



Organization of American States  
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# FACT SHEET CHILLIES & THE AFLATOXIN CONTAMINATION

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## **Chillies and the Aflatoxin Contamination**

### **1. History**

The term “aflatoxins” was coined in the early 1960’s when the death of thousands of turkeys and other domestic animals was attributed to the presence of *Aspergillus flavus* toxins in groundnut meal imported from South America. The chronic effect of low dietary levels (part per billion) of aflatoxin on livestock are also well documented.

### **2. What are aflatoxins?**

Aflatoxins are toxins produced by moulds which occur throughout the world. Aflatoxin may be produced, both before and after harvest. Dried figs and other dried fruits, chillies and paprikas, groundnuts, pistachios and other edible nuts and cereals are foodstuffs identified as highly susceptible to aflatoxin contamination. Aflatoxins are the most potent carcinogens of mycotoxins and are the most commonly found toxin in chilli and paprika spice.

Aflatoxins are only produced by some strains of *Aspergillus flavus* and *Aspergillus parasiticus* moulds if they encounter appropriate environments. The most potent aflatoxins are B1, B2, G1 and G2 all of which have been found in chilli and paprika spice. In addition occasionally ochratoxin A, produced by *Aspergillus ochraceus* or *Aspergillus carbonarius* may occur in chillies. Aflatoxins are chemically very stable. Therefore, if contamination has occurred, it is not possible to destroy them by processing or cooking.

### **3. What are the causes of Contamination?**

- Drought stress favours pre-harvest contamination,
- Post-harvest handling during the rainy season favours post-harvest aflatoxin contamination.
- Diseased fruits that aren’t removed after harvest, as they bear a risk of mould contamination that could lead to aflatoxin production.
- Drying temperature is too low resulting in a long drying time. Therefore the moisture content isn’t reduced quickly and mould hazard increases.
- Moisture content of the product above 11% during storage allows fungal growth and above 14% allows aflatoxin accumulation.
- Temperature above 13 °C during storage allows aflatoxin accumulation.
- Hygienic aspects aren’t fulfilled.

#### 4. What are the measures to reduce the Risk of contamination?

- Varieties of chilli and paprika should be selected that have a thin pulp and are as high in dry solid content as possible. This makes drying easier and reduces heat level of the fruits.
- Plants should be stable and have a fruit setting, which ensures that fruits do not get in contact with the soil.
- Fruits should not be susceptible to inner mould.
- In case of severe drought before harvesting, crops should be irrigated to avoid stress. Contact of irrigation water with the fruits should be avoided as this increases risk of microbial contamination.
- Time between harvesting and drying should be as short as possible. This includes transport from the field to post-harvest facilities; sorting and preparation for rapid drying.
- After harvesting diseased and injured fruits must be removed.
- Cutting of fruits into small pieces (2.5 x 2.5 cm for paprika) to achieve rapid drying is recommended. This method reduces drying time by 50 to 80 %. But cutting also gives fungi access to fruit tissues. Thus, cutting must be done quickly and should be done by an automatic shredder. Time between cutting and drying must be minimised. Hygienic handling is a must.
- It is important to reach quickly a 'safe' moisture content. That means a moisture content of ca. 8 % which is attained by drying within 48 hours. If the chillies are at an 'unsafe' moisture content for longer than 48 hours, mould can grow and mycotoxins be produced. A drying method which needs more than 48 hours to reach this level must be improved.

Solar drying is a very ecological and economical method, but utilises high temperatures and does not quickly dry fruits to a low moisture content. High temperatures do result in brown discoloration of the spice. If the weather conditions are not favourable due to rain, cloud, etc., drying temperatures are reduced and drying times are extended, potentially allowing aflatoxin accumulation.

Industrial dryers often produce a better and more uniform product. Industrial dryers often use a higher temperature of 60°C initially, until the moisture content drops. Then after about 6 hours the temperature is reduced to about 45°C to avoid browning during final drying.

Heat pump dryers operate at about 40 – 45 °C and low relative humidity, are economical to run and result in a good quality product. However, if a low humidity is not maintained due to overloading of the dryer, mould growth occur reducing the quality of the spice.

- After drying the chillies need to be packaged quickly in a low humidity environment within a moisture barrier, e.g. tea sacks or paper bags having a plastic bag outside. Storage temperature below 13 °C stops aflatoxin accumulation, too. However, if the product is properly dried and air tight packed this is not a must, but an additional measurement. Also sound sanitation practices need to be implemented to minimise the level of fungal contamination of the environment.
- Grinding should only be done shortly before shipment. Grinding can be done by a hammer mill. The spice is very hygroscopic after grinding and needs to be packed quickly as described above.
- But vacuum packing is best in order to achieve long shelf life of chilli/paprika powder. The shelf life is the time until the extractable colour has declined below the industrial standard. The red colour of paprika and chillies is due to presence of compounds known as carotenoids. Loss of red colour is caused by the autoxidation of the carotenoids. Carotenoids are very stable when they are present in intact plant tissues, but when the plant tissues are processed, carotenoids become isolated and vulnerable to the effects of heat, light and high oxygen tension. Shelf life of powder during storage at temperature of 37 °C is only 2 to 3 weeks! A number of factors influences the rate of autoxidation of carotenoids, for example cultivar, heat during drying and storage, and presence of oxygen. Ground paprika and chilli deteriorates in colour faster during storage than whole fruits due to the increase in flesh surface exposed to oxidation. Powder needs to be stored in cool conditions, which will reduce the formation of free radicals that take part in carotenoid oxidation and cause of colour loss. Furthermore, powder needs to be stored out of light. To avoid contact with oxygen vacuum packing is an feasible method.

### Limits of Contamination

The maximum legal limit of aflatoxins in human food is in:

- USA                    20 µg/kg (Food and Drug Administration, 1999)
- Australia            5 µg/kg (Australian and New Zealand Food Authority, 1996)
- Germany            2 µg/kg for Aflatoxin B1 and 4 µg/kg for total aflatoxin (German Aflatoxin Regulation)

### Summarized measures to be taken to avoid aflatoxins in chillies

- Select right varieties
- Avoid drought stress before harvest and post harvest handling during the rains
- Ensure short time between harvesting and drying
- Remove diseased and injured fruits

- Cut fruits before drying into small pieces
- Dry at high temperatures of 60 °C for the first 6 hours; reduce heat to 45 °C for final drying.
- Dry to moisture content of ca. 8 %.
- Pack quickly into air tight bags; avoid absorption of moisture
- Store under cool and dark conditions
- Grind to powder only shortly before shipment
- Pack quickly into air tight bags

## **Conclusions**

Often a technical solution is relatively easy to find, but implementation is the problem. To avoid aflatoxin contamination you can shorten the pre-drying handling time; improve the drying method, storage after drying, the hygienic aspects and expedite the marketing way of the product to the customer and so on. But most important is, that everyone who is involved with the product focuses his thinking on the important details of the process and promotes a greater awareness of its necessity.