



## Preliminary study of aflatoxin contamination of sorghum food chain in south Haiti

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### Abstract

Sorghum is the third most consumed cereal in Haiti. It is cultivated in almost all departments of Haiti. Studies conducted on the safety of sorghum food chain in Haiti are rare. This preliminary study is aimed at evaluating the aflatoxin (AF) contamination of products across three steps of sorghum food chain in South Haiti. Significantly different AF contaminations were noticed among samples ( $p < 0.05$ ). Mean AF concentrations are  $5.40 \pm 0.62$ ;  $20.53 \pm 16.05$  and  $40.88 \pm 43.36$  ppb in freshly harvested sorghum (FHS), sorghum street vendors (SSV) and manufactured sorghum products (MSP), respectively. Moreover, 50 and 44.44% of tested MSP and SSV had AF concentrations  $> 20$  ppb (limit of US Food and Drugs Administration) while none of FHS is  $> 20$  ppb. Findings suggest that MSP and SSV are the steps with the highest aflatoxin contamination in South Haiti. Complementary investigations are needed to confirm the present findings through more reliable AF quantification techniques.

**Keywords:** aflatoxin contamination, sorghum, Haiti

### 1. Introduction

Sorghum is the third most consumed cereals after rice and maize in Haiti. Sorghum is cultivated in almost all departments of Haiti. South department is one of the most important as for cereals [1]. Sorghum is consumed as either freshly harvested products (FHP), or manufactured sorghum products (MSP), like flour and milled sorghum. Agroecological condition and agricultural practices could offer suitable conditions for the growth of moulds that produce aflatoxin (AF) in developing countries like Haiti. High AF contamination was so far reported [2, 3] in drinking water, maize, baby food flour and peanuts produced in Haiti.

These previous studies were all focused on a single step of the Haitian food chain, although cereal products, like sorghum, can be infected by moulds that produce AF during (i) seed selection, (ii) plantation and growth steps, (iii) post-harvest treatments and (iv) storage. Contamination of freshly harvested maize and sorghum [4, 5] and manufactured products [6, 7] was indeed reported. Furthermore, several studies [8, 9] mention mycotoxin contaminated products suggesting the role played by the street vendors and the structure of selling points in developing countries.

Surveys of the whole food chain of cereals are rare. This is the reason for the present preliminary study aimed at evaluating the AF contamination of products across three steps of sorghum food chain in South Haiti.

### 2. Materials and methods

#### 2.1 Sampling

A total of 22 sorghum samples were collected in South, Haiti during September 2018. They were specimens of (i) freshly harvested sorghum (FHS), (ii) retails sorghum street vendors (SSV) and (iii) manufactured sorghum products (MSP) (Table 1). The mass of each sample was around 300 g. The products were

put in a plastic bag, transported to the *Agrolab* of the Agriculture Faculty of the University Notre Dame of Haiti (located at Torbeck) and stored at 5 °C until the AF test [10, 11].

#### 2.2 Aflatoxin quantification

The screening for total aflatoxins (B1, B2, G1 and G2) concentration was performed with the Reveal<sup>®</sup> Q+ aflatoxin test (Neogen<sup>®</sup>) following the instruction by the producer [12].

#### 2.2 Statistical analysis

The SPSS statistical package for Windows, v. 22.0 (SPSS Inc.) was used for all analyses [13]. For a descriptive analysis, minimum, maximum, arithmetical mean and standard deviation were computed for the AF concentration. A one-way analysis of variance (ANOVA) was performed using provenance of samples as fixed. The tests were performed at  $p < 0.05$ .

### 3. Results & Discussion

The 22 samples collected were submitted to one-way ANOVA test. The results are reported in Table 1. Significant differences were noted among tested materials as for their provenance ( $P = 0.027$ ). FHS samples were less AF contaminated than MSP ( $p < 0.05$ ), the latter showing an 8 times larger AF concentration than the former. The maximum AF concentrations were 6.5 and 92.5 ppb in FHS and MSP, respectively. Similar findings are in line with those of other authors [14, 15].

No significant difference ( $p > 0.05$ ) was noted between SSV and FHS. Minimum AF concentrations were 4.7 and 5.5 ppb in FHS and SSV, respectively, in agreement with other works [4].

AF contamination of FHS showed a smaller error range than SSV and MSP, the relevant standard deviation (SD) being 0.62; 16.05 and 43.36, respectively. None of the 7 FHS samples has AF

content larger than the USFDA limit (20 ppb). Yet, 50 and 44.44% of MSP and SSV samples showed AF concentrations beyond this limit. Similar findings were reported in other works [2, 16].

An additional statistical analysis was performed on MSP samples. The results are shown on Fig 1. The origin of MSP seems to have a great impact on the AF concentration in tested materials. The mean of the AF concentrations in products from Kans and Fonfrède was 52.73 and 5.3 ppb, respectively. These findings are in line with those reported by other authors [17, 18]. SSV samples from three different street markets (Table 1) revealed important variations (SD=16.05). No significant difference was noted among tested SSV products (P=0.75). The mean AF concentration in SSV products (data not reported in tables and figures) was 15.37, 19.63 and 26.60 ppb for Marché Jeudi, Marché Relais and Marché en Fer, respectively, in line with previous studies conducted in Haiti [19, 20, 12].

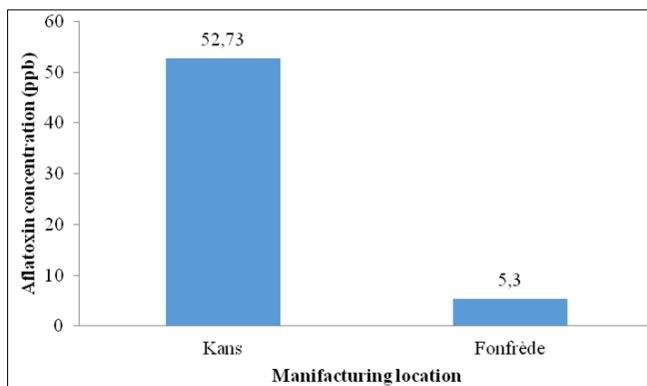
**Table 1:** Nature and origin of sorghum samples of the study

Nature of samples	Origin	Number of samples
Freshly harvested sorghum	Kans	4
	Fonfrède	3
Manufactured sorghum products	Kans	3
	Fonfrède	3
Sorghum street vendors	Marché en Fer	3
	Marché Relais	3
	Marché Jeudi	3
Total		22

**Table 2:** Aflatoxin concentration of tested samples

Aflatoxin (ppb)			
Origin of samples	Rank	Mean±SD	>20 (USFDA limit)
Freshly harvested sorghum	[4.70; 6.50]	5.40±0.62a	ND
Sorghum street vendors	[5.50; 48.10]	20.53±16.05 ab	4/9 (44.44%)
Manufactured sorghum products	[4.90; 92.50]	40.88±43.36b	3/6 (50%)
Probability	-	0.027	-

Samples with different letter are significantly different at p<0.05. ND: not detected; SD: standard deviation.



**Fig 1:** Aflatoxin concentration (ppb) of manufactured sorghum products from Kans and Fonfrède areas.

#### 4. Conclusion

This preliminary study is the first research that takes in consideration samples collected across three steps (Farmers fields/ freshly harvested sorghum, manufactured products and selling points/ street vendors) of the sorghum food chain in South Haiti. The results suggest that the AF contamination of sorghum along the food chain would be mainly related to inappropriate MSP and SSV practices rather than to the freshly harvested product (FHS). This finding indicates the necessity to develop programs aimed at improving the manufacture and sale practices to reduce the aflatoxin risk for the Haitian consumers of sorghum.

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