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Analysis of White Sesame (Sesamum indicum L..) seeds and oil: Properties and Composition

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Abstract

Sesame (Sesamum indicum L.) is an ancient oilseed valued for its nutritional richness and diverse applications; yet comprehensive studies, especially on Nigerian cultivars remain limited. This study provides a holistic characterization of white sesame seeds and oil from Kwali Area Council, Abuja, using standard methods to determine proximate composition, mineral content, physicochemical properties, antioxidant activity, phytochemical constituents, fatty acid profile, and spectroscopic fingerprints (UV–Vis and FTIR. Proximate analysis revealed notable protein (6.63% w/w) and lipid (46.8% w/w) contents, alongside high levels of calcium (9.11 mg/g) and magnesium (1.37 mg/g), with appreciable zinc and iron. Fatty acid profiling indicated a predominance of vaccenic acid (67.5% w/w) and palmitic acid (6.12% w/w). The oil exhibited favorable physicochemical properties (iodine value: 191.6 wij; acid value: 3.37 mgKOH/g; viscosity: 88.5 mPa·s; smoke point: 190°C), supporting its suitability for culinary and industrial applications. Strong antioxidant activity (IC50: 7.42 mg/ml) and the presence of diverse bioactive compounds—including saponins, alkaloids, phenols, glycosides, steroids, terpenoids, sterols, and volatile oils—underscore its functional significance. Spectral fingerprints (UV–Vis λmax at 344 nm; FTIR peaks at 404–721 cm^{-1} and 2361 cm^{-1}) further validate quality assessment. Collectively, these findings emphasize the nutritional and functional value of sesame seeds and oil, suggesting promising applications in food science, nutrition, and healthcare. Future studies should explore processing optimization and integration into functional foods and nutraceuticals.

Keywords: Bioactive compounds, Fatty acid composition, Functional foods, Physicochemical properties, Sesamum indicum L, Spectroscopic analysis

1. Introduction

Sesame (*Sesamum indicum* L.), a member of the family Pedaliaceae, is among the oldest cultivated oilseeds crops, with a history of use spanning more than 3,000 years (Pathak et al., 2014; Ram et al., 1990; Siddik et al., 2016; Wei et al., 2022). Originating from India, sesame has become a global agricultural staple due to its adaptability to diverse environments, drought tolerance, and high oil content (Zohary & Hopf, 2000). The seeds are typically creamy-white, small, and pear-shaped, valued for their nutty flavor and nutritional richness. Beyond culinary applications, sesame provides multiple byproducts of economic importance. Sesame oil meal serves as a protein-rich livestock feed, while the leaves, rich in mucilage, have traditional medicinal uses (Bedigian, 2013). Despite its long history and versatility, sesame cultivation faces challenges such as capsule dehiscence, which leads to seeds loss during harvest (Langham, 1949). Efforts to address this include breeding dehiscence-resistant varieties and developing mechanical harvesting techniques (Ram et al., 1990; Oplinger & Putnam, 2011). Although sesame is widely consumed and recognized for its nutritional and health-promoting properties, comprehensive studies on its nutritional composition, phytochemical constituents, and industrial applications remain limited, particularly for Nigerian cultivars. This study aims to provide a holistic characterization of *Sesamum indicum* seeds from Kwali Area Council, Federal Capital Territory, Nigeria, focusing on proximate composition, physicochemical properties, phytochemical constituents, fatty acid profiles, and spectroscopic characteristics.

2. Literature review

Sesame seeds are recognized for their balanced nutritional composition, containing proteins, lipids, carbohydrates, and dietary fiber. Studies from Bangladesh and the Republic of Congo reported lipid contents comparable to Nigerian cultivars, while carbohydrate levels varied significantly (Siddik et al., 2016; Oboulbiga et al., 2023). Such differences highlight the influence of environmental and genetic factors on nutrient composition (Getinet & Sharma, 1996). Sesame seeds are rich in essential minerals such as calcium, magnesium, zinc, and iron, which contribute to bone health, enzyme activation, and antioxidant defense. Regional variations in mineral concentrations have been documented, underscoring the importance of localized analyses to assess dietary contributions (Wei et al., 2022). Sesame oil is valued for its stability, high iodine value, and favorable saponification characteristics. Studies conducted in Saudi Arabia, Brazil, and the Republic of Congo reported physicochemical properties consistent with high-quality vegetable oils suitable for culinary and industrial applications (Oboulbiga et al., 2023; Bhatnagar et al., 2009). These properties also support its use in cosmetics and soap production (Nkwor et al., 2021).

Sesame oil contains diverse bioactive compounds, including saponins, alkaloids, phenols, glycosides, steroids, terpenoids, and phytosterols, which contribute to its antioxidant and therapeutic potential (Ghorase et al., 2022; Oboulbiga et al., 2023). Antioxidant assays, such as DPPH radical scavenging, have confirmed its ability to mitigate oxidative stress, suggesting applications in food preservation and nutraceutical development (Lima et al., 2021). Spectroscopic techniques (UV–Vis and FTIR) have been widely used to characterize sesame oil, revealing absorption peaks associated with unsaturated fatty acids and functional groups (Smith, 2018; Vogt et al., 2023). Fatty acid profiling typically identifies linoleic and oleic acids as dominant components (Siddik et al., 2016; Wei et al., 2022). However, recent studies have reported variations, including the presence of vaccenic acid, which may reflect cultivar-specific differences (Yoo et al., 2024).

3. Materials and methods

3.1. Sample collection and preparation

White sesame (*Sesamum indicum* L.) seeds were obtained from a local market in Kwali Area Council, Federal Capital Territory, Abuja, Nigeria. seeds were cleaned, sorted, blended using an electric blender, and stored in clean polythene bags until analysis.

3.2. Proximate analysis of *Sesamum indicum* seeds

The seeds underwent proximate composition analysis, including moisture content, ash, crude protein, crude fat, crude fiber, and carbohydrates. The moisture, crude lipid, and crude fiber contents were determined following Udo and Oguwele (1986), ash content was determined following James (James, 1995), Crude protein was determined using the micro-Kjeldahl method described by AOC (AOC, 1990), and the total proportion of carbohydrates was determined following James (James, 1995).

3.3. Elemental analysis of *Sesamum indicum* seeds

The seeds sample (1g) was digested with 10 mL of HNO_3 on a hot plate, filtered into a 100 mL volumetric flask made up to mark, and analyzed using a Thermos Scientific iCE 3000 series spectrometer. The spectrometer results were converted from mg/L to mg/kg of seeds using the equation.

$$\text{Concentration} = \left(\frac{C_s - C_b}{m}\right) \times 100 \qquad 1$$

Where m is the mass (g) of the seeds sample digested, C_s and C_b are the concentrations (mg/L) of the seeds sample and blank, respectively.

3.4. Extraction of *Sesamum indicum* seeds oil

The blended seeds sample (60g) was placed in a cellulose thimble (Macherey-Nagel, Germany) and extracted in a 200 mL Soxhlet apparatus with 400 mL of n-hexane for 9 hours (at 6 cycles/h). The extracted n-hexane was evaporated using a vacuum rotary evaporator, and the remaining n-hexane in the oil was dried in a fume cupboard and weighed. The yield of the extract was expressed as a percentage of the weight of the extract obtained after extraction relative to the weight of the dry seeds used for extraction, as described in Equation 2.

$$\text{Yield\% (\%)} = \frac{\text{Weight of oil g)}}{\text{weight of seed 9g)}} \times 100 \qquad 2$$

3.5. Determination of physicochemical properties of *Sesamum indicum seeds oil*

The properties of the extracted oil, including density, refractive index, iodine value, peroxide value, acidity, and saponification value, were determined according to AOAC (1990) methods. The oil's viscosity was measured using an ND-5S viscometer with a size 2 spindle at 30 revolutions per minute. Smoke and melting points were determined using a mercury-in-glass and infrared thermometer (KM-JT1600, Kaemeasu, Japan) by heating 25ml of the oil in a beaker covered with aluminum foil on a hot plate until it started boiling. The oil's ability to allow the passage of light rays was observed against an electric bulb, and its color was determined by comparing it with a color chart. Density determination was carried out using a 25 mL density bottle.

3.6. Determination of antioxidant properties of *Sesamum indicum* seeds oil

The DPPH (1, 1-diphenyl-2-picryl hydrazyl) method was used to assess the antioxidant activity of the oil extract. A stock of the oil was prepared by dissolving 200mg of the oil in 220 ml of ethanol to give a 10mg/ml concentration. Serial dilutions were prepared to obtain concentrations of 10, 5, 2.5, 1.25, and 0.625 mg/ml. 3 mL of each oil concentration was mixed with 1 mL of DPPH (40µg/ml) in triplicate. The mixture was allowed to stand in a dark cupboard for 20 minutes, and the absorbance (As) was measured at 517nm using 6850 UV-visible spectrometer (JENWAY, UK). The percentage inhibition of the various oil concentrations was calculated using the following equation:

$$\%\ \text{Inhibition} = \frac{Ao - As}{Ao} \times 100 \qquad 3$$

Where Ao is the absorbance of the blank. The IC_{50} value was calculated from the linear regression plot of the antioxidant activity against the oil concentration (C), represented by the equation:

$$\%\ \text{Inhibition} = mC \pm I \qquad 4$$

Where m and I are the slope and intercept, respectively, of the plot.

3.7. Qualitative phytochemical screening of *Sesamum indicum* seeds oil

Qualitative tests were performed following Adedunni et al. (2016) to detect the presence or absence of various phytochemical compounds, such as alkaloids, flavonoids, tannins, saponins, steroids, glycosides, phenols, terpenoids, volatile oils, sterols, phlobatannins, and resin.

3.8. Fatty acid profiling of *Sesamum indicum* seeds oil

The fatty acid profile of the oil was determined through a series of chemical processes. Initially, 400mg of the oil was mixed with 4 ml of 0.5M methanolic KOH for saponification. The mixture was heated at boiling point under reflux for 15 minutes, followed by the addition of 1.6 ml of methanolic HCl (HCl: MeOH, 4:1) and further heating for 25 minutes. After cooling, 8 ml of deionized water was added and mixed. The fatty acid methyl esters (FAMES) were then extracted using a total of 15 ml of n-hexane in three stages. The n-hexane extract was dried using Sodium sulfate and used for GC-MS analysis. The GC-MS analysis was performed on an Agilent GCMSD system (Agilent Technologies, USA) fitted with an HP-5ms Ultra Inert column (30 m x 250 µm x 0.25 µm), and helium was used as the carrier gas at an average speed of 31.147 cm/sec. The oven temperature was initially set at 40 °C for 2 minutes, then ramped up to 180 °C at a rate of 15 °C/min, then slowly increased to 205 °C at a rate of 3 °C/min, and finally ramped up to 300 °C at a rate of 8 °C/min, where it was held for 7 minutes. A 2 µL sample was injected in a split mode (split ratio 5:1) at a temperature of 250 °C. The FAMEs were identified by comparing their retention times with those of FAME standards. The MS analysis was carried out in SIM/Scan mode with a mass range from 46 to 600 amu and a dwell time of 100 ms for 18 specific ions. The data acquisition was managed by the Agilent MassHunter software.

3.9. Spectrophotometric characterization of *Sesamum indicum* seeds oil

Thermoscientific Nicolet iS5 FT-IR (Thermo Fisher Scientific, USA) equipped with iD7 ATR accessory was used to analyze, in neat mode, the molecular structure and functional groups present in *Sesamum indicum* seeds oil. UV-Vis spectrometry was also performed on the oil (with and without solvent) using 6850 UV/Vis. Spectrophotometer (JENWAY, UK) with a scan range of 190.0-1100.0nm, scan step of 1.0nm, and scan filter of 10. The resulting spectrum was recorded as a plot of absorbance against wavelength and then re-plotted for analysis.

4. Data analysis

Quantitative experiments were conducted in triplicate, except for elemental composition, which was analyzed in duplicate. Results from triplicate measurements are expressed as mean values ± standard deviation, while duplicate measurements are reported as mean values. This approach ensured accuracy and reproducibility across all analyses. Statistical treatment and graphical representations were performed using Microsoft Excel (Microsoft Corporation, USA).

5. Results and discussion

5.1. Proximate composition of *Sesamum indicum* seeds

The proximate composition analysis of *Sesamum indicum* seeds (presented in Table 1) revealed a well-balanced nutritional profile. The seeds exhibited low moisture content (3.790%), indicating good stability and suitability for storage. The ash content (5.510%) suggests the presence of essential minerals, contributing to the seeds' overall nutritional value. Notably, the seeds demonstrated a high crude lipid content (46.849%), signifying a rich source of dietary fats. The lipid content agrees with results reported for *Sesamum indicum* grown in Bangladesh and the Republic of Congo (Oboulbiga et al., 2023; Siddik et al., 2016). The moderate levels of crude protein (6.632%) and carbohydrates (28.397%) further contribute to the seeds' nutritional significance. The crude protein is lower than the 20%, while the carbohydrate content is higher than the 14-20% reported for seeds grown in Bangladesh (Siddik et al., 2016).

The balanced composition observed in this analysis supports the traditional and commercial applications of *Sesamum indicum* seeds in various culinary and industrial contexts.

Table 1: Proximate composition of *Sesamum indicum* seeds

Property (%)	Value (%)
Moisture content	3.790 ± 0.1
Ash content	5.510 ± 0.2
Crude fiber	8.822 ± 0.4
Crude lipid	46.849 ± 1.3
Crude protein	6.632 ± 0.1
Carbohydrates	28.397 ± 0.1

5.2. Elemental composition of *Sesamum indicum* seeds

The elemental composition analysis of *Sesamum indicum* seeds, as presented in Table 2, revealed a diverse array of essential minerals. The seeds exhibited appreciable levels of zinc (0.061mg/g), manganese (0.070mg/g), magnesium (1.372mg/g), iron (0.071mg/g), calcium (9.113mg/g), and copper (0.042mg/g), indicating their potential contribution to the dietary intake of these essential nutrients. These minerals play vital roles in various physiological functions, such as bone health, enzyme activation, and antioxidant processes (Kibiti & Afolayan, 2015; Mezzaroba et al., 2019). Notably, the absence of cobalt suggests that *Sesamum indicum* seeds may not be a significant source of this particular element. The low levels of cadmium (0.025mg/g), lead (0.595mg/g), chromium (0.020mg/g), nickel (0.033mg/g), and sodium (0.226mg/g) indicate minimal presence of potentially harmful heavy metals. The results obtained align with the observations of Wei et al. (Wei et al., 2022).

The overall elemental composition aligns with the seeds' reputation as a nutritionally valuable food source and highlights their potential role in promoting a balanced micronutrient intake in diets.

Table 2: Elemental composition (mg/g) of *Sesamum indicum* seeds

Zn	Mn	Mg	Cd	Pb	Cr	Co	K	Fe	Ca	Cu	Ni	Na
0.061	0.070	1.372	0.025	0.595	0.020	ND	2.057	0.071	9.113	0.042	0.033	0.226

5.3. Physicochemical properties of *Sesamum indicum* seeds Oil

The physicochemical analysis of *Sesamum indicum* seeds oil revealed favorable characteristics for various applications, as shown in Table 3. The low acid value (3.366 mg KOH/g) and free fatty acid content (1.683 mg KOH/g) signify good oil quality and stability (Bhatnagar *et al*., 2009). Moreover, the high iodine value (191.619 wij) indicates a higher degree of unsaturation and potential benefits for culinary and industrial purposes, compared to seeds from other regions (Bhatnagar *et al*., 2009; Oboulbiga *et al*., 2023). Furthermore, the low peroxide value (1.000 mEq/kg) indicates low oxidative rancidity, contributing to the oil's longevity and suitability for storage (Bhatnagar *et al*., 2009). The saponification value (182.325 mg KOH/g), which is similar to results for seeds grown in Saudi Arabia, the Republic of Congo, and Brazil (Oboulbiga et al., 2023), aligns with the fatty acid composition, reflecting the oil's potential in soap and cosmetic industries. These results are consistent with the findings of (Wei *et al*., 2022). The viscosity of 88.5 mPa.S indicates the oil's fluidity and ease of use in various applications. The high smoke point (190.0 ^{0}C) and boiling point (302.0 ^{0}C) make the oil suitable for cooking at high temperatures without significant degradation. The observed relative density of 0.906 further supports the oil's potential in industrial applications. The amber-yellow color and transparency of the oil enhance its aesthetic appeal and suitability for culinary purposes (Gebeyehu et al., 2021).

The physicochemical properties of *Sesamum indicum* seeds oil, which align well with the findings of Nkwor (2021), position it as a versatile and valuable resource with applications in cooking, food processing, and various industrial sectors. These findings provide essential insights for industries seeking stable, high-quality vegetable oils and highlight the potential of *Sesamum indicum* seeds as a valuable agricultural commodity.

Table 3: Physicochemical properties of *Sesamum indicum* seeds

Property (%)	Value
Acid value (mg KOH/g)	3.366 ± 0.1
Iodine value (wijs)	191.619 ± 0.3
Peroxide value (mEq/Kg)	1.000 ± 0.1
Saponification value (mg KOH/g)	182.325 ± 0.4
Free fatty acid (mg KOH/g)	1.683 ± 0.1
Viscosity (mPa.S)	88.5 ± 2.2
Smoke point (^{0}C)	190.0 ± 2.6
Boiling point (^{0}C)	302.0 ± 3.3
Relative density	0.906 ± 0.1
Color	Amber Yellow
Transparency	Transparent

5.4. Antioxidant properties of *Sesamum indicum* seeds oil

The antioxidant property of *Sesamum indicum* seeds oil, as evaluated in this study, revealed significant inhibitory effects against free radicals. The oil demonstrated a concentration-dependent inhibition, with percentages of 65.420%, 43.627%, 27.101%, 15.609%, and 7.692% at concentrations of 10.000 mg/ml, 5.000 mg/ml, 2.500 mg/ml, 1.250 mg/ml, and 0.625 mg/ml, respectively, as shown in Figure 1. The calculated IC_{50} value, representing the concentration of the oil required to inhibit 50% of free radicals (Lima et al., 2021), was found to be 7.416 mg/ml. This parameter serves as a crucial indicator of the antioxidant efficacy of the oil. The lower the IC_{50} value, the more potent the antioxidant activity, signifying the oil's ability to neutralize oxidative stress effectively. These findings, which align with the observations of Oboulbiga et al. (2023), underscore *Sesamum indicum* seeds oil's potential as a natural antioxidant. Such antioxidant properties are particularly valuable in mitigating oxidative damage, which is implicated in various health conditions.

The results provide valuable information for industries interested in harnessing natural antioxidants for food preservation and nutraceutical formulations. Additionally, the antioxidant potential adds to the overall nutritional value of *Sesamum indicum* seeds oil, enhancing its appeal for various applications in the food and health sectors.

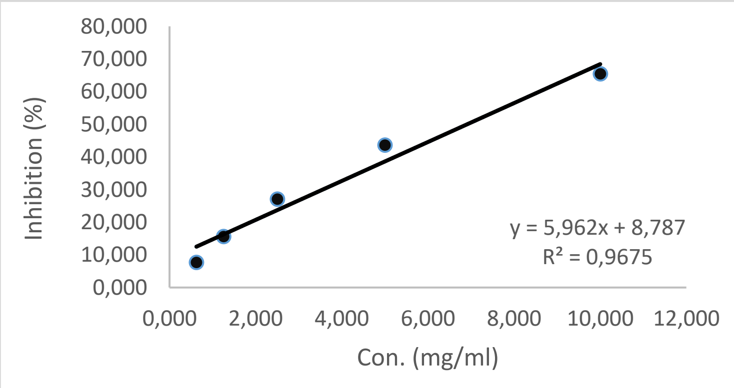

Figure 1: Graph of concentration (mg/ml) of *Sesamum indicum* against inhibition (%)

5.5. Phytochemical Profile of *Sesamum indicum* seeds Oil

The results of the phytochemical analysis of *Sesamum indicum* seeds oil (shown in Table 4) revealed a diverse array of bioactive compounds. The presence of saponins, alkaloids, phenols, glycosides, cardiac glycosides, steroids, terpenoids, volatile oils, and sterols underscores the rich phytochemical composition of the oil. These compounds are known for their various bioactive properties and potential health benefits (Ghorase et al., 2022). The absence of tannins, flavonoids, resin, and phlobatanins, while notable, does not diminish the overall phytochemical richness of the oil, as the detected components play crucial roles in imparting therapeutic and nutritional value. Saponins, for instance, are recognized for their antioxidant and immune-modulating properties, while alkaloids and phenols contribute to the oil's bioactivity. Glycosides and cardiac glycosides are associated with cardiovascular health, and the presence of terpenoids and volatile oil may contribute to the oil's distinctive aroma and potential medicinal properties. These findings align with the observations of Oboulbiga et al. (2023), who reported the presence of over 160 different phytochemical compounds in sesame seeds oil, including lignans, polyphenols, phytosterols, phenols, anthraquinones, naphthoquinones, triterpenes, cerebroside, fatty acids, vitamins, proteins, essential amino acids, and sugar. He also reported the absence of certain phytochemicals in the sesame seeds oil.

The phytochemical profile unveiled in this study provides a foundation for understanding the potential health-promoting attributes of *Sesamum indicum* seeds oil. These bioactive compounds may contribute to the oil's versatility, positioning it as a valuable resource for both traditional and modern medicinal applications. Further exploration of specific phytochemical interactions and their biological activities could unveil novel therapeutic avenues and applications for *Sesamum indicum* seeds oil.

Table 4: Phytochemical composition of *Sesamum indicum* seeds oil

Phytochemical	Presence
Saponins	+
Alkaloids	+
Phenols	+
Tannins	-
Flavonoids	-
Glycosides	+
Quinone	-
Cardiac glycosides	+
Steroids	+
Terpenoids	+
Volatile oil	+
Sterols	+
Resin	-
Phlobatanins	-

5.6. Spectroscopic characteristics of *Sesamum indicum* seeds oil

The spectroscopic analysis of *Sesamum indicum* seeds oil, as presented in Figures 2 and 3, offers valuable insights into its molecular characteristics. The UV-visible spectrum of the oil and the oil-hexane mixture (1ml: 2ml) exhibit distinct absorption peaks at 344 nm and 207 nm, respectively, suggesting the presence of specific compounds that absorb light at these wavelengths. The absorption peak at 344 nm in the oil is likely due to unsaturated fatty acids, common in vegetable oils (Jadhav & Annapure, 2023; Oboulbiga et al., 2023). These fatty acids, with one or more double bonds, lead to conjugated systems, and such systems absorb light in this spectrum through $\pi \rightarrow \pi^*$ electronic transitions (Vogt et al., 2023). These characteristic absorption bands play a crucial role in identifying and characterizing the components present in the oil.

The infrared (IR) spectrum (Figure 4) further elucidates the molecular structure of the seeds oil. Various peaks at distinct positions and intensities reveal the presence of specific functional groups and bonds. Key peaks include those at 404.47, 457.87, and 721.49 cm^{-1}, indicating vibrational modes associated with functional groups like C-H stretching and bending (Coates, 2000). The peak at 3007.45 cm^{-1} represents the unsaturation moiety (Coates, 2000; Nkwor et al., 2021). The intense peak at 2360.86 cm^{-1} suggests the presence of a carbonyl group, possibly indicating the existence of fatty acids in the oil (Smith, 2018). The FTIR result is consistent with the findings of Nkwor (2021), who also reported the presence of fatty acids in sesame seeds oil based on IR spectroscopy. The absolute threshold of 99.050 and sensitivity of 50 emphasize the reliability and precision of the spectroscopic measurements. The recorded spectra serve as reference data for quality control, enabling the detection of any deviations or adulterations in *Sesamum indicum* seeds oil.

These spectroscopic characteristics contribute to the understanding of the molecular composition of the seeds oil. The identified peaks and absorption bands provide a foundation for future studies, such as assessing oil quality, detecting contaminants, and ensuring the authenticity of *Sesamum indicum* seeds oil in various applications, including food, pharmaceuticals, and cosmetics.

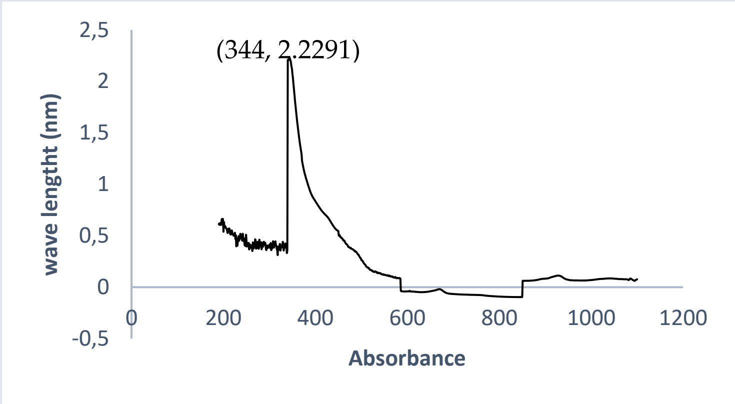

Figure 2: *Absorbance spectrum of Sesamum indicum seeds oil in the absence of solvent, showing* λ_{max} *and Absorbance (nm) at* λ_{max}

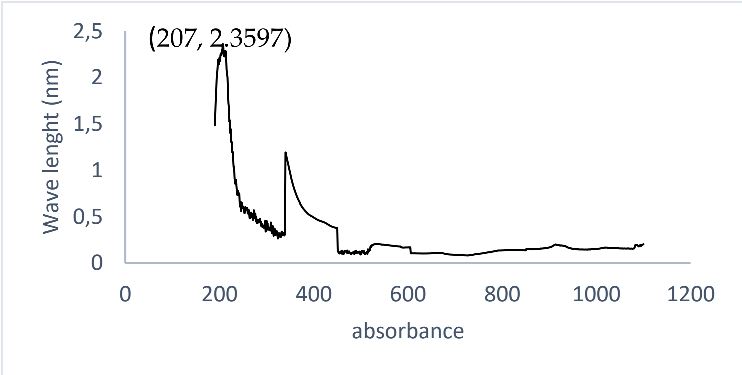

Figure 3: *Absorbance spectrum of 1 mL of Sesamum indicum seeds oil in 2 mL of n-hexane showing* λ_{max} *and Absorbance (nm) at* λ_{max}

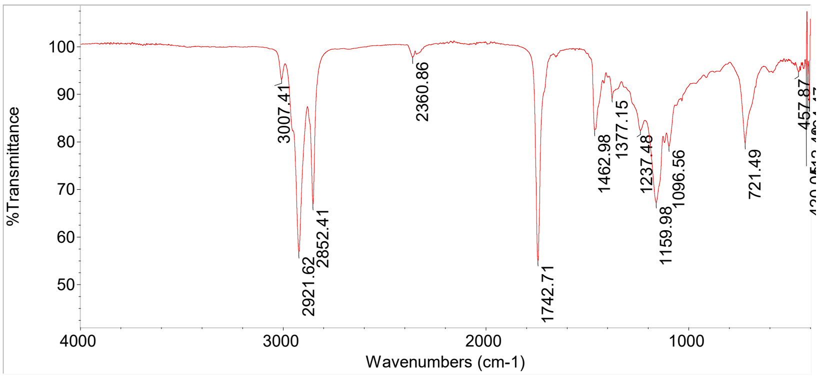

Figure 4: FTIR spectrum of *Sesamum indicum* seeds oil

5.7. Fatty Acid Profile of *Sesamum indicum* seeds Oil

The concentrations (%, w/w) of the fatty acid derivatives obtained from the GCMS analysis of the trans-esterified *Sesamum indicum* seeds oil were converted to their equivalent fatty acid concentrations (%, w/w) and normalized to 100%. The fatty acid profile, detailed in Table 5, offers an in-depth understanding of its lipid composition. The GC-MS analysis identified significant fatty acids, including palmitic acid, stearic acid, elaidic acid, vaccenic acid, oleic acid, and arachidic acid. Notably, *Sesamum indicum* seeds oil contains a high proportion (85.070%) of monounsaturated fatty acids (MUFA), which are recognized for their health benefits, such as reducing inflammation and lowering the risk of heart disease (Oboulbiga et al., 2023). The concentration of unsaturated fatty acids (TUFA) significantly surpasses that of saturated fatty acids (SFA), further emphasizing the oil's potential health advantages. These findings are consistent with existing literature (Oboulbiga et al., 2023). However, the absence of linoleic acid and the quantity of oleic acid diverge from values reported by researchers (Oboulbiga et al., 2023; Siddik et al., 2016). Of particular interest is the high concentration (67.495%) of Vaccenic acid, a trans fatty acid, and an omega-7 fatty acid. Vaccenic acid has been associated with potential health benefits, including improved cardiovascular health, cancer prevention, enhanced immune function, and improved cholesterol and triglyceride levels (Yoo et al., 2024).

Table 6 lists non-fatty acid components found in the trans-esterified *Sesamum indicum* seeds oil and their normalized composition, such as 2-Methyl-Z, Z-3,13-octadecadienol, Cyclohexane, methyl-, methyl-13-Oxabicyclo [10.1.0]tridecane, and Z, Z-4,16-Octadecadien-1-ol acetate. These compounds contribute to the seeds oil's chemical complexity. The identification of these compounds enriches our understanding of the seeds oil's chemical composition. The fatty acid profile plays a crucial role in determining the nutritional and functional properties of the oil. The high proportion of monounsaturated fatty acids underscores the potential health-promoting attributes of *Sesamum indicum* seeds oil. This analysis provides valuable insights for various applications, including food and pharmaceutical industries, where specific fatty acid compositions are desirable.

Table 5: Fatty acid composition (%, w/w) of trans-esterified *Sesamum indicum* seeds oil

Concentration (%)	Fatty acid	Common name	Type
6.116	Hexadecanoic acid	Palmitic acid	SFA
67.495	11-Octadecenoic acid	Vaccenic acid	MUFA
3.049	Octadecanoic acid	Stearic acid	SFA
0.833	Eicosanoic acid	Arachidic acid	SFA
6.778	Octadec-9-enoic acid	Elaidic acid	MUFA
10.797	9-Octadecenoic acid (Z)-	Oleic acid	MUFA
4.932	Cyclopentaneundecanoic acid	—	SFA
100	Total		
14.930			TSFA
85.070			TMUFA
0.000			TPUFA
85.070			TUFA

Table 6: Non-fatty acid composition (%, w/w) of trans-esterified *Sesamum indicum* seeds oil

Concentration (%)	Compound
Cyclohexane, methyl	3.282
13-Oxabicyclo[10.1.0]tridecane	21.067
Z,Z-4,16-Octadecadien-1-ol acetate	23.068
2-Methyl-Z,Z-3,13-octadecadienol	52.583
Total	100

6. Conclusion

This study provides a detailed characterization of *Sesamum indicum* seeds and oil cultivated in Kwali Area Council, Nigeria. The results highlight their rich nutritional profile, favorable physicochemical properties, antioxidant activity, and diverse phytochemical constituents. Fatty acid profiling and spectroscopic analyses further establish sesame oil as a promising candidate for functional food and nutraceutical development. The key contributions of this work lie in: (i) comprehensive nutritional profiling of Nigerian sesame seeds, (ii) detailed physicochemical and phytochemical characterization of the oil, (iii) demonstration of antioxidant potential, and (iv) spectroscopic fingerprinting for authenticity and quality control. Collectively, these findings advance understanding of Nigerian sesame cultivars and reinforce their value in food science, nutrition, and industrial applications.

7. Recommendation

Further studies should explore the bioavailability of the identified nutrients and their potential health benefits, contributing to the development of functional foods or nutraceuticals.

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References

1. Adedunni, E. S., Olawumi, O. O., Idoko, O., Olufemi, A. A., & Asuquo, T. S. (2016). Comparative study of the physicochemical properties of *Zizyphus spina* and *Moringa oleifera* seed oils. *American Journal of Applied and Industrial Chemistry, 2*(3), 18–22. https://doi.org/10.11648/j.ajaic
2. AOAC. (1990). *Official methods of analysis of AOAC International* (16th ed., Vol. II). AOAC International.
3. Bedigian, D. (2013). African origins of sesame cultivation in the Americas. In R. Voeks & J. Rashford (Eds.), *African ethnobotany in the Americas* (pp. 67–120). Springer. https://doi.org/10.1007/978-1-4614-0836-9_4
4. Bhatnagar, A. S., Prasanth Kumar, P. K., Hemavathy, J., & Gopala Krishna, A. G. (2009). Fatty acid composition, oxidative stability, and radical scavenging activity of vegetable oil blend with coconut oil. *Journal of the American Oil Chemists' Society, 86*(10), 991–999. https://doi.org/10.1007/s11746-009-1435-y
5. Coates, J. (2000). Interpretation of infrared spectra: A practical approach. In *Encyclopedia of analytical chemistry* (Vol. 12, pp. 10815–10837). John Wiley & Sons Ltd.
6. Gebeyehu, A., Hammenhag, C., Ortiz, R., Tesfaye, K., & Geleta, M. (2021). Characterization of oilseed crop Noug (*Guizotia abyssinica*) using agro-morphological traits. *Agronomy, 11*(8), 1479. https://doi.org/10.3390/agronomy11081479
7. Getinet, A., & Sharma, S. M. (1996). *Niger: Guizotia abyssinica (L.f.) Cass.* IPGRI.
8. Ghorase, M., Udaipure, S., & Bele, P. (2022). Phytochemical screening and quantitative analysis of active phytoconstituents of *Guizotia abyssinica* seed to know their therapeutic values. *International Journal of Health Sciences, 6*(S2), 2880–2892. https://doi.org/10.53730/ijhs.v6nS2.5794
9. Jadhav, H. B., & Annapure, U. S. (2023). Triglycerides of medium-chain fatty acids: A concise review. *Journal of Food Science and Technology, 60*(8), 2143–2152. https://doi.org/10.1007/s13197-022-05499-w
10. James, C. S. (1995). *Analytical chemistry of food* (Vol. 1). Seale-Hayne Faculty of Agriculture, Food and Land Use, University of Plymouth.
11. Kibiti, C. M., & Afolayan, A. J. (2015). The biochemical role of macro and micro-minerals in the management of diabetes mellitus and its associated complications: A review. *International Journal for Vitamin and Nutrition Research, 85*(1–2), 88–103. https://doi.org/10.1024/0300-9831/a000226
12. Langham, D. G. (1949). Improvement of sesame in Venezuela. In *Proceedings of the First International Sesame Conference* (pp. 74–79).
13. Lima, J. F., Dias, M. I., Pereira, C., Ivanov, M., Soković, M., Steinmacher, N. C., Ferreira, I. C. F. R., & Barros, L. (2021). Characterization of nonconventional food plant seeds *Guizotia abyssinica* (L.f.) Cass., *Panicum miliaceum* L., and *Phalaris canariensis* L. for application in the bakery industry. *Agronomy, 11*(9), Article 9. https://doi.org/10.3390/agronomy11091873
14. Mezzaroba, L., Alfieri, D. F., Colado Simão, A. N., & Vissoci Reiche, E. M. (2019). The role of zinc, copper, manganese, and iron in neurodegenerative diseases. *NeuroToxicology, 74*, 230–241. https://doi.org/10.1016/j.neuro.2019.07.007
15. Nkwor, A. N., Ukoha, P. O., & Ifijen, I. H. (2021). Synthesis of sulfonated *Sesamum indicum* L. seed oil and its application as a fatliquor in leather processing. *Journal of Leather Science and Engineering, 3*(1), 16. https://doi.org/10.1186/s42825-021-00053-4

16. Oboulbiga, E. B., Douamba, Z., Compaoré-Sérémé, D., Semporé, J. N., Dabo, R., Semde, Z., Tapsoba, F. W.-B., Hama-Ba, F., Songré-Ouattara, L. T., Parkouda, C., & Dicko, M. H. (2023). Physicochemical, potential nutritional, antioxidant, and health properties of sesame seed oil: A review. *Frontiers in Nutrition, 10,* 1127926. https://doi.org/10.3389/fnut.2023.1127926

17. Oplinger, E. S., & Putnam, D. H. (2011). *Sesame*. Purdue University.

18. Pathak, N., Rai, A. K., Kumari, R., Thapa, A., & Bhat, K. V. (2014). Sesame crop: An underexploited oilseed holds tremendous potential for enhanced food value. *Agricultural Sciences, 5*(6), 6023. https://doi.org/10.4236/as.2014.56054

19. Ram, R., Catlin, D., Romero, C., & Cowley, C. (1990). Sesame: New approaches for crop improvement. In *Proceedings of the First National Symposium "New Crops: Research, Development, Economics"* (pp. 225–228). Indianapolis, IN: Purdue University.

20. Siddik, A., Shirazy, B. J., Islam, M. M., Hoque, A., & Haque, M. (2016). The combined effect of nitrogen and NAA on the yield of sesame (*Sesamum indicum* L.). *Scientia Agriculturae, 13*(1), 1–19. https://doi.org/10.15192/PSCP.SA.2016.13.1.19

21. Smith, B. (2018). The C=O bond, Part VI: Esters and the rule of three. *Spectroscopy, 33*(7), 20–23.

22. Udo, E. J., & Oguwele, J. A. (1986). *Laboratory manual for the analysis of soil, plants, and water samples* (3rd ed.). University of Ilorin.

23. Voeks, R., & Rashford, J. (2012). *African ethnobotany in the Americas*. Springer.

24. Vogt, C., Wondergem, C. S., & Weckhuysen, B. M. (2023). Ultraviolet-visible (UV–Vis) spectroscopy. In I. E. Wachs & M. A. Bañares (Eds.), *Springer handbook of advanced catalyst characterization* (pp. 237–264). Springer. https://doi.org/10.1007/978-3-031-07125-6_11

25. Wei, P., Zhao, F., Wang, Z., Wang, Q., Chai, X., Hou, G., & Meng, Q. (2022). Sesame (*Sesamum indicum* L.): A comprehensive review of nutritional value, phytochemical composition, health benefits, development of food, and industrial applications. *Nutrients, 14*(19), 4079. https://doi.org/10.3390/nu14194079

26. Yoo, M., Lee, H. J., Lee, K.-W., & Seo, D. (2024). Analysis of vaccenic and elaidic acid in foods using a silver ion cartridge applied to GC × GC-TOFMS. *Frontiers in Nutrition, 10,* 1320550. https://doi.org/10.3389/fnut.2023.1320550

27. Zohary, D., & Hopf, M. (2000). *Domestication of plants in the Old World: The origin and spread of cultivated plants in West Asia, Europe and the Nile Valley*. Oxford University Press. https://doi.org/10.5555/200130148

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