intestinal environment by alterations in existing nutritional strategies including adjustment in levels of amino acids, dietary minerals, or protein.

Exogenous enzymes are added to poultry feed with the objective to improve nutrient availability and digestibility, which ultimately results in improvements in bird performance. The mechanisms in which these enzymes improve bird performance have been extensively researched in healthy birds. However, limited literature is available in regards to how animals respond to disease challenges when they are being supplemented with exogenous enzymes, including widely used phytases. Enzymes can influence availability of nutrients for both the host and microbial population with performance and/or intestinal health alterations, and the response elicited could be different in a compromised intestinal environment as compared to a healthy one.

Maintaining a Community of Beneficial Bacteria

The intestines of poultry house a diverse community of bacteria, which are important for growth performance and protection against pathogenic bacteria (van der Wielen et al., 2002). The gastrointestinal system is not only the major site for nutrient digestion and absorption, but also works as the largest immunological organ in the animal, protecting the host against pathogens. This physical barrier, which has a surface area 150 times greater than that of the skin, is the first defense of the bird against pathogens (Tlaskalová-Hogenová et al., 2004). Bacteria in the intestine form a natural defense barrier and exert numerous protective, structural, and metabolic effects on the epithelium. Feed additives, such as enzymes, probiotics and prebiotics, can alter intestinal microbiota and ultimately impact bird performance and animals' susceptibility to diseases.

Conclusion

The intestine is a dynamic environment that is continually in a state of maintenance and turn-over. The function of the intestine at any given point in time is a reflection of the integrity of the villus and crypt balance, enterocyte maturity, secretion type and abundance, pH, microbial community, and digestive and absorptive capability. Certainly, bird management, diet, and intestinal health contribute substantially to the integrity of intestinal function and ultimately determine the success and efficiency of broiler and turkey performance. With changing dietary influences and pathogen challenges in today's commercial industry and in the years ahead, alternative approaches and perhaps adjustments to standard adopted practices must be evaluated for identification of opportunities to maintain intestinal integrity and bird performance.

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