AFLATOXIN CONTAMINATION OF SOME EDIBLE GRAINS FROM LAGOS AND OTA MARKETS, NIGERIA

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ABSTRACT: Levels of aflatoxin in maize, sorghum, millet, wheat and rice obtained from Lagos and Ota markets in Nigeria are reported. Aflatoxin determination was carried out using high performance liquid chromatograph coupled with diode array detector (HPLC-DAD). The concentrations of aflatoxins in the grains obtained from Mile 12 market, Lagos ranged between 34.3 µg/kg and 300.1 µg/kg while the concentrations in the grains obtained from Dada market, Ota ranged between 42.3 µg/kg and 1245 µg/kg. The levels of total aflatoxins were generally higher in the grains sampled from Lagos market. These values exceed the maximum limits of 10 µg/kg set by regulatory bodies in Nigeria, thus posing a great health risk for consumers. Recovery studies indicated that the method was efficient as recovery of the residue ranged between 82.2% and 96.2%. There is need for the creation of awareness on aflatoxin in order to sensitize people on health hazards associated with its contamination. In addition, there is need to promote proper practices of grain production and storage to prevent its contamination and reduce exposure.

Keywords: Aflatoxin, Grains, Contamination, Nigeria.

INTRODUCTION
Aflatoxins are by-products of fungal metabolism mainly synthesized by fungus of the genus Aspergillus. In Nigeria, the risk of chronic exposure to aflatoxins from susceptible foods, especially maize, a staple food, is of great concern owing to the health hazards associated with it. Dietary exposure to low doses of aflatoxins is a known risk cause of liver cancer and may also affect protein metabolism and immunity thereby leading to low immunity and malnutrition (Williams et al., 2004). Consumption of highly contaminated foods results in severe, acute hepatitis also known as aflatoxicosis. Symptoms of this disease include vomiting, jaundice, abdominal pain, liver failure and sometimes death. Four different aflatoxins, B₁, B₂, G₁ and G₂ have been identified with B₁ being the most toxic. Human exposure to aflatoxins can result directly from ingestion of contaminated foods or indirectly from consumption of foods from animals previously exposed to aflatoxin in feeds (Odoemelam and Osu, 2009).

Grains are small, hard, dry seeds with or without attached hulls or fruit layers harvested for human or animal consumption. After being harvested, dry grains are more durable than other staple foods and this durability has made grains well suited to industrial agriculture, since they can be mechanically harvested, transported by rail or ship, stored for long periods in silos, and milled for flour or pressed for oil. Sorghum, millet, maize, wheat and rice are the most important cereals in Nigeria (Omotosho and Muhammadu-Lawal, 2008; Obatolu, 2002). Millet is the cereal of the dryer regions with little rainfall. Sorghum crops are the cereals of the savannah and stretch into the sub-humid environments. Maize and rice are crops of the humid tropic-areas with high rainfall, swamps and areas with or without water for irrigation. Rice can grow in upland areas, such as those suitable for maize. Other types of rice grow in swamps, requiring lots of water. While maize is found across Nigeria's upland and irrigated lands, rice also grows well wherever there is adequate water/irrigation (Ekwuruke, 2005).

In Nigeria, the use of cereals range from preparation of "Akamu" and "Agidi" to preparation of "Nrioka", "Tuwoshinkafa" and "Tuwomasara". Roasted corn, boiled corn or popcorn is also consumed as...
snacks. Cereals are also used in preparation of animal feed and fodder. They are used in the production of alcoholic beverages and fermentation products (Ekwuruke, 2005).

Storage is an important activity, which enhances marketing efficiency by providing utility. Storage is particularly important in agriculture because agricultural production is seasonal while the demands for agricultural commodities are evenly spread throughout the year. There is need to meet average demand of agricultural products by storing excess supply during the harvesting season for gradual release to the market during off-season periods thereby stabilizing food prices. Postharvest facilities or appropriate storage technology has been the major problem of Nigerian agriculture for a long time (Adejumo et al., 2007). Aflatoxins are found in many countries of the world, especially in tropical and subtropical region where the warm and humid weather provides optimal conditions for the growth of aflatoxigenic molds. The optimum temperature for the growth of the moulds is 24 – 35°C, thus crops grown in tropical and subtropical conditions are more prone to aflatoxin contamination than those in temperate regions. Being a tropical country, Nigeria’s conditions of temperature and humidity favour pre-harvest and post-harvest contamination of stored grains by the fungi (Odoemelam and Osu, 2009).

**EXPERIMENTAL**

**Sample Collection.** This study examined two popular grocery markets namely Ota market and Mile 12 market in Lagos. Both markets are located in South West, Nigeria. Stratified random sampling was carried out to obtain 5 kg from the bulk of stored grains (rice, wheat, sorghum, millet and corn) in stores and open markets. The samples obtained were put in paper bags and refrigerated in the laboratory at 4°C. A laboratory size of 500g was obtained from the grounded sample and analysed.

**Apparatus and Reagents.** All glasswares used were thoroughly washed with distilled water, rinsed with acetone and dried in an oven prior to use. The apparatus used included High Performance Liquid Chromatography (HPLC) from Agilent technologies, top loading balance, orbital shaker, hot plate, hot oven, Erlenmeyer flasks, filter paper, pipette, test tubes, funnel, beaker, micro syringe, measuring cylinder and vials with TFE caps. Thesetands were obtained from Sigma –Aldrich. All reagents used were of HPLC grade. Acetonitrile was obtained from Lichrosolv, Germany and methanol was obtained from Tedia Company, USA.

**Materials and Methods.** Determination of Aflatoxins in the grains was carried out in accordance with the standard methods outlined in AOAC Official Method 994.08 with some modifications. It involved solid phase extraction with HPLC analysis.25 g of each ground sample was weighed into a 250 mL Erlenmeyer flask and 100 mL of a mixture of acetonitrile and water (84:16 v/v) was added. The mixture was shaken for one hour on an orbital shaker and then filtered through a fast qualitative filter paper.4 mL of the filtrate was passed through a SupelcoAflazea SPE cartridge. The toxin was eluted with 2 mL of HPLC grade methanol. The eluate was evaporated to dryness and reconstituted with deionized water. The mixture was constituted using a vortex mixer and 20 µL was injected into the HPLC. The HPLC was set for analysis of total aflatoxins at ambient temperature, with a flow rate of 0.8 mL/min, injection volume of 20 µL and run time of 13 minutes. The mobile phase used was an isocratic mixture of water: methanol: acetonitrile (50:40:10); analytical column: ZORBARX Eclipse XDB C18 Column, 4.6 mm × 250 mm. The diode array detector was set at a wavelength of 365 nm.

**RESULTS AND DISCUSSION**

The mean levels of aflatoxins in grains from Ota and Lagos markets are shown in Tables 1 and 2 while recovery studies of some selected samples are shown in Table 3.Total aflatoxins in grains from Ota market was highest in maize with a concentration of 300.1 µg/kg while the level in sorghum from Mile 12 market was the highest. Even though AFB1 was not detected in millet and sorghum samples from Ota market and in maize, sorghum and rice from Mile 12 market Lagos, it is worrisome that the level of AFB1 was beyond the permissive limit of 5 ppb in all the other grains sampled (Commission Regulation, 2006).
This is because AFB$_1$ is carcinogenic and the most potent of the aflatoxins. The levels of total aflatoxins were generally higher in the grains sampled from Lagos market. This might be due to poor storage conditions and a higher level of exposure to contaminants. From the study, it is observed that sorghum has high concentrations in both markets (220.5 µg/kg and 1245.1 µg/kg). These values indicate that sorghum is highly susceptible to aflatoxin infestation. Also, it is observed that the concentration of aflatoxin in millet obtained from Ota is relatively low with a mean concentration of 34.3 µg/kg compared with 120.3 µg/kg obtained from Lagos. Generally, the absence of AFB$_1$ and AFB$_2$ in samples of sorghum obtained from both markets is remarkable. Recovery Studies of some selected samples ranged from 82.2% to 96.2% indicating that the method used was satisfactory.

<table>
<thead>
<tr>
<th>Sample</th>
<th>AFB$_1$</th>
<th>AFB$_2$</th>
<th>AFG$_1$</th>
<th>AFG$_2$</th>
<th>Total AFs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>10.4</td>
<td>143.9</td>
<td>ND</td>
<td>145.7</td>
<td>300.1</td>
</tr>
<tr>
<td>Millet</td>
<td>ND</td>
<td>11.8</td>
<td>ND</td>
<td>22.5</td>
<td>34.3</td>
</tr>
<tr>
<td>Sorghum</td>
<td>ND</td>
<td>ND</td>
<td>130.3</td>
<td>90.1</td>
<td>220.5</td>
</tr>
<tr>
<td>Wheat</td>
<td>13.0</td>
<td>23.5</td>
<td>ND</td>
<td>86.5</td>
<td>123.1</td>
</tr>
<tr>
<td>Rice</td>
<td>11.5</td>
<td>18.6</td>
<td>8.2</td>
<td>47.2</td>
<td>85.7</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Sample</th>
<th>AFB$_1$</th>
<th>AFB$_2$</th>
<th>AFG$_1$</th>
<th>AFG$_2$</th>
<th>Total AFs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>ND</td>
<td>567.6</td>
<td>13.6</td>
<td>21.3</td>
<td>602.6</td>
</tr>
<tr>
<td>Millet</td>
<td>20.3</td>
<td>12.9</td>
<td>ND</td>
<td>87.2</td>
<td>120.5</td>
</tr>
<tr>
<td>Sorghum</td>
<td>ND</td>
<td>ND</td>
<td>1203.8</td>
<td>41.3</td>
<td>1245.1</td>
</tr>
<tr>
<td>Wheat</td>
<td>9.1</td>
<td>5.9</td>
<td>ND</td>
<td>27.2</td>
<td>42.3</td>
</tr>
<tr>
<td>Rice</td>
<td>ND</td>
<td>ND</td>
<td>60.2</td>
<td>13.4</td>
<td>73.6</td>
</tr>
</tbody>
</table>

ND- Not Detected

This study reports levels of total aflatoxins that are not within the acceptable limits of 10 ppb (EMAN, 2006). The levels of aflatoxins obtained in this study was in consonance with earlier reports and studies conducted (Bankole and Adebanjo, 2003; Gwaryet _et al._, 2012; Aroworaet _et al._, 2012). The aflatoxin levels in grains obtained from open markets are, therefore, unsafe for human consumption and could pose a health risk to consumers.

**CONCLUSION**

Results of this study showed that there is presence of high levels of the toxin in grains obtained from the selected markets, which exceeds the permissible limits set by regulatory bodies for consumers. The toxin was detected in all the samples with maize having the highest concentrations. Therefore, there is need to prevent aflatoxin contamination in the grains by adoption of moisture-control measures that promote improved storage and educating farmers on the importance of Good Agricultural Practices during planting, harvesting and postharvest handling of crops.

**REFERENCES**


