



Physicochemical Properties and Nutritional Composition of *Allanblackia floribunda* Oliv. Seed oil

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ABSTRACT

This study provided information on the physicochemical properties, nutritional composition and dominant functional group of *A. floribunda* seed oil. The oil was extracted with petroleum ether using Soxhlet extractor (45°C); nutritional and physicochemical evaluations of the oil were done using standard procedures while fourier-transform infrared spectroscopy (FTIR) was used to determine the functional groups present. The oil was solid at room temperature with specific gravity less than water. It has low acid and peroxide values with high saponification value and intermediate iodine value. β -Sitosterol and stigmasterol were the most abundant phytosterols. The most abundant monounsaturated fatty acid was oleic acid while saturated fatty acid was stearic acid. Vitamin E was found in high amount while potassium was present in significant concentration. The most abundant phospholipids were phosphatidylcholine. The FTIR spectroscopic peaks suggest the presence of ester groups. Therefore, consumption of food products enrich with this oil may give health advantage.

Keywords: *Allanblackia floribunda*; physicochemical properties; nutritional composition; vitamin; oil; seed; phytosterol.

INTRODUCTION

Allanblackia floribunda is a tree that is found in the rain forests of West, Central and East Africa. The seed contains essential oil used in cooking and soap making. It has great industrial relevance because of its potential for making butter with low trans-fats (Ochieng, 2007). The potential nutritional values that *A. floribunda* seed oil holds in the global food market have made many organizations in Nigeria, Ghana and Tanzania to come together under the umbrella Novella Africa (Attipoe *et al.*, 2006) to develop a sustainable *Allanblackia* oil business.

Nutritional and physicochemical evaluation of oils provides scientific information that directs their usage either for nutraceutical or manufacturing purposes. Generally, the assessment of the nutritional composition of oils gives information on their phytosterol, free fatty acids, vitamins, phospholipids, glycerides, mineral contents etc. Evaluation of the saponification value, refractive index, iodine value, peroxide value, free fatty acids, unsaponifiable matter, specific gravity and acid value of oils provides useful details on their physicochemical properties. In addition, fourier-transform infrared spectroscopy (FTIR) can be used to suggest the major functional groups that are present in oils.

The nutritional and physicochemical properties are useful in rating fats and oils quality including their applications in the food and manufacturing industries. For example, oil that is rich in vitamin A and E can resist autooxidation and will likely have a long shelf life while the oils high in stearic acid could be useful for the control and management of cardiovascular disease since it does not increase the level of plasma low density lipoprotein (bad

cholesterol) (Nestel *et al.*, 1998). Oils that have high saponification value would be a good candidate for soap production. Furthermore, for the purpose of paint and cosmetic production, oils can be drying, semi-drying or non-drying in nature depending on the iodine values. Therefore, this study provided information on the physicochemical properties and nutritional composition of *A. floribunda* seed oil. It also assessed the various functional groups that exist in the seed oil at the temperature of extraction, 45°C.

MATERIALS AND METHODS

Sample Collection

The fruits of *A. floribunda* were harvested from Uhogua community, Benin City, Nigeria on January 15th, 2020. The fruit was authenticated by Dr H.A. Akinnibosun, at the Department of Plant Biology and Biotechnology, Faculty of Life Sciences, University of Benin, Nigeria and voucher specimen of the sample (UBHA361) was deposited at the herbarium of the same department. The fruit was allowed to ripe and thereafter, the seeds were removed from the fruits and washed to free them from any adhering flesh.

Extraction of *A. floribunda* Seed Oil

Seeds of *A. floribunda* were harvested from the fruits, air-dried in the laboratory in the absence of sunlight. Thereafter, the seeds were cracked open to remove its shell. The resulting *A. floribunda* seed were milled in a grinder to fine powder. The oil was extracted from the seed using a Soxhlet extractor and petroleum ether as solvent. Ten grams (10 g) of the powdered *A. floribunda* seed was refluxed for 6 hours in mild temperature, 45 °C in a Soxhlet extractor. The solvent was evaporated using a rotary evaporator (RE 300, Bibby Scientific, UK) with

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reduced pressure at 45°C. The extracted oil was kept in an air-tight container until when needed.

Physicochemical analysis of *A. floribunda* Seed Oil

Saponification value, acid value, peroxide value and iodine value (Wijs' method) of *A. floribunda* seed oil were determined using AOCS (1992) as reported by Akinola *et al.* (2010). Specific gravity and density were determined according to the method reported by Jacob (1999).

Estimation pH Value

Hot distilled water (13 mL) was added to a clean beaker containing 2 g of *A. floribunda* seed oil. The mixture was stirred slowly and then cooled in a water bath (25°C). Electrode was used to measure the pH of the sample and the reading was recorded. This process was repeated thrice.

Evaluation of the Nutritional Composition of *A. floribunda* Seed Oil

Phytosterols, fatty acids, phospholipids and glycerides of *A. floribunda* seed oil were determined using Gas Chromatography HP 6890 powered with HP ChemStation Rev. A 09.01 [1206] software. Fat soluble vitamins were determined using High Performance Liquid Chromatography (HPLC) Dionex Technical Note 89. The identification of the peaks was performed by comparing the retention times with those of reference standards (Supelco Inc.). Mineral contents were evaluated using UNICAM 929 London, Atomic Absorption Spectrophotometer powered by the SOLAAR software. Mineral contents were quantified via extrapolation from standard calibration curve.

Phytosterol Composition of *A. floribunda* Seed Oil

Phytosterol was quantified using the AOAC (2000a; 2000b) method with some slight modifications. Oil sample (0.5 g) was added to screw-capped test tubes and then saponified at 95°C for 30 minutes, by using 3 mL of 10% KOH in ethanol, to which 0.20 mL of benzene had been added to ensure miscibility. Three milliliters (3 mL) of deionized water was added and the non-saponifiable materials were extracted with n-hexane. This process was repeated three times with 2 mL of n-hexane at 1 h, 30 min and 39 min to achieve complete sterol extraction. The hexane was concentrated to 2 mL in the vial for gas chromatography analysis and 1 µL was injected into the injection port of Gas Chromatography (GC). GC condition for the determination of phytosterol is described below.

Capillary column BPX 70 (30 m × 0.25 mm × 0.25 µm) and flame ionization detector (FID) detector. The inlet temperature was 250°C with the split ratio of 20:1 and detector temperature was 320°C. The injection volume was 1.0 µL and nitrogen was used as a carrier gas. Oven program was; initial temperature at 60°C, first ramping at 10 °C/min for 20 min - maintained for 4 min, second ramping at 15 °C/min for 4 min - maintained for 10 min.

Fatty Acid Composition of *A. floribunda* Seed Oil

Fatty acid methyl esters (FAME) were determined using AOAC (2000a). The first stage was derivatization to increase volatility. This was done by esterifying 50g of the oil at 95°C for 5 min with 3.4 mL of the 0.5M KOH in dry methanol. Thereafter, 0.7M HCl was used to neutralize the mixture and 14% boron trifluoride in

methanol (3 mL) was added. The mixture was heated (90°C) for 5 min to achieve complete methylation. Redistilled n-hexane was used to extract the fatty acid methyl esters thrice. The content was concentrated to 1 mL for gas chromatography analysis and 1 µL was injected into the injection port of Gas Chromatography (GC). GC condition for FAME quantification is described below.

Column type was HP INNOWax (30 m × 0.25 mm × 0.25 µm) and detector was flame ionization detector (FID). Split injection was used, and detector temperature was 320 °C. Split ratio was 20:1, injection volume was 1.0 µL, nitrogen was used as a carrier gas, inlet temperature (250 °C), hydrogen pressure and compressed air were 22 psi and 35 psi respectively. Oven program was initial temperature at 60 °C; first ramping at 12 °C/min for 20 min, maintained for 2 min; second ramping at 15 °C/min for 3 min, maintained for 8 min.

Fat soluble vitamins composition of *A. floribunda* seed oil

Fat soluble vitamins were determined using High Performance Liquid Chromatography (HPLC) Dionex Technical Note 89. The mobile phase used was CH₃OH: CH₃CN (8:2, v/v) and methyl tert-butyl ether (MTBE). Column used was acclaim PA, 3µm, 120 A, 3.0 × 150mm. Column temperature and injection volume were 25°C and 10µl respectively. Prior to injection, the solution were filtered through a 0.2 µm filter (Millex-GN).

Phospholipids Composition of *A. floribunda* Seed Oil

Phospholipid content determination was carried out using Raheja *et al.* (1973). Extracted oil (0.01g) was added to test tube and solvent was completely removed by passing stream of nitrogen gas on the oil to ensure complete dryness for phospholipids analysis. Chloroform (0.4 mL) and chromogenic solution (0.1 mL) were added to the tube respectively. Thereafter, the tube was heated at 100 °C in a water bath for 1 min, 20 sec. After heating, the tube was cooled to laboratory temperature and 5 mL of hexane was added. The tube and its content was shook gently multiple times. The two resulting layers were allowed to separate. The hexane layer was recovered and concentrated to 1 mL for gas chromatography analysis using pulse flame photometric detector (PFPD).

Column type was HP 5 and dimension, 30 m × 0.25 mm × 0.25 µm. The inlet temperature was 250°C with the split ratio of 20:1 and detector temperature was 320°C. The injection volume was 1.0 µL, nitrogen was used as a carrier gas, hydrogen pressure and compressed air were 20 psi and 30 psi respectively. Initial temperature was at 50°C, first ramping at 10 °C/min for 20 min - maintained for 4 min, second ramping at 15 °C/min for 4 min - maintained for 5 min.

Glycerides Composition of *A. floribunda* Seed Oil

The oil sample preparation for glyceride analysis followed the method of ASTM D6584 (2017). The oil was derivatized using the same method described in the determination of fatty acid composition. Column type was Elite-Biodiesel M (14 m × 530 mm × 0.16 µm) and detector was FID. The inlet temperature was 60°C with the split ratio of 20:1 and detector temperature was 380°C. The injection volume was 1.0 µL, helium was used as a carrier gas, flow rate was 1ml/min, hydrogen pressure and compressed air were 45 ml/min and 450

ml/min respectively. Oven program was; initial temperature at 60°C for 2 min, first ramping at 10 °C/min to 200 °C, second ramping at 8 °C/min to 300 °C constant at 5 min.

Estimation of Mineral Composition of *A. floribunda* Seed Oil

Ash of 0.2 g of oil sample was weighed into a pre cleaned borosilicate 250 mL capacity beaker for digestion. Nitric oxide (10 mL) was added to the sample and placed on a hot plate for digestion in a fume cupboard. After digestion, the sample was allowed to cool. After cooling, another 10 mL of digesting solvent was added and digestion was repeated. The mixture was filtered into a 250 mL volumetric capacity borosilicate container. The filtrate was made up to the mark by deionized water. The digested samples were analyzed for its elemental composition.

Functional Group Identification using FTIR Spectroscopy

The FTIR spectra of *A. floribunda* seed oil was measured using a SHIMADZU FTIR-8400S at a scan rate of 4 cm⁻¹ between wave numbers 4000-400 cm⁻¹ as described by Liang *et al.* (2013).

Statistical Analysis

The statistical analysis was performed using the statistical package for social science (SPSS) for windows, version 16.0 (SPSS Inc., Chicago, IL, USA). One way analysis of variance (ANOVA) test was used to determine significance differences between the Mean values. Statistical significance was declared when p value was less than 0.05 (p < 0.05).

RESULTS AND DISCUSSION

The physical properties of *A. floribunda* seed oil are shown in Table 1a. The oil yield from the seed was 38% with the pH value of 5.82 ± 0.20 which is slightly acidic. The colour of the seed oil was light yellow, and it was solid at 30°C. The chemical properties such as peroxide value, acid value, free fatty acids, iodine value and saponification value of *A. floribunda* seed oil are shown in Table 1b.

The analysis of *A. floribunda* seed oil showed that its specific gravity and density are less than that of water, the specific gravity of the oil is used in relation with other physicochemical properties to show the level of purity (Yahaya *et al.* 2012) and the density of the oil is dependent on the fatty acids' composition of the oil. *A. floribunda* seed oil may therefore be a suitable candidate for cream production (Oyeleke *et al.*, 2012b).

The results in Table 1b, the acid value of *A. floribunda* seed extract (0.68 mg KOH/g) is similar to the data reported for shea tree seed oil (Kyari, 2008) and palm kernel oil (Afolabi, 2008). However, the acid value of *A. floribunda* seed is low when compared to literature report on groundnut oil, and white melon seed oil, (Ayoola and Adeyeye, 2010; Olaofe, *et al.*, 2012). The low acid value of *A. floribunda* oil means it can be stable for a long period of time with slow pace of oxidative rancidity. The acid value measures the levels of free fatty acid present

in the oil. These free fatty acids are normally released from the degradation of triglyceride by either enzymatic oxidation (lipase) or nonenzymatic oxidation (heat and light).

The free fatty acid of *A. floribunda* seed oil (0.34 mg KOH/g) was low compared to other common seed like white melon seed oil and groundnut seed oil (Ayoola and Adeyeye, 2010; Olaofe, *et al.*, 2012). High level of free fatty acids is a disadvantage in unrefined oil because free fatty acid like linoleic acid in oils can shorten shelf life, impact off-flavour and reduce the quality of the oil. The oil from *A. floribunda* may be considered of high quality because it has low free fatty acid contents (Table 1b). The free fatty acid is a measure of the percentage by weight of a specific fatty acid (Nielson, 1994).

The iodine value obtained for *A. floribunda* seed oil was 108.34 mI₂ /g; this value is comparable to previous reported data on groundnut oil (Ayoola and Adeyeye, 2010) but lower when compared to white melon seed oil (Olaofe *et al.*, 2012) and higher when compared to palm kernel seed oil (Evbouwman *et al.*, 2013) and shea tree seed oil (Kyari, 2008). Oils with iodine value less than 100 mI₂/g are non-drying in nature, above 100 mI₂/g are semi drying oils while iodine value greater than 130 mI₂ /g are drying oils. Therefore *A. floribunda* oil is a semi-drying oil (Table 1b), with characteristics long storage capacity and it can be a precursor for oil-based ice cream (Oderinde *et al.*, 2009). Iodine value assesses qualitatively the levels of double bonds in oils or fats by measuring the degree of unsaturated fatty acids. Low iodine value means a fewer number of unsaturated bonds and lesser ability to react with molecular oxygen.

A. floribunda seed oil has a saponification value of 203.69 mg KOH/g which is far lesser than the value reported for melon seed oil (Edidiong and Ubong, 2013) but higher than common oil like groundnut seed (Ayoola and Adeyeye, 2010), almond seed oil (Ogunsuyi and Daramola 2013) and yellow pumpkin seed oil (Akubugwo *et al.*, 2008). The average saponification value of *A. floribunda* oil (Table 1b) suggests that it will be good for soap production. The saponification value of oil measures the presence of fatty acids with higher number of carbon atoms and provides information on the average molecular weight.

The peroxide value of *A. floribunda* seed oil, 1.73 mEq/kg was in close range to the data reported for groundnut seed oil (Ayoola and Adeyeye, 2010) but lower when compared to melon seed oil (Edidiong and Ubong, 2013), almond seed oil, (Ogunsuyi and Daramola, 2013), Moringa seed oil, (Abiodun *et al.*, 2012) and dark yellow African pear seed oil (Akubugwo and Ugbogu, 2007; Aremu *et al.*, 2015). This seed oil low peroxide value shows that it can withstand oxidative rancidity. Higher peroxide values between 20 and 40 mEq/kg do result in rancid taste in oil (Akubugwo and Ugbogu, 2007). The peroxide value measures the degree of peroxidation in oils, it can be used to rate the quality of fats and oils (Ekwu and Nwagu, 2004).

Table 1: Physical and chemical properties of *A. floribunda* seed oil

a. Physical properties		b. Chemical properties	
Parameters	Properties	Parameters	Properties
pH Value	5.82 ± 0.20	Peroxide value (mEq/kg)	1.73 ± 0.04
Density (g/cm ³)	0.86 ± 0.01	Acid value (mg KOH/g)	0.68 ± 0.01
Specific gravity	0.87 ± 0.00	Free fatty acid (%)	0.34 ± 0.01
Colour	Light yellow	Iodine value (mI ₂ /g)	108.34 ± 1.85
Odour	Agreeable	Saponification value (mg KOH/g)	203.69 ± 1.04
State at 30°C	Solid		
Solubility	Soluble in non-polar solvent		
Lipid content (%)	38		

Values are expressed as mean ± SEM, n = 3/group.

Nutritional Composition of *A. floribunda* Seed Oil

The fatty acid composition of *A. floribunda* seed oil is presented in Table 2a and the gas chromatographic spectra is in Figure 2a. The result shows that the most abundant monounsaturated fatty acid was oleic acid (45.48%) while saturated fatty acid was stearic acid (33.45%). Linoleic acid was 10.71% while other fatty acids were in low amount. Medium chain fatty acids were not detected in *A. floribunda* seed oil. *A. floribunda* seed oil was hard at room temperature, this characteristic is common to Shea butter, Cocoa butter and Borneo Tallo fat. Furthermore, the percentage stearic acid and oleic acid estimated for *A. floribunda* is close to the one previously reported by Belitz *et al.* (2004) for Shea butter, Cocoa butter and Borneo Tallow fat. The high stearic acid, low palmitic acid and not detectable level of myristic and lauric acid in *A. floribunda* seed oil make it a potential therapeutic agent for the management of hypercholesterolemia (Nestel *et al.*, 1998). Several reports have shown that stearic acids do not raised low density lipoprotein and oleic acid has neutral effects on cholesterol concentration (Grundy, 1994).

Phytosterol composition of *A. floribunda* seed oil is shown in Table 2b. β -Sitosterol (135.96 mg/100g) was the most abundant phytosterol and this was followed by stigmasterol (28.55 mg/100g) and campesterol (14.80 mg/100g). Ergosterol and Δ -5-avenasterol were in trace amounts. The β -Sitosterol of *A. floribunda* seed oil was low compared to the report of Yang *et al.* (2019) on groundnut seed oil, soybean seed oil, sesame oil, olive oil and corn oil but β -Sitosterol content was higher when compared to literature data on Camellia oil and grape seed oil. Phytosterols are also known as stanols with a saturated ring structure (Ma. *et al.*, 2021), they are structurally similar to cholesterol, and they have excellent nutritional and health values. Phytosterol can lower blood LDL-cholesterol and reduce susceptibility to cardiovascular disease (Bai, 2019). Phytosterol structural similarity to cholesterol decreases its incorporation into the mix micelles in the intestinal chyme during absorption. The absorption of cholesterol is thereby reduced and more of it is expelled through the faeces (MacKay and Jones, 2011). Also, phytosterol competes with cholesterol uptake into the enterocyte by Niemann-Pick C1 Like1 (NPC1L1) transport proteins. The absorbed phytosterols are selectively sent out into the lumen with the help of ATP-binding cassette transporter (ABC also called ABCG5 and ABCG8 system). Furthermore, phytosterols in the circulatory system are excreted into the bile by ABCG5/G8 system (MacKay and Jones, 2011). These activities result in cholesterol reduction and stimulate its endogenous synthesis from

LDL-cholesterol (de Jong *et al.*, 2003). These therefore cause a significant reduction in the bad cholesterol content of the blood. *A. floribunda* seed oil can serve as a source of phytosterol when used in food production (see the gas chromatographic spectra in Figure 2b).

Phospholipids (PL) content of *A. floribunda* seed oil is shown in Table 2c and the gas chromatographic spectra is in Figure 2c. From Table 2c, *A. floribunda* seed oil is rich in phosphatidylcholine (42.32 mg/100g), phosphatidylserine (25.95mg/100g) and phosphatidylethanolamine(21.32mg/100g). Phosphatidylinositol, lysophosphatidylcholine and phosphatidic acid occurred in very low amount. Phospholipids are lipids whose molecule has a hydrophilic head containing a phosphate group, and two hydrophobic tails derived from fatty acids, joined by a glycerol molecule. Phospholipids are mainly used as base component in pharmaceutical, cosmetic and food industries (Alvarez *et al.*, 2000). Phospholipids are applied to formulate liposome which helps to transport drugs that are not soluble in water to target sites. In cosmetic industry, phospholipids serve as a vehicle to deliver active compound such as vitamins. In food industry phospholipids have been used as a stabilizing agent in bonding chocolate with margarine (Belitz *et al.*, 2004). The high levels of phosphatidylcholine in *A. floribunda* seed oil may have contributed to its relevance in manufacturing industries (Belitz *et al.*, 2004). Triglycerides were the most abundant glycerides in *A. floribunda* seed oil (Table 2c). The low level of monoglycerides in *A. floribunda* seed oil distinguished it from palm oil and palm kernel oil (Crockett, 2015). The triglycerides content of *A. floribunda* seed oil may increase its relevance in pharmaceutical industry because triglycerides are important for parenteral drug delivery and excipient in lipid-based formulation (Tan *et al.*, 1981). Lipid based formulation maintains a supersaturated drug concentration *in vivo* to increase oral absorption, promotes increase digestibility and distribution of drugs (see Figure 2d for the gas chromatographic spectra of *A. floribunda* glycerides).

Fat soluble vitamins (A, D, E and K) were detected in *A. floribunda* seed oil, the results are shown in Table 2e while the gas chromatographic spectra are represented in Figure 2e. Vitamin E was the most abundant in *A. floribunda* seed oil. The presence of significant amount of vitamin E impact increase shelf life on *A. floribunda* seed oil because this organic compound has the capacity to combat oxidative rancidity that occurs in oil during storage. Mineral composition of *A. floribunda* seed oil is shown in Table 2f. Potassium was the most abundant

mineral in *A. floribunda* seed oil while calcium, magnesium and sodium were relatively low. Other minerals present in *A. floribunda* seed oil were in trace amount. Sodium, calcium, potassium and magnesium are some of the main minerals needed by humans for general metabolism. About 50 mg of these minerals are required by humans per day (Adubofuor, 2013) and *A. floribunda* seed oil could contribute to this requirement

when consumed. *A. floribunda* seed oil may not contribute to high blood pressure as it has Na/K ratios of less than 0.6 (Nieman *et al.*, 1992). Similarly, the low Zn/Cu ratio of *A. floribunda* oil suggests that it may not contribute to cardiac abnormalities since Zn/Cu ratio of less than 16 indicates that there would be reduced risk of cardiac abnormalities (Ma and Betts, 2000).

TABLE 2: Fatty acid, phytosterol, phospholipids, fat soluble vitamins and mineral composition of *A. floribunda* seed oil

a. Fatty acids	Composition (%)	c. Phospholipids	Amount (mg/100g)
Caprylic acid; C8:0	0.00	Phosphatidylethanolamine	21.32
Capric acid; C10:0	0.00	Phosphatidylcholine	42.25
Lauric acid; C12:0	0.00	Phosphatidylserine	25.95
Myristic acid; C14:0	0.00	Phosphatidylinositol	2.71
Palmitic acid; C16:0	9.36	Lysophosphatidylcholine	0.13
Palmitoleic acid; C16:1	0.04	Phosphatidic acid	0.25
Margaric acid; C17:0	0.09	d. Glycerides	Amount (g/100g)
Stearic acid; C18:0	33.45	Monoglycerides	1.49
Oleic acid; C18:1	45.48	Diglycerides	4.44
Linoleic acid; C18:2	10.71	Triglycerides	88.69
Linolenic acid; C18:3	0.049	Total	94.62
Arachidic acid; C20:0	0.061	e. Fat soluble vitamins	Amount (mg/100g)
Arachidonic acid; C20:4	0.35	Vitamin A	0.128
Behenic acid; C22:0	0.17	Vitamin D	0.002
Erucic acid; C22:1	0.13	Vitamin E	19.215
Lignoceric acid; C24:0	0.12	Vitamin K	0.012
SAFA	43.25	f. Minerals	Amount (ppm)
MUFA	45.65	Sodium	0.173
PUFA	11.11	Potassium	8.162
MCFA	0.00	Calcium	1.262
Total	100	Zinc	0.018
b. Phytosterol	Composition (mg/100g)	Iron	0.040
Campesterol	14.80	Manganese	0.003
Stigmasterol	28.55	Magnesium	0.362
β -Sitosterol	135.96	Copper	0.002
Δ -5-Avenasterol	9.98×10^{-2}	Selenium	0.001
Ergosterol	2.28×10^{-3}	Chromium	0.001
Total	179.41	Sodium / Potassium ratio	0.021
		Zinc / Copper ratio	9

FA = fatty acids, SAFA = saturated fatty acid, MUFA = monounsaturated fatty acid, PUFA = polyunsaturated fatty acid and MCFA =medium chain fatty acid.

FTIR Spectroscopy Analysis of *A. floribunda* Seed Oil

The following spectroscopic peaks in Figure 1 were observed in the chemical functionality: O-H stretching vibration peak at 3468 cm^{-1} Fig. 2, vibration peak at 2917 cm^{-1} representing unsaturated C-H stretching of carbon chain, saturated carbon chain C-H stretching vibration peak at 2851 cm^{-1} , vibration peak at 1736 cm^{-1} indicate a C=O stretching, vibration peak at 1472 cm^{-1} denoting a bending symmetric vibration of C-H bonds of CH_2 groups, the carbon skeleton vibration peak is observed at 723 cm^{-1} , the stretching vibration peak of C-O in triglyceride at 1179 cm^{-1} is an indicator of possible ester group and the vibration peak at 718 cm^{-1} describes an overlapping of CH_2 rocking vibration and the out-of-plane vibration of cis $-\text{HC}=\text{CH}-$ group of disubstituted olefins. The results from this finding agree with similar assertion made by Olujinmi *et al.* (2017).

CONCLUSIONS

Our findings have shown that *A. floribunda* seed oil is solid at room temperature with a density less than water

and is semi-drying and can resist oxidative rancidity. Nutritionally, this oil is rich in oleic acid, stearic acid, vitamin E, triglycerides and phytosterols with high amount of phosphatidylcholine. The FTIR spectroscopic peaks suggest the presence of ester group. Therefore, this oil could be combined with other oils or fats to achieve specific physical properties. Also, *A. floribunda* oil may play useful role in the manufacturing, therapeutic and nutraceutical industries because of its rich nutritional contents.

DECLARATIONS

Author's contributions OSE, IF and EO designed the study. IF, EO and OAM carried out the experimental work. IF, EO and OAM analyzed the data .IF, EO and OAM wrote the manuscript. All authors read and approved the final manuscript.

Conflict of interest

The authors declare that there was no conflict of interest.

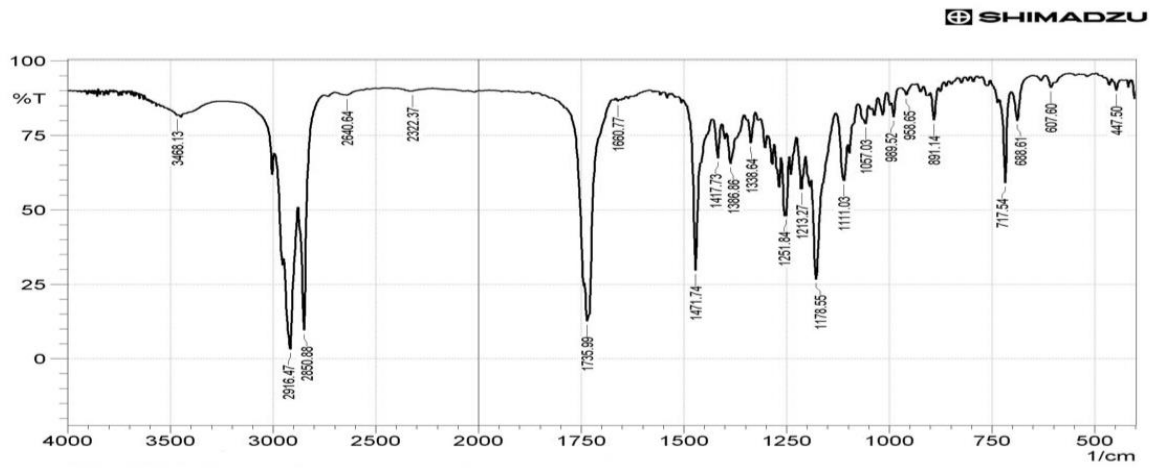


Figure 1: FTIR analysis showing the spectra of *A. floribunda* seed oil

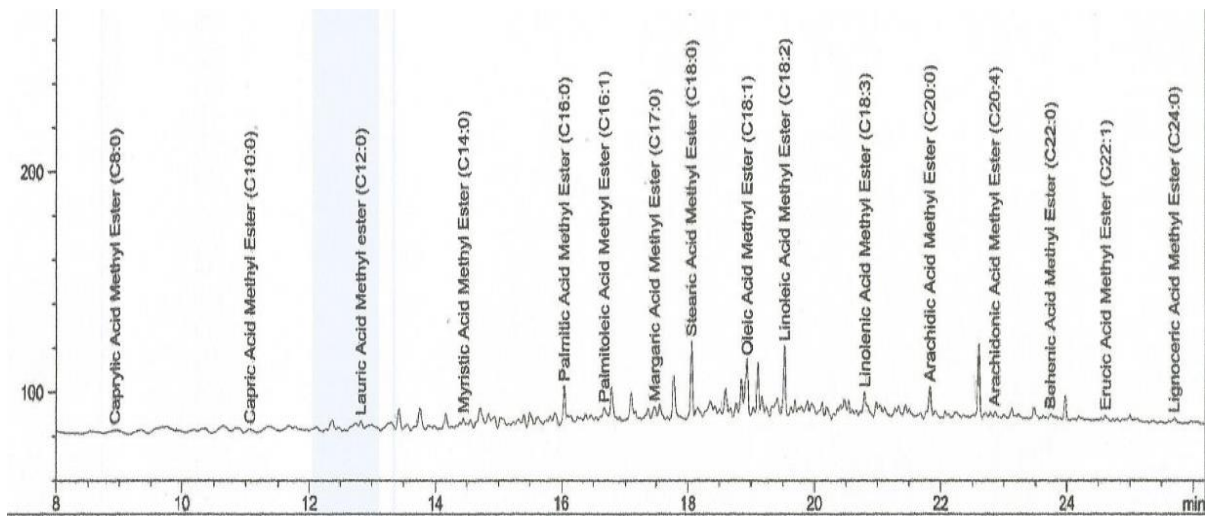


Figure 2a: Gas chromatography spectra of fatty acids

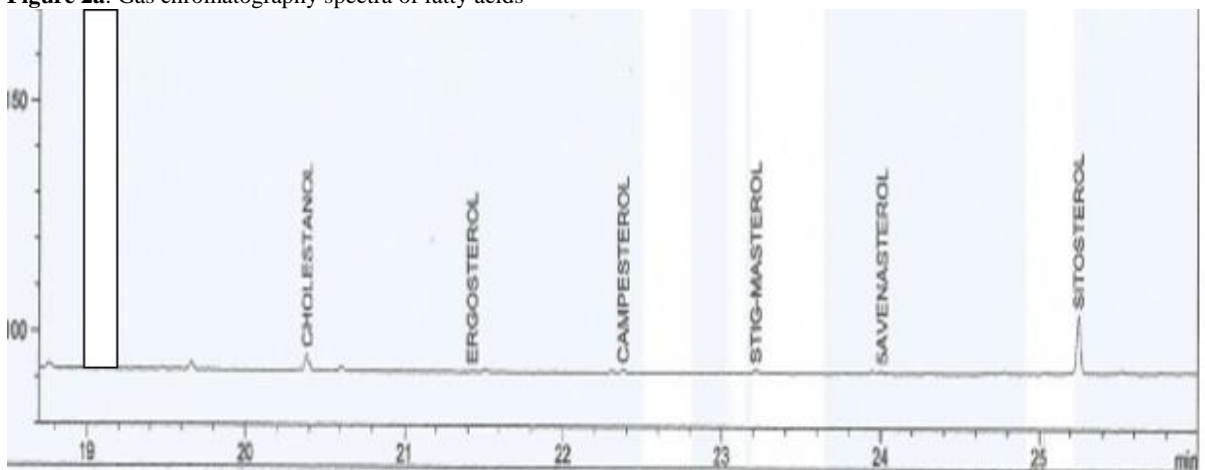


Figure 2b: Gas chromatography spectra of phytosterols

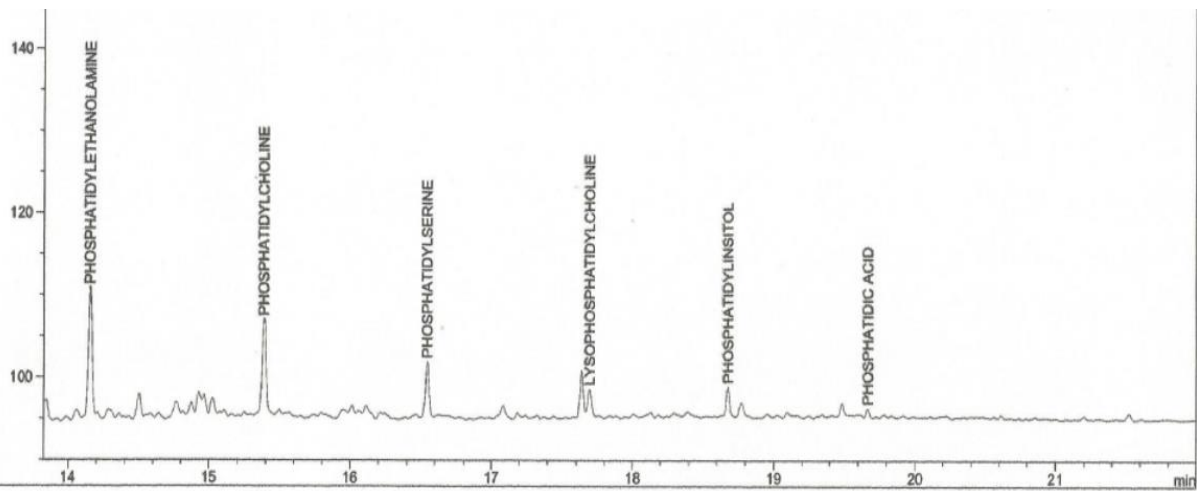


Figure 2c: Gas chromatography spectra of phospholipids

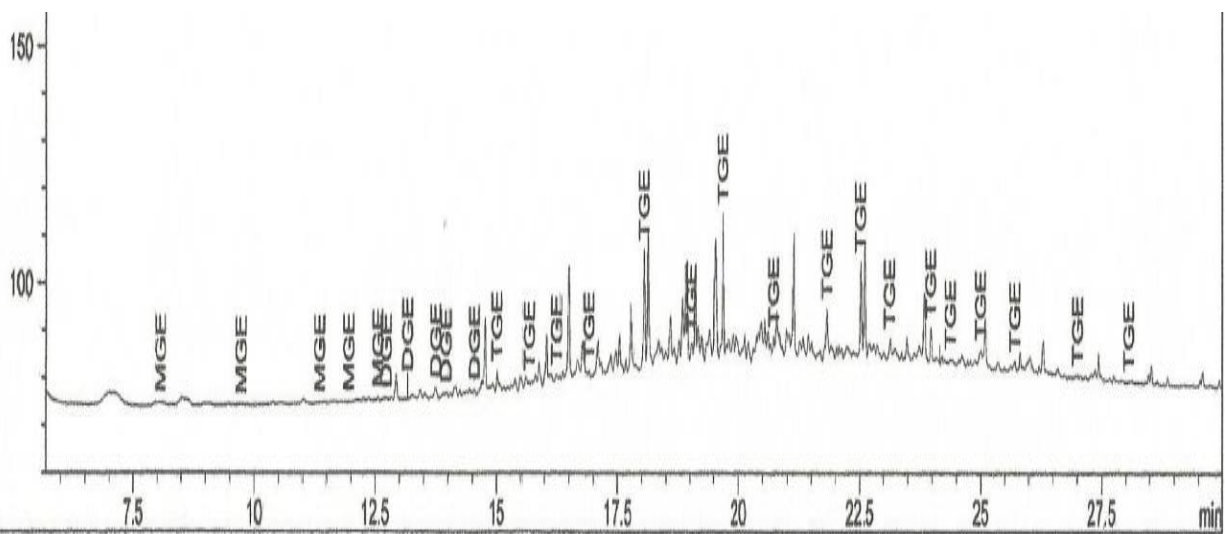


Figure 2d: Gas chromatography spectra of glycerides

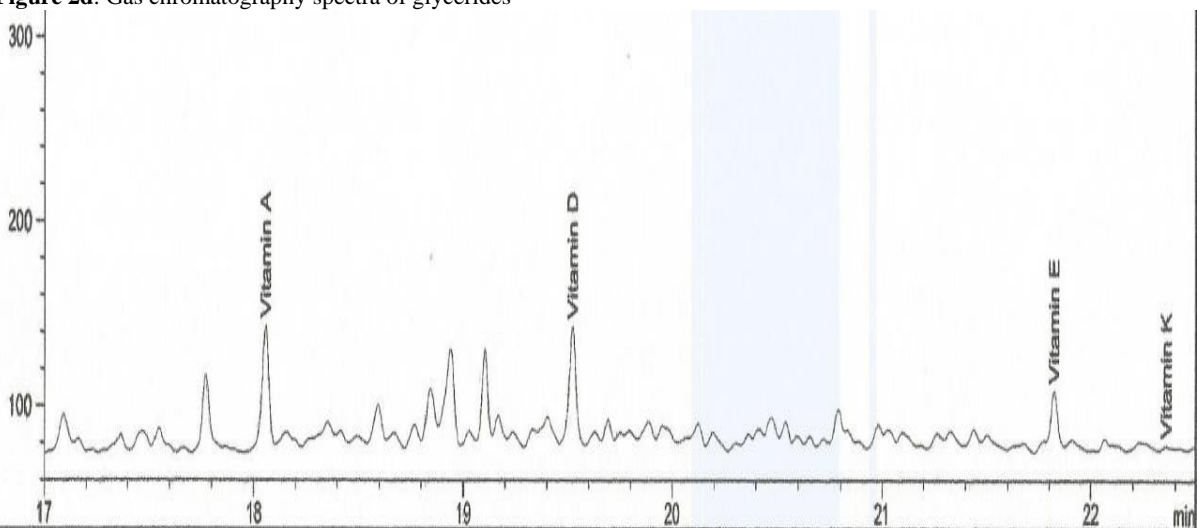


Figure 2e: Gas chromatography spectra of fat-soluble vitamins

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