



Aflatoxin Assay on *Dakuwa* Produced at Different Roasting Times and Preserved with *Aframomum Danielli*

^{1*}Bagirei, S.Y., ²Adegoke, G.O., ^{1,3}Mohammad, Y.S., ³Muhammad, M.A., ¹Abdulkadir F. and ¹Maude, M.M.

¹Department of Food Science and Technology, IBB University, Lapai, Niger State, Nigeria

²Department of Food Technology, University of Ibadan, Nigeria

³Department of Chemistry, IBB University, Lapai, Niger State, Nigeria

ABSTRACT

Dakuwa was produced from local varieties of groundnuts (Kampala Variety), tiger nuts (Verre Variety) and sorghum (Mbaburi Variety) roasted. Aflatoxin level was monitored from the raw materials through processing to the final product. *Aframomum danelli* was added during processing at three concentrations of 50ppm, 100ppm, and 150ppm. Samples packaged in free PVC sachets and in aluminum foil were stored at ambient conditions (relative humidity 69%, dry bulb temperature, 24± 1°C) for two months. Results of the study revealed that increase in roasting time led to increase in the percentage reduction of aflatoxin levels in the product by up to 33%. Also, addition of *Aframomum danielli* was observed to significantly reduce Aflatoxin levels in *dakuwa* by up to 25% and also showed anti mould activity on the product.

Keywords: Aflatoxin Assay, *Dakuwa*, *Aframomum danielli*

INTRODUCTION

Dakuwa is legume-based snack consumed widely in the northern parts of Nigeria. It consists basically of roasted tiger nut and roasted groundnuts while sorghum is optional. Various portions of the legumes are mixed and pounded continuously until a thick, stiff mass is obtained (oral interview). *Dakuwa* is of enormous economic importance among the local communities of northern Nigeria as it features prominently is social functions like wedding and naming ceremonies. *Dakuwa* production is a major occupation for a large number of women populations.

The origin of *dakuwa* is probably lost in antiquity, but it appears to have developed over the years as a cheap ready-to-eat convenient food during critical periods such as during wars, hunting expedition and long distance travel. This is because during such periods food preparation from scratch may prove difficult. This is evident from the fact that *dakuwa* is sometimes referred to as “food-for-warriors.” The simple preparation was able to support men in critical times probably due to the cereal-legume complementation effect which provides not only the much needed calorie but also essential amino acids necessary for protein biosynthesis.

Although no Aflatoxin-related cases of poisoning were reported implicating *dakuwa*, the growing concern over Aflatoxin toxicity is a limiting factor on the trade and distributing of grains, legumes and their products. Hence the development and possible industrialization of *dakuwa* can be limited by the Aflatoxin profile of the product. Aflatoxins are a group of structurally related toxic compounds which contaminate certain food and result in the production of acute liver carcinogens in the human body. The major Aflatoxins of concern are designated B1, B2, G1 and G2. These toxins are usually found together in foods (Heathcote and Hibbert, 1978). Aflatoxin B1 is usually predominant and the most toxic of the four categories. It has been identified in corn and corn products, groundnut and groundnut products, cotton seed, milk and tree nuts such as Brazil nuts, pecans, pistachio nuts and walnuts (FAO-WHO, 1997). A 1997 report by the joint FAO/WHO Expert Committee on Food Additives (JECFA) concluded that “aflatoxins should be treated as carcinogenic food

Received 13 April, 2021

Accepted 20 May, 2021

Address Correspondence to:

sybagirei@gmail.com; +234-806-887-8100

contaminants the intake of which should be reduced to levels as low as reasonably achievable” (FAO-WHO, 1997). Various methods of Aflatoxin detoxification were reported, which include chemical detoxification (e.g. ammonification, nixtamalization, and the use of sodium bisulphite, formaldehyde etc.), physical detoxification (e.g. thermal inactivation), irradiation and absorption from solution and covalent binding.

However, whatever method is adopted for a particular application should be technically and economically viable and should meet the criteria listed by FAO-WHO (1997). These criteria are that the process;

- a- Destroys or inactivates the toxin
- b- Does not produce toxic or carcinogenic byproducts in the finished products.
- c- Destroys fungal spores and mycelia that could proliferate and produce the toxin
- d- Preserves the nutritive value and acceptability of the product
- e- Does not significantly alter important technological properties of the product.

Aframomum danielli spice which is used as a preservative in this work belongs to the ginger family zingiberaceae which originated from Africa and is related to cardamom. Detoxification of aflatoxin contaminated commodities with *Aframomum danielli* was reported (Ikeorah and Okoye, 2000). *Aframomum danielli* extract is also shown to have anti-oxidative, antimicrobial and cyto-protective properties. Aflatoxin detoxification properties of *afmomum danielli* spice can be said to meet the FAO/WHO criteria. Adegoke *et al* 2004 reported the control of lipid oxidation and fungal spoilage of roasted groundnuts using *Aframomum danielli* spice in oils. Other works by Adegoke *et al.* (2000, 2002) demonstrated the control of microbial growth, browning and lipid oxidation by the spice and also the protection of maize (*zea mays*) and soybeans (*Glycine max*).

Therefore, the effect of *Aframomum danielli* extract to on the aflatoxin profile of *dakuwa* is herein demonstrated. Therefore, the aim of this research was to carry out aflatoxin assay on *dakuwa* produced at different roasting times and preserved with *afmomum danielli*.

METHODOLOGY

Raw Materials Collection

The basic *dakuwa* raw materials groundnuts (Kampala Variety), tigernuts (Verre Variety) and sorghum (Mbaburi Variety) were obtained from the market stock at Jimeta ultramodern market, while *Aframomum danielli* seeds were obtained from the market stock at Ojaoba Market, Ibadan.

Dakuwa Preparation

Dakuwa was produced according to the known traditional method as observed by the researcher and presented in Fig. 1. Each of the raw materials was sorted, washed, and dried under the sun. They were then roasted at a constant temperature of 125°C while varying the time. Roasting times of 15, 12 and 9 minutes were chosen as long, medium and short roasting times respectively in the case of groundnuts and tigernut, while sorghum, on the other hand was roasted at 20, 18 and 16 minutes as long, medium and short roasting times due to its high thermal resistance compared to the former two. The roasted materials were then milled to a uniform flour particle size of $2.0 \times 10^2 \mu\text{m}$ using laboratory hammer mill.

Preparation of *Aframomum danielli* Extract

Aframomum danielli seeds were sorted, cleaned and ground to power. During mixing, *afmomum danielli* powder was added at three then packaged in free PVC sachets and aluminium foil and stored at ambient conditions (relative humidity, 69%. Dry bulb temperature $24 \pm 1^\circ\text{C}$) for two months.

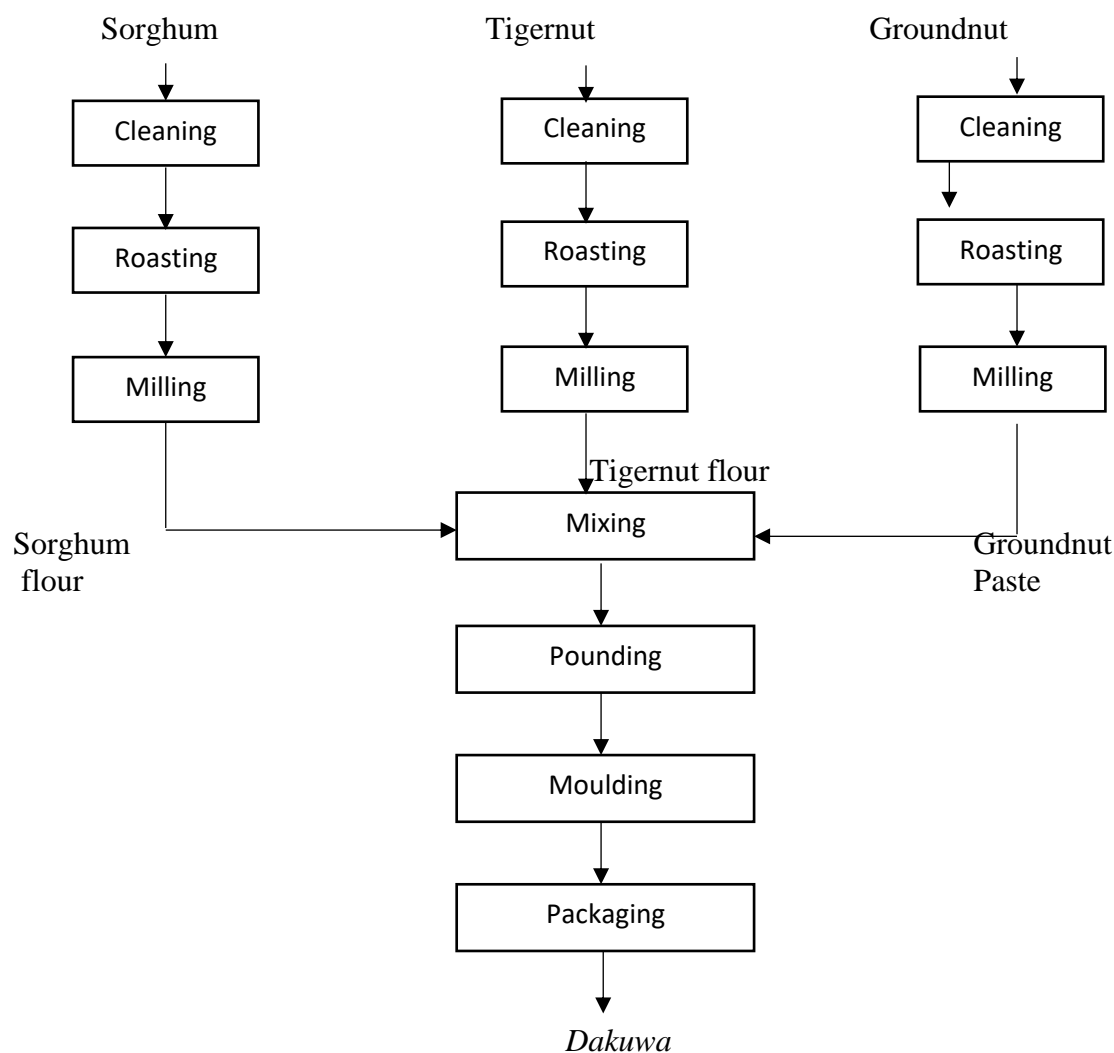


Fig. 1: Flow Diagram for Dakuwa preparation

Aflatoxin Assay

The whole raw materials, semi-processed products and the finished *dakuwa* were subjected to aflatoxin assay by TLC method as described by Adegoke (2004). Twenty-five grams (25g) of each sample was subjected to N-hexane extraction to reduce their fat content prior to aflatoxin extraction. The samples were each mixed with 100ml methanol/water, 55:45 (v/v) and shaken for 30 minutes. 50ml filtrate of each was collected by filtration through whatman No.1 filter paper with celite filter aid. To each 25ml of the extract, 30ml saturated sodium chloride solution was added and mixed thoroughly to break any oil emulsion or flask to separate the oil from the solution. 10m × 3 chloroform was added to the methanol-water solution to extract the toxin and then evaporated to dryness at 50°C. 500ml chloroform was added

to the residue and subjected to TLC using diethyl ether:methanol:water at a ratio of 96:3:1, as development solvent. Micrograms of aflatoxin B1 per kilogram sample is obtained as:

$$= \frac{XSV}{YM}$$

where X= volume in ml of the standard of aflatoxin B1; Y= volume in ml of the extract having similar intensity of fluoresces; S = mass concentration microgram of aflatoxin B1 per ml of standard solution; V= final volume of the extract in ml obtained taking into account the dilution factor; M= mass in grams of the test portion corresponding to the volume of extract subjected to column clean up.

RESULTS AND DISCUSSION

Results of the aflatoxin assay conducted on the whole and roasted materials are shown in Table 1. Roasting at 125°C for the three roasting times reduced the toxin level in groundnut by 33% while that of sorghum and tiger nut were reduced by 20% each. Though, groundnut exhibited highest initial toxin concentrations and also recorded highest percentage reduction. This is probably due to its relatively soft textural characteristics which allow greater heat susceptibility. Roasting therefore, is a critical operation in *dakuwa* processing which must be scheduled such that maximum toxin reduction will be achieved while giving acceptable finished product.

Results of the effect of *Aframomum danielli* on aflatoxin are as presented in Table 2. *Aframomum danielli* was observed to have the ability to reduce the concentration of aflatoxin B1 in *dakuwa*, depending on the concentration of the spice added. While 50ppm *Aframomum*

danielli has no observable effect on the toxin level, 100ppm showed the capacity to reduce the toxin considerably. 150ppm *A. danielli* reduced the toxin level by 12.5% - 25% depending on the component ratio of the raw materials. On the whole, combined effect of processing technique and *A. danielli* may have the capacity to reduce aflatoxin level in *dakuwa* by 32% - 58% depending on the roasting conditions and the concentration of *A. danielli* used. While excessive roasting may lead to the development of burnt flavor, bitter taste and unattractive colour, excessive concentration of *A. danielli* may result in a product with strong, hot spicy taste characteristics of *A. danielli* seeds. After two months of storage under ambient condition, mould growth was observed on the control sample, which contains no *A. danielli*, but sample treated with 100ppm of *A. danielli* and packaged showed no mould growth though the texture hardened probably due to loss of moisture

Table 1: Effect of roasting (125 °C, 9 -18 minutes) on aflatoxin levels

Material	Whole		Roasted		%Reduction
	mg/kg	ppb	mg/kg	ppb	
Groundnuts	15,000	1.5	1000	1.0	33.3
Sorghum	1000	1.0	800	0.8	20.0
Tigernut	1000	1.0	800	0.8	20.0

Table 2: Effect of *A. danielli* on aflatoxin level in *Dakuwa* in mg/kg

Treatment	Concentration of <i>A. danielli</i>			% Reduction
	50ppm	100ppm	150ppm	
LL111	800	700	600	25
MM212	800	710	700	12.5
HH211	800	710	700	12.5

Key: HH212 = Roasting time: 15 and 20 minutes components ratio, 2:1:2, (High treatment)
 MM211 = Roasting time: 12 and 18 minutes, components ratio 2:1:1 (Medium treatment)
 LL111 = Roasting time: 9 and 16 minutes, components ratio 1:1:1 (Low treatment)

Conclusion

Cleaning and roasting operations involved in *dakuwa* processing may be considered as critical control points against aflatoxin contaminated raw materials. This is because, the outcome of this study demonstrated that roasting at 125°C for 9 to 20 minutes depending on the material, can reduce the toxin level by up to 33%, and while *Aframomum danielli* can reduce the level by up to 25%. However, *A. danielli* was also

found to have antimould effect on *dakuwa* packaged in free PVC. The spice may therefore be considered as a possible preservative against mould, and by extension mycotoxins in *dakuwa*.

REFERENCES

- Adegoke, G. O., Fasoyiro, S. B. and Skura, B. (2000). Control of microbial growth, browning and Oxidation by the spice *Aframomum danielli*. *European Food Research Technology*, 211, 34
- Adegoke, G. O., Gbadamosi, R., Enwerhurhoma. F., Uzo-Peters, P. I., Falade, K. O., Moody, O. O. and Skurma, B. (2002). Protection of maize (*zea mays*) and soybean (*glycine max*) using A.A. *European Food, Research Technology*, 214, 408 -411.
- Adegoke, G. O. (2004). Understanding food microbiology (2nd Ed) Alleluia Ventures Ltd. Ibadan. p 163-166.
- Food Agriculture Organization and World Health Organization (1997). Joint FAO/WHO Expert Committee on food additives (JECFA), Rome
- Food Agriculture Organization and World Health Organization (1997). FAO/WHO/UNEP conference on mycotoxins held in Nairobi, Kenya.
- Heathocote, J. G. and Hibbert, J. R. (1978). Aflatoxins: chemical and biology aspects. Elsevier, New York, p 173-186
- Ikeorah, J. and Okoye, W. (2004). Aflatoxin in Nigeria: A review of NSPRI experience. NAFDAC/IAEA Regional Workshop on Mycotoxins, Lagos.