Managing Mycotoxins in Laying Hens

By Dr Swamy Haladi, Alltech Global Technical Manager for the Mycotoxin Management Team

Table 1. Relationship between skeletal abnormalities and mycotoxins.

<table>
<thead>
<tr>
<th>Skeletal abnormality</th>
<th>Causative mycotoxin(s)</th>
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<tbody>
<tr>
<td>Tibial dyschondroplasia</td>
<td>Fusarium chlamydosporum, T-2 toxin, DAS</td>
</tr>
<tr>
<td>Rickets</td>
<td>Aflatoxins, ochratoxins, T-2 toxin</td>
</tr>
<tr>
<td>Articular gout</td>
<td>Ochratoxins, aflatoxins, citrinin</td>
</tr>
<tr>
<td>Spiking mortality syndrome</td>
<td>Fumonisins</td>
</tr>
<tr>
<td>Cage layer fatigue</td>
<td>Aflatoxins, ochratoxins</td>
</tr>
</tbody>
</table>

Table 2. The mode of action of mycotoxins on egg shell quality.

<table>
<thead>
<tr>
<th>Mycotoxin(s)</th>
<th>Mode of action</th>
</tr>
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<tbody>
<tr>
<td>Aflatoxins/Cyclopiazonic</td>
<td>Reduced minerals (Ca, P and Zn), vitamins (A and D) and parathyroid hormone functions, increased Ca excretion</td>
</tr>
<tr>
<td>T-2 toxin, DAS, DON</td>
<td>Reduced shell surface density, kidney damage, reduced Ca binding proteins</td>
</tr>
<tr>
<td>Zearalenone</td>
<td>Oestrogen mimicking effects, disrupts localisation of carbonic anhydrase enzyme in the shell increased P</td>
</tr>
<tr>
<td>Citrinin and patulin</td>
<td>Reduced egg shell Ca content, altered egg shape</td>
</tr>
<tr>
<td>Fumonisins</td>
<td>Reduced shell weight</td>
</tr>
</tbody>
</table>

Source: Devegowda and Ravikiran, 2008

MycoSorb supplementation to the mycotoxin group contributed to the control of mycotoxins.

To conclude, laying hens are susceptible to mycotoxins due to long term exposure and an increased trend in the use of by-products in the diets. The non-specific symptoms and subtle nature of the mycotoxicosis challenge warrants the implementation of mycotoxin prevention steps all along the production chain, rather than waiting for the devastation to happen.

Every layer operation should have their own mycotoxin management programme to ensure that their team is trained on the issue; that the problem is diagnosed at an early stage and that the necessary control steps are implemented.

Source: Devegowda and Ravikiran, 2008
Mycotoxins in breeding chickens get greater attention from the poultry industry when compared to commercial broilers and layers. This is understandable, considering minor reductions in fertility and hatchability in breeding chickens can lead to significant losses in farm profits.

A minor increase in mortality rates of breeding chickens can reduce the potential of the farm to produce the necessary number of chicks for their operations. The immune and reproductive systems are generally more sensitive to mycotoxins than growth indices.

Although more than 500 mycotoxins have been characterised, the most significant ones from the breeding chickens’ perspective are aflatoxins, ochratoxins, vomitoxin (DON), T2 toxin, zearalenone, and fumonisins.

Alltech’s 37+ Program, wherein more than 37 mycotoxins can be analysed using state-of-the-art UPLC-MS/MS, has indicated the role of several other mycotoxins in addition to those listed above.

Mycotoxins are proven to affect the bottom line of breeder operations in many ways. These include effects on egg production, egg weight, egg shell thickness, leg weakness, fertility, hatchability, and immunity.

The effects of egg production and egg weight can be explained by the negative impact of mycotoxins on feed intake, liver health, and gut integrity. Effects on the immune system, both antibody and cell mediated, often make the birds more susceptible to infectious diseases. Last of all, the effect on reproduction can be attributed to the direct effects of mycotoxins such as zearalenone on reproductive organs or the result of indirect effects on immunity and feed intake.

**Egg shell quality**

Optimum egg shell quality in breeders is critical to control nutrient losses and reduce bacterial contamination and embryonic mortality. Shell integrity is the parameter of egg shell quality most commonly affected by mycotoxins.

However, mycotoxins can also impact shape, texture, and cleanliness of eggs. Please refer to Part 1 of this Mycotoxin Solutions Series for more information on the key effects and mode of action of mycotoxins on egg shell quality.

**Mycotoxins and reproduction**

The feeding of 38mg/kg DON in F. graminearum-infected corn increased the percentage of non-viable eggs and late embryonic deaths (Moran et al., 1987). The eggs in this study had relatively less yolk and more albumen.

Yegani et al. (2006b) reported increased early embryonic mortality, associated with reduced eggshell thickness, in eggs produced by broiler breeder hens fed naturally contaminated diets containing 12.6mg/kg DON, and lesser amounts of 15-acetoxyl DEC and ZEN. DON at a concentration of 4.9mg/kg, combined with other Fusarium toxins in naturally contaminated oats, increased embryonic developmental anomalies and delayed ossification (Bergsja et al., 1993).

Body weight, feed efficiency, and egg production were not affected in breeders fed diets contaminated with Fusarium mycotoxins in spite of the various adverse effects in the above experiments.

Stanley et al. (2004) fed 3ppm aflatoxins to breeder hens and observed no negative effects on fertility. However, hen-day egg production, percentage of hatchability and serum total protein concentrations were significantly lower in the birds fed aflatoxins. Crucially, there was a significant increase in embryonic mortality.

**Mycotoxins and immunity**

Robust immunity is particularly important in breeders to protect these birds during their relatively long life and to ensure success of vaccination programs. It is also required for the transfer of maternal immunity to the progeny at a level sufficient to provide protection during the first few days post-hatching.

Fusarium mycotoxins, even at concentrations that do not result in an obvious adverse effect on performance, can be subtle modulators of immunity. Broiler breeder pullets fed naturally contaminated grains did not restore the pre-challenge percentage of circulating CD8+ cells upon recovery from coccidial infection (Girgis et al., 2008).

Decreased immune response to vaccines has also been observed in layers, broilers, and other poultry species. Serum antibody titers to infectious bronchitis virus decreased in broiler breeders fed naturally contaminated diets (Yegani et al., 2006b).

Antibodies to Newcastle disease virus (NDV) decreased in layers exposed to DON (Harvey et al., 1991) or to multiple Fusarium mycotoxins (Dünicke et al., 2002).

The use of a HACCP-like approach to control mycotoxins is highly recommended in feed mills and farms so that factors such as moisture and water activity of grains, temperature and relative humidity of environment are controlled. Better aeration of storage silo structures and frequent cleaning of feed mill equipment is also desirable to control mycotoxin production.

To conclude, breeding chickens are susceptible to mycotoxins due to long-term exposure and increased sensitivity of reproduction systems to mycotoxins. The non-specific symptoms and subtle nature of the mycotoxin challenge warrants the implementation of mycotoxin prevention steps all along the mycotoxin production chain, rather than waiting for the devastation to happen.

Every breeder operation should have their own mycotoxin management program to ensure that their team is trained on the issue, the problem is diagnosed at an early stage and necessary control steps are implemented.
Managing Mycotoxins in Breeding Chickens Part 3

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Mycotoxin management

The formation of mycotoxins in the field is influenced by many factors, most of which are outside the control of animal producers. The production of mycotoxins during storage of raw materials and feed, however, can be controlled to a greater extent. A HACCP-like approach to control mycotoxins, therefore, is highly recommended in feed mills and farms so that factors such as moisture and water activity of grains, temperature and relative humidity of environment are controlled. Better aeration of storage silo structures and frequent cleaning of feed mill equipment are also desirable to control mycotoxin production.

This is the basis of Alltech’s MIKO Program, a comprehensive and integrated approach to control mycotoxicoses in poultry. Several peer-reviewed studies in broiler chickens have shown that feeding Mycosorb contributed to the control of mycotoxins (Arvind et al., 2003; Kamalzadeh et al., 2009).

To conclude, mycotoxins can induce economic losses in broiler chickens. Every broiler operation should have their own mycotoxin management programme to ensure that their team is trained on how to control mycotoxins. The problem is diagnosed at an early stage and necessary control steps are implemented.

Mycotoxins and Bone Strength

The tremendous body weight of broiler chickens compromises bone strength and mycotoxins can exaggerate such negative effects. Broilers with poor bone strength cannot readily access feed and water, leading to death or poor weight gains.

Mycotoxins and Immunity

Aflatoxins, T-2 toxin, deoxynivalenol (DON or vomitoxin), fumonisins and many other mycotoxins are known to affect either cell-mediated or antibody-mediated immunity or both. This means that we can expect higher mortality in flocks exposed to mycotoxin-contaminated feeds. Aflatoxins have been very well studied in broiler chickens and have been shown to affect mainly cell-mediated immunity (Swamy, 2009).

Recent evidence supports the fact that mycotoxins affect performance parameters such as weight gain and feed efficiency mainly through compromising intestinal health. This is particularly true for Fusarium mycotoxins. Unlike pigs, broiler chickens continue to consume Fusarium mycotoxin-contaminated feeds and therefore their gastro-intestinal tract gets exposed to toxin assault (Swamy et al., 2004).

Mycotoxins and Feed Efficiency

Fusarium mycotoxins can affect feed efficiency through reducing intestinal vill height and width. This affects both digestion of feed and absorption of nutrients. Nivalenol, one of the Fusarium mycotoxins commonly seen in European feeds, can also cause gizzard erosion which, in turn, can affect digestion of feed. Fusarium mycotoxin-induced reduction in liver size may also affect the ability of the liver to produce bile salts and hence compromise feed digestion.

Last but not least, what about mycotoxins and broiler meat quality?

Aflatoxins and DON have been associated with reddish discolouration of meat. Although the mechanism of action of these two mycotoxins on meat discolouration is different, the ultimate effect is carcass condemnation, meaning poor profits for broiler operations (Swamy et al., 2002).

Mycotoxins and Performance

The ultimate objective of any broiler operation is to produce quality meat as efficiently as possible.

For this to happen, it is necessary to achieve optimum intestinal health along with general health of birds. Recent evidence supports the fact that mycotoxins affect performance parameters such as weight gain and feed efficiency mainly through compromising intestinal health. This is particularly true for Fusarium mycotoxins. Unlike pigs, broiler chickens continue to consume Fusarium mycotoxin-contaminated feeds and therefore their gastro-intestinal tract gets exposed to toxin assault (Swamy et al., 2004).

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