



Occurrence of Aflatoxins in Retail Kola Nuts in Ibadan Metropolis

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Authors' contributions

This work was carried out in collaboration among all authors. Authors OOA and OOK conceived and designed the experiment. Authors OOA and OOK performed the experiment. Authors OOK, SAO, LOO and AAA analyzed the data and wrote the paper. All authors read and approved the final manuscript.

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ABSTRACT

Aim: This study was designed to determine Aflatoxins present in kola nuts sold in Ibadan metropolis.

Study design: Kola nuts were randomly purchased from different markets in Ibadan, Oyo State.

Methodology: Thin layer chromatography (TLC) and spectrophotometric method were used for the determination of aflatoxins in the kola nuts samples.

Results: All the samples collected were contaminated with aflatoxins. Aflatoxin B₁ and B₂ were present in the kola nuts samples ranging from 9.73 - 25.43 µg/kg and 10.90 - 29.67 µg/kg respectively.

Conclusion: The levels of aflatoxins in the sampled kola nuts were mostly above recommended tolerable limits. It is imperative to enlighten stakeholders on possible ways of handling kola nuts towards reducing the aflatoxin incidences to the barest minimum in order to safeguard the health of the populace.

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1. INTRODUCTION

Aflatoxins are by-products of secondary metabolism of filamentous fungi that can bring about damaging effects on human and animal health, thereby leading to crucial economic losses [1,2]. They are found as contaminants in many agricultural products such as nuts [3], fruits and vegetables [4], grape juice [5], coffee [6], animal feed [7], cereals, wheat, milk and dairy products, spices and herbs, cocoa, etc. Aflatoxin is one of the most important mycotoxins known today and the most studied mycotoxins among those with a wide range of deadly biological activities. Aflatoxins exhibit carcinogenic, mutagenic, teratogenic and immunosuppressive effects [8-11]. More than thirty aflatoxins have been discovered, however, Aflatoxin B₁, B₂, G₁ and G₂ are the most notable [12]. Under favorable conditions, *Aspergillus flavus*, *A. nomius*, and *A. parasiticus* are known to produce the common aflatoxins found in food and feeds [13,14]. However, other species of fungi that produce aflatoxins also exist [15]. Incidence of aflatoxin producing fungi and production of aflatoxin on agricultural products could occur anywhere along the production chain; including the field before harvest, after harvest, during processing and in storage. Generally, aflatoxins is said to have a high prevalence of 43.5% in Africa [16]. In Nigeria, aflatoxins have been detected in so many products, including cereals, cowpeas, groundnut, flour made from cassava and yam, cocoa, animal feeds and nuts [17-21].

Kola nut is an important cash crop in Nigeria. They are obtained from the fruit of kola tree. A significant number of Nigerians are involved in its farming and trading. The country produces an estimated 88% of the world's kola nuts with an annual production of 200,000 metric tons, which are mostly from Southwest Nigeria. Over 90% of kola nuts produced in Nigeria is consumed within the country, the remaining is exported to neighboring countries in the west and other African countries [22,23]. Kola nut is revered as sacred for social and religious ceremonies mostly in Southern Nigeria. It is also important because of its pharmacological properties, biologically active constituents, and its industrial usage [24-26]. Kola nuts are of three varieties (the red, white and pink), however the red variety is most commonly encountered in the villages and cities,

sold by merchants and retailers at different open market places.

It is a common knowledge that kola nuts are consumed directly as purchased from the market places. This is a cause for concern because like other agricultural commodities, they are susceptible to mould infection [27]. Mould growth is a serious problem encountered by retailers in the process of preservation and storage of kola nuts. The peasant way of preserving and storing predisposes the kola nuts to mould contamination, which becomes worse during the period of sales due to manner with which it is handled. The consumers on the other hand, are sometimes reluctant to dispose seemingly mouldy kola nuts because of its economic value. Kola nuts infected with moulds could harbor aflatoxins or other mycotoxins, thus putting the health and safety of the consumers at risk. Kola nuts are very important in the day to day lives of Nigerians, thus the need to examine the kola nuts for presence of aflatoxins

2. MATERIALS AND METHODS

2.1 Sample Collection

Dried nuts of *C. acuminata* were purchased from different markets and road side retailers in Ibadan metropolis, Oyo State. These include Oje, Orita-challenge, Challenge, Oja-Oba, Molete, Ojo and Bodija markets in Ibadan. The nuts samples were selected randomly from each market. A total of 20 samples were collected and taken to the laboratory for analysis.

2.2 Extraction and Determination of Aflatoxins

A slightly modified method of AOAC was used [28]. The nuts were cleaned up, pulverized to powder and mixed thoroughly before 50g each of the samples were taken for the extraction of aflatoxin using chloroform as solvent. Aflatoxin was later eluted using methanol-chloroform. Thin layer chromatography was done with benzene-acetonitrile and developed plates were viewed under ultra violet light and the pattern of florescent was noted. Quantification was done by comparing the florescent intensities of the samples with the standard and the concentration in µg / kg was calculated.

3. RESULTS AND DISCUSSION

The levels of aflatoxin B₁ (AFB₁) and Aflatoxin (AFB₂) were examined in kola nuts sold along Ibadan metropolis. The results showed that all the samples obtained were contaminated with AFB₁ (Table 1) and AFB₂ (Table 2). Several reports have shown the presence of aflatoxins in different foods and feeds around the globe [14,29-35]. The occurrence of aflatoxins in nuts have also been reported [36-39]. However, report on the occurrence of aflatoxin in kola nuts in Nigeria is very few. The levels of aflatoxins observed in this study varied with respect to different samples with concentrations ranging from 9.73 - 25.43 µg/kg and 10.90 - 29.67 µg/kg for AFB₁ and AFB₂ respectively (Tables 1 & 2). The aflatoxin content of these kola nuts should be a great concern because of their importance in different homes, ceremonies and social gatherings without any further processing or removal of any contaminant before consumption. Different levels of AFB₁ and AFB₂ have also been reported in kola nuts obtained from southwest Nigeria [39]. Likewise in this study, the levels of AFB₁ and AFB₂ observed varied with

different samples and locations. Aflatoxin concentrations in kola nuts could vary due to environmental factors, agricultural practices, susceptibility to fungal invasion, processing and storage methods. The manner, with which it is handled during sales, most especially by the retailers, is also a contributory factor [27]. These factors are responsible for the disparity observed in the levels of aflatoxins at different locations recorded in this study. Generally, the levels of AFB₁ and AFB₂ observed in this study are very high and mostly above the tolerable limits/regulatory limits set for aflatoxin in nuts by different authorities around the world such as the United States Food and Drug Administration (FDA), the World Health Organization (WHO), the Food Agriculture Organization (FAO), the European Food Safety Authority (EFSA) and the International Agency of Research on Cancer (IARC). It has been reported that a consistent low-level consumption of mycotoxins contaminated foods could lead to significant health problems such as, immune dysfunction, impaired growth and development and alterations in DNA metabolism [40].

Table 1. Aflatoxin B1 contents (µg/kg) of *Cola acuminata* from seven markets along Ibadan Metropolis

Location/Sample	S1	S2	S3	S4	S5
Bodija	16.02	9.73	14.10		
Oje	12.67	25.43	12.48		
Oja-Oba	21.40	19.25	22.33	12.28	23.34
Challenge	16.33	18.20			
Molete	10.42	19.26	24.29		
Ojoo	20.90	14.20			
Orita-challenge	18.67	21.72			

Table 2. Aflatoxin B2 contents (µg/kg) of *Cola acuminata* from seven markets along Ibadan Metropolis

Location/Sample	S1	S2	S3	S4	S5
Bodija	24.40	17.20	29.67		
Oje	22.00	18.33	18.02		
Oja-Oba	17.29	23.00	26.67	22.10	23.56
Challenge	19.64	15.72			
Molete	16.25	16.28	20.89		
Ojoo	15.00	21.33			
Orita-challenge	10.90	18.50			

4. CONCLUSION

Aflatoxins were found in the sampled kola nuts. The levels of aflatoxins were relatively high and mostly above recommended tolerable limits. It is therefore imperative to enlighten stakeholders, especially the producers and seller on possible ways of handling kola nuts towards reducing the aflatoxin incidences to the barest minimum in order to safeguard the health of the populace. Practices such as sorting and rinsing with clean water should be emphasized for the benefit of the consumers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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