

Impact of aflatoxicosis on fish aquaculture and poultry

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Abstract: World populations increased dramatically annually and consequently increase the demand for foods of animal origin, particularly from fish and poultry where the meat of fish are characterized by high protein content with high level of calcium and phosphorus beside its availability in the markets at any time with suitable prices in addition to the relatively short production cycle. Also poultry meat production has been considered as a rapid important source of protein, where it has a short life cycle and high capacity of feed conversion-Aquaculture is the fastest growing food producing sector in the world, with regard to the rapid development, expanding and intensity in this industry, it required increase in the essential requirements from feeds, medication and control of diseases. With growing demand for aquaculture comes increasing concern about the dependable supply of raw materials necessary to support this growth. Aqua feeds usually depend on fishmeal as a protein source, but recently the trend has moved towards using of nutrients replacements to obtain a plant protein with reasonable prices. The preparation of fish meals with non-hygienic measures either during storage or exposure to unfavourable environmental conditions which leads to spoilage or deterioration of protein and growth of fungi. As a result of this trend, aquaculture feeds have a higher risk of contamination by one or more types of aflatoxins. Aflatoxins are distributed worldwide. *Aspergillus* species are able to grow in a wide variety of substrates and under different environmental conditions. Aflatoxins are principally produced by *Aspergillus flavus* and *Aspergillus parasiticus*, but may also be produced by other strains, such as *Aspergillus nomius*, *Aspergillus tamari*, and *Aspergillus pseudotamarii*.

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Introduction

Aflatoxins are a toxic compounds formed by *Aspergillus flavus* and *A. parasiticus*. The fungi can grow in incorrectly stored feeds and feeds with inferior quality of ingredients or stored under unfavourable environmental conditions (high relative humidity and elevated temperature). Aflatoxins is considered a severe source of pollution in foods and feed in most regions of the world (Murjani, 2003). Aflatoxicosis is a serious disease that can affect many species of fish and shellfish after feeding on foods contaminated with aflatoxins (Bautista *et al.*, 1994; Hernandez *et al.*, 2005). The first reported cases of aflatoxicosis in fish occurred in the 1960s in trout hatcheries, in which domesticated rainbow trout (*Oncorhynchus mykiss*) were fed a pelleted feed supplemented with cottonseed meal polluted with aflatoxins, which leads to formation of tumors in the liver tissues (Ashley, 1970) and in another accident under the same condition about 85% of stock of fish had died in a hatchery (Taniwaki, 2001). Aflatoxicosis in Avian species is a disease of poultry caused by ingestion or inhalation of aflatoxins. Young age poultry are most infect with aflatoxins than adults.

Ducks are more sensitive than chickens, and turkeys have intermediate sensitivity (Vegad, 2008).

In tropical and subtropical conditions, the spoilage of feeds is increased due to storage elevation in the relative humidity and higher temperatures. International trade has been stated affected due to affection of products particularly of plant protein with aflatoxines, which attract the attention of the company's worldwide to the important of aflatoxins pollution as the economic effects are massive (Golan and Paster, 2008). There are four major types of aflatoxins (AFB1, AFB2, AFG1 and AFG2) were reported as direct pollutants of grains and prepared feeds containing fish pellets.

Some kinds of molds such as *Aspergillus flavus* and *A. parasiticus* are capable of producing aflatoxins as serious toxic substances. Under unhygienic or unsuitable conditions of storage, molds can grow and multiply on the grains or on the foods containing low quality ingredients in their formulation and secreting a toxic substance causing a hazard effects on human and animals (Fish, poultry and farm animals).

Globally, Aflatoxins is considered one of the most toxicant found in the grains or foods exposed to pollution with some kinds of fungi such as *Aspergillus*

flavus and *A. parasiticus*. These toxins are responsible for causing high mortalities in different animal species and in some instances in human being consumed meat or meals contaminated by aflatoxins (Murjani, 2003). Aflatoxin B1 was found within different studies to be the most severe kind of aflatoxins that leads to high risk to both animals and human health.

Several investigators follow up the pathological lesions which can be occurred due to aflatoxicosis, they reported that aflatoxin B1 can induce a tumors in the liver and considered as a carcinogenic agent in fishes in different species such as rainbow trout, salmonid, tilapia, guppy, channel catfish, and Indian major carps (Jantrarotai and Lovell, 1990; Lovell, 1992; Tacon, 1992; Wu, 1998; Chavez *et al.*, 1994; Murjani, 2003) and *Penaeus monodon* (Bautista *et al.*, 1994). Moreover, the studies concerning the effect of aflatoxins on Nile tilapia (*Oreochromis niloticus*) is still limited (Chavez *et al.*, 1994; Diab *et al.*, 1998; Tuan, 2001).

The studies established that aflatoxins were isolated for the first time in turkeys and of tumor in rainbow trout fed on rations formulated from peanut and cottonseed meals. The aflatoxins are formed as secondary metabolites by *Aspergillus flavus* and *A. parasiticus* fungi under a temperature ranged between 24 and 35 °C, and a more than 7% relative humidity (moisture) or reach 10%RH with ventilation (Rucker *et al.*, 2002; Williams *et al.*, 2004). There are many factors influencing the rate of aflatoxin production rather than temperature and humidity including: water activity, substrate composition, atmosphere (CO₂ and O₂ level), pH, microbial competition, mechanical damage to the seeds, mold lineage, insect infestation, instability of toxigenic properties, plant stress, fungal strain specificity and variation, and use of fungicides or fertilizers. In addition, the production of aflatoxins from the fungus is a cumulative not collected at for one time but require several times depending on the onset of collection, drying and storage is significant in the amount of obtained aflatoxins (Hussein and Brasel 2001; Prandini *et al.*, 2009; Oliveira *et al.*, 2013).

Importance of Aflatoxins in Aquaculture

Toxicity with aflatoxins in aquaculture are consider of high risk disorders and are responsible for 60% of the total deaths in fish farms (Tuan, 2001). Sub-lethal doses of aflatoxins particularly AFBI in contaminated feeds were found to be affecting adversely on the weight body gain and decreased the counts of RBCs in Nile tilapia fish fed aflatoxin contaminated feeds (Chavez *et al.*, 1994). The severity of aflatoxicosis depends on many factors like the age and species of the fish, for instant fry are more susceptible to Aflatoxin toxicity than adults and some species of fish are sensitive to Aflatoxins than others (Jantrarotai and Lovell, 1990).

The mode of action of aflatoxins may be due to the direct action on body systems or indirectly through their actions on the important constituents in the feeds. Aflatoxins have been to influence the some essential components in the feed through destruction of these compounds, for instances vitamin C and thiamine which are necessary for immune system and nervous system metabolism, respectively were found to be destroyed by aflatoxins. Therefore, the fish are severely susceptible to viral, bacterial or parasitic infections due to suppression in the immune system after feeding on feed polluted with aflatoxins (Herrera, 1996). In some cases the known symptoms of aflatoxicosis as reduction in body gain not observed but instead some symptoms may be recorded such as diminish in body gain, reduction conversion rates,, reduced weights of the fished product, wastage of fish feed and increased medical cost (Ferguson, 1989; Tacon, 1992; Wu, 1998; Royes and Yanong, 2002).

Moreover, adverse effects and symptoms of aflatoxicosis in fish usually appear in different forms as, liver cancers (Ashley, 1970); reduction in growth rate and depression in appetite (Royes and Yanong, 2002) and formation of pathological lesions and abnormalities particularly in liver tissues (Wu, 1998).

Implications of Aflatoxins in Fish Feeds

The concentration of aflatoxins in the diet particularly AFTB1 is critical for determination of the severity of symptoms, 20-200ppb it was found to reduce the appetite, decrease in the feed-intake and reduced, these symptoms can be controversial by supplementation with essential dietary ingredients like lysine or methionine. With increasing in the concentration of aflatoxins in the diet (1,000-5,000ppb) it was associated with exaggeration of the symptoms and leads to acute toxicity and death.

Aflatoxins in poultry

Food and feed contamination by aflatoxins is found in tropic area, they contaminate crops before harvest or invade foodstuffs during processing, transport or storage and recognized as major contaminant of many grains used for poultry diet The most obvious effect of mycotoxin on poultry is mortality which is produced when high levels of aflatoxins are present in feeds (Jand, et al., 2005) Aflatoxins have economical significant effect on growing of birds as causing decrease growth and poor feed conversion (>1ppm). Consumption of even low levels of mycotoxin causing lowering feed consumption, poor growth rate and increased susceptibility to infectious disease. Mortality causing by high levels. weight gain and productivity were affected. Drop in egg production and poor hatchability were recorded in layers (Jordan et al., 2002).

Moreover, with regard to the potency of aflatoxins particularly (AFB1), the studies reported

that AFTB1 is naturally found in the environment, having sever toxic effect and is one of the famous carcinogenic substance in some animal, fish, poultry and man. With respect to aflatoxicosis in human, disorders in human being are increased as a result to exposure to acute aflatoxicosis. The increased in the incidence of aflatoxicosis in humans is due to shortage in food sources, changes in the circumstances environment that favor fungal growth in crops and supplies, and lack of regulatory roles or instructions for aflatoxin checking and control. The expression of aflatoxin-related diseases in humans may be affected by many factors such as nutritional status, age, sex, and/or concurrent exposure to other causative agents such as viral hepatitis (HBV) or parasite infestation. In tropical and subtropical conditions, this potential is further increased due to storage under unfavorable situations such as elevated temperature and high moisture.

Aflatoxicosis affected adversely on the international trade due to the spreading of aflatoxins in the world specially in grains and food by products thus, it is a worldwide concerns and the economic effect due to high numbers of deaths among animals yearly. Moreover, Aflatoxicosis and subsequent epizootic liver carcinoma have been recorded in a wide range of fish due to the presence of *Aspergillus* species-contaminated foodstuffs in the feed. Aflatoxin B1(AFB1) is considered one of the greatest potent famous hepatotoxins and carcinogens. Therefore, it is an important potential toxicant to the most of the commonly cultured fish species.

Increased Danger of Aflatoxicosis

Aflatoxin production is a multifactorial including a combination of species, substrate and environment. These affecting factors which influence aflatoxin production can be classified into three main topics: environment, nutritional and biological factors. Environmental or physical factors comprise humidity, temperature, pH, light, aeration and level of atmospheric gases. The favorable temperature for growing of fungi and production of aflatoxins are ranged between 12 and 14°C and the optimal temperatures is 25 to 35°C (Asis *et al.*, 2002). Though, interest in the toxic effects on cultured warm-water fishes, like tilapia (*Oreochromis* spp.) and catfish (*Clarias gariepinus*), has increased because the formulated feed contain a high percentage of plant protein rather than of animal origin in order to decrease the cost of feedstuffs as well as the high temperature and humidity as in tropical weather conditions. This factors increase the possibility for increasing in the rate of aflatoxicosis among these species because, plant components have a higher potential than animal components for contamination with aflatoxins.

Human Exposure to Aflatoxin.

Two main populations of exposure exist in the world. In countries with commercial food systems as in developing countries in Europe and USA, the rate of exposure is generally low because the food system permit the degree of exposure to be adjusted to <10 ppb, and managed, and the other aspect of exposure is governed by the economic conditions in these countries which permit for the additional costs and capital requirements to obtain these levels to be absorbed, and production methods that minimize the risk to be adopted. In the some countries where these economic conditions do not exist there is little protection of people from the aflatoxins even where regulations do exist. However, the level of exposure is such that only occasionally does acute illness and death from aflatoxicosis occur, and the majority of exposure seems to be at the chronic level.

Prevention of Feed Contamination

One of the main basis for controlling and prevention of aflatoxicosis through controlling of the factors enhancing growth of molds or fungi in feed and foodstuffs to prevent which is essential for both the feed manufacturer and livestock producer. Control of mold growth in feeds can be achieved through keeping moisture low, keeping feed fresh, keeping equipment clean, and using mold inhibitors (Pier *et al.*, 1985). Grains and other dry feed such as hay should be stored at a moisture level 14 percent or less to prevent mold growth.

Aeration of grain bins is important to reduce moisture migration and to keep the feedstuffs dry (Pier *et al.*, 1985).

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