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Aflatoxins in Food and Feed

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Abstract

Aflatoxins (AFs) are polyketide-derived; cancer causing toxic fungal metabolites (mycotoxins) produced by filamentous fungal species Aspergillus flavus, Aspergillus parasiticus, Aspergillus pseudocaelatus, Aspergillus pseudonomius and rarely Aspergillus nomius in/on foods and feeds, exclusively in field corn and peanuts. AFs frequently contaminate agricultural commodities and thus pose serious health hazards to plants, humans and domestic animals. AFs are "natural" contaminants of foods, their formation is unavoidable and it's very important to detoxify chemically or physically crops of foods that are contaminated by toxins in ways that retain their edibility. This review focuses on the most important detection methods of Aflatoxin (AF) fungi and quantification of their toxic products which are threated to humans, animals and crops.

Keywords: Aflatoxins, Metabolites, Biosynthesis, Food contamination, Detection

Introductions

Aspergillus flavus produces AFB1 and AFB2 whereas Aspergillus parasiticus produces AFB1, AFB2, AFG1, and AFG2. Its order of toxicity is B1 > G1 > B2 > G2. AFB1 is the most toxic in both acute and chronic Aflatoxicosis whereas AFM1, (i.e., a metabolite in milk) is as acutely hepatotoxic as AFB1 but not as carcinogenic. These investigators elucidated the various relative potencies of different AF and reported LD50 values of 0.36, 0.78, 1.70, and 3.44 mg/kg of duckling consuming AFB1, AFG1, AFB2 and AFG2. The Food and drug administration (FDA) has set limits of 20 ppb total AFs for interstate commerce of food and feed and 0.5 ppb of AFM1 for sale of milk. When AFB1 is ingested by cows, it is transformed into itshydroxylated product, AFs M1 and M2. Such AFs is secreted in the milk and is relatively stable in during milk pasteurization. Primarily a hepatoxin (liver toxin) effects range from acute death to chronic disease such as tumors [1].

Molecular genetics of aflatoxicn biosynthesis

The synthesis of AF occurs through a series of highly organized oxidation-reduction reactions, current research provides to understand the biochemistry, genetics and regulation of AF biosynthesis genes and their function. The rapid development of high throughput sequencing made it possible in genetic research to advance from single gene cloning to whole genome sequencing. As we know AFs are synthesized by polyketide metabolic pathway and tremendous advances have been made in understanding the genetics of AF producing and non-producing fungi. The biosynthesis of AFs has been extensively studied, at least 25 genes, only four (norA, norB, aflT and ordB) have yet to have the function of their protein product determined experimentally and 15 stable precursors are involved and the gene cluster (70 kb) reveals new insights of AF biosynthesis. Anthocynins and related flavonoids effects AF biosynthesis. AF production may be a vestigial trait that has survival due to the clustered gene organization; other hypothesis suggested that suggested such an organization of genes may allow coordinated regulation of the pathway. Globally acting transcription factors that respond to nutritional and environmental signals may regulate expression of some genes. The production of AFs is posh by key factors such as temperature. pH, carbon, stress and certain metal salts [2].

Pathogenicity

The occurrence of AFs in foods and feeds has been fully well studied in agricultural products such as, cerals (sorghum, barely, maize, rice and wheat), spices (turmeric, coriander, ginger, black pepper and chili), and fat containing crops including tree nuts (Brazil nuts, pistachios, almonds and walnuts) and peanuts, and oilseeds (soybean, sesame, cotton and sunflower). The name Aflatoxin originated from filamentous Aspergillus flavusMany researches have investigated the presence of AF-producing fungi in corn. Corn and its associated by-products are food and feed ingredients for human and animals and it can be infected by various fungi (Aspergillus flavus) at optimal temperature and humid conditions it can happen before and after harvesting the corn [3].

Detection of aflatoxigenic fungi and their toxic products

A number of highly sensitive techniques have been developed AF detection. AFs are fungal metabolites produced by micro fungi that often contaminate foodstuffs and feedstuffs and an identification of toxigenic fungi, requires proficiency in mycology [4]. AFs are polyketide-derived difuranocumarins, primarily detected at 30 h of growth in fungal culture grown in liquid aflatoxin-permissive medium. Toxin levels increase at maximum rates during a conversion from the exponential growth phase to stationary phase between 30 h and 48 h and transcripts and proteins reached high levels at 48 h of growth. These AF are fluoresce and distinguished by their fluorescing properties. Letters B and G refer to its blue and green fluorescence colors produced by these compounds under UV light and differ in their toxicity. Numbers 1 and 2 indicate major and minor compounds, respectively. Aspergillus differential medium (ADM), czapek and yeast extract sources support Aspergillus growth, with methyl-βcyclodextrin plus bile salts enhances the natural fluorescence of AFs, allows detection (365 nm UV lamp) of aflatoxigenic fungal colonies after three days incubation and it possible to distinguish AF-produces and nonproducers with phosphorescence. It is possible to detect to exposure of infected corn kernels that contain

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AFs to 365 nm UV light results in intense blue-green fluorescence of aflatoxincontaining kernels. PCR-based techniques now allows for the rapid and reliable identification of fungi in food stuffs [5].

Conclusions

Current knowledge has been made in AF detection methods and control strategies as well as understanding the biochemistry, genetics and regulation of AF synthesis. Different methods for detection and quantification of AFs have been listed in this paper. Due to high risk of AFs to humans and animals, the researchers all over the world are looking for methods to detect and quantifythem. Apparently, the measurement of AFs in the future inclines to be the combination of optical, immunochemical and fluorescence techniques. Awareness about AFs and their toxicity is essential to protect populations from their harmful effects and the development of sophisticated methods or kits for the detection of minute amounts of is most important step towards safer food and feeds in developing countries.

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Conflict of Interest

None

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