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AFLATOXINS- AN OVERVIEW

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ABSTRACT

The aflatoxin producing fungi, Aspergillus spp., are widespread in nature and have severely contaminated food supplies of humans and animals, resulting in health hazards and even death. Hence, to ensure the safety of human health, there is great demand for aflatoxins research to develop suitable methods for their quantification, precise detection and control. This review throws light on the resources, production, detection and control measures of aflatoxins to ensure food and feed safety. The review is informative for health-conscious consumers as well as research experts in the fields. Furthermore, providing knowledge on aflatoxins toxicity will help in ensuring food safety and meet the future demands of the increasing population by decreasing the incidence of outbreaks due to aflatoxins.

KEYWORDS: Aflatoxins, mycotoxins, hepato toxicity, Aspergillus, food grains.

INTRODUCTION

India is predominantly an agricultural country with nearly three fourths of the population dependent on agriculture and hence affecting rural economy. The most outstanding achievement of Indian agriculture since independence is the phenomenal growth of foodgrains output. Nearly seventy percent of the total production of foodgrains in India is retained at farm level where the unscientific and faulty storage conditions enhance the chances of fungal attack and thereby mycotoxin production. The common mycotoxin contaminating Indian foodgrains is Aflatoxin.

Source of Aflatoxin: Aflatoxins are a family of toxins produced by certain fungi that are found on agricultural crops such as maize (corn), peanuts, cottonseed, and tree nuts. Aflatoxins are a group of mycotoxins produced by the fungus Aspergillus and are potent hepatotoxins and carcinogens in the liver.[1]

Chemistry: Structurally all aflatoxins contain a coumarin ring and an unsaturated lactone moiety. The most well characterized aflatoxin is aflatoxin B_1 and its metabolite aflatoxin M_1 which was first identified in milk. Chemically, aflatoxins (AFTs) are difuranocoumarin derivatives in which a bifuran group is attached at one side of the coumarin nucleus, while a pentanone ring is attached to the other side in the case of the AFTs and AFTs-B series, or a six-membered lactone ring is attached in the AFTs-G series.[2]

Occurence: These fungi (moulds) that are found naturally all over the world. Aflatoxin-producing fungi can contaminate crops in the field, at harvest, and during storage. People can be exposed to aflatoxins by eating contaminated plant products (such as peanuts) or by consuming meat or dairy products from animals that ate contaminated feed. Farmers and other agricultural workers may be exposed by inhaling dust generated during the handling and processing of contaminated crops and feeds.Exposure to aflatoxins is associated with an increased risk of liver cancer. Aflatoxins can be found in foodstuffs contaminated with aflatoxin-producing Aspergillus or in dairy milk from animals fed contaminated feed. Aflatoxin G_1 is also highly toxic and carcinogenic in certain animal models. Aflatoxin B_2, G_2, and M_2 are potent hepatotoxicants but have not been demonstrated to be carcinogenic. AFTs were first discovered in 1960 in England after the outbreak of Turkey disease that resulted in death of over 100,000 turkeys and of cancer development in rainbow trout fed on rations formulated from peanut and cotton seed meals.[3]

These molds (*Aspergillus flavus* and *Aspergillus parasiticus*) grow in soil, decaying vegetation, hay, and grains. They are regularly found in improperly stored staple commodities such as cassava, chili peppers, cottonseed, millet, peanuts, rice, sesame seeds, sorghum, sunflower seeds, sweetcorn, tree nuts, wheat, and a variety of spices. When contaminated food is processed, aflatoxins enter the general food supply where they have been found in both pet and human foods, as well as in feedstocks for agricultural animals. Animals fed on contaminated food can pass aflatoxin transformation products into eggs, milk products, and meat. For example, contaminated poultry feed is suspected in the findings of high percentages of samples

of aflatoxin-contaminated chicken meat and eggs in the Indian subcontinent.

Detection: The detection and quantification of aflatoxin in food and feed is a very important aspect for the safety concerns. Aflatoxins are usually detected and identified according to their absorption and emission spectra, with peak absorbance occurring at 360 nm. B toxins exhibit blue fluorescence at 425 nm, while G toxins show green fluorescence at 540 nm under UV irradiation. This florescence phenomenon is widely accepted for aflatoxins. Thin layer chromatography (TLC) is among one of the oldest techniques used for aflatoxin detection while high performance liquid chromatography (HPLC), liquid chromatography mass spectroscopy (LCMS), and enzyme linked immune-sorbent assay (ELISA) are the methods most frequently used for its detection.[2]

Health effects of aflatoxin: Human exposure high enough to cause acute toxicity, also known as aflatoxicosis, is rare in developed countries but more prevalent in African and Asian countries. Symptoms of aflatoxicosis include hemorrhagic necrosis of the liver, edema, and lethargy.Children are particularly affected by aflatoxin exposure, which is associated with stunted growth, delayed development, liver damage, and liver cancer. In the short term, aflatoxin poisoning may cause nausea, vomiting, and abdominal pain and convulsions. Long-term or chronic exposure to aflatoxins has several health consequences including causing liver cancer, and have been linked to other types of cancer. AFB_1 is known to be carcinogenic in humans; the potency of aflatoxin to cause liver cancer is significantly enhanced in the presence of infection with hepatitis B virus (HBV). Aflatoxins are mutagenic in bacteria (affect the DNA), genotoxic, and have the potential to cause birth defects in children. Children may become stunted. In addition, aflatoxins cause immunosuppression, therefore may decrease resistance to infectious agents (e.g. HIV, tuberculosis);

Economic effects of aflatoxin: Aflatoxins also pose a significant economic burden, causing an estimated 25% or more of the world's food crops to be destroyed annually. According to Indian Council of Medical Research (ICMR)-Lucknow, 21 per cent of groundnut in India is unfit for human consumption due to aflatoxin. Another study conducted by Icrisat reveals that the level of aflatoxin in Indian groundnut is 40 times more than permissible limits.[3]

Control measures: Control measures are required both pre as well as postharvest. The most long-term, stable solution to controlling pre-harvest aflatoxin contamination is through enhancing the ability of the crop to resist fungal infection and/or prevent production of aflatoxins by the invading fungus.Oxidizing agents readily destroy aflatoxin, and treatment with hydrogen peroxide may be useful. It is believed that eating vegetables like carrots and celery reduces the carcinogenic effects of aflatoxins. Aflatoxin contamination of grain, seeds, spices, and edible nuts is most prevalent in warm, humid regions of the world where conditions are favorable for the growth of mold. Storage of these food commodities under inappropriate conditions also facilitates mold growth and production of aflatoxin. For this reason, the monitoring of aflatoxin levels and strict regulation of grain storage is mandated in the United States and certain European countries.

CONCLUSION

Aflatoxin contamination of food and feed have gained global significance due to its deleterious effect on human and animal health and its importance in the international trade. In spite of extensive research which has provided tremendous insights on various aspects of Aflatoxin, it continues to pose a serious challenge. Much remains to be elucidated and more research is necessary towards the understanding of molecular mechanisms, which would improve global health and to develop protection strategies and novel technologies to combat Aflatoxin contamination.

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CONFLICT OF INTEREST

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

ABBREVIATIONS

AFT- Aflatoxins, UV-Ultraviolet, TLC- Thin layer chromatography, HPLC- High performance liquid chromatography, ELISA- enzyme linked immune-sorbent assay, ICMR- Indian Council of Medical Research.

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