Improving pig performance by preventing the action of mycotoxins

by Marta Gutierrez, specialities product manager, Norel SA, Pl Can Coll, c/Industria 1, 08185 Llica de Vall, Barcelona, Spain.

Effect of zearalenone in a gilt.

Approximately 70% of the production costs in the swine industry are those intended for feed. These costs are influenced by the price of raw materials, mainly grains and oilseeds.

Nowadays, with the continuous increase of the price of raw materials, there is a tendency to formulate feeds with cheaper raw materials to control production costs. But reducing production costs by reducing feed costs may not be a good idea. It is necessary to consider that feed conversion ratio has a great economic impact and the most important thing is the final cost per kilogram of pig.

Therefore, if we have to use economical raw materials, we must invest in control methods to ensure the same high quality of the feed and thus obtain maximum benefit.

The FAO has estimated that 25% of the world's food crops, including many basic foods, are affected by mycotoxins producing fungi and hence cases of mycotoxicosis. Usually, these intoxications are caused by the ingestion of feed contaminated with mycotoxins and they lead to different clinical and pathological symptoms in animals mostly associated with infectious diseases.

It is also possible that the incidence of mycotoxins is the real reason of un-diagnosed cases.

Mycotoxin intoxication signs

The main signs of mycotoxins intoxication are feed refusal, a decrease in average daily gain, reproductive failure and immune system depression. The mycotoxins that affect swine production more frequently are fumonisin, ochratoxin A, aflatoxin, zearalenone and trichothecenes.

Aflatoxin, ochratoxin A and fumonisin suppress the immune system. Zearalenone induces oestrogenic effects: premature oestrus, vulvar oedema, and enlargement of breast tissue. Trichothecenes significantly suppress the immune response, lower blood cell production in bone marrow and inhibit DNA synthesis and protein.

Aflatoxin ingestion is associated with susceptibility to salmonellosis and dysentery in pigs and a decrease in weight gain and feed conversion ratio. In sows, AFB1 from feed has been found in milk as AFM1. Acute intoxication can even cause an increase in mortality. A bad appearance, jaundice, decreased appetite and loss of weight are observed when a chronic ingestion of contaminated feed occurs.

The pig is one of the most sensitive species to the adverse effects of Ochratoxin A, which produces nephrotoxicity, immunotoxicity and reproductive and developmental toxicity.

The presence of ochratoxin A in feed is considered to be the most important cause of spontaneous porcine mycotoxic nephropathy. Ochratoxin A has been reported to have an adverse effect on sperm production and semen quality in boars given daily doses of 20µg per animal.

Zearalenone is not acutely toxic but it poses a great oestrogenic effect. It affects every stage of the pig but it is more important in sows. Zearalenone imitates the oestrogen hormone.

In high concentrations, this mycotoxin induces genital and rectal prolapses, oedema and redness of the vulva. It also interferes with conception, ovulation, implantation, foetal development and viability of piglets (weak piglets and those with locomotive problems). All these actions result in a poor fertility ratio at farm level.

More common trichothecenes are vomitoxin (DON) and T-2 toxin. Trichothecenes are toxic to all tested animal species, but the sensitivity varies considerably between animals and the different mycotoxins. Pigs are especially sensitive to them.

Trichothecenes have been shown to be potent inhibitors of the protein synthesis, and DON and T-2 toxin alters the levels of dopamine, tryptophan, serotonin and serotonin metabolites in pigs. Pigs challenged with a feed containing 1mg DON/kg reduced their feed intake and suppressed their immune system response. Moreover, when challenged with 10mg DON/kg, pigs lost appetite and vomited.

Decreased immune response

Animals challenged with lower concentration of T-2 toxin showed a decrease in feed intake and a bad immune response. The decreased response of the immune system is easily explained by the inhibition of the protein synthesis. It is clear that the presence of mycotoxins in feed could produce significant economic losses.

Studies on this matter show sufficiently high occurrences and concentrations of mycotoxins to suggest that they are a constant concern for the producer. Several methods to control the impact of fungus and mycotoxins have been considered along the years and the addition of mycotoxin binders to contaminated diets has been considered the most promising dietary approach to reduce the effects of mycotoxins.

Nowadays, there are a variety of products available on the market for animal feed with a 'toxin binder' capacity, and the risk of mycotoxins in the animal organism is reduced or avoided. For practical purposes,

Continued on page 39

Continued from page 37
these products minimise the risk of mycotoxicosis that could be derived from the use of contaminated feeds.

Toxiwall, with its combination of bentonite-montmorillonite, diatomaceous earth and yeast cell walls, has the power to bind in a high percentage the main mycotoxin that affects animal production.

Bentonite is a general clay material originating from volcanic ash and containing primarily montmorillonite as the main constituent.

Montmorillonite clay is a hydrated sodium calcium aluminim magnesium silicate hydroxide. Its laminar 3D structure is able to adsorb organic substances in the external surface and in its interlaminar sites through the interaction or substitution with interchangeable cations.

Adsorption does not depend on pH and temperature. Aflatoxins are trapped inside the tridimensional structure of the silicate, like polar molecules associated to cations located between layers. Bentonite can bind AFB1 and T-2 toxin but not ZEN or nivalenol. Montmorillonite can break the entero-hepatic cycle of adsorption and excretion of AFB1 and AFB2, making elimination through faeces faster.

Diatomaceous earth is a naturally occurring siliceous sedimentary rock. It consists of fossilised diatoms (hard-shelled algae). It has shown the potential in vitro to bind aflatoxin, sterigmatocystin, T-2 toxin, zearalenone (ZEN) and ochratoxin.

Diatomaceous earth chemical composition is silica, alumina and iron oxide. The addition of this ingredient to a contaminated diet alleviated the negative effects resulting from OTA, reaching values not significantly different from the control.

Major structural constituents of the wall of a yeast cell are polysaccharides, mainly glucans and mannans, with a minor percentage of chitin. Other components of the cell wall are variable quantities of proteins, lipids, and inorganic phosphate.

This structure is highly dynamic and can vary according to the yeast strain. β-D glucans are the yeast components responsible for the complexion of ZEN, and the reticular organization of β-(1,3)-D glucans and β-(1,6)-D glucans play a major role in the efficiency of the mycotoxins binding.

The geometrical symmetry of ZEN molecule and the open site in the helix of β-D glucans favours a close association between the two molecules. As a result, the ZEN molecule is totally entrapped inside β-D glucans structure.

The geometry of AFB1 molecule allows it to easily enter the open structures of the helical structure of β-D glucans. The small size of PAT enables it to penetrate deep within the helix of β-(1,3)-D glucans. DON was able to interact with β- D glucan molecule through at least two hydroxyl bonds.

Adsorption efficiency

All aflatoxins, citrinin, ergotamine, T-2, paspalitrems, slaframine and verrucarin can probably bind to β-D glucans due to their 'aflatoxin-like', 'deoxynivalenol-like' or 'zearalenone-like' structures.

The similarity of molecular geometry of the binder and the toxin, associated with the existence of electrostatic and hydrophobic interactions between glucose units in a single helix of β-D glucans and mycotoxins were identified as key factors in adsorption efficiency. Also, the fibrous material from the yeast cell wall was shown to have a potential to bind several mycotoxins. Even more, esterified glucomannan polymer was shown to bind with aflatoxin, ochratoxin and T-2 toxin, individually and combined.

Therefore, Toxiwall is active against aflatoxins, trichothecenes (vomitoxin and T-2 toxin), zearalenone, ochratoxins and other mycotoxins with similar structure to the toxins above mentioned.

For that, Toxiwall reduces the impact of mycotoxicosis in production animals, guarantees their optimum growth and productivity by adding it to the feed, and guarantees, moreover, a longer shelf life of feeds. Toxiwall is also effective at low levels of inclusion, so does not reduce the nutritional composition of the rations. ■

References are available from the author on request