EFFECT OF PROCESSING ON AFLATOXIN

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ABSTRACT

Naturally occurring toxicant contamination of foods with mycotoxins is unavoidable and unpredictable and poses a unique challenge to food safety. Aflatoxins are toxic mold metabolites produced by toxigenic strains of Aspergillus species. Primary commodities susceptible to aflatoxin contamination include corn, peanuts and cottonseed and animal-derived foods such as milk when the animal is fed aflatoxin-contaminated feed. Risks associated with aflatoxin-contaminated foods can be reduced through the use of specific processing and decontamination procedures. Factors, which influence the effectiveness of a specific process or procedure, include the chemical stability of the mycotoxin(s), nature of the process, type and interaction with the food/feed matrix and interaction with multiple mycotoxins if present. Practical decontamination procedures must: 1) inactivate, destroy, or remove the toxin, 2) not produce or leave toxic residues in the food/feed, 3) retain the nutritive value of the food/feed, 4) not alter the acceptability or the technological properties of the product, and, if possible, 5) destroy fungal spores. For aflatoxins, multiple processing and/or decontamination schemes have been successful in reducing aflatoxin concentrations to acceptable levels. Physical cleaning and separation procedures, where the mold-damaged kernel/seed/nut is removed from the intact commodity, can result in 40-80% reduction in aflatoxin levels. Processes such as dry and wet milling result in the distribution of aflatoxin residues into less utilized fractions of the commodity. The ammoniation of aflatoxin-contaminated commodities has altered the concentrations as well as toxic and carcinogenic effects of aflatoxin by greater than 99%. Nonbiological materials such as selected anticaking agents covalently bind aflatoxins from aqueous suspensions, diminish aflatoxin uptake by animals, prevent acute aflatoxicosis, and decrease aflatoxin residues in milk. Ultimately, the best processing or decontamination process is one that is approved by regulatory agencies, cost-effective, and reduces the mycotoxin concentration to acceptable levels.
INTRODUCTION

Aflatoxins are naturally occurring secondary mold metabolites produced primarily by *Aspergillus flavus* and *A. parasiticus*. The primary agricultural commodities associated with aflatoxin contamination include corn, peanuts, tree nuts, cottonseed and dairy products. Toxins of primary public health concern include aflatoxin B₁, B₂, G₁ and G₂ and an animal metabolite, aflatoxin M₁, which occurs in milk when lactating dairy cows are fed rations containing aflatoxin B₁. Aflatoxins are potent liver carcinogens and toxins. The International Agency for Research on Cancer (IARC) has classified aflatoxin as a probable human carcinogen (Stoloff, 1982). In fact, there is epidemiological evidence that humans are not immune to aflatoxicosis, as reported in India and Kenya (Park and Stoloff, 1989); and, where other factors are present such as hepatitis B virus, the carcinogenic event can occur (Henry et al., 1999). All of these factors have highlighted the importance of establishing appropriate food safety management programs for aflatoxins (Park and Stoloff, 1989; Lopez-Garcia and Park, 1998; Park et al., 1999; Park, 1993; Park and Liang, 1993).

FOOD SAFETY MANAGEMENT PROGRAMS

Factors crucial to the effectiveness of food safety management programs for aflatoxin include the establishment of regulatory limits and monitoring programs, the control of aflatoxin formation through good agricultural practices and proper storage and handling, reduction of aflatoxin levels in contaminated commodities through processing and decontamination procedures, and adequate education programs for agricultural producers, food and feed processors and consumers (Lopez-Garcia et al., 1999; Phillips et al., 1994). The primary goal of these efforts is to reduce human exposure to aflatoxin to the lowest practical level while at the same time provide for an adequate food supply. Information necessary for the establishment of regulatory limits and monitoring programs include the toxicological properties of the toxin and metabolites, the major commodities affected, the levels of the toxin in affected commodities, the dietary intake, the availability of analytical methods, and the impact of regulatory limits on the availability of the food/feed supply. It is inappropriate to enact strict programs that would restrict marginally aflatoxin contaminated food/feed products in the absence of a clear public health benefit.

PHYSICAL METHODS OF AFLATOXIN REMOVAL AND DETOXIFICATION

Cleaning and Segregation

The first option in aflatoxin reduction strategies is the physical separation of the mold-damaged kernel/seed/nut from the intact and apparently non-contaminated product. These procedures such as cleaning, sorting and handpicking (Dickens and Whitaker, 1975) are non-evasive and do not alter the product significantly. Flotation and density segregation have been reported to be useful in separating aflatoxin-contaminated corn and peanuts (Cole, 1989). However, complete removal of the contaminated product or aflatoxin cannot be expected with physical methods of separation. Should there be high residual levels of contamination, other procedures must be used to reduce aflatoxin concentrations in the final product to acceptable levels. The peanut industry uses a combination of segregation and other techniques to reduce aflatoxin levels in peanut products such as peanut butter (Table 1). Physical separation is a good alternative for the food industry. An initial investment to purchase adequate equipment is necessary; however, maintenance expenses are minimal.