Ask the Expert...

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The incidence of mycotoxins seems to be increasing over recent years. Is this truly the case or do we just hear more about it?

Unfortunately there has been an increase in the incidence of mycotoxicosis in pigs and other animals over recent years. Summary analyses suggest that 25-35% of all feeds may be affected by mycotoxins. This may be due to a number of reasons:

- There has been a change in the global weather pattern, with increased incidence of droughts, floods and extreme temperatures, especially at harvest time. All of these increase the risk of mycotoxin contamination of crops and feed stuffs.
- There is an increase in the global trading of grain and sources of protein
- Recently, feed prices have been extremely high and there has been a tendency to increase the inclusion levels of cheaper novel or alternative feeds for pigs, as well as screenings and damaged or broke grains. These are often contaminated with mycotoxins.
- The modern pig, with its high genetic potential for growth and reproduction, is more sensitive to stressors and challenges during its productive life than the more traditional pig genotypes. They are more vulnerable at critical periods in their development (e.g. weaning, moving into different accommodation/groups).
- There is a higher incidence of disease, such as PRRS, PMWS, PDWS, Circo virus-type and other ailments. These reduce resistance to many diseases, as well as mycotoxins.
- In many countries there has been a move to higher welfare systems of production, often with straw bedding. Several surveys have shown that straw bedding is a prime source of moulds and mycotoxins.
- Less attention is given to storage conditions on farm and the system of feeding per se. Storage bins and feed systems must be emptied and cleaned out regularly, especially under hot/humid conditions.
- In terms of crop production, use of fungicide sprays has decreased and less resistant strains of feed crops are being planted. Thus, mycotoxins are more prevalent.
- Furthermore, there is increasing awareness and monitoring of feeds for mycotoxins and veterinarians and producers have become more alert to the symptoms of mycotoxicosis.

Which mycotoxin(s) should I be concerned about and why?

Pigs are especially sensitive to mycotoxins during all stages of production, including the breeding animal. The development of novel feeding and housing systems has added a new dimension to mycotoxin control in pigs. Mycotoxin exposure can occur in both dry and wet feeding systems, and especially the latter, with long distribution lines that are hard to clear. In addition, high welfare systems using straw bedding pose an additional risk, and this is especially pertinent to the group-housing of sows. Mycotoxins suppress immune function in pigs and this may eventually decrease resistance to infectious diseases, re-activate chronic infections and/or reduce vaccine and therapeutic efficiency.

Common symptoms associated with mycotoxicosis include:

- Reduced feed intake
- Poorer growth rate
- Decreased feed conversion efficiency
- Increased incidence of disease
- Reduced immunity
- Vomiting
- Rectal / vaginal prolaps
- Sudden death

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- Pale / weak pigs
- Bloody faeces
- Reduced sow productivity
- Abortion
- Increased foetal re-absorption = return to oestrus
- Inconsistency of sow body condition
- Delayed puberty in gilts and boars
- Reduced libido
- Poorer semen quality = reduced fertility
- Higher incidence of liver and/or kidney disease

A summary of different fungi, the mycotoxins they produce and the effect of these in pigs, is provided below.

Fungi	**Mycotoxin**	**System affected**
Aspergillus flavus	Aflatoxin B1, B2, G1, G2	Liver necrosis, fatty infiltration of the liver, immune-suppression
Fusarium moniliforme	Fumonisin, Fusaric acid	Pulmonary oedema, Immune-suppression, Vomiting, lethargy, loss of muscle condition
Fusarium graminearum	Deoxynivalenol (DON, Vomitoxin etc.)	Vomiting, intestinal lesions, immune-suppression
Fusarium roseum	Zearalenone	Hyperoestrogenism, abortion, infertility, prolapses, ulceration
Claviceps purpurea	Ergotoxin	Reduced appetite, gangrene, agalactia, mammary gland failure

(Smith et al., 2005)

A summary of the threshold levels at which the different mycotoxins affect pig performance and immune function is presented below:

Toxin	**Threshold level**
Aflatoxin	50 ppb
Ochratoxin	50 ppb
Zearalenone	200 ppb
Fumonisin	200 ppb
Trichothecenes	200 ppb
Ergotoxin	0.1%

What levels of Zearalenone are safe to feed to pigs?

Basically there are no safe limits as performance is affected at all levels; the higher the concentration the greater the effect. Zearalenone has a major effect on the breeding pig and causes rectal prolapses in grow-finish pigs.
Clinical effects/signs

The most striking clinical feature is the swollen, red vulva of gilts and sows. Reproductive performance is also affected and the consumption of Zearalenone-contaminated feedstuffs results in the birth of small litters, as well as stillborn, splay-legged and weak piglets. Piglet birth weight is also variable, as blood flow within the uterus may be impaired. Semen quality is boars may also be affected.

The clinical effects of zearalenone poisoning and the concentrations at which they occur are listed below:

- Pre-breeding gilt: 1-3 ppm
  Swelling and reddening of vulva, enlargement of teats and mammary glands, ovarian and uterine swelling, uterine oedema, retention of CL and anoestrus, increased duration of oestrus cycle.
- Sows: 3-10 ppm
  Additional to the above: Pseudo pregnancy (retention of CL), reduced litter size, abortions, reduction and variability in piglet birth weight, birth of weak, stillborn and spay-legged piglets, vulva/teat enlargement in female piglets, increased wean-mating interval.
  >30 ppm
  Complete embryonic failure
- Boars: >30 ppm
  Reduction in semen quality, increase in abnormal sperm, reduced libido, loss of hair, oedema of prepuce.
- All animals:
  Rectal and vaginal prolapses, reduced performance.

The proposed action / intervention level for zearalenone is 200 ppb.

My pigs are experiencing abortions; could this be due to mycotoxins present in the feed?

Abortions are caused by both infectious and non-infectious factors and it is important to differentiate between the different causes. Abortions can be caused by a number of infections, such as PPRS, Parvovirus, African Swine Fever, Brucella suis, Aujesky' disease etc. Non-infectious causes include: poor management, hygiene and husbandry, as well as inadequate nutrition and low feed intake in lactation, including excessive loss of body condition and body weight in lactation, poor lighting, stress, inadequate and contaminated water supply, a negative response to a vaccine, anaemia, poor semen quality, poor boar contact and incompetent mating of the sow, poisonous plants, mouldy feed and mycotoxins. One of the most common causes of abortion is mycotoxicosis, and the mycotoxin with the greatest effect on abortion is Zearalenone. At levels of 5-10 ppm in early gestation, abortions are a common occurrence. Zearalenone binds to the receptors for the reproductive hormone oestrodiol -17-ß. This inhibits the secretion of FSH, which results in the arrest of pre-ovulation follicle maturation. More corpora lutea are retained, which may result in prolonged oestrus activity for up to 40-60 days (pseudo pregnancy). Weight of the ovaries is reduced and implantation is impaired. There are fewer embryos, early embryo deaths are incurred and abortion is common.

Other factors that can cause rectal prolaps are lack of water, constipation, low fibre content of feed, poor environmental conditions, excessive coughing etc. However these are unlikely to occur in modern, sophisticated systems of housing with liquid feeding.

Liquid feeding systems present a significant challenge in respect to mycotoxins and it is important to employ strict hygiene procedures to minimise the problem of mycotoxins in the mixer tanks, feed lines and troughs. It is important that the tank, feed lines and troughs are cleaned and flashed through between batches of pigs with an effective cleaning agent and discard the cleaning water. The use of a suitable acidification product will also help; a blend of acids is better than a single acid, and make sure that the correct amount is added. This will help to suppress any mould growth. However, if rectal prolapses still persist then mycotoxins are the likely cause. An effective mycotoxin binder, such as Mycosorb®, should be added at the equivalent of 2 kg/kg dry feed until the problem is overcome, and thereafter at the equivalent of 1 kg/kg dry feed as an insurance.

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Why are baby pigs more susceptible to the effects of mycotoxins than mature animals?

The baby pig is dependent upon the sow's milk as its sole source of nutrition. Thus, the quality and quantity of the milk produced will influence piglet performance. Some mycotoxins, for example zearalenone, are transferred in milk and they affect the piglet. Only high quality diets of the correct nutrient specification should be fed to sows, with the correct feeding strategy. If quality, for whatever reason, is suspect, then an effective mycotoxin binder should be added to the diet. The quality of the piglet and its immunocompetence - and therefore its ability to overcome any challenge - may also be compromised, since immunoglobulins do not cross the placenta. The piglet is dependent on a good intake of quality colostrum to build up its immunity in early post-natal life; that is passive immunity. The piglet's own active immunity doesn't start to develop until 10-14 days after birth. If the immunocompetence of the piglet is low because of low intake of immunoglobulins and especially IgG, then it will be more susceptible to stressors, such as mycotoxins.

What level of DON will cause feed refusal in different classes of pigs, especially sows and small piglets and what can be done to overcome this?

DON (Deoxynivalenol, Vomatoxin) is one of the most common Fusarium trichothecene mycotoxins. It is generally associated with feed refusal, vomiting and lesions of the gastro-intestinal tract of pigs. Studies have shown that at 3-5 mg DON/kg feed, appetite in pigs is greatly depressed, resulting in reduced performance. This of course has consequences for all pigs, but especially the lactating sow, since reduced intake influences milk yield and hence the growth rate and weaning weight of the piglets. There is a loss of both body weight and body condition, which influences the wean-oestrus interval and hence subsequent performance. DON also has immune-suppressive properties and this reduces the animal's ability to overcome an infection challenge. For these reasons it is recommended that action be taken if the concentration of DON in animal feed is >0.2 ppm.

In many parts of the world the usage of by-products is increasing. Mainly in the US the so-called new generation DDGS in pig feed, up to 50% in some cases. In Eastern Europe 10-20% of DDGS is available. What could be the danger of feeding high levels of these products (DDGS) to fattening pigs and sows?

There is increasing interest in the feeding of DDGS to farm livestock because of the quantities likely to be generated from bio-fuel production. The following points should be taken into account when considering the use of DDGS in pig feeds:

- What is the origin of the DDGS, wheat, barley, corn etc.? as this will influence its nutrient composition. There is also the question of variability depending on how the product is produced. It is important that the manufacturer of the product provide good chemical composition values.
- DDGS, if not dried properly, is a potential source of mycotoxins. It is therefore recommended, as a security, that Mycosorb® be added at 1-2 kg/ton.
- The amino acid content needs to be checked, as this may vary; the digestibility of the amino acids may be reduced during processing and drying of the product. On the other hand, the fermentation process per se removes a lot of phytic acid and so the digestibility of P in the product is increased.
- The DE content of DDGS is high, on a dry matter basis, and comparable to other cereals. However, DDGS is high in both fibre and protein, which means that the net energy (NE) for growing-finishing pigs will be reduced compared with that of other cereals. This is important from a practical perspective, as several of the studies carried out in North America have shown a reduction in performance at higher inclusion rates. This can be attributed to the lower NE values of DDGS compared with other cereals. Furthermore, diets were based on total and not on digestible amino acid content and digestible AA content is less than that of soya. Thus, the feed value of DDGS needs to be based on NE and digestible amino acids.
- One way to improve the nutritive value of DDGS would be to add Allzyme SSF. There should be a 3-4% improvement in nutrient digestibility, including amino acids and minerals. The recent work of James Pierce and Jim Bannerman has shown that adding Allzyme SSF to diets with 30% DDGS resulted in similar performance and an increased margin of $1 per pig.
- One consequence of feeding too high a level of DDGS may be the quality of fat, with soft carcass fat. In this respect, one has to bear in mind that these studies have been carried out with maize DDGS from the USA and not barley/wheat DDGS that will become available in Europe. There may also be benefits in that DDGS may reduce skatole production in the large intestine, thus reducing taint and hence improve meat quality.

- How much can be used? Recommendations are to a maximum of 10% in grower diets and 20% in finisher diets. The normal ingredients to replace would be soya bean, wheat feed and some cereal. However, it is important to maintain both energy and amino acid content and synthetic amino acids may need to be used. It is also important to formulate the diets based on NE and digestible AA content.

The incidence of mycotoxicosis from feeding DDGS needs to be considered. If corn containing mycotoxin is delivered to an ethanol plant for ethanol production, these mycotoxins are not destroyed or inactivated during the fermentation process and will therefore be present in DDGS from this source of corn. In fact, the concentration of mycotoxin in DDGS will be 2-3 times higher than the initial concentration in the grain because the removal of starch during the fermentation process concentrates all of the unfermentable portions of the grain that remain after fermentation. It is therefore important that the DDGS be screened and tested for mycotoxins, especially if 20-30% of the feed contains DDGS.

Often our customers find low levels of mycotoxin in finished feed, although in some time they see red vulvas among 1 or 2 litters per farrowing house. What causes this?

These are the classical symptoms of the mycotoxin zearalenone. If the sow is fed feed contaminated with these mycotoxins then these are transferred into the milk. When the piglets suckle, they consume contaminated milk, hence the symptoms in piglets. There may be low levels of mycotoxins analysed in feed, but there are many, many mycotoxins and since these act synergistically, then the effects are greater than the sum of the individual toxins. Thus, the threshold level at which clinical symptoms are observed and at which performance is influenced is much lower than if they acted singly.

What are masked mycotoxins?

Masked mycotoxins are toxins which are bound to different components of the feed and are only released during digestion by the animal. They are therefore not detected by conventional chemical analysis for mycotoxins. Special pre-treatment is necessary to release these toxins to make them apparent by analysis. Generally they are conjugated mycotoxins in which the toxin itself is bound to a more polar molecule, for example glucose. In this form the toxins escape detection by normal routine procedures, but still release their toxic precursors after hydrolysis in the small intestine and hence have a greater effect on production than is indicated by the level of mycotoxin measured by normal analytical procedures. This is one reason why the results of a standard mycotoxin analysis should only be considered as an indication of mycotoxin contamination and not a measure of the actual amount. A typical example of a masked mycotoxin is DON-3-glucoside, where DON is attached to a glucoside molecule which is not detected by standard analysis.

Can mycotoxin contribute to poor bone strength in pigs?

There is evidence in poultry that aflatoxin and ochratoxin can influence skeletal development and structure in poultry. Hence it could be assumed that pigs would be similarly affected.