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AFLATOXINS AND SAFETY OF FOOD, ANIMAL AND HUMAN HEALTH-AN ISSUE OF GLOBAL CONCERN

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ABSTRACT:

Ensuring the safety of food as well as consumer health has been one of the major concern all over the world. Various factors produce obstacles in achieving the target. Mycotoxins- secondary metabolites produced by certain fungi are one of these, which upon entering the food chain cause adverse effects in animals and human beings. Aflatoxins are one of the major group of mycotoxins produced by Aspergillus species, resulting into symptoms commonly known as Aflatoxicosis. These pose a serious threat to the human as well as animal health by causing a variety of health hazards. There are number of reports of aflatoxins outbreaks from all over the world including India. More than 20 different types of aflatoxins are produced in nature, out which Aflatoxin B_1 produced by Aspergillus flavus and A. parasiticus is considered as most toxic one. Fungal contamination may occur at pre as well as post harvest stage. Aflatoxins are produced in variety of commodities, especially stored ones. There is an imperative need to find some suitable method for quantification, detection and control to ensure the safety of food as well as health of the consumers. The major focus of the present review is on the health hazards of Aflatoxins and its control measures along with a brief account of their chemistry and biosynthesis. A consolidated account of Aflatoxin occurence, detection and health hazards will be of immense help to develop the methodology for the food safety against the aflatoxin contamination. It may also be helpful to chalk out various strategies to prevent outbreaks of aflatoxin contamination.

Key Words: *Aflatoxins, Aflatoxicosis,Food safety, Fungal Contamination, Health Hazards, Mycotoxins.*

1. INTRODUCTION:

Currently, one of the major problem faced by the world is of insufficient availability of safe food to the people. It is not only the availability rather it is the safety of food and consumer health that is ofmajor concern. Various physical, chemical and biological as well as microbial factors are responsible for the contamination of food articles there by rendering them unfit for consumption.. Food and Agriculture Organization (FAO) and World Health Organization (WHO) have recognized number of toxins present in various agriculture commodities [1].

Mycotoxins are one of the major causes responsible for contamination of various food articles resulting into various health implications[2,3]. The major problem with mycotoxins is that they are not destroyed by cooking even. Many studies have been conducted to investigate the various aspects of food safety related to mycotoxin contamination. Aflatoxin contamination of food as well as cattle feed pose a serious threat to health of human beings and other animals[FIG. 1]. Aflatoxin contamination of maize, ground nuts and other stored grains lead to aflatoxicosis in human beings and other animals [4-6]. There are number of reports of Aflatoxin out breaks all over the world. A major aflatoxin out break was reported from Kenya in 1981[7]. Since then number of out breaks, especially from the rural areas of East Province of Kenya have been reported. The major cause behind these was reported to be home grown mold contaminated maize. Preliminary investigations revealed the presence of aflatoxins. In 2013, aflatoxin contamination of milk was reported in various countries of Europe. An out break of Hepatitis due to Aflatoxins was reported from Gujarat and Rajasthan, India [8].The out break lasted for about two months and resulted into 100+deaths. Later on studies indicated that aflatoxins were the major cause behind it. [9]. Similar kind of aflatoxin outbreak affecting humans as well as dogs was reported in the north west part of India. [10,11].

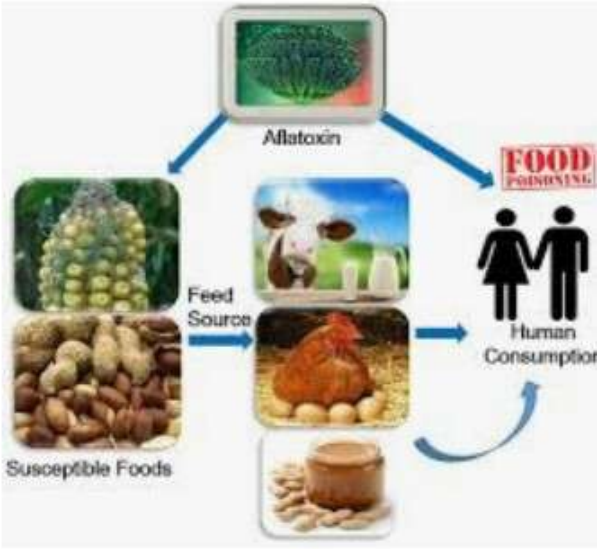

Fig 1

Since 1985, the United States Food and Drug Administration has restricted the limit for mycotoxin concentration in food articles. A research laboratory has been established by The USDA Grain and Plant Inspection Service (GPIS) for the inspection of mycotoxins in grains. Aflatoxins were on Rapid Alert System for Food and Feed (RASFF) of European union in 2008 because of their hazardous effects [12]. AFB 1 has been categorized as group 1 carcinogen by the International Agency for Research on Cancer [13]. Recently,

various advances have been made in food processing for reducing the chances of mycotoxin contamination and ensuring food safety [14,15].

2. AFLATOXINS , ITS TYPES AND THEIR SOURCE:

Aflatoxins are mycotoxins produced by fungus belonging to genus *Aspergillus* [Fig.2] These are reported to be chiefly produced by *A. flavus*, *A. parasiticus and A. nomius* [16] as well as various *Emericella* species [17].

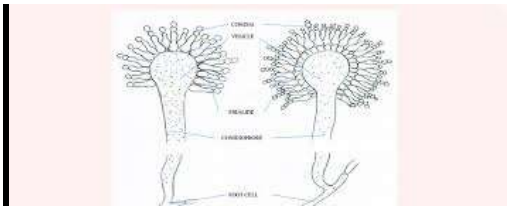

Fig2

Presently, more than 20 aflatoxins are known. Four main types of Aflatoxin B1&B2 (AFB1& AFB2) produced by *A. flavus* , Aflatoxin G1& G2 (AFG1& AFG2) along with AFB1&AFB2 [Fig.3] are produced by *A. parasiticus* [18].Their toxicity levels are in order of AFB1>AFG1> AFB2> AFB2. Aflatoxin MI&M2 (AFM1& AFM2) are hydroxylated metabolites of AFB1& AFB2 respectively [19,20].

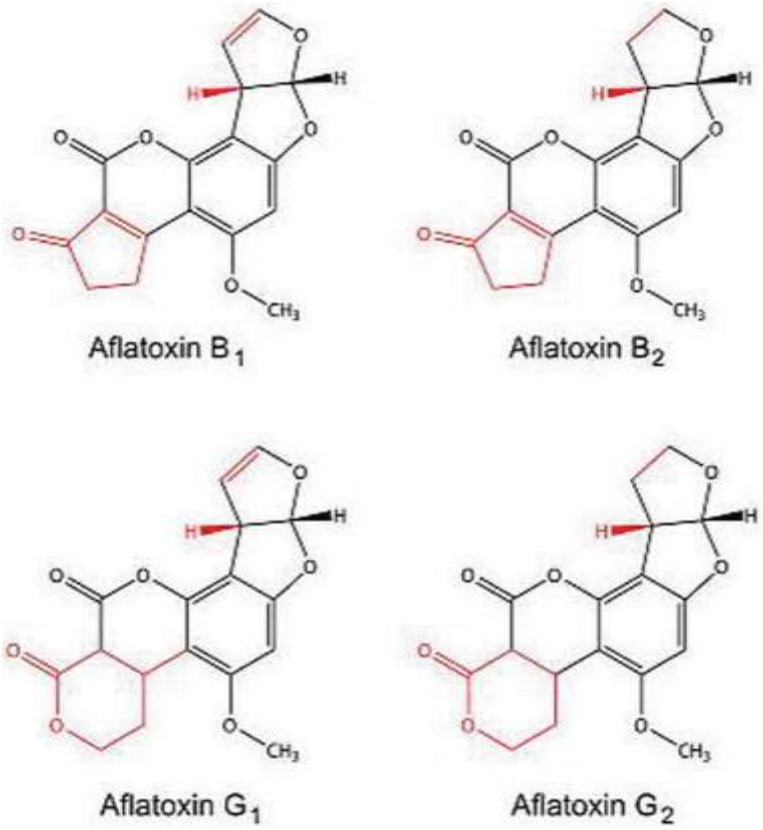

Fig 3

3. CHEMISTRY AND BIOSYNTHESIS Of AFLATOXINS:

Chemically, aflatoxins are difuranocoumarins derivatives in which bifuran group is attached at one side of coumarin nucleus, while a pentanone ring is attached to the other side in case of AFTs and AFTs B series, or 6-membered lactone ring is attached in AFTs G series. [21,22]. AFT B1 heat resistant and is of carcinogenic nature. Biosynthetic pathway of aflatoxins consists of eighteen enzymatic steps for conversion from acetyl CoA. Aflatoxins fluorescence strongly in ultraviolet light.

4. OCCURRENCE AND EFFECTS ON FOOD AND AGRICULTURE COMMODITIES:

Aflatoxins are found in various cereals, oilseeds, spices and nuts [23,24].*Aspergillus* species colonize in them and produce aflatoxins. Fungal contamination may occur at different stages i.e. in field, during harvesting , during post harvest stage, transportation or storage [25,26]. Commodities like corn, peanuts, coconut, brazil nut etc are more prone to aflatoxin contamination [27,28], while wheat, oats, millet, rice, barley, beans, pulses etc are usually resistant to aflatoxin contamination. Occurrence of aflatoxins in various agricultural commodities depend upon a variety of factors like geographical distribution, climatic conditions under which a particular crop is sown, harvested or stored.

5. MANAGEMENT OF AFLATOXIN CONTAMINATION:

Biological control is emerging as a promising approach for the management of aflatoxin contamination. *Bacillus subitilis, Lactobacillus, Pseudomonas, Ralstonia* species are effectively used against aflatoxin contamination [29]. Several strains of *Bacillus subitilis* and *Pseudomonas solanacearum* isolated from the non-rhizosphere of maize soil have been reported to eliminate aflatoxin [30,31]. *Trichoderma* species have been reported to reduce incidence of aflatoxin contamination in ground nut by 20-90% [32]. Biochemical markers and genes for resistance in maize could also be used. Various biotechnological approaches have been reviewed for the management of aflatoxin contamination [33].

6. CONCLUSION:

Mycotoxin contamination especially due to aflatoxins is of major concern all over the world. Due to lack of appropriate knowledge and consumption of contaminated food and feed , aflatoxin contamination result in number of disease outbreaks occur . Several physical, chemical, biological techniques have been employed for mitigation and management of aflatoxin contamination. However, developing fungal resistant varieties of the crops to combat pre harvest contamination is of major concern. Various post harvest treatments also need to made more popular among the farmers to reduce the chances of fungal contamination [34]. Some of the microflora of the soil can also be effectively used against aflatoxin contamination. Currently, application of genetic recombination in various species of *Aspergillus* is being investigated for its potential to mitigate

aflatoxins to ensure safety and quality of various edible and agricultural commodities. Keeping in view the issue of providing nutritious and safe food to human beings and other animals, there is an imperative need to prevent the aflatoxin contamination of food and feed .

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