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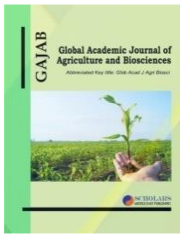

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Original Research Article

Comparative Analysis of Oil Yield, Fatty Acid Composition (GC-MS), Functional Groups (FTIR), and UV Radiation Absorbance of Nine Underutilized Nigerian Seed Oils: Implications for Sunscreen, Cosmetic, and Food Applications

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Abstract: This study investigates the chemistry and potential applications of oils extracted from nine underutilized Nigerian seeds for cosmetic, pharmaceutical, and food industries. Oils were obtained from *Balanites aegyptiaca*, *Arachis hypogaea*, *Hyptis spicigera*, *Sesamum radiatum*, *Sesamum indicum*, *Swietenia macrophylla*, *Citrullus lanatus*, and two *Cucumeropsis mannii* varieties using mechanical pressing, then analyzed by GC-MS and UV spectrophotometry. Five seeds—*B. aegyptiaca*, *A. hypogaea*, *S. radiatum*, *S. indicum*, and *S. macrophylla*—yielded 20.9–36.8% oil, indicating commercial viability. GC-MS revealed 9,12-Octadecadienoic acid (linoleic acid) as the most abundant component across all samples, while *S. macrophylla* oil contained n-hexadecanoic acid and cis-vaccenic acid as major constituents. All oils demonstrated adequate UV absorbance across UVC to UVA regions (200–420 nm). Notably, *C. lanatus*, *H. spicigera*, and *S. macrophylla* exhibited the highest UVA absorbance ranges of 1.394–1.718, 1.449–1.702, and 1.402–1.711, respectively. While all samples can protect skin from UV radiation, these three oils possess superior potential for use as sunscreens with high sun protection factor (SPF). Further studies on antimicrobial, cosmeceutical, and nutraceutical potentials of these oils are recommended.

Keywords: Sunscreen, Fatty Acids, Physicochemical, Seed Oils, GC-MS Analysis, UV Absorbance.

1.0 INTRODUCTION

They used to say that curiosity is the mother of invention, thus given our environment, one could wonder why some oils are more revered than others. Even though they may look similar, oils have different physicochemical characteristics. Oils can be classified into edible and non-edible categories based on their origins, and they can also be categorized as volatile and nonvolatile oils based on relative stability when subjected to certain environmental conditions [1].

Various oil seeds, fruits, nuts, and seed kernels all contain oil [2]. Though not all seeds and nuts that are oil-producing contain edible oil. Some are only used for paints and contain toxins or bad flavors while some for production of biodiesel [3]. In this work, nine oil containing seeds which includes: *Balanites aegyptiaca* Del, *Arachis hypogaea*, *Hyptis spicigera*, *Sesamum radiatum*, *Sesamum indicum*, *Swietenia macrophylla*, *Citrullus lanatus*, and two different sizes of *Cucumeropsis mannii* were subjected to extraction and their composition determined. The UV radiation of these samples was determined at different region of radiation in order to revealed the sun protection (sunscreen) potentials of these samples. Other parameters were considered either as preliminary assessments for the constituents of the oils or validation of the novel approach for the extraction of the oils. Groundnut (Arachis hypogea) oils which are mainly use for cooking, has a lot of health benefit such as improving lipid profile as well as reduce the oxidation of low-density lipoprotein, reducing the risk of some terminal diseases like, cardiovascular diseases and colorectal cancer. Its health benefit may not be unrelated to the presence of unsaturated fatty acid which is mainly oleic acid [4]. In addition, the oils are reported to have high iodine and saponification values which confer their potential uses in cosmetic industries [5]. Balanite aegyptiaca (desert date) is a tree containing spine with mid average high commonly found in the desert like areas of Africa. The plants have been traditionally utilized in treatment of jaundice, intestinal worm infection, wounds, malaria, syphilis, epilepsy, dysentery, constipation, diarrhea, hemorrhoid, stomach aches, asthma, and fever [6]. The physicochemical property of the hexane extract of the seed oils shows saponification and iodine values being 194.33 mg KOH/g and 98.09 g/100g respectively [7]. *Hyptis spycigera* is popularly known for its essential oil's contents of extracted from the leaves. However, of recent, a focus on the seeds oil contents has gain researchers' attention. The physicohemical properties and fatty acid profile of *hyptis spycigera* was reported by [8]. Furthermore, the findings revealed that the oil content 71.85% linoleic acid and 16.06% palmitic acid. Different types of sesame (benniseeds) exist with each having different percentage yield, physicochemical properties, saponification and iodine values. In the work of Rani *et al.*, two varieties of sesame (HT-1 and HT-2) were analyzed for their Free fatty acid, Peroxide value, Iodine value, Saponification value, and Unsaponifiable matter. The evaluation revealed Free fatty acids were found to be higher in HT-1 (1.7±0.3) (as %oleic acid). Peroxide value was found to be less in HT-2 (2.5±0.2meq/kg) as compared to HT-1(2.6±0.1meq/kg). Iodine value was higher in HT-2 (117±0.5g/100g) compared to HT-1(111±0.7g/100g). Saponification value was higher in HT-1 (196±0.1 mg/g KOH) as compared to HT-2 [9]. Castor oil is not well suited for small-scale processing and requires extremely thorough processing to make it safe [4]. Vegetable oils are widely used in household cooking, as a component of other meals including baked foods and snacks, and as a raw material for the production of body oils, soap, and detergents [5]. Oil is extracted from crops like maize using solvents that dissolve the oil. Plant cells store oil, which is released when the cells are damaged [6]. The composition of the source material affects the oil extraction process. While palm fruits are processed wet, some seeds are treated dry. This is incredibly nutrient-dense and can be added to other foods or used as animal feed [5].

In addition to being used as food (edible oil), seed oils are typically used as raw materials in the production of biobased polyols, polymers, resins, fuels, soaps and detergents, lubricants, and other products for the chemical industry [7]. Using gas chromatography, the fatty acid composition of fourteen vegetable oils, including safflower, grape, *Silybum marianum*, hemp, sunflower, wheat germ, pumpkin seed, sesame, rice bran, almond, rapeseed, peanut, olive, and coconut oil, was determined (GC). The major fatty acids were discovered to be saturated (SFA), monounsaturated (MUFA), and polyunsaturated (PUFA), also known as palmitic acid (C16:0; 4.6%-20.0%), oleic acid (C18:1; 6.2%-71.1%), and linoleic acid (C18:2; 1.6%-79%), respectively [6]. Linoleic acid (C18:2 Omega-6) was found to be a polyunsaturated (essential) fatty acid, and its concentration ranged from 5.654% in soyabean oil to 9.198% in groundnut oil [8].

Another investigation on four seeds—sesame, soybean, avocado, and jatropha—found that they all contain varying amounts of oils, ranging from 2 to 50%. Hexane was used as the solvent in a soxhlet extractor to extract the oils. The oil content of sesame seeds was 51.34%, while avocado seeds produced the lowest oil content, 2.51% on average. Additionally, avocado seeds had the maximum viscosity, measuring 63.30 mPa.s, whereas jatropha seeds had the lowest value, 52.60 mPa.s. The metrics' values indicate the oils' potential for use in home and industrial settings [7].

Due to its dual roles as a tumor initiator and a tumor promoter, UV radiation is categorized as a "complete carcinogen" since it is both a mutagen and a non-specific harmful agent [9]. UV exposure is the most significant environmental risk factor that can be altered for skin cancer and many other skin conditions that are impacted by the environment [10]. UV has complex and contradictory impacts on human health because it facilitates the skin's own production of vitamin D and endorphins, which is beneficial to human health [11]. However, prolonged exposure to UV radiation poses serious health hazards, such as atrophy, pigmentary changes, wrinkles, and cancer. Basal cell carcinoma, squamous cell carcinoma, and malignant melanoma, the three most prevalent kinds of skin cancer that collectively afflict more than a million Americans each year, are epidemiologically and molecularly connected to UV [12]. The risk of UV-mediated skin illness is also influenced by genetic variables. In particular, melanocortin 1 receptor (MC1R) gene polymorphisms are associated with increased cancer risk, increased UV sensitivity, and fair skin [13].

Interaction of UV irradiation and emulsion of crude oil was reported where crude oil emulsions demonstrated the presence of micelles containing dispersed crude oil in a continuous water phase as well as crude oil components floating on the surface before irradiation. With irradiation, the size of the crude oil micelles shrank, but emulsions kept their high level of polydispersity. More so than visible light, UV radiation affected the stability of emulsions. Other properties that were affected are the pH of emulsions which also dropped and the conductivity raised, acid concentrations and induction of ion production were as well increased as the result of this irradiation [14].

Extra virgin olive oil (EVOO) and canola oil (CO) quality and composition variations with temperature are tested using UV-Vis absorption and fluorescence spectroscopy. The amplitudes of the absorbance and fluorescence signals gradually decreased as the temperature rose, indicating a change in the molecular structures of both types of oils. The primary spectra of pheophytin-a, b, carotenoids, lutein, and vitamin E in EVOO as well as linoleic acid and oleic acid in CO nearly completely disappeared at 200 C, which was a substantial change [15].

During accelerated storage, the effects of UV and X-ray treatments on the oxidative stability of soybean oil were assessed and well documented [9]. Treating the samples with radiation (UV and X-ray) stimulated the oxidation process in soybean oil in comparison with samples that did not receive radiation [9]. Similar work by Golmakani *et al.*, [16], reveals that Neroli oil demonstrated less antioxidant activity, whereas -carotene neither acted as an antioxidant nor a pro-oxidant when added to the soybean and subjected to the same irradiation.

This research is aimed at identifying plants seed with triple action potentials for used in cosmetics, food and pharmaceutical industries. Nine plant's seed; *Balanites aegyptiaca* Del (desert date), *Arachis hypogaea* (red vatal ground nut), *Hyptis spicigera*, *Sesamum radiatum(*Black sesame or benniseed), *Sesamum indicum* (White sesame or benne), *Swietenia macrophylla* (mahogany), *Citrullus lanatus* (watermelon), *Cucumeropsis mannii (big egusi)* and *Cucumeropsis mannii (small egusi)* obtained from Adamawa and Kano States of Nothern Nigeria where subjected to mechanical oil pressing. The scientific parameters of interest in this work includes: the percentage yield which will be calculated using the mathematical formular: $P = \frac{V}{W} X\ 100$, where P is the percentage yield, W is the weight of the seed sample subjected for extraction and V stands for the volume of the oil obtained from the measured seeds sample. The GC/MS analysis will reveal the composition of each sample, the component with possible highest percentage (percentage abundance) will be noted, as this could be related to the biological and UV interactivity properties of the oil sample. The investigations under this study do not include antimicrobial analysis of the samples, however, the UV analysis is aimed at identifying the possibilities for these samples to be used as sunscreen which is well needed by both the melanated and melanin deficient skin in the country to serve as protection from sun scourging effect. The melting and freezing point analysis is a pointer which shows the dominant components of the oils characterized into saturated and unsaturated fatty acids. The findings in this work will encourage further studies on the antimicrobial analysis of the oil samples, study of the Sun protection factor (SPF) of these samples, and cosmeceutical and nutraceutical potentials of these sample will be further encouraged.

2.0 MATERIALS AND METHODS

Plant Material

Freshly harvested seeds were used as sources of oils in this work**.** *Balanites aegyptiaca* Del fruits were obtained from Bagale forest of Girei Local government of Adamawa State. *Citrullus lanatus* seeds were purchased in Jimeta modern market as waste of generated by melon fruits sellers. *Arachis hypogaea*, *Swietenia macrophylla*, *Sesamum radiatum* and *Sesamum indicum*were obtained from band store produce of Pela farms in Hong Local Government Area of Adamawa State. Whereas*, Cucumeropsis mannii* and *Cucumeropsis mannii* were obtained from Mutum biyu farms in Taraba State Nigeria. The materials were transported to the Chemistry Laboratory, National Open University of Nigeria for sample preparations.

2.1 Sampling Preparation of Plant Material

Freshly harvested seeds were used as sources of oils in this work. The *Balanites aegyptiaca* Del fruit dates were soaked in water for 24 hours and hand squeezed to remove the epicarp (skin) and the mesocarp (pulp) after which the kernel which is a hard husk was then cracked with plyer tools to obtained the pyrene, the main seed that bears the oil. I n like manner, the hull of *Arachis hypogaea* was removed by hand cracking followed by soaking the seeds in warm water for 1 hour then dried for 3 days in the Chemistry laboratory. The seeds were then hand squeezed to remove the seed coat then threshed. Other samples were equally processed the same as illustrated above except the sample of *Citrullus lanatus* whose tiny seeds were subjected to mechanical extraction without removing the pericarp. The list of samples, their sources and locations are presented in table 1. After which, all the prepared samples were washed with distilled water, air dried in the Chemistry laboratory National Open University of Nigeria for 2 weeks. 500 g of the samples each were measured using S. Mettler, FA2104 Electronic balance (SHP0200517096 215-08).

Table 1: List of Selected Plants Used in the Study

Identification Number	Scientific Name	Local Name	Family	Part collected	Location
S1	*Balanites aegyptiaca* Del	Adu'a (desert date)	Zygophyllaceae	Fruits	Bagale forest reserve
S2	*Arachis hypogaea*	Gyda (red vatal ground nut)	Leguminosae or Fabaceae	Whole seeds	Pela farms, Hong
S3	*Hyptis spicigera*	Buntsurun pageh (black sesame)	Lamiaceae	Whole seeds	Gongola river bank, Banjiram, Guyuk
S4	*Sesamum radiatum*	Bakin ridi (Black benniseed)	Pedaliaceae	Whole seeds	Pela farms, Hong
S5	*Sesamum indicum*	Farin ridi (white benniseed)	Pedaliaceae	Whole seeds	Pela farms, Hong
S6	*Swietenia macrophylla*	Madachi (mahogany)	Meliaceae	Whole seeds	Hong
S7	*Citrullus lanatus*	Kankana (water melon)	Cucurbitaceae	Whole seeds	Jimeta market
S8	*Cucumeropsis mannii*	Agusi (big egusi melon)	Cucurbitaceae	Whole seeds	Mutum biyu farms
S9	*Cucumeropsis mannii*	Agusi (small egusi melon)	Cucurbitaceae	Whole seeds	Mutum biyu farms

2.2 Oil Extraction

Mechanical pressing was used to extract oils from the samples as described by Lavenburg and colleagues [17], using oil extracting machine; TBVECHI Oil Press Machine, 610W Electric Oil Expeller Stainless Cold Hot Press Squeezer set at maximum 50^{o}C. The duration for extraction varied, depends on the type of seed sample subject for extraction. After the extraction, the oils were spined using centrifuging machine (Searchtech Instrument British Standard 90-2), which was operated at 2000 to 39,000 rpm for 20 minutes. The color, the quantity and the temperature changes of the samples were recorded.

2.3 Gas Chromatography Mass Spectrum Analysis

Gas chromatography/mass spectroscopy was utilized to determine the chemical makeup of the oils [18]. Agilent Gas chromatography (7890A) mass spectrometry (5975C) analysis was carried out on the samples by dilution of 9:1 ratio of dichloromethane to oil respectively. 1µl of the samples was injected into the inlet of the Gas chromatography where it volatilizes into the column of the instrument (Agilent 19091S-433: 469.56509. HP-5MS 5% Phenyl Methyl Silox 325 °C: 30 m x 250 µm x 0.25 µm). The temperature programming was initiated at 80 ˚C for 1 min and then continue increased by 15 ˚C/min to 250 ˚C and hold for 6 min, which makes the total time of run to be 18 minutes. Moreover, 280 ˚C was maintained and split ratio of (1:1) injection was utilized for the oil samples. Also, helium gas of high purity was used as the carrier gas at flow rate of 1 ml/min and pressure of 9.3825 Psi. Finally, the identity, structure and molecular weight of the samples were obtained by the interpretation of mass spectrum using the data base of National Institute Standard and Technology (NIST 2014 and NIST 2011). The constituents of the oils were then identified base on comparison of the retention indices and mass spectra of existing compounds whose data is available in NBS75K and NIST08 Libraries.

2.4 Freezing and Melting Point Temperature Determination

The physical state of the oils was determined using freeze dryer set at -60 ^{o}C at atmospheric pressure. 5 mL each of the oil samples was placed in a plastic beaker and lowered into the cooling chamber of the freeze dryer and allowed to solidify for 15 minutes. Immediately after solidification, the sample is brought out of the cooling chamber and the thermometer bulb of the freeze dyer is inserted in to the sample and the stable temperature (temperature that is observed for few second without increase or decrease when the thermometer is in constant with solid or liquid phase of the oil sample) of the liquid layer of the sample is taken for its melting temperature while the stable temperature of the lower solid part of the sample is taken as the freezing temperature.

2.5 UV Spectrophotometer Analysis

The UV analysis was conducted using GZ spectrophotometer UV-754 ARI. The prepared samples were scanned at wavelength between 200 to 420 nm which is considered as the range for UVB to UVA. The wavelength is increase at 10 nm interval.

FTIR Analysis

The FTIR analysis was performed using Agilent Cary 360 FTIR Spectroscopy, which was used to detect the characteristic peaks and their functional groups using Attenuated Total Reflectance (ATR) accessory. The IR scan was performed in the wave number region of 4000- 550 cm^{-1}. The FTIR technique was adopted in order to identify functional groups with characteristic of oils and other organic compounds. In this work, FTIR was used to validate the efficacy of the mechanical extraction method adopted in this work. Where there are functional groups other than what is expected from oil components, the extraction is said to be inefficient.

3.0 RESULTS

3.1 Percentage Oil Yield, Freezing and Melting Temperature of Studied Oil Samples

The results of the analysis are of the percentage yield which shows the amounts of oils per 100 weighs of the oil source, are presented in table 2 below. The compositional analysis using GC/MS, the functional group analysis using FT-IR and the measurement of the UV absorptivity of the various oils. Result in Table 1 reveals that *Sesamum indicum* (White sesame or benne seeds), *Arachis hypogaea* (red vatal ground nut) and *Balanites aegyptiaca* Del (desert date) had the highest percentage yield of 36.869%, 29.454% and 28.478% respectively. Whereas, *Sesamum radiatum (*Black sesame or benniseed; 23.937) and *Swietenia macrophylla* (mahogany; 20.951%) had intermediate percentage yield while *Citrullus lanatus* (watermelon) recorded the least percentage yield of 4.126%. These oils were tested for their change in state it was discovered that, *Citrullus lanatus* and *Hyptis spicigera* have the lowest freezing point of -17.4 and -15.7 °C and melting point of 9.5 and 8.1 °C respectively. *Swietenia macrophylla* (mahogany) has the highest freezing and melting temperature of 14.3 and 25.5 °C respectively. Looking at these findings, it is clear that *Sesamum indicum, Arachis hypogaea and Balanites aegyptiaca* Del which have high percentage yields can serve as sources of oils for use in cosmetics and food industries. From the melting and freezing points results, it shows that all the oils subjected to test are liquid under room temperature, indicate that there is substantial quantity of unsaturated fatty acid in their constituents.

Table 2: Percentage Yields and the Effect of Temperature on the Physical Appearance of the Sample Oils

S/N	Sample	Seeds Sample Weigh (g)	Oil Quantity Volume (ml)	Percentage Yield (%V/W)	Freezing (°C)	Melting Temperature
1	*Balanites aegyptiaca* Del (desert date)	235.2	67.2	28.4	2.6	7.0
2	*Arachis hypogaea* (red vatal ground nut)	110.3	32.5	29.4	1.9	6.3
3	*Hyptis spicigera*	272.4	20.4	7.4	-15.7	8.1
4	*Sesamum radiatum(*Black sesame or benniseed)	221.7	53.0	23.9	0.8	6.8
5	*Sesamum indicum* (White sesame or benne)	216.9	80.2	36.8	2.0	5.6
6	*Swietenia macrophylla* (mahogany)	105.0	22.0	20.9	14.3	25.5
7	*Citrullus lanatus* (watermelon)	557.4	23.2	4.1	-17.4	9.5
8	*Cucumeropsis mannii (big egusi)*	1168.7	80	6.8	3.2	6.0
9	*Cucumeropsis mannii (small egusi)*	1,321.8	111.4	8.4	1.5	10.9

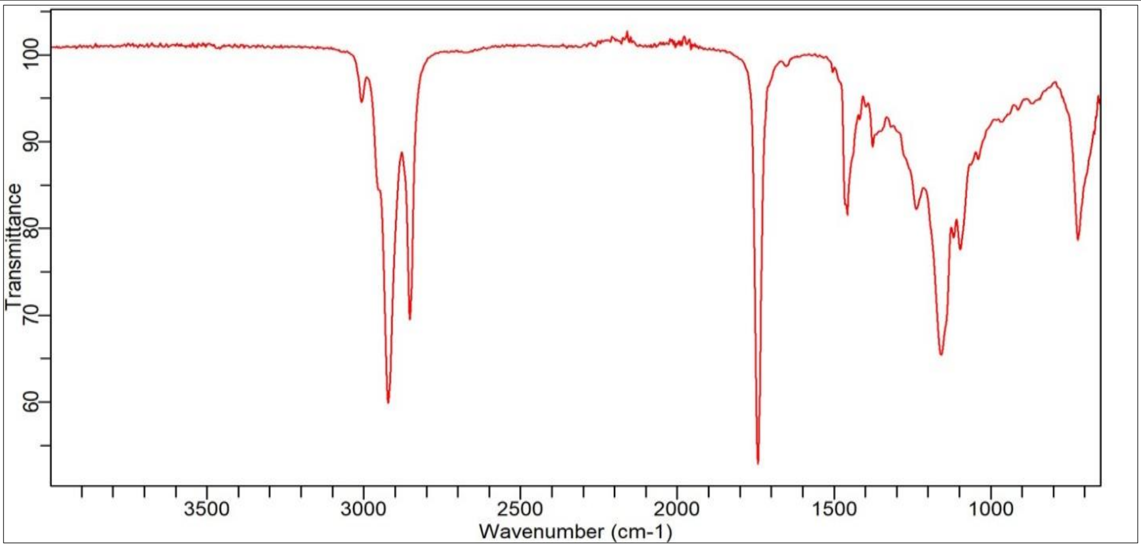

Figure 1: FTIR Spectrum of *Sesamum radiatum (*Black sesame or benniseed) seeds Oil

Table 3: FTIR Spectroscopy Result for *Sesamum radiatum (*Black sesame or benniseed) seeds Oil

Peak Number	Wavenumber (cm-1)	Intensity	Functional froup
1	721.23987	0.51660	C-H group
2	868.46972	0.83198	C-H group
3	913.19777	0.81660	OH group
4	967.24417	0.78999	C-O-C group
5	1039.92726	0.70271	C-O-C group
6	1097.70099	0.49606	C-H group
7	1157.33840	0.25278	
8	1237.47616	0.58829	C-O group
9	1377.25133	0.73234	CH3CH2 bonding of alkane
10	1459.25276	0.58219	Phenolic group
11	1653.07433	0.91710	C=C group
12	1742.53044	0.00000	C=O group
13	2853.27711	0.33337	C-H grouping
14	2922.23286	0.14098	C-H group
15	3007.96163	0.83485	C-H group

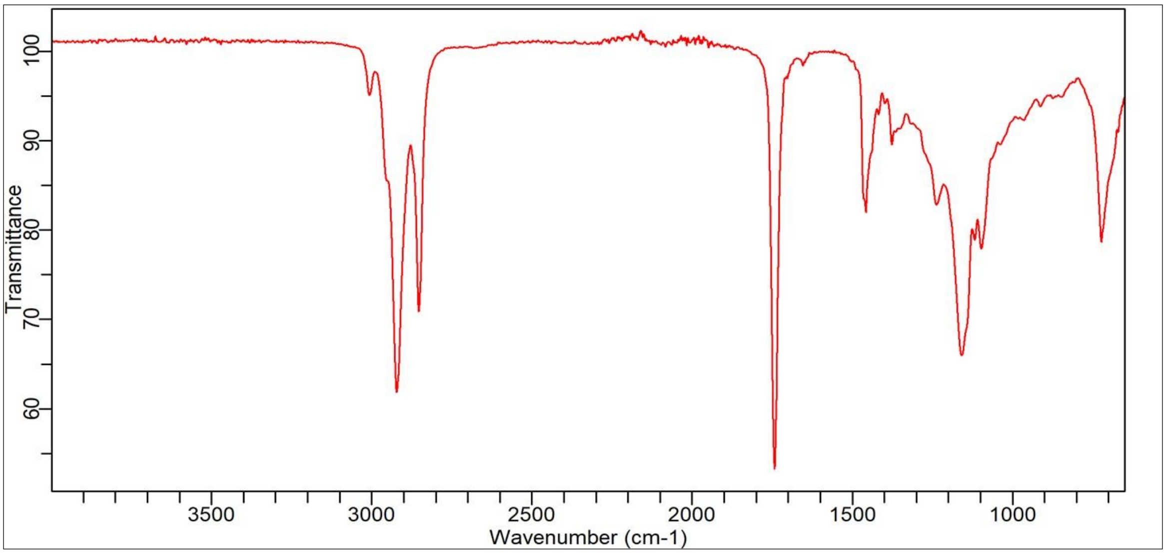

Figure 2: FTIR Spectrum of *Sesamum indicum* (White sesame or benne) seeds Oil

Table 4: Result of FTIR Spectroscopy of *Sesamum indicum* (White sesame or benne) seeds Oil

Peak Number	Wavenumber (cm-1)	Intensity	Functional group
1	721.23987	0.51794	C-H group
2	1038.06359	0.74031	C-O-C Group
3	1097.70099	0.50261	C-O-C Group
4	1120.06502	0.52436	C-O-C Group
5	1159.20207	0.25954	C-O Stretch
6	1237.47616	0.60278	C-O stretch
7	1377.25133	0.74050	OH bend
8	1459.25276	0.59195	Phenol ring
9	1742.53044	0.00000	C=O Stretch
10	2853.27711	0.35994	Methyl group
11	2922.23286	0.17603	Methyl group
12	3007.96163	0.85333	OH stretch

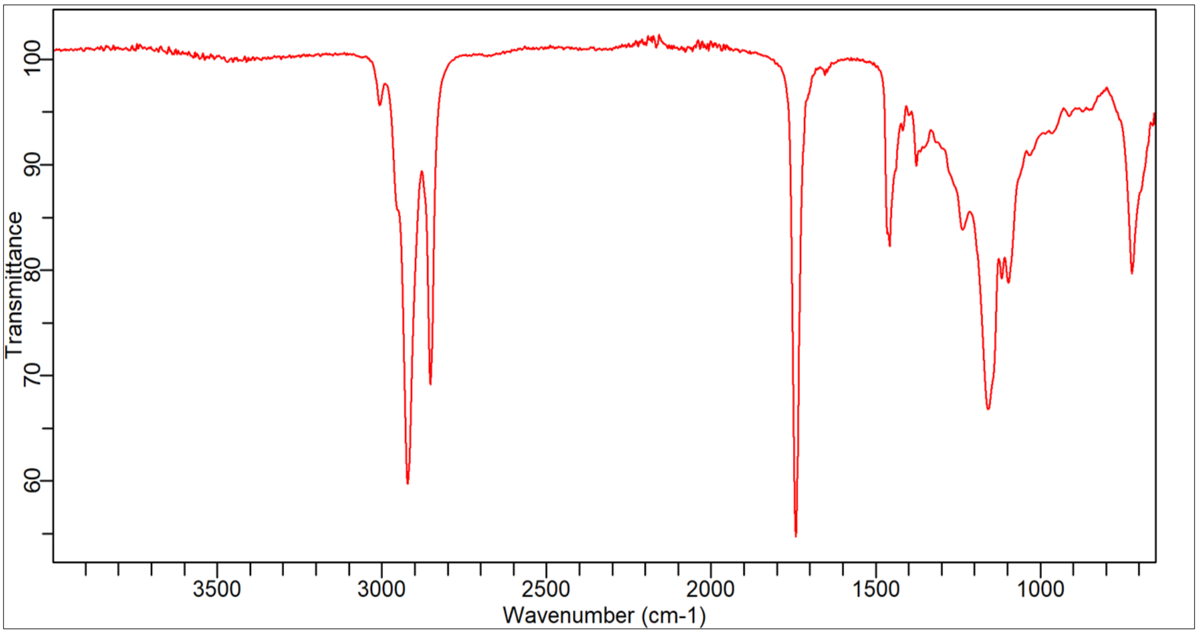

Figure 4: FTIR Spectrum of *Arachis hypogaea* (Red Vatal ground nut) Oil

Table 5: Result of FTIR Spectroscopy of *Arachis hypogaea* (Red Vatal ground nut) Oil

Peak Number	Wavenumber (cm-1)	Intensity	Functional group
1	721.23987	0.52351	C-H group
2	1030.60891	0.75955	C-O-C group
3	1097.70099	0.50656	C-O-C group
4	1118.20135	0.51394	C-O-C group
5	1157.33840	0.25424	C-O-C group
6	1235.61249	0.61042	C-O group
7	1377.25133	0.73856	C-O group
8	1459.25276	0.58227	Phenol ring
9	1654.93800	0.91799	C=O group
10	1742.53044	0.00000	C=C group
11	2853.27711	0.30815	OH group
12	2920.36920	0.10591	Methyl group
13	3006.09797	0.85866	OH group

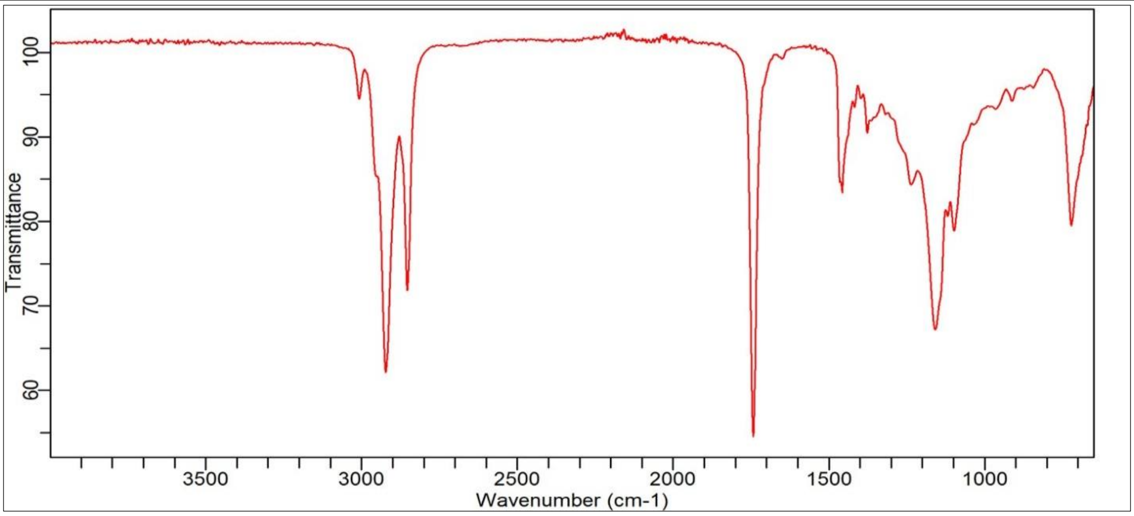

Figure 5: FTIR Spectrum of *Cucumeropsis mannii* (big egusi) Seed Oil

Table 6: Result of FTIR Spectroscopy of *Cucumeropsis mannii* (big egusi) Seed Oil

Peak Number	Wavenumber (cm-1)	Intensity	Functional group
1	721.23987	0.51705	C-H group
2	844.24202	0.85563	C-H group
3	913.19777	0.82347	OH group
4	965.38050	0.80327	C-O-C group
5	1097.70099	0.50516	C-O-C group
6	1159.20207	0.26310	C-N group
7	1235.61249	0.61793	C-O group
8	1377.25133	0.74557	C-O group
9	1395.88802	0.83050	OH group
10	1459.25276	0.60803	Phenol ring
11	1742.53044	0.00000	C=O group
12	2853.27711	0.35827	Methyl group
13	2922.23286	0.15793	Methyl group
14	3007.96163	0.82917	OH group

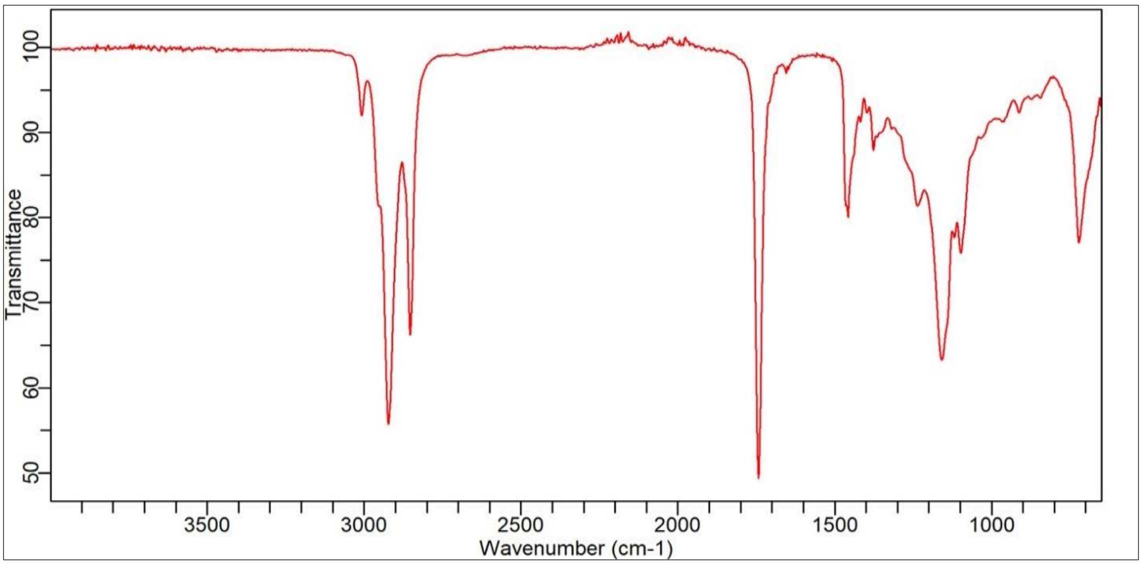

Figure 6: FTIR Spectrum of *Cucumeropsis mannii* (small egusi) Seed Oil

Table 7: Result of FTIR Spectroscopy of *Cucumeropsis mannii* (small egusi) Seed Oil

Peak Number	Wavenumber (cm-1)	Intensity	Functional group
1	721.23987	0.52749	C-H group
2	913.19777	0.81857	OH group
3	1097.70099	0.50451	C-O-C group
4	1159.20207	0.26554	C-N group
5	1235.61249	0.60967	C-O group
6	1377.25133	0.73393	C-O group
7	1459.25276	0.59059	Phenolic group
8	1742.53044	0.00000	C=O group
9	2853.27711	0.32104	Methyl group
10	2922.23286	0.12119	Methyl group
11	3007.96163	0.81233	OH group

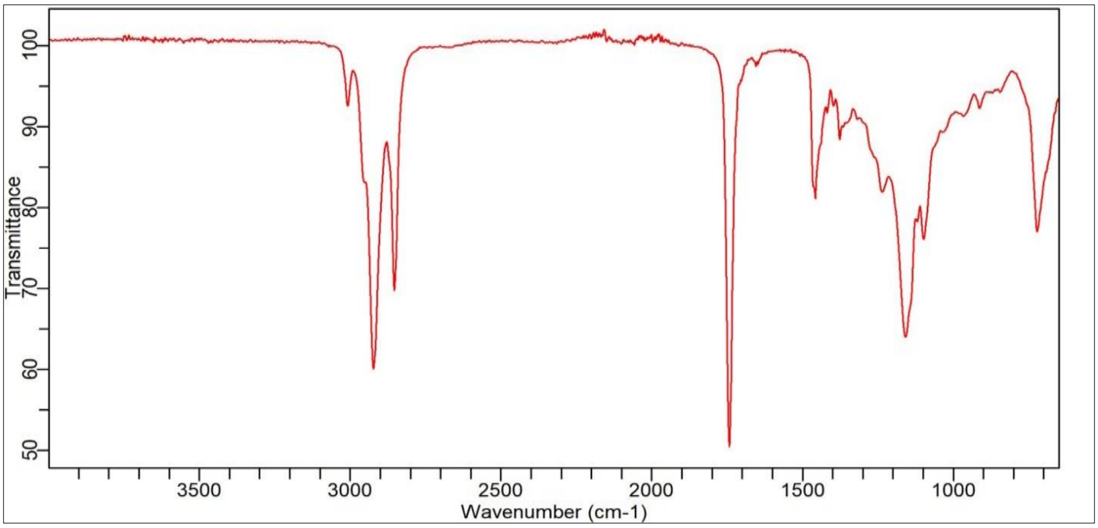

Figure 9: FTIR Spectrum of *Citrullus lanatus* (watermelon) Seed Oil

Table 8: Result of FTIR Spectroscopy of *Citrullus lanatus* (watermelon) Seed Oil

Peak Number	Wavenumber (cm-1)	Intensity	Functional group
1	721.23987	0.51551	C-H group
2	913.19777	0.81055	O-H bend
3	965.38050	0.79185	C-O-C group
4	1097.70099	0.49655	C-O group
5	1159.20207	0.26439	C-N group
6	1235.61249	0.61055	C-O Stretch
7	1319.47759	0.78378	C-O Stretch
8	1377.25133	0.73732	C-O group
9	1395.88802	0.81696	O-H Bend
10	1459.25276	0.60059	-C-H group
11	1654.93800	0.91100	C=C group
12	1742.53044	0.00000	C=O group
13	1910.26064	0.96016	
14	2853.27711	0.37499	Methyl group
15	2922.23286	0.18700	Methyl group
16	3009.82530	0.81786	OH group

The result of the FTIR for *Sesamum radiatum (*Black sesame) (Table 2) shows that carbon to hydrogen bond stretching was detected at 721.23987, 868.46972 and 3007.96163 CM^{-1} with medium to high intensity of 0.5 to 0.8 and a low intensity of 0.4 carbon to hydrogen bond stretching with wavelength 1097.70099. Other peaks that appeared at the fingerprint region are Ether groups (967.24417 and 1039.92726 CM^{-1}), alkane bonding at 1377.25133^{-1}, carbonyl group at 1237.47616^{-1} and a phenolic group at 1459.25276 CM^{-1}. Beyond the fingerprint region, the highest intensity (0.91710) peak was detected at 1653.07433 CM^{-1} which correlated to C==C unsaturated alkene.

Unlike it's like specie, *Sesamum indicum* (White sesame or benne) (Table 3) has ether groups at 1038.06359, 1097.70099 and 1120.06502 with high and medium intensity. Other peaks that appeared within the fingerprint region are 721.23987 (C-H stretch) 1159.20207 (O-H stretch), 1237.47616, 1377.25133 (C-O stretch) and 1459.25276 (phenolic group). Beyond the fingerprint region are 1742.53044 (C=O) with low intensity, two methyl groups peaks corresponding with 2853. 27711 and 2922.23286 CM^{-1} while another peak was detected at 3007.96163 corresponding to O-H group.

The fingerprint region of the spectrum for *Arachis hypogaea* show the presence of predominantly ether groups stretch at peaks of 1030.60891, 1097.70099, 1118.20135 and 1157.33840CM^{-1} with different intensities as shown in table 4 above. Other peaks represent C-H group at 721.23987 CM^{-1}, C-O groups with peaks at 1235.61249 and 1377.25133 CM^{-1}, while another peak (1459.25276 CM^{-1}) still within the fingerprint region represent phenolic ring. Beyond the fingerprint region, Carbonyl groups, hydroxyl and methyl functional groups were detected at peaks of 1654.93800, 1742.53044, 2853.27711, 2920.36920 and 3006.09797 respectively.

From the result of *Cucumeropsis mannii* (table 5) also known as Egusi by the locals in Nigeria, the fingerprint has a mixture of C-H groups *(*721.23987 and 844.24202CM^{-1}*)*, hydroxyl group *(*913.19777, 1395.88802 and 3007.96163 CM^{-1}*)*, ether groups having two peaks at 965.38050 and 1097.70099 CM^{-1}, C-O group appearing at two positions of 1235.61249 CM^{-1} and 1377.25133 CM^{-1}, while methyl groups were detected at 2853.27711 and 2922.23286 CM^{-1}. however, N-H functional group from protein was detected at 1159.20207 CM^{-1}.

Like its specie discussed above, the small egusi seed oil (table 6), has a mixture of functional groups at the fingerprint region. However, N-H group from protein was also detected at the peak of 1159.20207 CM^{-1} and another hydroxyl group peak appeared at 913.19777 CM^{-1}. There is a disappearance of one C-H group which was seen at the group at 844.24202 CM^{-1} of the Big Egusi spectroscopy and a total reduction of the functional groups to 11 in the Small Egusi seeds oils when compared to the Big Egusi seed which has a total 14 functional groups.

From the result of the FTIR for water melon seed oil (table 7), the finger print is dominated by C-O group at peaks 965.38050, 1097.70099, 1235.61249 and 1319.47759 CM^{-1}. Other peaks show the presence of hydroxyl group, ether, C-N and methyl groups at 721.23987, 913.19777, 1159.20207, 1395.88802 and 1459.25276 CM^{-1} respectively. Beyond the fingerprint region are two methyl groups (2853.27711 and 2922.23286), a hydroxyl group (3009.82530) and an unknown functional group which appeared at 1910.26064 CM^{-1} which bears the highest intensity.

Other researchers have also reported the peaks at 1670-1820 for C=O vibration of carbonyl group, 1050-1150CM^{-1} C-O vibration of alcohol and 3500 -0 3700 CM^{-1} O-H strong vibration from alcohol while 1670-1820CM-1 corresponds with C=O vibration from carbonyl group (Pongpiachan, 2014). In addition to the above-mentioned groups, 1080-1360CM^{-1} was attributed to C-N from protein and 1584.24CM^{-1} for phenolic group (Lingegowda *et al.*, 2013).

General constituents of vegetable seeds are protein, carbohydrate and oils in varying quantities (Zhang *et al.*, 2017). Using mechanical and temperature regulated extraction, it is critical to be certain that the oil extracted are void of protein, carbohydrate and other non-oil constituent in the extract. FTIR was deployed in this work to identify the presence of functional groups reflecting these major constituents of the seeds. From our findings, *Cucumeropsis mannii* (big egusi) Seed Oil, *Cucumeropsis mannii* (small egusi) Seed Oil and *Citrullus lanatus* (watermelon) Seed Oil have C-N stretch at 1159.20207 and of similar intensity(concentration) of 0.26310, 0.26554 and 0.26439 respectively. This finding also revealed that the seeds of Cucumeropsis species (Small and Big Egusi) and *Citrullus lanatus* have tresses of non-oil components (impurities) which may require to be refined while the *Sesamum* species and *Arachis hypogaea* show high degree of purity in their oil constituents.

3.2 GC-MS Analysis of the Sample Oils

The Gas chromatography and Mass spectra obtained from the analysis of the various samples are presented in Figure 1. The results of the GC/MS of the white sesame (Table 2) shows the present of 14 compounds with 9,12-Octadecadinoic acid an unsaturated fatty acid as the lead compound which has relative area percentage of 76.85 %. Other compounds that have considerable area percentage are Gamma-Tocopherol (7.71 %), Octadecane, 1-(ethenyloxy)- (4.80 %) and cis-Vaccenic acid (2.37 %). The oil sample composition has a mixture of aldehyde, esters, saturated and unsaturated fatty acids.

The oil sample of *Sesamum radiatum* sample (Table 3) revealed the presence of 8 compounds with 9,17-Octadecadienal, (Z)- having 40.71 being the lead compound. Following the lead compound is 9,12-Octadecadienoic acid (Z,Z)- which has slightly lower area percentage of 36.97 %. Other compounds with significant percentage are 11-Octadecenoic acid, methyl ester, (Z)- (11.37 %), 2-Heptadecenal (3.42%) and 15-Octadecenoic acid, methyl ester (3.00%). These results show that in spite of the oil being a mix compound, two compounds have significantly high concentration.

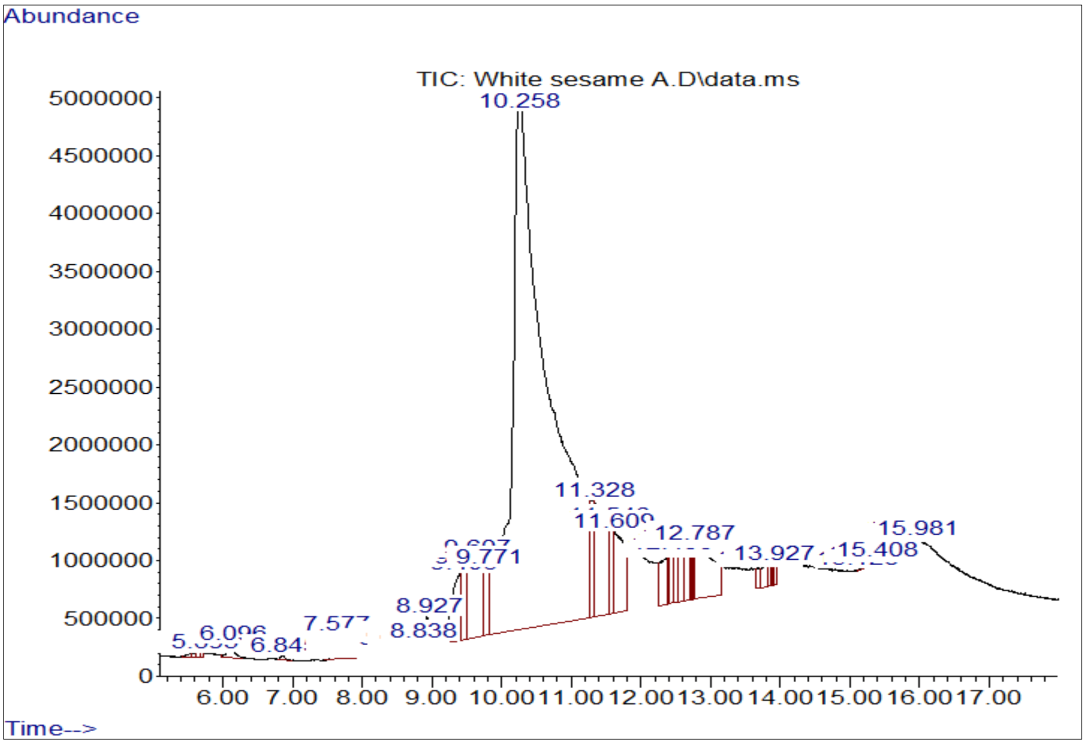

Figure 1: GC Spectrum of *Sesamum indicum* (White sesame or benne) Seed Oil

Table 9: GC/MS Result of *Sesamum indicum* (White sesame or benne) Seed Oil

S/N	**Compound**	**Area %**
1	1-Undecene, 8-methyl-	0.06
2	Hexadecanoic acid, methyl ester	0.21
4	2-Heptadecenal	0.01
5	Cyclopropaneoctanal, 2-octyl-	0.16
6	cis-Vaccenic acid	2.37
7	n-Hexadecanoic acid	1.44
8	Oleic Acid	4.80
9	Octadecane, 1-(ethenyloxy)-	1.36
10	9,12-Octadecadienoic acid (Z,Z)-	76.85
11	9,17-Octadecadienal, (Z)-	1.16
13	gamma.-Tocopherol	7.71
14	1-Naphthalenol, decahydro-4a-methyl	

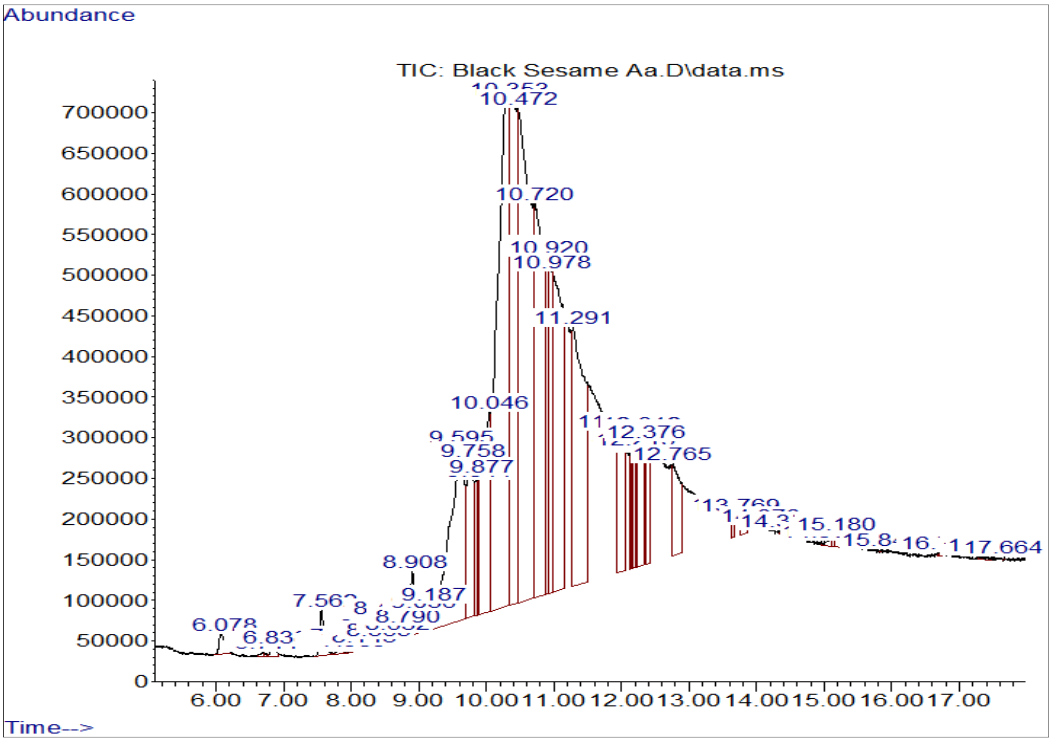

Figure 2: GC Spectrum of Seamum radiatum (Black sesame or benniseed) Seed Oil

Table 10: GC/MS Result of *Sesamum radiatum (*Black sesame or benniseed) Seed Oil

S/N	COMPOUNDS	% area
1	Hentriacontane	0.56
2	Heptadecanoic acid, 16-methyl-,methyl ester	0.41
3	Cetene	0.97
4	11-Octadecenoic acid, methyl ester,(Z)-	11.37
5	15-Octadecenoic acid, methyl ester	3.00
6	9,17-Octadecadienal, (Z)-	40.71
7	9,12-Octadecadienoic acid (Z,Z)-	36.97
8	2-Heptadecenal	3.42

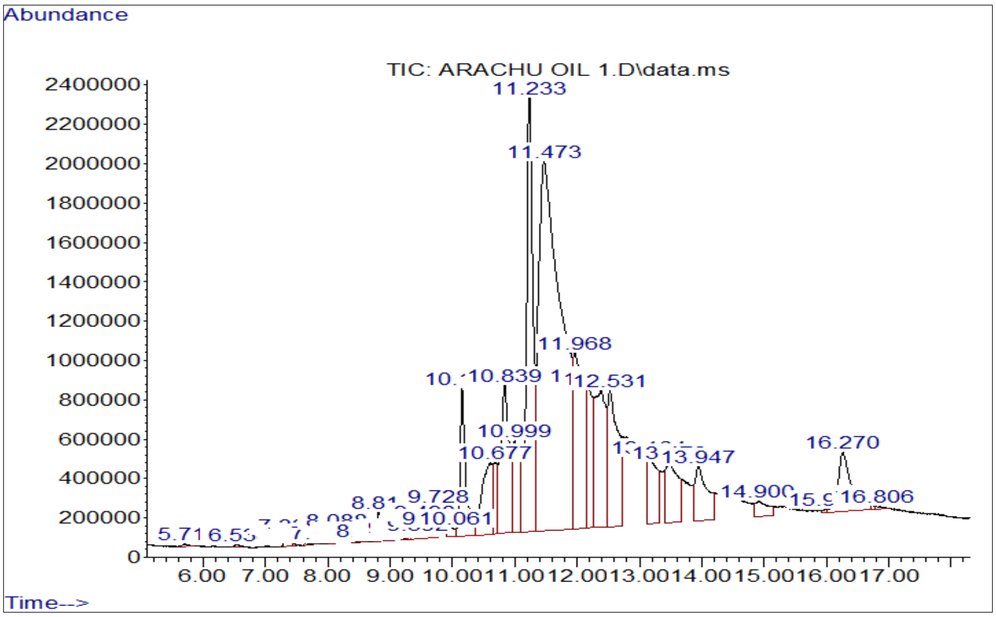

Figure 3: GC Spectrum of *Arachis hypogaea* (Red Vatal ground nut) Seed Oils

Table 11: GC/MS Result of *Arachis hypogaea* (red vatal ground nut) Seed Oil

S/N	COMPOUND	% area
1	10-Methylnonadecane	0.54
2	Tetradecane	0.57
3	Pentadecane	0.31
4	o-Terphenyl	0.13
5	Hexadecanoic acid, methyl ester	0.92
7	Cyclohexadecane	0.23
8	Octadecanoic acid, ethyl ester	3.33
9	n-Hexadecanoic acid	4.24
10	cis-13-Octadecenoic acid, methyl ester	5.16
11	Methyl stearate	2.43
12	Ethyl Oleate	12.00
13	9,12-Octadecadienoic acid (Z,Z)-	44.46
14	Z,E-3,13-Octadecadien-1-ol	3.80
15	12-Methyl-E,E-2,13-octadecadien-1-ol	5.98
16	3-Eicosene, (E)-	11.99
17	Squalene	3.27

The GC/MS analysis of the sample *Arachis hypogaea* (red vatal ground nut) (Table 4) seed oil revealed the presence of 17 compounds. Several compounds have concentration with significant important such as 9,12-Octadecadienoic acid (Z,Z)-(44.46), Ethyl Oleate (12.00%), 12-Methyl-E,E-2,13-octadecadien-1-ol and cis-13-Octadecenoic acid, methyl ester both have percentage concentration of 5.98% and 5.16% respectively.

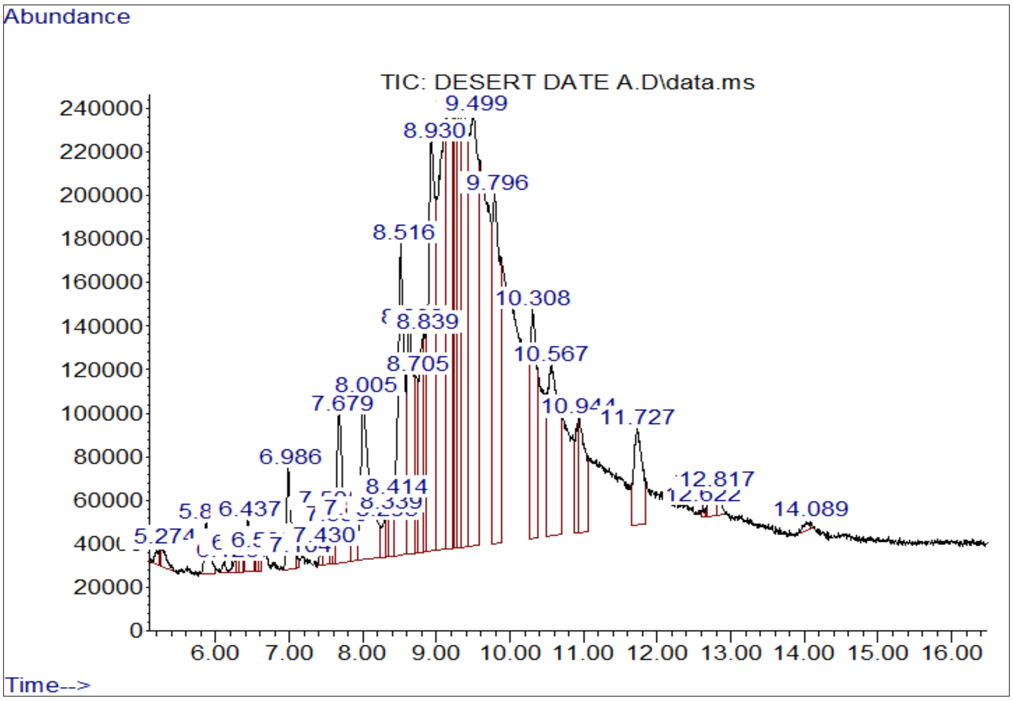

Figure 4: GCMS Spectrum of *Balanites aegyptiaca* Del (desert date) Seed Oil

Table 12: GC/MS Result *Balanites aegyptiaca* Del (desert date) Seed Oil

S/N	COMPOUND	% area
1	2,6-Dimethyldecane	0.73
2	10-Methylnonadecane	1.29
3	Cyclopentadecane	0.20
4	1,8-Nonadien-3-ol	0.23
5	Hexadecanoic acid, methyl ester	2.89
6	Xanthumin	0.56

S/N	COMPOUND	% area
7	Tetradecane	3.90
8	1-Dodecanol, 2-octyl-	1.54
9	1-Dodecanol, 2-hexyl-	0.35
10	17-Pentatriacontene	2.07
11	13-Octadecenal, (Z)-	5.82
12	Heptadecanoic acid, 16-methyl-, methyl ester	3.60
13	tert-Hexadecanethiol	3.59
14	1-Tridecene	8.23
15	9,12-Octadecadienoic acid (Z,Z)-	12.67
16	12-Methyl-E,E-2,13-octadecadien-1-	4.09
17	9,17-Octadecadienal, (Z)-	25.06
18	3-Eicosene, (E)-	11.89
19	1-Decanol, 2-hexyl-	4.15
20	Heptadecanoic acid, heptadecyl ester	2.26
21	1Decanol, 2-octyl-	2.20

Total of 21 compounds were identified in the sample *Balanites aegyptiaca* Del (desert date) Seed Oil as seen in Table 5. The lead compound being 9, 17-Octadecadienal, (Z)- has percentage concentration of 25.06% followed by 9,12-Octadecadienoic acid (Z,Z)- (12.67 %). Other compounds are 3-Eicosene, (E) - (11.89%), 13-Octadecenal, (Z)- (5.82%), 1-Decanol, 2-hexyl- (4.15) and 12-Methyl-E, E-2,13-octadecadien-1- (4.00). the oil sample has a mixture of saturated and unsaturated fatty acid, esters, and ether compounds. Therefore, it is reasonable that FTIR result of this sample showing multiple functional group.

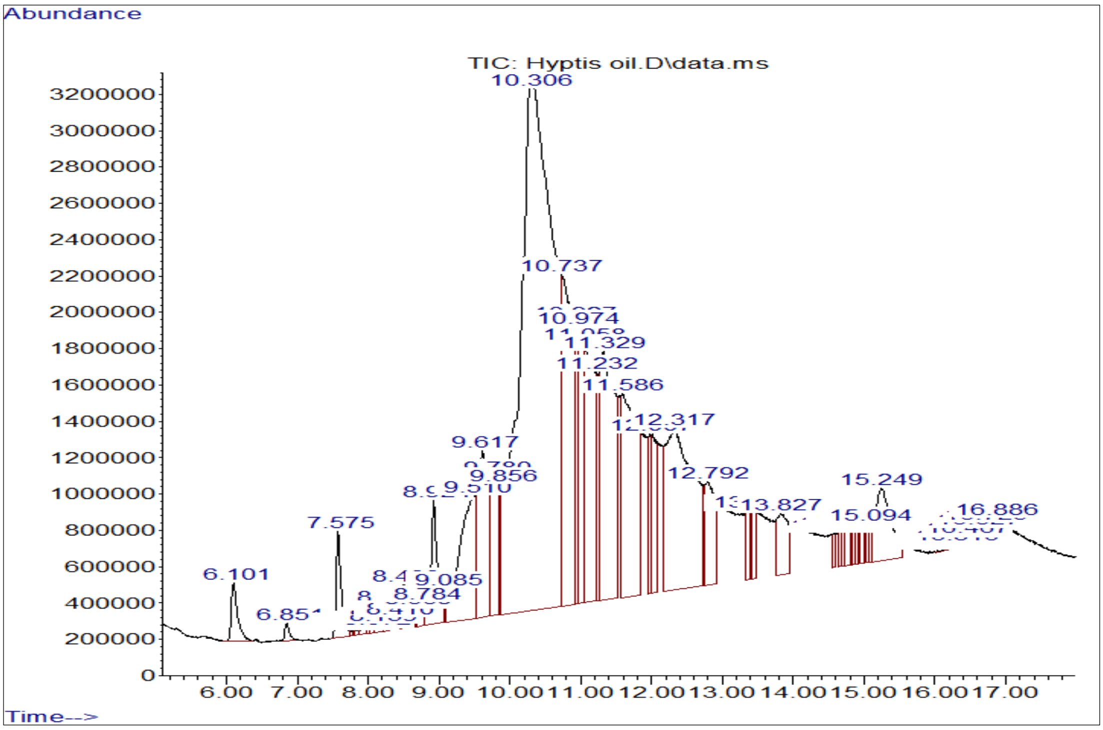

Figure 5: GC Spectrum of *Hyptis spicigera* Seed Oil

Table 13: GC/MS Results of *Hyptis spicigera* Seed Oil

S/N	COMPOUND	% area
1	Hexadecane	2.46
2	Hentriacontane	1.07
3	n-Hexadecanoic acid	3.85
4	cis-Vaccenic acid	3.48
5	Cyclohexane, 1-(1,5-dimethylhexyl)-4-(4-methylpentyl)-	1.77
7	Oleic Acid	0.51

S/N	COMPOUND	% area
8	9,12-Octadecadienoic acid (Z,Z)-	47.13
9	cis-11,14-Eicosadienoic acid, methyl ester	4.95
10	2-Methyl-Z,Z-3,13-octadecadienol	27.08
11	Cyclopropaneoctanal, 2-octyl-	0.50
12	Squalene	2.28

The Gas chromatography spectrum of the *Hyptis spicigera* Seed Oil sample is presented in Figure 5. The Mass spectrometry as shown in Table 6 reveals the presence of 12 compounds leading by 9,12-Octadecadienoic acid (Z,Z)- (47.13 %) and followed by 2-Methyl-Z,Z-3,13-octadecadienol (27.08%). Other compounds of significant concentration are cis-11,14-Eicosadienoic acid, methyl ester (4.95%), n-Hexadecanoic acid (3.85%) and cis-Vaccenic acid (3.48%). The oil sample has in significant concentration cis-Vaccenic acid which has antimicrobial effect. Other functional groups identified by the FTIR analysis were also revealed by the GC/MS.

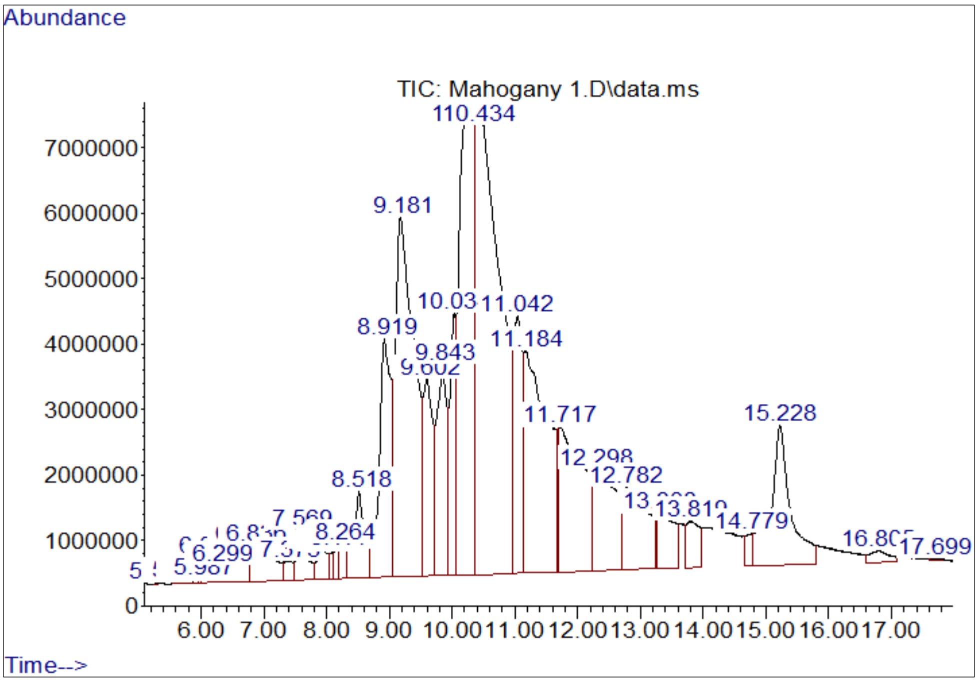

Figure 6: GC Spectrum of *Swietenia macrophylla* (mahogany) Seed Oil

Table 14: GC/MS Result of *Swietenia macrophylla* (mahogany) Seed Oil

S/N	COMPOUND	% area
1	Hexadecane	0.28
2	Decane, 3,8-dimethyl-	0.27
3	Dodecanoic acid	2.62
4	Dodecane, 2-methyl-6-propyl-	0.79
5	Pentadecanoic acid	0.56
7	Tetradecanoic acid	0.65
8	Dodecanoic acid, ethyl ester	1.69
9	n-Hexadecanoic acid	26.11
10	trans-13-Octadecenoic acid	11.45
11	cis-Vaccenic acid	24.30
12	9-Octadecenoic acid (Z)-, 2-hydroxy-1-(hydroxymethyl)ethyl ester	8.98
13	Oleic Acid	9.03
14	6-Octadecenoic acid, (Z)-	1.06
15	2-Methyl-Z,Z-3,13-octadecadienol	0.41
16	Squalene	5.00

The Gas chromatography spectrum of the *Swietenia macrophylla* (mahogany) Seed Oil Sample is presented in Figure 6. The Mass spectrum of this sample displayed in Table 7 reveals the presence of 16 compounds with n-Hexadecanoic acid (26.11%) being the lead compound slightly higher than cis-Vaccenic acid (24.30%). Other compounds are trans-13-Octadecenoic acid (11.45%), 9-Octadecenoic acid (Z)-, 2-hydroxy-1-(hydroxymethyl) ethyl ester (8.98), Oleic Acid (9.03) and Squalene (5.00%). The constituents of this sample have biological important being essential oils.

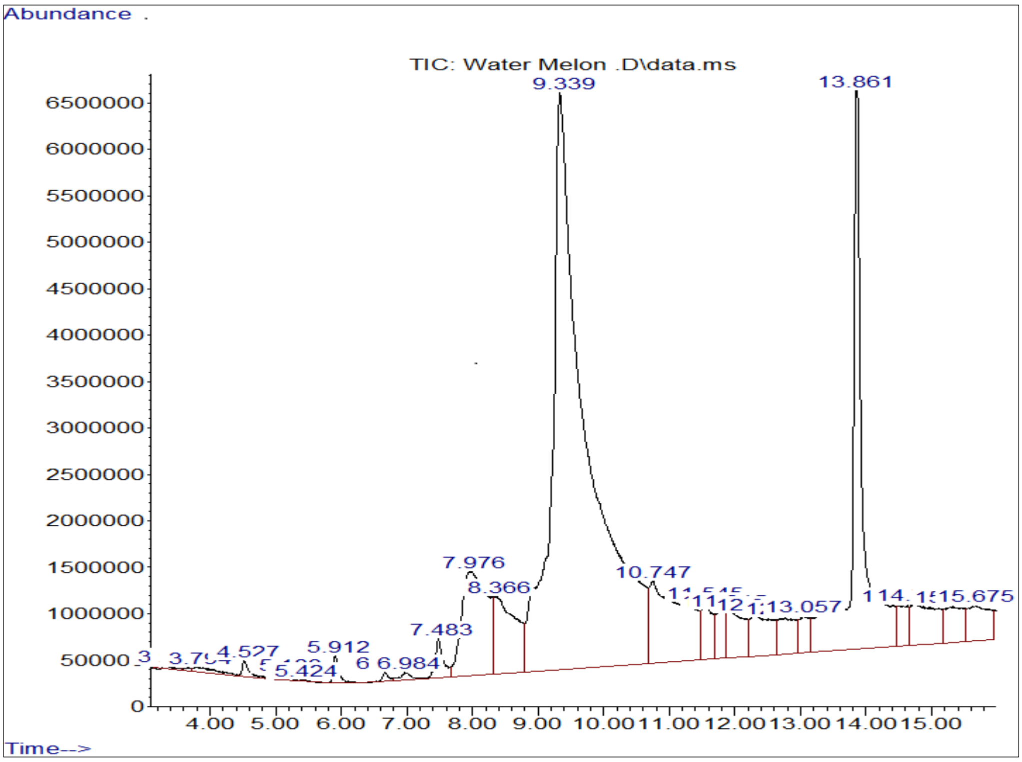

Figure 7: GC Spectrum of *Citrullus lanatus* (watermelon) Seed Oil

Table 15: GCMS Result of *Citrullus lanatus* (watermelon) Seed Oil

S/N	COMPOUNDS	% AREA
1	n-Hexadecanoic acid	10.64
2	9,12-Octadecadienoic acid (Z,Z)-	64.88
3	Squalene	14.94
4	2-Methyl-Z,Z-3,13-octadecadienol	1.09
5	Cyclopropaneoctanal, 2-octyl-	2.63
6	9,12-Octadecadienoyl chloride, (Z,z)	1.62
7	2-Methyl-Z,Z-3,13-octadecadienol	1.90

The Gas chromatography spectrum of *Citrullus lanatus* (watermelon) Seed Oil is presented in Figure 7. The Mass spectrometry analysis of the sample shows the presence of 7 compounds with 9,12-Octadecadienoic acid (Z,Z)- having 67.88% being the lead compound. Other compounds are triterpenoid Squalene (14.94%), n-Hexadecanoic acid (10.64%) and Cyclopropaneoctanal, 2-octyl- (2.63%).

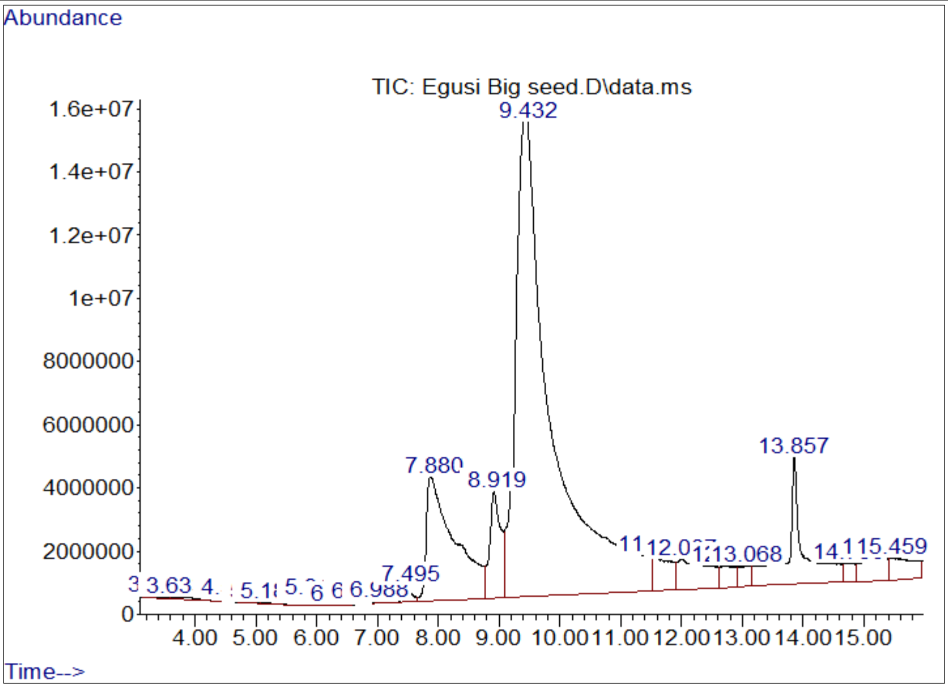

Figure 8: GC Spectrum *Cucumeropsis mannii (*small egusi*)* Seed Oil

Table 16: GC/MS Result of *Cucumeropsis mannii (*small egusi) Seed Oil

S/N	COMPOUNDS	% AREA
1	n-Hexadecanoic acid	12.57
2	Linoleic acid ethyl ester	4.21
3	9,12-Octadecadienoic acid (Z,Z)-	72.45
4	Squalene	7.65
5	2-Methyl-Z,Z-3,13-octadecadienol	2.07

The Gas chromatography of *Cucumeropsis mannii (*big egusi) Seed Oil is presented in Figure 8 while the Mass spectrum in Table 9) shows the presence of 5 compounds with 9,12-Octadecadienoic acid (Z,Z)- (72.45%) being the lead compound. Other compounds are n-Hexadecanoic acid (12.57) and triterpenoid Squalene (7.65%). The compounds identified in this sample have their functional group earlier presented in the FTIR result Table 5.

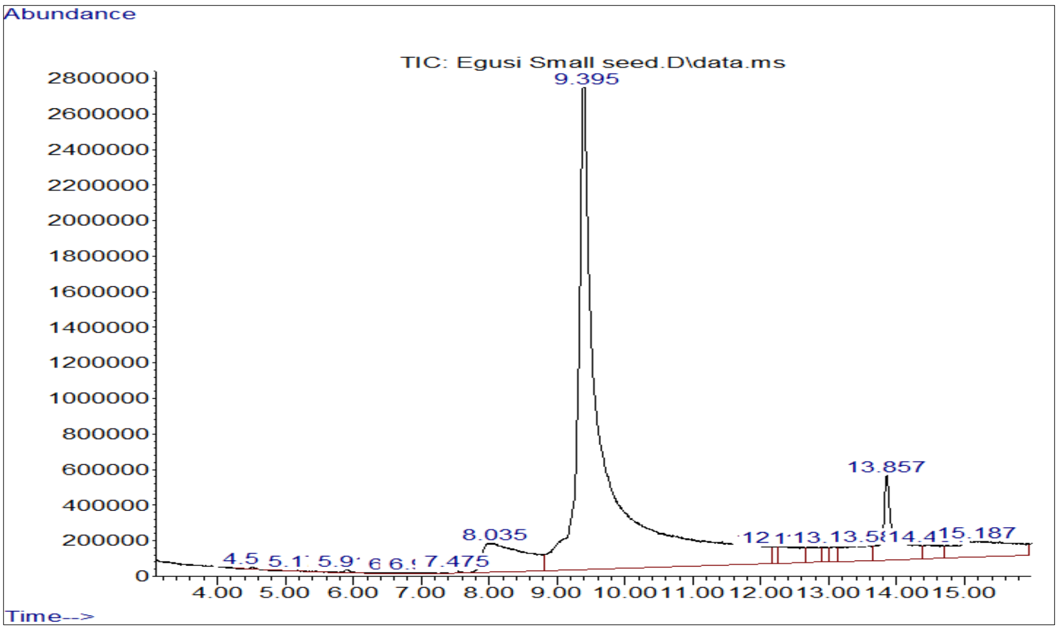

Figure 9: GC/MS Spectrum *Cucumeropsis mannii* (big egusi) Seed Oil

Table 17: GC/MS Result of *Cucumeropsis mannii (big egusi)* Seed Oil

S/N	COMPOUNDS	% AREA
1	n-Hexadecanoic acid	7.31
2	9,12-Octadecadienoic acid (Z,Z)-	80.07
3	Squalene	6.20
4	2-Methyl-Z,Z-3,13-octadecadienol	5.90

In figure 9, the Gas spectrum of *Cucumeropsis mannii (big egusi)* Seed Oil is presented with 9,12-Octadecadienoic acid (Z,Z)- (80.07) being the lead compound. Other compounds are n-Hexadecanoic acid (7.13%), Squalene (6.20%) and 2-Methyl-Z,Z-3,13-octadecadienol (5.90%). The seed of Big Egusi and the Small Egusi are differentiated from each other base on their sizes. However, in this work, it has been shown that the big egusi has higher percentage concentration of 9,12-Octadecadienoic acid (Z,Z)- (80.07) compare to 72.45% presence in small egusi. The number of compounds in small egusi are higher (5) compare to 4 compounds found in big egusi.

Table 18: UV Interactivity of Various Oil Samples

Wavelength λ(nm)	ABSORBANCE								
	Water melon	**Egusi small**	**Egusi Big**	**Hyptis oil**	**Desert date**	**Black sesame**	**White sesame**	**Mahogany**	**Arachis oil**
200	1.810	1.806	1.802	1.812	1.810	1.838	1.808	1.809	1.808
210	1.843	1.835	1.846	1.841	1.829	1.851	1.858	1.845	1.851
220	1.850	1.839	1.840	1.855	1.845	1.850	1.843	1.852	1.849
230	1.988	1.982	1.983	1.987	1.984	1.989	1.985	1.987	1.988
240	1.856	1.846	1.854	1.859	1.858	1.861	1.852	1.869	1.864
250	1.704	1.701	1.703	1.703	1.704	1.770	1.708	1.706	1.707
260	1.717	1.712	1.711	1.720	1.717	1.719	1.717	1.714	1.718
270	1.692	1.692	1.689	1.689	1.689	1.696	1.692	1.699	1.701
280	1.534	1.541	1.541	1.537	1.539	1.536	1.534	1.529	1.556
290	1.451	1.448	1.448	1.452	1.451	1.454	1.451	1.453	1.451
300	1.476	1.468	1.471	1.473	1.475	1.475	1.470	1.473	1.473
310	1.522	1.520	1.522	1.523	1.526	1.522	1.520	1.523	1.514
320	1.394	1.444	1.423	1.449	1.436	1.451	1.460	1.402	1.247
330	1.318	1.314	1.310	1.317	1.303	1.317	1.321	1.317	1.073
340	1.111	1.107	1.102	1.112	1.086	1.109	1.107	1.192	0.865
350	1.131	1.126	1.106	1.132	1.669	1.132	1.128	1.131	0.772
360	1.131	1.117	1.065	1.131	1.036	1.137	1.121	1.136	0.652
370	1.051	0.988	0.933	1.026	0.968	1.031	1.049	1.028	0.519
380	1.523	1.090	1.013	1.436	1.251	1.405	1.299	1.368	0.493
390	1.604	0.900	0.882	1.598	1.400	1.560	1.362	1.604	0.439
400	1.718	0.741	0.765	1.702	1.565	1.668	1.383	1.711	0.402
410	1.780	0.618	0.688	1.756	1.655	1.727	1.378	1.783	0.408
420	1.801	0.535	0.635	1.736	1.733	1.717	1.311	1.804	0.403

Table 18 is the result of the absorbance by various oil samples exposed to Ultra violet radiation set at the range of 200 to 420 nm (UVA, UVB, UVC and UV visible). The result above show that all the oil samples contain certain compounds capable of absorbing UV radiation within the said ranges of wavelength. However, the amount of radiation absorbed changes with change in wavelength. At the UVC region (200 to 290 nm), the samples absorbance is within the value of 1.8 at wavelength of 200 to 220 nm, a shoot in the absorbance was recorded (1.9) at 230 nm in all the samples. This increase happens to be the highest throughout the experimental period. A sudden decline of absorption (1.8) was recorded after the wavelength was increase to 240nm and eventually the decline in absorbance continued to the extreme end of the UVC radiation wavelength of 290 nm which all the samples had relative absorbance of 1.4.

At the beginning of the UVB radiation wavelength of 290 nm and 300 nm, the absorbance was still 1.4, but this value changed to 1.5 when the wavelength was increased to 310. Afterwards, the absorbance by the oil samples decreased to 1.4 at extreme end of the UVB wavelength 320 nm except for samples of *Citrullus lanatus* (watermelon) and *Arachis hypogaea* (red vatal ground nut) which have 1.394 and 1.247 respectively. At the UVA region (320 to 400 nm), *Arachis hypogaea* recorded lowest value of 1.073 to 0.402 at wavelength range of 330 to 400 nm. An average value of 1.7 was recorded in three oil samples; *Citrullus lanatus*, *Hyptis spicigera oil* and *Swietenia macrophylla* (mahogany). Beyond the UVA is the UV Visible*, at this wavelength of 400 to 420 it was observed that 3 oil samples; Arachis hypogaea* (red vatal ground nut), *Cucumeropsis mannii* (big egusi melon) and *Cucumeropsis mannii* (small egusi melon) *have the lowest value for absorbance of* 0.403, 0.635 and 0.535 respectively.

4.0 DISCUSSIONS

In this work, non-volatile oils were extracted from rare oil containing seeds such as the two species of egusi melon (*Cucumeropsis mannii*), *Citrullus lanatus*, *Hyptis spicigera oil*, *Swietenia macrophylla* (mahogany) and *Balanites aegyptiaca* Del (desert date). The percentage of the oil yields for *Swietenia macrophylla* (mahogany) and *Balanites aegyptiaca* Del, 28.478 and 20.951 respectively are comparable with the yield of some known sources of cooking oils such as groundnut and sesame seeds which yielded 29.454 and 36.869 %. This shows that these plants can be good alternative sources of commercial vegetable oils which can take care of current shortage of raw materials require by industries. Solvent extraction is widely employed by researcher for extraction of non-volatile and essential oils with advantage of having increased percentage yield. The technique adopted in this research shows that the challenges associated with solvent extraction such as recovery of the pure oil, tendency of hydrolysis of triglyceride to diglyceride and fatty acids especially when hot water is used for solvent extraction and presence of other dissolved materials which might be difficult to separate from the oils by mechanical separation and many more challenges are averted in this technique. Evidently, the oils obtained have essentially different appearances, melting and freezing temperature and void of contaminations as revealed by the GC/MS results. Lower freezing point indicates the presence of unsaturated fatty acids in the oil sample. Unsaturated fatty acid are associated with health benefits like improve blood cholesterol levels, ease inflammation, and stabilize heart rhythms [19]. In normal alkane, radiation can course polymerization of short chain alkanes. When unsaturated fatty acids are expose to radiation depends on the radiation quantity, the molecule gets excited and may form gel with other molecules of the fatty acids. This effect can be harnessed by cosmetic industries in order to complement the function of melanin toward absorbing UV radiation by the sun. This work has revealed that all the oils subjected to this test are liquid far below room temperature with *Hyptis spicigera* and *Citrullus lanatus* (watermelon) having the lowest at -15.7 and -17.4 ^{o}C respectively. As such, the oils have the potentials to be used as agent of sun filters protection. In addition, the oils being rich in unsaturated fatty acids may posses this finding indicates that these oils have several health benefits as mention above.

FTIR analysis was also utilized and the purpose was not to determine the constituents of the oil samples rather, the main purpose for the FTIR analysis in the work is to validate the efficacy of the method of extraction of the oils from their sources using the regulated temperature Mechanical pressing. Presence of C-N group in *Cucumeropsis mannii* (big egusi) Seed Oil, *Cucumeropsis mannii* (small egusi) Seed Oil, *Balanites aegyptiaca* Del (desert date) Seed Oil and *Citrullus lanatus* (watermelon) Seed Oil shows that there are traces of residual protein in the oil. As such, other suitable methods other than the mechanical method should be explored.

The GC/MS results shows that 9,12-Octadecadienoic acid (Z,Z) - is the most predominant constituents in all the oil samples. These compounds were reported by other scholars to have antimicrobial, antioxidant, hepatoprotective, and hypocholesterolemia as well as cancer preventive activities [20].

The GC/MS analysis of Sesamum indicum (White sesame or benne) Seed Oil shows that the sample contains Gama tocopherol and this compound is the most biologically active form of vitamin E [21]. Therefore, this oil can be channel for use in cosmetics and food industries owing to its ability to trap lipophilic electrophiles and reactive oxygen and nitrogen species.

9,17-Octadecadienal, (Z)- is the second most abundant constituents in *Balanites aegyptiaca* Del (desert date) *Sesamum radiatum (*Black sesame or benniseed) oils which account for 25.06 and 40.71 % respectively of the total constituent of each oil sample. Therefore, any biological and physicochemical property exhibited by these oils should be attributed to the synergy effects of the most abundant constituent (9, 12-Octadecadienoic acid (Z,Z)-) and the second most abundant (9,17-Octadecadienal, (Z)-). Oils that contain significant amount of 9,17-Octadecadienal, (Z)- possess certain degree of antioxidant and antimicrobial activities [22, 23].

Oils extracted from the seeds of Sesamum indicum (White sesame or benne) and *Swietenia macrophylla* (mahogany) Seed Oil contain a rare component; cis-Vaccenic acid of significant constituent's amounting to 2.317 and 24.30 respectively which was discovered in this work. Vaccenic acid ((11*E*)-11-octadecenoic acid) is commonly found in milk, rumen fat and the

Orbitofrontal cortex of humans [24]. The trans-fatty acid has anticancer effect when converted to rumenic acid. Application of the oils obtain from *Swietenia macrophylla* (mahogany) in the management of measles by the locals, can be attributed to high content of Vaccenic acid. Other health benefit of this fatty acid includes reduction of blood cholesterol, low density lipoprotein and triglycerides. Oxidation of this fatty acid on the skin will lead to unpleasant smell of an old man. Although, many scholars have reported that this oil is found in animal and humans, its presence in plant seeds such as *Sesamum indicum* (White sesame or benne) and *Swietenia macrophylla* (mahogany) cannot be explain in this work hence further studies to validate this finding is recommended. Furthermore, this work has validated the claim by locals on the application of *Swietenia macrophylla* (mahogany) oils in management of measles.

Squalene is found in *Arachis hypogaea* (red vatal ground nut (3.27 %), *Hyptis spicigera* Seed Oil (2.28 %), *Swietenia macrophylla* (mahogany) (5.00%), *Citrullus lanatus* (watermelon) (14.94), *Cucumeropsis mannii (*big egusi) Seed Oil (7.65) and *Cucumeropsis mannii (big egusi)* (6.20). The triterpene is reported to have the ability to convey oxygen in the human system like hemoglobin in addition to its anticancer, antitumor activities [25]. The quantity of squalene is relatively high in *Citrullus lanatus* (watermelon) (14.94%), this indicate that the oil obtained from the seeds of water melon can be channeled for use in the above health applications.

The numerous types of wavelengths that make up solar radiation have various skin-related impacts. Through the production of reactive oxygen species (ROS), inflammation, and elevation of the energy state of organic molecules, UV radiation (UVA and UVB) has cutaneous biological effects that range from photoaging and immunosuppression to melanoma formation, while visible light is responsible for producing ROS, pigmentation, cytokine production, and matrix metallopeptidases [26]. In this work, UV interactivity with the sample oils was report and the result discussed. The highest absorbance of 1.9 was recorded at the UVC region (230nm). UVC is not a major concern since it is absorbed by the ozone layer but, for the depletion of this natural covering it has become critical to search for more substances that can provide protection against the UVC radiation. On the other hand, all the samples showed a good absorbance for UVB from 1.4 to 1.5. Direct DNA absorption of UVB results in molecular rearrangements that give rise to particular photoproducts, like cyclobutane dimers and 6-4 photoproducts [27]. The findings in this work shows all the oil samples have the ability to protect the epidermis from the UVB radiation and consequently preserving the DNA.

Longer wavelength UVA reaches well into the dermis after penetrating the epidermis. This effectively produces reactive oxygen species that can harm DNA through unintentional photosensitizing reactions [28]. From the result obtained oils of *Citrullus lanatus*, *Hyptis spicigera* and *Swietenia macrophylla* (mahogany) have presented good ability to absorb radiation at UVA regions and hence they are good choice for formulating sunscreen.

5.0 CONCLUSION

Nine plant seeds were subjected to mechanical extraction where each yielded different quantity of oils specific to the type of the plant seed. From the percentage yield results, *Balanites aegyptiaca* Del (desert date), *Arachis hypogaea* (red vatal ground nut), *Sesamum radiatum (*Black sesame or benniseed), *Sesamum indicum* (White sesame or benne) and *Swietenia macrophylla* (mahogany) can be good sources of raw material for commercial quantity of oil production which are require in cosmetic, pharmaceutical and food industries. The freezing and melting points findings show that all the oil samples are liquid at room temperature which indicate that unsaturated fatty acids are the major constituents of these oils. The GC/MS results shows that all the samples contain mixture of different compounds in their compositions and were analyzed by GC/MS technique. In addition, the GC/MS results confirmed that the major constituents of the oils are unsaturated fatty acids. The UV interactivity of the sample oils demonstrates that these sample can be harnessed in formulating UV protective creams (sunscreens) with high Sun Protection Factor (SPF) especially the oils extracted from *Citrullus lanatus*, *Hyptis spicigera* and *Swietenia macrophylla* (mahogany) seeds. This work has revealed various novelties which includes; application of freezdryer in determination of melting and freezing temperature of oils, extraction of oils from rare seeds species (*Balanites aegyptiaca* Del, *Hyptis spicigera*, *Swietenia macrophylla* and *Citrullus lanatus*) using temperature regulated mechanical extractor. The claims by local for oral ingestion and topical application of the oils of *Swietenia macrophylla* in children infected by measles has been validated and the active compound identified in this work. This research has created a gap to be filled by other researchers on the formulation of organic sunscreen using the sample oils as active ingredients. More work is required to isolate vaccenic acids from *Swietenia macrophylla* seeds and testing same on Measles morbillivirus, the virus that causes measles.

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