Mycotoxins and Mold:
Aflatoxin & Human Health

Victoria “Cinder” Camerano

The Evergreen State College

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Dr. Lalita Calabria

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Introduction

Mycotoxins and Mold: Aflatoxins in Our Food Systems

Aflatoxin is a mycotoxin found in cereal, medicinal, and animal products. Rice, peanuts, grain, maize, and cannabis are foods that can be contaminated with Aflatoxin. Humans and animals can be exposed to Aflatoxin by eating contaminated cereal and grain, as well as eating animal products that have ingested contaminated feed. Transmission via breast-feeding to a human or animal offspring can happen when the mother has eaten contaminated foods. Methods of decontamination and prevention have varying results including lack of nutritional value and long-term environmental contamination from anti-fungal applications.

Health effects from Aflatoxin can have acute responses such as vomiting and diarrhea and can culminate in the long-term health effect of liver cancer. The human body metabolizes Aflatoxin via the liver, and the immunosuppressant and carcinogenic effects are often misdiagnosed as allergies, or other underlying conditions. Contamination is difficult to monitor due to some crops being grown in climates with high humidity. Recalls of products such as cooking oil, peanut butter, and dog food are the result of complications with management strategies.

Several management methods exsist to prevent Aflatoxin contamination in the food chain. Fungicide applications are done pre-harvest and decontamination treatments are done while in storage. There are a handful of methods used to test for Aflatoxin, as well as agents of detoxification if exposure happens. In cases of infastructure collapse there are few options to systemically ensure food safety in Aflatoxin prone food stores (Wu et al., 2014). This review will outline Aflatoxin as a mycotoxin, how Aflatoxin effects human health, and management methods that are employed to mitigate Aflatoxin contamination.

Literature Review

Aflatoxin and our Health

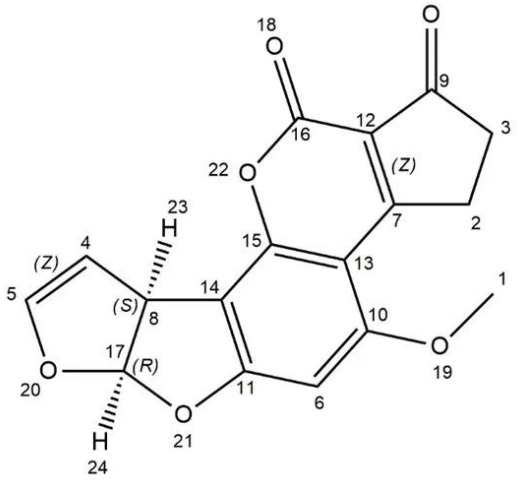
Aflatoxins are carcinogenic contaminants that grow in the soil and are commonly found in humid climates. A variety of cereal foods and animal products can be contaminated with Aflatoxin and result in serious health issues for both humans and animals. Management strategies have mixed results with treatment of Aflatoxin contamination having a negative effect on the nutritional value of the food store, as well as various fungicides contributing to negative long-term pollution in the environment. There is a need for more transparency and education around Aflatoxin management and how Aflatoxin affects human and animal health.

What is Aflatoxin and Where is it Found?

Aflatoxins are secondary metabolites that are found in the *Aspergilllus flavus, and Aspergillus parasiticus* filamentous fungi strains and are prodominatly found in cereal foods such as wheat, tree nuts, spices, peanuts, and corn. Aflatoxin is a soil born mycotoxin that can contaminate food stores if it is exposed to the carcinoginic mold. This specific mycotoxin was indentified in the 1960s when a fowl die off revealed that the turkeys were exposed to a contaminated peanut feed. Aflatoxin is considered one of the most deadly mycotoxins in the world due to its carcinogenic effect on the liver (Peng et al., 2024). Aflatoxin has also been identified on cannabis crops which is often inhaled when consumed, contaminating the lungs. Cooking oil, peanut butter, and dog food are all products that have been recalled due to Aflatoxin contamination, resulting in subtantial financial loss for producers and manufacturers.

Figure 1

Chemical Structure of Aflatoxin B_1



Note: Taken from the Molecular Aspects of Mycotoxins (Janik et al., 2020).

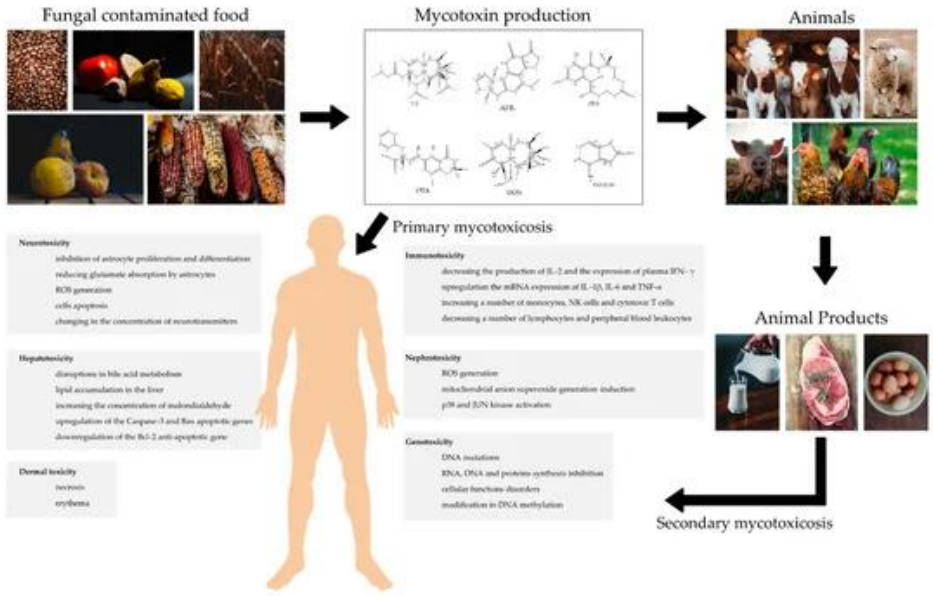
How Does Aflatoxin Affect Human Health?

Exposure to Aflatoxin happens from consuming food sources that have been exposed to Aflatoxin such as peanut butter, bread, or milk from a cow that has eaten contaiminated grain (Sirot et al., 2013). An estimation of a 28% of heptocellular carcinoma worldwide is said to be a direct result of Aflatoxin and how it is metabolized in the liver (Janik et al., 2020). There are a variety of nuerological effects such as hepatoxicity, teratogenicity, and immunotoxicity that have both acute and long term health risks. Some immediate effects of aflatoxosis is abdominal pain, vomitting, edema, and necrosis of the liver (Janik et al., 2020). Aflatoxin is mutagenic and has limiting effects in developing children resulting in stunted growth and divergent brain function (Huang et al., 2021). There is also evidence showing the transmission of Aflatoxin through the milk of breast feeding mothers to their children, possibly creating a bio-accumulation effect (Sherif et al., 2009). Though some long-term consequences remain to been fully understood,

studies show that Aflatoxin exposure is highly carcinogenic and detrimental to human and animal health.

Figure 2

Mycotoxin Exposure in Humans



Note: This was taken from the Molecular Aspects of Mycotoxins. The image shows the toxic cycle of how mycotoxins develop and are introduced into the human body (Janik et al., 2020).

What Are The Aflatoxin Management Stratgies?

Management methods of Aflatoxin happens in the field prior to harvest, in production and storage facilities, and in preparation before consumption. These methods include fungicidal applications, thermal treatments, mechanical sorting, irridation, heat treatments, and cooking. One study shows that Aflatoxin management using UV exposure, fumigation, and fungicides pose a varity of threats to human health and have been shown to degrade the quality and protien of the peanut; however, experimental methods using radio frequency have shown that the protien

and quality of the groudnut can be retained, while have a negative effect on the Aflatoxin (Peng et al., 2024). Methods that can retain the nutritional value of the high protien and affordable peanut is important as global food security becomes more of a concern. For instance, in Somalia, civil war and social unrest prevented safe handeling practices and management infastructure for Aflatoxin exposure, with maize being the primary food source (Wielogorska et al., 2019). The importance to be able to test and decontaminate the food chain on a variety of levels can stem mass famine and systemic disease in regions where there is social conflict.

There are detoxification stratagies that help to mitigate long-term health effects if exposed. Clay and activated charcoal can be used to prevent damage to the liver and immune system if an exposure happens. Eating organic grains and peanut butter has a higher probability of having aflatoxin contamination due to the lack of fungicides used in agricultural production. Management methods are critical in the prevention of Aflatoxin contamination in the food chain, especially in organic foods.

Summary & Critical Analysis

Sustainability and Accesssiblity of Aflatoxin Management

Mycotoxin prevention and decontamination strategies vary with several methods shown to degrade the soil, water, and the nutritional value of the food stores being managed. One must approach methods with cost and infastructure in mind. Localizing decontamination and prevention stategies instead of a using mycotoxin management as capital gain strategy is important. As identified in Somalia where civil unrest left no sustainable way to manage food stores and incoming crops, one saw an increase in community exposure and child mortality. Also, with global dependancy leaning heavy on imported goods, clear standardized methods with

screening and contamination management is fundemental for food safety. Peanut butter made from peanuts imported from China may not have the same screening procedures done, or perhaps used an outdated method of decontamination as compared to a method used in the states. Regulation and consistancy are integral to the safety of both human and animal health.

Conclusion

Do we have all the data and relevant information about bio-accumulation of Aflatoxin in both human and animal milk? Studies have linked Aflatoxin to liver cancer, as well as being transmissble from mother to baby through breast feeding. Contaminated feed can bioaccumulate in bovine milk and is turned into cheeses and frozen lasagnas in the convenience section of the grocery store. Long-term unseen health effects may be masked in a not-so-visible food such as a milk-chololate bar. Developing a transparent way to ensure contamination management is essential to the long-term survival of the worlds population.

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