PARTIAL OIL CHARACTERIZATION, VITAMIN, MINERAL AND ANTIOXIDANT CONTENT OF SESAME (*Sesamumindicum*) SEED

**ABSTRACT**

**BackgroundandObjectives:** Sesame (*Sesamumindicum*) is one of the earliest human production and consumption crops in the family of Pedaliaceae. It is also an erect annual herb that grows 60–150 cm tall, having simple or branched stem, and with leave opposite or alternately at each node.**MaterialsandMethods:** The mineral properties, vitamin content, partial oil characterization, and antioxidant properties of sesame seed were analyzed using standard laboratory methods. **Results:** The mineral analysis carried out revealed the presence of calcium,magnesium,sodium,potassium,selenium, cobalt, copper, iron, zinc, and manganese in castor seeds to be 9.55 $\pm 0.01,$ 6.63 $\pm 0.02, $3.79$\pm 0.01,$ 3.34 $\pm 0.04, $0.36 $\pm 0.00$, 0.09 $\pm 0.00$, 1.43 $\pm 0.01,$ 0.14 $\pm 0.00$, 0.36$\pm 0.00$ respectively. The physicochemical properties were recorded at Specific gravity (0.93 $\pm 0.00), $Cloud pointoC( 12.4$\pm 0.20$)*,* Flash pointo C (267.66 $\pm 1.52$), Melting pointoC (6.23 $\pm 0.25$), Boiling pointoC (319 $\pm 3.00$). Vitamin C was the vitamin with the highest composition (56.75$\pm 0.43), followed by$ vitamin D (26.16 $\pm 0.13$ ), vitamin E (20.4$6 \pm 1.07$), vitamin A (17.39$\pm 0.08$ ).The partial oil characteterization and the antioxidants properties were also revealed.**Conclusion:** This study showed that the sesame seed is a good source rich in vitamin minerals and oil. *Sesamumindicum* L. The oil extracts exhibited good physicochemical properties and could be useful for health and industrial applications.

**Keywords:** sesame seed, physicochemical properties mineral properties,vitamin,partial oil characterization,antioxidant properties

**INTRODUCTION**

Sesame (*Sesamumindicum*) is one of the earliest human production and consumption crops in the family of Pedaliaceae (Zech-Matterne*et al.,*2015), rape, soybean, and peanuts, known as China’s four major oil crops. It was first discovered in ancient sites in Pakistan, sesame is a long-established cultivated crop (Bedigian, 2010). Globally, India, sesame (French), goma (Japanese), gergelim (Portuguese) and ajonjoli (Spanish Sudan, Myanmar, China, and Tanzania) are the major producers of sesame. In recent years, the production of sesame seeds in African countries has increased, and Tanzania has replaced India as the leading producer of sesame seeds. According to the Food and Agriculture Organization of the United Nations, the global production of sesame in 2017 was 5.899 million tons, of which 806,000 tons were produced in Tanzania and 733,000 tons in China (Xu and Zhang, 2018). Among the oilseed crops, sesame has been cultivated for centuries, particularly in Asia and Africa, for its high content of edible oil and protein. It is commonly known as til (Hindi), hu ma (Chinese).

 Sesame seeds are a source of edible oil such as sesame oil, used in cooking and decorating foods (Dakia*etal.,* 2015). Additionally, sesame seeds consist of various bioactive compounds, minerals vitamins and antioxidants, (El-Adawy and Taha, 2001).

They are known to be rich in healthy fats, particularly mono- and polyunsaturated fatty acid which have been associated with cardiovascular health (Siddique *et al.,*2017). Sesame seeds also contain a diversity of minerals which includes; calcium, iron magnesium, and zinc. These minerals play an important role in maintaining overall health and well-being.

Furthermore, sesame seeds are a source of various vitamins, such as vitamin E, niacin, and folate (Badr*et al*., 2019) which contribute to their potential health benefits and functional properties.

MATERIALSANDMETHODS

**Studyarea**Themineralproperties, vitamin content, partial oil characterization, and antioxidant properties were carried out in Docchy Analytical Laboratories, from March to May, 2023.

**Sample collection:** The sample (sesame seed) were purchased from Eke-Awka market, Awka south local government area in Anambra state.

**Sample preparation:** The outer covering (hull) of the sesame seed were de-shelled to give the endosperm. The endosperms which are whitish in color were what we used to carry out the analysis.The endosperm was blended and stored in an airtight plastic container.

Laboratory equipment’s used

Beaker, Crucible, Conical flask, Weighing balance, Desiccator, Measuring cylinder, Spatula,Distilledwater, Muffle furnace,Volumetric flask, Oven, Burette, Water bath, UV- spectrometer, Analytical weighing balance, centrifuge.

**Reagentsused:**All the reagents used were already prepared and commercially obtained.

ANTIOXIDANTS

**ABTSScavengingeffects**

The antioxidant effect of the sesame seeds were studied using ABTS (2, 2’-azino-bis- 3-ethylbenzthiazoline-6-sulphonic acid) radical cationdecolourisation assay according to the method of(Shirwaikar*et al*.2006).

Reagent

ABTSSolution(7mMwith2.45mMammoniumpersulfate)

Procedure

ABTS radical cations (ABTS+) were produced by reacting ABTS solution 7mM with 2.45mMammonium persulphate.The mixture was allowed to stand in the dark at room

temperature for 12-16 hours before use. Aliquots (0.5ml) of the different samples were added to 0.3ml of ABTSsolution and the final volume was made up to 1ml with ethanol. The absorbance was read at 745nm in a spectrophotometer and the percent inhibition was calculated using the formula

Inhibition(%) =((Control –test) ×100)/Control

Superoxide scavenging activity

The superoxide scavenging abilityof the sesame seedswere assessed by the method of (Winterbourn*et al*.1975).

Principle

This assay is based on the inhibition of the production of nitrobluetetrazoliumformazon of the superoxide ion by the samples and is measured spectrophotometrically at 560nm.

Reagents

1. EDTA(0.1M containing1.5mgof NaCl)
2. Nitrobluetetrazolium(NBT –1.5mM)
3. Riboflavin(0.12mM)
4. Phosphatebuffer (0.067M,PH7.4)

 5. Thiobarbituricacid(1%)

**Procedure**

A solution of H2O2, 40Mm was prepared in phosphate buffer. Seed sample at the concentration of 10mg/10µl were added to H2O2 solution 0.6ml and the total volume was made up to 3ml.

The absorbance of the reaction mixture was recorded at 230nm in a spectrophotometer (Genesys 10-S, USA). A blank solution containing phosphate buffer, without H2O2 was prepared. The extent of H2O2 scavenging of the sample samples was calculated as

 % scavenging of hydrogen peroxide = (A0 –A1) × 100

A0= Absorbance of control

A1 - Absorbance in the presence of sample

**MEASUREMENT OF SUPEROXIDE SCAVENGING ACTIVITY**

The superoxide scavenging ability of the samples was assessed by the method of Winterbourn*etal*., (1975).

**PRINCIPLE**

This assay is based on the inhibition of the production of nitrobluetetrazoliumformazon of the superoxide ion by the sample samples and is measured spectrophotometrically at 560nm.

**REAGENTS**

1. EDTA (0.1M containing 1.5mg of NaCN)

2. Nitrobluetetrazolium (NBT - 1.5mM)

3.Riboflavin (0.12mM)

4. Phosphate buffer (0.067M, pH 7.6)

**PROCEDURE**

Superoxide anions were generated in samples that contained in 3.0ml, 0.02ml of the seed samples 20mg, 0.2ml of EDTA, 0.1ml of NBT, 0.05ml of riboflavin and 2.64ml o phosphate buffer. The control tubes were also set up where DMSO was added instead of the sample samples. All the tubes were vortexed and the initial optical density was measured at 560nm in a spectrophotometer (Genesys, 10-S, USA). The tubes were illuminated using a fluorescent lamp for 30 minutes. The absorbance was measured again at 560nm. The difference in absorbance before and after illumination was indicative of superoxide anion scavenging activity.

**MEASUREMENT OF NITRIC OXIDE SCAVENGING ACTIVITY**

The extent of inhibition of nitric oxide radical generation in *vitro* was followed as per the method reported by Green *et al*., (1982).

**PRINCIPLE**

Sodium nitroprusside in aqueous solution, at physiological pH, spontaneously generates nitric oxide, which interacts with oxygen to produce nitrite ions that are estimated spectrophotometrically at 546nm.

**REAGENTS**

1. Sodium nitroprusside (100mM)
2. Phosphate buffered saline (pH 7.4)
3. Griess reagent (1% sulphanilamide, 2% H3PO4 and 0.1% naphthylethylenediaminedihydrochloride)

**PROCEDURE**

The reaction was initiated by adding 2.0ml of sodium nitroprusside, 0.5ml of PBS, 0.5ml of seed samples 50mg and incubated at 25°C for 30 minutes. Griess reagent 0.5ml was added and incubated for another 30 minutes. Control tubes were prepared without the samples. The absorbance was read at 546nm against the reagent blank, in a spectrophotometer (Genesys 10-S, USA).

**MEASUREMENT OF HYDROXYL RADICAL SCAVENGING ACTIVITY**

The extent of hydroxyl radical scavenging from Fenton reaction was quantified using 2'-deoxyribose oxidative degradation as described by Elizabeth and Rao (1990).

**PRINCIPLE**

The principle of the assay is the quantification of 2'-deoxyribose degradation product, malondialdehyde, by its condensation with thiobarbituric acid.

**REAGENTS**

1. Deoxyribose (2.8mM)

2. Ferric chloride (0.1mM)

3. EDTA (0.1mM)

4. H2O2 (1Mm)

5. Ascorbate (0.1mM)

6. KH2PO4-KOH buffer (20mM, pH 7.4)

7. Thiobarbituric acid (1%)

**PROCEDURE**

The reaction mixture contained 0.1ml of deoxyribose, 0.1ml of FeCl3, 0.1ml of EDTA, 0.1ml of H2O2, 0.1ml of ascorbate, 0.1ml of KH2PO4-KOH buffer and 20µl of sample samples in a final volume of 1.0ml. The mixture was incubated at 37°C for 1 hour. At the end of the incubation period, 1.0 ml of TBA was added and heated at 95°C for 20 minutes to develop the colour. After cooling, the TBARS formation was measured spectrophotometrically (Genesys 10-S, USA) at 532nm against an appropriate blank. The hydroxyl radical scavenging activity was determined by comparing the -absorbance of the control with that of the samples. The percent TBARS production for positive control (H2O2) was fixed at 100% and the relative percent TBARS was calculated for the sample treated groups.

**ESTIMATION OF VITAMIN A**

Vitamin A was estimated by the method of Bayfield and Cole (1980).

**PRINCIPLE**

The assay is based on the spectrophotometeric estimation of the colour produced by vitamin A acetate or palmitate with TCA.

**REAGENTS**

1. Saponification mixture (2N KOH in 90% alcohol)

2. Petroleum ether (40°C-60°C)

3. Anhydrous sodium sulphate

4. Chloroform

5. Vitamin A palmitate

6. TCA reagent (60% TCA in chloroform) - prepared fresh.

**PROCEDURE**

All procedures were carried out in the dark to avoid the interference of light. 1g of sample was mixed with 1.0ml of saponification mixture and refluxed for 20 minutes at 60°C in the dark. The tubes were cooled and 20ml of water was added and mixed well. Vitamin A was extracted twice with 10ml of (40°C - 60°C) petroleum ether. The two samples were pooled and washed thoroughly with water. Anhydrous sodium sulphate was added to remove excess moisture. An aliquot of the sample (1.0ml) was taken and evaporated to dryness at 60°C. The residue was dissolved in 1.0ml chloroform. Standards (vitamin A palmitate) of concentrations ranging from 0-7.5MIU/g were pipetted out into a series of test tubes.

The volume in all the tubes was made up to 1.0ml with chloroform. TCA reagent 2.0ml was added rapidly, mixed and the absorbance was read immediately at 620nm in a spectrophotometer (Genesys 10UV). The same procedure was repeated for the sample tubes also. Vitamin A content was expressed as mg/kg.

**ESTIMATION OF VITAMIN E**

Vitamin E was estimated in the sample samples by the Emmerie-Engel reaction as reported by Rosenberg (1992).

**PRINCIPLE**

The Emmerie-Engel reaction is based on the reduction of ferric to ferrous ions by Vitamin Es, which, with 2,2'-dipyridyl, forms a red colour. Vitamin E and carotenes are first sampled with xylene and read at 460nm to measure carotenes. A correction is made for these after adding ferric chloride and read at 520nm.

**REAGENTS**

1. Absolute alcohol

2. Xylene

3. 2,2'-dipyridyl (1.2g/L in n-propanol)

4. Ferric chloride solution (1.2g/L in ethanol)

5. Standard solution (D,L-α-Vitamin E, 10mg/L in absolute alcohol)

6. Sulphuric acid (0.1N)

**EXTRACTION OF VITAMIN E**

The sample 2.5g was homogenized in 50ml of 0.1N sulphuric acid and allowed to stand overnight. The contents of the flask were shaken vigorously and filtered through Whatman No.1 filter paper. Aliquots of the filtrate were used for the estimation.

**PROCEDURE**

Into 3 stoppered centrifuge tubes, 1.5ml of sample sample, 1.5ml of the standard and 1.5ml of water were pipetted out separately. To all the tubes, 1.5ml of ethanol and 1.5ml of xylene were added, mixed well and centrifuged. Xylene 1.0ml layer was transferred into another stoppered tube. To each tube, 1.0ml of dipyridyl reagent was added and mixed well. The mixture (1.5ml) was pipetted out into a cuvette and the extinction was read at 460nm.

**DETERMINATION OF VITAMIN C**

Vitamin C was analysed by the spectrophotometric method described by Roe and Keuther (1943).

**Principle**

Absorbate is converted into dehydroascorbate on treatment with activated charcoal, which reacts  with2,4-dinitrophenyl hydrazine to form osazones. These osazanes produce an orange coloured solution when dissolved in sulphuric acid, whose absorbance can be measured spectrophotometrically at 540nm.

**Reagents**

1. TCA (4%)

2. 2,4dinitrophenyl hydrazine reagent (2%) in 9N H2SO4

3. Thiourea (10%)

4. Sulphuric  acid (85%)

5. Standard ascorbic aid solution: 100µg/ml in 4% TCA

**Extraction of Vitamin C**

Ascorbate was extracted from 1g of the sample using 4% TCA and the volume was made up to 10ml with the same. The supernatant obtained after centrifuging at 2000rpm for 10minutes was treated with a pinch of activated charcoal, shaken vigorously using a cyclomixer and kept for 5 minutes. The charcoal particles were removed by centrifugation and aliquots were used for the estimation.

**Procedure**

Standard ascorbate ranging between 0.2 -1.0ml, 0.5ml and 1.0ml of the supernatant were taken. The volume was made up to 2.0ml with 4% TCA. DNPH reagent (0.5ml) was added to all the tubes, followed by 2 drops of 10% thiourea solution. The contents were mixed and incubated at 370oC for 3 hours resulting in the formation of osazane crystals. The crystals were dissolved in 2.5ml of 85% sulphuric acid, in cold. To the blank alone, DNPH reagent and thiourea were added after the addition of sulphuric acid. The tubes were cooled in ice and the absorbance was read at 540nm in a spectrophotometer.

A standard graph was constructed using an electronic calculator set to the linear regression mode. The concentration of ascorbate in the sample were calculated and expressed in terms of mg/kg of sample.

**VITAMIN D**

Vitamin D was assayed according to the method of Brockmann*et al*., (1974).

**Principle**

The principle is base on the formation of a yellow color by reaction of the vitamin with a chloroform solution of trichloroacetic acid.

**Standard preparation**: Weigh accurately 25 mg vitamin D3 working standard was taken 25 ml

volumetric flask with solution mixture (chloroform and methanol in ratio 1:9) dissolved and dilute with solution mixture and make up to the mark mix well.

**Sample preparation**: Weigh accurately equivalent 0.1ml sample was taken 25 ml volumetric flask with solution mixture (chloroform and methanol in ratio 1:9) dissolved and dilute with solution mixture and make up to the mark mix well. 1.6ml of 0.25N HCL, 0.5ml of 15.0%trichloroacetic acid (TCA) and 0.5ml of 0.375% of thiobarbituric acid (TBA) was added It was absorbance recorded at 464 nm against blank.

**DETERMINATION OF FATTY ACID**

**Acid value**

**Procedure:**

(i) Diethyl ether, 25ml was mixed with 25ml of alcohol and 1ml phenolphthalein (1%) and it was carefully neutralized with 0.1M NaOH.

(ii) Dissolve 1-10g of the oil or melted fat in the mixed neutral solvent and a titrate with aqueous 0.1M NaOH shaking constantly until pink colour which persists for 15 seconds is obtained.

Calculation:

Acid value = *titre (ml) x 5.61*

*weight of sample used*

The FFA figure is usually calculated as oleic acid (1ml 0.1M sodium hydroxide = 0.0282g oleic acid), in which case the acid value = 2x FFA.

For most oils, acidity begins to be noticeable to the palate when the FFA calculated as oleic acid is about 0.5- 1.5 %

For palm oil as palmic( 1ml 0.M NaOH = 0.0256g).

For palm kernel, coconut and similar lauric acid ( 1ml 0.M NaOH =0.0200g).

**IODINE VALUE**

**Determination of iodine value**:

(i) The oil was poured onto a small beaker, a small rod was added and a sutaible quantity of the sample was weighed into a dry glass-stoppered bottle of about 250ml capacity. The approximate weight in g of the oil to mbe taken was be calculated  by dividing 20 by  the highest expected iodine value.

(ii) Carbon tetrachloride 10ml was added to the oil or melted fat and dissolve.

(iii) Wijis’ solution 20ml was added, the stopper was inserted (previously moistened with potassium iodine solution) and it was allowed to stand in the dark for 30 minutes.

(iv) Potassium iodine solution (10%) 15ml and 100ml water was added, it was mixed and titrated with 0.1M thiosulphate solution using starch as indicator just before the end-point ( titration = aml).

(v) A blank was carried out at the same time commencing with 10ml of carbon tetrachloride (titration = bml).

Iodine value =  *(b - a) x 1.269*

 *wt. (g) of sample*

Note: if (b-a) is greater than b/2 the test must be repeated using a smaller amount of the sample.

It should be noted also that the less unsaturated fats with low iodine values are solid at room temperature, or conversely, oils that are more highly unsaturated are liquid ( showing there is a relationship between melting points and the iodine value).

**Preparation of wijis’ solution**:

(i) Iodine trichloride 8g in 200ml glacial acetic acid was dissolved.

(ii) Iodine 9g in 300ml carbon tetrachloride was dissolved

(iii) The two solutions was mixed and diluted to 1000ml with glacial acetic acid.

**PEROXIDE VALUE**

Procedure:

(i) Oil or fat, 1g was weighed into a clean dry boiling tube and while still liquid, 1g powdered potassium iodide and 20ml of solvent mixture was added ( 2 vol glacial acetic acid + 1 vol chloroform).

(ii) The tube was placed in boiling water so that the liquid boils within 30 seconds and it was allowed to boil vigorously for not more than 30 seconds.

(iii) The contents was poured quickly into a flask containing 20ml of potassium iodide solution (5%), the tube was washed twice with 25ml water and titrated with 0.002M sodium thiosulphate solution using starch.

(iv) A blank was performed at the same time.

**SAPONIFICATION VALUE**

Procedure:

(i) Oil or fat, 2g was weighed into a conical flask and exactly 25ml of the alcoholic potassium hydroxide solution was added.

(ii) A reflux condenser was attached and the flask was heated in boiling water for 1hr, shaking frequently.

(iii) Phenolphthalein (1%) solution 1ml was added and a hot excess alkali was titrated with 0.5M hydrochloric acid ( titration = aml)

(iv) A blank was carried out at the same time ( titration  = bml)

Calculation:

Saponification value = *(b-a) x 28.05*

 *wt. (g) of sample*

**THIOBARBITURIC ACID NUMBER OR VALUE ( Tba)**

Procedure:

(i) Fatty food, 10g was macerated with 50ml water for 2 minutes and washed into a distillation flask with 47.5ml water.

(ii) Hydrochloric acid 2.5ml was added to bring the PH to 1.5, followed by an antifoam preparation and a few glass beads.

(iii) The flask was heated by the means of an electric mantle so that 50ml distillate is collected in 10 minutes from the time boiling commences.

(iv) Distillate of 5ml was pipette into a glass-stoppered tube, 5ml TBA reagent (0.2883g/100ml of 90% glacial acetic acid) stopper was added, it was shaked and heated in boiling water for 35minutes.

(v) A blank was prepared similarly using 5ml water reagent. Then cool the tubes in water for 10 minutes and measure the absorbance (D) against the blank at 538nm using 1cm cells. TBA ( as mg malonaldehyde per kg sample ) = 7.8D

**Specific gravity**

i. A 50ml pycometer bottle thoroughly washed was with detergent, water and petroleum ether, it was dried and weighed.

ii. The bottle was filled with water and it was weighed.

iii. After drying the bottle, it was filled with the oil sample and it was weighed

Calculation

Specific gravity = *weight of Xml oil*

 *Weight of Xml water*

**Refractive index**

i. The Abbe refractometer was reset with a light compensator

ii. The oil sample was seared on the lower prism of the instrument and closed

iii. A light was passed by means of the bangled mirror, the reflected light appears in form of a dark background

iv. Using the fine adjustment the telescope tubes was moved until the lack shadow appears central in the cross wire indicator

v. The refractive index smoke, flash and fire point was read off.

i. Volume of the oil 10ml was poured into an evaporating dish

ii. A thermometer was suspended at the centre of the dish ensuring that the bulb just dips inside the oil without touching the bottom of the dish.

iii. The temperature of oil was gradually raised using hot plate

iiii. The temperature at which the oil sample gave off a thin bluish smoke continuously was notted as the smoke point

v. Similarly the temperature at which the oil started flashing without supporting combustion was equally noted as the flash point

vi. The temperature at which the oil starts supporting combustion was recorded as the fire point.

**Methods for the Elemental Analysis**

Heavy metal analysis was conducted using Agilent FS240AA Atomic Absorption Spectrophometer according to the method of APHA 1995 (American Public Health Association).

**Working principle**: Atomic absorption spectrometer's working principle is based on the sample being aspirated into the flame and atomized when the AAS's light beam is directed through the flame into the monochromator, and onto the detector that measures the amount of light absorbed by the atomized element in the flame. Since metals have their own characteristic absorption wavelength, a source lamp composed of that element is used, making the method relatively free from spectral oklhuuoradiational interferences. The amount of energy of the characteristic wavelength absorbed in the flame is proportional to the concentration of the element in the sample.

Sample Digestion (Adrian, 1973)

1. Approximately 2g of the dried sample was weighed out in to a digestion flask and add 20ml of the  acid mixture (650ml  conc HNO3; 80ml perchloric acid; 20ml conc H2SO4)
2. The flask was heated until a clear digest is obtained.
3. It was diluted the digested with distilled water to the 100ml mark.

**Preparation of reference solutions**

A series of standard metal solutions in the optimum concentration range are prepared, the reference solutions were prepared daily by diluting the single stock element solutions with water containing 1.5 mL concentrated nitric acid/litre. Calibration blank was prepared using all the reagents except for the metal stock solutions.

**RESULTSANDDISCUSSION**

**Antioxidant results**

**Hydroxyl Radical Scavenging Activity Result**

The graph below shows that the sesame seed has lower activity in hydroxyl radical scavenging antioxidant activity compared to the standard, gallic acid with a higher activity in hydroxyl radical scavenging antioxidant activity.

**Figure 1: Hydroxyl radical scavenging antioxidant activity of the seed of *sesamum***

***indicum***

**Superoxide Scavenging Activity Result**

The figure below shows that sesame seed has superoxide scavenging activity, but when compared to the standard, gallic acid it is slightly lower.

**Figure 2: Superoxide scavenging activity of the seed of*sesamumindicum***

**Ferric Reducing Power Activity Result**

The graph below shows that the sesame seed has lower activity in ferric reducing power activity when compared to the standard, gallic acid with a higher activity in ferric reducing power activity.

**Figure 3: Ferric reducing power activity of the seed of *sesamumindicum***

**Abts Activity Result**

The graph below shows that sesame seed have an effective ABTS activity, but when compared with the standard, gallic acid, it is slightly lower than the standard.

**Figure 4: ABTS activity of the seed of *sesame indicum***

**Nitric Oxide Activity Result**

The graph below show that sesame seed has a very low nitric oxide activity when compared to the standard, gallic acid.

**Figure 5: Nitric oxide activity of the seed of *sesamumindicum***

**Vitamin Result**

The vitamins concentration found in *sesamumindicum* are shown in table 2. In *sesamumindicum* the vitamin A content is 17mg/kg, vitamin C (56.75mg/kg), vitamin D (26.16mg/kg), and Folate (0.27mg/kg).

**Figure 6: A bar chart showing different vitamin results**

**Partial Oil Charaterization Results**

The partial oil characterization parameter found in the seed of *sesamumindicum* are shown in table 1. In the seed of *sesamumindicum* the Free fatty acid and acid value is 6.00% and 12.01% respectively. The shows that seed of *sesamumindicum* is less susceptible to oxidative aging. The value of peroxide value (6.00mleq/kg) shows that it is fresh and of good quality, considered suitable for human consumption. The iodine value (110.84) shows that the oil of*sesamumindicum* contains unsaturated fatty acid (oleic and linoleic fatty acid) and it also has stability and nutritional quality. The value of specific gravity shows that the oil of *sesamumindicumis*less dense than water.

**Table 1: Partial oil characterization parameters of *sesamumindicum***

**Parameters Concentrations**

**Acid value (%) 12.01** $\pm 0.5$**0**

**Free fatty acid (%) 6.00** $\pm 0.22$

**Saponification value(mgKOH/kg) 273.95** $\pm 7.05$

**Peroxide value (mleq/kg) 6.46**$\pm 0.30$

**Iodine value 110.84** $\pm 1.36$

**Refractive index 1.41** $\pm 0.01$

**Viscosity (Mpas.sec) 138** $\pm 1.73$

**Specific gravity 0.93** $\pm 0.00$

**Cloud pointoC 12.4** $\pm 0.20$

**Flash pointo C 267.66** $\pm 1.52$

**Melting pointoC 6.23** $\pm 0.25$

**Boiling pointoC 319** $\pm 3.00$

**Minerals Results**

The table 2 and 3 shown above consist of the macromolecule andnmicromolecule contained in the seed of *sesamumindicum*

**Table 2: The macrominerals and their concentrations**

**MacromineralsConcentrations[ppm]**

 **Magnesium 6.63** $\pm 0.02$

**Sodium 3.79**$\pm 0.01$

**Calcium 9.55** $\pm 0.01$

**Potassium 3.34** $\pm 0.04$

**Table 3: The microminerals and there concentrations**

**Microminerals Concentrations[ppm]**

**Iron 1.43** $\pm 0.01$

**Zinc 0.14** $\pm 0.00$

**Selenium 0.36** $\pm 0.00$

**Copper 0.57** $\pm 0.01$

**Cobalt 0.09** $\pm 0.00$

**Manganese 0.36**$\pm 0.00$

**Discussion**

Free radical production is a continuous process which occurs as part of normal cellular function. However, excessive production of free radicals is strongly implicated in many diseases (Young and Woodside, 2001). The key function of antioxidants is to prevent adverse effects caused by free radicals (Naczk and Shahidi, 2004). To determine if sesame seeds could exert antioxidant effects through single-electron donation, the ABTS assay was used. The pattern of results for this assay was 71.161%. Previous studies reported a scavenging activity of 58% or between 62 - 79% of sesame seed extracts. These observations suggest that the results for the current study were significantly higher than that of previously published work.

The potent hydroxyl radical can be generated through the Fenton reaction in cells. The radical chain reaction mediated by the hydroxyl radical depends on Fe3+. Thus, the ability of a compound to reduce Fe3+ to Fe2+ could contribute to its antioxidant potential. The results obtained in Ferric reducing power activity indicated that sesame seed has an effective reducing power. The reducing power of sesame seed is concentration-dependent similarly with Gallic acid. Higher absorbance indicates increasing reducing power capacity.

To determine the other nutritional benefits that can be derived from the consumption of sesame seeds, physicochemical, mineral and vitamin analysis was carried out. This analysis showed that the magnesium, sodium, calcium and potassium content of sesame seed was 6.63 $\pm 0.02 mg,$ 3.79$\pm 0.01 mg,$ 9.55 $\pm 0.01 mg$ and 3.34 $\pm 0.04 mg$ respectively. This mineral content of sesame seed is similar to that of the ones found in the previous studies which shows that magnesium, sodium, calcium and potassium content of sesame seeds are 5.79 ± 0.04 mg, 1.22 ± 0.04 mg, 4.15 ± 0.03 mg and 8.51 ± 0.03 mg ( Nzikuo*et al*., 2009).

The results obtained from the physicochemical analysis indicates that sesame oil has an effective refractive index, iodine value which determines the types of fatty acid present in sesame oil, such as saturated fatty acids (e.g., palmitic acid), monounsaturated fatty acids (e.g., oleic acid), and polyunsaturated fatty acids (e.g., linoleic acid). The fatty acid profile of sesame oil contributes to its nutritional properties and potential health benefits (Pham *et al.,* 2015).

**Conclusion**

This study showed that the sesame seed is a good source rich in vitamin minerals and oil. *Sesamumindicum* L*.* seed oil is of unsaturated type and contains mainly the fatty acids oleic C18:1 and linoleic C18:2. The oil can be classified in the oleic-linoleic acid group. High saponifiable matters content (273.95mgKOH/kg**)** guarantees the use the oils in cosmetics industry. The oil extracts exhibited good physicochemical properties and could be useful for health and industrial applications.

**References**

1. Bedigian, D. (2010) Characterization of Sesame (*Sesamumindicum L.*) Germplasm: *A Critique. Genet.Resour. Crop Evol.* **57:** 641–647*.*
2. Naczk, M. and Shahidi, F. (2004). Extraction and analysis of phenolics in food, *Journal of chromatography,* **1054 (1-2):**95–111 .
3. Young, I.S. and Woodside J.V., (2001). Antioxidants in health and disease, Journal of Clinical Pathology. improve blood pressure? A systematic review and meta-analysis of controlled trials. *Journal science,***54 (3):** 176–186.
4. Xu, G. and Zhang, W. (2018) Analysis of the changing trend of world sesame production and trade structure. *World Agric*. **10**: 131–137.
5. Zech-Matterne, V.; Tengberg, M.and Van Andringa,W. Sesamumindicum L., (2015) (Sesame) in 2nd Century BC Pompeii, Southwest Italy, and a Review of Early Sesame Finds in Asia and Europe. *Veg. Hist. Archaeobotany*, **24**: 673–681.
6. Pham, T. H., Kwon, H., Song, Y. J. and Lee, S. J. (2015). Chemical composition, antioxidant and antimicrobial activities of essential oil from Korean sesame (Sesamumindicum L.) seeds. *Food Science and Biotechnology,* **24(6):** 2407-2412.
7. Dakia, P. A., Wathelet, B. and Paquot, M. (2015). Isolation and chemical evaluation of sesame seed lignans. *Journal of Food Science and Technology*, **52(6):** 3393-3403.
8. Badr, F. H., El-Sebae, A. H., and Nasser, R. A. (2019). Chemical composition, functional properties and antioxidant activity of defatted sesame seed flour. *Journal of Food and Dairy Sciences***, 10(6):** 219-226.
9. El-Adawy, T. A., and Taha, K. M. (2001). Characteristics and composition of different sesame (Sesamumindicum L.) *cultiv.*
10. Siddique, F., Elworthy, A. C., and Griffiths, G. (2017). Quantification of lignan content in sesame seeds and sesame oil: A critical review. *Journal of AOAC International*, **100(6):** 1709-1715.