Biosciences, Biotechnology Research Asia Vol. **5**(1), 99-106 (2008)

Proximate composition and some nutritionally valuable minerals in the dehulled seeds and seed hull of *Anacaridium occidentale* (L.) and *Blighia sapida* (Koenig)

E.I. ADEYEYE* and M.A. OYAREKUA[1]

*Department of Chemistry, University of Ado Ekiti, P.M.B. 5363, Ado-Ekiti (Nigeria)
[1]Department of Science Technology, Federal Polytechnic, P.M.B. 5351, Ado-Ekiti (Nigeria)

(Received: January 14, 2008; Accepted: May 17, 2008)

ABSTRACT

The proximate and mineral composition of the hull and dehulled seeds of *Anacardium occidentale* (L.) (cashew) and *Blighia sapida* (Koenig) (akee) were determined. The proximate composition showed that both dehulled samples of *A. ocidentale* and *B. sapida* were high in crude protein with respective values of 32.0g/100g and 20.4g/100g dry weight. The crude fat in *B. sapida* was high (21.0g/100g) while the carbohydrate in the dehulled samples had almost similar values with *A. occidentale* (42.7g/100g) and *B. sapida* (43.1g/100g) which is 0.42% variation. Both the dehulled and hull of *A. occidentale* would be good sources of Ca, Mg, Zn and P while the dehulled and hull samples of *B. sapida* would be good sources of Ca, Mg, Zn, P, K and Na. The hull in *B. sapida* was better concentrated in Ca, Mg, Zn, P and Fe than the dehulled analogue. The results showed that *B. sapida* seeds could be exploited for human use rather than being thrown away.

Key words: *Anacardium occidentale*, *Blighia sapida*, proximate composition, nutritionally valuable minerals.

INTRODUCTION

The cashew (*Anacardium occidentale* L., *Anacardiaceae* family) is native to the American tropics from Mexico to Brazil and to the West Indies, but it has since become naturalized in many lowland tropical areas[1]. Other areas of cultivation are: India, Sri Lanka, Malaya, Mozambique, Tanzania, Kenya, Malawi, Malagasy Republic, Nigeria and Senegal[2,1].

The cashew tree is a spreading, fast growing evergreen up to 12 m in height. The flowering period is between March and July with a peak in April and May. Sporadic flowering may continue till September[3]. Plants are propagated from seed and will begin to fruit in about three years. There are two distinct varieties in cultivation; one has a red-tinted fruit, the other a more vigorous variety with slightly larger leaves, has a yellow fruit[4].

The cashew fruit consists of a soft, shiny, pear-shaped, swollen, juicy basal portion or hypocarp, commonly known as a cashew apple. The 'apple' bears at its summit a kidney-shaped, single seeded nut (achene) with a hard, grey-green pericarp or shell. The seeds are exalbuminous with a reddish brown testa, two large white cotyledons and a small embryo. The seeds are inedible when raw and must be cooked or roasted to drive off the oil before it is opened or shelled[5]. World production of cashew nut is about 700 000 t, out of which about 80% comes from India (230 000 t), Mozambique (200 000 t) and Tanzania (150 000 t)[5].

The akee (*Blighia sapida* Koenig, *Saprindaceae* family) [6] is among the minor African fruiting plants. The akee is a broad – spreading tree native to West Africa. The flowering period is between March and June; between September and

November. Its fruits, which is a three-celled capsule, is gathered from the wild or occasionally from cultivated trees. The edible part of the fruit is the white pulp which surrounds the bottom half of each seed, and this is eaten raw or cooked when ripe but not overripe[1]. Plants are propagated from seed and will begin to fruit in about five years. Tree grows to 9.30 m or more. Akee grows relatively in poor soils. The fruit is bright red when ripe[4].

Both cashew and akee trees are grown as ornamental plants and they are both used as marks for boundary positions. Both trees are hardy, evergreen, drought resistant and thrive well under a wide range of climatic conditions. Both are given various names in Nigeria (Table 1)[4]. However, there is a great deal of current interest in the cashew crops because of its various uses, such interest has not been extended to the akee crop.

Some works had been reported on the cashew kernel; they included the evaluation of the fatty acid composition[7] and the amino acids composition[8] while the nutritional values and functional properties of ripe and naturally opened *Blighia sapida* fruit had been evaluated[9]. The present paper reports on the proximate composition and some mineral contents of dehulled and hull samples of cashew nut and akee nut. The major aim is to compare the analytical results of the two nuts and expose the potentials derivable from the akee nut.

MATERIAL AND METHODS

Collection and treatment of samples

Samples of cashew nuts were collected from Akure (Ondo State, Nigeria) during the fruiting season. After collection, the nuts were sun-dried until the kernels rattle in their shells. (Sharp rattle indicates that the nut has fully dried)[1]. Drying was carried out for about ten days. After drying, the hands were protected with gloves and a sharp knife was used to open the exocarp (shell). The testa and the dehulled seeds were then separated, ground into a fine powder and separately stored in airtight containers. The yellow apple cultivar nuts were used for this work.

The akee nuts were collected from Ikere (Ekiti State, Nigeria) during the fruiting season. After collection, the testa of the fresh nuts was removed with a sharp knife. The dehulled seeds and the testa were then separately sun-dried, milled and separately stored in airtight containers.

Samples were withdrawn as required for chemical analysis. All analyses were carried out on duplicate samples.

Analytical methods

Proximate composition was determined by the official methods of the Association of Official Analytical Chemists [10]: moisture (AOAC, 925.10), ash (AOAC, 923.03), ether extract (oil content) (AOAC, 920.85) and crude fibre (AOAC, 920.86). Protein (NX 6.25) was determined by the micro-Kjeldahl method[11]. Nitrogen-free extract (total digestible carbohydrate) was determined by subtracting the sum of crude protein, ether extract, crude fibre, ash and moisture from 100. The moisture was determined for dry-matter estimation. All constituents were therefore expressed on dry-matter basis.

The calorific value was obtained by multiplying the mean values of the crude protein, fat and carbohydrate by the Atwater factors of 4, 9 and 4, respectively, taking the sum of the products and expressing the result in kilocalories [12].

Mineral analysis was determined by the

Table 1: Nigeria names for cashew and akee crops

Crop	Botanical name	Yoruba	Ibo	Hausa
Cashew	*Anacardium occidentale*	Ekaju	Kashuu	Kanju
Akee	*Blighia sapida*	Ishin	Okpu	Fisa gwanja kusa

digestion of the sample with 20% HNO_3 on a hot plate for 5 h and the resulting solution made up to 100 millilitres[13]. The mineral constituents (Ca, Mg, Zn and Fe) were then determined by atomic absorption spectrophotometry using a Pye Unicam, Cambridge, UK, Model Sp 9 instrument. Sodium and potassium were determined using flame photometer (Corning, UK, Model 405). Phosphorus was determined colorimtrically at 440 nm, using the phosphovanadomolybdate reagent method (AOAC, 948.09) with a Spectronic 20 (Gallenkamp, UK) instrument.

RESULTS AND DISCUSSION

Table-2 shows the proximate composition of the dehulled and hull samples of cashew nut. Dehulled sample moisture (8.02g/100g) is favourably comparable to the moisture content (7%) of processed cashew nuts[5]. The dry matter for dehulled cashew nut is high and it is within the range of most legumes[14]; the crude fibre is low but high in crude protein. The value of crude protein (32.0g/100g) is higher than that reported by Opeke[15] with a value ranging from 20-22%. Cashew nut can contribute significantly to the recommended daily protein requirement of 23-56 g[16]. It is reported that the protein quality approximates that of soya beans but more superior to that of the ground nut (peanut) [15]. No risk of aflatoxin is expected from cashew nut. The fat of dehulled cashew nut reported here is lower than the value reported by Kochhar[5] but mineral matter (ash), crude fibre and carbohydrate are highly in value than those reported by Kochhar[5]. The fat in cashew nut contains the fat soluble vitamins A, D and K while vitamin E occurs to a level of 200-210 mg/100g; roasting the nuts lead to vitamin pp development[15]; these vitamins are known to exert a sparing action on the B group vitamins as well as assisting the metabolism of lactose and thiamine. The fat also contains a reasonable quantity of linoleic acid[7,15], its consumption is a great aid in avoiding high cholesterol levels and coronary diseases (like coronary thrombosis). 80-82% of its fats is in the form of unsaturated fatty acids, hence its consumption could militate against the development of fatty liver[7,15]. The calorific value of 398 kcals indicates that 754 g of the cashew nut can provide daily requirement of 2500 to 3000 kcals for adults[17].

The hull of cashew nut is low in total ash, crude fat, crude fibre and moisture (Table 2); it is however high in crude protein, carbohydrate, dry matter and energy. The values of the proximate composition show that the hull can be used in preparing livestock feed. This is because the values are in good comparison with those of cocoa shell[14] which have been successfully used as cattle feed.

Table 2: Proximate composition of the hull and dehulled samples of *Anacardium occidentale* seeds (g/100g dry matter)[a]

Constituent	Dehulled	Hull	Grand mean	± SD*	CV (%)+
Moisture	8.02	3.45	5.74	3.23	56.3
Dry matter	92.0	96.6	94.3	3.23	3.43
Ash	3.86	1.39	2.63	1.75	66.6
Crude protein	32.0	13.4	22.7	13.2	58.0
Crude fat	11.0	3.21	7.11	5.51	77.5
Crude fibre	2.40	8.75	5.58	4.49	80.5
Carbohydrate	42.7	69.8	56.3	19.2	34.0
Calorific value(Kcals/100g)	398	362	380	25.6	6.74

[a] Determinations were made in duplicate

* Standard deviation

+ Coefficient of variation.

The coefficients of variation percent (CV%) between the dehulled and hull in cashew nut show that the dry matter in both is about similar (CV = 3.43%), same is observed for the calorific value (CV = 6.74%) while the highest variation is noticed in the crude fibre (CV = 80.5%). This is expected since the hull should have more fibre.

Table 3 shows the proximate composition of the dehulled and hull samples of akee nut. The dehulled seed is high in dry matter, total ash, crude protein, crude fat and calorie but low in moisture and crude fibre. With a value of 21.0g/100g for crude fat the akee nut is qualified as an oil-rich seed, especially when compared with soya beans which have fat content of about 19% [14,18]. The crude fat has golden yellow colour (like the colour of cashew nut oil). This oil can be expressed and refined for culinary purposes, as well as for the production of soap, margerines and bakery fat. The residual meal may find use in the production of chocolate, confectionery products, food or feed enrichment and instantized products.

The crude protein content of the akee nut (dehulled) is 20.4g/100g. The adult man of 70 kg body weight requires 0.57g/kg of protein[19], that is 39.9 g of protein daily. Assuming complete protein absorption (if consumed) about 195 g of the nut will satisfy the daily requirement of an adult. The calorific value of 443 kcals/100g indicates that 677 g of the akee nut can provide the daily requirement[17]. This is better than the value reported for cashew nut above.

In the hull of akee nut the dry matter, crude protein, carbohydrate and calorific value are high while other parameters are low with the crude fibre being less than 1.0g/100g. The testa (hull) might be good as a component of livestock feed[14].

A pairwise comparison of the hull and the dehulled akee nut (Table -3) shows that their proximate compositions are similar in most cases with coefficients of vaiation being lower than 50% with the exception of crude fat (CV = 140%) which is almost absent (1.0g/100g) in the hull.

Table 4 is the pairwise comparison of the hull of both cashew and akee nuts. Differences in values in the proximate composition are low in most of the parameters determined particularly in dry matter, crude protein, carbohydrate and calorific value but high difference is observed in the crude fat content. In Table 5, the comparison of the dehulled samples shows a better similarity in their results. Differences are very low as shown by the coefficients of variation, for example less than 1.0% variation is observed for dry matter and carbohydrate while the highest variation is recorded in crude fat which is 31.3%. These close similarities in values may be a useful information that can lead to the exploitation of the akee nut for human use.

Table 6 shows the elemental composition of the hull and dehulled samples of cashew nut. The dehulled sample will be a good supplement in the supply of Ca, Mg, P and Fe to the body when consumed. However, it will supply enough body

Table 3: Proximate composition of the hull and dehulled samples of *Blighia sapida* seeds (g/100g dry matter)

Constituent	Dehulled	Hull	Grand mean	± SD	CV (%)⁺
Moisture	8.47	5.44	6.96	2.14	30.8
Dry matter	91.5	94.6	93.1	2.14	2.30
Ash	3.15	3.98	3.57	0.59	16.5
Crude protein	20.4	10.6	15.5	6.93	44.6
Crude fat	21.0	0.08	10.6	14.8	140
Crude fibre	3.83	3.28	3.56	0.39	11.0
Carbohydrate	43.1	76.6	59.9	23.7	37.6
Calorific value (Kcals/100g)	443	350	396	46.9	11.8

Table 4: Proximate composition of the seeds hull of *Anacardium occidentale* and *Blighia sapida* compared

Constituent	*A. occidentale*	*B.sapida*	Mean	±SD	CV (%)
Moisture	3.45	5.44	4.45	1.00	22.5
Dry matter	96.6	94.6	95.6	1.41	1.47
Ash	1.39	3.98	2.69	1.30	48.3
Crude protein	13.4	10.6	12.0	1.38	11.5
Crude fat	3.21	0.08	1.65	1.57	95.2
Crude fibre	8.75	3.28	6.02	2.74	45.5
Carbohydrate	69.8	76.6	73.2	3.39	4.63
Calorific value (Kcals/100g)	362	350	356	8.55	2.40

Table 5: Proximate composition of the dehulled seeds of *Anacardium occidentale* and *Blighia sapida* compared

Constituent	*A. occidentale*	*B.sapida*	Mean	±SD	CV (%)
Moisture	8.02	8.47	8.25	0.23	2.79
Dry matter	92.0	91.5	91.8	0.32	0.35
Ash	3.86	3.15	3.51	0.36	10.3
Crude protein	32.0	20.4	26.2	5.78	22.1
Crude fat	11.0	21.0	16.0	5.01	31.3
Crude fibre	2.40	3.83	3.12	0.72	23.1
Carbohydrate	42.7	43.1	42.9	0.18	0.42
Calorific value (Kcals/100g)	398	443	421	32.1	7.64

Table 6: Some nutritionally valuable minerals in the hull and dehulled samples of *Anacardium occidentale* seeds (mg/100 g dry matter)[b]

Mineral element	Dehulled	Hull	Grand mean	± SD	CV (%)
Ca	90.0	71.0	80.5	13.4	16.7
Mg	65.0	9.00	37.0	39.6	10.7
Zn	58.3	34.7	46.5	16.7	35.9
P	67.7	17.8	42.7	35.3	82.6
Fe	4.48	0.89	2.69	2.54	94.5
K	4.00	3.00	3.50	0.71	20.3
Na	16.0	16.0	16.0	0.00	0.00

[b] Determinations were made in duplicate.

requirement of zinc (6.23mg) per day[20]. The dehulled sample of cashew nut is low in K and Na. The mineral composition of the hull shows lower values when compared to the dehulled values with the exception of Na which is similar (16.0mg/100g) in the two samples. Mg, P and Fe are highly varied.

Table 7 shows the elemental composition of the hull and dehulled samples of akee nut. The dehulled samples are low in Ca, Mg and P but are good sources of Zn, Fe, K and Na. In fact, it will produce enough daily requirement of Zn (6.23mg) and Fe (11.2mg)[20] if there is total absorption of Zn (183mg) and Fe (13.5mg) in 100g of sample respectively or 11.4 g of akee nut (dehulled) will supply the daily requirement of man in zinc. The sample will also supply about half of daily requirement of sodium and be a good supplement of the supply of potassium. Looking at the values of the hull in Table 7, it is observed that Ca, Mg, Zn, P and Fe are correspondingly higher than in the dehulled sample but correspondingly lower in K and Na. This type of observation was noticed also in the elemental composition of dehulled and hull samples of three different cultivars of the African yam bean (AYB) (*Sphenostylis stenocarpa*) seeds[21]. The high content of the mineral concentration in the hull will make akee nut testa a very good ingredient in animal feed production and it also places it in a better position for this function than the hull of cashew nut.

Table 8 compares the mineral of the hull in cashew nut and akee nut. High variation in mineral composition is observed for Mg, Zn, P and Fe with values in the akee testa on the high side while variation is low in Ca, K and Na although akee testa still maintains being on the high side.

Table 7: Some nutritionally valuable minerals in the hull and dehulled samples of *Blighia sapida* seeds (mg/100 g dry matter)

Mineral element	Dehulled	Hull	Grand mean	± SD	CV (%)
Ca	5.00	76.0	40.5	50.2	124
Mg	12.0	30.0	21.0	12.7	60.6
Zn	183	288	236	74.2	31.5
P	18.4	316	167	211	126
Fe	13.5	25.3	19.4	8.35	43.1
K	355	4.00	180	248	138
Na	930	16.5	473	646	136

Table 8: Some nutritionally valuable minerals in the seeds hull of *Anacardium occidentale* and *Blighia sapida* compared

Constituent	***A. occidentale***	***B.sapida***	**Mean**	**±SD**	**CV (%)**
Ca	71.0	76.0	73.5	2.50	3.40
Mg	9.00	30.0	19.5	10.5	53.9
Zn	34.7	288	161	127	78.5
P	17.8	316	167	149	89.4
Fe	0.89	25.3	13.1	12.2	93.2
K	3.00	4.00	3.50	0.50	14.3
Na	16.0	16.5	16.3	0.25	1.54

Table 9 is a comparison of mineral elements in the dehulled samples. Cashew nut will be better sources of Ca, Mg and P while akee nut will be better sources of Zn, Fe, K and Na. Ca, Mg, P and protein are all involved in bone formation[22]. Na and K are required to maintain osmotic balance of the body fluid, the pH of the body, regulate muscle and nerve irritability and control of glucose absorption[23,22]. Fe is present in the haemoglobin of the blood and it is reported to be very important for normal function of the central nervous system[24]. Zinc is present in all tissues of the body and is a component of more than 50 enzymes[25].

Table 9: Some nutritionally valuable minerals in the seeds hull of *Anacardium occidentale* and *Blighia sapida* compared

Constituent	*A. occidentale*	*B. sapida*	Mean	±SD	CV (%)
Ca	90.0	5.00	47.5	42.5	85.5
Mg	65.0	12.0	38.5	26.5	68.8
Zn	58.3	183	121	62.4	51.7
P	67.7	18.4	43.0	24.6	57.2
Fe	4.48	13.5	8.98	4.50	50.1
K	4.00	355	180	176	97.0
Na	16.0	930	473	457	97.6

CONCLUSIONS

The largest percentage of roasted and shelled cashew is utilised in nut salting, consumed primarily as table nuts and some are used in bakery goods and confectionery. The uses of the various parts of cashew have been well established in various reports. The report of the present work shows that many similarities exist between cashew and akee nuts. Akee can therefore be regarded as a crop with very great potential; for example akee nut with its high content of oil and appreciable amount of protein is of great nutritional value. More research work is therefore needed in the culture, breeding, biochemistry, nutrition and pharmaceutical importance of the akee nut.

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