

Aflatoxins in Cottonseed Hulls¹

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Abstract

Previous studies indicate that aflatoxins were found in laboratory-prepared hulls from cottonseed which contained aflatoxins. However, no aflatoxins were found in hulls commercially processed from cottonseed containing aflatoxins, crops of 1964 and 1965, which were analyzed in our laboratory. Some lots of hulls prepared from contaminated cottonseed in our laboratory, simulating commercial conditions, were found to contain small but measurable quantities of aflatoxins. In normal oil mill operation the linters content of the seed is reduced 80% to 90% before dehulling. In the laboratory operation, small quantities of fine meats containing aflatoxins may have been trapped in linters on the hulls, resulting in a positive test for aflatoxins. It may be concluded that commercial hulls processed from cottonseed with moderate aflatoxin contamination will contain little or no aflatoxins.

Introduction

Although aflatoxins have been found in cottonseed in the United States, they are not a problem in most cotton-producing areas. During the three crop years beginning in 1964-65, the U.S. Department of Agriculture, in cooperation with the National Cottonseed Products Association and its members, surveyed the extent of contamination of cottonseed in the United States (1).

During this three-year period, aflatoxin-contaminated cottonseeds were found infrequently in all areas of production. In some areas aflatoxins in minor amounts were found once or twice during one year of the survey but not found at all during the other two years. At a sizeable number of locations, no aflatoxins were found during the entire survey period. At other locations, however, aflatoxins were found during each of the three years. The aflatoxin content was determined by the Pons-Goldblatt method (2).

During this survey weekly samples of cottonseed and cottonseed meal made from seed represented by the seed samples were analyzed for aflatoxins. Cottonseed hulls were not included in this survey.

Although considerable information is available on aflatoxins in cottonseed, little has been reported on aflatoxins found in cottonseed hulls. Mayne et al. (3) reported that in laboratory experiments cottonseed hulls were a relatively poor substrate, compared with cottonseed meats, for aflatoxin elaboration by *Aspergillus flavus*.

Pons and Goldblatt reported a sizeable amount of aflatoxins remaining in contaminated cottonseed hulls from which the fine meats had not been removed (2). This would be expected since aflatoxins would be found in the fine meats fraction that had not been removed from the hulls. McMeans et al. reported finding up to 360 ppb aflatoxins in cottonseed hulls prepared in the laboratory (4). Nothing has been

found in the literature on aflatoxins in commercially-produced cottonseed hulls.

Method of Separating Hulls and Meats at Cottonseed Oil Mills

During processing at the oil mill, cottonseeds are first cleaned, then the linters are removed. The linters content, which varies from 7% to 13%, is reduced to about 2% (varying from 0.8% to 3%). The hulls and meats are then separated by passing the seeds through a bar huller. The bar huller consists, in part, of a frame which holds stationary knives. A cylinder rotating within this frame contains knives which are set at a determined distance from the stationary knives to crack or cut the seed. A minimum of cutting is desired in order to prevent the formation of fine meats.

In the hulling process, the seeds are passed through a huller, cutting approximately 80% to 85% of the seed in the first pass. The cut seeds are then put over a shaker-separator to remove the free meats. The hulls and uncut seeds are passed through a hull beater and then through a hull and seed separator to remove the uncut seeds. The uncut seeds are returned to the huller and the hulls are passed through a beater having a fine screen to remove fine meat particles. These beaters are quite efficient in removing fine meats from hulls.

Analysis of Hulls for Aflatoxins

During the first year of our cottonseed aflatoxin survey a few 2 lb samples of hulls were received from two mills at a time when aflatoxins were found in the weekly seed and meal samples at these locations (Table I). In no instance was aflatoxin found in the hulls. These hull samples were not representative of the crop but were selected because aflatoxins had previously been found at these locations. The wide variation in aflatoxin found in the weekly seed and meal samples in this Table may be attributed to the high concentration of aflatoxins in a small proportion of the cottonseed with the remainder of the seed free of contamination (5).

Again during the second year of the study samples of production hulls together with seed and meal were received from three mills (Table II). As stated previously, these hull samples were not representa-

TABLE I
Aflatoxin Content of Cottonseed, Meal and Hulls Representing Seed Processed and Meal and Hulls Produced During a Specified 24 hr Period, (two mills), 1964-65

Sample	Aflatoxin content, ppb		
	Cottonseed B ₁	Cottonseed meal B ₁	Cottonseed hulls B ₁
1	250	220	ND ^a
2	1,500	650	ND
3	30	90	ND
4	10	175	ND
5	20	250	ND
6	300	125	ND
7	40	160	ND
8	10	150	ND
9	10	150	ND
10	5	200	ND
11	125	310	ND
12	75	300	ND

^a ND, none detected.

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TABLE II
Aflatoxin Content of Samples of Cottonseed, Meal and Hulls Representing Seed Processed and Meal and Hulls Produced During a Specified 7 day Period (3 mills), 1965-66

Sample	Aflatoxin content, ppb					
	Cottonseed		Cottonseed meal		Cottonseed hulls	
	B ₁	B ₂	B ₁	B ₂	B ₁	B ₂
B	50	0	65	20	ND ^a	ND
B ₁	380	90	40	10	ND	ND
D	0	0	95	20	ND	ND
D ₁	160	65	160	55	ND	ND
F	30	5	190	50	ND	ND
F ₁	10	0	140	40	ND	ND
L	30	0	110	35	ND	ND

^a ND, none detected.

tive of the crop but were specially selected. Again, no aflatoxins were detected in the hulls made from contaminated seed.

Laboratory Dehulling of Cottonseed

Since it was impossible to obtain cottonseed meal and hulls from mills during the 1968-69 season, a number of samples of cottonseed of the 1967-68 crop with known aflatoxin content, were separated into hulls and meats in our laboratory simulating as nearly as possible the commercial method used in oil mills. The laboratory method was carried out in four steps.

First the hulls were cracked or cut by a Bauer laboratory attrition mill which is a standard item of equipment in most cottonseed laboratories. Actually, this mill is a miniature disc huller, the type of huller which was used at oil mills before the bar huller came into use. This attrition mill has one stationary plate and one moving plate. There are bars and ridges with sharp edges on the plates with cutting edges radiating from the center. When the plates are properly spaced, the Bauer mill delivers seed in a form well adapted for separation.

In our next step the seeds were screened using a 20 mesh screen to remove large hulls. The remaining hulls and meats were passed over a 40 mesh screen. All large meats and separated linters were removed. The hulls were then cleaned by passing a jet of air through the hulls in a chamber of 40 mesh screen to remove fine meats. This step simulates the fine-meats beater used in the oil mill. The hulls were

TABLE III
Aflatoxin Content of Cottonseed Hulls and Meats Separated in the Laboratory From Cottonseed Contaminated With Aflatoxins (Crop 1967-68)^a

Sample	Aflatoxin content, ppb, µg/kg					
	Meats		Hulls ^b			
	B ₁	B ₂	B ₁	B ₂	B ₁	B ₂
A	14	ND ^c	ND		ND	
B	610	200	5		ND	
21	715	240	3		ND	
22	835	360	5		ND	
24	1,180	450	20		ND	
25	1,115	430	4		ND	
26	600	215	5		ND	
29	240	90	5		ND	
30	640	210	5		ND	
1	8,640	1,250	20 ^d		ND ^d	
2	1,945	350	3 ^d		ND ^d	
3	60	20	ND ^d		ND ^d	
4	1,620	325	3 ^d		ND ^d	
5	120	35	ND ^d		ND ^d	

^a Sample of cottonseed, 100 g, hull yield approximately 30%.

^b No air cleaning used.

^c ND, none detected.

^d Air cleaning process used in addition to hand cleaning.

then reground, the linters separated during grinding were removed, and aflatoxin analyses were made on the hulls.

On the first series of hull samples analyzed, we omitted step 3, that of cleaning the hulls of fine meats and dust by air. All cleaning was done by hand. As a result we found aflatoxins in eight of nine hull samples (Table III). However, in every case the aflatoxin content was quite low.

A second series of samples was prepared using 1967-68 crop cottonseed. In only one instance was aflatoxin in excess of 5 ppb found in the hulls. Since the meats in this particular sample contained more than 8,000 ppb of aflatoxin B₁, the 20 ppb found in the hulls are relatively inconsequential. Also, the possibility of milling cottonseed with contamination of this magnitude is indeed very rare.

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