Featured expert of the month...

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Introduction

Mycotoxins are secondary metabolites of molds and are toxic to livestock, poultry and humans. The death of thousands of turkey poults in UK in 1960, due to aflatoxins, triggered phenomenal growth in the science of mycotoxins. Although there are hundreds of mycotoxins known, in depth research have been done only on few of them. Given the simplicity of handling as well as relatively low expenses, a great deal of mycotoxin research has been conducted in poultry and this added significantly to our understanding of mycotoxicoses in general.

Comparative toxicity of key mycotoxins in poultry

Based on LD50 values (amount of mycotoxin required to kill 50% of test population), the order of severity for some of the mycotoxins is as follows: Ochratoxins > Diacetoxyscirpenol (DAS) > T-2 toxin > Moniliformin > Oosporein > Aflatoxins > HT-2 toxin > Neosolaniol > Deoxynivalenol (DON) (Table 1; Leeson et al., 1995). Although aflatoxins are very well studied in poultry, ochratoxins, DAS and T-2 toxin are more toxic than aflatoxins. Additionally although DON is relatively less toxic it is an important to mycotoxin to be aware of due to its global presence at higher concentrations. Another important factor to bear in mind is that usually DON and T-2 toxin presence indicates the presence of dozens of other equally toxic Fusarium trichothecene mycotoxins (DeVries et al., 2002).

Table 1. LD50 values for some of the mycotoxins commonly found in poultry feed

Mycotoxin	LD50 (mg/kg BW)
Ochratoxin	2.14
DAS	3.82
T-2 toxin	5.00
Moniliformin	5.4
Oosprein	6.12
Aflatoxin B1	6.5
HT-2 toxin	7.22
Neosolaniol	24.87
DON	140

Mycotoxin interactions in poultry

Mycotoxins do not occur in isolation in poultry feeds and feed ingredients. The mycotoxins discussed above and many more occur together. This presence depends on several factors and the key ones are geographical location, climatic conditions, agricultural practices and trade of feed ingredients.

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This co-occurrence further complicates our understanding of mycotoxicoses as many of these mycotoxins interact within the body of birds and produce several toxicological interactions. The interactions can be additive, synergistic or antagonistic (Table 2).

Table 2. Examples of mycotoxin interactions in poultry

Mycotoxins	Type of interaction	References
Aflatoxin & Ochratoxin A	Synergistic	Huff and Doerr (1981) Raju and Devegowda (2000)
Aflatoxin & DAS	Synergistic	Kubena et al. (1993)
Aflatoxin and DON	Additive	Huff et al. (1986)
Aflatoxin and T-2 toxin Ochratoxin A and T-2 toxin	Synergistic Additive/synergistic/ antagonistic	Huff et al. (1988) Kubena et al. (1989a) Raju and Devegowda (2000)
Ochratoxin A and Citrinin DON and T-2 toxin DON and Ochratoxin A	Antagonism Synergistic < than additive/antagonistic	Manning et al. (1985) Kubena et al. (1989b) Kubena et al. (1988)
Fumonisin B_1 and Moniliformin	Additive	Javed et al. (1993)
Fumonisin B_1 and T-2 toxin	Additive	Kubena et al. (1995) Kubena et al. (1997)
Fumonisin B_1 and DON	Additive	Kubena et al. (1997)

The toxicity responses and clinical signs observed in poultry when more than one mycotoxin is present are complex and diverse. Mycotoxin interactions can alter clinical signs, resulting in a set of diagnostic characteristics that differ from the sum of individual effects. This subsequently makes field diagnosis of mycotoxin cases difficult and emphasizes the need to characterize mycotoxin interactions in detail. Interactions also pose challenges to the development of uniform methodologies for the prevention of mycotoxicoses in poultry. Although a preventative protocol may effectively reduce the toxicity of one mycotoxin, other mycotoxins may persist at harmful concentrations and cause toxicity. This is an important factor to be borne in mind while developing mycotoxin binders.

Common symptoms of mycotoxins in poultry

The biggest challenge with mycotoxicoses is the non-specific nature of symptoms in poultry. This makes it very hard for the poultry producer to diagnose the problem and take appropriate actions. The symptoms of mycotoxicoses can also be similar to those arising as a result of poor management, nutrition and health. Hence it is quite common under commercial conditions to compare the mycotoxin results of poultry feed with the symptoms on the farm to confirm mycotoxicoses. Some of the most common symptoms of mycotoxins in 3 classes of chickens are indicated in Table 3.

Table 3. Common symptoms of mycotoxicoses in poultry

Ruffled feathers
Diarrhea
Reduced feed intake
Reduced weight gains
Reduced egg production
Poor FCR
Poor fertility
Poor shell quality
Poor hatchability
Reduced number of chicks produced
Increased mortality
Poor antibody titers
Increased serum liver enzyme concentrations
Enlarged and damaged liver, kidney and gizzard
Meat discoloration

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Economic assessment of mycotoxicoses in poultry

One of the most common questions poultry producers ask is what are the economic consequences of mycotoxins? The symptoms listed above are self explanatory but only few of those can be used as economic end points.

Body weight gain: It is very common to see a reduction of 100 g or more in the final body weight of commercial broilers when exposed to mycotoxins. This parameter works well for some broiler operations who would like to get their birds to the market as early as possible. Achieving faster body weight also reduces labor and increases the number of broiler cycles per year. The disadvantage of using body weight gain as an indicator of mycotoxicoses is that it does not take into account the impact of mycotoxins on feed utilization. For example, a bird consuming mycotoxin-contaminated feed can weigh more at the cost of eating more.

Feed efficiency: This is the parameter most broiler integrators and layer producers look for to assess the impact of mycotoxins. This parameter takes into account the impact of mycotoxins both on feed intake as well as on the ability of the bird to convert feed into meat or egg mass. The challenge with this indicator is that it is often difficult to measure the feed intake accurately under field situations and there can be potential for errors. Depending on the body weight and market scenario, poultry producers lift the broilers for marketing at different ages and this makes it even more difficult to assess the precise FCR. Variation in the mortality can also affect FCR as it is very difficult to record and weigh the dead birds under commercial conditions. Accurate FCR records are critical for calculating the ROI of any mycotoxin binder under evaluation.

Mortality: This is an important economic parameter to consider while assessing the impact of mycotoxins in breeders and layers as they can get exposed to low levels of mycotoxins for long periods of time. However, mortality can occur in broilers as well when they are exposed to high levels of mycotoxins. Mortality is generally considered as an economic end point to assess the impact of mycotoxins on the immune system of poultry. However, a poor immune system can also affect morbidity (poor growth and feed efficiency). In order to assess the true impact of mycotoxins it is important to record when the bird actually died in the group as well as its body weight. This helps in calculating number of bird days.

Number of chicks produced per hen: This is the ultimate indicator used in breeders and covers the impact of mycotoxins on egg production, fertility, egg shell quality and hatchability.

Egg grades: Based on the egg shell quality, eggs can be graded as sound eggs, cracked eggs and bucket eggs. Even if egg production and egg weight are optimum, if the shell quality is poor the eggs still have to be discarded. Many mycotoxins are proven to affect egg shell quality.

European Production Efficiency Factor (EPEF): Although still there is a debate on whether this is the best economic indicator for broiler chickens, the use of EPEF to assess the impact of mycotoxins on broiler performance as well as the benefits of mycotoxin binders is increasing. The advantage of this method is that this takes into account the variation in mortality as well as age at marketing in arriving at an Index which reflects the efficiency with which broilers achieved their weight gains. However, this does not really put a $ value on the negative impact of mycotoxins on broiler performance.

Return on Investment (ROI): This simply implies the ratio of return to investment. The higher the return, the higher is the ROI. This can be calculated based on FCR (feed cost savings) and mortality and is very commonly used to assess the effectiveness of a mycotoxin binder or to compare various mycotoxin binders on the market. In many places around the world, the term ROI and REO are used interchangeably. However, these are different and need to be evaluated as separate entities.

Conclusions

Poultry are a sensitive species to mycotoxins but the sensitivity varies from toxin to toxin. An understanding of mycotoxicoses in poultry is complicated by the occurrence of several mycotoxins together in poultry feed, mycotoxin interactions and non-specific symptoms. It is important to use the right economic indicators to assess the impact of mycotoxins on poultry as well as to evaluate the effectiveness of mycotoxin binders.

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