Available online at http://www.ifgdg.org

Int. J. Biol. Chem. Sci. 13(3): 1821-1825, June 2019

ISSN 1997-342X (Online), ISSN 1991-8631 (Print)

International Journal of Biological and Chemical Sciences

Short Communication http://ajol.info/index.php/ijbcs http://indexmedicus.afro.who.int

Aflatoxin contamination of baby food flour sold on Haitian markets

Junior ARISTIL

Centre de Recherche Interdisciplinaire pour la Vulgarisation Agricole et le Développement Local (CREIVADEL), Université Notre Dame d'Haïti, Faculté d'Agronomie, BP: HT 8110, Redon, Torbeck, Sud d'Haïti.

E-mail: junior2aris@gmail.com ; Tél: (+ 509) 46 92 31 73/ 41 53 90 57

ABSTRACT

Mycotoxins (Mox) are secondary metabolites produced by filamentous moulds. Among Mox, aflatoxins (AFs) are noted as the most preoccupant carcinogen substances known. AFs contaminate several food materials and derived products such as flour. The present investigation aimed at evaluating the AF contaminations of maize, cassava, moringa and rice flour products utilized as baby food in Haiti. Twenty five samples were collected in South Haiti (from street's vendors and, Les Cayes markets and supermarkets). Those products were tested for AFs content using and following Reveal® Q+ aflatoxin test (Neogen®) supply instruction. Results reveal that AF contaminations of substrates range from 2.7 and 119 ppb. Cereal products were more AF contaminated compared to tuber and moringa. Maize flour samples were more AF contaminated than rice. AF contaminations of maize seem to depend on provenance ($p< 0.05$). AF contaminations of maize from Iron and *Relais* markets were respectively 5.2 and 32.1 ppb. Moreover, AF contaminations of maize collected from street vendors represented almost seven times of that from Les Cayes supermarkets. Similar results suggest necessity to perform and develop programs for managing AF contaminations on baby food in Haiti.

Keywords: Aflatoxin, flour, maize, cassava, moringa, rice.

INTRODUCTION

Mycotoxins (Mox) are secondary metabolites produced by filamentous moulds. Mox contaminate approximately 25% of the cereals in the world and are mainly common of developing countries (Al-Taher et al., 2017). Aflatoxins (AFs) are the most avoiding and documented Mox (Huertas-Pérez et al., 2018).

AFs are produced by *Aspergillus flavus*, and *A. parasiticus*, which are worldwide distributed and relatively predominant in tropical and subtropical areas. Other species such as *A. nomius*, *A. pseudotamarii*, and *A. bombycis* also produce AFs. AFs are cancer-causing and immuno-depressing and could be source of several infant diseases (Al-Taher et al., 2017). Consumption of aflatoxin-contaminated products could reduce infant immunity and weight-gain (Kachapulula et al., 2017). AFs contaminate a range of products included maize (*Zea mays*), cassava (*Manihot esculentum)* and derived products (Matsiko et al., 2017).

Haiti, in Americas, has the highest rate of underweight and malnourished children (Evans and Bassani, 2018). Most of those Haitian malnourished children cases are treated using local agricultural products (Irarrázaval et al., 2018). The most consumed agricultural crops in Haiti are cereals and

DOI: https://dx.doi.org/10.4314/ijbcs.v13i3.49

derived products. In Caribbean region, Haiti is the second consumer of maize after Cuba with 66 grams per person per day. Maize and rice provide up to 35% of Haitian daily calorie intake (Chaudhary et al., 2018). Those cereals are consumed in different forms including flour. Flour products were reported to be contaminated by toxigenic moulds and toxins in country presenting similar climate characteristic like Haiti (Temba et al., 2017; Matsiko et al., 2017).

Benzolive (*Moringa oleifera L)* derived products are also used against malnutrition (Kane et al., 2016). Moringa oil and fresh leaves powders are consumed (Mawouma et al., 2017). Contamination of maize, moringa, peanut and rice were documented (Huertas-Pérez et al., 2018; Schwartzbord and Brown, 2015). Positive correlation was reported between peanut consumption and the AF detected from adult's urines in the area of Port-Au-Prince (Schwartzbord et al., 2016). Flour products are infant basic food materials and, are enriched for combating malnutrition in Haiti. But till now, there is no investigation conducted on AF contaminations of those products in Haiti. Therefore, the present study aimed at investigating the AF associated with maize, cassava, moringa and rice flour products sold and used as basic baby food in Haiti.

MATERIALS AND METHODS

Sampling

A total of 25 basic baby flour foods were sampled in South, Haiti during February 2018. Sampled products included maize (n= 14), moringa (n=3), cassava (n=4) and rice (n=4). Maize flour products were collected in Iron and *Relais* markets and from retails street vendors and supermarkets of Les Cayes commune. Each collected sample weighted around 200 g. Collected products were put in a plastic bag, transported to the *Agrolab* of Agriculture Faculty of University Notre Dame of Haiti, located at Torbeck. Products were then stored at 5 °C until the aflatoxin test (Ekpo et al., 2017; Hellar-Kihampa, 2011).

Aflatoxin quantification

The screening for total aflatoxins (B1, B2, G1 and G2) concentration was performed following Reveal® Q+ aflatoxin test (Neogen®) supply instruction. Reveal® Q+ for AFs is a single-step lateral flow immuno chromatographic assay based on a competitive immuno assay format for the quantitative testing of AF. The range of AFs detection of kit is 2- 1500 ppb. Briefly, 10 grams of powder was mixed with 50 ml of ethanol 65% (ethanol: water; 65: 35, vol/ vol) in a plastic cylinder (1:5, flour: ethanol 65%, weight: vol) and shacked manually for three minutes. With a Fisher pipette, 100 µl of extract were transferred into sample cup and 500 µl of diluents added. One hundred µl of the dilution were transferred into another sample cup. A strip was immerged into the solution and incubated at room temperature during six minutes. At the end of incubation, the tip was inserted into an AccuScan Gold detector for quantifying total AFs. AF test was performed less than three days after sampling.

Statistical analysis

The SPSS statistical package for Windows, v. 22.0 (SPSS Inc.) was used for all analyses (Corp, 2013). AFs content of samples were submitted to descriptive analyze. Minimum, maximum, arithmetical mean and standard deviation were calculated for AF concentrations of each baby food material. Student t test was performed using origins (Iron / *Relais* markets and street vendors/ supermarkets) of samples as fixed. The tests were performed at $p< 0.05$ (Sakpere et al., 2018).

RESULTS

Cereals and tuber products are listed as the most important basic baby food in Haiti. Seventy-two percent of collected samples were cereals. The proportion of maize products was almost four times of those of rice and cassava. Results of AF contaminations of those substrates are shown in Table 1. AF contaminations of Haitian samples range from 2.7 to 119 ppb.

The maximum and minimum AF contaminations were noted in maize and cassava flour samples, respectively. All cassava products showed < 5 ppb fixed by the European Union (EU). Cassava samples were less AF contaminated compared to moringa. Mean AF contaminations registered from moringa was 10.3 ppb. Moringa baby food products had AF contaminations higher than 5 ppb.

Comparing tuber and cereals products, the last ones were more AF contaminated. AF contaminations of rice ranged from 4.1 to 5.4 ppb. The most AF contaminated of tested baby flour foods was maize. Almost 22 % of maize samples had AFs concentration greater than US Food and Drugs Administration (USFDA) limit (20 ppb).

Maize AF contaminations depend on provenance. Maize collected at Iron market was less AF contaminated compared to *Relais* market ($p<0.05$). Mean AF contaminations of maize from Iron and *Relais* markets were respectively 5.2 and 32.1 ppb (Figure 1). AF content of maize products from *Relais* market represents almost seven times of that of Iron market. Moreover, maize from Les Cayes supermarkets was less infected compared to street vendors ones with respectively 6.1 and 23.9 ppb (not shown).

Table 1: Aflatoxin concentration (ppb) of Haitian baby food products tested in the current survey.

Basic baby flour foods	Number of samples	Max	Mean	Min	>10 ppb
Maize	14	119	4.5±31.3	4.4	5
Rice	4	5.4	4.9±0.6	4.1	0
Moringa	3	12.4	10.3±1.8	9.1	1
Cassava	4	4.7	4.0±0.9	2.7	0
Total	25	-	-	-	6

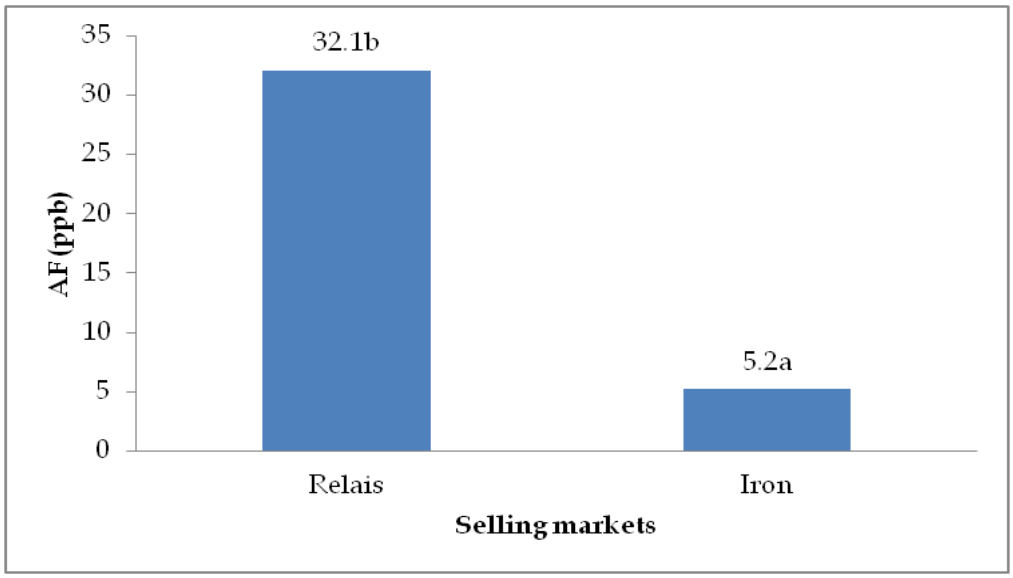

Figure 1: Aflatoxin (ppb) quantified in maize flour from *Relais* and Iron markets of Les Cayes. Bars with different letters indicate difference at $p< 0.05$.

DISCUSSION

AF contaminations are one of the most preoccupant problems of developing countries. Developing countries located in tropical area like Haiti are often subject to AF contaminations. The most documented food materials in Haiti for AF are peanut and maize. AF contaminations of maize in Haiti were reported by (Aristil, 2017). Several techniques and methods were used for AF quantification. High Performance Liquid Chromatography and Enzyme-Linked Immunosorbent Assay are the most developed. In developing country with very limited resources, other techniques are also employed for AFs quantification such as Reveal® Q+. In the current survey, the last category was utilized.

In this investigation, maize is more AF contaminated compared to other food materials. Contaminations of maize by AF could be due to inappropriate storage and post-harvest management (Hell et al., 2000). Almost 22% of AF quantified in Haitian maize baby flour food was greater than USFDA limit of 20 ppb, which are congruent with (Schwartzbord and Brown, 2015). Maize from *Relais* market and street's vendors were more AF contaminated compared with Iron market and Les Cayes supermarkets. The difference could be due to the structure of those storage places and selling points.

Contrarily to maize flour, all rice samples had AF contaminations less than 10 ppb, which is not consistent with (Liu et al., 2006).

Tuber such as cassava is basic food in Haiti. AF quantified in Haitian cassava was < 5 ppb, which is in concordance with (Matsiko et al., 2017).

Moringa is often noted as appropriate for combating several diseases (Leone et al., 2015). Moringa leave powder is used as supplement of baby food and tea in Haiti. Moringa leaves powders of this study are contaminated by AF > 5 ppb. Similar results support data reported by Aristil et al. (2017). Those contaminations could be due to inappropriate storage condition and post-harvest managements.

Conclusion

Cereals and tuber products are used by different ways in Haiti. Infants and adults are consuming those food materials. This research is the first conducted putting emphasis on AF contaminations of baby flour foods in South, Haiti. Findings reveal infant aflatoxicosis risk exposure in Haiti. Results suggest necessity to perform and develop programs for managing AF contaminations in baby foods in Haiti.

COMPETING INTERESTS

The author has not declared any competing interests.

ACKNOWLEDGEMENTS

Deep thanks to Augustin Dieunisse and Cleanta Laugene for their support during aflatoxin quantifications.

REFERENCES

Al-Taher F, Cappozzo J, Zweigenbaum J, Lee HJ, Jackson L, Ryu D. 2017. Detection and quantitation of mycotoxins in infant cereals in the US market by LC-MS/MS using a stable isotope dilution assay. *Food Control*, **72**: 27-35. DOI: http://dx.doi.org/10.1016/j.foodcont.2016.07.027

Aristil J, Venturini G, Spada A. 2017. Occurrence of Toxigenic Fungi and Aflatoxin Potential of Aspergillus spp. Strains Associated with Subsistence Farmed Crops in Haiti. *J. Food Prot.,* **80**(4): 626-631.

Chaudhary A, Gustafson D, Mathys A. 2018. Multi-indicator sustainability assessment of global food systems. *Nature Communications*, **9**(1): 848.

Corp IBM. 2013. IBM SPSS statistics for windows, version 22.0. Armonk, NY: IBM Corp.

Ekpo IA, Kechia FA, Iwewe YS, Ngueguim AD, Nangwat C, Dzoyem JP. 2017. Species distribution and antifungal susceptibility profile of Candida spp isolated from urine of hospitalized patients in Dschang District Hospital, Cameroon. *Int. J. Biol. Chem. Sci.,* **11**(3): 1212-1221. DOI: https://dx.doi.org/10.4314/ijbcs.v11i3.23

Evans A, Diego B. Trends and determinants of childhood malnutrition in Haiti pre-and post-the earthquake. 2018: 533-533.

Hell K, Cardwell KF, Setamou M, Poehling HM. 2000. The influence of storage practices on aflatoxin contamination in maize in four agroecological zones of Benin, West Africa. *Journal of Stored Products Research*, **36**(4): 365-382. DOI: https://doi.org/10.1016/S0022-474X(99)00056-9

Hellar-Kihampa H. 2011. Organochlorine pesticide residues in soil from sugarcane plantations in Kilimanjaro, Tanzania. *Int. J. Biol. Chem. Sci*., **5**(1*)*: 247-257.

Huertas-Pérez JF, Arroyo-Manzanares N, Hitzler D, Castro-Guerrero FG, Gámiz-Gracia L, García-Campaña AM. 2018. Simple determination of aflatoxins in rice by ultra-high performance liquid chromatography coupled to chemical post-column derivatization and fluorescence detection. *Food Chem.,* **245**: 189-195. DOI: https://doi.org/10.1016/j.foodchem.2017.10.041

Irarrázaval B, Barja S, Bustos E, Doirsaint R, Senethmm G, Guzmán MP, Uauy R. 2018. Influence of Feeding Practices on Malnutrition in Haitian Infants and Young Children. *Nutrients*, **10**(3): 382. DOI: 10.3390/nu10030382

Kachapulula PW, Akello J, Bandyopadhyay R, Cotty PJ. 2017. Aspergillus section Flavi community structure in Zambia influences aflatoxin contamination of maize and groundnut. *Int J Food Microbiol.*, **261**: 49-56. DOI: https://doi.org/10.1016/j.ijfoodmicro.2017.08.014

Kane C, Bâ A, Mahamat SAM, Ayessou N, Mbacké MK, Diop CGM. 2016. Combination of alum and extracted Moringa oleifera bioactive molecules powder for municipal wastewater treatment. *Int. J. Biol. Chem. Sci.*, **10**(4): 1918-1929. DOI: http://dx.doi.org/10.4314/ijbcs.v10i4.39

Leone A, Spada A, Battezzati A, Schiraldi A, Aristil J, Bertoli S. 2015. Cultivation, genetic, ethnopharmacology, phytochemistry and pharmacology of Moringa oleifera leaves: An overview. *Int J Mol Sci.,* **16**(6): 12791-12835. DOI: https://doi.org/10.3390/ijms160612791

Liu Z, Gao J, Yu J. 2006. Aflatoxins in stored maize and rice grains in Liaoning Province, China. *Journal of Stored Products Research*, **42**(4): 468-479. DOI: https://doi.org/10.1016/j.jspr.2005.09.003

Matsiko F, Kanyange C, Ingabire G, Dusingizimana T, Vasanthakaalam H, Kimonyo A. 2017. Detection and quantification of aflatoxin in cassava and maize flour sold in Kigali open markets, Rwanda. *International Food Research Journal*, **24**(1): 459.

Mawouma S, Ponka R, Mbofung CM. 2017. Acceptability and solubility of iron and zinc contents of modified Moringa oleifera sauces consumed in the Far-north region of Cameroon. *Food science & Nutrition*, **5**(2): 344-348. DOI: https://doi.org/10.1002/fsn3.398

Sakpere AMA, Bankole M, Oyekola OB, Akinyemi OS, Akosile OR, Adegboye OA, Akinropo MS, Obisesan IA. 2018. Effect of different Moringa oleifera extracts and fruit peels on the growth of Solanum scabrum. *Int. J. Biol. Chem. Sci.*, **12**(4): 1543-1549. DOI: http://dx.doi.org/10.4314/ijbcs.v12i4.2

Schwartzbord JR, Brown DL. 2015. Aflatoxin contamination in Haitian peanut products and maize and the safety of oil processed from contaminated peanuts. *Food Control*, **56**: 114-118. DOI: https://doi.org/10.1016/j.foodcont.2015.03.014

Schwartzbord JR, Leroy JL, Severe L, Brown DL. 2016. Urinary aflatoxin M1 in Port-au-Prince and a rural community in north-east Haiti. *Food Addit Contam: Part A.*, **33**(6): 1036-1042. DOI: https://doi.org/10.1080/19440049.2016.1185899

Temba MC, Njobeh PB, Kayitesi E. 2017. Storage stability of maize-groundnut composite flours and an assessment of aflatoxin B1 and ochratoxin A contamination in flours and porridges. *Food Control*, **71**: 178-186. DOI: https://doi.org/10.1016/j.foodcont.2016.06.033