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Nutritional composition studies of sun dried *Blighia sapida* (k. koenig) aril from Côte d'Ivoire

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ABSTRACT

Objective: To determine the nutritional composition of *Blighia sapida* (ackee) aril dried on the sun and the physico-chemical characteristics of the oil extracted from this aril.
Methodology and Result: 1 Kg of *Blighia sapida* fresh aril collected in Côte d'Ivoire (Northern Côte d'Ivoire) was used. The aril was exposed to the sunlight for 2 weeks, 6 hours a day. The dry aril was ground and samples were used to determine the proportions of nutriments and the physico-chemical properties of oil extracted from this dry aril. G-test (Log likelihood ratio) was used to make comparison. The proximate composition showed crude fat to be (45.32%), the highest followed by carbohydrate (24.43%). Protein content (11.99%) was important but was less than that recommended for human diet. They were several kinds of minerals in the ash of the aril. Iodine value was less than 100. Saponification value was comparable to saponification value of some oils used to make soap.
Conclusions and application of findings: The result of this study showed that *Blighia sapida* aril dried on the sun is rich nutritiously. Its high oil and carbohydrate content indicated that it could serve as food. But the protein content which is lower than what has been recommended by the Food and Agriculture Organisation showed that it could be better to add another source of protein in a diet based on aril. The physico-chemical properties of oil extracted from this dried aril indicated that, it contains low unsaturated fatty acid, it has a low deteriorating rate and can therefore be store for a relatively long time. It is a non drying oil, edible and may be suitable for soap making. It can also serve to make margarine.
Key word: *Blighia sapida*, aril, nutritional value, oil, physico-chemical properties.

INTRODUCTION

Blighia sapida (*ackee)* is a wild food plant that belongs to the family of Sapindaceae. The tree is originated from west and centre tropical Africa (Hill, 1952; Bressler *et al.,* (1969). It is planted in some countries such as Côte d'Ivoire, Jamaica and Haiti. The fruit of the tree, splits to expose a freshly cream coloured pulp (aril) attached to a shiny black oblong seed (Akintayo *et al.,* 2002). The aril is eaten freshly, raw, or made into sauce, or fried in oil (Arbonnier, 2002). When the fruit is collected unripe, the aril contains a high quantity of a toxic molecule call hypoglycin A which can cause death. *Blighia sapida* aril is an element not to be neglected in mathematical appreciation of people diet in many regions (Auffrey and Tanguy, 1948; 1958). After industrial processing the aril is put in cans and sold in the United Kingdom and Canada where it is welcomed by the Jamaican immigrants. The aril generates for Jamaica more than 13 millions U. S dollars per year (Orane *et al.,* 2005).

In Côte d'Ivoire, in order to keep it over a long period, it is exposed to sunlight. In fact, in Côte d'Ivoire, the aril is readily available and mostly consumed after being sun dried. This exposure is known to destroy or modify most quantities of the toxic molecule (hypoglycin A) (OPS, 2002), as well as some nutritional elements (proteins, lipids, vitamins) (FAO, 1990F).

A study has been carried out in Nigeria by Akintayo *et al.* (2002) about the aril nutritional composition and the physico-chemical properties of the oil extracted from. This study dealt with a fresh aril previously dry on an electric oven at 50°C ±5°C. There is no data as far as the nutritional composition and the physico-chemical properties of the sun dried aril. The current study is conducted to determine the nutritional composition and some physico-chemical properties of the aril dried on the sun.

MATERIAL AND METHODS

Plant material: In Côte d'Ivoire, *Blighia sapida* is planted in Katiola region (North Côte d'Ivoire). The aril is consumed in this region by people. The aril used for the experimentation was brought from Katiola in the period of March, April, and May when it is more available. It was spread on polythene paper and exposed to sunlight to dry for two weeks, six hours a day. In the night, it was kept on the plastic and put in a house at room temperature (25°C- 30°C). After the drying process of the fresh aril, the dried arils were kept in plastic bags and sent to Abidjan (South of Côte d'Ivoire). The arils were analysed at the University of Cocody-Abidjan (Côte d'Ivoire). All organic solvents and Chemical used in the analysis were obtained from the Laboratory of Biochemistry and Alimentation Sciences in the University of Cocody-Abidjan (Côte d'Ivoire). Dried *Blighia sapida* arils used in the experimentation were first ground to fine powder using a grinder (magimix, automatic 41000 multicuve). The dried samples were kept in air tight sample containers in a refrigerator (4°C) until ready for analysis.

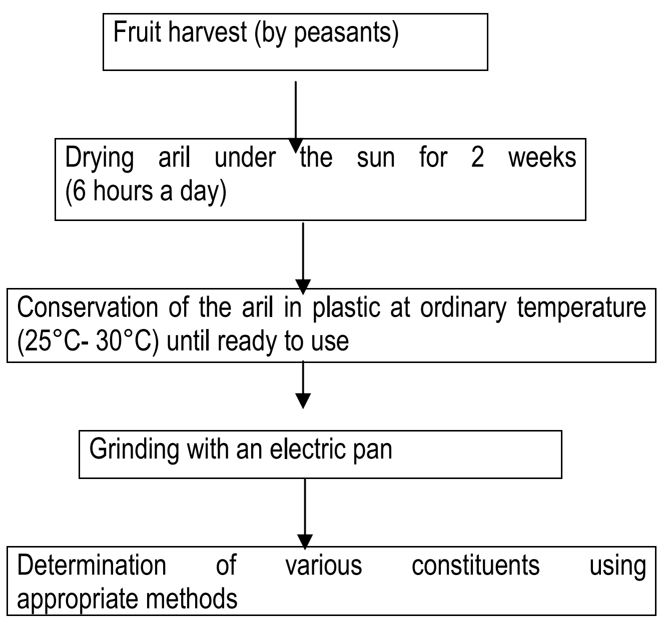

Figure 1: figure indicating the different stages of the process to determine the chemical composition of *Blighia sapida* aril and the physico-chemical properties of its oil in relation with its avaibility in Côte d'Ivoire.

Determination of the proximate composition: The recommended methods of Association Analytical Chemists (AOAC, 1975) were employed in determining the levels of moisture, ash, crude protein and crude fat.
Moisture content was determined by heating 2 g of samples to a constant weight in crucible placed in an oven (MMM Medcenter Gmbh (D-82152, Munich, Germany) maintained at 105°C for 4 hours.
Ash was determined by incineration of 1 g samples placed in a muffle furnace (P Selecta, Espagna) maintained at 550°C for 6 hours.
Crude protein content (% total nitrogen × 6.25) was determined by Khedjahl method (Pearson, 1976), using 1 g samples.
Crude fat was obtained by exhaustively extracted 5 g of each sample in a Soxhlet apparatus for 8 hours using hexane as the extractant (Bourely, 1982).
Total carbohydrate (%) was estimated by difference as show in the equation:

Total carbohydrate (%) = 100 – [Protein (%) + Lipids (%) + Asch (%) +Fibre (%)]

Analysis of minerals in the dry aril: The minerals were extracted from ash by adding 20 ml of 2.5% Hcl, heated in a steam bath to reduce the volume to about 7 ml, and this was transferred quantitatively to a 50 ml volumetric flask. It was diluted to volume (50 ml) with deionised water, stored in clean polyethylene bottles and mineral contents determined using an atomic absorption spectrophotometer (Perkin-Elmer, Model 2380, USA). Sodium and Potassium were determined using flame photometry (Chapman and Pratt, 1961). Phosphorus was determined as phosphate ion (PO_4^{3-}) by the vanadium phosphomolybdate (vanadate colorimetry method) in which the phosphorus present as the orthophosphate reacts with a vanadate molybdate reagent to produce a yellow-orange complex, the absorbance of which was measured at 420 nm.

Sugar content: Total soluble sugar and free sugar were analysed according to colorimetric method for determination of sugars and related substances describes by Dubois *et al.* (1956).

Oil used to determine the physico-chemical characteristics: Oil used to determine the physico-chemical property was extracted from the fine powder at room temperature (25°C- 30°C) in using a mechanical press (physical method).

Analysis of the oil: The acid and peroxide values were determined by the method of Devine and Williams (1961). The saponification number was determined by the method of Williams (1950) while iodine value was obtained by the method of Strong and Koch (1974). Specific gravity was determined by universal hydrometer and refractive index at 25°C was determined using refractometer. Melting point was determined by the method described by Hamilton and Rossel (1986). Melted *Blighia sapida* aril oil (2 g) was poured into a Pasteur's pipette and frozen. The pipette containing butter was then put in an icy bain-marie (40°C) which was heated until the frozen *B. sapida* aril oil started to melt. The temperature of the bain marie was read at 40°C with a digital refractometer Atago R×5000 (Cat. N^{er} 3251).

Statistical analysis: The data were subjected to statistical analysis for calculation of mean and standard error (mean ± standard error). The values obtained in this study were compared to some values found in the literature using G-test « Log likelihood ratio » (logiciel R. version 2.0.1 windows). Differences were considered statistically significant at $p<0.05$.

RESULT

The proximate compositions of the dry aril studied are presented in table 1. From the data the highest component of the dried aril is crude fat (45.32±2.90) followed respectively by carbohydrate (4.13±2.24), protein (11.99±1.12), moisture (6.84±1.13), ash (4.90±1.07) and crude fibre (3.21±0.34). Total soluble sugar and reducing sugar contents of the dry aril were (3.31± 0.14), (1.52±0.06) respectively.
The mineral content of the dry aril is shown in table 2. According to the data potassium has the highest concentration (1503.30±1.89). This was followed respectively by magnesium (53.17±1.03), calcium (139.67±0.85), sodium (53.17±1.03) and iron (17.33±0.85). The least abundant mineral is zinc (4±0). Elements analysed in this study represented 38.81% of the total ash.
The physico-chemical properties of *B.sapida* aril oil are shown in table 3. The oil extracted from the aril is yellowish in colour. It has a specific gravity of (0.933±0.017). It has a refractive index of (1.48±0.13). Acid value, peroxide value, iodine value and saponification value are (7.38±0.18), (174.44±0.09), (56.26±2.55), (188.40±1.75) respectively.

Table 1: Proximate nutritional composition of the dried aril (value are expressed in percentage**)**

Components	**Value**
Moisture	6.84±1.13
Oil	45.32±2.90
Protein	11.99±1.12
Crude fibre	3.21±0.34
Total ash	4.90±1.07
Total sugar	3.31±0.14
Free sugar	1.52±0.06
Carbohydrate (by difference)	24.43±2.24

Values are means±SE for five determinations.

Table 2: Essential elements of the dry aril (concentration in mg/100g)

Elements	**Value**
Potassium (K)	1503.3±1.89
Magnesium (Mg)	215.33±1.03
Calcium (Ca)	139.67±0.85
Sodium (Na)	53.17±1.03
Iron (Fe)	17.33±0.24
Zinc (Zn)	4±0

Values are means±SE for five determinations.

Table 3: Chemical properties of aril oil exposed to the sunlight

Properties	Value
Iodine value	56.26±2.55
Acid value	7.38±0.18
Peroxide value	174.44±0.09
Saponification value	188.40±1.75
Refractive index	1.48±0.13
Melting point	28.13±1.27°C

Values are means±SE for five determinations.

DSCUSSION

Fat content: The high fat content reported in this work is in agreement with the work of Morton (1987) and Akintayo *et al.* (2002). The oil content of *Blighia sapida* aril is comparable (p> 0.05) to oil content of *Arachis hypogaea* (groundnuts) (45%) and *Moringa oleifera* (moringa) (41.58%) reported by FAO (2000) and Anhwange *et al*. (2004) respectively.

Carbohydrate content: This result shows that although *B. sapida* aril is a pulp (a part of a fruit), it contains a high quantity of carbohydrate (24.43± 2.24). It is known that carbohydrate and fat are the main source of energy in the organism (Legrand *et al.,* 2001; Remesy, 2004). Then, this high quantity of carbohydrate and fat can justify in part the use of aril as base food when there is famine.

Protein content: Protein content reported in this work is lower than that reported by Akintayo *et al.,* (2002), (24.30%) in a fresh sample from Nigeria previously exposed in the oven at 50±5°C for 48 h. This decrease can be attributed to the sunlight destruction. It was shown that solar radiations cause the alteration of certain proteins in fruits and legumes (FAO, 1990F). Protein is the source of amino acid of food. The value reported in this work is lower (p>0.05) than the percentage recommended by the Food and Agriculture Organisation (FAO, 2003) which is ranged from 12-15%. The lower protein content reported in this work suggests that adding complementary protein sources into a diet base on aril could prove more efficient.

Moisture content: Moisture content reported in this study is lower (p>0.05) in comparison to moisture content of dry seed of *Phaseolus vulgarus* (common bean) (12%) and dry cashew nut (7.2%) according to FAO (2000) and Akinhanmi *et al.* (2008). It is reported that dry cashew nut and dry seed of *Phaseolus vulgarus* (common bean) whose moisture content is lower can be stored for a long time without spoilage. Sun dried *Blighia sapida* aril with low moisture content (6.84±1.13%) could be stored for a long time without spoilage.

The percentage of fibre reported in this work is lower than that reported by Akintayo *et al.* (2002), (4.23%). This fibre content is lower than that recommended by the American Institute of Nutrition (Reeves, 1993). Fibre is known to make digestion easier and to reduce the serum total cholesterol and LDL-cholesterol level. Then, fibre reduces the risk of cardiovascular diseases (Liu *et al.,* 1999). So, because of the aril low fibre content, high consumption of diet base on aril could provoke cardiovascular diseases.

Total ash: The percentage of total ash in aril exposed to the sunlight (4.90%) is lower than that reported by Akintayo *et al.* (2002) (5.60%). The high varieties of minerals found in aril shows that it is good for alimentation.

Iodine value: Oils are classified into drying, semi drying and non-drying according to their iodine values (codex alimentaria, 1999). The iodine value found in this study (56.26±2.55) is lower than 100 mg iodine/100g ($p<0.05$). This result (56.26±2.55) is in close agreement ($p>0.05$) with the value of 65.4mg iodine/100g found by Akintayo *et al.* (2002). *Blighia sapida* aril oil can only be classified as non-drying oil. The low iodine value indicated that *Blighia sapida* aril oil has a low content of unsaturated fatty acid (AOAC, 1975). *Blighia sapida* aril iodine value is comparable ($p>0.05$) to iodine value of palm oil (45-58), but it is less than ($p<0.05$) iodine value of olive oil (83-87), groundnuts oil (90- 98) and soy bean oil (125- 138) (Anhwange *et al.,* 2004).

Acid value: The acid value obtain is lower than the minimum safe limit (15%) mean for consumption. This suggests that this oil has a low deteriorating rate and can therefore be stored for relatively long period (Ekpa and Ekpa, 1996).

Peroxide value: The peroxide value obtained in this work was less ($p>0.05$) than that reported by Akintayo *et al.* (2002). This suggests that sunlight exposure does not raise rancidity of *Blighia sapida* aril oil.

Saponification value: The saponification value (177) of *Blighia sapida* aril oil reported in this work is in agreement with that reported by Akintayo *et al.* (2002). This value is comparable ($p>0.05$) to the saponification value of palm oil (190- 209), olive oil (190-192), soybean oil (189-195), cotton seed oil (189-198). Palm oil, olive oil, soybean oil and cotton seed oil are commonly used for soap making (Anhwange *et al.,* 2004). This is an indication that *Blighia sapida* aril oil may be also suitable for soap making.

CONCLUSION

The nutritional composition of *Blighia sapida* aril suggests that it could be used in human diet. However, adding complementary protein sources to a diet based on aril is important. The analysis of the sun dried aril-oil for iodine value, saponification value, acid value, peroxide value shows that this oil could be used in human diet and as raw material.

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