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Full Length Research

Nutritional Evaluation and Physico-chemical properties of *Caesalpina bonduc* and *Entada gigas* oil seeds.

Adeleke, A.E. [1], Adegbite, S.A. [2], Onifade A.P[2]

[1]Department of Basic Sciences, Adeleke University, Ede, Nigeria
[2]Department of chemical Science, Joseph Ayo Babalola, University Ikeji-Arakeji, Nigeria.

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A comparative study was carried out on the mineral element composition, fatty acid composition and physico-chemical properties of *Caesalpinia bonduc* and *entada gigas* seed and oil using Atomic Absorption Spectrophotometer, gas chromatographic technique and standard Analytical methods. The mineral elements composition for C. *Bonduc* were K (36.68mg/g),Ca (40.98mg/g), Na(475.65mg/g), Mg(13.20mg/g), Zn (61.80mg/g), P(18.5mg/g) Cu(0.06 mg/g), Fe(12.80mg/g) and *E. gigas* were: K(101.87mg/g), Ca(59.43mg/g) Na(463.57mg/g), Mg(14.20), Zn (66.20mg/g), P(23.86mg/g) Cu(0.08) and Fe (28.3mg/g). The results suggested that *C. bonduc* and *E. gigas* were significantly richer in mineral content with sodium (Na) being the most abundant element while the samples were lower in copper (Cu). The fatty acids compositions for *C. bonduc* and E. gigas showed that the E. gigas seed oil contained of unsaturated fatty acids (57.62) than C. *Bonduc* seed oil with (13.7%) thus making it more nutritionally important. Also, E. gigas was very rich in essential fatty acids (oleic and linolic) while *C. bonduc* was richer in saturated fatty acid (non-essential) (palmitic and hexadecadienoic). The physico-chemical properties results for *C. bonduc* and *E. gigas* ranges were: Acid value (7.85-8.08), periodic value (0.06-0.10), free fatty acid (2.0 – 3.33), Iodine value (2.64 – 5.08), Saponification value (72.93 – 156), Refractive index (1.441-1.449) and specific gravity. This results in this study suggested that the oils of E.gigas might be useful for domestic consumption due to essential fatty units in it while that of C. b*onduc* may find applications in industries.

Key words: Physico-chemical properties, Nutritional Evaluation, *Caesalpinia bonduc*, *Entada gigas* oil seed.

INTRODUCTION

The fatty acid composition of oil is its most useful chemical feature. Many of the chemical test for oil identity or purity can be related to the fatty acid content of the oil. Also, poly unsaturated fatty acids such as linoleic acid plays an important role in modulating human metabolism and consumers consider fatty acid composition to be one of the important parameters of nutritional quality. In particular, consumers are concern with saturated/ unsaturated fatty acid ratio and special attention has been on the essential fatty acids with emphasis on the health potential of polyunsaturated fatty acids. Such fatty acids are known to be essential for human health (Mbofung et al., 1994). It is also known that diet plays an important role in preventing certain diseases. The relationship between dietary fat and certain chronic illness including cardiovascular, neaplastic, endocrine disease and so on is also recognize.

Recent studies have shown that mono-unsaturated fatty acid are better contributors to plasma cholestesol lowering effects (Grundy et al., 1989). Mineral element are of great physiological importance particularly body metabolism (Schwart, 1975). *Caesalpina bonduc*, commonly known as fever nut or *bonduc* nut in English. It's popularly referred to as "Ayo" in South west part of Nigeria. It is widely grown in India (in the plains on waste lands and coastal areas) and in different parts of Nigeria. If bears non-edible fruits and its seeds are bitter with no toxic effect when consumed. The leaves of this plant are

*Corresponding author. Emaill adelekeabosede5@gmail.com

useful in curing intestinal worms and fever.

Entanda gigas plant is the third largest family of flowering plants or the legume or pea family. It is also known as sea heart. It is also known locally as “monkey ladder and “Agbigbara” in Yoruba Land. The plants may grow 100 feet in 18month (flowering vines of the world, 1970). It’s a medicinal plant used in curing, contraception, constipation, and as a coffee additives and food.

This study was carried out to compare the mineral contents, fatty acid composition and the physico-chemical properties of oil seeds in order to know their suitability for edible purpose and industrial applications.

MATERIALS AND METHODS

Collection of materials: *C. bonduc* and *E. gigas* seed were purchased from local markets in Akure, Ondo State of Nigeria. The pods were separated from the seed and then pulverized. The seed oils were extracted separately using the continuous soxhlet extraction method with n-hexane (40-60^{o}C) for 7hours.

The solvent was removed completely and oils obtained were used for both fatty acid determination and physico-chemical properties.

Fatty acid profile: The fatty acid profile was determined using the standard method described by Halls (1982). The fatty esters analyzed using a PYE Unican 304 Gas Chromatography filled with a flame ionization detector and PYE unican computing integrator. Helium was used as Carrier gas. The column initial temperature was 150^{o}C rising at 5^{o}C per min to a final temperature of 200^{o}C respectively. The peaks were identified by comparison with the standard spectral libraries.

Mineral analysis: The method of Ajayi *et al.* was followed in the determination of the mineral elements composition of seed flours.

1g of seed flour was dried-ashed in a muffle furnace at 550^{o}C for 5hours until a white ash was obtained. The minerals were extracted from ash by adding 2ml of concentrated HNO_3 (63%). The digested samples were carefully filtered into 100ml standard bottle and made up to mark with distilled water. Minerals were estimated with the acid of Atomic Absorption Spectrophotometer (Perkin Elmer modfel 703, USA). A blank sample was also used for each sample.

Physico-chemical properties: The physico-chemical properties of C. *bonduc* and E. gigas seeds oils such as Acid value, Peroxide value, Free fatty acid, Iodine value and Saponification value, were determined using the standard analytical method recommended by AOAC, (1984). Also, the specific gravity and refractive index were determined according to method described by Pearson (1980).

RESULTS AND DISCUSSION

The mineral element composition of *C. bonduc* and *E. gigas* seed flours were shown in Table 1. The least abundant minerals in both samples were Copper, Manganese and Nickel while Sodium (Na) was found to be the most abundant mineral (475.65mg/g) and (463.57mg/g) respectively. These value were significantly higher when compared with the value (71.94mg/g) reported for Huracrepitan seed flour by Adeleke *at al.* 2009). However, these value were lower compared to the mean value reported for AFZ celia Africana seed flour (5588mg/g) by Ogungbende (2014).

Potassium (K) was significantly higher in *E. gigas* flour (101.87mg/g) than that of *C. bonduc* flour (36.68mg/g) However this values were significantly lower than (831mg/g) reported for *Afzelia africana* seed flours by (Ogungbenle, 2014) the potassium which was more concentrated in agricultural products (Olaofe and Sanmi, 1988) is highly needed for intra-cellular activities in the body. Na/K ratio is highly significant. However the ratio is far above the recommended value in these samples.

Calcium is an indispensable component of the structure of the body. Bones and teeth owe their hardness and strength to the presence of this calcium in the body both contributing to the blood. Low Ca/K ratio facilitates calcinations of calcium in the bone and helps to increase the absorption of calcium in the small intestine. Calcium and phosphorous values (59.43mg/g) and (23.86mg/g) for entada gigas seed flour in this study was higher than the values (40.98mg/g), and (18.5mg/g) for *Caesalpinia bonduc* flour. However, Ca/K ratio of C. *bonduc* and E. gigas seed flours were greater than I, indicating that it would serve as good source of minerals for bone formation.

However, the values obtained for Na/K ratio was significantly greater than 1. This suggested that the consumption of C. *bonduc* and E. gigas flours would probably not reduce high blood pressure.

Table 2 presents the physico-chemical properties of oils. C. *bonduc* and *E. gigas* oils were yellow and yellowish in colour with the specific gravity ranged from (0.78-0.79) indicating they are less dense than water. The refractive index for C. *bonduc* (1.449) and E. gigas (1.441) oil were in agreement with that of (1.462) for *Blighia . sapida* oil (Akintayo et al., 2002), this showed that the oils were less thick when compared with most drying oils whose refractive indices were between 1.475 and 1.485 (Duel, 1951). The saponification values (156.10) for C. *bonduc* was significantly higher than the value (72.93) for E. gigas seed oil. However, these values were lower than coconut oil (253mg/g), palm kernel oil (247mg/g) and butter fat 225(mg/g). It has been reported by Pearson, (1976) that oils with higher saponification values contained high proportion of lower fatty acids. Therefore, the value is high and this suggested the use of the oil contained in production of liquid soap, shampoos

Table 1. Mineral Consumptions (mg/L)forC.bonduc and E.gigas seed flours.

Minerals	*Caesalpinia bonduc* seed flour	*Entada gigas* seed flour
Potassium (K)	36.68	101.87
Calcium (Ca)	40.98	159.43
Sodium (Na)	475.65	463.57
Copper(Cu)	0.06	0.09
Magnesium(Mg)	13.20	14.80
Zinc (Zn)	61.80	66.20
Phosphorous (P)	18.50	23.86
Nickel (NI)	14.70	13.40
Ferrous (Fe)	12.80	15.60

Table 2. Physico-chemical properties of oils for *Caesalpinia bonduc* and *Entada gigas* seed flours.

Parameters	*Caesalpinia bonduc* oil	*Entada gigas* Oil
Acid value	8.08± 0.02	7.85± 0.03
Iodine value	0.64± 0.02	5.08 ± 0.02
Periodic value	0.10 ± 0.01	0.06± 0.01
Saponification value	156.10 ± 0.31	72.93± 0.30
Free fatty acid	2.0 ± 0.00	3.33 ± 0.00
Refractive index	1.449 ± 0.00	1.441± 0.52
Specific Gravity		

and lather shaving creams. The acid values for *C. bondue* and *E. gigas* oils were in close range. However high acid values (7.85 – 8.08) in this study shows that they were lower when compared with the report of Oderinde *et al*. (2009) (19.04) for *Hura crepitan* seed and *Plukenitia conophora* (11.5mg/g) as reported by Akintayo and Bayer (2002). The value recommended for 3.0mg/g for edible oils. However, these higher values obtained in this study suggested that the oils may be useful for industrial purposes when subjected to refining and not for consumption. The iodine value for E. gigas (5.08) and (2.64) C. *bonduc* were significantly lower when compared with the report of Oderinde *et al.* (2009) (20.81), *Citrullus vulgaris* (38.1) by Achinowhu (1990). The low iodine values in this study suggested the amount of double bond present in the oils which reflects the susceptibility of oil to oxidation and this places those oils as non-dying oils groups. This may be useful in the manufacture of vegetable oil based ice creams (Ibiyemi *et al.*, 1992)

The peroxide value for C. *bonduc* (0.10) and E. gigas oil (0.06) were significantly lower than (20.0) reported for *Dacryodes edilis* seed flour (Ogungbenle, 2009) this showed these oils were not rancid and considered stable (Ajayi *et al.*, 2002)

Table 3 presents the fatty acid composition of *Caesalpinia bonduc* oil and *Entada gigas* oil. The predominant fatty acids are Hexadedicadienoate (28.92%) and Linoleic acid (29.73%) for *C. bonduc* and *E. gigas* oils respectively. The oleic acid value (25.64%) was significantly higher in *E. gigas* oil when compared with (2.49%) reported for *C. bonduc* oil. The acid and linoleic acid were significantly lower than (40.45%) reported for *D. edulis* pulp oil by (Ajayi and Adesanwo, 2009). However, the palmitic acid values (21.65%) and(20.34%) for *C. bonduc* oil and *E. gigas* oil were significantly lower than values (43.16) reported for *D. edulis* seed oil by Ajayi and Adesanwo, 2009). However, these values (2.86%) reported for *A. africana* seed oil by (Ogungbenle, 2014).

Linoleic acid derivatives serve as structural components of the plasma membrane and are precursors of some metabolic regulatory compounds (Ajayi *et al*, 2004). This is of significant importance nutritionally. It has been reported by vles and Gultenbos that diary fat rich in linoleic acid prevents disorders such as coronary heart diseases and atherosclerosis. The presence of linoleic and oleic acid(the essential fatty acids) in Entada gigas oil makes it to be nutritionally valuable. The quantity of myristic acids (4.45%) for C.bondue oil and (6.12%) E.gigas oil were significantly higher than 0.04% reported for Afzelia oil by Ogungbenle, 2014) and 0.2% reported for soy bean oil by pauletal, 1985

However, the total saturated fatty acids in *Caesalpinia bonduc* oil (86.30%) and total unsaturated fatty acids was

Table 3. Fatty acid composition of *C. bondue* and *E. gigas* oils

Fatty Acids	*Caesalpinia bonduc* oil (%)	*Entada gigas* oil (%)
Myristic	4.473	6.12
Palmitic	21.65	20.34
Palmitoleic	0.65	0.06
Hexadecadienoale	28.92	0.02
Stearic acid	19.883	16.40
Oleic acid	2.49	25.64
Linoleic acid	7.85	29.73
Linolenic acid	0.41	0.07
Arachodic acid	7.46	0.00
Behamic acid	3.26	0.82
Euric acid	1.91	0.53
Lignoceric acid	1.05	0.23
Lauric acid	0.00	0.04
Total saturated fatty acids	86.30%	42.38%
Total unsaturated fatty acids	13.70%	57.62%

(13.70%). The low value of unsaturated fatty acids in *C. bonduc* oil suggested that it is not desirable for cooking oil. It also suggested that the *C. bonduc* oil is less liable to oxidative rancidity. However, *Entanda gigas* oil contained high amount (57.62%)of unsaturated fatty acids compared to (42.38%) saturated fatty acids. This suggested that this oil will be useful for cooking due to the presence of linoleic acids in it. It also confirmed that when consumed, the polyunsaturated fatty acids present in this E. gigas oil lower serum Cholesterol (keys et al., 1957).

Conclusion

The results showed that *Caesalpinia bonduc* and *Entada gigas* are good sources of essential minerals and contained appreciable quantity and quality oil for both domestic and industrial uses.

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