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Assessment of Proximate and Mineral Composition of Sesame Seed (*Sesamum indicum linn*) Grown in Kashere

T. S. Tyohemba[1]*, S. M. Ladan[2], N. N. Ndukwe[1], C. O. Attah[3], A. Jummai[4], G. G. Memi, S. Z., Na'inna[1], A, Mamoon[1] and S.W. Kopdorah[5]

[1]Department of Biological Sciences, Federal University, Kashere, Gombe State, Nigeria
[2]Department of Chemical Sciences, Federal University, Kashere, Gombe State, Nigeria
[3]Chemistry Department , Federal College of Education, Kano, Nigeria.
[4]Medical Biotechnology Department, National Biotehnology Development Agency,Abuja,Nigeria
[5]Biochemistry Department , Federal University, Gashua, Yobe State, Nigeria

Corresponding Author: terhide27@gmail.com

ABSTRACT

This research paper employs standard procedures to analyse the proximate and mineral composition of *Sesamum indicum* seeds grown in Kashere. Proximate analysis results revealed moisture content of 6.89±0.014%, total ash of 5.79±0.021%, crude fibre of 6.69±0.021%, crude protein of 18.43±0.11% and carbohydrate of 19.72±0.16%. The mineral analysis showed that *Sesamum indicum* seeds grown in Kashere contain significant amounts of sodium (29.50±0.707 mg/100g), potassium (113.55±0.495 mg/100g), calcium (249.80±0.424 mg/100g), magnesium (2.98±0.035 mg/100g), and iron (2.88±0.035 mg/100g). Therefore, these seeds can be considered a excellent source of essential nutrients, minerals, and crude fibre. The significant amounts of crude protein and carbohydrate make them a valuable source of nutrition for humans and animals, and their total ash and crude fibre content suggest potential as an ingredient in the food industry. The significant presence of vital minerals, including calcium and phosphorus, found in *Sesamum indicum* seeds grown in Kashere can help improve bone health. The study's results provide valuable information concerning the nutritional value of sesame seeds. These findings can support the supplementary use of sesame seeds in human and animal nutrition as well as their inclusion in the food industry.

Keywords: Sesame seed, Proximate, Mineral composition , Kashere.

INTRODUCTION

Sesame (*Sesamum indicum* linn) is an ancient oilseed that humans have used for centuries under different names, including gingelly, benniseed, simsim, and till (Ashri, 1988). Although its origin is in Africa, sesame has since become prevalent in Japan,West Asia, India, and China. Its productivity may be relatively low, but it is still one of the top thirteen oilseed crops that account for 90% of the worldwide production of edible oils (Kamal-Eldin *et al.*, 1995). Sesame is an annual herb with a taproot and a diverse surface mat of feeder roots, making it resilient to drought. The seeds are diminutive and do not have endosperm; their colour varies from white, grey, brown, chocolate to black (Ashri, 1988). Commercial bakeries employ sesame seeds widely to prepare several products, including crackers,rolls, cakes, and pastry items. In addition, sesame butter (tahini) and halva are produced using these seeds (Aremu *et al.*, 2006). Numerous sesame varieties and ecotypes have adapted to various ecological conditions. However, modern variety cultivation is limited due to insufficient genetic information.

Sesame oil, extracted from the seeds, serves cooking, massage, and therapeutic purposes for the body. Beyond its popularity as a cooking oil, sesame oil is valuable for the production of margarine, soap, pharmaceuticals, paints, and lubricants. Sesame oil acts as a base for developing perfumes in the beauty industry, and its seed cake is rich in protein (Price and Smith, 1991). A section of the nutritious seed cake serves as animal feed while the remaining portion is processed into sesame flour and applied in health foods. Due to their nutritional, disease-preventive, and therapeutic characteristics, sesame seeds have extensive use in culinary and traditional medicine.

Sesame seeds comprise 45-55% oil, 19-25% protein, and approximately 5% water content, and are abundant in methionine and tryptophan, both essential amino acids (Godin and Spensley, 1971). An ounce of dehulled seeds provides 6 grams of protein, 3.7 grams of fibre, and 14 grams of total fat. The lipid content of sesame seeds is predominantly composed of fatty acids, with monounsaturated and polyunsaturated acids making up 38% and 44%, respectively. These compounds are characterized by their resistance to oxidation, a property that can be ascribed to the high antioxidant activity of phytochemicals present in sesame seeds, such as sesamol and lignans. Additionally, these phytochemicals possess anticarcinogenic properties, and phytosterols, which are also present in sesame seeds, exhibit cholesterol blocking effects and can effectively manage hypertension, while increasing circulating vitamin E level in animals. These findings have been documented in various studies (Price and Smith, 1999; Patnaik, 1993). Sesame seeds contain lignans, including sesamin, sesamol,pinoresinol, and lariciresinol (Morris *et al.*, 2002).

Sesame oil has been discovered to possess noteworthy analgesic, antipyretic, and anti-inflammatory properties in animal models (Cooney *et al.*, 2001). Additionally, one research study exhibited that the consumption of sesame oil as a dietary supplement yielded these benefits, and the anti-inflammatory properties were corroborated by the suppression of paw edema stimulation caused by the injection of carrageenan (an edematogenic agent) into the sub-plantar area of the rat's right hind paw. According to the Food and Agriculture Organization (FAO, 2008), approximately 963 million people worldwide are undernourished, primarily due to escalating food prices, a growing population, limited arable land, and constraints on food imports. The ongoing global financial and economic crisis is expected to increase the number of people impacted by food insecurity. Recently, there has been a shift towards identifying local food sources to address this issue (Ihenetu, 2019). Thus, it is imperative to examine the nutritional value of indigenous plants, wild herbs, and edible seeds that are abundant in protein (Sirato-Yasumoto *et al.*, 2001). Numerous studies have demonstrated the high nutritional value of various indigenous plant species. However, data on their proximate and mineral compositions, particularly in relation to sesame seeds, remains scarce (Chakraborthy *et al.*, 2008; Obiajunwa, 2005). Sesame seeds, on the other hand, have been recognised as a promising solution for tackling micronutrient deficiencies prevalent in contemporary nutrition (Ihenetu, 2019).

MATERIALS AND METHODS

Study Area

The investigation was conducted in Kashere, a municipality in Gombe State, Nigeria's Akko Local Government Area. The town's geographical coordinates are Latitude 9o 46' 0" N and longitude 10 o 57' 0" E, with an altitude of 431m above sea level. The administrative centre resides in Kumo town, which spans approximately 427 km2 (158 sqkm) and had a population of 7,715, according to the Federal Republic of Nigeria's 2006 census data. Over the past five years, the population and level of activity within the local government area has increased, possibly due to the introduction of the new Federal University. The inhabitants of the area are mainly engaged in agriculture and trade.

Sample Collection

The seeds of *Sesamum indicum* were collected from a local farmer in Kashere and were immediately taken to the laboratory for analysis. Cleaning was carried out using clean water and adapted to the method of collection. The seeds were dried in the sun until they were of a stable weight, ground in an electric mixer and stored in a sealed container with appropriate labelling for analysis as documented by Beshaw *et al.* (2022).

Proximate Analysis of Sesame Seeds

Determination of Moisture Content

A 5 g sample was weighed using clean, dried and pre-weighed crucibles. The crucibles and sample were then placed in a moisture extraction oven at 110°C and dried for four hours. The samples were removed from the oven and allowed to cool in a desiccator. They were then reweighed. This process was repeated until a constant weight was achieved. The experiment was repeated three times and the mean value was taken as the moisture content according to AOAC (1990).

$$\% \text{ moisture} = \frac{\text{Initial weight of sample} - \text{weight of overdried sample Moisture}}{\text{initial weight of sample}} \times 100$$

Determination of Ash Content

The crucibles were first washed and dried using an electronic balance, then 5g of sample was weighed in each crucible. The samples were then allowed to dry in a moisture extraction oven until a constant weight had been reached. The samples were then placed in a muffle furnace using tongs and ashing was carried out at 550ºC for four hours until white ash was obtained. After ashing, the samples were removed from the oven and cooled in a desiccator. They were then reweighed.

$$\% \text{ Ash Content} = \frac{\text{weight of ash}}{\text{initial weight of sample}} \times 100$$

The percentage ash was calculated as followed and the average taken (AOAC, 1990).

Determination of Lipid (Fat)

To extract ether soluble materials from the sample, 1g was placed in a thimble and sealed with greaseless cotton. The thimble was then placed in the fat extraction tube of a Soxhlet apparatus. This was then connected to a Soxhlet flask. About 75 ml of hexane (Penpokey Organy, India) was poured through the sample in the tube into the bottle, and the top of the extraction tube was attached to the condenser. The sample was extracted for a period of 6 hours at a temperature of 40 °C on a heating mantle. At the end of the extraction period, the thimble was removed from the apparatus and the extract was concentrated using the Rota Vaporizer (Shang hel shen sheng biotech, China) at 40°C. The concentrated extract was then dried (PID system types M400VF, Italy) at 100°C for 1 hour. It was cooled and weighed. The difference between the weight of the original sample and the weight of the dried extract was an indication of the amount of ether-soluble material in the sample (Enyoh *et al.*, 2017).

Determination of Protein Content

The Kjeldahl method comprised of three stages: digestion, distillation and titration.

Digestion: 0.2g of previously air-dried and ground seed sample was weighed and placed in a Kjeldahl flask which was thoroughly cleaned and dried. 0.1g of copper tetraoxosulphate iv crystals, 0.5g of sodium tetraoxosulphate iv crystals, and 25ml of highly concentrated H2SO4 acid were added to the flask. Glass beads were also introduced to prevent any bumping. The

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flask was inserted into a digestion chamber located in a fume cupboard and continuously rotated until the sample changed colour from black to pale blue. Afterward, the flask was taken out and allowed to cool. The digest was diluted with distilled water to achieve a final volume of 100ml, and the solution was mixed thoroughly by vigorous shaking.

Distillation: Using a pipette, 20ml was transferred from the homogenous digest solution into a distillation flask. A precise 20ml of 40% sodium hydroxide solution was carefully added down the side of the flask through a funnel. Then, a receiving flask was used to add 50ml of 2% boric acid solution and two drops of methyl red indicator. To connect the condenser to the receiving flask via a glass tube, the distillation apparatus was assembled while ensuring that the condenser is cooled continuously with cold water from a tap. The end of the glass tube was submerged in boric acid. The distillation unit was then heated with a heating mantle until the pink boric acid solution transitioned to blue, and the volume of the distillate increased to approximately 100ml

Titration: Ten ml of the distillate was titrated against 0.1 N hydrochloric acid to a colourless final point. In order to detect any traces of nitrogen in the blank, a blank solution was also titrated. All the titration volumes were recorded.

.Determination of Crude Fibre

2g of defatted sample was weighed and placed into a 250ml beaker with 200ml of 0.125M tetraoxosulphate IV acid (sulphuric acid). The mixture underwent heating in a steam bath at a temperature range between 70°C to 90°C for 2 hours followed by cooling. It was then filtered using muslin cloth on a Buckner funnel. The residue was washed thrice with hot water to eliminate the acid and transferred to another beaker containing 200ml of sodium hydroxide. The mixture was reheated on a steam bath for 2 hours. Subsequently, the solution was filtrated, and the residue was rinsed thrice with hot water and then treated with alcohol and water. The eventual residue was then deposited in a clean crucible, which was pre-weighed, and dried in an oven at 120°C until a steady weight was observed. After dried, the crucible that contained the sample was placed in a muffle furnace and burned at 550°C for 30 minutes until the ash was white. The container and its contents were taken out from the oven, cooled in a drying device, and weighed again according to the AOAC (1990) guidelines.

Determination of Minerals

Aqua-regia (HNO3:HCl 1:3) was used to extract the mineral content of the seed extracts. An accurately weighed 2 g of seed powder was placed in a test tube. 20 ml of aqua regia was then added. The mixture was allowed to stand for 24 h and then filtered.The filtered water was used for mineral analysis (Ca, P, K, Mg, Na, Fe and Zn) using Perkins Elmer A Analyst 400 AAS (Enyoh *et al.*, 2017).

Statistical Analysis

All of the statistical analyses were carried out using IBM SPSS Statistics 20 software. The results are presented in terms of mean values and standard deviations.

RESULTS

Proximate Analysis of Sesame Seed

The findings of the proximate composition analysis, as presented in Table 1, indicate that the moisture content of the sample was determined to be 6.89 ± 0.014%, the total ash content was found to be 5.79 ± 0.021%, the crude protein content was measured at 18.4 ± 0.11%, the carbohydrate content was determined to be 19.78 ± 0.16%, and the crude fat content was calculated to be 42.48 ± 0.071%. Notably, among all the proximate parameters investigated, the sesame seed exhibited a particularly high concentration of crude fat.

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Table 1: Proximate Composition (%) of *Sesamum indicum* Seed

Parameters	Concentration %
Moisture	6.89±0.014
Crude Protein	18.43±0.11
Crude fat	42.45±0.071
Crude fibre	6.69±0.021
Total Ash	5.79±0.021
Carbohydrate	19.72±0.16

Values are mean ± SD for triplicate analysis (n=3)

Mineral Analysis of *Sesamum indicum* Seed

Table 2 shows the mineral composition of sesame seed. According to the results, the highest mineral content observed was calcium, with a value of 249.8 ± 0.424 mg/100g. This was followed by phosphorus, which had a value of 133.05 ± 0.779 mg/100g, and potassium, with a value of 113.55 ± 0.496 mg/100g. The mineral content of sodium was also detected, with a value of 29.50 ± 0.707 mg/100g. Magnesium was present as well, with a value of 2.98 ± 0.035 mg/100g. Finally, the mineral composition analysis revealed the presence of iron, with a value of 2.88 ± 0.035 mg/100g.

Table 2: Mineral Composition (mg/100g) of *Sesamum indicum* Seed.

Minerals	Concentration (mg/100g)
Calcium (Ca)	249.8±0.424
Phosphorous (P)	133.05±0.779
Potassium (K)	113.55±0.495
Magnesium (Mg)	2.98±0.035
Sodium (Na)	29.50±0.707
Iron (Fe)	2.88±0.035

Values are mean ± SD for triplicate analysis (n=3)

DISCUSSION

The proximate composition of sesame seeds (*Sesamum indicum*) is shown in Table 1, while Table 2 gives an overview of the mineral composition of sesame seeds. The moisture content of the analysed sesame seeds is 6.89 ± 0.014 %, which is within the range of 10.91 %, 6.61 %, 5.41 %, and 4.11 % reported by several researchers such as Blessing *et al.*(2010); Nagedra *et al.*(2012); Makinde and Akinoso, 2013; and Hatfom *et al.*(2015). The moisture content values obtained in this study are considered acceptable and may improve the shelf life of sesame seeds.Low moisture content is indicative of stability, quality, shelf life and high yield as noted by Sangkom and Ekasit (2015).

Furthermore, the ash content of the sample was 5.79 ± 0.021%, which is slightly lower than the figures reported by Blessing *et al.* (2010) (9.62%), Makinde and Akinoso (2013) (7.31%) and Haftom *et al.* (2015) (9.00%), but still within the acceptable range. A sample with a significant level of ash content is expected to have a high concentration of various mineral elements that can stimulate metabolic processes and aid in growth and development (Betty *et al.*, 2016). Ash is the inorganic residue that remains after total oxidation or combustion of organic matter in food.

Finally, the crude oil or fat content of the analyzed sesame seeds was found to be 42.45±0.071%, which aligns with the findings of Shah (2013) (43.3%), Nzikou *et al.* (2009) (48.5%), Anilakumar *et al.* (2010) (43.3%), and Dashak and cali. (1993) (34.6%). Variations in the oil content of sesame seeds may be attributed to a range of factors, including the soil type, variety of sesame, climate, seed harvesting time, plant maturity, and extraction methods employed (Egbekun and Ehieze, 1997; Rahman *et al.*, 2007). The oil contained in sesame seeds serves as a concentrated energy source and enhances flavour appeal (Hassan *et al.*, 2008).

The crude protein content of sesame seeds was found to be 18.43±0.11% in this study, which is in agreement with the results of previous studies. Anilakumar *et al.* (2010) reported a value of 18.3%, while Nzikou *et al.* (2009), Shah (2013) and Dashak and cali. (1993) documented 20%, 18.3% and unspecified values, respectively. These results suggest that sesame seeds are a valuable source of dietary protein for both humans and animals, according to Pugalenthi *et al.* (2004). The carbohydrate content of the sesame examined in this study was 19.72 ± 0.16%, which is slightly higher than that reported by Blessing *et al.* (2010), Nagendra *et al.* (2012), Alege *et al.* (2013) and Haftom *et al.* (2015), who reported a similar value. Nevertheless, this value is lower than the Recommended Daily Allowance (RDA) prescribed by FAO/WHO (55%), implying that a diet comprising sesame seeds ought to be supplemented with other carbohydrate-rich foods to fulfill the daily requirement. Carbohydrates function as the primary energy source for the human body while playing a crucial role in multiple physiological processes. Carbohydrate derivatives also contribute to reproduction, the immune system and blood clotting. The present investigation disclosed the existence of 6.69±0.21% crude fiber in sesame seeds, which is consistent with the range of 3.2%-10.0% previously reported by Obiajunwa *et al.* (2005) and El-khier. (2008). The ingestion of dietary fibre is vital for maintaining good health, by reducing cholesterol and glucose levels in the body, as identified in Bello *et al.*'s (2008) report. Sesame seed contains a significant amount of fibre, which suggests that it has potential as a remedy for lowering blood cholesterol and reducing the risk of several cancers, as stated by Gabriel *et al.* (2018). Furthermore, research conducted by Betty *et al.* (2016) has shown that sesame seeds have the ability to enlarge the inner walls of the colon, facilitating the movement of waste and effectively treating constipation.

Table 2 displays the mineral content analysis of the sesame seed sample with Calcium (Ca) having the highest value of 249.80±0.424mg/100g, followed by phosphorous (P) at 133.05±0.79 mg/100g, and then potassium (K), Sodium (Na), and Magnesium (Mg) with values of 113.55±0.495mg/100g, 29.50±0.707mg/100g, and 2.88±0.035mg/100g respectively. These findings are consistent with previous research by Blessing *et al.* (2010), Negendra *et al.* (2012), Alege *et al.* (2013), and Haftom *et al.* (2015).Minerals are essential for proper bodily functions and to meet the nutritional needs of humans. They are required in small quantities to regulate water retention and metabolic processes. The body relies on various metabolic processes, that in turn rely on minerals, for the regulation and maintenance of water retention. Potassium is a crucial nutrient required for the synthesis of amino acids and proteins (Malik, 1982). Magnesium and calcium play a crucial role in photosynthesis, in the metabolism of carbohydrates, in nucleic acids and in the binding agents of the cell wall (Russel, 1973). Calcium is also essential for the development of teeth (Brody, 1994) and magnesium, like calcium and chloride, is essential for enzyme activity. Magnesium also participates in maintaining the body's acid-alkaline balance. Phosphorus is essential for kidney function ,bone growth, and cell growth, and also helps maintain the body's acid-alkaline balance (Fallon, 2001).Iron is a vital mineral that carries oxygen throughout the body and produces red blood cells (Beard *et al.*, 1996). Moreover, sodium and potassium play a role in regulating water and acid-base balance across the blood and tissues.

CONCLUSION

The objective of the study was to analyze the proximate and mineral compositions of *Sesamum indicum* seeds cultivated in Kashere and assess their nutritional properties. Results reveal that the seeds are abundant in fats/oil, carbohydrates, crude fibre, calcium (Ca), phosphorus (P), potassium (K) and sodium (Na), identifying them as a valuable source of nutrition. These seeds can be used as a commercial supplement in both human and animal diets, providing essential minerals that contribute to optimal health. It is, therefore,

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recommended that *Sesamum indicum* seeds are incorporated into the daily diet, especially in developing countries where malnutrition is an urgent issue. This action could significantly mitigate the increasing incidence of malnutrition in such regions.

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