Mycotoxins – A risk for companion animals?

Karin GRIESSLER DI (FH), Technical Manager, BIOMIN Holding GmbH

Due to several recalls of different pet food products in the last year the discussion about the potential risk of mycotoxins in companion animals has increased. Mycotoxins are highly toxic secondary metabolic products of molds generally produced by *Fusarium*, *Aspergillus* and *Penicillium* species and found on common feedstuffs such as grains. They may cause different toxic effects in animals, called mycotoxicoses, varying from immune suppression, oestrogenic or neurotoxic effects, to death in severe cases. Moreover, sensitivity to the various mycotoxins differs between animal species and depends also on other factors such as those that are toxin-related (type of mycotoxin consumed, level and duration of intake), animal-related (sex, age, breed, general health, immune status, nutritional standing) and environment-related (farm management, hygiene, temperature). Therefore it is very difficult to detect and diagnose problems related to mycotoxins in the animal.

Mycotoxins certainly represent a potential health threat to companion animals. According to a recently published mycotoxin survey, raw materials that are used in commercial pet foods are frequently contaminated with mycotoxins (Rodrigues, 2009). Dry pet food is of particular concern because of its high cereal content. Böhm *et al.* (2008) investigated 76 dry dog food samples from Austria for their mycotoxin contamination. The results of this survey showed that 97% of all tested samples were contaminated with deoxynivalenol with concentrations up to 1386 ppb. Zearalenone was found in 47% (concentrations up to 664 ppb) of the samples, and 42% (concentrations up to 568 ppb) of the dry dog food samples contained fumonisins.

Figure 1: Moldy corn

What are the possible effects of mycotoxins in pets?

The most commonly known mycotoxins are aflatoxins due to the fact that they are potential carcinogens and can be toxic to the liver. Loss of appetite, jaundice, lack of energy, vomiting or death has been described in dogs and cats exposed to aflatoxins (Hussein et. al. 2001). In addition it was observed, that death generally occurs in 3 days with LD_{50} levels ranging from 0.5 to 1.0 mg/kg in dogs and 0.3 to 0.6 mg/kg in cats depending on the age of the animal (Hussein et. al. 2001).

Recently, it was reported that hundreds of dogs were killed after aflatoxin ingestion in the period from November 2008 to January 2009. Samples of the dog foods consumed showed contamination levels of aflatoxins up to 150 ppb (Feedinfo 2009 and All about feed 2009). Additionally, Compas *et al.* (2009) investigated 180 dog food samples in Brazil for the presence of fungi which may produce mycotoxins. *A. flavus* and *A. parasiticus* were the prevalent species found and were considered a potential risk for production of AfB_1 in feedstuffs where environmental storage conditions were not adequate.

The sensitivity of different pet species to aflatoxins expressed as oral LD_{50} levels varies a lot, with rabbits at 0.3 mg/kg of body weight (BW), cats at 0.55 mg/kg of BW, dogs at 1.0 mg/kg of BW and guinea pigs at 1.4-2.0 mg/kg of BW. These pet species are more sensitive than e.g. mice (9.0 mg/kg of BW) or hamsters (10.2 mg/kg of BW) (Leung et al. 2006). In guinea pigs affected by aflatoxins, pale

liver syndrome increased with the dose of aflatoxins (CAST Report 2003). Moreover, aflatoxins have been associated with equine deaths after consuming corn contaminated with a total aflatoxin concentration of 130 ppb. (Vesonder *et al.* 1991).

Other commonly found mycotoxins are ochratoxins (OTA). As with other animal species, the kidney is the primary target organ of ochratoxins in pets with dogs being particularly susceptible to ochratoxins. In one study, a daily dose of 0.2 mg OTA/kg BW for 2 weeks or a single dose of 7.8 mg OTA/kg BW was lethal to young male beagle dogs. Clinical signs of ochratoxins in dogs varied from anorexia, weight loss and vomiting to increased body temperature, dehydration, and prostration (Boermans and Leung 2007). Pühringer *et al.* (2007) investigated the ochratoxin A content of 101 feline kidneys and 55 cat food samples. The kidney samples (38 were contaminated with ochratoxins A) contained 0.31 - 5.18 µg of ochratoxin A/kg whereas the ochratoxin A content in the cat food was very low with 0.31 – 2.41 µg ochratoxin A/kg (14 samples were positive). The results of this study suggested an increased dietary ochratoxin exposure in the cats but did not correlate with the pathological findings in the different kidney samples.

Fusarium mycotoxins (trichothecenes, zearalenone and fumonisins) are of main concern to companion animals due to the fact that many feed ingredients are known to contain these toxins. For instance, zearalenone and fumonisin B_1 were found in 84 and 100% of pet food samples, with the highest levels being 299.5 and 1410 µg/ kg of feed respectively (Leung *et. al.* 2006).

Generally, trichothecenes cause negative effects on the immune system and lead to digestive disorders (vomiting, diarrhea or feed refusal) or hemorrhages (EFSA 2004). In one study, food consumption was significantly reduced at levels of 4.5 µg/kg deoxynivalenol in dog food and 7.5 µg/kg deoxynivalenol in cat food (Hughes *et al.* 1999) and vomiting of the animals was noted. Trichothecenes, as in other animals, induce feed refusal, loss of appetite, reduced performance, weight loss and an unthrifty appearance (CAST Report 2003).

Zearalenone, an estrogenic *Fusarium* mycotoxin, has been reported to cause problems in the reproduction system of all animal species (EFSA 2004). A 7-day dietary exposure of 200 µg zearalenone/kg of BW/day in female dogs showed cell damage in ovaries, edema and hyperplasia and there was a general pathological change in the canine reproductive system (Boermans and Leung, 2007).

Other important *Fusarium* mycotoxins, the fumonisins, are found mainly in corn and the most abundant group is fumonisin B_1, representing up to 70% of food-borne fumonisins. Fumonisins inhibit sphingolipid synthesis and metabolism and damage various organs in animals (Voss *et al.* 2007). In horses, fumonisins can cause Equine leukoencephalomalacia (ELEM), also called “hole-in-the-head-disease” due to liquefaction of neural tissue in the brain. ELEM is also characterized by feed refusal, lameness, blindness and depression. Death may occur 4 to 12 hours after the first symptom are observed (Marasaas *et al.* 1988).

Mycotoxin Risk Management

Mycotoxins are possible contaminants of pet food, and therefore they possess a potential health threat to companion animals. Pre- and postharvest controls like GAP (“Good Agricultural Practice”) or proper storage can reduce the risk of mycotoxin contamination but not totally avoid it. Therefore, to protect companion animals from the hazardous effects of mycotoxins, feed additives are indispensable. These feed additives protect animal health by deactivation of the mycotoxins in contaminated feed. These products deactivate the toxins directly in the gastrointestinal tract of animals, based either on adsorption of those mycotoxins with suitably located polar functional groups, or biological degradation. As adsorption is only successful for some mycotoxins, the

Mycofix® product line from BIOMIN represents specially developed feed additives that protect animals from mycotoxicoses by adsorption, biotransformation and bioprotection and represents an optimal solution for Mycotoxin Risk Management for companion animals!

References

All about feed (2009) Aflatoxins kills hundreds of Taiwanese dogs http://www.allaboutfeed.net, accessed: 06/01/2009

Boermans,H.J. and Leung, M.C. (2006) Mycotoxin in the pet food industry: toxicological evidence and risk assessment. International Journal of Microbiology 119(1-2), 95-102.

Böhm J, Koinig L. and Razzazi-Fazeli E. (2008) Mycotoxins in dry dog food, 8th International Conference “Mycotoxins and moulds”, Bydgoszcz, pp 44

Campos, S.G., Keller, L.M., Cavaglieri, L.R., Krueger, C., Fernández Juri, M.G., Dalcero, A.M., Magnoli, C.E. and Rosa, C.A.R. (2009) Aflatoxigenic fungi and aflatoxins B1 in commercial pet food in Brazil. World Mycotoxin Journal, 2(1) 85-90

CAST Report (2003). Mycotoxins: risks in plant, animal, and human systems (Richard, J. L and Payne, G. A. eds.) Council for Agricultural Science and Technology Task Force report No. 139, Ames, Iowa, USA.

EFSA (2004) Opinion of the Scientific Panel on Contaminants in the Food Chain on a request from the Commission related to Deoxynivalenol (DON) as undesirable substance in animal feed. EFSA Journal 1-41.

EFSA (2004) Opinion of the Scientific Panel on Contaminants in the Food Chain on a request from the Commission related to Zearalenone as undesirable substance in animal feed. EFSA Journal 1-35.

Feedinfo News Service (2009) Aflatoxin in Pet Food Kill Dozens of Dogs in China, Brand Was Not Authorized for Import http://www.feedinfo.com, accessed: 13/01/2009

Hughes, D.M., Gahl, M.J., Graham, C.H., Grieb, S.L., (1999) Overt signs of toxicity to dogs and cats of dietary deoxynivalenol. Journal of Animal Science 77, 693–700.

Hussein, H. S. and Brasel, J. M. (2001) Toxicity, metabolism, and impact of mycotoxins on humans and animals. Toxicology 167, 101-134.

Leung, M.C.K., Díaz-Llano,G. and Smith, T.K. (2006) Mycotoxins in Pet Food: A Review on Worldwide Prevalence and Preventive Strategies. Journal of Agriculture and Food Chemistry 54, 9623-9635.

Marasas, W. F., Kellerman, T. S., Gelderblom, W. C., Coetzer, J. A., Thiel, P. G. and van der Lugt, J. J. (1988). Leukoencephalomalacia in a horse induced by fumonisin B1 isolated from Fusarium moniliforme. Onderstepoort Journal of Veterinary Research 55, 197-203.

Rodrigues, I. (2009) Mycotoxin survey shows size of the problem. Feed Mix 17(2), 22-25.

Puehringer, S.; Razzazi, E.; Kebber, A.; Iben, C. (2007) Untersuchungen zum Vorkommen von Ochratoxin A in Alleinfutermitteln für Katzen sowie in Nieren sezierte Katzen. Wiener Tierärztliche Monatszeitschrift 94, 192-196.

Vesonder, R., Haliburton, J., Stubblefield, R., Gilmore, W. and Peterson, S. (1991). Aspergillus flavus and aflatoxins B1, B2, and M1 in corn associated with equine death. Archives of Environmental Contamination and Toxicology 20, 151-153.

Voss, K. A., Smith, G. W. and Haschek, W. M. (2007). Fumonisins: Toxicokinetics, mechanism of action and toxicity. Animal Feed Science and Technology 137, 299-325.