COMPOSITION AND PROPERTIES OF *COLA NITIDA* AND *COLA ACCUMINATA* FLOUR IN NIGERIA

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ABSTRACT

The proximate analysis, mineral content and certain food functional properties of the nuts of *Cola nitida* and *Cola acuminata* were investigated. The average composition of *Cola nitida* was as follows: 2.3% moisture, 10.5% crude protein, 3.1% ash, 13.3% crude fat, 17.5% crude fibre and 53.2% total carbohydrate, while *C.acuminata* contained 5.8%' moisture, 9.4% crude protein, 4.2% ash, 12.5% crude fibre, 15.8% crude protein and 52.2% total carbohydrate. Both nuts have an abundance of Mg, Na, K and P and trace minerals were low. The nuts have good gelation properties, high water absorption capacity and oil absorption capacity, but lower values for oil emulsion capacity, oil emulsion stability, foaming capacity and foaming stability.

KEY WORDS: Composition, properties, *Cola nitida*, *Cola acuminata*.

INTRODUCTION

Kolanut, a member of the family of Sterculiaceae has a long history in Nigeria (Adeyeye and Ayejuyo, 1994). Areas of cultivation include West Africa and parts of the Carribean Islands, especially Jamaica (Opeke, 1982). *C. nitida* can be identified by its nuts of two cotyledons whereas *C. acuminata* can also be identified by its nuts of between three to six cotyledon. *C. nitida* has color varieties of white, red and pink, but *C. acuminata* has color varieties of white and pink.

In Africa and Nigeria in particular, report show that Kolanut has got many uses ranging between pharmacentical and beverages preparation, religion, social and ritual functions as well as stimulants, to mention just a few (Opeke, 1982; Oguntuga, 1975; Nwafor and Ogbeneaga,1992)

Some authors have previsiosly worked on these nuts, but there is no information regarding their functional properties. Its is the aim of this study to provide more information on the nutritive value and certain functional properties of the two different nuts.

MATERIALS AND METHODS

The samples were obtained from a market at Akure, Ondo State of Nigeria. The nuts were washed in distilled water, sun dried for 72 hours, milled in a Kenwood blender, sieved with a mesh of aperture 425mm and stored in a sample bottles for further analysis.

Proximate Analysis

Method of AOAC (1990) was followed, crude fat, ash, and moisture were determined in triplicate. Nitrogen was determined by the micro-Kjeldahl method described by Pearson (1976) and the percentage nitrogen was converted to crude protein by multiplying by 6.25. The total carbohydrate content was determined by difference.

Mineral Analysis.

Ash obtained from the nuts was boiled with 15cm^3 of 20% hydrochloric acid, filtered and made up to 100cm^3 with deionized water. Na, K, Co, Zn, Mg, Fe and Ca were determined using an Atomic Absorption spectrophotometer (Buck Scientific model- 200A /210, Connecticut). P was determined colourimetrically using a spectronic 20 (GallenKamp, UK) using phosphovanado molybdate method (AOAC, 1990).

Functional Properties

Least Gelation Concentration(LGC)

The method of Coffmann and Garcia (1977) was employed. Appropriate flour suspense of 2,4,6,8,10,14,&16% (^{w}/v) were prepared in 5cm^3 distilled water. The test tubes conaining suspension were heated for 1 hour in boiling water followed by rapid cooling under running tap water. The LGC was determined as the concentration in which the flour from the inverted test tube did not fall down or ship.

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Table 1 : Proximate composition (%) of *C. nitida* and *C. acuminata*[a]

Composition	Concentration	
	C. nitida mean ± SD[c]	*C. acuminata* mean ± SD
Moisture	2.3± 0.33	5.8 ± 0.11
Dry matter (DM)	97.7 ± 0.26	94.2 ± 0.21
Crude Protein (CP)	10.5 ± 0.14	9.4 ± 0.25
Ash	3.1 ± 0.60	4.2 ± 0.30
Crude Fat	13.3 ± 0.35	12.6 ± 0.28
Crude Fibre (CF)	17.6 ± 0.40	15.8 ± 0.15
Carbohydrate[b]	53.2 ± 0.22	52.2 ± 0.28

a   Determinations were in triplicate

b – Determination by difference

●   SD – Standard deviation.

Table 2: Mineral composition (mg/Kg) of *C. nitida* and *C. acuminata*.[a]

Composition	Concentration	
	C. nitida (Mean ± SD)	*C. acuminata* (Mean ±SD)
Ca	4.72 ± 0.16	5.92 ± 0.01
Mg	16.13 ± 0.01	14.25 ± 0.03
Na	198.00 ± 0.07	178.88 ± 0.21
K	92.00 ± 0.21	84.35 ± 0.22
Zn	0.80 ± 0.04	0.78 ± 0.01
Mn	0.04 ± 0.01	0.60 ± 0.02
Cu	0.29 ± 0.10	0.36 ± 0.01
Co	0.20 ± 0.05	0.34 ± 0.03
Fe	2.20 ± 0.05	0.34 ± 0.03
P	50.23 ± 0.10	52.10 ± 0.12

a - Determinations were in triplicate.

Water Absorption Capacity (WAC)

The WAC was determined using the method of Beuchat (1977). 1g. flour was mixed with 10cm³ distilled water in a mixer, kept at rooms temperature (30°c) for 30 minutes, centrifuge at 3500rpm for 30 minutes and the supernatant meted in a 10cm³ graduated cylinder. The density of water was assumed to be 1g/cm³

(Adeyeye et al, 1994). The excess water absorbed by the flour was expressed as the percentage water bound by 100g sample.

Foaming Capacity (FC) and foaming stability (FC).

FC and FS were studied according to the method of Coffmann and Garcia (1977). 1g.

sample was whipped with 50cm³ of distilled water for 5 minutes in a Kenwood blender at speed settings 'fast' and was poured into a 100cm³ graduated cylinder. Total volume at intervals between 25 minutes and 1500 minutes were noted for the FS. To obtain the FC, volume increase (percentage) was calculated according to the following equation.

$$\text{Vol. Increase} = \frac{\text{Volume after whipping} - \text{Volume before whipping}}{\text{Volume before whipping}} \times 100$$

Table 3:Certain funtionals properties (%) of *C. nitida* and *C. acuminata.*

Sample[b]	WAC	OAC	OEC	FC	LGC
C. nitida	200	192	24	4	14
C. acuminata	210	172	32	6	14

.b- WAC *(Water absorption capacity)*

OAC (Oil absorption capacity)

OEC (Oil emulsion capacity)

FC (Foaming capacity)

LGC (Least gelation capacity)

Oil absorption capacity (OAC)

Sosulski's (1962) test procedure was used 0.5g of the sample was added to 3.0cm³ of vegetable oil in 10cm³ graduated centrifuge tubes. The mixture was stirred with glass rod to disperse the flour in the oil. After holding for a period of 30 minutes, at speed setting 'fast' and the volume of separation oil was noted; The excess oil absorbed was expressed as the percentage oil bound by 100g sample. The density of the oil was determined by means of specific gravity bottles.

Oil Emulsion Stability (OES)

An emulsion was prepared according to Beuchat's procedure (1997). 1g. of sample was blended in a Kenwood blender with 50cn³ of distilled water for 30 minutes at maximum speed. Vegetable oil was added in 5cm³ portioned with continued blending. A drop in consistency or decrease in resistance to blend was considered the point at which to discontinue oil addition. The emulsion so prepared was then allowed to stand in a graduated cylinder and the volume of water separated at intervals between 1 hour and 24 hour was noted in each case.

Oil emulsion capacity (OEC)

The procedure of Inklaar and Fortuin (1969) was followed. 1g. of four was made into a slurry in 20cm³ of distilled water using an Erlenmeyer flask by stirring at 100rpm for 15 minutes with a small magnetic bar, 5cm³ of vegetable oil was then added over a period of 5 minutes, which stirring at 100rpm. Stirring was continued for an extra minute. The system was transferred to a centrifuge tube heated in a water bath monitored at 850°c for 15 minutes in a water bath maintained at 250°c. The tube was finally centrifuge at 3500rpm until the volume of oil separated from the emulsion was constant. Results were expressed as the percentage of that emulsified oil after separating the upper layer from the emulsion.

RESULTS AND DISCUSSION

The proximate compositions of the kolanut varieties are shown in Table 1. Crude protein, crude fibre, crude fat and total carbohydrate of *C. acuminata* and *C. nitida* varied from 9.4%- 10.5%; 12.6%-13.3%; 15.8%-17.6%, and 52.2%-52.2% respectively, while ash and moisture of *C. nitida* and *C. acuminata* varied from 3.1%-4.2% and 2.3%-5.8% respectively.

The values for the nuts compared favourable with the work of Adeyeye and Ayejuyo, (1994) on *C. acuminata* and *G. kola* (Opeke, 1982). According to Adeyeye and Ayejuyo

(1994), the low moisture content of the nuts is advantageous for their long preservation since it will prevent early spoilage.

The mineral contents of C. nitida and C. acuminata are shown in Table 2. Among the nuts, sodium was abundant mineral with values of 178.8mg /kg in C. acuminata and 198.0mg/kg in C. nitida, while cobalt was the least abundant with values ranging from 0.20mg/kg to 0.34mg/kg.

Table 2 shows that both nuts are rich in most of the minerals and could therefore serve as additional sources of such minerals. In comparison of this result to that of minerals in mangoes, quava it was found that these nuts contain less, but are richer in protein, fat, fibre, ash and carbohydrate.

Functional properties

The least gelation capacity for both nuts

was 14% as shown in Table 3. This value was higher than those obtained for other seeds by Adeyeye, et al (1994); Oshodi and Ekperigin (1989); Oshodi and Adelodun (1993); and Fagbemi and Oshodi (1991). Thus C. nitida and C. acuminata might be useful in the production of curd or as an additive to other minerals for gel formation in food products, since protein gel formation provides a structural matrix for holding water, flavour, sugars and food ingredients.

The WAC ranged between 201% in C. nitida to 210% in C. acuminata. These values (Table 3) are much higher than values reported for some seeds by Oshodi and Ekperigin (1989), Adeyeye et al (1994); Olaofe et al (1993) but compared favourably with values reported by Ige et al (1984) for three varieties of melon. Since WAC is considered a critical function of protein in viscous food then these nuts could be used for viscous

Table 4: Emulsion Stability (cm³) of C. nitida and C. acuminata[a]

Time	C. nitida	C. acuminata	Mean	± SD[b]	CV(%)[c]
1	22.58	15.15	18.67	3.72	19.69
2	22.58	15.15	18.67	3.72	19.69
3	22.58	15.15	18.67	3.72	19.69
4	22.58	15.15	18.67	3.72	19.69
5	22.58	15.15	18.67	3.72	19.69
6	22.58	15.15	18.67	3.72	19.69
22	16.13	13.64	14.89	1.25	8.39
24	16.13	13.64	14.89	1.25	8.39

a- Determination in triplicate
b- Standard Deviation
c- Coefficient of variation

Table 5: Foaming stability (cm³) of C. nitida and C. acuminata[a,b]

Time	C. nitida	C. acuminata	Mean	± SD	CV(%)
25	50.00%(1.0cm³)	33.33%(1.0cm³)	41.67	8.33	20
50	50.00%(1.0cm³)	33.33%(1.0cm³)	41.67	8.33	20
60	0.00%(0.0cm³)	0.00%(0.0cm³)	0.00	0.00	0

a- Determinations in triplicate
b- Foaming stability was determined for 60 minutes
± SD-standard deviation
CV (%)-coefficient of variation

food formulations.

The OAC is also shown in Table 3. The value is higher than that obtained for variegated grasshopper, 33.3% (Olaofe *et al*, 1998); wheat flour, 84.2% and Soya flour, 84.4%, but comparable to African Yam flour, 109-145% as obtained by Oshodi *et al*, (1997) and Oshodi (1992) reported the value of 206.7% for whole seed flour and 125.9% for dehulled seed flour of *Adenopus breviflorus* benth flour and cowpeas ranged from 281-310% as obtained by Olaofe *et al*, (1993). OAC is important, as oil acts as a flavour retainer and improves the mouth feel of foods (Kinsella, 1979), so the nuts would be good in these respects.

The OEC for *C. nitida* was 24% while that for *C. acuminata* was 32% (Table 3). The value compared to the value of 20-70% reported by Adeyeye *et al*, (1994) and better than those reported for wheat flour (7-11%), soya flour 80% by Lin *et al*, (1974). The value was lower than 95% recorded for sunflower flour by Lin *et al*, (1974). The nuts may be useful as an additive for the stabilisation of fat emulsion in the production of sausage, soup and cake (Althschul and Wilcke, 1985).

Both nuts have a stable emulsion for the period of 24 hours (Table 4). Emulsion stability of C nitida was higher compared with *C. acuminata*. This protein would be useful in products that depend on the formation of stable emulsions.

The results of FC and FS are shown in Tables 4 and 5. The FC and FS were low with only 4-6% foam formed and that collapsing completely within 25 minutes. Most commercial

products are stable for more than 2 hours. Consequently, *C. nitida* and *C. acuminata* would not be attractive for products where foaming is important (Kinsella, 1979).

CONCLUSION

The seeds of *C. nitida* and *C. acuminata* have good nutritional qualities by virtue of their significant mineral content. The flour obtained from the nuts have great potential for use in food formulation because of their impressive functional properties.

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REFERENCES

Adeyeye, E.I and Ayejuyo, O.O., 1994. Chemical composition of *Cola acuminata* and *Garcinia kola* seeds grown in Nigeria. Int. J. Fd. Sci. And Nutr. 45: 223 – 230.

Adeyeye, E. I, Oshodi, A. A. and Ipinmoroti, K. O., 1994. Functional properties of some varieties of African Yam bean (*Sphenostylis stenocarpa*) flour II. Int. J. Fd. Sci and Nutr. 45: 115 – 126.

Althchul, H. M and Wilcke, H. I., 1985. New protein foods, Vol.5, seed storage proteins London: Academy Press.

Association of Official Analytical Chemists (AOAC), 1990. Official methods of Analysis. 15th Edition, Washington DC.

Beuchat, L. R., 1977. Functional and electrophoretic characteristics of succinylated peanut flour protein .J.Agric. Food. Chem. 25: 258 – 261.

Coffmann, C. W and Garcia, V.V., 1977. Functional properties and amino acid content of a protein isolate from mung bean flour. J Food Tech. 12: 473 – 484.

Fagbemi, T. N. and Oshodi, A. A., 1991. Chemical composition and functional properties of full fat fluted pumpkin seed flour (*Telfairia occidentalis*). Nig Food J. 9: 26 – 32.

Ige, M. M, Ogunsua, A. O. and Oke, O. L., 1984. Functional properties of the proteins and some Nigeria oil seeds, conophor seeds and three varieties of melon seeds. J .Agric Food Chem. 32: 822 – 825.

Inklaar, P.A and Fortuin, J., 1969. Determining emulsifying and emulsion stabilization capacity of protein meat addition. J.Food Techn. 32, 103

Kinsella, J. E., 1979. Functional properties of soy proteins. J.Am. Oil Chem. Soc. 56: 242 –258.

Lin, M. J. Y., Humbert, E. S and Sosulki, F. W., 1974. Certain functional properties of sunflower meal products. J.Food Sci. 39: 368 – 370.

Nwafor, A. and Ogbeneaga, I. E., 1992. Influence of *Garcinia kola* on in – vivo secrection of gastric acid ,African. J. Pharm. Sci: 8(22): 107 – 109.

Oguntuga, D. B. A., 1975. Chemical composition of and potential commercial uses kolanut, C. *nitida*.Ghana J. Agric Sci. 8: 121-125

Olaofe, O, Arogundade, L. A., Adeyeye, E. I. and Falusi, O. M., 1998. Composition and food properties of the variegated grasshopper. *Zonocerus variegatus* .Tropical Sci. 38: 233-237.

Olaofe. O.. Umar, Y.O and Adediran. G. O., 1993. The effect of nematicide on the nutritive value and functional properties of cowpea seeds (*Vigna unguiculata* L.walp). Food Chem. 46: 90-96.

Opeke, L. K., 1982. Tropical Tree Crop, New York: John Wiley & Sons Limited.

Oshodi. A. A.. Ipinmoroti. K. O. and Adeyeye, E. I., 1997. Functional properties of some varieties of African Yam bean (*Sphenostylis stenocarpa*) flour 111. Int. J. Food Sci. & Nutr. 48: 243-250.

Oshodi. A. A.. 1992. Proximate composition nutritionally valuable minerals and functional properties of *Adenopus breviflorus* benth seed flour and protein concentrate. Food Chem. 45, 79-83.

Oshodi. A. A. and Adelodun, M. O. A. 1993. Proximate composition, some valuable minerals and functional properties of three varieties of lima bean (*Phaseolus lunatus* linn) flour. Int.J. Food Sci. Nutr. 43: 181-185.

Oshodi, A. A. and Ekperigin, M. M.. 1989. Functional properties of Pigeon pea (*Cajanus cajan*) flour. Food Chem. 30: 187-191.

Pearson, D. C., 1976. Chemical analysis of foods. 7th edition London: J &A Churchill.

Sosulski. F. W., 1962. The centrifuge method for determining flour absorption in hard red spring wheats. Cereal Chem. 39: 344-350.