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Evaluation of fungal flora and mycotoxin potential associated with postharvest handlings of Cashew Nut

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ABSTRACT

Objective: To investigate the incidence and distribution of fungi flora associated with farmers postharvest handling practices in cashew production vis-à-vis the safety quality of cashew nut for consumption. Methodology and results: Farmers fields and storages from designated study locations at Ochaja, Kabba, Ilorin, Ibadan and Ogbomoso were surveyed for the postharvest practices employed and their cashew nut samples collected for mycoflora assay. Four fungigenera; Aspergillus, Penicillium, Lasiodiplodia and Fusarium were isolated from the nut samples and were identified based on morphological characters. A. flavus, A. fumigatus and Penicillium sp. are most commonly distributed isolates and the isolates incidences was highest in Ochaja followed by Ilorin and Ogbomoso nuts. Deficiency in postharvest practices by cashew farmers were harnessed as base line for further training in best practices for better cashew production and safe consumption of the produce.

Keywords: Cashew nut, postharvest, fungal flora, infestation, nut count.

INTRODUCTION

The world annual production of all tree nuts in their raw state is 6.74 million tonnes as reported by [14] among them cashew ranks first accounting for about 32% followed by almond (26.2%), hazelnut (14.3%), walnut (13.5%), pistachio (8.6%) and pecans (3.7%) making cashew production the subject of interest for development agencies, producer, government and advocates of sustainable economic and environmental development [5].Worldwide, nuts are esteemed and highly priced food delicacy because of their pleasant taste and flavor in addition to their content of proteins and antioxidants [10].Cashew nuts have similar characteristics to other oil-bearing nuts or fruits and must have similar requirements as other nuts with regards to care during harvesting and postharvest handling.

Postharvest food loss is one of the major sources of food insecurity in Africa. Pre-and post-harvest food losses in Africa are higher than the global average and impact more severely on already endangering livelihoods [11].Mature agricultural products in the field go through a lot of production and processing techniques to convert them into suitable or acceptable forms for human consumption. There are many opportunities for food to be lost between harvest and consumption. Cashew has a short harvesting season of about 60 days beginning from February to April depending on the area of growth. The crop season in West Africa is from February/March to June, there is not a general standard for cashew nuts and the appreciation on the market but some parameters which include out turn/yield, nut count, moisture/humidity, foreign matters and defective can establish the quality of the cashew.

About 48% of the world's production of cashew comes from Africa and out of this only 10% is produced in Africa. Itis estimated that at least 10% of Africa crop productivity is lost on and off farm, resulting from lack of access by most farmers to appropriate production technologies, inadequate availability of food processing technologies and erratic climatic condition such as heavy rains, droughts and other related factors [9].

Cashew nut quality is of utmost importance as the kernel, which is the edible part of the nut directly enters the retails market. Pest and disease play an important role in determining nut quality since they can cause pre-mature nut fall. Nuts are among the crops that can be contaminated by mycotoxins which represent a major problem in several countries, North America [4], Brazil [13], Asia [15]and Africa [2].Food must not only be produced to achieve food security, it must also be fit and safe to eat. A lot of food is lost through harvesting and postharvest mainly because most of the farming communities do not have access to the appropriate technologies. The economic loss resulting from fungal and mycotoxin contamination of nuts is difficult to estimate. However, judging from the widespread occurrence of fungal and mycotoxin contamination and the large number of nuts affected, one can assume that such losses must be large. These losses constitute direct nut losses, human illness and reduced productivity and livestock losses from deaths and lower growth rates [8].This preliminary investigation however emphasizesfarmers postharvest practices as it relate to mycoflora contamination vis-à-vis the safety quality of cashew nut for consumption.

MATERIALS AND METHODS

Nut samples were collected from farmers' storage in cashew major producing ecologies; Kogi, Kwara and Oyo States in the North-Central and South-Western region of Nigeria. Collected nutsfrom study locations (Ochaja, Kabba, Ilorin, Ibadan and Ogbomoso) were subjected to physical observation prior to opening of kernel for further cotyledon assessment and microbial assay. The nut samples were cut into two equal halves using a sterile nut-cutting device and the cotyledons were assessed by visual observations for colour, deformity and microbial status. The nut samples were assayed for associated mycoflora by pour plate methodas described by [12] and [17]were used to determine the total viable count and mould count and fungi colonies were identified according to morphological and microscopic characteristics [16].

RESULTS

Differences were observed in the methods and techniques employ by farmers in the handlings of cashew nut especially in the harvesting, drying and storage in the study locations. Most farmers allow the apple to rotten on the farm ground and pick the nuts thereafter, some other harvest the nut on observation of its ripeness but some however observe routine and regular picking of apples prior to rotten, while apples on some instances are not neatly detached from the nut. Most farmers package their nut in water proof bags in their store on bare floor, some heap nuts on the farm land and some other farmers dry briefly on bare floor and put in storage. Some farmers still heap the nut on concrete floor in their warehouse. The cotyledons are commonly creamy-white in cases they are intact but some rotten ones were observed in nut samples from Kabba and Ilorin.

Table 1: Characteristics of nut samples from study locations

*Sample source	Initial weight (g)	Final weight (g)	Moisture content (%)	Nut count//100g	Colony count (cfu/ml@10^{-5})
Ibs	61.65	57.32	7.55	171	3.0
Iba	58.14	54.12	7.43	170	1.0
Kab	95.47	92.99	2.67	112	7.0
Och	41.58	39.50	5.27	258	52.0
Ilr	43.5	38.63	12.61	230	17.0
Ogb	45.0	40.76	10.40	220	4.0

**Ibs-Ibadan (sun-dry); Iba-Ibadan (air-dry); Kab-Kabba; Och-Ochaja; Ogb-Ogbomoso; Ilr-Ilorin*

The nut count of cashew from Ibadan, Kabba and Ochaja range from 112 to 258 nuts, the moisture content of the nuts from 2.67 to 7.55%. The highest nut count of 258 was recorded in Ochaja, followed by 230 in Ilorin and the least count of 112 in Kabba. The moisture content of the nut samples was highest (12.61%) in Ilorin while the lowest of 2.67% was recorded in Kabba, and the colony count of the isolated flora range from 1.0 to 52.0 x 10^5 (table 1).

Table 2: Occurrence of mycoflora associated with cashew nut

Sample source	*Aspergillus*spp.	*A. niger*	*Penicillium*sp.	*L. theobromae*	*A. fumigatus*	*A. flavus*	*A. parasiticus*	*A. repens*	*Fusarium*sp.
*Och	+	+	+	+	+	+	+	+	-
Kab	+	+	-	+	-	-	+	-	-
Iba	+	-	-	-	+	+	+	-	-
Ibs	+	-	+	-	+	-	-	+	-
Ilr	+	-	+	+	-	+	-	-	+
Ogb	-	-	+	-	+	+	-	-	+
% Inc.	83.33	33.33	66.67	50	66.67	66.67	50.0	33.33	33.33

**Och-Ochaja;Kab-Kabba;Iba-Ibadan (air-dry);Ibs-Ibadan (sun-dry);Ilr-Ilorin; Ogb-Ogbomoso;Inc-Incidence Present (+); Absent (-)*

Pathogens isolated from kernels, shell and testa were identified to be mainly fungal species dominated by genera *Aspergillus, Fusarium, Penicillium,* which are well known for the production of aflatoxins and other mycotoxins. The species identified were *Aspergillusfumigatus, A. flavus, A. parasiticus, A. niger, A. repens*and another unidentified species of *Aspergillus.* Other fungal isolates were *Penicillium*sp., *Fusarium*sp. and *Lasiodiplodia theobromae. A fumigatus, A. flavus,* and *Penicilium*sp. has 66.67% occurrence each followed an unidentified *Aspergillus*sp. which had the highest of 83.33% in nut from study locations. *L. theobromae, A. parasiticus*had 50% incidence on nut samples, each of *Fuasrium*sp., *A. repens*and *A. niger* was found only in two of the nut samples. The incidence of fungi flora was highest in Ochaja, followed by incidences in Ilorin and Ogbomoso.

DISCUSSION

Low moisture levels limit mould growth during storage, most of the nuts with moisture content above the acceptable level of 10-12% are due to farmers attitude of keeping nuts in water proof sacks (not jute bag), heap nuts on farm or under shade and not properly spread-drying or store rightly. Cashew is one of the few commodities that travel a long distance between times of harvest and when consumed [14], nut spoilage may occur during this period making drying a very important step in the postharvest activity and drying was normally done in farmers homes. Incidence of these isolates depend on a number of factors including temperature moisture and storage time [7], poor postharvest management can also lead to the initiation of these fungal activities thereby causing losses of commercial and nutritional values in the nuts and most importantly endanger the life of consumers by exposure to mycotoxins infestation.

Some of the species, especially of *Aspergillus*and *Penicillium*(table 2) associated with the nuts are known to have strains that produce toxic metabolites [6]. Thus, they pose a potential hazard to consumers' health. The conditions generally known to influence the production of mycotoxins in foods and allied agricultural products include presence of a toxigenic mould, a suitable substrate for the growth of the mould, and an environment conducive for the toxin production by the mould[3].

The isolation of fungi genera from cashew nut in earlier report of [10] is confirm in this study that *A. fumigatus, A. flavus*and *A. niger* were most pronounce in the nut and [10] also reported the detection of aflatoxin B1&B2 from *A. flavus*while Ochratoxin A was reported in *A. niger.* Also reported is the presence of two species of genera *Aspergillus*and *Penicillium*been cultured from an unsterilized salted and pure cashew.

CONCLUSION

Poor management of harvesting and post-harvest practices may result in losses due to microbial infestation of the nut and posing serious health risk to consumers, therefore small holder farmers require better exposure to best practices in postharvest handlings and processes for cashew production.

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