Can a suppressed immune system affect growth?

Many factors can influence the immune response of an animal under stress. Application of an effective vaccination program is considered necessary to reduce the mortality rate that occurs in modern poultry production. However, immunisations have sometimes been administered too frequently and in large doses. Improper vaccination may lead to immune system stress. Several studies have demonstrated that stress can affect the intestinal function in animals and also disturb the absorption of nutrients.

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Digestive enzymes are important in the absorption and utilisation of nutrients in the alimentary tract. As a result, they are often used to indicate the intestinal function of nutrient absorption. Research has shown that a defective immune response can affect growth performance and the prevalence of enteric diseases in commercial poultry. It can also contribute to losses in productivity, an increase in mortality, and an increase in the contamination of products meant for human consumption.

Impaired defence

Extensive research over the last couple of decades has confirmed that mycotoxins are commonly prevalent in the majority of feed ingredients. A marked decline in poultry productivity with obvious clinical signs and post-mortem lesions, including mortality, can result from acute cases caused by ingestion of high levels of mycotoxins. Most cases of mycotoxicosis are chronic and are caused by ingestion of fungal metabolites at low-levels.

The result is a measurable decline in performance and the occurrence of non-specific changes, which include subcutaneous haemorrhage and immunosuppression. It can be questioned if mycotoxins can significantly affect the normal immune system functions of birds which can cause them to become much more susceptible to different viral, bacterial or parasitic diseases. The answer is yes, they can and they do.

One of the most important problems in the poultry industry is avian mycotoxicosis. Avian mycotoxicosis results in severe losses because of lost performance.

It is also an immunosuppressive agent which increases the birds' susceptibility to diseases and mortality. Several reports have shown that mycotoxins such as aflatoxins, ochratoxins, patulin or fumonisins are able to affect the inflammatory response at different levels.

For example, they can directly affect the viability of phagocytes (macrophages and neutrophils) or impair the activity or the secretory functions of these cells. It has been demonstrated that the broad immunosuppressive effect of mycotoxins on cellular and humoral-mediated immune responses can decrease host resistance to infectious diseases. For example, T-2 toxin increases the susceptibility of chickens to infection by Salmonella species and Cryptosporidium baileyi. The ingestion of aflatoxins increases the severity of infection of coccidiosis and salmonellosis in chickens and Japanese quail.

Ochratoxin A has been found to increase the susceptibility of chickens to coccidiosis, salmonellosis and colibacillosis.

Vaccination response

The immunity that is acquired through vaccination can be impaired by the ingestion of mycotoxins. The Egyptian study by Hegazy et al. (2011) revealed that mycotoxicosis might be the cause of vaccination failure against AI virus. The immunosuppression caused by mycotoxin may manifest as depressed T- or B-lymphocyte activity and production, as well as impaired macrophage/neutrophil-effector functions.

The level of antibodies following infection or vaccination, and the activity of phagocytic cells, are reduced by mycotoxins.

The suppression of the immune function by mycotoxins can eventually decrease resistance to infectious diseases, reactivate chronic infections and/or decrease vaccine efficacy.

A breakdown in vaccinal immunity and the occurrence of diseases such as infectious bursal disease virus (IBDV), Adenovirus or Marek's disease can result from the presence of mycotoxins in poultry rations.

Low levels of toxins in rations, which are below observable overt toxic levels, can also alter normal immune functions.

Mycotoxin deactivation

It is known that 70% of the immune system of the body is located inside the gastrointestinal tract (GIT). The intestine is relatively enriched with cells actively secreting IgA from the lamina propria of villi in the duodenum and jejunum. Peyer's patches are important components of intestinal mucosal immunity.

Mucosal immunity is an important part of the humoral immunity. Secretory IgA is the most important antibody present at mucosal surfaces, and is the factor of mucosal immunity. It provides passive immune-protection against invading pathogens in the GIT. A very important part of the Nutriad mycotoxin management strategy is the promotion of the intestinal IgA production, thereby stimulating the local immune system in the GIT. Effective mycotoxin management is a very complex topic and consists of many different strategies.

Immune system support is one of them. Without proper mycotoxin management birds, like other animal species, are constantly exposed to different concentrations and combinations of mycotoxins. The immune system of the birds will be weakened and they will be unable to defend themselves against infectious diseases.

The use of nutritionally inert feed additives with the capacity to bind and immobilise mycotoxins in the GIT of animals, thereby reducing their bioavailability, is the common approach for the detoxification of mycotoxins.

Whilst this approach successfully eliminates the risk of certain mycotoxins, such as the aflatoxins, it does not work comprehensively on all of the mycotoxins relevant to the poultry industry.

In general, the negative effects of a mycotoxin on the animal depends on the extent and rate of its absorption from the GIT, its distribution, its binding or localisation in tissues, its biodegradation and its excretion processes. Natural bio-inactivation is a complex mix of different processes that can occur simultaneously to provide a defence against a variety of mycotoxins.

Natural mycotoxin bio-inactivation generally takes place in the GIT and liver and is a result of the action of gastrointestinal microflora and tissue enzymes. In the GIT, naturally occurring bacteria, yeast and protozoa have the ability to bio-inactivate mycotoxins from the trichothecenes family into non-or less toxic metabolites.

In poultry, the T-2 toxin is usually metabolised and eliminated after ingestion. This process takes place in the crop, small intestine and liver where hydrolysis, hydroxylation, de-epoxidation and conjugation yield more than 20 different metabolites.

Bio-inactivation has been one of the proven approaches for the detoxification of the non-adsorbable mycotoxins (trichothecenes) either by altering their molecular structure into non-toxic metabolites or by binding onto the surface of probiotic bacteria.

In conclusion, mycotoxins may alter the bird's susceptibility to infectious diseases by affecting the intestinal health, and the innate and adaptive immune system. Further research will be necessary to investigate the impact of mycotoxins on infectious diseases and to develop practical and economically justified solutions to counteract mycotoxin contamination of feed, and its effects on animal health. ■

References are available from the author on request