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RESEARCH PAPER

Properties of Oil Extracts from Local Sesame Seeds (Sesamum Indicum L.)

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A B S T R A C T:
This study was conducted to determine the main physiochemical properties of sesame oil extracted from three sesame seeds samples, the differences between mixed (A-C) and the sieved sesame seed (A1-C3): which were taken from Sharzoor in Sulaymaniyah (S, mixed brown), Akre in Duhok (A, mixed brown) and Mala Omar in Hawler (MO, mixed brown). And to evaluate the differences between the OIL characteristics of mixed (Akre ,A, Sharzoor B, Mala Omar ,C) and the sieved seeds with three different mesh size sieve (1.50, 1.35, 1) mm included (A1,A2,A3,.B1,B2,B3 ,C1,C2 and C3). The properties that included to study in this work were viscosity, specific gravity, fatty acid content, acid value, iodine value, and peroxide value. From the results of this study, it was found that the Mala Omar sample in all parts especially C2 48.42% is considered good source for oil, the viscosity of (hawler) samples especially C3 with 0.0490 Pas, the lowest viscosity while the A1 has a maximum viscosity 0.0525 Pas. More than 80% of sesame seeds' fatty acid composition is unsaturated, with high concentrations of oleic, linoleic, and lenolinic acids. Saturated fatty acids, primarily palmitic and stearic acids, account for the remaining 20%. Acid value in sample A1 of sharazoor sesame oil had the lowest content (2.1030 mg KoH\gm oil), whereas sample C3 had the greatest concentration. Omar Mala 15.5815. A3 sharazoor sample a higher 11.4954 gm I2\100gm oil, iodine value. While the maximum peroxide value was found in the B3 sesame oil sample of 15.9267 meq/kg, and the lowest peroxide value was found in the B sesame oil sample at 3.8850 meq/kg.

KEY WORDS: Local sesame seed, physicochemical properties, sieving size, sesame oil extraction
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1. INTRODUCTION:

Sesame seeds are belong to the Pedaliaceae family, and are known as "benni," "benne," and so on, depending on where they're grown. Sesame seeds are also known by the Hebrew names "simsim" (simsim) and "tila" (Hassan, 2012). It's one among the world's most important and oldest oilseed crops. In addition to oil, protein, calcium, and phosphorus are all found in sesame seeds, making them an important economic resource for oil production across the world. This seed is crucial to the regular supply because of the export and industry.

Double crops of sesame seeds are common when it comes to making sesame oil. Approximately 70426 fedans of sesame crops were grown in Egypt each year, resulting in approximately one and fifty four thousandths ton of sesame (Statistical Year Book, 2005). The governorate of Erbil produced 16 tons (7%); the overall expected output of sesame in Kurdistan for the growing period of 2013 was 237 tons, an increase of 30% compared to 2012. Sulaimani accounted for 59% of total output, while Duhok Governorate contributed 24% with 56 tons, and Garmian Administration had a production of 25 tons with the rate of 10%.(Agriculture statistics department, 2014).

Vitamins and minerals are also included in the seed's composition, making it a good source of nourishment. Sesame oil's potential to decrease

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cholesterol levels is due to the unsaturated fatty acids oleic and linoleic acids contained in the oil. When it comes to emulsifying and dissolving fats in water, lecithin is a key ingredient (Lichtenstein and Deckelbaum, 2001).

Other uses include cooking, medicines, shortenings and margarine, soap fat and pesticide synergists (Baker and Grant, 2018). Sesame oil is also a nutritional diet, particularly helpful to health. Other uses include the production of perfumery cosmetics, such as skin conditioning and moisturizing agents; bath oils; face and hand creams; pesticide; paint; and varnish. Because the majority of sesame seeds are grown in underdeveloped nations, it has been difficult to create large-scale, completely automated methods for extracting and processing their oil. A variety of ways exist for extracting sesame oil, depending on the ingredients and equipment available. Sesame oil extraction is standard practice in developing countries employing less expensive and time-consuming procedures such as hot water flotation, the bridge process, the ghani process, or pressing followed by chemical solvent extraction (Kamal-Eldin and Appelqvist, 1995).

The aim of the study was to determine the physical and chemical properties of sesame oil were grown in different places in the Kurdistan region such as Sharazoor in Sulaymane, Akre in Duhok and Mala Omar in Hawler. That extracted from sesame seeds of different location in Kurdistan Region, The properties that included to study in this work were (viscosity, specific gravity, acid value, iodine value and peroxide value). The study similar to (Visavadiya et al., 2009) to see the differences.

2. MATERIALS AND METHODS

2.1 Sample Collecting:

The samples of sesame seeds which were used in the study were obtained from a farm in Sharazoor in Sulaymaniyah (S), Akre in Duhok (A) and Mala Omar from Erbil (MO). They were collected between October and November 2021. Foreign matter such as stones, dirt, and broken seeds were manually removed from the sesame seeds.

2.2 Sample Preparation

Sesame oil was extracted from sesame seeds for each sample seeds mixed (A, B, C) and seed parts (A1, A2,A3, B1,B2,B3, C1,C2 and C3), after sieving the seeds in three sieves which have 1.5, 1.35 and 1 mesh according to their pore volume from greater to smaller. Sesame seeds were dried in an oven using an (Oven, Lab Tech, LDO, 660E) at 105 oC then crushed and separated into the particle size by using a mixer (Vortex mixer, Gemmy industrial Vm300p).

2.3 Sesame Seed Oil Extraction

Sesame oil was extracted by using Soxhlet apparatus,.15g of each sample was placed inside the main chamber of the Soxhlet extractor. By refluxing using 300 ml of petroleum ether (40-60oC) solvent through the thimble using a condenser and a siphon side arm, the extraction cycle is typically repeated for 4 hrs. at 60 oC. at 200 oC. After extraction the solvents removed by rotary vacuum evaporator (Rotary evaporator, LYELA, rotary evaporator, N-1000) at 65oC and dried in oven at 60 oC to remove what remaining solvent from it (Visavadiya et al., 2009).

2.4 Physiochemical Properties Determination

2.4.1 Viscosity determination

The viscosity of each sample was measured by using Digital rotary viscometer (Viscometer, NDJ- 8S, Digital Rotary Viscometer, China) at 25 oC according to (Emil et al, 2010).

2.4.2 Specific Gravity Determination by Hydrometer

The Specific gravity of each sample was measured by adding 50 ml of sesame oil sample to hydrometer cylinder at 25 oC, then lowered the hydrometer pleasantly in to the oil sample until it floats and the specific gravity was recorded from the scale inside the stem. (Brosk, 2013).

2.4.3 Fatty acid estimation by Gas Chromatography

The fat in oil extracts were estimated depending on the (AOAC, method), this estimation was achieved by the following processes:

a.Oil esterification:

The samples were prepared on based of based on the trans esterification of oil, by their reaction with methanolic potassium hydroxide, which is prepared by dissolving 11.2 g of KOH in 100ml of methanol. 8 ml of methanolic potassium hydroxide with 5 ml of hexane was added to 1g of sesame oil in a separation funnel and shaked quickly for 30 sec then leaved to separate in to two layers. The esterified oil was taken from the upper layer (Hexane layer), after that it was injected in to the Gas chromatographic instrument for analysis of fatty acids compounds.

b.Sample analysis by Gas chromatographic Technique

The fatty acids compounds in sesame oil samples were analyzed by Gas chromatographic instrument (GC, 2010, Shimadzu model, Japan) by using flame ionized detector (FID) and Capillary separation column type (SE -30) with lengths (30m*0.25 mm), the temperature injection area 280 oC, Detector 310 oC and of separating column 120 – 290 (10 oC/ min), the gas flow rate under 100 Kpa (Zhang et al, 2015).

2.4.4 Acid value

The acid value of sesame oil sample was determined by dissolving 1 g of sesame oil sample in mixture of ethanol and ether 50:50 then titrated with 0.1 N Potassium hydroxide solution by using 2 -3 drops of phenolphthalein indicator. The acid value and free fatty acid calculated by this equation according to (AOAC, 2005) method.

$$\text{Acid value} = \frac{V\ of\ KOH \times N \times 56}{weight\ of\ sample\ (g)}$$

% free fatty acid = Acid Value × 0.503

Where:

%FFA= percent free fatty acid (g/100g) expressed as oleic acid, V= volume of KOH titrant (ml), N= normality, 56= molecular weight of potassium hydroxide (g/mol)

2.4.5 Iodine Value

Iodine value was determined by adding 1 ml sesame oil to 0.5 ml chloroform solvent with 1.5 ml of hanus solution. Then leaving it for 30 min, the solution is treated with 0.5 ml potassium iodide and 5 ml distilled water, after adding 2-3 drops of starch then estimated by titration with sodium thiosulfate solution. The Iodine value was calculated from the expression below: depending on the (AOAC, 2005) method.

$$\text{Iodine value} = \frac{[(B-S)\times N \times 126.9]}{sample\ wt.g}$$

Where:

B= Volume of titrant (ml) with blank,
S= Volume of titrant (ml) with sample,
N= Normality of Na2S2O3 solution,
126.9= molecular weight of Iodine.

2.4.6 Peroxide Value

1g sesame oil sample to 25 ml mixture prepared from 16.6 ml glacial acetic acid and 8.4 chloroform with 1 gm KI then the mixture was leaved at dark place for 1min., 35 ml distilled water and 2-3 drops of starch add as indicator then 2-3 drops of starch add as indicator then titrated with sodium thiosulfate. According to AOAC method No.965.33 (AOAC, 2005).

It was expressed as mille-equivalent of peroxide oxygen per Kg sample of oil (meq/kg).

$$PV\ (meqO2/kg\ oil) = \frac{[\,(S-B)\ *\ N]\ x1000}{sample\ wt.g}$$

Where:

S= Volume of titrant (ml) with sample,
B= Volume of titrant (ml) with blank,
N= Normality of sodium thiosulfate

2.5 Statistical Analysis

Statistical analysis was done by using the property program SPSS (SPSS software (version 26, 2019)), to analysis data by the experiment of the factorial in a completely randomized design. The means were compared by using Duncan's multiple range tests at ($P \leq 0.05$).

3. RESULTS AND DISCUSSION

3.1 Sesame Seeds Oil Extraction

Sesame seeds provide the raw material for sesame seed oil. Toasted sesame seeds give it a somewhat sweet, nutty flavor that's heightened by

the oil itself. Oil yield varied from (15.193% to 48.42%), figure 1 shows that C2 Mala Omar sample the highest oil percent while A3 sample has the lowest oil percent , Chakraborty et al, 2017 mentioned that the oil contains in sesame seed of three varieties which included off white, black and brown color using hexane as solvent was 47.5,37.5 and 34% respectively.

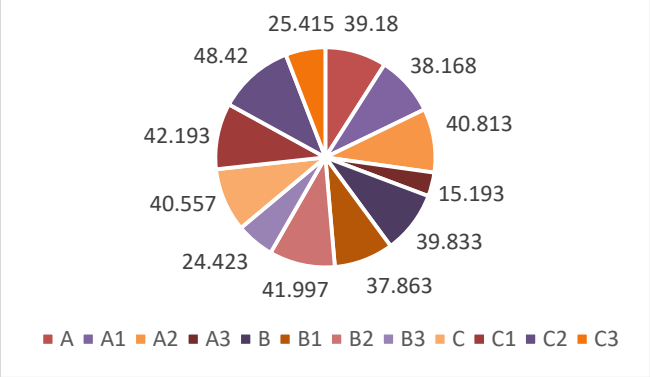

Figure 1: Oil percentage extracted from sesame seed samples

3.2 Viscosity

The viscosity of an oil is a significant consideration. As a crucial first step in analyzing flow properties and lubricant performance, most oil analysis laboratories begin with this procedure. It becomes thinner as the temperature drops and thickens as it rises. The viscosity of sesame oil varied from 0.0525 to 0.0490 (pa.s). In terms of viscosity, A1 sesame seed oil sample had the highest (0.0525 Pas), whereas B3 had the lowest (0.0490 Pas). Viscosity (0.0525 to 0.0351 Pa.s.) at 26 and 50 oC respectively. Reported in earlier studies by Diamante and Lan's (2014).

3.3 Specific gravity

Hydrometers are used to measure the density of water. The Archimedes principle, which states that a floating solid displaces its own weight, is the basis for this device. Hydrometers are used to measure both heavy and light liquids. Table 1 demonstrates that sample B3 sesame seed oil 0.910 had the highest specific gravity, whereas sample A1 sesame seed oil 0.9 had the lowest. In addition, Rahman et al., 2007 conducted a research. The specific gravity values ranged from 0.91 to 0.913.

3.4 Fatty acid composition of sesame seed oil

More than 80% of sesame seeds' fatty acid composition is unsaturated, with high concentrations of oleic (C18:1), linoleic (C18:2), and linolenic (C18:3) acids. Saturated fatty acids, primarily palmitic (C16:0) and stearic acids (C18:0), account for the remaining 20%. (Orsavova et al, 2015). As indicated in Table 1, sesame seed oil has a high concentration of omega-6 fatty acids. As well as, the fatty acid contents of the parts of oil which are extracted from Sharazoor, Akre and Mala Omar sesame seeds oil samples are shown in figure 3.

Sesame oils were analyzed by Hojjati et al, (2015) using gas chromatography (GC) to determine the fatty acid compositions, and their results showed that oleic acid was the most prevalent fatty acid in all samples .

The results obtained shown in table 1 and figure 2.Which indicates that the monounsaturated the monounsaturated fatty acid, oleic acid (C18:1) was the dominant fatty acids. The second significant fatty acid was linoleic acid (C18:2) components characterized in the sesame oils were as follows: oleic acid and linoleic acid. The highest content of oleic acid observed in A1 large size part of Akre which was (41.05%), whereas lowest oleic acid content was noticed in B3 sesame oil. The highest linoleic acid content was (30.54%) in A1 sample, while, the minimum oil content was observed B3 sesame seed oil (27.49%). This result is in agreement with Devarajan et al, (2016). The highest content of Linolenic acid observed in A1sesame oil part of Sh sample was (0.51%), whereas lowest Linolenic content was noticed in B3 sesame oil (0.35). The data of Linolenic acid in sample oil sesame seed are in the range of the result obtained by Borchani et al, (2010) with (0.53 – 0.48 %).

Regarding to Saturated fatty acids, as shown in Table 1, The highest content of Palmitic (C 16:0) acid obtained in A1 part which (4.11%), whereas lowest Palmitic content was noticed in B3 sesame oil (3.15) figure 4.11, this result is in agreement with Carvalho et al, (2012). The highest content of stearic acids (C18:0) recorded in A1 sample part was (11.12%), whilst lowest stearic acid content was noticed in B3 sesame oil (10.38), this result is in agreement with Borchani et al, (2010).

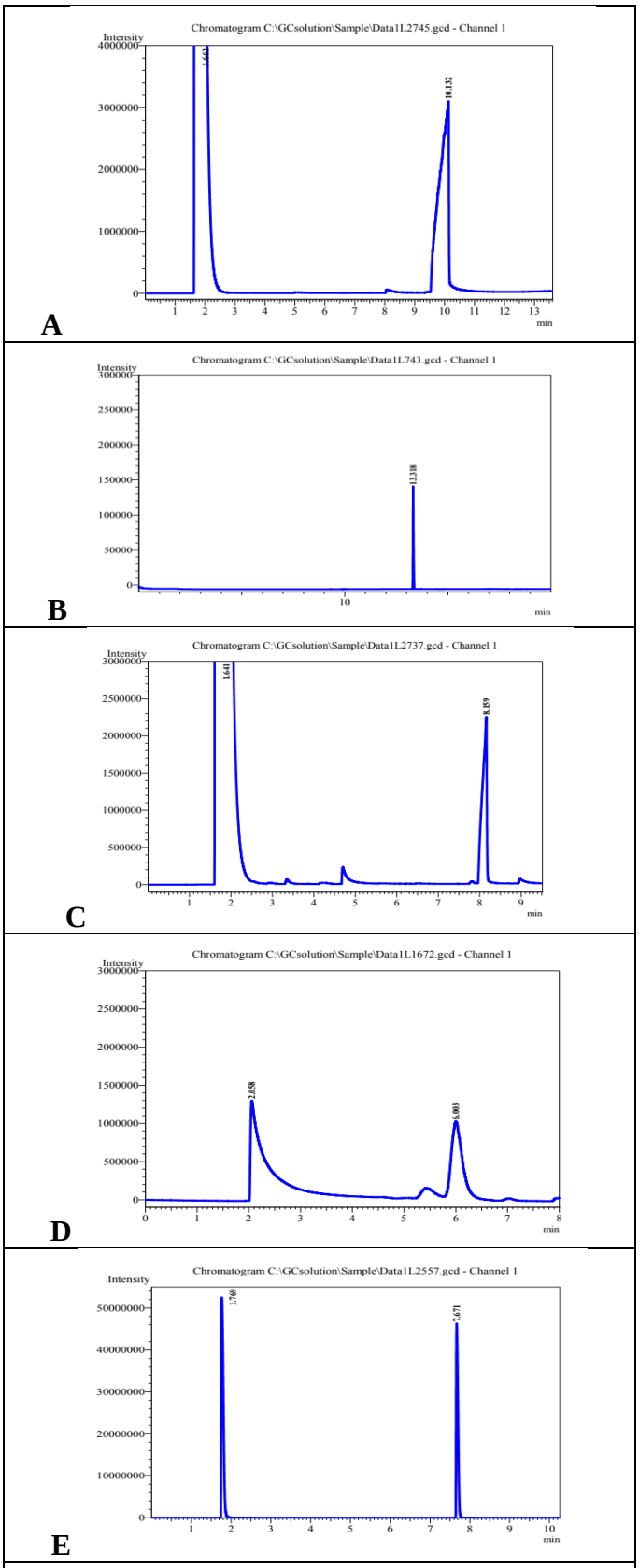

Figure 2: Gas chromatogram of (A) lenolic, (B) linolinic, (C) oleic, (D) palmitic and (E) stearic in extracted oil from sesame seed parts of Sharazoor, Akre and Mala Omar samples

Table 1: The fatty acid composition of sesame seed oil

Parts	Palmitic %	Stearic %	Oleic %	Linoleic %	Linolenic %
A	4.06	11.12	40.96	30.35	0.49
A1	4.11	11.22	41.05	30.54	0.51
A2	4.01	11.02	40.36	30.01	0.47
A3	3.89	10.79	39.55	29.22	0.42
B	3.61	10.90	39.01	29.21	0.41
B1	3.88	11.00	39.87	29.51	0.43
B2	3.41	10.65	38.47	28.55	0.39
B3	3.15	10.38	37.58	27.49	0.35
C	3.92	11	39.86	29.62	0.45
C1	4.00	11.12	40.56	29.85	0.47
C2	3.67	10.89	39.22	29.05	0.42
C3	3.41	10.66	38.02	28.22	0.38

3.5 Acid Value

Acidity is the amount of potassium hydroxide needed to neutralize one gram of a chemical compound. Free fatty acids may be made by hydrolyzing fats and oils. Time, temperature, and moisture content all have an effect on the amount of FFA that is formed throughout the digestion process. As shown in Table 1, the lowest acid value content (2.1030 mg KOH \gm oil) was found in sharazoor sesame oil sample A1, while the highest acid value level was found in sample C3 Omar Mala sample. Which another study result obtained by (Borchani et al, 2010) as (1.64 – 1.10).

3.6 Iodine Value

Fats and oils, for example, have an iodine value, which measures how much iodine is taken up by the item. Centigrams of iodine per gram of the item being examined are the units used to represent the iodine concentration in test samples. Sesame oil samples had IVs ranging from (7.733 and 114.954 g/100 g). The highest iodine value showed in A3 part of sesame oil Sh sample 11.4954 g/100 g while the lowest iodine value contain in B2 part of sesame oil sample A 7.733 which another study result indicated as (103- 116 g/100 g) obtained by Parthasarathy et al, (2014).

3.7 Peroxide Value

For hydroperoxides, the peroxide value is an important metric since it tells us how much

oxygen there is in the compound. The peroxide value tells us how much oxidation has occurred. Table 1 shows samples of sesame oil with peroxide levels between 3.8850 and 15.9267 meq/kg. The B3 sesame oil sample had the highest peroxide value of 15.9267 meq/kg, while the B sesame oil sample had the lowest peroxide value of 3.8850 meq/kg. Similar to a study carried out by Gharby et al,(2017) which their results that the PV ranged (2.7 – 6.9) meq/kg.

Table 2: physiochemical properties of sesame oil samples

NO	Sample	Viscosity (pa.s). At 25 ºC	Specific gravity at 25 ºC	Acid value mg KOH \gm oil	Iodine value g/100 g	Peroxide value meq/kg
1	A	0.0522	0.902	2.2358	35.182	4.4029
2	A 1	0.0525	0.9	2.1030	28.901	5.2835
3	A 2	0.0520	0.906	2.7370	29.340	4.4169
4	A 3	0.0511	0.904	3.1022	114.954	10.5789
5	B	0.0500	0.909	2.6175	16.413	3.8850
6	B 1	0.0504	0.908	2.4156	10.551	5.8275
7	B 2	0.0499	0.9012	2.9871	7.733	3.8986
8	B 3	0.0490	0.910	3.3422	18.644	15.9267
9	C	0.0516	0.906	5.4134	22.410	3.8955
10	C 1	0.0518	0.900	4.6145	16.512	5.8433
11	C 2	0.0510	0.908	6.7338	12.214	3.9502
12	C 3	0.0500	0.906	15.5815	32.145	12.0975

4. CONCLUSIONS

The Mala Omar sample especially the medium size part is considered a good source for obtaining oil, since its higher extracted oil of 48.420% than other samples. Small sesame seeds of higher FFA than other parts and large parts of higher quality have lower FFA and MO parts as a general of higher 10.40 acid value and higher free fatty acids. The higher IV is of sharazoor sample parts i.e this sample of higher content of multi unsaturated Free fatty acids i.e of higher quality rich of different omega parts. Higher PV is found in small parts of local samples, especially in Akre (B3) sample sesame seeds they are unstable and undergo oxidation of components

References

Agriculture statistics department, (2014). Summer Crops agricultural report Planting year 2013

AOAC., (1995). Official methods of analysis 16th edition. Association of official analytical chemists. Washington, DC, USA.

AOAC (2005) Official Methods of Analysis of the Association of Analytical Chemists. 18th Ed. Gaithersburg, MD, USA., ISBN-13: 978-0935584752

Baker, B.P. and Grant, J.A., 2018. Sesame & Sesame Oil Profile.

BORCHANI, C., BESBES, S., BLECKER, C.H. & ATTIA, H., (2010). Chemical characteristics and oxidative stability of sesame seed, sesame paste, and olive oils. Journal of Agricultural Science and Technology, 12(5),585-596.

BROSK F. A. ZANGANA, (2013). Experiment No. 2: Density and Specific Gravity (Hydrometer).

CHAKRABORTY, D., DAS, J., DAS, P.K., BHATTACHARJEE, S.C. & DAS, S., 2017. Evaluation of the parameters affecting the extraction of sesame oil from sesame (Sesamum indicum L.) seed using soxhlet apparatus. International Food Research Journal, 24(691-695.).

DEVARAJAN, S., SINGH, R., CHATTERJEE, B., ZHANG, B. & ALI, A., (2016). A blend of sesame oil and rice bran oil lowers blood pressure and improves the lipid profile in mild-to-moderate hypertensive patients. Journal of clinical lipidology, 10(2),339-349.

DIAMANTE, L.M. & LAN, T., (2014). Absolute viscosities of vegetable oils at different temperatures and shear rate range of 64.5 to 4835 s− 1. Journal of food processing 2014:1-6.

EMIL, A., YAAKOB, Z., SATHEESH KUMAR, M.N., JAHIM, J.M. & SALIMON, J. (2010) Comparative evaluation of physicochemical properties of jatropha seed oil from Malaysia, Indonesia and Thailand. Journal of the American Oil Chemists' Society. 87 (6). 689-695.

GHARBY, S., HARHAR, H., BOUZOUBAA, Z., ASDADI, A., EL YADINI, A. & CHARROUF, Z., (2017). Chemical characterization and oxidative stability of seeds and oil of sesame grown in Morocco. Journal of the Saudi Society of Agricultural Sciences, 16(2), pp.105-111.

HASSAN, M.A., (2012). Studies on Egyptian sesame seeds (Sesamum indicum L.) and its products 1- physicochemical analysis and phenolic acids of roasted Egyptian sesame seeds (Sesamum indicum L.). World Journal of Dairy & Food Sciences, 7(2), 195-201.

HOJJATI, M., NOGUERA-ARTIAGA, L., WOJDYLO, A. & CARBONELL-BARRACHINA, A.A. (2015). Effects of microwave roasting on physicochemical properties of pistachios (Pistaciavera L.). Food science and biotechnology. 24 (6).1995-2001.

Kamal-Eldin, A. and Appelqvist, L. A. 1995. The effects of extraction methods on sesame oil stability. Journal of the American Oil Chemists' Society 72(8): 967-969.

Lichtenstein, A. H. and Deckelbaum, R. J. 2001. Stanol/sterol ester–containing foods and blood cholesterol levels: A statement for healthcare professionals from the nutrition committee of the council on nutrition,

physical activity, and metabolism of the American heart association. Circulation 103(8): 1177-1179.

ORSAVOVA, J., MISURCOVA, L., AMBROZOVA, J.V., VICHA, R. & MLCEK, J., (2015). Fatty acids composition of vegetable oils and its contribution to dietary energy intake and dependence of cardiovascular mortality on dietary intake of fatty acids. International journal of molecular sciences, 16(6): 12871-12890.

PARTHASARATHY, U., NANDAKISHORE, O.P., SENTHIL KUMAR, R. & PARTHASARATHY, V.A., (2014). A comparison on the physico-chemical parameters of seedbutters of selected Indian garcinia spp.

RAHMAN, M.S., HOSSAIN, M.A., AHMED, G.M. & UDDIN, M.M., (2007). Studies on the characterization, lipids and glyceride compositions of Sesame (Sesamum indicum linn.) Seed Oil. Bangladesh Journal of Scientific and Industrial Research, 42(1): 67-74.

Book, G., (2005). Ministry of Agriculture and Land Reclamation. Economic Affairs Sector, Central Administration for Economic.Visavadiya, N. P., Soni, B. and Dalwadi, N. 2009. Free radical scavenging and antiatherogenic activities of Sesamum indicum seed extracts in chemical and biological model systems. Food and chemical toxicology 47(10): 2507-2515.

Zhang, H., Wang, Z. and Liu, O., (2015). Development and validation of a GC–FID method for quantitative analysis of oleic acid and related fatty acids. Journal of Pharmaceutical Analysis, 5(4): 223-230.