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# FATTY ACIDS PROFILING AND LIPID INDICES IN BLACK AND WHITE SESAME SEEDS OIL

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**Abstract**

Experiments conducted in Junagadh Agricultural University for analysis of lipid indices in black and white sesame seeds The data showed that the nine fatty acids were detected in both the seed oils but higher amount of PUFA was found in black seeds and Lipid indices calculations revealed that black seed had greater values for ODR (0.574), PUFA(50.47), DU(139), and UI (619) than white sesame oils, whereas white seed had higher values for O/L (0.8), LDR(0.01), MUFA (39.17), SFA(12.64), AI, and TI. So, after observing the trends in lipid indices, it is clear that black sesame has a huge opportunity for healthier lipids. Overall, sesame seed oils are beneficial for health.

**Keywords:** Fatty acids, *Sesamum indicum* L., lipid indices, GC/MS

## Introduction

Sesame (*Sesamum indicum* L.) is used as oil seeds in India from centuries. Sesame, a genus of Sesamum, is a member of the Pedaliaceae family. According to the difference in germplasm color, sesame can be classified as white sesame, black sesame, and yellow sesame () Approximately 70% of global sesame seeds are used to make oil. BSS contains approximately 44–58% of high-quality oil, the white sesame has many foods application in spite of good oils. White Sesame seeds, also known as Safed til, is one of oldest condiments known to man. It may be a small seed but no doubt a very powerful. Black sesame seeds (BSS) also called as kala til in India & are being considered as traditional healthy winter food with notable nutritional value and pharmacological properties for centuries in India. It has many uses in making oils and fist too. BSS is recognized for its potent anti-oxidant properties, attributed to its rich content of melanin's, amino acids, phenolic compounds, lignans, and terpenoids. (Zhenxia *et al*. 2024) [8]. Numerous studies have shown that sesame seeds & oil are richer in phytochemicals and have higher nutritional value than other plant organs of sesame. Sesamin, sesamol and other chemical components have a variety of pharmacological values as well as used in the treatment of diseases such as anti-inflammatory, antioxidant (Yasuko, *et al*.1985) [7], anti- cancer, anti-melanogenic, auditory protection, anti- cholesterol, and anti-aging, and have a protective effect on the heart, liver, and kidneys (Wei, 2022) [6]. similarly, Zhu *et al*. (2023) [6]. demonstrated antioxidant activity DPPH radicals. In addition to this BSS exhibits prominent bioactivities demonstrated in animal and *in vitro* studies, including antioxidant, anti-cancer (Albaqami, 2024) [6]., anti-inflammatory, hepato and nephro protective and anti- obesity, neuroprotective, antidepressant, as well as lowering blood pressure and anti-diabetic effects (Zhenxia *et al*. 2024). [8] Due to these many applications, it is imperative to study on the oil characteristics of sesame. As our regions

always eat the black sesame during winter and cool seasons. Therefore, the study was undertaking to see the differences in oils and characteristics fatty acids differences among theboth types. Many literatures cited the fatty acids profiling but as the awareness in lipid profiles and after corona there was more incidence of CHD and heart attack in human beings. so, the things were influenced to see the cause of oil characteristics so researcher has keen interest in lipid indices in oils. This is the nutritional lipid indices can showed the source to cause in increased in Atherogenic or thrombogenic process as well as cholesterol synthesis in human beings. Despites of these facts, to assess the nutritional value of FAs contained in sesame seeds can have possibility of their use in the prevention and treatment of diseases too. So theoretically whether this lipid indices can work or not in plant as such.

## Material and methods

**Extraction of seed oils:** Black and while sesame seeds were slight break with mortar pastel. Weight in and put in to thimble. Soxhlet apparatus were used for extraction of oils. Hexane as solvents used for extraction of oils. After evaporating the hexane in hot air oven remaining oils was used making the methyl ester. Standard procedure was applied. Preparation of sample for the GC MS analysis as per given table. The auto sampler was filled with the dilutes methyl ester. The injunction volume was set in the instruments. The column types and other details as per the following details.

## GCMS conditions

Extracted oils was used for derivatives and make methyl ester and applied in autosampler tubes. GC-MS analyses were performed using a DB-5MS capillary column (30 m × 0.25 mm i.d., film thickness 0.25 μm, Agilent Technologies, Santa Clara, CA, USA). The chromatographic runs were started as per the following details conditions [GC-2010]. The GCMS conditions as per table indicated: ionization mode, electron ionization (EI) mode; ionization current, 60 μA; ionization voltage, 70 eV. Each sample was analysed. Eluted compounds were identified using the NIST (http://www.nist.gov/srd/nist1a.cfm), the Wiley NBS, the mass spectral data as well as used pubmed and other data sources for detection.

Fatty acids and compounds were used for google search, NIST library for the potential application for food and industrial application.

**Instruments protocol for analysis of GCMS-FAMEcalculated by formula given by Ulbricht and Southgate (1991), Szpunar-Krok and Wondołowska (2022).** [4, 5]

$$AI = \frac{(C12{:}0+(4x14{:}0)+C16{:}0)}{MUFA+PUFA}$$

$$TI = \frac{(C12{:}0+C16{:}0+C18{:}0)}{(0.5\ x\ MUFA)+(0.5\ x\ n6PUFA)+(3\ x\ n3PUFA)+(\frac{n\ 3PUFA}{n\ 6PUFA})}$$

| | | |
|---|---|---|
| Column Oven Temp. | 40.0 ℃ | MS table: Start Time :2.50min, End Time :30.50min, ACQ Mode: Scan, Event Time :0.50sec, Scan Speed 1428, Start m/z :50.00, End m/z :700.00, Sample Inlet Unit: GC " [GCMS-QP2010 Plus], Ion Source Temp :200.00 ℃, Interface Temp.:290.00 ℃, Solvent Cut Time :2.00 min, Detector Gain Mode: Relative Detector Gain: +0.00 kV, Threshold 100" |
| Injection Temp. | :250.00 ℃ | |
| Injection Mode | : Split | |
| Flow Control Mode | : Pressure | |
| Pressure | :49.5 kPa | |
| Total Flow | :54.0 mL/min | |
| Column Flow | :1.00 mL/min | |
| Linear Velocity | :36.1 cm/sec | |
| Purge Flow | :3.0 mL/min | |
| Split Ratio | :50.0 | |
| High Pressure Injection | : ON | |
| High Press. Inj. Pressure | :250.0 kPa | |
| High Press. Inj. Time | :1.00 min | |
| Carrier Gas Saver | : OFF | |
| Splitter Hold | : OFF | |
| Oven Temp. Program | | |
| Rate | Temperature(℃) | Hold Time(min) |
| - | 40.0 | 3.00 |
| 6.00 | 290.0 | 10.00 |

**Calculation of lipid indices:** FA were grouped in to the presence and the number of double or triple bonds and classified as saturated fatty acids (SFA), unsaturated fatty acids (UFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA). Calculation of lipid indices were done according to Ulbricht and Southgate (1991) [4] for Indices of atherogenicity (AI) and thrombogenicity (TI) were counted according to following formulas and The standard formula for DU (Degree of unsaturation), IU (Index of unsaturation), ODR(oleic desaturation ratio), LDR(linoleic desaturation ratio), ER (Elongation ratio), O/L ratio (Oleic/Linoleic ratio) were

**Results and discussion**

The Fatty acids profiling detection through GC MS in white sesame oil and Black Sesame are presented in Table.1 and Table.2 & 3. data shown nine class of fatty acids presence in oils. Similar observation also observed by Agidew *et al*. (2021) [1]. Rathod (2023) [3]. The maximum area covered by 18:2ω-6(Linoleic acids) at RT of 22.308 with 47.8 % in while sesame while the same fatty acids was detected at RT of 23.303 with 50.14%. That indicated that the black seeds had higher amount of Essential fatty acids. Second major fatty acid was 10-Octadecenoic acid, methyl ester with the area of 38.32% in white sesame seed oils where as black showed 37.48. similar observation of higher found in black seeds. For Octadecanoic acid, α-Linolenic acid, Arachidic acid, Palmitoleic acid were commonly found in both the seed oils with varying proportion. Major differences showed that Cyclopropaneoctanoic acid, 2-hexyl-, methyl ester only found in white sesame not in black sesame variety similarly Behenic acid only founds in black sesame seed oils. The comparing table of fatty acids with carbon number showed higher value for white sesame seeds in all cases except Linoleic acid (LA) it was found to be higher in black seeds. (table.3). The lipid indices calculation showed higher value in black seed for ODR, PUFA, DU, UI in comparison to white sesame oils and higher value for white seed are observed in O/L, LDR, MUFA, SFA, AI, TI. So, after observing the trends of lipid indices it is clear that the black sesame has enormous opportunity of healthier lipid indices. In concluding remarks, the comparison showed negligible variation in value. Overall sesame seed oils are good for health.

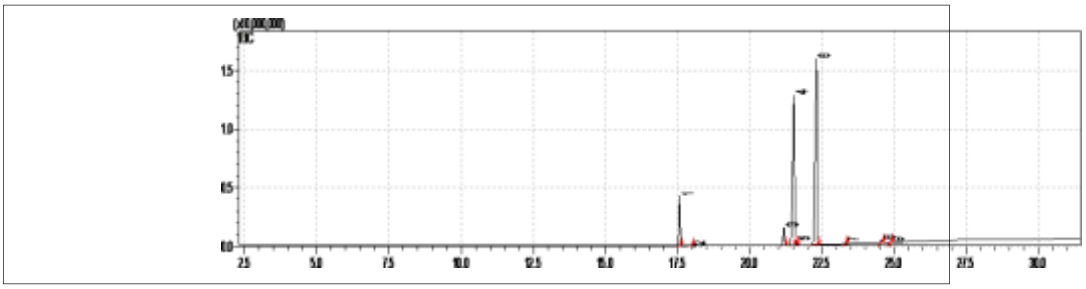

**Fig 1:** Chromatogram for FAME of White sesame seed oil

**Table 1:** Fatty acids profiling detection through GC MS in white sesame oil

| Peak No. | RT | Area % | Compound name | Carbon number & Bond | Common name | Class |
|---|---|---|---|---|---|---|
| 1 | 17.565 | 8.21 | Hexadecanoic acid | 16:00 | Palmitic acid | SFA |
| 2 | 17.982 | 0.07 | Cyclopropaneoctanoic acid | 15:00 | - | SFA |
| 3 | 21.183 | 3.82 | Octadecanoic acid | 18:00 | Stearic acid | SFA |
| 4 | 21.528 | 38.32 | 10-Octadecenoic acid | 18:1 D,10 | - | MUFA |
| 5 | 21.607 | 0.68 | 10-Octadecenoic acid | 18:1 D,10 | - | MUFA |
| 6 | 22.308 | 47.8 | 9,12-Octadecadienoic acid | 18:2ω-6 | Linoleic acid (LA) | PUFA |
| 7 | 23.307 | 0.39 | 9,12,15-Octadecatrienoic acid | 18:3D9,12,15 | α-Linolenic acid | PUFA |
| 8 | 24.55 | 0.54 | Eicosanoic acid | C20:0 | Arachidic acid | SFA |
| 9 | 24.867 | 0.17 | 7-Hexadecenoic acid | C16:1 (Lipid ω−7 | Palmitoleic acid | MUFA |

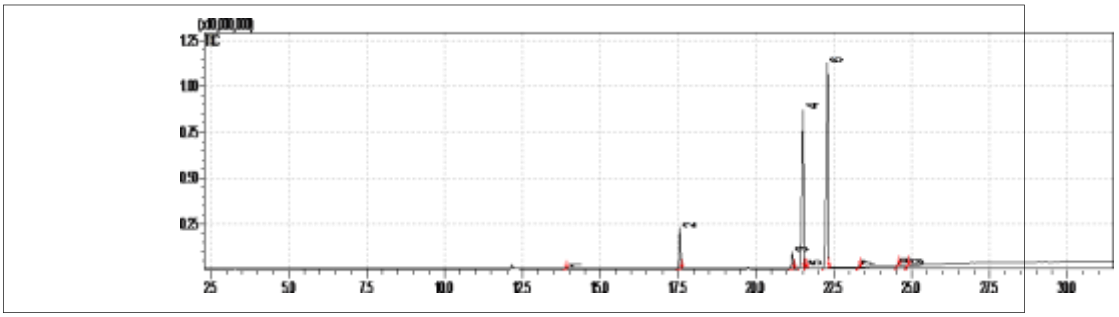

**Fig 2:** Chromatogram for FAME of Black sesame oils

**Table 2:** Fatty acids profiling detection through GC MS in Black sesame

| Peak No. | RT | Area % | Compound name | Carbon number & Bond | Common name | Class |
|---|---|---|---|---|---|---|
| 1 | 13.88 | 0.16 | Isopropyl Myristate | | Lauric | SFA |
| 2 | 17.557 | 7.2 | Hexadecanoic acid | 16:00 | Palmitic acid | SFA |
| 3 | 21.167 | 3.54 | Octadecanoic acid | 18:1 D,10 | | SFA |
| 4 | 21.509 | 37.48 | 10-Octadecenoic acid | 18:1 D,10 | s-10-octadecenoic acid) Isooleic acid | MUFA |
| 5 | 21.593 | 0.59 | 10-Octadecenoic acid | 18:1 D,10 | s-10-octadecenoic acid Isooleic acid | MUFA |
| 6 | 22.291 | 50.14 | 9,12-Octadecadienoic acid | 18:2ω-6 | Linoleic acid (LA) | PUFA |
| 7 | 23.303 | 0.33 | 9,12,15-Octadecatrienoic acid | 18:3D9,12,15 | α-Linolenic acid | PUFA |
| 8 | 24.549 | 0.42 | Eicosanoic acid | C20:0 | Arachidic acid | SFA |
| 9 | 24.864 | 0.14 | 4-Decenoic acid | 22:00 | Behenic acid | SFA |

**Table 3:** Fatty acids (Area %) used for calculation of lipid indices for black and white sesame seed oil

| Variety | | White sesame | Black sesame |
|---|---|---|---|
| C14 | SFA | - | - |
| C16:0 | Palmitic acid | 8.21 | 7.2 |
| C18:0 | Stearic acid | 3.82 | 3.54 |
| C18:1(n-9) | Oleic | 38.32 | 37.48 |
| 18:2(n-6) | Linoleic acid (LA) | 47.8 | 50.14 |
| C18:3(n-3) | Alpha L-Linoleic acid | 0.54 | 0.33 |
| C20:0 | Arachidic acid (AA) | 1.31 | |
| C20:1(n=9) | Cis-11-Eicosenoic acid | 0.12 | 0.12 |

| | | | |
|---|---|---|---|
| C22:0 | Behenic acid | - | 0.42 |

**Table 4:** Trends of Lipid indices in black and white sesame seed oils

| Lipid index | White Sesame | Mathematical Symbol | Black Sesame |
|---|---|---|---|
| O/L | 0.802 | > | 0.748 |
| DR | 0.001 | = | 0.001 |
| ODR | 0.558 | < | 0.574 |
| LDR | 0.011 | > | 0.007 |
| MUFA | 39.170 | > | 38.070 |
| PUFA | 48.190 | < | 50.470 |
| SFA | 12.640 | > | 11.460 |
| DU | 135.550 | < | 139.010 |
| UI | 611.520 | < | 619.780 |
| AI | 0.094 | > | 0.081 |
| TI | 10.001 | > | 8.338 |

## Conclusions

The comparing the black and white sesame variety oils showed the healthier lipid indices. Total nine fatty acids are detected in both the seed oils but higher amount of PUFA was found in black seeds and Lipid indices calculations revealed that black seed had greater values for ODR, PUFA, DU, and UI than white sesame oils, whereas white seed had higher values for O/L, LDR, MUFA, SFA, AI, and TI. So, after observing the trends in lipid indices, it is clear that black sesame has a huge opportunity for healthier lipids. In conclusion, the comparison revealed small change in value. Overall, sesame seed oils are beneficial for health.

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