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REDUCTION OF AFLATOXIN β_1 IN AMMONIATED CORN

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Detoxification studies of corn were carried out to determine the extent of decontamination at various levels of temperature, moisture and added ammonia. Non-detectable levels of aflatoxin were obtained in 7 days at 30° and 18 % moisture with 1.5 % ammonia added. At 40° and 18 % moisture with 1.5 % ammonia added, the non-detectable levels were reached in three days, initial contamination being 500 μg/kg. Similarly with 100 μg/kg initial aflatoxin contamination level, non-detectable levels were achieved in 3 days at 40° 18 % moisture and 1.5 % ammonia added.

INTRODUCTION

Aflatoxin contamination can occur prior to harvesting and it may be difficult to prevent or control its production. Detoxification appear to be the only successful method for eliminating the aflatoxin contamination. Ammoniation has been tried and found to be the most successful method for most of the agricultural products. Vesonder *et al.* [1] reacted crystalline aflatoxin β_1 with pure ammonia at ambient temperature for 21 days as a result of which a brown product was obtained. The brown residue was found to be non-toxic to chicken embryos. Under high temperature and pressure conditions [2, 3] the reaction resulted in the formation of other less potent compounds such as decarboxylated Aflatoxin D_1.

Aflatoxin contamination of corn seems to be the result of cultural practices and uncontrollable environmental conditions. This study was under taken to establish the optimum processing conditions for ammoniation of corn at ambient conditions of temperature and pressure.

EXPERIMENTAL

Clean corn was experimentally contaminated by growing a toxigenic strain of *Aspergillus flavus* and then adjusting the amount of aflatoxin β_1 to a round figure of 1000 μg/kg and 500 μg/kg.

The corn samples (250 g) were placed in plastic bags (12 x 18 cms) and labelled according to the specific treatments. Moisture content was adjusted by adding measured amount of water and concentrated ammonia (33 %, Merk) was added to bring the ammonia concentration to the prescribed level. After heat sealing the bags the contents were thoroughly mixed and were kept at 20, 30 and 40° for 3–14 days. At the end of the specified period, 150 g of ammoniated, ground seeds were neutralized immediately under continuous agitation with 1.7 N sulphuric acid and analysed by using thin-layer chromatography, according to the Association of Official Analytical Chemists method for aflatoxin β_1 in corn products (26.037, 26.014–26.019 1975).

Presence of aflatoxin was confirmed by using trifluoroacetic acid [5].

RESULTS AND DISCUSSION

Corn detoxification results are reported in Tables 1 and

Table 1. Effect of ammonia and moisture levels in treated corn on residual aflatoxin β_1 content for reaction at 20,30 and 40°.

NH_3 added percent of dry matter	Corn moisture, percentage			
	12.0	15.0	18.0	21.0
	Residual aflatoxin β_1 ' μg/kg			
	14 days at 20°			
0.5	160	90	50	55
1.0	75	50	33	25
2.0	26	15	12	18
	7 days at 30°			
0.5	90	50	33	30
1.0	45	30	20	25
1.5	20	12	ND	5
2.0	12	10	8	8

(Continued.....)

(Table 1, continued)

		3 days at 40°		
0.5	50	35	20	28
1.0	33	20	12	15
1.5	16	9	ND	8
2.0	10	6	6	7

Initial aflatoxin β_1 content was 500 μg/kg.
All readings are average of two sets of values.
ND: Non-detected.

Table 2. Effect of ammonia and moisture levels, in treated corn on residual aflatoxin β_1 content for reaction at 20, 30 and 40°

NH_3 added percent of dry matter	Corn moisture, percentage			
	12.0	15.0	18.0	21.0
	Residual aflatoxin β_1, μg/kg			
	14 days at 20°			
0.5	350	160	90	95
1.0	120	90	75	60
1.5	80	55	20	18
2.0	50	40	22	25
	7 days at 30°			
0.5	180	80	65	70
1.0	100	50	32	30
1.5	60	44	10	15
2.0	38	25	15	20
	3 days at 40°			
0.5	100	60	42	40
1.0	50	20	10	12
1.5	20	12	ND	5
2.0	10	6	ND	12

Initial aflatoxin β_1 content was 1000 μg/kg.
All readings were average of two sets of values.
ND : Non-detected.

2. With 1.5 percent ammonia (w/w), moisture content 18 percent and the incubation temperature 20 ± 2° , 14 days were required to reduce the aflatoxin β_1 content from 500 μg/kg to 6 μg/kg. Increase in incubation temperature to 30 ± 2° reduced the period to 7 days for non-detectable levels. Other parameters being the same; it was further reduced to 3 days at 40 ± 2°

Corn sample with an initial aflatoxin content of 1000 μg/kg was next ammoniated and the results are depicted in Table 2. With 1.5 percent ammonia (w/w), moisture content 18 percent and incubation temperature 20 ± 2° , 14 days were needed to reduce the aflatoxin β_1 to 20 μg/kg. Increase in incubation temperature to 30 ± 2° reduced the period to 7 days and aflatoxin β_1 level to 10 μg/kg. It was further reduced to 3 days at 40 ± 2° and non-detectable levels of aflatoxin β_1 were achieved.

Bagley [5] reported pronounced effect of temperature on the changes of aflatoxin level with time. It was reported that 600 μg/kg aflatoxin contamination and 15 percent moisture level in the corn was reduced to below the FDA guideline of 20 μg/kg in about 3 weeks at 25° , but in only 3 days at 38° .

It has been observed that low temperature reduces ammonia's volatility; thus potential material handling losses in large scale applications are reduced. Temperature of the ammoniated corn should be adjusted to 30 ± 2° or higher for adequate detoxification within a normally acceptable time period. If the experiments reported above are to be carried out at ambient temperature and pressure, there will be significant economic benefits for the feed industries concerned. This would eventually lower the treatment costs and produce a more desirable end product.

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