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Physico-Chemical Characterization of Avocado (Persea Americana Mill) Oil.

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ABSTRACT

The physicochemical characterization of n-hexane extracted oil of avocado (Persea americana) seed was carried out according to American Organization of Analytical Chemists (AOAC)/IUPAC standard methods. The result of the analysis showed that the oil sample contains an acid value of 1.542 mg/g, iodine value 127.40 g/100g, saponification value 196.35 mg/g and peroxide value 4.80mg/g, as well as specific gravity (0.8627), flashpoint (288°C) and relative viscosity (24.69 Cst.). This indicates that the oil can be used industrially for various purposes, including food processing, cosmetics etc.

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Introduction

Avocado seed oil is a vegetable oil obtained from the seed of avocado plant, also known as *Persea americana*. It is a drying, amber coloured liquid with an irritating-like odour. The oil can be extracted from the seed by expression, solvent extraction or combination of both, but because avocado seed contains relatively small amount of oil, solvent extraction seems the most viable method. Avocado seed, which represents a considerable amount (up to 16%) of the total fruit, has a rich phytochemical profile and a long history of ethnobotanical use.[1, 2]

Modern research into the bioactivities of avocado seeds remains in its nascent stages. Currently, the seed is an under-utilized resource and a waste issue for avocado processors [3, 4]. *Persea americana* seeds is often discarded after taking the pulp of the fruit. However, research has shown that the avocado seed is a good source of carbohydrate, protein, fat and some mineral elements such as calcium, phosphorus, potassium and magnesium as well as high concentration of anti-nutritional factors such as phytate, oxalate and cyanogenic glycosides making the seed to appear potentially toxic [5].

This high anti-nutritional factors present in the raw seeds of *Persea americana* could be recognized as a potential threat in the use of these seeds in animal and human nutrition, in spite of its nutritional composition, although proper processing methods, such as soaking and boiling, can reduced the levels of these anti-nutrients present in the raw seeds to a great extent [6].

There is ethno-pharmacological information on the use of seeds for the treatment of health-related conditions, especially in South American countries where avocados are endemic and currently grown on a large scale. Current research has shown that avocado seeds may improve hypercholesterolemia, and be useful in the treatment of hypertension, inflammatory conditions and diabetes. Seeds have also been found to possess insecticidal, fungicidal, and anti-microbial activities. The avocado seeds are rich in phenolic compounds, and these may play a role in the putative health effects. Avocado seed oils have been reported to be used in healing skin eruptions [7]. Historically, extracts of avocado seeds have also been used as ink for writing and research in laboratories and this has explored the potential colorant properties of a polyphenol oxidase-produced colored avocado seed extract [3].

MATERIALS AND METHODS

Materials: The *Persea americana* seeds were obtained from the freshly consumed avocado fruit at various locations within Awka Metropolis, Anambra State, Nigeria. Only the undamaged seeds were chosen. All reagents used were of analytical grade.

Preparation of plant material: The *Persea amercana* seed was manually chopped into pieces after which it was sundried and ground to powdered form.

Oil extraction: The soxhlet method was used, with n-Hexane (b. p 40-60^{o}C). A 500ml boiling flask was washed and rinsed with distilled water and then with n-hexane and was allowed to dry. 250ml of n-hexane solvent was measured out and transferred into the boiling flask. 10g of the ground avocado seed sample was weighed into a filter paper, properly wrapped and placed inside the soxhlet. The extraction continued until the solution in the thimble becomes very clear, indicating that all the oil in the sample has been completely extracted, leaving the solvent behind. The oil was then recovered by evaporating the solvent using a heating mantle Model No: 4382 Fitcher Prod. at a temperature of 50-60^{o}C. The whole process was repeated several times to get the required quantity of oil.

PHYSICOCHEMICAL CHARACTERIZATION

Determination of melting point: The Capillary method was used for the melting point. A 1mm internal diameter thin walled capillary tube was filled to a height of 10mm with the oil and allowed to stand at below 5^{o}C for 24 hours. The tube was then inserted into a melting point apparatus together with a thermometer. The melting point was taken at intervals between the first sharp melt and when the oil has completely melted.

Determination of Viscosity: An Ostwald (U-tube) viscometer was filled to the upper mark with the oil. A stop watch was then set to zero before draining the oil. The reading was taken at the time when the last drop of the oil left the lower mark of the tube. The process was repeated using 10% glucose as blank. [8, 9]

Determination of the acid value: 4.0g of the oil sample was weighed out into 250ml conical flask. 50mls of equal volume of ethanol and diethyl ether was added and the solution was shaked to dissolve the oil. 2 drops of phenolphthalein indicator were added and the entire mixture titrated with 0.1N NaOH to a pink end point.

Determination of Iodine value: Wijs solution was used here. About 0.2g of the oil was weighed into 500ml conical flask and dissolved with 15ml of CCl_4 followed by addition of 25ml of wijs solution. The mixture was then covered and kept in a dark cupboard for about 1 hour for complete dissolution and homogenization. Subsequently, 20ml of 10% KI was added followed by 150ml of distilled water. The entire solution was then titrated with 0.1N sodium thiosulphate solution until the colour becomes clearer. 5ml of starch indicator was then added and titrated to a colourless endpoint with the same thiosulphate. This process was repeated with the blank solution (that does not contain the oil). [10, 11]

Determination of saponification value: 0.5g of the oil sample was weighed into 250ml conical flask, followed by 50ml of ethanolic KOH. The solution was then refluxed for 30 minutes. 3 drops of phenolphthalein indicator were added to the hot solution and titrated a colourless endpoint with 0.5N HCl. The process was repeated using a blank solution and the entire process repeated twice for effective result.

Determination of peroxide value: 1.0g of the oil sample was weighed into 250ml conical flask. A mixture of glacial acetic and chloroform in the ratio of 2:1 respectively was added into the flask. 2ml of saturated solution of KI was then added and the flask passed over CO_2. 3ml of starch indicator was subsequently added and the mixture titrated with 0.02N sodium thiosulphate to a clear endpoint. The process was also carried out using a blank solution

Determination of specific gravity: A dry empty specific gravity bottle was weighed and recorded. The S.G bottle was the filled with distilled water, weighed and recorded. The distilled water was discarded and the S.G bottle was dried and filled with the oil sample. It was then weighed and recorded. The respective weights of the water and oil sample was calculated and the specific gravity was calculated as well.

Determination of Flash and Fire point: 10ml of the oil sample was measured and transferred into a 50ml beaker and a thermometer inserted into it as well. The beaker was then heated until a flash appeared at any point on the surface of the oil. The observed flash point read as the temperature recorded on the flash point. The process was repeated and the average value was recorded as the flash point.

Determination of Refractive Index: The refractometer disk was cleaned and calibrated with acetone after which it was dried. The oil sample was placed inside the disk with the aid of a sample cell and the reading was taken. [5, 12-14]

RESULTS AND DISCUSSION

Oil extraction: The extracted oil, which was about 21.63% of the sample used (Table 1), was liquid at room temperature, although it tends to harden when left in the open air. The yield value is however, low to be considered an oilseed for commercial purposes, but their use may not be discouraged.

Table 1: Result of the extraction process

Weight of sample seed used	800.014g
Weight of oil extracted	173.043g
Total volume of solvent used	2500mls
% oil content of the sample	21.63%

Physicochemical Characterization of the Oil: Table 2 summarizes the result of the oil characterization. The acid value of 1.542 indicates the amount or proportion of free fatty acid present in the oil sample. This conforms well to that of the ASTM D1639-1690 and ASTM D1962-1967. Determination of this is essential because most oil deteriorate through hydrolysis of the oil in the hauled seed or extracted oil to give free fatty acid. The oil can also find use in food processing when refined, given that the acid value is well within expected range of 0.00 to 3.00 mg KOH/g for cooking [15].

The peroxide value of 4.80 indicates the oil to be relatively resistant to deterioration and oxidation. This value falls within Europe Standard EN 14214 (2003) and ASTM D6751 (2002) which is less than or equal to 5.0. [16]

The iodine value of is a clear measure of the proportion of unsaturated acids present in the oil sample. One of the properties of unsaturated organic compounds is the reactivity of the double bonds, especially their ability to form addition compounds with halogens. The value 127.40 is considerably higher than that of castor oil (80) but lower than soybean oil (132), this places the oil in semi-drying region (115-130). This also shows that the oil cannot be used as a lubricant for e.g. hydraulic brake fluid since the iodine value is more than 100 [15].

Table 2: Summarized Result of the Oil Characterization.

Test Parameters	Average Values	Standard Values
Melting Point (°C)	38 – 42	--
Viscosity (Cst)	24.69	--
Refractive Index @ 27°C	1.462	1.476-1.479
Acid Value (mg/g)	1.542	NMT 4
Iodine Value (g/100g)	127.40	115 – 130
Saponification Value (mg/g)	196.35	--
Peroxide Value (mg/g)	4.80	NMT 5
Specific gravity	0.862	--
Flash Point (°C)	288	130
Fire Point (°C)	329	NLT 300

The saponification value of 196.35 shows the average molecular weight of the oil sample. It does not however, give the actual molar mass of the oil but a constant usually expressed in milligrams of KOH required to saponify one gram of the oil sample. This value is considerably higher than that of castor oil (180) but lower than that of olive (200) and coconut oil (250) [17]. This value also suggests the oil may be used for soap making, shampoos and lather shaving creams [8].

The specific gravity of 0.862 of course indicates that as an oil, it is less dense than water. The viscosity of 24.69 of the oil sample indicates the flow rate of the oil through a standard orifice as well as its measure of resistance to deform under shear stress.

Considering the flash point value of 288, it conforms to the standard EN 14214 (2003) and ASTM D6751 (2002) (130°C), indicating that the oil is relative fire resistance and can withstand somewhat higher temperature[1, 18-20]. Finally, the refractive index value of 1.462 shows that light propagates 1.462 times faster in vacuum than it does in the sample and is very close to the recommended standard as shown in **Table 2**.

CONCLUSION

Based on the result of the analyses as has been summarized in table 2 and discussed above, the following conclusions can be drawn:

The saponification value of 196.35 suggests that the oil may contain some amount of unsaponifiables, which makes it an asset to cosmetic industries. Relatively small peroxide value (4.80) indicates that the oil has a slow rate of oxidation and can be an added advantage in food processing. The iodine value (127.40) gives the oil some drying properties.

The viscosity value 24.69, is slightly higher and this may render the oil sample unfit for use as a

hydraulic base oil, according to ISOAw68 specifications, given that viscosity stands as the chief controlling parameter for manufacture and selection. It can however, be used for higher grade lubricants. Overall, the oil extract exhibited good physicochemical properties and can be useful for industrial applications.

Conflict of interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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