Mycotoxicosis in Animals and Fish

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Abstract: Mycotoxins are secondary metabolites produced by fungi of various generations when they grow on agricultural products before or after harvest or during transportation or storage. They may be found also on building material or stored water. The present literature review of the symptoms, the severity, the factors influence mycotoxin production, the harmful effects on human and animals and detection of mycotoxin. The present study was concluded that many mycotoxins, with different chemical structures and biological activities, have been identified. They may be carcinogenic, oestrogenic, neurotoxin, nephrotoxic, dermonecrotic or immunosuppressive in animal and fish. Methods for controlling mycotoxins are largely preventive.
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Introduction:

Fungi are widely distributed in nature. They exist whether saprophytic or as normal commensally flora for most animal species and human, attacking the host when the immune status becomes low (opportunistic). Fungi possess three forms: yeast form, mould form and diphasic form. Mycotic infections that are induced by mycotoxins-producing fungi are commonly accompanied by mycotoxicosis on top of mycosis, even though the fungal element has been eliminated. Mycotoxins are secondary metabolites products before or after harvest or during transporatation or storage. They may be found also on building material or stored water.

The number of people affected by mycoses and mycotoxicosis is unknown Beside, mycotoxins are not only hard to define, they are also challenging to classify due to their diverse chemical structures and biosynthetic origins, their myriad biological effects, and their production by a wide number of different fungal species.

In general, mycotoxin exposure is more likely to occur in parts of the world where poor methods of food handling and storage are common, where malnutrition is a problem, and where few regulations exist to protect exposed populations, and inner city populations, and inner city populations are more likely to live in building that harbor high levels of molds.

Background

Mycotoxicosis is examples of "poisoning by natural means" and thus is analogous to the pathologies caused by exposure to pesticides or heavy metal residues. The symptoms of a mycotoxicosis depend on the type of mycotoxins; the amount and duration of the exposure; the age, health, and sex of the exposed individual; and many poorly understood synergistic effects involving genetics, dietary status, and interactions with other toxic insults. Thus, the severity of mycotoxins poisoning can be compounded by factors such as vitamin deficiency, caloric deprivation, alcohol abuse, and infectious disease status. In turn, mycotoxicosis can heighten vulnerability to microbial diseases, worsen the effects of malnutrition, and interact synergistically with other toxins (Bennett and Klich, 2003).

Awareness of mycotoxins has grown mainly in the last fifty years since the discovery of aflatoxins in the 1960, although they have accompanied mankind from the very beginnings and are probably associated with several mysterious disease known from history (Richard, 2007). Moreover, there is also a growing awareness of the mycotoxins present in the living and working environment and associated disease (Tarin et al., 2004; Shoemaker and House, 2005; Gutarowska & Piotrowska, 2007 and Wang et al., 2008).

Mycotoxins production is favored by both intrinsic and extrinsic factors influence fungal growth and mycotoxins production on a given substrate. The intrinsic factors include water activity and pH whereas extrinsic factors which influence mycotoxins production are relative e humidity, temperature and availability of oxgen, they can grow on feeds containing more than 12-15% moisture. The conditions suitable for mould growth and for mycotoxins formation are not necessarily the same. For example, the Fusarium moulds associated with Alimentary Toxic Aleukia have been reported to grow at 25-30°C without producing much mycotoxins, but at near freezing temperatures, they produce large quantities of mycotoxins with minimal mould growth. (CAST, 2003).

Table (1): Major mycotoxins groups or individual compounds, the fungal species producing them and health effects they cause. Symbols for mycotoxins are written in curly brackets (Kralj and Prosen, 2009).

Mycotoxins (s)	Fungal species	Major health effects
Aflatoxins {AFs}: B1, B2, G1, G2	*Aspergillus* ssp.	hepatotoxic, immunosuppressive, carcinogenic, teratogenic, mutagenic
Sterigmatocysin {STC}	*Aspergillus* ssp.	Precursor to aflatoxins
Fumonisins {FUMs}: B1, B2, B3	*Fusarium* ssp.	Liver and kidney tumors, oesophagal cancer, lung oedema (swine), leukoencephalomalacia (horses).
Trichothecenes-type A: T-2 and HT-2 toxin, neosolaniol {NEOS}, diacetoxyscirpenol {DAS}	*Fusarium* ssp.	Weight loss, diarrhea, dermal necrosis (poultry) Haemorrhagic syndrome
Trichothecenes-type B deoxynivalenol or vomitoxin {DON}, nivalenol {NIV}	*Fusarium* ssp	Food refused and vomiting, kidney problems, immunosupression (swine) impairment of haempiotic system
Resorcyclic acid lactones {RALs}: zearalenone {ZON}, zearalanone {ZAN}-α- and β-zearalenol {ZOL}	*Fusarium* ssp.	Oestrogenic effects, reproductive toxicity (major cause of cystic ovaries)
Ochratoxins {OTS} : A, B, α	*Aspergillus* and *Penicllium* ssp.	Kidney and liver toxin, carcinogen; chronic toxicity as accumulates in body.
Ergot alkaloids: ergovaline, clavinet alkaloids, lysergic acid derivatives and others	*Claviceps, Neotyphodium, Epichloe* ssp.	Ergotism: gangrene, central nervous system symptoms (convulsions), gastrointestinal symptoms (vomiting)
Enniatins: A, A1, B, B1, beauvericin	*Fusarium, Beauveria, Halosarpheia, Paecilomyces, Polyporus, Verticillium ssp.*	Acutely toxic, cardiac symptoms, herbicidal, insecticidal, antibiotic
Alternaria toxins: altertoxins {ATXs}, alternariol {AOH}, alternuene {ALT}, radicinin and others	*Alternaria* ssp.	acute toxicity (NUA)
Patulin {PAT}	*Penicillium* and *Aspergillus* ssp.	acutely toxic (NUA), genotoxic, carcinogenic, teratogenic, antibiotic
Moniliformin	*Fusarium* ssp.	acutely toxic, cardiac impairment
Citrinin {CIT}	*Penicillium, Aspergillus, Monascum* ssp.	hepatonephrotoxic, antifungal, antibiotic
Cyclopiazonic acid {CPA}	*Aspergillus and Penicillium* ssp.	weight loss, nausea, diarrhea, giddiness, muscle necrosis, convulsions
Roquefortin {RQ} Mycophenolic acid {MPA}	*Penicillium roqueforti*	RQ: acutely toxic (NUA), neurotoxic MPA: immunosupression, mutagenic, antibiotic.

Conditions that favor production of one type of mycotoxins may not be favorable for production of another type. For example, aflatoxin production by Aspergillus is dependent on concentrations of O_2, CO_2, zinc and copper, as well as physical location, while production of ochratoxin relates to air exhaustion (Homdork et al., 2000).

Frequently, toxigenic moulds have been isolated from building materials and air samples in building and barn where residents have suffered from non-specific symptoms possibly related to mycotoxins production, such as cough, irritation of eyes, skin and respiratory tract; joint ach; joint ach; headache; diarrhea and fatigue. It is only recently that the presence of some mycotoxins has been confirmed in crude building materials. Most mycotoxins have yet to be extracted from either air samples, dust present over carpets, cartons, sheets or bulk material derived from indoor environments. Also, very few studies have been conducted to show correlation between mycotoxin exposure and building-related illnesses (Jarvis, 2002; Nielsen, 2002 and Kuhn and Ghannoum, 2003).

Types of Mycotoxins:

Many mycotoxins, with different chemical structural and biological activities, have been identified.

1- Carinogenic: e.g: aflatoxin BI, ochratoxin A, fumonisin BI.
2- Oestrogenic: e.g: Zearalenone.
3- Neurotoxic: e.g: fumonisin BI.
4- Nephrotoxic: e.g: ochratoxins, citrinin, oosporeine.
5- Dermonecrotic: e.g: trichothecenes.
6- Immunosuppressive: e.g: aflatoxin BI, ochratoxin A and T-2 toxin.

Harmful effects of mycotoxins on human, animals andfish

Since mycotoxins are characterized by their cumulative effect in the body, they do not be broken down by cooking heat (the required temperature for their breakdown is higher than 430°C, they are poorly or not excreted and on the other hand, they are poorly immunogenic, mycotoxins exert their effects through several means:

1- Reduce intake or feed refusal.
2- Reduce nutrients absorption and impaired metabolism.
3- Alter endocrine and exocrine systems.
4- Suppress immune function.
5- Alter microbial growth.
6- Zeralenone can cause estrogenic effects and infertility in animals.
7- Impair bone marrow synthesis and haempiotic system.
8- DNA alteration as they impair the function of gyrases and structural proteins in the chromosomes.

Control:

Methods for controlling mycotoxins are largely preventive. The control measures to ensure mycotoxins-free food, feed and environment imply chemical analysis of the contaminants in a great variety of samples, further complicated by the structural diversity of mycotoxins which call for different analytical methods.

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