Levels of aflatoxins in grains from Santa Catarina State, Southern Brazil

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Abstract

Brazil is located mainly in tropical and subtropical regions with conditions of temperature and humidity suited to fungal growth. However, part of the country is located in the temperate zone with mild temperatures and four well-defined seasons. Most of the data obtained on aflatoxin contamination in grains produced in Brazil are from Sao Paulo (southeast region). A better picture of the aflatoxin situation in the country would be gained by carrying out surveys in other grain-producing regions. Therefore, a survey on grains produced in Santa Catarina State, located in the far south of the country was carried out.

Maize (*Zea mais* L.), rice (*Oryza sativa*) with and without husk, black bean (*Phaseolus vulgaris*) and soy bean (*Glycine max*) produced in Santa Catarina State during 1989 was sampled at 14 regional agricultural centres throughout the State, and classified and analysed for aflatoxins. Ochratoxin A, sterigmatocystin and zearalenone, were also analysed. Aflatoxin B_1, B_2, G, and G_2 were determined using a minicolumn with florisil for the screening test, silica gel thin-layer chromatography for quantification, followed by confirmatory tests. Detection was by ultraviolet light.

Of 229 samples of grain just over 1% were contaminated with aflatoxin. Only maize and black bean were involved and only aflatoxin B, was found. No contamination was detected in rice, either with or without husk, or in soy beans. Although the incidence of aflatoxin detected in grains was low, the level of aflatoxin detected in the few positive samples of both maize and black bean was higher than the maximum residue level. No correlation was found between water content and moulding of the stored grains and aflatoxin production. Aflatoxin contamination possibly originated in the field or during harvesting.

The data suggested that the problem of aflatoxin contamination on grains produced in 1989 in Santa Catarina was low, perhaps because of good harvesting and storage practices in that State, as well as the weather during that particular year.

Introduction

The presence of mycotoxin in food can result in losses throughout the food chain and risk to human and animal health. Of the many fungal toxins reported so far, aflatoxins produced by *Aspergillus flavus* and *A. parasiticus* are the most important. This group is comprised of various compounds, the most toxic being aflatoxin B_1, which cause liver cancer in animals through ingestion of contaminated grains and nuts.

Brazil, with an area of 8511965 km^2, is mostly a tropical and subtropical country, having the conditions of humidity and temperature favourable for fungal growth. However, the south region which is in the temperate zone, presents four well-defined seasons with milder temperatures and rainfall as well as good storage conditions and resources.

Most of the data on aflatoxins are from the southeast region, more specifically São Paulo State (Pregnolato and Sabino 1970; Sabino and Correa 1981; Sabino et al. 1986; Scussel 1984; Scussel and Amaya 1985, 1986, 1992; Soares 1987) which does not represent the conditions of aflatoxin contamination of the country as a whole. This survey investigates the condition of grains produced in Santa Catarina, the southernmost part of the country, during 1989. Santa Catarina is a major grain-producing region.

Materials and Methods

A total of 229 samples of grains— maize (*Zea mays* L.), rice (*Oryza sativa*) with and without husks, black bean (*Phaselolus vulgaris*) and soya bean (*Glycine max*)—produced in 1989 were collected from 14 different regional agricultural centres of Santa Catarina State.

The samples were sent under controlled conditions to the Central Laboratory for Classification of Products of Vegetable Origin (CIDASC) and to the Food Science and Technology Department, Federal University of Santa Catarina, for grain classification and analysis of aflatoxins, respectively.

Samples, 1 kg each, were homogenised, ground in a Tecnal mill (16 mesh), divided into four portions of 250 g each using a Boerner sample divider, collected in jars, labelled, and parts of them used for different analyses. From one of the portions 50 g was taken and used for aflatoxin analysis.

Aflatoxins B_1, B_2, G_1 and G_2 were determined using a minicolumn packed with alumina, silica gel G and Florisil for the screening test (Romer 1975; AOAC 1984) silica gel thin-layer chromatography for quantification (AOAC 1984) and confirmation with trifluoroatic acid (Przbylski 1975), sulphuric acid (Schuller et al. 1967) and diethyl ether (Nabney and Nesbitt 1965). The detection was achieved by their fluorescence under ultra violet light. For mycotoxins, the multimycotoxin method of Soares (1987) was used. Analysis of water content, 'ardidos' and mouldy grain were carried out using the Agriculture Ministry Official Methods.

Results and Discussion

The data obtained from grains produced in Santa Catarina in 1989 showed a lower incidence of aflatoxin contamination compared with those reported in the literature for the southeast region of Brazil (Pregnolato and Sabino 1970; Sabino and Correa 1981; Sabino et al.. 1986).

From the positive samples analysed, only aflatoxin B_1 was detected and no sample was contaminated with ochratoxin A, sterigmatocystin or zearalenone. Of the total samples of grains analysed 1.31% were contaminated with aflatoxin B_1, with 0.87 and 0.44% contamination of black beans and maize, respectively (Table 1).

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From the 75 samples of black bean analysed, only two samples (2.67%) were positive with 302.2 and 30.8 ppb of aflatoxin B_1. The only maize sample contaminated with aflatoxin had 259.0 ppb. Although only a few samples were positive for aflatoxins, they were contaminated with levels higher than MRL (20 ppb).

As far as water content is concerned, the minimum amount for toxin production reported in the literature is 18% (Gorelova and Lvova 1980a,b). The samples with positive aflatoxin levels showed 14.32% and 12.45% water content, for black bean and maize, respectively. Therefore, the aflatoxin contamination detected could have occurred before storage, perhaps in the field or during harvesting.

In contrast, no contamination was detected in rice, either husked or unhusked, and soya beans. The husked and unhusked rice samples had moisture contents of 13.96 and 13.15%, respectively, and contained 0.22 and 0.91% of fermented, broken and discoloured grains.

The low percentage of mouldy grain in the samples positive for aflatoxin indicates that the contamination is not dependent on the quality of mould but the strain of fungus and conditions, during harvesting and in the field.

The low contamination in cereals and legumes produced in Santa Catarina State during 1989 generally reflects good practices in harvesting and storage as well as favourable weather conditions.

Table 1. Water content, percentage of 'Ardidos' and levels of aflatoxins in grains produced in Santa Catarina State during 1989.

Grain	Regional Agriculture Centres		Samples analysed		Water content (%)[a]	'Ardidos' (%)[a]	Mouldy (%)[a]	Aflatoxins (ppb)			
	Name	Centre number	Number	Positive				B_1	B_2	G_1	G_2
Black bean (*Phaseolus vulgaris*)	Chapeco	2	13	1	14.50	0.22	0.51	302.2[b]	ND	ND	ND
	Concordia	3	7	1	13.80	0.10	0.10	30.8[b]	ND	ND	ND
	Joacaba	4	6	-	17.20	0.78	0.35	ND	ND	ND	ND
	Joinville	8	7	-	17.50	0.20	1.23	ND	ND	ND	ND
	Lages	6	1	-	17.60	0.72	2.28	ND	ND	ND	ND
	Mafra	7	29	-	15.54	0.18	2.30	ND	ND	ND	ND
	Rio do Sul	10	4	-	14.30	0.15	1.15	ND	ND	ND	ND
	Sao Miguel d'Oeste	1	6	-	14.40	0.53	0.64	ND	ND	ND	ND
	Xanxere	14	5	-	13.56	0.04	0.24	ND	ND	ND	ND
Soya bean (*Glycine max)*	Chapeco	2	1	-	13.00	4.80	1.32	ND	ND	ND	ND
	Mafra	7	3	-	15.13	1.92	NA	ND	ND	ND	ND
	Xanxere	14	5	-	13.56	1.73	0.26	ND	ND	ND	ND
Maize (*Zea mays)*	Chapeco	2	1	-	13.50	4.40	NAd	ND	ND	ND	ND
	Concordia	3	1	-	16.50	2.68	NA	ND	ND	ND	ND
	Sao Miguel d'Oeste	1	3	-	13.10	3.00	NA	ND	ND	ND	ND
	Xanxere	14	2	1	14.00	5.54	NA	250.0[a]	ND	ND	ND
Rice (*Oryza sativa)* with husk	Criciuma	13	28	-	13.30	0.11	NA	ND	ND	ND	ND
	Joinville	8	9	-	12.90	0.02	NA	ND	ND	ND	ND
	Rio do Sul	10	10	-	13.50	0.60	NA	ND	ND	ND	ND
	Tubaro	12	6	-	12.90	0.13	NA	ND	ND	ND	ND
Rice (*Oryza sativa)* without husk	Blumenau	9	9	-	12.40	0.13	NA	ND	ND	ND	ND
	Criciuma	13	12	-	13.40	0.10	NA	ND	ND	ND	
	Joacaba	4	5	-	14.60	0.10	NA	ND	ND	ND	
	Joinville	8	37	-	13.20	0.10	NA	ND	ND	ND	
	Lages	6	3	-	13.30	0.05	NA	ND	ND	ND	
	Rio do Sul	10	3	-	14.00	0.01	NA	ND	ND	ND	
	Sao Jose	11	9	-	13.00	0.02	NA	ND	ND	ND	
	Tubaroa	12	4	-	13.80	0.17	NA	ND	ND	ND	

[a] average of the total sample collected

[b] result of an individual sample

[c] not detected

[d] not analysed

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