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AFLATOXIN B_1 IN THE SETTLED DUST OF POULTRY FEED MILLS IN KARACHI

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Three poultry feed mills were surveyed for the presence of aflatoxin B_1 in the settled dust. Two hundred and twenty seven samples were analyzed, out of which 67.8% were found positive for aflatoxin B_1. Average content was 82 µg/kg and the range being 2 – 815 µg/kg. The levels of aflatoxin B_1 found in the airborne dust in the working area may effect the human health in one way or other.

Key words: Aflatoxin B_1, Feed mills, Dust.

Introduction

Aflatoxins are highly toxic, mutagenic, carcinogenic and teratogenic secondary metabolites of certain strains of fungi like *Aspergillus flavus* and *A. parasiticus* [1]. Since their discovery, aflatoxins have been considered as prime threat to the human and animal health more than any other mycotoxins [2]. The dust, often containing aflatoxins, is generated when grains are loaded and unloaded and also at the time of grinding and packing.

Grain dust may consist, parts of grains and contaminants like parts of plants and insects, fungi, mites, bacteria their waste material and metabolites, rodent's hair and excreta, pesticides and soil [3]. In a single case study the death of 8 and 12 months old children was diagnosed due to Rey's syndrome, whose mothers worked at a poultry farm which had an out-break of aflatoxicosis and aflatoxin B_1 was detected in the liver of the older child for which specimen was available [4].

Inhalation of aflatoxin contaminated peanut meal resulted in two deaths by pulmonary adenomatosis [5]. It was noted that farmers cleaning out mouldy silage from a silo suffered from pulmonary mycotoxicosis [6].

Aflatoxin from none to 43,700 µg/kg was detected in the airborne dust when corn containing 1240–1850 µg/kg aflatoxin was being ground, whereas workers in the vicinity were exposed to 429–1300 µg/kg of this toxin [7].

Workers were exposed to daily intake of 170 ng of aflatoxin B_1 in the feed manufacturing mill, when prepared mixed feed had 140 µg/kg of aflatoxin B_1 [8].

Material and Methods

The samples of settled dust from three different poultry feed mills were collected as sweeping per unit area at different distances from the sources of the generation of the dust like hammer mills, grinding, loading and unloading of feed ingredients and near the elevators. The amount of dust collected per eight hour working shift from different distance of these sources was 951 gm/sq. ft. from one foot and 112 gm/sq. ft. from seven feet. The vegetable sources of ingredients used for making poultry feed were cottonseed meal, sunflower meal, corn, broken rice, wheat, wheat bran, rapeseed meal and occasionally corn gluten meal. Fishmeal, blood meal, meat meal and poultry by-products meal etc. were used as animal sources of protein. The quantities of the samples, varried from 130-800 gm depending upon the distance from the source. The samples were collected at the end of the working hours in the feed mills and brought to the laboratory and analyzed within 24 hrs. Clean-up was done according to the Romer method and quantification was done by visual comparison with standards on thin layer chromatography plates as described, in the Official Method of AOAC [9]. Water slurries were made of the whole samples [10] to make the sub-sample more representative. 100 grams of slurry was blended with 200 ml of acetone in explosion proof blender for aflatoxin extraction. Ether: Methanol: Water (94:4.5:1.5) or Chloroform: Acetone (9:1) solvent systems were used for the development of TLC plates. Two dimensional thin layer chromatography was performed whenever the extract was not clean enough for one dimensional chromatography. Confirmation was achieved by making derivatives with triflouroacetic acid and by spray with 50% sulfuric acid on thin layer chromatography plates.

Results and Discussion

The survey was spread over a period of two years and three poultry feed mills were monitored (Table 1). A total of 227 samples were collected among these 154 samples (68%) were found containing aflatoxin B_1. In the year 1986, in the feed mill "C", 49 samples out of 61 were positive for AFB_1 with an average level of 92 µg/kg, which happens to be the highest content from any feed mill. The highest amount of AFB_1 815 µg/kg, was found in a sample collected in 1986 from feed mill "A". Over the period of study all three feed mills had over 50% samples positive for AFB_1 and the amount of AFB_1 ranged from 2-815 µg/kg in the settled dust. Thirty five samples collected in the year 1985 had AFB_1 less than 20 µg/kg, 27 had between 21 – 100 µg/kg and the same number of the samples contained AFB_1 more than 100 µg/kg

TABLE 1. PRESENCE OF AFLATOXIN B_1 µg/kg IN THE SETTLED DUST OF POULTRY FEED MILLS

Feed mill	Year	No. of samples collected	No. of positive samples	Percent contaminated samples	Average content	Range
A	1985	33	23	66	85	4-523
	1986	46	27	59	72	2-815
B	1985	14	10	71	68	4-424
	1986	19	13	69	73	5-547
C	1985	52	32	62	72	3-608
	1986	61	49	80	92	2-732
	Total	227	154	68	82	2-815

but not over 607 µg/kg. In the year 1986 a total of 126 samples of settled dust were collected from the same three feed mills with 77% samples positive for AFB_1. Among the positive samples, 37 contained AFB_1 upto or less than 20 µg/kg, while 29 had it between 21–100 µg/kg and the remaining 23 samples between 100 µg/kg and 815 µg/kg.

In the year 1985, aflatoxin B_2 was found in 29 samples (44%) out of the 65 positive samples for aflatoxin B_1 and the amount ranged from 3–89 µg/kg with an average content of 38 µg/kg. While in the year 1986 number of samples contai-ning AFB_2 were 27 (30%) out of 89 samples found positive for AFB_1 and the range of AFB_2 was 2–104 µg/kg with an average content of 44 µg/kg.

Inhalation of dust containing aflatoxins is of great concern to the workers in poultry feed mills and other mills where contaminated grains are being handled. In addition to aflatoxins, other mycotoxins, pesticides and fungal spores are also potential sources of health hazards to workers. Risk involved is very high for individual handling ingredients like maize, cottonseed meal, corn gluten meal and sunflower meal etc which are most likely and highly contaminated with aflatoxins. Fine dust particles, less than 6 um in size, are mostly inhalable and it is likely that aflatoxins are transmitted alongwith these fine suspended dust particles. The fine dust remains suspended in work area for considerable period of time thus exposing the workers continously to this toxic environments.

Occupational esposure of workers to aflatoxins through the inhalation of contaminated dust should be of great concern to the management of these mills because the workers in the developing countries, working in such environments, are usually unaware of danger to their health. The workers should be provided safety masks and proper exaust system in the working area. It is also recommended that the highly toxic ingredients may be detoxified, before milling, by various approved methods to safeguard the workers as well as the animal health.

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References

1. L. Stoloff, *Aflatoxin in Human and Animal Health* (eds.) I. V. Rodericks, C. W. Hesseltine and M. A. Mehlaman, (Park Forest South, III, Pathodox, 1977),pp.7-28.
2. World Health Organization, Mycotoxins, Environmental Health Criteria 11, Geneva (1979).
3. M. S. Palmgren, *Trichotecenes and other Mycotoxins*, J. Lacey, ed. (John Wiley and Sons Ltd., 1985), pp. 47-57.
4. I. Dvorackova, V. Kusak, J. Vesela and P. Nesindal, Ann. Nutr. Alim., **31**, 977 (1977).
5. I. Dvorackova, Brit. Med. J., **3**, 691 (1976).
6. D. A. Fmanuel, F. J. Wenzel and B. R. Lawton, Chest, **67**, 293 (1975).
7. W. R. Burg and O. L. Shotwell, J. Assoc. Off. Anal. Chem., **67**, 309 (1984).
8. J. H. Olsen, L. Dragsted and H. Autrup, Br. J. Cancer, **58**, 392 (1988).
9. Association of Official Analytical Chemists, Chapter 26,(1990), 4th ed.
10. J. Velasco and S. S. Morris, Agric. Fd. Chem., **24**, 86 (1976).