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COMPARATIVE PHYSIOCHEMICAL PROPERTIES OF *ANACARDIUM OCCIDENTALE* AND *BLIGHIA SAPIDA* SEED OILS

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ABSTRACT

A comparative investigation was carried out on the seed oils of *A. occidentale* and *B. sapida* for their physiochemical properties. Oils were extracted from the respective powdered seeds using Soxhlet extraction technique giving 17.14± 0.5 and 18.01±0.13% yields for *A. occidentale* and *B. sapida* respectively. The seed oils were subjected to physiochemical analysis using standard protocols as prescribed by the American Oil Chemist Society (AOCS) and the American Society for Testing and Materials (ASTM). The chemical characterization of the oils gave iodine values of 78.9±1.5 for *A. occidentale* oil and 88.7±1.1 for *B. sapida* oil and saponification values of 187.4 ± 2.7 and 195.8 ± 2.0 respectively for *A. occidentale* and *B. sapida* respectively. Similarly, acid values of 3.9±1.2 mg KOH/kg and 5.7±0.6 mg KOH/kg were obtained for *A. occidentale* and *B. sapida* seed oils respectively. *A. occidentale* gave 6.0±1.2 peroxide value as against 10.0±1.0 for *B. sapida.* The physiochemical results obtained showed that *A. occidentale* and *B. sapida* seed oils have the potential for use in a number of industrial applications.

KEYWORDS: *Anacardium*, *Blighia*, Seed oil, Physiochemical, Extraction, Dehulling.

1.0 INTRODUCTION

Cashew, *Anacardium occidentale*, is native to Brazil, now cultivated in tropical regions. It is an evergreen tree, up to 12 meters tall. Cashew nut is the seed, surrounded by a double shell containing caustic resin. The cashew nut consists of an outer shell (epicarp), a tightly fitted inner shell (endocarp), and a strongly vesicant cashew nut shell liquid (CNSL).[20] The true fruit of the cashew tree is the nut, a kidney-shaped structure approximately 2 - 3 cm in length. The nut is attached to the end of a fleshy pulp called the cashew apple. Products derived from the nuts include the world's highly delighted roasted kernel snacks, kernel oil, and cashew nut shell liquid; and from the apple: juice, jam, and alcohol are among the products. Cashew nut kernel is an edible nut rich in lipids, proteins, minerals[13], and health-beneficial bioactive compounds.[12;20] The cashew nut kernel has a pleasant taste and flavor and can be eaten raw, fried, and sometimes salted or sweetened with sugar. The kernel is considered to be of high nutritive quality. However, growing conditions and the variety of cashew may have an influence on kernel composition. Cashew nut is an important delicacy that is mainly used in confectionery and as a dessert nut. It was shown that the powdered milk used in the standard milk chocolate recipe can be replaced with 25% roasted cashew kernel. It also contains high food value with about 40-57% oil and 21% protein content. Cashew is of considerable economic importance because their components have various economic uses.[5] The cashew industry ranks third in the world production of edible nuts with an estimated value of US $ 2 billion, the world cashew nuts production comes from both wild and cultivated trees.[4] The nut is edible, rich in oil, protein, and fiber. It is used in food, cosmetics and pharmaceutical. Traditional medicine uses include anti-inflammatory and antimicrobial properties.[13]

Ackee, *Blighia sapida*, is a perennial herbaceous plant introduced to Jamaica in the 16th century mainly as a food for residents. It gained scientific recognition in 1793 when Captain William Bligh introduced it to England in honor of whom it was named '*Blighia sapida*'.[10] It is an evergreen tree, which grows to a height of between 7 and 25 m. Ackee tree grows well in Jamaica with little cultural attention and is cultivated mainly in the parishes of Clarendon and St. Elizabeth. It produces good yield of 7.5 to 10 cm long, lipid-bearing fruits almost all the year round, with two peak fruiting seasons of January to March and June to August.[10] Ackee is widely consumed in Jamaica as part of the national dish. It is also popular among Jamaicans in the United States and Canada, countries where it was previously prohibited. The main drawback to its application is the toxicity which manifests as diarrhea, hypoglycemia, nausea and vomiting commonly known as

Jamaican vomiting sickness (JVS) or toxic hypoglycemic syndrome.[14] The toxicity is now known to be due to the toxic amino acids hypoglycin A and B present in the unripe arils but which have now been shown to decrease by 13 and 7 folds respectively on ripening[14], hence, self-opened ackee fruits have been found to be quite safe for consumption. In addition, hypoglycin is water-soluble[21]; boiling ackee before consumption and use of extraction methods that are selective to the liphophillic components would enhance the elimination of hypoglycin from extracted oil. Although, literature shows some chemical and biological studies on ackee[3;15;19;21], information on the potential application as industrial/pharmaceutical base appears to be unavailable. The aim of this study therefore was to develop and standardize an extraction method for the lipid content of *Blighia sapida* (Ackee) arils and to perform qualitative and quantitative tests on the lipid in order to characterize its physicochemical properties that may be useful in its application as an industrial and pharmaceutical base. The present work was therefore aimed at fully investigating the characteristics of the oils with a view to establishing their potential uses.

2 MATERIALS AND METHODS

2.1 Sample collection and preparation

The fruits comprising the pulp and the seed, were gathered from Igele Market in Ondo, Ondo State, Nigeria. The fruits grown in Ondo area of Ondo West local government council were harvested on the day of purchase. The process of dehulling was performed, wherein the fruit was meticulously sliced in half, facilitating the extraction of the stone seeds. Subsequently, the sample was divided into several dimensions. The sample was air-dried for 48 h prior to pulverization using a hammer mill in order to decrease the moisture content, hence improving the efficiency of the extraction and distillation procedure. While grinding, caution was taken to avoid grinding the particles too finely, since this would impede the solvent's ability to flow freely during extraction, potentially resulting in a decrease in the yield of the extracted oil.

2.2 Extraction of seed oil

Precisely 70 g of the ground seed sample was measured and placed in a 500 cubic centimeter beaker. It was then immersed in 300 cubic centimeters of hexane for a duration of 24 h. The resulting solution was successively and meticulously filtered using Whatman No 2 filter papers (8 µm particle size range and slightly slower filtration speed), until all remnants of oil were completely removed from the sample. The oil-hexane mixture, often known as miscella, was separated using the Soxhlet equipment. To ensure the complete evaporation of any remaining hexane in the oil, the oil was heated at 78 °C for 2 h using a Gallen Kamp hot air oven model OV160. The aforementioned technique was employed to extract oil from the milled seeds of both *A. occidentale* and *B. sapida*.

2.3 Physiochemical characterization of the seed oils

The iodine value, acid value, peroxide value, saponification value, refractive index and specific gravity were measured using the established protocols outlined by the American Oil Chemist Society (AOCS) and the American Society for Testing and Materials (ASTM).

The iodine value is a measure of the unsaturation of a substance, specifically the number of double bonds it contains. Precisely 0.1 g of each oil sample was measured and placed into a conical flask. Then, 2.0 mL of tetrachloromethane were added to the oil sample, followed by 4.0 ml of Wij's solution. The mixture was stirred to mix, covered, and left undisturbed for 30 min in a dark environment. 3.0 mL of a 10% KI solution and 20 mL of distilled water were added to the mixture, which was then titrated with 0.1 N Sodium thiosulfate until a clear solution was obtained. The blank titration was done using all the reagents involved without any sample. Average of triplicate determinations was reported for both sample and blank titrations.

2.4 Calculation

2.4.1 Iodine value

$(g/100g\ oil) = (B - S \times W \times 12.69)$

where; B is the blank titer, value S is the sample titre value and the weight of the sample is
W.

2.4.2 Peroxide value

Precisely 0.1 g of the oil sample was weighed, and dissolved in a 30 mL acetic acid/chloroform mixture (3:2) and 0.5 mL of 10% KI was added to the mixture. It was agitated and kept for 2 min before adding 30 mL of distilled water and 0.5 mL of 1% starch solution and titrated with 0.1 N sodium thiosulfate till a milky solution was obtained and the titre obtained. The blank titre was obtained by using all the reagents without any oil sample.

$(Meq/kg) = S\text{-}B \times 0.1 \times 1000/W$

Calculation: Peroxide value where; B is the blank titer value, S is the sample titer value and W is the weight of the sample.

2.4.3 Acid value Each oil sample (1.0 mL) was weighed into conical flasks and 20 mL of ethanol/petroleum ether (1:1) was added to the samples. Two drops of phenolphthalein indicator were added to the mixture and titrated with 0.1 M KOH solution to a pink colouration which persists for 30 s. The titre value was obtained blank using all the reagents without any oil sample. Average of triplicate determinations was reported for both sample and blank titrations.

Calculation: Acid value

$(mgKOH/gOil) = V \times N \times 5.61/W$

where V is the volume of KOH, W is the weight of the sample examined (g), and N is the normality or molarity of KOH.

2.4.4 Saponification value

Precisely, 1.0 mL each oil sample was measured and placed into conical flasks, followed by the addition of 12.5 mL of a 0.5 M KOH solution. The combination was heated for a duration of 15 min, then let to cool. Following this, 2 drops of phenolphthalein indicator were introduced to the mixture. The substance was subjected to titration using a 0.1 M HCl solution until a transparent solution was obtained. The blank was prepared with all reagents except any oil sample. Average of triplicate determinations was reported for both sample and blank titrations.

Calculation: Saponification value where;
(mgKOH/gOil) = [28.05× (A-B) × F]/S
S is sample weight, A is the titre value of blank (ml), B is the titre value of sample (mL), and F is the molarity of the HCl standard solution.

3 RESULTS AND DISCUSSION

The physiochemical properties of the oils obtained in this study are shown in Tables 1 and 2, respectively.

Comparative studies of the characteristics of A. occidentale and B. sapida seed oils were carried out to ascertain their possible applications and the difference in their components. The percentage yield of the A. occidentale seed oil was 17.14± 0.5 while that of the B. sapida seed oil was 18.01±0.13%. Both oils have almost the same %yield.

3.1 Refractive index

According to Codex Standard[10], the refractive index for fats and oil from vegetable/ plant source should be around 1.4707 for virgin, refined and refined-pomace oils. From Table 1, for *A. occidentale* oil, the refractive index was 1.481±0.01 and that of *B. sapida* seed oil was 1.468±0.02.

Table 1: Physical Properties of Oils from *A. occidentale* and *B. sapida* seeds (n=3±SD)

Test	A.O seed	B.S seed
Yield (%)	17.14± 0.5	18.01±0.13
Refractive.index (cp)	1.46±0.0	1.46±0.0
Specific gravity (25˚C)	0.96±0.13	0.91±0.5
Colour	Light yellow	Golden yellow

Table 2: Chemical properties of oils from *Anacardium occidentale* and *Blighia sapida* seeds (n=3±SD)

Test	**A. O seed**	**B.S seed**
Acid value (mgKOH/g oil)	3.9±1.2	5.7 ± 0.6
Iodine value (mgI_2/100g oil)	78.9 ± 1.5	88.7 ± 1.1
Peroxide value (meq/kg)	6.0 ± 1.2	10.0 ± 1.0
Saponification value (meq/kg)	187.4 ± 2.7	195.8 ± 2.0

3.4 Acid value

According to Table 2, the acid value is a measure of the amount of free fatty acids in the oils. It serves as an indicator of the presence and degree of hydrolysis caused by lipolytic enzymes and oxidation.[6] Acid value has the range of 0.34 to 68.88 mgKOH/g oil. The *A. occidentale* oil has an acid value of 3.9±1.2 mgKOH/g which is higher than the 2.06 mgKOH/g reported by Pushkar et al.[18] and 3.01 mgKOH/g reported by Otaigbe et al.[17] *B. sapida* has an acid value of 5.7 ± 0.6mgKOH/g oil. The higher acid value of *B.sapida* seed oil implies greater hydrolysis of triglycerides and lower oil stability and shelf life.[17] A higher acid value is acceptable for soap making.[1]

3.5 Saponifcation Value

In Table 2, we saw that the *A. occidentale* seed oil has a saponifcation value of 187.4±2.7 meq/kg while *B.sapida* seed oil has a saponifcation value of 195.8 ±2 meq/kg. Both oils possess a high saponifcation value, indicating their suitability for soap manufacturing and oil-based body cream. The saponifcation value of oils varies between 5.58 milliequivalents per kilogram (meq/kg) to 249.90 meq/kg. It quantifes the level of oxidation that occurs throughout the storage process. Additionally, it signifies the degradation of oils and the existence of fatty acids. A high saponifcation value indicates a lower concentration of fatty acids in the oil, whereas a low saponifcation value suggests a higher proportion of fatty acids, rendering the oil inedible.

3.6 Iodine value

The iodine value is a quantitative measure of the level of unsaturation in seed oils, and it serves as an important criterion for identifying and characterizing these oils in the cosmetic industry.[7] The iodine value ranged from 2.65 to 153 g/100 g oil. It can be seen in Table 2 that the *A. occidentale* seed oil has an iodine value of 78.9 ± 1.5 g/100 g oil while the Iodine value of *B.sapida* is 88.7±1.1 g/100 g. This showed that the B. sapida seed oil had a higher degree of unsaturation.[8] The iodine value is a measure of the oil's double bond content, indicating its vulnerability to oxidation. A lower iodine value indicates a reduced amount of unsaturated bonds, resulting in decreased susceptibility to oxidative rancidity in the oil. Both oils are classified as non-drying oils due to their

iodine contents being below 100 g/100 g oil. They have the potential to serve as emollients, which can effectively moisturize and soften the skin. The low iodine values of both oils indicate minimal oxygen absorption reactivity, classifying them as non-drying oils. Therefore, both oils can be used effectively as plasticizers or lubricants.[17] The values are also an indication that the *B.sapida* seed oil may have more unsaturated bonds than the *A.occidentale* seed oil. Due to their non-drying properties, non-drying oils are not ideal for the manufacturing of ink and paint, but they may be beneficial in the production of soap and can be viewed as liquid oil.[2] Non-drying oils don't oxidize quickly, therefore they remain as liquid for a very long time. They are very helpful as lubricants and lamp fuel because of this property. These findings indicate that the oils derived from *A.occidentale* and *B.sapida* seeds can be used topically to safeguard the skin's protective barrier. This is achieved by creating a barrier that prevents moisture loss and promotes moisture retention in the skin, therefore lowering the loss of water through the skin. According to[11], the skin will become moisturized, resulting in increased flexibility and reduced appearance of fine wrinkles.

3.7 Peroxide value

The *A.occidentale* seed oil has a peroxide value of 6.0 ± 1.2 meq/kg, this accounts for the decreased unsaturated fatty acids of the oil and increased colour and viscosity. The peroxide value of the *B.sapida* oil is 10.0 ± 1.0meq/kg, which is higher than the peroxide value of the *A.occidentale* seed oil, as indicated in Table 2. The peroxide value is a quantitative indicator of the degree to which an oil sample has experienced primary oxidation.[16] Unrefined oil has a greater peroxide value compared to refined oil. It has a range of 0.45 to 290.

4 CONCLUSION

This study demonstrates that *A.occidentale* and *B.sapida* can both be used as substitute resource bases for fats and oils. The physio-chemical properties of these oils, point to their potential industrial applications. 17.14± 0.5 and 18.01±0.13 yields for *A. occidentale* and *B.sapida* were respectively obtained. The chemical characterization of the oils gave iodine values of 78.9 ± 1.5 mgI2/g for *A. occidentale* oil and 88.7 ± 1.1mgI2/g for *B.sapida* oil. Similarly, acid values of 3.9±1.2 and 5.7 ± 0.6mg KOH/kg were obtained for *A.occidentale* and *B.sapida* seed oils respectively. The *B.sapida* and *A.occidentale* seed oils are both considered non-drying oils, making them suitable for use in the cosmetics industry.

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