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Chemical, Functional Properties and Amino Acid Composition of Raw and Defatted Cashew Kernel (*Anacardium occidentale*)

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Author's contribution

This whole work was designed by the author OHN.

Original Research Article

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ABSTRACT

The proximate, minerals, anti nutrients, functional properties and amino acid of cashew kernel were studied. The results showed that the raw sample had high crude fat (48.1±0.5%), while the defatted sample had high crude protein (31.5±0.1%) and high crude fibre (4.21±0.01%). The samples contained nutritionally valuable minerals and essential amino acid for body development. The samples also contained low levels of anti-nutrients: tannin (0.71-1.00%) and oxalate (4.63-5.75mg/g) which would not retard the functionalities of the food properties.

Keywords: Chemical; functional; amino acid; cashew; kernel.

1. INTRODUCTION

Over-dependency of people on starch foods rather than protein foods is prevalent in under-developed countries because of economic crisis and lack of adequate nutritional knowledge of readily available but under-utilized crops in that immediate environment. In time past, dry legumes were considered to be basic foods, source of protein and as complement to enhance the protein quality of most cereals [1]. Recently, there are strong efforts made to increase the intake of protein foods in countries containing high levels of vasco cardial and diabetes diseases. Cashew fruit is among the widely cultivated fruits in south western

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Nigeria, Brazil and coast of Mozambique. The fruit can be squeezed and processed into fruit juice and the seed is processed to cashew kernel. Cashew kernel meal has recently been extended from human consumption to the feeding of poultry especially layers. The primary products of cashew seeds are the kernels which have nutritive and economic values as confectionary nuts. Cashew nut shell liquid (CNSL) is a liquid obtained from the shell of cashew seeds and the liquid can serve as important industrial raw material for resin production. There is little or no information on the functionality of cashew kernel, and therefore, the present work is designed to draw the attention of people to the nutritive potentials and also to provide useful information towards effective utilization in various food applications. The data obtained may serve as control, contradict and also as additional information to past results if any.

2. MATERIALS AND METHODS

The cashew fruits were collected from Ikole market in Ekiti State, South West of Nigeria. The fruits were detached from the nut and roasted, later cracked with manual cashew kernel cutter to separate the kernel from the shell. The kernels obtained were then sun dried and blended into powdered form and kept in a dry air tight rubber container. The moisture and ash contents determined using the air oven and dry ash methods [2]. The sample was analyzed for fat and crude fibre according to the methods [3]. Nitrogen was determined by micro-kjedahl method described by [3] and the percentage nitrogen was converted to crude protein by multiplying by 6.25. The carbohydrate content was obtained by method of difference. % Carbohydrate = (100–% moisture-% ash-% crude fibre-% crude fat-% crude protein).

The phytate content was determined using methods described [4,5] while alkaloid was determined [3]. The determination of oxalate and tannins were carried out according to the methods described [3,6]. The minerals were analyzed by dry ashing the sample at 550^{o}C to constant weight and dissolving the ash in 100 ml standard flask using distilled deionized water with 3ml of 3M HCl. Sodium and potassium were determined by using a flame photometer (model 405, corning, U.K). All other minerals were determined by Atomic Absorption Spectrophotometer (Perkin & Elmer model 403, USA). The water and oil absorption capacities of the sample were determined using the method [7]. 10cm^3 of water was added to 1.0g sample in a centrifuge tube. The suspension was mixed vigorously using votex mixer. This was then centrifuged at 3500 rpm for 25minutes and the volume of the supernatant left after centrifuging was noted. Water bound was calculated from the difference in the initial volume of the solvent used and the final volume after centrifuging. The same procedure was used for oil absorption capacity but oil replacing water in above process.

The slight modified procedure of [8] was used to determine least gelation concentration. Sample slurries of 2, 4, 6, 8, 10, 12, 14 and 16 were prepared in 5ml of distlled water. The test tubes containing these slurries were heated for one hour in boiling water followed by rapid cooling under running tap water. The test tubes were then cooled for 2hours at 4℃. The least gelation concentration was determined as concentration which did not fall or slip when the test tubes were inverted. The emulsion capacity and stability determined by [7].

The method [9] was employed to determine foaming capacity and stability. 1g of the sample was whipped with 50ml distilled water for 5 minutes in a Kenwood blender and later poured into a 100ml graduated flask to study the foaming stability (volume increase%). The foaming capacity was calculated according to the following equation.

$$\text{Volume increase \%} = \frac{\text{volume after whipping - volume before whipping}}{\text{Volume before whipping.}} \times 100$$

The amino acid profile was determined using the method described by [10].The sample was dried to constant weight and defatted using soxhlet extractor [3] and then followed by the preceding steps:

2.1 Hydrolysis of Sample

Two grammes defatted sample was taken into glass ampoule. 7ml of 6MHCl was added and oxygen was expelled by passing nitrogen into the ampoule (this is to avoid possible oxidation of some amino acids during hydrolysis) e.g. methionine and cysteine. The glass ampoule was then sealed with bursen burner flame put in an oven present at 105±5°C for 22 hours. The ampoule was allowed to cool before broken open at the tip and the content was filtered to remove the humins. The filterate was then evaporated to dryness at 40°C under vacuum in a rotary evaporator. The residue was dissolved with 5ml of acetate buffer (pH 2.0) and stored in plastic specimen bottles which were kept in the freezer.

2.2 Loading of the Hyrolysate into TSM Analyser

Hydrolysate (7.5µL) was dispensed into the cartridge of the analyser using a syringe. The TSM analyser is designed to separate and analyse free acidic, neutral basic amino acids of hydrolysate. The period of the analysis lasted for 76 minutes. The gas flow rate was 0.50ml/min at 60℃ with reproducibility consistent within±3%.

2.3 Method of Calculating Amino Acid Values from the Chromagram Peaks

The net height of each peak produced by the chart recorder of TSM (each representing an amino acid) was measured. The width of the peak at the half height was accurately measured and recorded. Appropriate area of each peak was then obtained by multiplying the height with the width of half-height.

The norcleucine equivalent (NE) for each amino acid in the standard mixture was calculated using the formula.

$$NE = \frac{\text{Area of Norcleucine peak}}{\text{Area of each amno acid}}$$

A constant “s” was calculated for each amino acid in the standard mixture.

Sstd = NE std X Mol. Weight X µ MAA std

Finally, the amount of each amino acid present in the sample was calculated in g/100g protein using the formula.
Concentration (g/100g protein) = NH XW @ NH/2 X Sstd X C.

$$\text{Where C} = \left(\frac{\text{Dilution X 16}}{\text{Sample wt(g) X N2\% X 10 X vol. loaded}} \right) \Big/ \text{NH X W (Nleu)}$$

Where NH = Net height

W = Width

Nleu = Norleucine

3. RESULTS AND DISCUSSION

The proximate composition of cashew kernel (%) are shown in Table 1. From the data it was observed that the defatted sample contained ash (3.69±0.01%) crude protein (31.5±0.1%), fat (13.9±0.4%), crude fibre (4.21±0.01%) and carbohydrate (41.3±0.3%). Some of these values slightly agreed with those reported by [11]. Cashew had low moisture content which could store for a longer time without spoilage. The crude fat (48.1±0.5%) of raw sample was comparable to some oil seeds (44.3 – 51.9%) reported by [12] and higher than 24.06% for dehulled African nutmeg [13]. The value obtained for carbohydrate in raw sample (17.36±0.01%) was lower than most legumes (20-26%) reported by [14]. The crude protein (31.5±0.1%), ash (3.69±0.01%) and crude fibre (4.21±0.01%) of the defatted sample were higher than that of raw sample. The reported value of crude fibre was higher than that of kidney bean reported by [15]. Fibre helps in the peristaltic movement of the intestinal tract, hence diet containing low fibre could cause constipation and eventually lead to colon cancer. The moisture (5.76±0.01%) and crude fat (48.1±0.5%) of raw sample were higher than that of the defatted sample. The removal of the fat had contributed to the increase in other nutritional parameters. The presence of oil in the sample demobilizes some of the protein globules. This suggests that the sample is better taken in defatted form especially for adult and children that need less of fat and much of protein. The value of crude protein in raw cashew kernel was higher than those reported for bambara groundnut (11.6%), kersting's groundnut (12.9%) and lower than that of scarlet runner bean (65.2%) reported by [16]. The value of crude protein of the raw sample compared favourably with that of *Terminalia catappa* seeds (23.8%) reported by [17] but higher than those of leaves (3.00%), stem (1.05%) and root (1.62%) of *Moringa oleifera* tree parts reported by [18]. Apart from its high oil content, cashew kernel is also very rich source of protein and essential amino acid.

Table 1. Proximate composition (%) of cashew kernel

Composition	Raw	Defatted
Ash	3.38 ± 0.02	3.69 ± 0.01
Moisture	5.76 ± 0.01	5.44 ± 0.03
Crude protein	21.8 ± 0.3	31.5 ± 0.1
Crude fat	48.1 ± 0.5	13.9 ± 0.4
Crude fibre	3.63 ± 0.08	4.21 ± 0.01
Carbohydrate (by difference)	17.4 ± 0.01	41.3 ± 0.3

The mineral content of cashew kernel is shown in Table 2. Potassium was the highest mineral in the sample with the value of 31.6 mg/100g in the defatted sample. This is in agreement with previous work on Nigerian agricultural products by [19].This trend was generally observed in the values of the mineral determined. Mg has been reported to be

involved in maintaining the electrical potential in nerves and activation of some enzyme systems. The calcium content was in agreement with the value reported by [11].Calcium is responsible for bone formation. Phosphorus had a mean value of 21.6mg/100g. Phosphorus and calcium occur together in the body to maintain body blood. Cu (0.03mg/100g) and Mn (0.07mg/100g) were the least abundant of the minerals. This was in close agreement with the observations of previous workers [16,19].The values of calcium, magnesium and potassium in both raw and defatted samples were lower than that of *Terminalia catappa* seeds reported by [17] but the present values for sodium in both raw and defatted cashew kernel were comparable to the value reported for *Terminalia catppa* seeds [17]. The iron content of the raw cashew kernel was lower than those of cowpea (4.9 mg/100g) and kersting's groundnut (4.20 mg/100g) reported by [16] but those values reported for defatted sample compared favourably. The value of copper in defatted cashew was lower than that of the raw sample. The Na/K ratio in the body is very important for the prevention of hypertension. A Na /K ratio of 0.60 is recommended [20]. Both the raw and defatted samples studied had values greater than 0.60 which is an indication that they would promote high blood pressure problem in the body.

Table 2. The mineral composition (mg/kg) of cashew kernel

Minerals	Raw	Defatted
Sodium	21.5	24.4
Potassium	29.3	31.6
Calcium	0.15	2.25
Magnesium	0.45	1.25
Zinc	0.04	1.25
Iron	0.15	1.02
Copper	0.32	0.03
NA/K	0.73	0.77

Table 3. presents the anti nutrients in the sample. In spite of the potential contribution of cashew kernel to the amelioration protein dearth in most under developed countries, their endowment with ability to synthesize anti-nutritional factors remains a major drawback to their direct use as food by man and livestock. For instance, the phytate, oxalate and cyanide varied from 25.6 to 19.2mg/g, 5.75mg/g to 4.63mg/g and 4.30mg/g to 3.62mg/g respectively. While tannic value in raw and defatted samples varied from 1.0mg/g to 0.71mg/g. This further confirms the wide occurrence of these two anti-nutritional factors in most leguminous seeds. The values of oxalate (4.63mg/g) and tannin (0.71%) in the sample were lower than that of date palm tannin (3.0%), oxalate (6.01mg/g) reported by [21]. This implies that cashew kernel contains low level of anti nutrient factors. The phytate level in both raw and defatted samples were 1.90 mg/g and 2.56 mg/g respectively. The phytate level in both the raw and defatted cashew kernels were lower than that of *Nypa fruiticans* seeds reported by [22], *Trichosanthes anguina* [23], *Pennisetum purpureum* [24] and *Chrysophyllum albidium* [25]. The knowledge of the phytate level in any food is necessary because high concentration can cause adverse effects on the digestibility [26]. Phytate also forms stable complexes with $Cu,^{2+}Zn,^{2+}Co,^{2+}Mn,^{2+}Fe,^{2+}Ca.^{2+}$ Therefore, the low level of phytate in cashew kernel would positively affect digestibility and hence, aid its quick digestion in small intestine.

Table 3. Anti nutritional factors of cashew kernel

	Raw	Defatted
Tannic acid (%)	0.71	1.00
Phytate (mglg)	1.90	2.56
Oxalate (mg/g)	4.63	5.75
Cyanide(mg/g)	3.62	4.39

The values of functional properties are presented on Table 4. The water absorption capacity (WAC) was 97.6% for the raw and the defatted was 103% and these compared favourably with those reported for some edible legume seeds [27]. The water absorption capacity (103%) for defatted cashew nut was lower than those of kidney beans (165%) reported by [15] and dehulled African nutmeg (160%) reported by [13]. The high WAC is considered important in viscous foods such as soup and gravies. The observed values for fat absorption capacity (FAC) of defatted and raw samples (91.1 and 86.0%) were higher than that reported by [27] for pigeon pea flour (89.7%) thus indicates its potential as flavor retainer. The foaming capacity and foaming stability (FS) for raw (8.50%, 2.50%) and defatted (13.0%, 3.50%) at 30 minutes when compared with the value reported by [28] for varieties of lima bean flour whose foaming stability (FS) ranged from 8.80 to 15.2% indicates that the cashew kernel may not serve as whipping agent. The values obtained for functional properties of the cashew kernel suggest that it has potential for the formulations of different food products.

Table 4. Functional properties (%) cashew kernel

%	Raw	Defatted
Water absorption capacity	97.6	103
Oil absorption capacity	86.0	91.1
Foaming capacity	8.50	13.0
Foaming stability	2.50	3.50
Emulsion capacity	56.0	45.0
Emulsion stability	29.0	18.0
Least gelation concentration (w/v)	18.0	16.0

The Table 5 shows the amino acid (AA) profile of *Anacardium occidentale*. The result indicates that tryptophan (2.49g/100g) and asparagine acid (1.76g/100g) were the major abundant amino acid in the sample. The total essential amino acids of the sample (10.1 g/100g) was lower than the selected oil seeds (melon, pumpkin and gourd seeds) ranging between 24.2-29.5% reported by [29,30]. Trytophan was the highest amino acid followed by alanine (1.73 g/100g). The total amino acid of the sample (%TAA) (19.7 g/100g) was lower than that of leaves of *Moringa oleifera* (76.4 g/100g) reported by [18]. It is interesting that the sample contains important amino acids in which taken may prevent most skin rashes and eczema. The result generally suggests that the diet of cashew kernel (*Anacardium occidentale)* may not contribute largely to the supply of essential amino acids as other edible seeds but can supply appreciable amount of essential amino acids needed in the body for development. The value of histidine (0.64g/100g) in the sample studied was lower than those of African cat fish (3.02 g/100g), snake fish (3.37g/100g) and tilapia fish (3.02g/100g) reported by [31] and this value is highly essential for development of children.

Table 5. Amino acid profile of cashew kernel

Amino acid	g/100g crude protein
Glycine	1.53
Lysine	1.64
Serine	1.07
Glutamic acid	0.46
Glutamine	0.35
Histidine	0.64
Alanine	1.73
Threonine	0.52
Methionine	0.61
Tyrosine	0.84
Valine	1.03
Proline	0.98
Leucine	1.17
Phenylamine	0.84
Tryptophan	2.49
Arginine	1.66
Asparagine	1.76
Aspartic acid	0.39
Total essential amino acids (TEAA)	10.1

4. CONCLUSION

It can be concluded that cashew kernel is rich in valuable minerals and essential amino acid. The protein and minerals were enhanced in the defatted sample but the level of anti nutrients increased. Also, the good functionality of the kernel indicates its potential usefulness in various food applications.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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