

Studies on Mycotic Contamination of Cashew Nuts (*anarcadium occidentale* L.) in Abakaliki, Ebonyi State and the Impacts on their Nutritional Qualities.

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ABSTRACT

Cashew nuts are essential source of food supplement to man all over the world. Cashew nuts eaten in Abakaliki Metropolis were analysed for fungal contaminations and the impacts on the nutritional qualities. The standard blotter method according to I.S.T.A. (2000) was used for the isolation of the fungi. Fungi concerned with the contamination of the cashew nuts include: *Aspergillus niger*, *Aspergillus flavus*, *Aspergillus terreus*, *Penicillium italicum*, *P. chrysogenum*, *P. notatum* and *Mucor species*. The evaluation of the proximate and mineral composition of infected and apparently healthy cashew nuts showed that the value of crude protein was higher in the apparently healthy nuts (20.68 ± 0.02 %) than the infected ones (15.28 ± 0.1 %). Crude fibre decreased with mean value of 3.35 ± 0.07 % and 4.15 ± 0.1 % in infected and apparently healthy nuts respectively. Moisture content also increased from 10.15 ± 0.1 % in apparently healthy nuts to 42.8 ± 0.12 % in infected nuts. The analyses of the mineral content of the cashew nuts showed that the value of Potassium depreciated from 0.78 ± 0.04g in apparently healthy nuts to 0.101 ± 0.001g in infected nuts. The values of calcium and phosphorus decreased appreciably from 0.206 ± 0.006g and 0.89 ± 0.01g respectively in apparently healthy nuts to 0.11 ± 0.01g and 0.83 ± 0.03g respectively in infected nuts. Magnesium and Sodium also decreased appreciably in infected cashew nuts. The proximate composition of nutrients in infected and apparently healthy cashew nuts showed no composition significant difference (p ≥ 0.05), while there is significant difference (p ≥ 0.05) in their mineral content. Fungi often contaminate the cashew nuts, causing reduction in their market and nutritional values.

Keywords: Cashew, Abakaliki, mycotic contamination, proximate analysis.

INTRODUCTION

The Cashew nuts are esteemed and highly priced food delicacy eaten all over the world because of their pleasant taste and flavor [1]. The post-harvest processing, packaging and marketing have been commercialized and modern technology and regulations adopted in major producing countries like India and Tanzania [2]. In Nigeria however, despite the cultivation of cashew in plantations and the establishment of cashew-processing factories peasant processing and packaging methods are still commonly adopted [3]. The peasant processing method predisposes the nuts to mould contamination especially during hawking of the product, which usually are packaged in hand-knotted thin polyethylene bags [4]. However,

mycotoxicoses are becoming increasingly implicated in human and animal pathology [5]. The situation may be worsened by consumers' reluctance to discard fairly mouldy food samples such as cashew nuts due to the irresistible taste and flavor [6].

Cashew is a highly nutritious and concentrated form of food, which provides a substantial amount of energy. Cashew provides essential fatty acids, B vitamins, fiber, protein, carbohydrate potassium, iron, and zinc. Like other nuts, cashews have a small percentage of saturated fat; however, eaten in small quantities cashews are highly nutritious foods [7] [8].

The cashew nut kernel has a pleasant taste and flavor and can be eaten raw,

fried and sometimes salted or sweetened with sugar, [9]. It also contributes to a vital source of invisible fat in our diet, being widely used in a variety of ways. There has been a growing demand for cashew in many temperate countries where the demand is increasing [10]. The nut contains an acrid compound which is a powerful vesicant that is abrasive to the skin. The cashew shell contains 25 % of this reddish brown oil, industrially known as Cashew Nut Shell Liquid (CNSL) which is a by-product of the roasting process. The kernel is considered to be of high nutritive quality and growing conditions or the variety of cashew may have an influence on kernel composition [11]. The overall composition of the cashew nut is protein 21 %, fat 46 % and carbohydrates 25 %, [12].

Protein content has been suggested to be considered as one of the most important factors in the future breeding and selection programs of cashew nut [13]. The analysis of cashew nut kernels has revealed that there is variation in the reducing sugar content from 1 % to 3 % and the non-reducing sugar from 2.4 % to 8.7 %. Starch content ranged from 4.6 % to 11.2 % and the oil content also showed a wide variability from 34.5 % to 46.8 %, [14].

The mineral content of cashew kernel appears to be minimal as compared to the higher mineral content of the cashew apple, especially the high Vitamin C content (240 mg). Most citrus species such as orange have only 45 mg of Vitamin C, [15]. Cashew is also one of the few sources of phenols (contains about 60 % of anacardic acid by weight). This acid is responsible for the vesicative activity of the shell liquid extract and can cause acute dermatitis. It is therefore essential to ensure that as little contamination as possible of CNSL should occur during processing of kernels. In traditional medicine however, this extract has been used successfully [16].

The high price of cashew kernels will certainly stimulate the planting programs in various countries. Since the cashew nut market competes with other nuts, there is bound to be increased production of all nuts. The present cost of processing cashew is much higher as

compared to other nuts which allow little flexibility in cashew kernel prices. It is therefore necessary to develop more efficient and cost-effective processing systems for cashew [17].

Cashew nuts are vital in cancer prevention, Normal heart functions [18], for Diabetics patients [19] as well as benefits pregnant women. Cashew nut aids in rejuvenating human skin and inhibits the occurrence of stretch marks in the times of pregnancy, [20]. They also decrease risk of heart problems particularly its high magnesium level inhibits pregnant females from the heart diseases. It aids in controlling the iron level of the body during pregnancy, thereby preventing the occurrence of anaemia. Cashew nut also improves the skin and hair quality among pregnant women, [21]. The magnesium content aids a lot in maintaining healthy and strong teeth and gums in man [22]. Niacin found in Cashew nut inhibits the skin disease called dermatitis or pellagra. Particularly, its copper content maintains the skin rejuvenates, healthy and glowing by combating with the free radicals as well as removing pigments, [23].

Cashew nut promotes healthy brain function, especially, its high level of copper element content is very necessary for body functions like hormone production, enzyme activation as well as maintenance of brain functions [24].

[25] stated that *Colletotrichum gloeosporioides*, *Curvularia lunata*, *Fusarium solani*, *Lasiodiplodia theobromae*, *Ophiostoma sp.*, *Pestalotiopsis guepinii*, *Pellinus sp.*, *Phoma sp.*, *Phomopsis anacardii*, *Spegazzinia tessarthra*, *Spiniger sp.*, *Torula sp.* and *Tritirachium sp.* were the pathogenic fungi isolated from cashew species in Brazil. Indeed, recent studies conducted on the mycoflora and mycotoxins in Brazilian cashew kernels revealed, for the first time, the presence of some fungal metabolites, including traces of aflatoxin G2 [26].

Studies conducted in Brazil demonstrated that fungi associated with kernel infection are endophytic to cashew plants or can invade ovaries through flowers or be introduced into the young kernels by insects (Freire *et*

al., 1999). In India, the presence of *Cladosporium sp.*, *A. niger*, *Fusarium sp.*, *Penicillium sp.* and *Rhizopus sp.* were associated with kernel rot in immature and mature nuts [27].

A comprehensive study of fungi occurring in cashew kernels has been provided in Thailand [28]. The presence in cashew kernels of fungi potentially toxigenic such as *Alternaria alternata*, *Aspergillus flavus*, *A. ochraceus*, *A. parasiticus*, *Chaetomium funicola*, *C. globosum*, *Penicillium citrinum* and *P.*

oxalicum is of concern to the exporters of all producing countries since foreign buyers have now severe limits for mycotoxins, mainly for aflatoxins.

In Nigeria, the occurrence of *Aspergillus sp.*, *Rhizopus nigricans*, *Fusarium spp.* and *Gliocladium spp.*, was the cause of kernel rot [29]. Different The impacts of these fungal contaminants to the nutritional values of cashew nut are the main aim of this research carried out in Abakaliki Metropois of Ebonyi State, Nigeria.

MATERIALS AND METHOD

Collection of cashew nuts

The cashew nuts were bought from Abakpa main market, Abakaliki, Ebonyi State and were taken to Applied Biology Department Laboratory for treatment and fungal analysis.

Isolation of the Fungi

The standard blotter method of the International Seed Testing Association (I.S.T.A) 1976 was used for the isolation of the fungi. The cashew nuts were washed with 1 % Sodium hypochlorite solution for ten minutes before plating seven seeds per Petri-dish with blotter paper; four at the outer side, followed by three nuts at the centre. The nuts were incubated in an incubator at 25 ± 20 °C for seven days. Three hundred seeds were incubated in this study. Pure culture was prepared from the fungal growth on the fruits. Identification of the fungi was carried out based on their fungal mycelia growth and spore morphology. Confirmation of the various fungi was achieved by making a smear of the fungal mycelia on slides and viewed under compound microscope (x40). The identification was done, following the fungal description by [30].

Analyses of the Food and Mineral Nutrients of the cashew nuts

The contaminated cashew nuts (with fungal growths) were thoroughly washed and dried, and were termed infected nuts and those freshly processed nuts bought from the Abakpa market and were termed apparently healthy nuts. The infected and contaminated nuts were analyzed in triplicate for carbohydrate, crude fibre, moisture, protein, lipid (fat), ash and minerals using standard method of A.O.A.C. (2005).

The proximate analyses were done using standard method of A.O.A.C. (2005). While the mineral content of both the infected and apparently healthy fruits were a well analysed. About 5 gm of the samples was weighed using electronic weighing balance and poured into a digestion flask. The mixture of HCL and HNO₃ (hydrochloric acid and nitric acid in the ratio of 1:2) was added and heated until clear solution was obtained. It was filtered into 250 ml volume flask and diluted with distilled water to the mark of 250 ml before it was analyzed for the mineral contents. This method was described by [31]

RESULTS AND DISCUSSIONS

The research project result showed that *Aspergillus niger*, *Aspergillus flavus*, *Aspergillus tereus*, *Penicillium italicum*, *P. chrysogenum*, and *P. notatum*, were the major contaminants of cashew nuts in Abakaliki Metropolis of Ebonyi State. This result tallies with the work of [32], who reported that *A. niger*, *A. flavus*, *A. fumigatus*, *A. restrictus*, *A. spp.*, *Penicillium sp.*, *Mucor sp.* and *Rhizopus sp.* are associated with the bio-deterioration of cashew nuts in Lagos state of Nigeria. Moreover, [33] found

that 25 fungal species were associated with cashew kernel deterioration. [34], isolated a total of 79 fungal species from cashew kernels in Brazil. [35] also reported the isolation of *Aspergillus flavus*, *Aspergillus niger*, *Aspergillus fumigatus* and *Penicillium sp.* from cashew nuts in Saudi Arabia.

[35], isolated *Absidia corymbifera*, *Aspergillus flavus*, *Aspergillus glaucus*, *Aspergillus niger*, *Mucor sp.*, *Neurospora crassa* and *Penicillium sp.* from the

stored cashew nuts using the direct plating and washing methods.

[4] reported that genera of *Aspergillus* and *Penicillium* were dominant fungi that contaminate cashew nuts. They further reported the isolation of *Aspergillus clavatus*, *A. flavus*, *A. parasiticus*, *A. ochraceus*, *A. ustus*, *Penicillium citrinum* and *P. oxalicum* from cashew nuts.

Similarly, [7] investigated the occurrence and distribution of fungi

associated with bio-deterioration of cashew in storehouse located in Kogi state, Nigeria and reported the isolation of *Aspergillus niger* as one of the fungal species causing bio-deterioration.

The results of the proximate and mineral composition of *Anarcadium occidentale* nut determined in this study were presented in Table 1 and 11 respectively.

Table 1: Proximate composition of *Anarcadium occidentale* (%)

S/No	Nutrient	Infected	Apparently healthy
1	Moisture	42.84 ± 0.12	10.15 ± 0.1
2	Protein	20.68 ± 0.02	15.28 ± 0.1
3	Fibre	3.36 ± 0.07	4.15 ± 0.1
4	Ash	3.56 ± 0.07	3.55 ± 0.07
5	Fat	20.58 ± 0.09	38.35±2.95
6	Carbohydrate	9.01±0.03	28.43±1.03

Statistical analysis using Pearson's chi square revealed that there was no significant difference between the values obtained for the different nutrients $p>0.05$. There were appreciable increases in moisture and protein contents respectively in infected cashew nut than in apparently healthy cashew nuts. The increase maybe as a result of the fungal activities which trigger the moisture and protein levels of the contaminated cashew nuts. According to [12], the protein content of cashew nut in India tallies with the value of the percentage of protein in apparently healthy cashew nuts in Abakaliki. The moisture content in apparently healthy cashew nut (10.15 %) is in agreement with [23], who stated that the moisture content of a product in a low or considerable amount increases the shell life of the product. The low level of moisture in apparently healthy nut increases the shell life of the product. The high moisture content enhances the growth of microorganism and hence microbial spoilage of cashew nuts.

Carbohydrate content was lower 9.01 % in infected nut and higher 28.43 % in apparently healthy nut of *A. occidentale*. The decrease in the carbohydrate level in the contaminated nut maybe as a result of the utilization of the

carbohydrates by fungi for their life activities.

[30] reported that the higher protein contents in food substances may result to the lesser content in carbohydrates.

The apparently healthy cashew nut had higher value (38.35 %) of fat, while the infected nut has lower fat values (20.58 %). The fat and oil content of cashew nut constitute substantially to its energy content, [2]. Fat plays an important role in determining the shelf-life of food products and relatively high content could be undesirable in baked food products. This is because fat can promote rancidity in food leading to development of unpleasant odorous compounds, [5]. Also diet high in fat predisposes consumers to different illness such as coronary heart disease, obesity, [9].

There is an appreciable reduction in the fat content of contaminated cashew nuts. This does not agree with the result obtained from the work of [14]. The high fibre content of apparently healthy cashew nut can act better in the digestive system without giving much problem of constipation. The ash content of cashew nut ranges from 3.55 % in infected nut of *A. occidentale* and 3.65 % in apparently healthy nut. The ash content of apparently healthy nut was higher than the 3.3 % recorded by [20] and higher than the value of 2.7 %

obtained for Africa oil bean, [27]. Ash content signifies the level of mineral

Ambrose present in the sample.

Table 2: Mineral content analysis of *Anarcadium occidentale* (mg/100g)

S/No	Minerals	Infected	Apparently healthy
1	Sodium	0.38 ± 0.3	0.34 ± 0.3
2	Potassium	0.101 ± 0.001	0.78±0.04
3	Calcium	0.206 ± 0.006	0.11 ±0.01
4	Magnesium	0.72 ± 0.02	0.37±0.02
5	Phosphorous	0.89 ± 0.01	0.83±0.01

Statistical analysis revealed that there was a significant difference between the values obtained for the different nutrients $p < 0.05$. There were appreciable increase in sodium, calcium, magnesium and phosphorus in infected cashew nuts, while potassium witnessed a reduction in value in infected cashew nuts. The increase in contents of sodium, calcium, magnesium and phosphorus in infected nuts maybe as a result in fungal deterioration of the nutrient component of the cashew nuts. The potassium serves as an electrolyte for maintaining normal fluid balance in a cell and a delicate balance of this element is reported to prevent an increase in blood pressure and maintain a normal cardiac rhythm [31]. Potassium deficiency may produce severe damage to the kidney [11].

The significant of magnesium content of cashew nut ranges from (0.72g) infected of magnesium has not only been reduced in its function in the skeleton, but also in muscle and soft tissue such as co-factor of many enzyme involved in

energy metabolism, protein synthesis, DNA and RNA synthesis [3]. The calcium content ranged from (0.206g) infected nut to (0.11g) apparently healthy nut. Calcium ion plays an essential role on neuromuscular function, blood clotting and in providing rigidity to the skeleton via phosphate salts. The deficiency of calcium causes rickets in children and osteomalacia in adults. The content of sodium ranged from (0.38 g) infected nut to (0.34 g) apparently healthy nut and sodium plays an important role in maintain balance in physical fluid system and it is also required for the operation of nerves and muscle. The amount of Na in adult markedly affects the heart and nutrition of the individual, high sodium diet are linked to a number of health problem such as increase in possibility of hypertension and damage of the kidney, while low intake of Na results in metabolic acidosis [5]. Hence the intake of infected nut of *A. occidentale* is deemed unfit as the nutrient values have been reduced by the action of fungi.

CONCLUSION

Cashew nut is very nutritious, with sweet and irresistible taste. The production and handling of cashew pose a lot of contaminations. Contaminants are mostly fungi which inhabit many environments and substrates. The

peasant processing methods, handling and distribution of the cashew nuts predispose them to mould and other microbial contaminations especially during hawking of the product.

RECOMMENDATION

From the result of this research, the recommendation so far is that apparently healthy nut of *Anarcadium occidentale* should be consumed by all, more especially adults because of its high content of carbohydrate and less

protein and also because of its considerable amount of sodium content which are beneficial to the health when compared to the infected nuts of *A. occidentale*.

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