IOSR Journal of Biotechnology and Biochemistry (IOSR-JBB)
ISSN: 2455-264X, Volume 6, Issue 3 (May – June. 2020), PP 52-62
www.iosrjournals.org

Nutritional Composition and In-vitro Free Radical Scavenging Potentials of S*esamumIndicum*Seeds

[a]Enemor, V.H.A.; Opara, P.O.; Martins, C.E.; Okafor, C.S.; Mbaka, O.P. and Obayuwana, E.A.
Department of Applied Biochemistry, Nnamdi Azikiwe University, Awka, Anambra State.

Abstract
Background*: Local seeds are known for nutritional values and often useful for immense medicinal properties. This study was carried out to investigate the nutritional compositions and in-vitro free radical scavenging potentials of Sesamum indicum seed.*
Materials and methods*:Proximate analysis and antinutrient compositions of the sample was carried out using appropriate methods described by the Association of Official Chemists (AOAC). The mineral and vitamin composition of the sample were determined spectrophotometrically. Percentage free radical scavenging activity, the reducing power activity, the inhibition of lipid peroxidation activity, hydrogen peroxide scavenging activity and in-vitro antioxidant enzyme assay of the sample were determined by spectrophotometric methods.*
Results:*The proximate analysis of the sample showed that the sample contains ash (6.29%), moisture (4.06%), crude protein (23.52%), crude fiber (5.14%), total lipid (46.20%), and total carbohydrate content (14.79%). The antinutrient composition of the sample were; oxalate (9.72mg/g), phytate (1.37%), alkaloids (5.08%), cardiac glycosides (11.90%), phenol (0.05mg/g), and tannins (0.54mg/g). Trypsin inhibition of the sample was 14.93IU. The mineral content of the sample were; calcium (2.62mg/g), copper (0.02mg/g), iron (0.04mg/g), magnesium (5.81mg/g), potassium (1.21mg/g), sodium (0.31mg/g), zinc (0.03mg/g), while cobalt, nickel and selenium were not detected. The vitamin content of the sample were; vitamin B1 (5.29 µg/g), vitamin B2 (25.58 µg/g), vitamin B3 (4.52 µg/g), vitamin B6 (7.30µg/g), vitamin B9 (4.21 µg/g), vitamin A (0.73 µg/g), vitamin C (0.50 µg/g), while vitamins B12, D and E were not detected. The in-vitro antioxidant activity of the sample showed the percentage free radical scavenging activity (µg/ml) is 28.40±16.76, the reducing power activity(µg/ml) is 0.32±0.23, the inhibition of lipid peroxidation activity (µg/ml) is 54.33±26.90, and the hydrogen peroxide scavenging activity was 18.19±18.85. The in-vitro antioxidant enzyme assay of the sample for SOD and Catalase were 0.0041±0.0008 and 0.3563±0.0637, respectively.*
Conclusion:*The findings from this study suggests that seed extracts of Sesamum indicum is rich in minerals, vitamins and exhibits high antioxidant activity and would play a huge role in managing the causes and effects of oxidative stress. Sesame seed meal is therefore recommended as a viable source for many of the major nutrients needed for various metabolic functions.*
Keywords*: Sesamum indicum, proximate analysis, Antinutrient composition, in-vitro Antioxidant scavenging activity.*

Date of Submission: 02-06-2020 Date of Acceptance: 17-06-2020

I. Introduction

Sesame (*Sesamum indicum)* is an ancient spice, one of the first recorded plants used for its seeds. It has been used for thousands of years and is still an oilseed of worldwide significance. It is also known as "benniseed", "gingelly", "sim sim" and locally as "Igogoo" in Kogi State of Nigeria (Bamigboye*et al.,* 2010). It is widely distributed and found in tropical, sub-tropical and Southern temperate areas of the world particularly India, China, Africa(Nigeria) and South America. Sesame is cultivated for its edible seeds which grow in pods (Hansen 2012). However, it is often stated that it has its origin in Africa and spread early through Western Asia(India, China and Japan). Sesame ranks among the top thirteen oilseed crops which make up to 90% of the world production of edible oils (Bamigboye*et al.,* 2010).*Sesamum indicum* is an annual plant which grows either bush-like or upright depending on the variety and grows to about 60-120cm in height. The seeds are very small and with no endospermand occurs in a variety of colours such as white, grey, brown, chocolate or black; it is believed that the seed colour affects its phytochemical contents and their biological activities (Zhou *et al.,* 2016).

The oil extracted from the seed could be used for cooking, massage and for treatment in certain health conditions. In addition to its popular use as oil for salads or cooking, sesame oil is used in producing margarines, soap making, pharmaceuticals, paints and lubricants. In the cosmetic field, sesame oil is used as a

base in developing perfumes (Price and Smith, 1999). Previous studies carried out on *Sesamumindicum* seed reported that sesame seed is rich in various categories of nutrients (Godin and Spensley, 1971). Some studies also esteemed sesame seed oil to be of high quality due to its content of endogenous antioxidants with high anticarcinogenic potentials (Price and Smith, 1999; Patnaik, 1993). The seed could also be rich in certain minerals (Obiajunwa *et al.*,2005).

Free radicals which have one or more unpaired electrons are produced in normal or pathological cell metabolism. Reactive oxygen species (ROS) reacts easily with free radical to become radicals themselves. There are various forms of activated oxygen, which include free radicals such as superoxide anion radicals and hydroxyl radicals as well as non-free radical like hydrogen peroxide species and the singlet oxygen (Vishwanath *et al.,* 2012). Excessive generation of ROS induced by various stimuli and which exceed the antioxidant capacity of the body leads to a variety of pathophysiological processes such as inflammation, diabetes, genotoxicity and cancer (Kourounakis *et al.,* 1999). They are often generated as byproducts of biological reactions, or from exogenous factors. ROS may also be very damaging as they can induce oxidation of lipids, causing membrane damage, decrease membrane fluidity and lead to cancer via DNA mutation (Cerutti, 1994). Polyphenols present in plants, fruits and vegetables are an important source of natural antioxidants as they act as reducing agents, hydrogen donors, singlet oxygen quenchers and potential metal chelators (Kahkonen *et al.,* 1999). The World Health Organization (WHO) estimated that approximately 80% of the world population relies primarily on traditional medicine as a source for their primary health care (Farnsworth *et al.,* 1985).

As nutritionally important as sesame seed is in some parts of the world, little is known and documented about the nutritional composition and *in-vitro* antioxidant potentials of Nigerian Sesame seeds in literature especially its proximate and mineral compositions and its antioxidative activities. Investigations has revealed that sesame seed is grown extensively in Benue State and some other states in Nigeria including Kogi, Gombe, Jigawa, Kano, Nasarawa, Kastina, Yobe and Abuja, all in Nigeria. This study was conducted to provide nutrition information and *in-vitro* antioxidant scavenging potentials of Nigerian-grown sesame seeds.

II. Methods of analyses

Samplecollection and preparation

Seeds of sesame werepurchased from Ega market in Idah local Government area of Kogi State, Nigeria. The sample was packaged in a polythene bag and taken to the Botany Department Nnamdi Azikiwe University, Awka for identification and authentication. The seeds were sorted and cleaned from debris and all extraneous materials by winnowing and hand picking. The samples were then dried in the oven at 45^{o}C for 24hours.

Preparation of Sample for Proximate Analysis

Two grams of the sample was weighed and ashed in muffle furnace at 550^{o}C. The ash produced was dissolved in 100ml of 0.1M HNO_3 and was used for the analysis.

Sample Preparation for Chemical Analysis

The dried sample was milled with a corona manual grinder into a fine powder and was stored in an airtight container till further use.

SampleExtraction:

Twenty grams (20g) of the milled sample was soaked in 100ml of 70% ethanol and was placed in a shaker (HY-4A multipurpose Oscillator) for one hour. It was then allowed to stand for 24hours at room temperature. The mixture was filtered through whatman paper No. 4 and the filtrate was evaporated at 78^{o}C using a water bath (Techmel and Techmel, 420 USA). The dried residue was weighed and reconstituted in 70% ethanol at a concentration of 10mg/ml and stored at 4^{o}C in a refrigerator till further use.

The sample were analysed in triplicate for moisture, crude protein, crude lipid, crude fiber and ash using various standard methods as contained in Association of Official Analytical Chemists (AOAC, 1995). The carbohydrate content was obtained by difference (subtracting the values obtained for moisture, crude protein, crude lipid, crude fiber and ash from 100).

The antinutrient composition of the sample were determined: cardiac glycoside and oxalate were determined using the method as described by Osagie (1998) while phytate content was determined as described by Young and Greaves (1940). Trypsin inhibitor was determined by using the reaction trypsin producing tyrosine in the presence of casein substrate as outlined by Jayaraman (1981). Total phenol and saponin were determined according to AOAC (1995) as described by Baros *et al.,* (2007).

Mineral analysis was conducted using Varian AA240 Atomic Absorption Spectrophotometer as described by Mevlude and Sezen (2005). In theprocess, the amount of energy of the characteristic wavelength absorbed in the flame is proportional to the concentration of the element in the sample.

Vitamin content of the sample were assayedaccordingly as contained in the AOAC (1995) methods of analysis, in which the absorption of vitamins A,B1,B2,B3,B6,B12,B9,C and D were determined spectrophometrically at their respective wavelenths.

The i*n-vitro* antioxidant assays of the sample were carried out using standard methods; twenty grams (20g) of the ground sample were soaked in 100ml of 70% ethanol and was placed in an oscillator for one hour. It was then allowed to stand for 24hours at room temperature. The mixture was filtered through whatman filter paper No.4 and the filtrate was evaporated at 78^{o}C using a water bath. The dried residue was weighed and reconstituted in 70% ethanol at a concentration of 10mg/ml and stored at 4^{o}C in a refrigerator till further use.

DPPH scavenging activity Assay

The stable 2,2-diphenyl-1-picryl hydrazyl radical (DPPH) was used for the determination of free radical scavenging activity of the ethanolic extract of the sample. This was assayed using the method of Ebrahimzadem*et al*., (2009) and Ghasemi *et al*., (2009). Exactly 0.3ml of different concentrations of the extract (0-1000µg/ml) were mixed with 2.7ml of ethanolic solution of DPPH (100µM) intest tubes. The mixture was shaken and kept in the dark for 60mins. The absorbance was taken at a wavelength of 517nM using spectrophotometer. BHA was used as standard. The percentage scavenging activity was calculated using the formula:

$\%RSA= [(A_{DPPH}-A_s)/A_{DPPH}]\times100$

where A_s is the absorbance of the test solution with the sample and A_{DPPH} is the absorbance of DPPH solution. The EC_{50} (concentration of sample at 50% RSA) was calculated from the graph of %RSA against the sample concentration.

Reducing Power Capacity Assay

The reducing power was determined according to the method of Barros *et al*,(2007). This method is based on the principle of increase in the absorbance of the reaction mixture.Exactly 2.5ml of various concentration of ethanolic extract of the sample (0-1000µg/ml) was mixed with 2.5ml of 0.2M sodium phosphate buffer (pH 6.6) and 2.5ml of 1% potassium ferricyanide. The mixture was incubated at 50^{o}C for 20mins. Then 2.5ml 0f 10% Trichloroacetic acid was added and the mixture centrifuged at 1000rpm for 8minutes. the upper layer (5ml) was mixed with 5ml of deionised water followed by the addition of 1ml of 0.1% ferric chloride. The absorbance was measured at 700nM. The graph of absorbance at 700nM against the extract concentrations was plotted. Butylated Hydroxyanisole (BHA) was used as a standard antioxidant.

Inhibition of Lipid Peroxidation Activity Assay

This was determined by the method of Barros *et al*. (2007). Determination of the extent of inhibition of lipid peroxidation was carried out using homogenate of brain of a goat. The brain was purchased from Kwata Slaughter at Awka from a goat of approximately 70kg. The brain was dissected and homogenized with pestle and mortar in an ice cold Tris-HCl buffer (pH 7.4, 20mM) to produce 50% w/v brain homogenate which was centrifuged at 3000g for 10mins. An aliquot (0.1ml) of the supernatant was incubated with 0.2ml of the sample extract at various concentrations (0-1000µg/ml), in the presence of 0.1ml of 10uM ferrosulphate and 0.1ml of 0.1nM ascorbic acid at 37^{o}C for 1hour. The reaction was stopped by the addition of 0.5ml of 28% TCA followed by the addition of 0.38ml of 2% TBA. The mixture was then heated at 80^{o}C for 20mins. After centrifugation at 3000g for 10mins to remove the precipitated protein, the colour intensity of the malondialdehyde (MDA)-TBA complex in the supernatant was measured by its absorbance at 532nM. The inhibition ratio (%) was calculated using the following formula:

Inhibition ratio (%) = $[(A-B)/A]\times100\%$

where A and B were the absorbance of the control and the compound solution, respectively. The extract concentration providing 50% lipid peroxidation inhibition (EC 50) was calculated from the graph of antioxidant activity percentage against the extract concentrations. BHA was used as the standard.

The H_2O_2 scavenging activity Assay

This was determined by the method of Ruch *et al*., (1989). The extracts (0-1000µg mL^{-1}) were dissolved in 3.4 mL of 0.1M phosphate buffer (pH 7.4) and mixed with 600 µL(0.6 ml) of H_2O_2 (40 mM) prepared in 0.1M phosphate buffer (pH 7.4). The absorbance value of the reaction mixture was recorded at 230 nm. The concentration of hydrogen peroxide (mM) in the assay medium was determined using a standard curve (r^2 :0.9895):

Absorbance =0.038x (H_2O_2)+ 0.4397

Using BHA as standard, percentage of H_2O_2 scavenging was calculated with the formula:

% Scavenged $[H_2O_2] = [(A_s - A_c)/A_s] \times 100$

Antioxidant Enzyme Assay

Sample preparation: one gramme (1g) of the ground sample was extracted in ice-cold 0.1M phosphate buffer (pH 7.4) and centrifuged at 1500rpm for 10mins. The supernatant was used for the enzyme activity assay.

Superoxidedismutase

Superoxide Dismutase activity was determined by the method of Sun and Zigma (1978). This is based on its ability to inhibit the auto-oxidation of epinephrine determined by the increase in absorbance at 480nm. The reaction mixture (3 ml) contained 2.95 ml 0.05 M sodium carbonate buffer pH 10.2, 0.02 ml of liver homogenate and 0.03 ml of 0.3mM adrenaline in 0.005 N HCL was used to initiate the reaction. The reference cuvette contained 2.95 ml buffer, 0.03 ml of substrate (epinephrine) and 0.02 ml of water. Enzyme activity was calculated by measuring the change in absorbance at 480 nm for 3 min. $\sum = 4020M^{-1}\ cm^{-1}$

Catalase activity Determination

The catalase activity was determined according to the method of Beers and Sizer as described by Aksenes and Njaa (1985) by measuring the decrease in absorbance at 240nm due to the decomposition of H_2O_2 in a UV recording spectrophotometer. The reaction mixture (3 ml) contained 0.1 ml of sample extract in phosphate buffer (50 mM, pH 7.0) and 2.9 ml of 30 mM H_2O_2 in phosphate buffer pH 7.0. An extinction coefficient for H_2O_2 at 240 nm of 40.0 $M^{-1}cm^{-1}$ (Aebi 1984) was used for the calculation. The specific activity of catalase was expressed as moles of H_2O_2 reduced per minute per mg protein.

III. Results

The nutritional contents of sesame seeds – proximate, phytochemicals (as antinutrients), minerals and vitamins are presented as means of three replicates (tables 1 – 4).

Table 1: Proximate compositionof *Sesemum indicum* seed (Data represent the mean of 3 replicates ± SD)

Parameters (%)Composition	
Ash6.29±0.16	
Moisture 4.06±0.13	
Crude protein	23.52±0.12
Crude fiber5.14±0.15	
Total lipid46.20±0.08	
Total carbohydrate 14.79±0.11	

The proximate analysis of sesame seed showed that the lipid content of the sample was in higherconcentration when compared with the moisture content, crude protein, ash, crude fiber and total carbohydrate. Protein content is also relatively high.

Table 2: Antinutrient composition of sesame seed (Data represent the mean of 3 replicates ± SD)

Antinutrients	Composition
Oxalate (mg/g)	9.72±0.04
Phytate (%)	1.37±0.09
Alkaloid (%)	5.08±0.03
Cardiac glycoside (%)	11.90±0.08
Phenol (mg/g)	0.05±0.12
Tannin (mg/g)	0.54±0.13
Trypsin inhibitor (IU)	14.93±0.09

The result showed that phenol was the lowest when compared with other anti-nutrients while Cardiac glycoside was highest followed by Oxalate and Alkaloids respectively. Trypsin inhibitor was shown to be high.

Table 3: Mineral contentof sesame seed (Data represent the mean of 3 replicates ± SD)

Minerals	Composition
Calcium (mg/g)	2.62±0.11
Cobalt	ND
Copper (mg/g)	0.02±0.04
Iron (mg/g)	0.04±0.07
Magnesium (mg/g)	5.81±0.01
Nickel (mg/g)	ND
Potassium (mg/g)	1.21±0.06
Selenium (mg/g)	ND
Sodium (mg/g)	0.31±0.11
Zinc (mg/g)	0.03±0.07

The findingss showed that magnesium, calcium and potassium have the highest concentrations while Nickel, Selenium and Cobalt were not detected.

Table 4: Vitamin content (µg/g) of sesame seed (Data represent the mean of 3 replicates ± SD)

Vitamins	Composition
Vitamin B1	5.29±0.06
Vitamin B2 25.58±0.12	
Vitamin B3 4.52±0.14	
Vitamin B6 7.30±0.07	
Vitamin B12 ND	
Folic acid 4.21±0.11	
Vitamin D ND	
Vitamin A 0.73±0.09	
Vitamin C 0.50±0.14	
Vitamin E ND	

The Vitamin assay revealed that sesame seeds have higher accumulation of the B vitaminscomparative with other brands of vitamin.

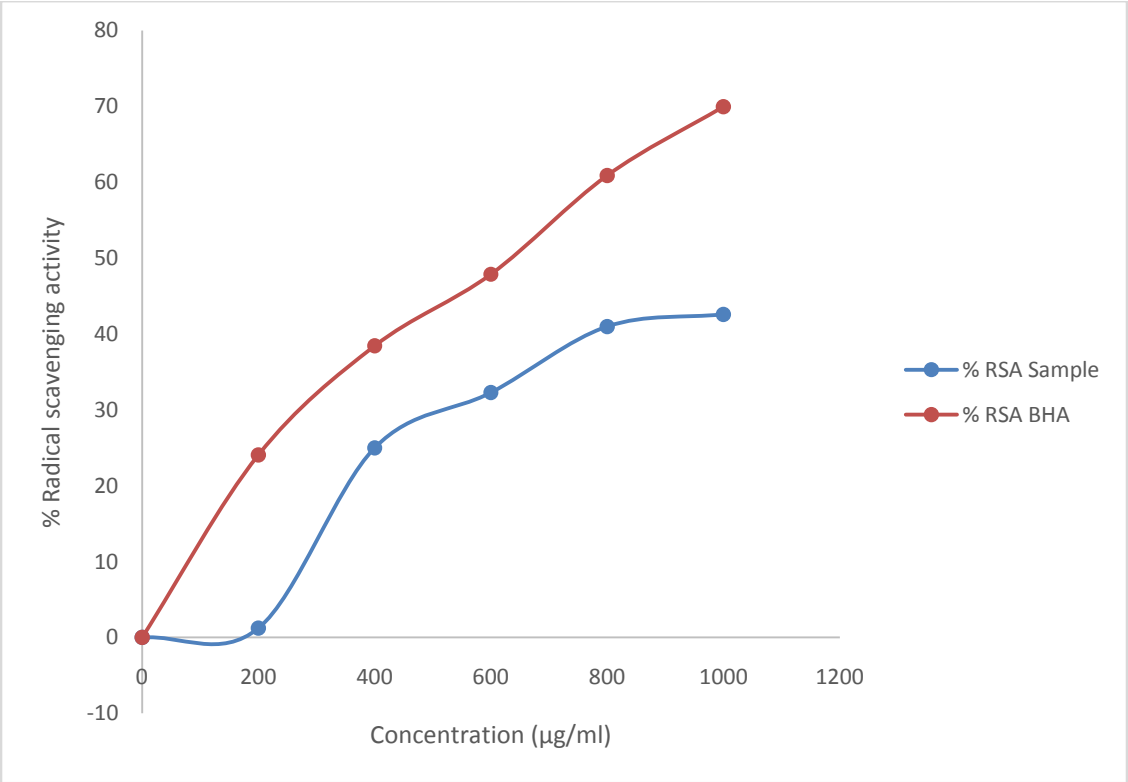

Figure 1: Radical Scavenging Activity (RSA) of sesame seed

The percentage radical scavenging activity(µg/ml) of the sample was 28.40±16.76 while that of the BHA was 48.24±18.12. The EC_{50} of the sample is lower (646.06µg/ml) when compared with that of BHA (1019.10µg/ml). This means that the percentage RSA of the sample has a better radical scavenging activity than that of percentage RSA of BHA.

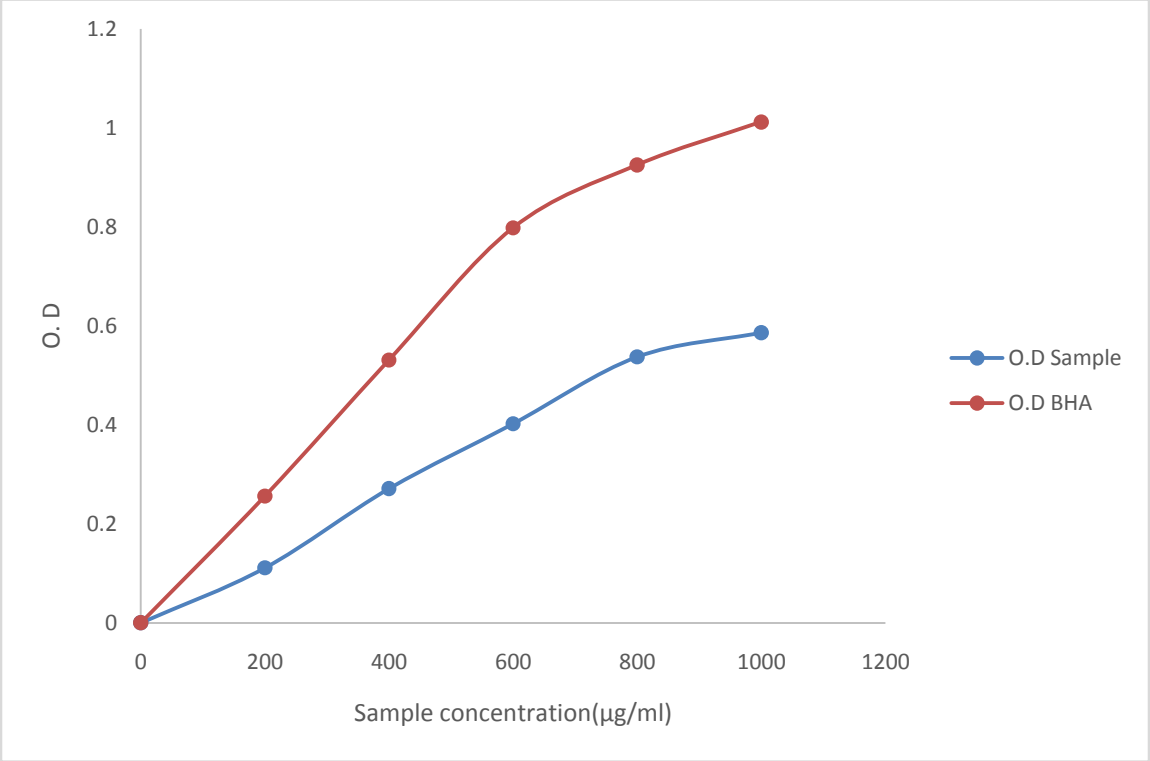

Fig. 2: Reducing Power Capacity of sesame seed

The result showed that the reducing power capacity (µg/ml) of the sample was 0.32±0.23 while that of the BHA was 0.59±0.40. The EC_{50} of the sample is 4994µg/ml while that of BHA is 8332µg/ml. this shows that the sample has a better reducing power capacity than the BHA.

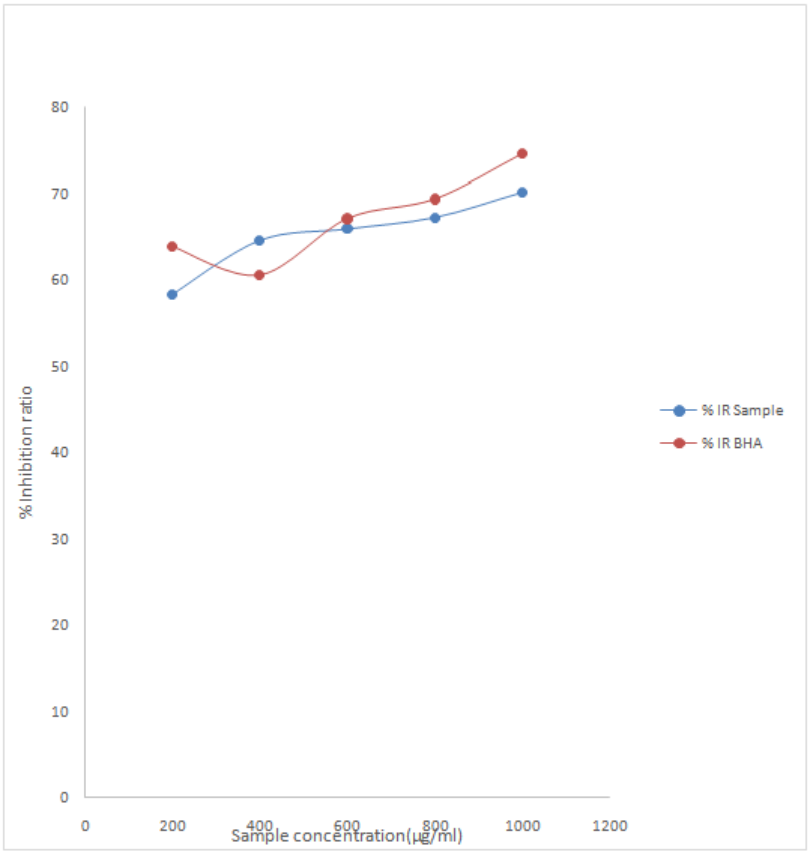

Figure 3: Lipid Peroxidation activity of sesame seed

The percentage inhibition of lipid peroxidation (µg/ml) of the sample was 54.33±26.90 while that of BHA was 55.97±27.83. The EC_{50} of the BHA is -536.46µg/ml while that of the sample is -562.06µg/ml. This means that the BHA inhibits lipid peroxidation better than the sample.

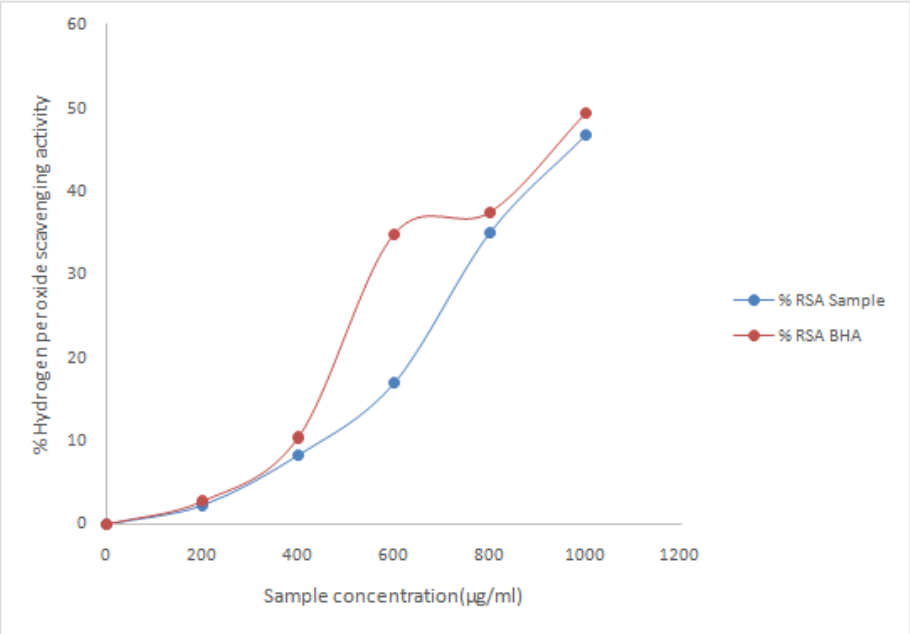

Figure 4: Hydrogen peroxide scavenging activity of sesame seed

The percentage hydrogen peroxide scavenging activity (µg/ml) of the sample was 18.19±18.85 while that of BHA was 22.44±20.65. The EC_{50} of the sample was 903.26µg/ml while that of BHA was 853.70µg/ml. BHA has a higher hydrogen peroxide scavenging activity thansesame seed sample.

In-vitro antioxidant assay

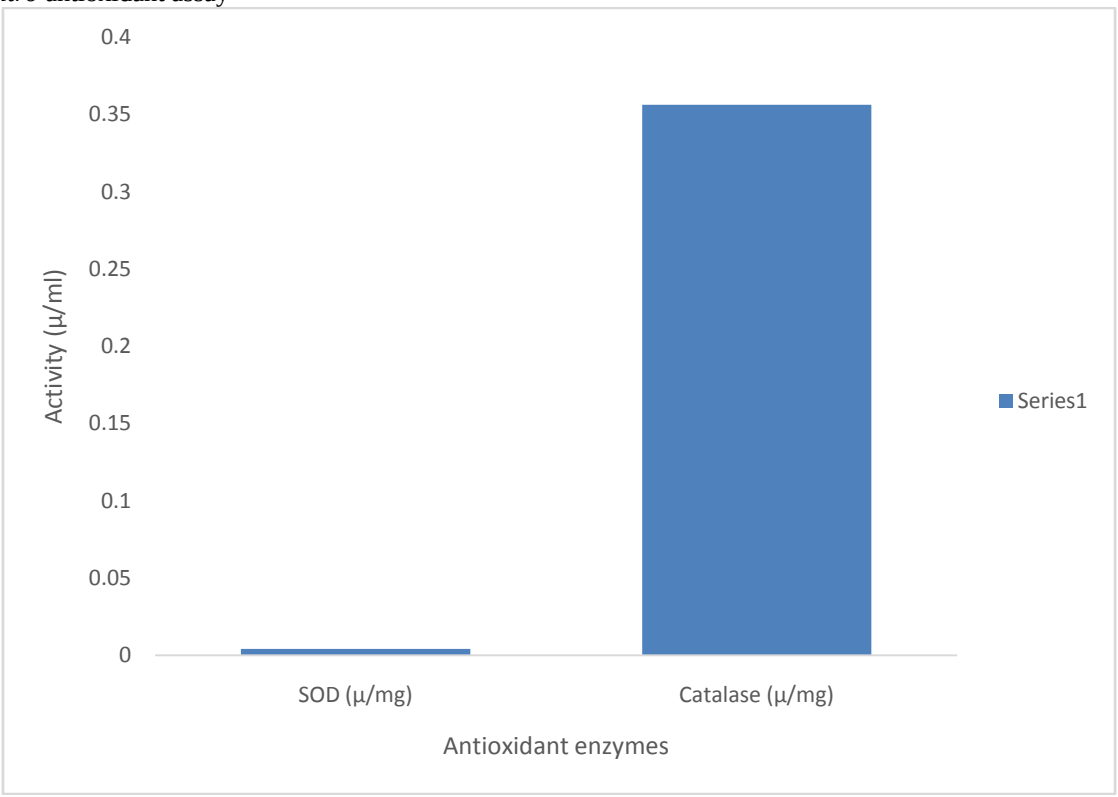

Figure 5: Antioxidant enzyme assay of sesame seed

*Sesamum indicum*seed has a higher catalase activity(IU)0.0637±0.3563 than that of superoxide dismutase (IU)0.0041±0.0008, as evident from figure 5.

IV. Discussion

The moisture content obtained in the analysis of the sample were low and this is in agreement with some earlier reports(Godin and Spensley, 1971; Bamigboye*et al.,* 2010). The very low moisture content of the seed sample was suggestive of its long shelf life and keeping quality and this might be an advantage since most spoilage microorganisms do not thrive well on food items that are low in moisture content (Tressler *et al.,* 1980; Bamigboye*et al.,* 2010). The value obtained for crude protein of the sample is slightly higher than that reported in the study carried out by Bamigboye*et al.,* (2010) and similar to that reported by Godin and Spensley (1971) on sesame seed respectively. This observed variation might have resulted from varietal and geographic differences. Since vegetables and fruits are the major contributing sources of protein in developing countries, the crude protein levels in sesame seed can qualify it as a good source of plant protein if it is bioavailable and easily digestible by the body.

The lipid content of the sample is slightly higher than that reported by Bamigboye*et al.,* (2010) and lower than that reported by Ensiminger and Ensiminger (1994) on Sudanese white and Indian black sesame seeds, respectively. The values obtained in this study for lipid content of sesame seed confirmed the fact that the seed is very rich in crude lipid.

The crude fiber of the sample is significantly higher than that reported by the study carried out by Zhou *et al.,* (2016) and the result was in line with the findings of Adepoju *et al.,* (2003) on *Moringa oleifera* seed and husk, that the greater percentage of the crude fiber was present in the hull of seeds. The significance of crude fiber cannot be overemphasized in human nutrition. High fiber content have been reported to be beneficial in preventing constipation and diverticulosis, bind to and remove toxic materials from the body, has high water holding capacity thereby making stooling easy and bulky (McDougall *et al.,* 1996; Jansen, 2004). However, it has been reported that dietary fiber improves glucose tolerance, hence is beneficial in treating maturity onset of diabetes and have health promoting potentials (Anderson, 1979; Larrauri *et al.,* 1996).

The ash content of the sample was relatively lower than that of the result of the study carried out by Bamigboye*et al.,* (2010). However, the high ash content in the sample is an indication that the hull contained about half of the total minerals present in the seed, hence it should not be discarded so as to retain the minerals, this was similarly observed by Adeolu *et al.,* (2010). The seed of *Sesamum indicum* were also rich in carbohydrate, a positive sign that the seed can serve as a good source of energy.

The antinutrient assay(table 3)reveals high value of oxalate, amolecule that affects calcium metabolism and reacts with protein to form complexes which has an inhibitory effect on peptic digestion (Oke, 1969). In the body, oxalic acid combines with divalent cations such as calcium and iron II to form crystals of the corresponding oxalates which are then excreted in urine as minute crystals. These oxalates can form larger kidney stones that can obstruct the kidney tubules. This however suggests the high toxicity tendencies of the seed extract at a high dose which could have deleterious consequences and could lead to fatality. However, this can be reduced by completely decortinating the seed as suggested by McDonald *et al.,* (1995).

The high value of protease inhibitor suggests the ability of the sample to inhibit the activities of proteolytic enzymes as similarly suggested by Liener and Kakade (1980) though this can be overcome by heat which significantly reduces the action of trypsin inhibitors. Cardiac glycosides are important class of naturally occurring drugs whose actions help in the treatment of congestive heart failure (Yukari*et al.,* 1995), hence the presence of high values of cardiac glycoside in the seed extract of *Sesamum indicum* is an indication of the potential of the seed as a source of pharmacologically active compounds with potentials for the treatment of cardiac diseases as well as other ailments such as cough, chest pain and diabetes mellitus as previously reported by Usunobum *et al.,* (2015) and Gaikwad *et al.,* (2014). Tannins are known to be useful in the treatment of inflamed or ulcerated tissues and have remarkable activity in cancer prevention and as an antimicrobial agent (Ruch *et al.,* 1989). The presence of tannins in the seed extract of *Sesamum indicum* suggests that it may serve as a potential source of bioactive compound(s) in cancer prevention and treatment and also confer antimicrobial effects as similarly reported by Ruch *et al.,* (1989) and Edeoga *et al.,* (2005).

Alkaloids are also important antimicrobial, antiviral, antimalarial and anti-hypertensive biomolecules. Some previous reports have suggested benefits associated with alkaloids(Trease and Evans, 2005; McDevit *et al.,*1998).

The free radical scavenging activity of *Sesamum indicum* seed extract analysed showed a high significant effect of the sample in inhibiting DPPH when compared with that of the standard antioxidant butylated hydroxyanisole (BHA). The seed sample has an EC_{50} of 646.06µg/ml while that of the standard antioxidant BHA was 1019.10µg/ml. this indicates that the free radical scavenging potential of the seed extract was less than that of BHA and this result is in accordance with the study carried out by Vishwanath *et al.,*

(2012). The reducing power capacity of the extract which may serve as a significant reflection of antioxidant activity of the sample was determined using a modified Fe^{3+} to Fe^{2+} reduction assay, whereby the yellow colour of the test solution changes to various shades of green and blue, depending on the reducing power of the extract on potassium ferricyanide as shown in figure 2. The reducing power of the extract increased as the concentration increased better than that of the standard antioxidant BHA. This result is in accordance with the study carried out by Vishwanath *et al.,* (2012) and Tanaka *et al.,* (1988). At the concentration of 1000µg/ml, the sample extract showed significant reducing power. The ability of the sample to inhibit lipid peroxidation showed that the sesame seed has lower capacity to inhibit lipid peroxidation when compared with BHA. The EC_{50} of the sample was found to be -562.06µg /ml while that BHA was -536.46µg/ml, this means that the BHA inhibits lipid peroxidation better than the seed sample. Hydrogen peroxide scavenging activity of the sample as shown in figure 4 was lower when compared with BHA. The EC_{50} of the sample was 903.26µg/ml while that of BHA was 853.70µg/ml; however it can be observed that the sample has a potent hydrogen peroxide scavenging activity which is agreement with the study carried out by Vishwanath *et al.,* (2012).

Mineral analysis of sesame seed (table 2)indicates calcium and potassium were high and this is in agreement with the study carried out by Bamigboye*et al.,* (2010): magnesium concentration is also high in the seed sample. This result affirms the report by Obiajunwa *et al.,* (2005), indicating that sesame seeds are rich in calcium, potassium, iron and phosphorus. However the values of iron and zinc were lower than that reported by Adeolu *et al.,* (2010). Sodium content was low, and this can be an advantage of its usefulness as an additive or condiment in food preparation. It is high in calcium, magnesium and potassium and can serve as a good source of these minerals. Its zinc levels can qualify it as a good source of important mineral for growth and maintenance of good health.

The results of the vitamin analysis of the sample shown in table 4. The values obtained for vitamin B2, B6, B1, B3 and B9 (folic acid) were high and this suggests that the seed is a good source of these vitamins for enhanced metabolic processes in the body and good health. However, vitamin A and C were also detected in the seed sample in much smaller quantity; the presence of these vitaminsis suggestive of antioxidative potentials of the sample. Vitamins are known to act as cofactors to enzymes in other for the enzyme to function properly. The high content of vitamin B2 which acts as a mild anti-inflammatory agent that significantly reduces the expression of High Mobility Group Protein B1 (HMGB1) is one of the factors responsible for reduction of inflammation in Systemic Inflammatory Response Syndrome (SEPSIS).

In-vitro antioxidant assay showed that sesame seed has a higher catalase activity than superoxide dismutase. However the result shows that the sample has the potential of scavenging superoxide anion and showed more capability of the sample extract to scavenge peroxide radical, hence the sample is more potent in scavenging peroxide radical than superoxide anion. Although superoxide anion by itself is a weak oxidant when compared with peroxide radical, it however generates dangerous hydroxyl radicals as well as singlet oxygen, both of which contribute to oxidative stress (Mayer and Isaken, 1995; Babu *et al.,* 2001). According to Agbafor and Nwachukwu (2011), the increase in the levels of antioxidant enzymes is as a result of the presence of antioxidant phytochemical such as phenols, flavonoids, tannins, phytates in the plant extract. However, the study carried out by Zhou *et al.,* (2016) suggests that there is a correlation between the lignin concentration in sesame seed and its antioxidant potentials, suggesting further that lignans greatly affect hepatic fatty acid oxidation and triacylglycerol levels. However, the reportdid not overlook the possibility that compounds other than lignans could be linked to the antioxidative activities of sesame seeds.

V. Conclusion

Sesame seeds were high in lipid, protein, carbohydrate, and mineral content, and can serve as a good source of these nutrients. Because of its nutritional value, it can be used as food supplement to complement and improve the nutrient content of other food items which may be low in protein and essential nutrients. The free radical scavenging properties of sesame seed extract investigated in comparison with the synthetic antioxidant showed its potential as a natural preservative, its applicability in the food and pharmaceutical industries.The potentials of sesame seed can be harnessed nutritionally, pharmacologically and in combination as a nutraceutical product.

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