

Presence of Aflatoxins in Foods and Feeds Available in the Tamil Nadu Region

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The survey has shown that there are possibilities for the presence of mycotoxins in various foods and feed. It becomes essential that proper post harvest handling, drying and storage of commodities is practiced to prevent mould growth. There is a need for disseminating the knowledge on the harmful effects of mycotoxins and the possible dangers of consuming mouldy foods. Government should establish monitoring agencies and set up laboratories for the surveillance of foods and feeds for mycotoxins.

It is now well recognised that almost any type of food or feed can harbour toxigenic strains of *Aspergillus* which can produce aflatoxins under suitable conditions and on proper substrates. These include cereals, legumes, oil seeds, horticultural produce, dairy and meat products etc. The carcinogenic effects of aflatoxins have been documented by de Luca (1971). In India, outbreaks of aflatoxicosis was recorded by Sastry et al. (1965) in Murrah buffaloes in Andhra Pradesh implicating contaminated groundnut cake in the feed. In another outbreak at Karnataka (Gopal et al., 1968) severe death rate of cross bred cattle was reported due to high levels of aflatoxin in the feed. Recently, heavy mortality and lowered egg production in some poultry farms of Periyar district were investigated by Neelakantan et al (1978). All the samples of feed were positive for *A. flavus* spores and the levels of aflatoxin were found to be as high as 1000 µg/mg,

Aflatoxicosis in humans in India has also been reported by several workers (Krishnamachari et al., 1975, Amla et al., 1971 and Sreenivasamurthy, 1975) leading to cirrhosis of the liver, jaundice, rapidly developing ascites, portal hypertension and in severe cases death. Mycotoxicoses could become a serious public health problem in the future enveloping the whole of mankind if proper precautionary measures are not undertaken promptly. In India, this problem has serious connotation, because majority of our people are poor, illiterate and have low nutritional status and poor hygienic practices. A survey was undertaken to screen the various foods, feeds and feed ingredients available in the region of Tamil Nadu for the presence of mycotoxins under a Government of India scheme.

MATERIAL AND METHODS :

Various food products and feed ingredients were purchased on 'as is'

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basis randomly from different shops as sold in the market without disclosing the purpose. No attempt was made to screen for appearance, colour or quality. The samples were well mixed and coarsely ground to 50 mesh size in a hand grinder. Fifty grams of the sample were analysed as described by Neelakantan *et al.* (1978) using standard TLC procedures. Standard aflatoxins (B_1 , B_2 , G_1 and G_2) were obtained from the Biochemicals Unit, V. P. Chest Institute, Delhi and from C. F. T. R. I., Mysore. The characteristic fluorescent coloured spots at the same R_f values as that of the standard toxins under U. V. excitation was used as the presumptive evidence. Confirmation of the suspected samples was obtained by rechromatography along with that of standard toxins.

RESULTS AND DISCUSSION :

i) *Foods and Food Products* : The data on the aflatoxin contamination of foods and food products surveyed are shown in Table No. 1. Groundnut candy is a very common snack items that is eaten with relish by both young and old throughout India. Four samples were found to be contaminated with aflatoxin out of the ninety one samples analysed. The incidence of the toxins in the candies is mainly due to the inclusion of spoiled mouldy nuts during the candy manufacture. Contamination of groundnuts with aflatoxin has been reported earlier (Rao *et al.*, 1965, Wagle, 1970). Aflatoxin in candies can be prevented only at the manufacturer's level by proper

selection of good quality nuts and also by thorough picking of damaged and mouldy nuts manually.

Thirty seven samples of lime pickles in the form of single serve unit packages either in polythene pouches or in pouches made of dried leaves were analysed and six of them were found to be contaminated. Mould growth is possible in pickles whenever there is insufficient use of oil or salt. In such cases, housewives generally remove the surface mat of the mould and use the pickle sometimes after keeping in the sun for a shortwhile. Thus, pickles also could be a serious source of contamination in the dietary.

In South India, various vegetables are commonly salted and dried at homes under the sun. Four samples of *Sundaikkai vathal* were found to contain aflatoxin. Hygienic methods of preparation should be practiced and quicker drying is essential. When the sky is over cast or during unexpected rains, the product will take weeks for safe drying. During these periods mould growth occurs resulting in the production of mycotoxins. There are no reports of incidence of mycotoxins in dried vegetables.

Dried dates are imported into India from west Asian countries. Generally trade in this commodity is under very unhygienic conditions even from the place of its origin. Aflatoxin B_1 was found in one sample which had white patches on it and which was found to be insect damaged. Since dates are purchased commonly

good quality nuts and thorough picking of damaged nuts manually.

seven samples of lime in the form of single serve packets either in polythene or in pouches made of dried coconut analysed and six of them were found to be contaminated. This is possible in pickles where there is insufficient use of preservatives.

In such cases, housewives should remove the surface mould and use the pickle after keeping in the sun for a while. Thus, pickles also become a serious source of contamination in the dietary.

In India, various vegetables are usually salted and dried at the sun. Four samples of *vi vathal* were found to contain aflatoxin. Hygienic methods should be practiced and drying is essential. When ever cast or during unseasonable rains, the product will take a long time for drying. During these periods mould growth occurs resulting in production of mycotoxins. There are reports of incidence of mycotoxins in dried vegetables.

Dates are imported into various west Asian countries. It was found in this commodity that under very unhygienic conditions in the place of its origin, aflatoxin was found in one sample which showed white patches on it and was found to be insect damaged. These are purchased commonly

by people from all walks of life, proper manufacturing and marketing of this commodity is essential. Stringent quality control measures should be followed. There are no literature reports on the occurrence of mycotoxins in dates.

Pan chewing is a common habit amongst almost all sections of our society. *Areca nut* (*Areca catechu*) in its various forms is invariably used as an ingredient. A total number of 147 samples consisting of scented *supari* (67 samples), broken processed areca nut (54 samples) and areca nut flakes (26 samples) were analysed. Two samples of *supari* and one areca nut sample were found to contain aflatoxin. At various times during the monsoon seasons, it could be seen that contents of *supari* packets caked up with diffuse mould growth on them due to high relative humidity. Besides, areca nut as such is also known to be susceptible for fungal invasion unless properly dehusked and dried after harvest. Since it is found that *Supari* can also be a substrate for aflatoxin production unscrupulous utilisation of the mouldy nuts in the processing and manufacture of *supari* can pose a severe health problem. There are no records of mycotoxins detected in *Supari* so far.

Different fruit samples purchased from local market were included in the study. It was found that out of six samples of apple tested, one showed the presence of aflatoxin B₁. These samples were not of premium grade and they showed signs of damage. Generally such apples are

priced low and are purchased by people of lower economic status. There are reports of experimental production of aflatoxin in various fruits including apples (Frank, 1966, Detroy et al., 1971) and thus it becomes obvious that people should be educated to be cautious while using such low grade produce.

Out of six samples of dried coconut analysed two were found to be contaminated with aflatoxin B₁. During storage of broken coconuts, mould growth invariably occurs either mildly or severely depending upon the storage period and generally the housewives scrape off the top mouldy layers and use the bottom portions. Occurrence of aflatoxin in copra has also been reported earlier (Narasimhan, 1968).

ii) Feeds and Feed Ingredients :

The data pertaining to the samples of feeds and feed ingredients that were analysed is shown in Table No. 2. It is seen that except for brans in all the categories of samples were found to be contaminated with aflatoxins. Most of the positive samples had shown the presence of both aflatoxin B₁ and B₂. Ingestion of the aflatoxin containing feeds by the cattle is known to result in the loss of productivity, besides excretion of the toxic metabolites, aflatoxins M₁ and M₂ in milk, indirectly affecting the human health.

It has been well documented that cotton seed is a good substrate for the growth of various *Aspergillus* species and supports the production

of aflatoxin (Raghavendra Rao *et al.*, 1970). Two of the thirty cotton seed samples analysed were positive for aflatoxin and both these samples were found discoloured.

There was found severe contamination of groundnut cake in the survey. Of the 134 samples analysed, 28 were positive for aflatoxin. Fifteen of them contained both aflatoxins B₁ and B₂. Aflatoxins have been found to be regular contaminants in groundnut cake (Rao *et al.*, 1965, Rampal, 1976). In India, processing of groundnuts is oriented only towards the production of oil. Since the spoiled mouldy seeds are not removed before crushing, there is a huge loss of about 3.6 million tonnes of high protein oil seed cake becoming unfit for human consumption every year. Countries importing groundnut cake from India have fixed a limit of 60-120ppb of aflatoxin and there is some quality consciousness in the export trade only.

Similarly in the case of gingelly and coconut oil cake, the survey has shown the presence of aflatoxins in them. Four out of the 83 samples of the gingelly oilcake and 3 out of the 96 samples of coconut oilcake were positive. Occurrence of aflatoxin contamination have not been reported in gingelly oilcake so far.

There is at present a booming business in the animal feed and poultry feed industry in our country. The survey has shown that these items can be a source of gross contamination with mycotoxins. Seven of animal feeds, 19 of poultry feeds and 4 of oilseed cake

mixtures showed contamination out of 38, 60 and 10 samples analysed respectively. If stringent quality control measures are not adopted by the feed manufacturers, it can seriously affect the productivity of the animals and may end up in severe economic loss besides causing health hazards to our population. Brans and hulls obtained while processing cereals, legumes and millets are invariably used as feeds as a regular practice. Eighty seven of such samples were included in the survey and none of them were found to contain aflatoxins. Possibly such brans do not support the production of aflatoxin since they are not generally good sources of readily usable carbohydrates.

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REFERENCES

- AMLA, I., C.S. KAMALA, G.S. GOPALAKRISHNA, A. P. JAYARAJ, V. SREENIVASAMURTHY and H. A. B. PARPIA. 1971 cirrosis in children from peanut meal contaminated by aflatoxin. *Am. J. Clin. Nutr.* 24 609
- D. LUCA, H. F. 1971. Diet and aflatoxin toxicity *Nut. Rev.* 29, 181.
- DETROY, R. W., E. B. LILLEHOJ, and A. CIEGLER. 1971. Aflatoxin and related compounds In *Microbial toxins*. Vol VII, ed. A. CIEGLER S. KADIS and S. J. AJI. Acad. Press, N. Y. 72.
- FRANK, H. K. 1966. Aflatoxin in *Lebensmitteln Arch. Lebensmittel Hyg.* 17, 237.
- GOPAL, T., S. ZAKI, M. NARAYANASWAMY and S. PREMLATHA. 1968. Aflatoxicosis in dairy cattle. *Ind. Vet. J.* 45, 707.

owed contamination out of 10 samples analysed respectively. Stringent quality control is not adopted by the feeders, it can seriously affect the health of the animals and may end in economic loss besides health hazards to our population. Hulls obtained while processing legumes and millets are used as feeds as a regular practice. Out of seventy seven of such samples analysed in the survey and none of them were found to contain aflatoxins. Such brans do not support the growth of aflatoxin since they are usually good sources of readily available carbohydrates.

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REFERENCES

- S. KAMALA, G. S. GOPALAKRISHNA, V. SREENIVASAMURTHY and A. B. PARPIA. 1971. Cirrhosis in man from peanut meal contaminated by aflatoxin. *Am. J. Clin. Nutr.* 24: 609.
- W. F. 1971. Diet and aflatoxin toxicity in man. *Am. J. Clin. Nutr.* 29: 181.
- W., E. B. LILLEHOJ, and A. CIEGLER. 1971. Aflatoxin and related compounds. In: *Microbial toxins*, Vol. VII, ed. A. CIEGLER and S. J. AJI. Acad. Press, N. Y.
- K. 1966. Aflatoxin in *Lebensmitteln*. *Lebensmittel Hyg.* 17: 237.
- S. ZAKI, M. NARAYANASWAMY and M. LATHA. 1968. Aflatoxicosis in dairy cattle. *Ind. Vet. J.* 45: 707.

KRISHNAMACHARI, K. A. V. R., R. V. BHAT. V. NAGARAJAN and T. B. G. TILAK. 1975. Hepatitis due to aflatoxicosis outbreak in Western India. *Lancet* i, 1061.

NEELAKANTAN, S., R. SWAMINATHAN, T. BALASUBRAMANIAN, R. BALASARASWATHI and G. INDIRA JASMINE. 1978. Aflatoxin in commercial poultry feeds. *Ind. Poultry Gaz.* 62, 40.

NARASHIMHAN, M. J., Jr. 1968. On the occurrence of aflatoxin in copra. *Hindustan Antibiotics Bull.* 11, 104.

RAGHAVENDRA RAO, S., A. S. INDULKAR and H. S. VEDANAYAGAM. 1970. Mycotoxins in cottonseed. Final Report, Regional Res. Lab., Hyderabad.

RAMPAL VARMA, B. K. and D. D. SRIVASTAVA. 1976. Aflatoxin in groundnut oil, groundnut

cake and hydrogenated oil in Hapur (U. P.) Market. *J. Fd. Sci. Technol.*, 16, 169.

RAO, K. S., T. V. MADHAVAN and P. G. TULPULE. 1965. Incidence of toxigenic strains of *A. flavus* affecting groundnut crop in certain coastal districts of India. *Ind. J. Med. Res.* 53, 1196.

SASTRY, G. A., J. V. NARAYANA, P. R. RAO, K. J. CHRISTOPHER and K. R. HILL. 1965. A report on the groundnut toxicity in Murrah buffaloes in Andhra Pradesh. *Ind. vet. J.* 42, 79.

SREENIVASAMURTHY, V. 1975. Mycotoxins in foods. *Proc. Nutr. Soc. India.* 34, 1.

WAGLE, N. G. 1970. Detection and estimation of aflatoxin in groundnut and groundnut products. *Ind. Stds. Inst. Bull.* 22, 299.

TABLE 1 Incidence of aflatoxins in foods and food products

Sample	No. of samples analysed	No. of contaminated samples	Aflatoxins observed B ₁	Aflatoxins observed B ₁ & B ₂	Remarks on contaminated samples
Groundnut candies	91	4	2	2	insect damaged and white patches
Dried dates	18	1	1	-	
Scented <i>Supari</i>	67	2	1	1	
Broken processed arecanut	54	1	1	-	
Areanut flakes	26	-	-	-	
Lime pickles	37	6	4	2	<i>Sundaikkai vathal</i> (<i>Solanum torvum</i>)
Dried vegetables	43	4	3	1	Physical damage & poor quality Mouldy
Apples	6	1	1	-	
Dried coconut	6	2	2	-	

(Solanum torvum)
Physical damage &
poor quality Mouldy

Dried vegetables	43	4	3	1
Apples	6	1	1	-
Dried coconut	6	2	2	-

TABLE II Incidence of aflatoxins in feeds and feed ingredients

Sample	No. of samples analysed	No. of contaminated samples	Aflatoxins observed		Remarks on contaminated samples
			B ₁	B ₁ & B ₂	
Cotton seed	30	2	-	2	discoloured
Groundnut oil cake	134	28	13	15	-
Gingelly oil cake	83	4	1	3	-
Coconut oil cake	96	3	3	-	-
Animal feeds	38	7	5	2	Two were sent by veterinary officers as suspected samples
Poultry feeds	60	19	11	8	-
Oilseed cake mixtures	10	4	4	-	-
Brans and hulls	87	-	-	-	-