Impact of low mycotoxin contamination on animal health and performance

Mycotoxins are toxic compounds that represent a major threat from the feed for animal health and performance. It has been estimated that more than 300 mycotoxins exist. Nevertheless, the scientific community agrees that only a few mycotoxins are of concern in animal and public health because of their occurrence and toxicity: aflatoxins, ochratoxins, fumonisins, trichothecenes and zearalenones.

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Emerging mycotoxins and masked mycotoxins are rare and/or less toxic than the mycotoxins previously cited and therefore do not represent a significant threat to animals.

Mycotoxins are synthesised by fungi, either at pre-harvest (trichothecenes, fumonisins and zearalenones), mainly by Fusarium, or at post-harvest (aflatoxins and ochratoxins), mainly by Aspergillum and Penicillium.

Climate conditions and cultivation methods are the major factors affecting fungi growth and mycotoxin development, explaining why the mycotoxin profile of contamination varies a lot from one region to another.

Mycotoxin regulation in feed

In order to mitigate mycotoxins impact on animal health and performance, many countries have established regulations or recommendations of maximum permitted levels in feed for the major mycotoxins. For instance, in Europe, a maximum level of 20ppb (µg/kg) of aflatoxin B1 (AFB1) is accepted in all feeds for monogastrics.

The maximum permitted level is stricter for ruminants at 5ppb. Recommended maximum values of 900, 100-250, 50 and 5,000ppb were set respectively for deoxynivalenol (DON), zearalenone (ZEN), ochratoxin A (OTA) and fumonisins B1 and B2 (FUM) in swine feed.

The European recommended values for poultry feed are set at 5,000, 100 and 20,000ppb respectively for DON, OTA and FUM. These European regulations are the strictest in the world.

Natural co-occurrence of mycotoxins

So far, scientific studies mostly focus on exposure to single, high, mycotoxin concentrations for a short period, in order to obtain significant effects under experimental conditions.

Nevertheless, the feed and livestock industry observes deleterious effects from mycotoxins at lower levels than the ones found in scientific literature or set by authorities.

In fact, little is known on the impact of mycotoxin mixtures on animals, whereas several surveys have reported the importance of natural mycotoxin co-occurrence worldwide.

As part of its Myco'Screen offer, Olmix has developed a partnership with a French public laboratory, Labocea. This laboratory performs contaminant analyses with specific expertise on liquid chromatography-tandem mass spectrometry allowing the detection of more than 45 mycotoxins per tested sample.

The Olmix-Labocea database is composed of more than 10,000 feed ingredient samples, collected worldwide from 2013 to 2020. This database shows that 68% of the feedstuffs are contaminated with more than six mycotoxins, trichothecenes (DON and its derivates), fumonisins and zearalenone being the most frequently found.

In 2016, Smith et al. concluded that amongst the infinity of mycotoxin mixtures that may be found, AFB1+FUM, DON+ZEA, AFB1+OTA, and FUM+ZEA combinations are the most observed.

Impact of low contaminations on livestock

Recent studies focus more on the impact of low levels of natural mycotoxin mixtures on animal performance with the aim to better evaluate the real mycotoxin impact in field conditions.

A two-year large scale feeding trial, with 18

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successive trials, each including 2,200 one-day-old Ross-308 chicks, was performed by Kolawole et al. from 2017 to 2019, to evaluate the effect of natural low doses of mycotoxin mixtures on the performance of broiler chickens.

The feed was naturally contaminated with DON, FUM and ZEA at lower levels than EU guidance. A strong positive correlation was observed between feed conversion ratio of birds and mycotoxin exposure.

The authors conclude that the results obtained from this study show that prolonged exposure of broiler chickens to low doses of multiple mycotoxins below EU guidance limits can negatively influence broilers' feed efficiency.

Another study performed by Lucke et al. in 2017 evaluated the specific effects of low to moderate DON contamination on broiler performance. This study focuses on DON effect as it is the most frequent mycotoxin found worldwide.

In this study, the authors observed a negative impact of DON at low contamination (2,500ppb) and concluded that low to moderate doses of DON significantly affect dry matter intake, body weight, and carcase traits of broilers.

Even if birds are considered less sensitive to mycotoxins, the latest studies show that even low levels of mycotoxins can impact their performance.

Similar studies have also been performed in swine. For instance, in 2015, Alizadeh et al. showed that a low level of DON (900ppb) for a short exposure (10 days) can significantly alter gut health and immune status leading to reduced growth in piglets.

A recent paper published by Schothorst Feed Research measured the transmission of low levels of ZEA, DON, and their derivatives from sows to piglets during lactation. In this study, the dietary exposure to ZEA (100-300ppb) and DON (250ppb) did not affect the performance of sows and piglets.

However, sows exposed to 300ppb ZEA in the last week of gestation presented a decrease in backfat thickness concomitantly with a decrease in serum oestradiol and leptin. Piglets from the sows exposed to 300 ppb ZEA presented increased serum levels of DON and de-DON and also experienced inflammation.

These latest results illustrate the potential deleterious impact of low doses of mycotoxins on swine performance.

How to protect the animals?

It is now well established that even low doses of mycotoxins can provoke deleterious effects on animal health and performance thanks to experimental studies and field experience.

Special care must be taken for fusariotoxins, because of their high occurrence, co-occurrence and deleterious effects even at low doses.

To avoid these detrimental effects, it is important to limit both the intestinal absorption of mycotoxins and their contact with epithelial cells in the lumen to protect gut integrity.

Mycotoxin-adsorbing agents are large molecular weight compounds that bind mycotoxins in contaminated feed without dissociating along the gastrointestinal tract of the animal, so that the mycotoxins are not in contact with the epithelial cells.

Mycotoxin-adsorbing agents are a promising strategy to reduce mycotoxin damage in the gut and mycotoxin intestinal absorption.

Nevertheless, most mycotoxin adsorbing agents available on the market have limited capacity to bind major mycotoxins such as DON and FUM.

Today, one hybrid material based on clay and algae demonstrated its capacity to bind a wide spectrum of mycotoxins including the DON + FUM mixture in an in vitro gastrointestinal model (TNO-TIM-1, The Netherlands) without altering nutrient absorption. ■

References are available from the author on request