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Physicochemical analysis of *Blighia sapida* (Sapindaceae) seed oil from Zago, Agaie Local Government Area of Niger state

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Abstract
Dried *Blighia sapida* seeds were divided into two portions: one portion dehulled (DS) while the other was left as whole seed (WS), and made into fine powder. The oil was extracted with diethylether using Soxhlet extractor, and characterized by determining the percentage yield, acid, saponification, iodine and peroxide values. Moisture, ash, carbohydrate, lipid, protein and crude fibre contents were determined according to standard methods of analysis. The respective proximate analysis for dehulled seed (DS) and whole seed (WS) indicated low moisture content (6.00 ± 0.28 and 3.57 ± 0.21% WW), ash content of (2.50 ± 0.10 and 3.50 ± 0.16% DW), carbohydrate (49.45±0.00 and 54.60 ± 0.14% DW), lipid (36.55 ± 0.1 and 18.20 ± 0.03% DW), protein (9.5 ± 0.16 and 9.70 ± 0.01% DW) and crude fibre content (2.10 ± 0.08 and 14.00 ± 0.24 DW). The DS had the highest saponification value (244.60 ± 0.25 mgKOH/g), acid value of (5.16 ± 0.01 mgKOH/g), while peroxide value (9.14 ± 0.08mg/g and Iodine value (8.10 ± 0.21mg/g) are higher in WS. The results of the physicochemical analysis of the oil revealed that the oil has high stability to rancidity due to low levels of iodine and peroxide values, which invariably indicate low unsaturation tendency and therefore high level of saturation. The high level of saponification values suggests the potential of the oil for use in industries for making soaps, shampoos, cleaners, shaving creams and lubricants.

Keywords: Industries, proximate analysis, rancidity, saponification, unsaturation.

Introduction

Blighia sapida also known as ackee apple is a member of the family *Sapindaceae*, which is spread across tropical West Africa, India, West Indies, Jamaica and tropical America (Ghedhill, 1972). In Nigeria it is popularly called *Isin* in yoruba; Y*ila* in Nupe and the Hausas call it Fisa'a' (Rogers, 2003). It is commercially cultivated in Jamaica where the fruit (aril) serves as a major component of a traditional dish, ackee and codfish. It is an ever green tree with a dense crown that grows to a height of 10-12 m at maturity with trunk of up to 1.8 m in circumference. The leaves are compound with 3-5 pairs (6-10 leaves) oblong, 8-12 cm wide. It flowers are bisexual and fragrant with five petals that are greenish-white and bloom during warm months. The fruits are pear-shaped, which turns from green to a bright- red to yellow- orange when ripe, and splits open to reveal three large, shiny black seeds surrounded by soft, creamy or spongy, white yellow aril (Morton, 1987). The fruit takes seven to eight weeks to attain full maturity. There are two fruit bearing seasons: January – March and June – August. (Orwa *et al*., 2009). The roots, fruits, seeds or leaves of *B. sapida* have been reported to contain carbohydrate, protein, fats, vitamins and minerals which are essential for healthy growth (Hargaty, 1986). It is also reported that the root of *Blighia sapida* contain crude protein of 2.10±0.20% and 39.45±2.20% total carbohydrates (Abolaji *et al.,* 2007). The knowledge of nutritional value of these wild seeds is necessary in order to encourage its increase cultivation and to supplement the nutrients of the staple foods (Achu *et al*., 2005). This plant is present in abundance in Zago town in Agaie local government area of Niger state. However, the nutritional chemical composition of *B. sapida* might vary depending on its habitat, species, location, season and environmental conditions. Thus there is need for investigating the characteristic properties of these seeds to

Materials and Methods

Sample collection and preparation

The ripe *Blighia sapida* fruits were harvested from three different forests in Zago village of Agaie Local Government Area of Niger State. The seeds were removed manually from the fruit which were sun- dried, divided into two portions; as dehulled and whole seeds. The samples were made into powder using pestle and mortar, kept in dried plastic bottles at room temperature prior to analysis.

Proximate and physicochemical composition

The proximate analysis of the dehulled and whole seeds of the *Blighia sapida* were carried out using the method described by (AOAC, 1990). The crude protein content was determined using micro Kjeldahl method described by (Pearson, 1976) and the Carbohydrate content was obtained by difference while energy value was by the method described by (James, 1995). All the determinations were in triplicates.

The physicochemical analysis for saponification, iodine, acid and peroxide values were also determined using the method described by (AOAC, 1990). The mean molecular mass and free fatty acids (FFA) were calculated by [Energy Value (kJ per 100g) = (Available carbohydrates x 17) + (crude proteins x 17) + (crude lipids x 37)], [% FFA = Acid value x 0.508MgKOH/g] in (Ajiwe *et al*., 1997) respectively. But calorific value of the oil was calculated in kJ/kg using the method of (Barminas *et al.*, 2001).

Results and Discussion

Table 1: Proximate composition of *Blighia sapida* seed (g/100g DW).

Components	Dehulled seed (DS)	Whole seed (WS)
*Moisture content	$6.00^{a} \pm 0.28$	$3.57^{b} \pm 0.21$
Ash content	$2.50^{b} \pm 0.10$	$3.50^{a} \pm 0.16$
Crude protein	$9.50^{a} \pm 0.16$	$9.70^{a} \pm 0.01$
Crude lipid	$36.55^{a} \pm 0.10$	$18.20^{b} \pm 0.03$
Crude fibre	$2.10^{b} \pm 0.08$	$14.00^{a} \pm 0.24$
Carbohydrate(by difference)	$49.45^{b} \pm 0.00$	$54.60^{a} \pm 0.14$
Energy value (kJ/100g)	$2352.50^{a} \pm 0.14$	$1766.50^{b} \pm 0.00$

Values are mean ± standard deviation of triplicate determination (* %wet weight). Means in a row with different superscripts are significantly different (P<0.05)

Table 2: Physicochemical properties of *Blighia sapida* seed oil.

Parameters	Dehulled seed (DS)	Whole seed (WS)
Acid Value (mgKOH/g)	$5.16^{a} \pm 0.01$	$3.87^{b} \pm 0.04$
FFA (as oleic acid)	$2.63^{a} \pm 0.40$	$1.97^{a} \pm 0.13$
Saponification Value (mgKOH/g)	$244.60^{a} \pm 0.25$	$227.21^{b} \pm 0.44$
Iodine Value (mg/gI_2)	$5.58^{b} \pm 0.03$	$8.10^{a} \pm 0.21$
Peroxide Value (mg/g)	$6.76^{b} \pm 0.13$	$9.14^{a} \pm 0.08$
Calorific Value (kJ/kg)	$38249.80^{b} \pm 0.01$	$38901.18^{a} \pm 0.00$
Ester Value	$239.44^{a} \pm 0.14$	$223.34^{b} \pm 0.03$
Specific gravity (g/cm3) at 25^{o}C	$0.92^{a} \pm 0.03$	$0.94^{a} \pm 0.06$
Mean molecular mass	$229.39^{b} \pm 0.01$	$247.35^{a} \pm 0.14$

Values are mean ± standard deviation. Means in a row with different superscripts are significantly different (P<0.05)

The results of proximate composition indicated that the samples have low moisture content of 3.57 ±0.21% for whole seed (WS) and 6.00 ±0.28% for Dehulled seed (DS) seed as shown in Table 3.1. Since seeds with moisture level greater than 15% are prone to deterioration from mould growth, heat, insect damage and sprouting (Onimawo, 2003), therefore, both samples DS and WS have good shelf life and by implication WS will have longer shelf life. The value of WS is comparable with results obtained for *Hura creptains* whole seed with the value of 3.00 ± 0.11% (Oderinde *et al.,* 2009).

Ash is an index of total mineral content. The ash content of the seeds was found to be 3.50 ± 0.10% DW in WS and 2.50 ± 0.16% in DS. These results were lower than those of African locust bean seeds reported by Hassan and Umar (2004), which account for 4.67 ± 0.47% and 4.68 ± 0.45% for WS and DS respectively. The values are in the same range with those obtained for *Parinari polyandra* fruit (2.53 ± 1.20%) and *Blighia sapida* roots 3.66 ± 1.20% (Abolaji *et al.,* 2007). The result is also comparable with that obtained for *Deterium microcarpum* 3.76% (Nkafamiya *et al.,* 2007).
It is known that solar radiations cause the alteration of certain proteins in fruits and legumes (FAO, 190F). The low percentage of protein obtained in this work (9.50 ± 0.16% and 9.70 ± 0.01%) for DS and WS respectively are comparable to the value reported by Abighor *et al.* (1997) for *Blighia sapida* of 14.00 ± 0.28% could be attributed to sunlight destruction or variation between seasons (Mishara *et al.,* 1993). These values for (DS and WS) are also lower than 22.20 ± 0.60%DW *Hura creptians* (Oderinde *et al.*, 2009) and 28.54 ± 1.70%, 41.84 ± 2.24% *Parkia biglobosa* (Hassan and Umar, 2004) whole seed and dehulled seeds respectively.

The percentage crude lipid of the seed as shown in Table 3.1 ranged between 18.20 ± 0.03% for WS and 36.55 ± 0.10% for DS per 100g. The WS contain low level of oil compared to DS. The higher content of crude lipid is comparable with some common seeds like soyabean oil 19.10 g%, locust bean 20.30% and cotton seed 14.05% (Ayodele *et al.,* 2000). Therefore it could be exploited commercially as source of vegetable oil. These values are yet lower than *Sesamum indicatum* 53.80% but higher than that of *Sesanum latifolia* 33.91% (Hiremath *et al.*, 2007) for dehulled seed. The crude lipid content obtained for *Blighia sapida* WS 26% (Kyari, 2008) is higher than the obtained value. But fall within the range of 14.15 ± 0.91% *Blighia sapida* in (Oderinde *et al*., 2009), but are lower than the values obtained for DS (36.55 ± 0.10%).

The crude fibre content was higher in the WS (14.00 ± 0.24%) than DS (2.10 ± 0.08%). The WS value is higher than *B.sapida* 6.33 ± 1.10% reported by Oderinde *et al.* (2009), but comparable with 14.47 ± 1.10% for *Gradenia embescens* fruit and 13.39 ± 0.80% for *Strychnos innocua* seed flour (Bello *et al.,* 2008). Fibres help in diets; promote the wave-like concentration that moves food through the intestine. Higher fibre food expands the inside walls of the colon, ease the passage of waste (Eromosele and Eromosele, 1993).

The carbohydrate content is relatively high in both DS (49.45 ± 0.00%) and WS (54.60 ± 014%). This higher values obtained suggest its use as source of supplements for energy deficient feed formulation (Barker, 1996; Kubmarawa *et al.,* 2008). The carbohydrate content is high compare to the seeds of *Isoberlinia doka* and *Heeria insignis* (31.48% and 33.10%) reported by Kubmarawa *et al.* (2008) and (45.29%) for *Diospyros mespiliformis* fruits (Hassan *et al.,* 2004). Energy values recorded in this work are 2352.50 ± 0.14kJ and 1766.50 ± 0.00 kJ for DS and WS respectively which that the seed is a major source of energy. But the value is low compared to *Ceiba pentandra* seeds 7,833.32 kJ (Hassan *et al.,* 2006).

Physicochemical of the Oil reveal the acid value of DS (5.16 ± 0.01 mgKOH/g) and WS (3.87 ± 0.04 mgKOH/g) are higher compared to the 0.34 mgKOH/g for *Blighia sapida* reported by Kyari (2008). The acid value for WS is comparable with that of seeds from *Telfairla accidentalis;* 3.05 ± 0.809 mgKOH/g (Kayode *et al.,* 1998). These values are lower than the seeds of *Elaesis guineesis,* (14.04 ± 0.22 mgKOH/g), *Landolphia owariensis (*15.33 ± 0.27 mgKOH/g), *Napoleana imperialis*, (15.15 ± 0.16 mgKOH/g) as reported by (Akubugwo and Ugbogu, 2007). The values are in the same range with *Chrysophyllum albidum (*3.56 ± 0.20 mgKOH/g) and *Dacryodes edulis* (5.56 ± 0.07 mgKOH/g) seeds in the same report (Akubugwo and Ugbogu, 2007), and comparable with *Crotalaria cleomifolia* seed 4.3 mgKOH/g (Noor and Ikram, 2009). Free fatty acid (FFA) is the index for oil to find application in cooking or for industrial purposes. FFA for edible oil is to fall within the range between 0.00 – 3.00% (Abitogun *et al.,* 2009). The FFA of WS and DS *B. sapida* are 1.97 ± 0.13% and 2.63 ± 0.40% respectively. The low free fatty acid suggests its consideration for use as cooking oil (Abitogun *et al.,* 2009). These values are low compare to the free fatty acid values from seeds of *Plukenetia conophora* (5.6 ± 0.1%) but higher than *Adenophus breviflorus* (1.0 ± 0.1%) seeds (Akintayo and Bayer, 2002).

The saponification value of *B. sapida* DS and WS are 244.60 ± 0.25 and 227.21± 0.44 mgKOH/g oil respectively. The values are comparable to 217 ± 0.10 mgKOH/g oil obtained for *B. sapida* reported by Oderinde *et al.* (2009) and 261 mgKOH/g oil (Kyari, 2008) respectively. The values obtained are comparable with other oils 193.35 mgKOH/g for *Sesamum indicum* seed oil (Hiremath *et al.,* 2007), (195.6mgKOH/g), *Trichosanthes cucumerina*, *Cucurbita pepo* (210.4 mgKOH/g*)* and *Luffa aegy*ptiaca 206.3 mgKOH/g (Adebooye, 2009). The relatively high saponification values recorded suggest that oil obtained from both DS and WS have potential industrial uses (Amoo *et al.,* 2004), such as in soap making and shaving creams (Alsberg and Taylor, 2001; Eka and Chidi, 2009). The saponification value is inversely proportional to RMM of the fatty acids presents in the oil (Eka, 1989), which is an indication that the *B. sapida* lipid contain glycerides with lower molecular weight.

The iodine value is 5.58 ± 0.03 mg/gI_2 for DW and 8.10 ± 0.21 mg/gI_2 for WS. This low iodine value is an indication that the oils are low in unsaturation for that there will be more of saturated fatty acid compare to unsaturated fatty acid. The values are comparable to (16.0 mg/gI_2) Tiger nut (Kamalu and Oghome, 2008), Hura criptians 20.81 ± 0.20 mg/gI_2 (Oderinde *et al.,* 2009), *B. sapida* 7.00 ± 1.0 mg/gI_2 (Oderinde *et al.* 2009). The low iodine value of *B. sapida* seed oil indicates that, the oil is non-drying and as such not suitable for paint industries but useful in lubricants, leather dressing and cosmetics making (Alsberg and Taylor, 2001).

The peroxide value of the oil is use as an index of rancidity of oils (Akubugwo and Ugbogu, 2007). *B. sapida* seed oil has low peroxide value (6.76 ± 0.13 mg/g) and (9.14 ± 0.08 mg/g) for DS and WS respectively. These low peroxide values suggest that the oil can resist lipolytic hydrolysis and oxidative deterioration; as such they are stable and can stay long without being rancid since high peroxide value is an indication of high rancidity and deterioration of oil (Matos *et al*., 2009). The oils are more of saturated oil as such it will have good shelf life. The peroxide values are comparable to *Annona squamosa* (1.0 ± 0.2 mg/g), *Catauna regum nilotica* 0.9 ± 0.1mg/g Abdal Basit *et al.* (2010).

The oil calorific value was high 38249.80 ± 0.01 kJ/kg in DS and 38901.18 ± 0.00 kJ/kg in WS. This is shows that it is potentially high energy oil which make it susceptible for use as biofuel (Hassan *et al.,* 2005). The values are high compared to1253.59 kJ/100g reported for *Cassia siamea* leaves (Hassan and Ngaski, 2007).

Conclusion

In the physicochemical analysis of *B. sapida* seed oil with the proximate composition of the seeds for its possible industrial and nutritional use, results obtained indicated that the seed has about 9% crude protein, which could help in improving certain diets. The fibre, crude lipid and carbohydrate contents are high; therefore the seeds are promising energy supplement and a source of oil for commercial exploitation. The result revealed that the oil is of high stability to oxidative rancidity due to low levels of iodine and peroxide values, which invariably indicate low unsaturation tendency and therefore high level of saturation. The high level of saponification value suggests the potential of the oil for use in industries for making soaps, shampoos, cleaners, shaving creams and lubricants.

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