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Aflatoxins: Contamination of animal feeds and food products

Abstract

Mycotoxins are toxic chemicals produced by certain species of molds during their growth on numerous substrates. Molds can invade the food and feed supply at various points throughout production, storage, processing, and distribution. Of most concern are the aflatoxins, which are highly toxic and classified as probable human carcinogens. Aflatoxins are often associated with crops that have undergone stress or feeds and foods that have been stored improperly. Tremendous economic implications are associated with regulation, testing, and loss of agricultural products from aflatoxin contamination. Dairy cattle excrete a portion of consumed aflatoxins into milk, thus, leading to a strict action level of 0.5 ppb in fluid milk. Several types of processed food products have been demonstrated to be occasionally contaminated with these toxins.; Dairy Day, 1993, Kansas State University, Manhattan, KS, 1993;

Keywords

Dairy Day, 1993; Kansas Agricultural Experiment Station contribution; no. 94-149-S; Report of progress (Kansas Agricultural Experiment Station); 694; Dairy; Aflatoxins; Molds; Carcinogens; Toxins; Federal regulations

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AFLATOXINS: CONTAMINATION OF ANIMAL FEEDS AND FOOD PRODUCTS

R. K. Phebus

Summary

Mycotoxins are toxic chemicals produced by certain species of molds during their growth on numerous substrates. Molds can invade the food and feed supply at various points throughout production, storage, processing, and distribution. Of most concern are the aflatoxins, which are highly toxic and classified as *probable human carcinogens*. Aflatoxins are often associated with crops that have undergone stress or feeds and foods that have been stored improperly. Tremendous economic implications are associated with regulation, testing, and loss of agricultural products from aflatoxin contamination. Dairy cattle excrete a portion of consumed aflatoxins into milk, thus, leading to a strict action level of 0.5 ppb in fluid milk. Several types of processed food products have been demonstrated to be occasionally contaminated with these toxins.

(Key Words: Aflatoxins, Molds, Carcinogens, Toxins, Federal Regulations.)

What Are Aflatoxins?

Mycotoxin is the general term for a wide range of chemical toxins produced by numerous species of fungi (molds). Aflatoxins are a particular class of mycotoxin produced by three species of the mold *Aspergillus*. Over 10 forms of aflatoxins have been identified differing only by a slight change in the molecule's chemical structure; however, these forms have different associated toxicities. The B and G forms of the toxin are predominantly produced in agricultural crops in the field or

during storage. These toxins have very high toxicities as demonstrated in several species of test animals. Other structural forms of aflatoxins are produced during metabolism of ingested aflatoxins by animals. These metabolic forms have various levels of toxicity. Aflatoxin M is found in milk secreted by lactating animals and is relatively toxic compared to the other forms.

Toxicity to Humans and Animals

Aflatoxins are extremely toxic to most species of animals. Acute (immediate effect) toxicities occur as a consequence of ingestion of high levels of the toxins in a contaminated food or feed. This would be an unlikely occurrence in the United States for humans; however, it has occurred in developing countries because of lack of food and starvation. Livestock would be more prone to acute toxicity effects, and symptoms would include reduced feed consumption, dramatic drops in milk production, weight loss, liver damage, and even death.

A more common problem with prolonged exposure to aflatoxins is chronic (long-term) toxicity. The predominant organ affected in most species is the liver, where degeneration and cancer are often observed. Aflatoxin B₁ is one of the most potent carcinogens known to man. Other chronic effects include reduced feed efficiency, immunosuppression, and reproductive problems. Research has shown that giving dairy cattle feeds contaminated with 120 ppb aflatoxin over a prolonged period of time resulted in a reduction in breeding efficiency, birth of smaller calves, diar-

rhea, acute mastitis, respiratory disorders, prolapsed rectums, hair loss, and reduced feed consumption. After removal of aflatoxin from the animals' diets, milk production increased 28%. Obviously, severe economic implications can result from aflatoxin contamination of livestock feeds.

Occurrence and Regulation

Mycotoxins can contaminate many foods and feeds prior to harvest and/or during storage. Several crops can become contaminated in the field, with corn, peanuts, cottonseed, and nuts having the highest risks of becoming toxic. Also at some risk are raisins, figs, and spices. During storage, other crops normally resistant to field contamination can become infested, if environmental conditions are appropriate for mold growth. These include soybeans, grain sorghum, millet, wheat, oats, barley, and rice. Finally, aflatoxins can be secreted into raw milk by lactating dairy animals as aflatoxin M. Approximately 1% of the total aflatoxins ingested by dairy cattle is excreted in the animals' milk.

Aflatoxin in raw agricultural products can lead to contamination of processed foods. Aflatoxin is very stable to most of the processing technologies including

retort and pasteurization. Therefore, the toxin can be carried into processed foods derived from these commodities. Some processed foods that have been implicated include peanut butter, corn, hominy, spaghetti, flour, milk, nonfat dry milk, and cheddar cheese.

In the United States, aflatoxins are the only mycotoxins formally regulated. The Food and Drug Administration has set guidelines for acceptable levels of these "unavoidable contaminants" in foods and animal feeds. Foods for human consumption can contain no more than 20 ppb and milk no more than 0.5 ppb of aflatoxin M₁. Other countries have different action levels for foods contaminated with these toxins, which often leads to difficulties in world trade. Currently, the international community is considering lowering the level of permissible aflatoxin M₁ in milk to 0.05 ppb.

Animal feeds have a general action level of 20 ppb. For cottonseed meal and corn used for feedlot cattle, the limit is 300 ppb. Corn intended for finishing swine cannot contain more than 200 ppb. Corn for breeding animals and mature poultry has an aflatoxin limit of 100 ppb.