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A Review on Mycotoxin in Dried Herbs

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Mini Review

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Abstract

Herbs can be used in different forms such as fresh and dried. A mycotoxin is the greatest concern in the case of dried herbs, due to their low water activity, microbial contamination may persist in these products, and thus, herbs can be sources of outbreaks of foodborne diseases. The toxigenic fungal compounds called mycotoxin are poisonous substances produced by different species of fungus. Three major genera of fungus are identified to produce mycotoxins: they include Aspergillus, Fusarium, and Penicillium. Although other genera also produce these toxigenic compounds. The presence of mycotoxins in dried herbs poses health risks ranging from mild to severe damage to the liver and kidney. Fungal toxicity could be prevented by controlling the environmental condition that influences fungal growth, which is by controlling the physical conditions of the dried herbs and by the use of mold inhibitors and anti-cracking additives. The control of the toxigenic compounds could also be by removing the suspected dried herbs with a fungal toxin or by the addition of the toxin binder to the ratio of the dried herbs.

Keywords: Dried; Fungal; Herbs; Microbial; Toxicity

Introduction

Herbs have long been associated with human culture present in almost all kinds of food preparation where they intensify flavor, aroma, and color or provide a distinct sensorial characteristic [1-3]. They have been recognized as a valuable source of high-value nutritional compounds such as antioxidants and essential oils [2]. Herbs can be used in different forms such as fresh and dried [4,5]. Microbial food safety is probably the safety aspect of the greatest concern in the case of dried herbs, due to their low water activity and thus, dried herbs can be sources of outbreaks of foodborne diseases [1,6]. Dried herbs can be naturally exposed to microbial contamination during any stage of production from pre-harvesting to harvesting, processing, distribution, storage, and use by consumers [2]. They can be carriers of pathogenic microorganisms and some toxin and spore producers [1,2]. Food safety is an issue of high priority to protect the health of the consumers [1,3,6].

Mycotoxins are toxic compounds that are naturally produced by certain types of molds (fungi) which grow on numerous foodstuffs such as cereals, dried fruits, nuts herbs, and spices [7,8]. Many fungi produce poisonous substances called mycotoxins that can cause acute or chronic intoxication and damage the liver and the kidney and impair animal health, thereby causing great economic losses of livestock through diseases (Aflatoxin from *Aspergillus flavus* [9-11].

There are three major genera of fungi that produce mycotoxins: include Aspergillus, Fusarium, and Penicillium [11]. Several factors that influence the degree of fungal growth plant products and the production levels of mycotoxins are climate, physical interference, and stress Ambient temperature (12-47°C) and moisture levels of about >70% are optimal for proper fungal development and mycotoxin production [9,12,13].

The main objective of this systematic review is to provide comprehensive data, occurrences, and contamination levels and to suggest possible solutions to how these fungal toxins in dried herbs production can be prevented, control/manage, and also to provide a simple, searchable dataset for further studies.

Major Sources of Mycotoxins

The primary sources of mycotoxin tend to be corn, barley, wheat, cottonseed, sorghum, dried herbs, spice, and by-products feeds that have been mishandled [11,14].

Common Members of the Mycotoxin Family Exist on Dried Herbs

Aflatoxins: Aflatoxin is a group of mycotoxins produced mainly by Aspergillus flavus, A. parasiticus, and A. nomius. Aflatoxin, especially AFB1 is the most potent toxic metabolite, which shows hepatotoxic teratogenic and mutagenic properties, causing such diseases to humans as toxic hepatitis, hemorrhage, edema, immunosuppression, and hepatic carcinoma [9,15,16]. Although aflatoxin is perhaps the most dangerous of mycotoxins, it does little practical damage. A. flavus outbreak can occur in the field during pre-harvest or in storage at a substrate moisture content of 14% and temperature of 25-40°C [11,17,18].

Deoxynivalenol (DON): DON is produced by molds of the Fusarium species. High doses of pure DON have caused no noticeable problems; however, lower doses of DON in associate with other mycotoxins. Also, nervous symptoms, diarrhea, and intestinal hemorrhage have been reported. For this reason, DON is often referred to as a "marker" mycotoxin, i.e., the presence of DON is usually associated with other mycotoxins that may not be easily identified. Levels of DON below 500 ppb are probably safe for consumption [14,19].

Zearalenone: Zearalenone is a mycotoxin with an estrogenic activity that is produced by molds of the Fusarium species [19]. Similarly, Zearalenone is a toxin produced in stored grain contaminated by Fusarium sp. but it is reported to provoke 5-10 times the estrogen response levels of Zearalenone, [20]. Below 250 ppb are probably safe to food adult person if no other molds are contaminating the food [14,19].

T-2 Toxin (One of the Trichothecenes): T-2 toxin is produced by several molds of the Fusarium species and consumption of greater than 100 ppb is probably dangerous [11]. Fifty (50) ppb is the safe suggested limit for this toxin [12,21].

Fumonisin: Fumonism is thought to potentiate the toxicity of other trichothecene toxins [12,18]. Safe levels have been estimated to be below 50,000 ppb. 5, 000 ppb is the maximum safe level.

Ergot Alkaloids: Ergot Alkaloids are amides of the terpenoid indole derivative D-lysergic acid and are produced by a wide range of fungi, predominantly Clavicipitaceae [20]. The food at 1% (10,000 ppb) had increased abortion rates with calves that were born alive being weak and debilitated [12,21].

Ochratoxin: Ochratoxin is a mycotoxin produced almost always as a result of poor storage conditions by molds of the Penicillium family and by Aspergillus ochraceus(12, 13). Safe levels are assumed to be less than 10, 000 ppb.

Citrinin: Citrinin is a secondary metabolite produced by Penicillium citrinum and P. viridicatum, which usually accompanies ochratoxin A; it is also a metabolite of some Aspergillus species [22,23]. Citrinin has been related to kidney damage in laboratory animals and may be involved in cases of swine nephropathy. Some studies have addressed its potential for immunotoxicity [24].

Patulin: Patulin is a highly reactive unsaturated lactone (4-hydroxy-4 H-furo [3,2-c] pyran-2 (6H)-one) produced by certain species of Penicillium, Aspergillus, and Byssochlamys [25,26]. It is of public health concern because of its potential carcinogenic properties [15,25,27]. This toxin is highly reactive and has been shown to bind to sulfhydryl groups such as cysteine, thioglycolic acid, and glutathione [26].

Mycotoxicosis and Symptoms of Mycotoxicosis

The manifestation of mycotoxin poisoning has long been appreciated as an acute cause of poor animal performance [18,28,29]. Mycotoxins are widely distributed in nature and several general symptoms that may make one suspicious that a mycotoxin problem may exist are

a. Consumption of dry matter is much less (-2.0kg or 5Ib) or much more (+2.0 kg to 5Ib) than would be predicted for the present production. Less dry matter is generally a symptom of aflatoxin or other serious mycotoxins. More intake than production warrants can indicate a problem with DON (deoxynivalenol) or Zearalenone.

b. A high incidence of digestive upsets. These upsets can take the form of diarrhea and/or rumen stasis (impactions). Presence of a lot of mucous in the manure. This is symptomatic of all mycotoxins, but much more prevalent with aflatoxin or T-2 toxin. The presence of large amounts of mucous is symptomatic of a toxin, although it may not always be a mycotoxin.

c. A high incidence of disease associated with depressed immune function, such as urea plasm or Pasteurella pneumonia. Presence of an equalized tissue edema. This is often evidence by swelling in the brisket and hock areas. Cows are very sensitive to any type of impact or insult. Swelling is often more than what would be expected. This is associated with mycotoxins of the Fusarium sp.

d. High rate of abortion or fetal resorption without obvious infection disease involvement. A total rate of abortion and resorption above 15% would be considered high again almost one mold provoke an abortion. High levels of even benign molds can cause mycotic abortions. However high resorption rates coupled with short heats or nymphomania may indicate Zearalenone contamination.

e. A general unthrifty appearance of the cattle with lower milk production would be expected. Cows could have rough hair coasts, a "sad" appearance, and generally a slightly arched back.

Analysis and Identification of Mycotoxins in Food

Sampling Skills: Due to the mycotoxin contamination is heterogeneous the precaution is must be taken in sampling to obtain a reliable quantitative estimate of the concentration of a mycotoxin in a given food [18,30,31]. The sampling skill need are: - samples must be representative of an entire lot (food), obtain samples from multiple locations, use of a dried herbs sampling probe is recommended, take samples at various unloading sites, 10 pounds minimum, mix thoroughly, subsampling, send 2 to 5 pounds for analysis, freezing or air-tight packing if necessary (especially), for high moisture samples and sources of mycotoxins test kits (CSID and mini-column).

Prevention of Mycotoxin Contamination of Foods

The mycotoxin is prevented by the following steps [21,30,31].

1. Control the environmental factors that influence fungal growth such as Moisture contents of grain (< 14%), Relative humidity (< 70%), Temperature (-22degree centigrade), Oxygen availability
2. Control the physical condition of the grain such as Minimize grain damage during harvest, and Screen grain to reduce broken kernels
3. Clean storage system regularly,
4. Use mold inhibitors and anti-cracking additives
5. Ammonization to reduce aflatoxin concentrations
6. Floating separation-Fusarium-infected kernels are higher than sound Kernels
7. Wash, wet or dry milling and heating process (roasting, boiling, baking, and frying)
8. Addition of 0.5%hydreated sodium calcium aluminosilicate in the formulated food

Control of Mycotoxin Contamination in Food

If mycotoxin is suspected, the suspected feed should be removed or at least the quantities of the suspected food decreased, and a toxin binder should be added to the ration. For example: To make high-quality silages, it is necessary to fill quickly and pack continuously. This is mainly impossible if hand labor is used to unload trucks and/or distribute the silages. It is the recommendation of almost all experts in the field that 15cm of silage be removing daily from across the entire face of the silo to prevent mold growth, another broadway of controlling mycotoxin contamination by mold is by daily treatment of the silo face with a mold inhibitor. Such as propionic acid, which will help to reduce mold growth? In all cases of a proven mycotoxin, a binder should be added to the ration wherever mycotoxin is suspected. The major setbacks of toxin binders vary in their ability to bind toxins, and some toxin binders can bind one type of toxin and not bind any other type of toxin [21].

Conclusion and Recommendation

This review gives a comprehensive overview of the current knowledge on the fungal toxin in dried herbs based on what the scholars were said about fungal toxicity on dried herbs and put footnotes for further research. The mycotoxin toxic producing levels are often produced only under certain environmental conditions. Identification and prevention of these environmental conditions will play an important role in minimizing the adverse effects of these toxins. Increased production of dried herbs will be needed in the future to satisfy growing herbal demand in developing countries. Under these circumstances, the occurrence of mycotoxins in dried herbs will continue to remain on the health and economic policy agenda. The occurrence of mycotoxins is of special concern, for instance, in the case of cancer promoter and potent human carcinogen where a complimentary toxicity mechanism of action occurs. In developing countries, consumers will likely be confronted with a diet that contains a low level of toxin and in many cases, there may be other toxins present. Implicit with these reviews is the existence of mycotoxin in dried herbs is based on the environmental condition in which the herbs were dried, hygienical practice during drying handling, transportation, storage, and using by a human for consumption. Further review and research will be needed on fungal toxicity on dried herbs according to Ethiopia's context will be needed.

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