Mycotoxins and (in)effective breeder vaccination

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What happens when two very complex issues such as mycotoxins and immunity come together? Much has been said regarding the clinical effects of mycotoxins, the secondary metabolites by fungi; however, what still remains quite unspoken are the effects which go beyond what your veterinarian can see.

Poultry producers in different countries share at least one doubt – at what level of mycotoxins will they see effects on their flocks? Although a simple and concrete answer would be more satisfying, in the case of mycotoxins this is generally not possible due to several reasons. One of them is the fact that – even at levels of mycotoxins which would not cause visible effects – birds will certainly face sub-clinical problems, such as immunosuppression.

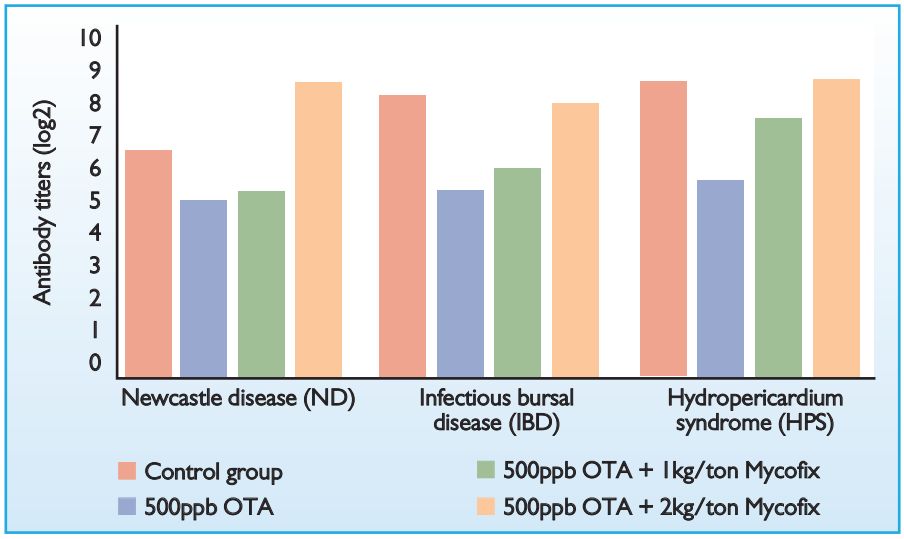

Fig. 1. Antibody titers of broilers fed 500ppb aflatoxins with and without a mycotoxin deactivator.

The avian immune system

The avian immune system is divided into non-specific and specific immune mechanisms. While the non-specific is innate to the animal and includes temperature, anatomic features, normal microflora, respiratory tract cilia and phagocytic cells (such as macrophages, monocytes and granulocytes), the specific is acquired and much more complex, comprising humoral and cellular components.

The humoral component involves the immunoglobulins (antibodies) and their producing cells, called B-lymphocytes.

These are produced from 15 days of incubation until 10 weeks of age by the embryonic liver, yolk sac and bone marrow. After that, they migrate to the bursa of Fabricius where they are programmed.

Due to the existence of memory cells, if the animal is exposed a second time to an antigen (foreign substance), the response is quicker and a much higher level of immune cell and antibody production occurs. This is, in general, the aim of vaccination.

On the other hand, T-lymphocytes – programmed in the thymus – are associated with the cellular component together with all cells that react to specific antigens, except those associated with antibody production.

The impact of mycotoxins

The most important mycotoxins negatively impacting animal production are the aflatoxin, fumonisin, zearalenone, ochratoxin and trichothecene families. Although being structurally and chemically different, all of them have been shown to exert an impact on the immune system of animals, leading to consequences such as increased susceptibility to diseases, impaired vaccination response and increased risk of infections.

In terms of economic impact, those effects are difficult to quantify but, in practical terms, flock managers will be faced with higher medication costs, inappropriate response to immune challenges and infections widespread in their flocks.

Aflatoxin B1 has been shown to primarily affect the innate and cell-mediated responses, and to a lesser extent humoral responses.

Exposure to fumonisin B1 modulates the least specific but quicker immune responses, the innate mechanism. It can trigger inflammatory responses and alter cytokine expression and functional responses of macrophages and other elements of the innate immune system at sites of tissue damage.

Ochratoxin A (OTA) presence can alter cellular, humoral or innate immune responses. Studies indicate that OTA can potentiate inflammation at target sites – namely in the kidneys – while reducing the capacity of immune cells to respond to inflammation.

Trichothecenes, such as deoxynivalenol (DON), suppress cellular and humoral responses and, at higher levels, DON promotes leukocyte apoptosis. Feeding of different Fusarium toxins, such as DON, zearalenone (ZON) and fusaric acid, resulted in a significant decrease in the biliary IgA, an important line of defence against bacteria and viruses.

Vaccination failure

Vaccination failure occurs when after administration of a given vaccine animals fail to develop adequate antibody titer values and/or are susceptible to a field disease outbreak. Mycotoxins, as immunosuppres-

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sors, are acknowledged as one of the factors which may impair the vaccination success.

In a study published by Azzam and Gabal (1998) layer hens were fed an aflatoxin-contaminated diet and vaccinated against Newcastle disease (ND), infectious bronchitis virus (IBV) and infectious bursal disease virus (IBDV). Antibody titers were significantly reduced in all aflatoxin exposed groups when compared to the non-exposed groups. When challenged with these diseases, mortality was also higher in the aflatoxin exposed groups.

Daenicke et al. (2002) fed various fusariotoxins to laying hens and concluded that serum antibody titers to NDV were significantly lower in animals exposed to the mycotoxins.

Counteraction of effects

Based on this information, immunological parameters are a must in studies involving mycotoxins and the so-called mycotoxin deactivators. Recently, a trial was conducted with Mycofix in turkey poults. Exposure to 500ppb aflatoxin B1 caused a significant alteration of both cellular and humoral mediated immunity. These adverse immunological effects of 500ppb aflatoxin B1 were completely overcome by the addition of the evaluated feed additive. In another trial the effects of mycotoxins in the immune response of broilers to ND, IBDV and hydropericardium syndrome, were considered. The humoral response of the group fed 500ppb OTA was significantly lower than the control group for the three tested diseases (Fig. 1).

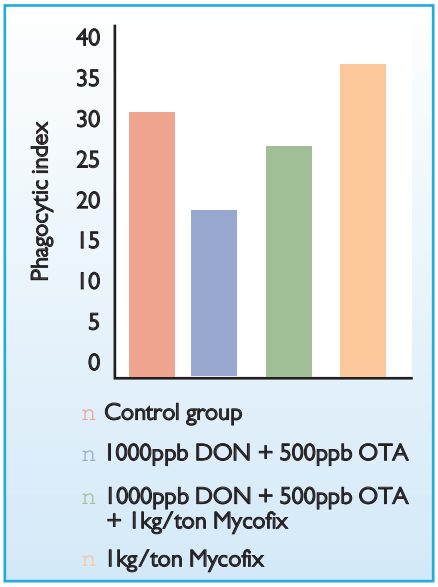

Fig. 2. Phagocytic index of broilers fed OTA and DON contaminated diets as an indication of innate immunity.

The supplementation with Mycofix significantly increased the antibody titers when in comparison with non-treated groups.

In the same manner as the humoral immunity, the function of innate defence, expressed by the phagocytic index, was also affected by OTA and/or DON contamination of feed. In an experiment, broilers were given 1000ppb DON and 500ppb OTA and this parameter was measured.

Overall, innate immunity was severely affected by OTA and/or DON and the inclusion of the feed additive was able significantly improve this parameter (Fig. 2).

So, now do you believe in immunosuppression by mycotoxins?

Either by impacting the innate immunity with the impairment of the phagocytic index, by altering the cellular-mediated immunity, or by directly impairing humoral response (vaccination response), it is more than certain that mycotoxins exert a serious negative impact on the immune system of poultry. Although often not recognised, these effects can lead to an even more substantial loss of money as whole flocks can be lost to diseases. If you wonder why your animals are not responding well to treatment or vaccination, you may want to add 'mycotoxin load of feed' in your list of things to check in your problematic flock. ■

References are available from the author on request