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Research Article

Comparative Proximate Composition of Six Sesame (*Sesamum indicum* L.) Accession Cultivated in Katsina State, Nigeria

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ABSTRACT
Sesame (*Sesamum indicum* L.), known locally as beniseed, is a major oilseed crop in Nigeria. This study evaluated the proximate composition of six sesame accessions (IGBOHO BLACK, 02M, E8, EXSUDAN, KENAN 4, and BOGORO LOCAL) to identify nutritionally superior lines. Proximate analyses (moisture, ash, crude protein, crude fiber, fat and oil, and carbohydrate) were conducted using standard methods. One-way ANOVA indicated significant differences among accessions for all traits ($p \leq 0.05$). IGBOHO BLACK and E8 recorded the highest moisture contents (3.40 ± 0.10% and 3.38 ± 0.00%, respectively). IGBOHO BLACK had the highest ash (5.98 ± 1.10%) and crude fiber (5.77 ± 1.10%), while E8 showed the highest crude protein (7.21 ± 0.20%) and highest fat and oil content (60.50 ± 1.40%), closely followed by KENAN 4 (60.46 ± 2.13%). Carbohydrate content was greatest in IGBOHO BLACK and BOGORO LOCAL (27.63 ± 1.30% and 27.62 ± 1.18%, respectively). The accessions IGBOHO BLACK and E8 had favorable levels of moisture content, crude fibre, protein, fat and oil, carbohydrates that suggest they are promising accessions for nutritional and economic value, followed closely by KENAN 4 and BOGORO LOCAL. Further evaluation of *Sesamum indicum* L. under different environments and yield trials is recommended for breeding and cultivation purpose.

Keywords: Composition; E8; IGBOHO BLACK; Proximate; Sesame

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INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the oldest crops in the world, cultivation in Asia for several years. The crop has early origins in East Africa and in India, today India and China are the world's largest producers of sesame, followed by Myanmar, Sudan, Uganda, Nigeria, Pakistan, Tanzania, Ethiopia, Guatemala and Turkey. World production fluctuates due to local economic, crop production disturbance and weather conditions (Toan *et al.*, 2010).

Sesame is one of the ancient and most important sources of quality plant oil used by human beings (Olawuyi *et al.*, 2023). It is typically an annual oilseed crop and grown in the tropics and warm subtropics. Sesame seed is rich in nutrition value and due to the quality of oils; this sesame is known as the "Queen of oilseeds". The lignan compound and its derivatives prevent oxidation of the oil and help it to have long shelf life and stability (Toan *et al.,* 2010).

The sesame plant is an annual herb in the family Pedaliaceae, and is considered to be one of the most important oilseed crops used in various cuisine in Nigeria, Sudan, and Ethiopia chiefly for its commercial and nutritional benefits. In most parts of Katsina, sesame seeds are mixed with heated jaggery, sugar which is made into balls and consumed as food, in Northern and Southern part of Nigeria, the seeds are fried, and eaten with garden egg, peanuts and made into soup (Olawuyi *et al.*, 2023).

The local names are ridi in Hausa, isasa in Yoruba and ekuku in Igbo. Sesame seeds are considered to have the highest oil contents 44-60 percentage among major oilseed crops including peanut, soybean, rapeseed, and also rich in proteins, vitamins, and antioxidants such as sesamin. The oil of sesame is used as active ingredients in antiseptics, bactericides, viricides, disinfectants, moth repellants, anti-tubercular agents, and a considerable source of calcium, tryptophan, methionine, and many minerals (Adebowale *et al.*, 2010). The outstanding characteristic of sesame oil is its stability and shelf-life quality as well as resistance to decomposition. Nigeria is one of major supplier of sesame to the Japanese market, the world's largest import market for sesame. Nigeria generates 540 billion naira from sesame seed production annually (FAO, 2015). There two types of sesame produced in Nigeria, the white/raw (Food-grade) used in widely in baking industry and the brown/mixed (Oil-grade) cultivated in Nasarawa, Jigawa, Taraba and the Benue, Yobe, Borno, Adamawa, Niger, Kano, Katsina, Kogi, Gombe, and Plateau States (Olawuyi *et al.*, 2023).

The crop thrives best on moderately fertile, well-drained soils with a pH ranging from 5.5 to 8.0 and is sensitive to salinity (Ali, 2015). The plant thrives in high ecological aptitude due to its tolerance to drought and can survive where other crops fail mineral deficiencies (Olawuyi *et al.*, 2023).

Nigeria was ranked as the fifth largest producers of sesame in the world and third in Africa (84 million hectares under cultivation) one of the major sesame-producing countries that contributes over 20% and consumes ~30% of the world's production, with the highest yield level around the world (UNFAO, 2010). The production of sesame is highly beneficial with high returns on investment (FAO, 2015). The commonly cultivated sesame variety is the white sesame because of its nutritional appeal, numerous health benefits, industrial usage in medicine, baking and source of animal feed (Olawuyi *et al.*, 2023).

The plant is gaining significance in Nigerian agriculture because of the economic importance of its seeds as well as the nutritional value of the leaves when used as a vegetable (Olawuyi *et al.*, 2023). The morphology of sesame has been reported as a primary tool in estimating its genetic variability among sesame genotypes and morphological characterization of the plant has been reported. This study is aimed at comparing the proximate composition of six sesame accessions cultivated in Katsina State in order to identify nutritionally superior accessions for breeding and utilization purpose.

MATERIALS AND METHODS

Sample Collection

Seeds of *Sesamum indicum* L. were purchased from agro stores outlet licensed by the National Agricultural Seeds Council (NASC) Funtua, Katsina state. The six varieties collected are IGBOHO BLACK, 02M, E8, EXSUDAN, KENAN 4, and BOGORO LOCAL.

Determination of proximate analysis

Matured sesame seed samples were collected and subjected to proximate analysis to determine total contents of moisture, ash, crude protein, lipids (fat & oil), crude fibre, and carbohydrates. This analysis was carried out based on A.O.A.C. (1990) methods in three replicates.

Moisture Content

A clean crucible was first dried in an oven for about 30 minutes and then cooled in a desiccator. The cooled crucible was weighed as W1, and 0.5g of each sample was introduced into the crucible and weighed as W2 before drying. This was placed in an oven set at 102–105°C for an interval of two hours, cooled in a desiccator, and weighed as W3. This process was repeated until a constant weight was obtained. The moisture content, represented by the weight loss, was calculated as follows:

$$\text{Moisture Content (\%)} = [(W2 - W3) / (W2 - W1)] \times 100$$

Ash Content

A clean crucible was dried in an oven and weighed (W1). Approximately 0.5g of the sample was added to the crucible and weighed as W2. The crucible and its contents were then transferred into a muffle furnace set at 500–600°C for about 4 hours until a grey ash was obtained, indicating complete ashing. The crucible was removed, cooled in a desiccator, and weighed as W3. The percentage organic matter and ash content were calculated as follows:

$$\text{\% Organic Matter} = [(W2 - W3) / (W2 - W1)] \times 100$$

$$\text{\% Ash Content} = [(W3 - W1) / (W2 - W1)] \times 100$$

Fat and Oil Content

Lipid content was determined using a Soxhlet extractor with petroleum ether (40–60°C) as the solvent. 5g of each sample was weighed into a clean filter paper, tied securely with thread, and re-weighed. The wrapped sample was placed into the extraction column. Petroleum ether was introduced into the round-bottom flask until half filled (~300 cm3). The extractor was connected to a cooling water source and heated using a heating mantle. Continuous extraction was allowed to proceed for about 6 hours to ensure complete fat extraction. Afterwards, the defatted sample was removed, dried in an oven to a constant weight, and the percentage lipid was calculated:

% Lipids = (Weight Loss / Weight of Sample) × 100

Crude Protein Content

The Micro-Kjeldahl method was used for protein determination. 0.5g of the sample was weighed into a Kjeldahl digestion flask. Then, 0.5g of CuSO4·7H2O, 10g of Na2SO4, and 25 cm3 of concentrated sulphuric acid were added. The flask was heated gently for 15 minutes and then vigorously for 45 minutes in a fume cupboard until the mixture turned into a clear brilliant green, indicating complete digestion. The flask was cooled, and the digest was diluted with distilled water to 250 mL. This method relies on the conversion of organic nitrogen into ammonium sulphate, followed by distillation and titration.

Crude protein (%) = Nitrogen × 6.25

Crude Fibre Determination

A known weight of the sample (0.5g) was defatted with petroleum ether for 2 hours. It was then boiled under reflux for exactly 30 minutes with 200 cm3 of 1.25% HCl, filtered, and washed with distilled water until no longer acidic. The residue was boiled with 200 cm3 of 1.25% KOH for another 30 minutes, filtered into a previously weighed crucible (X2), and dried at 105°C. It was cooled in a desiccator and weighed. The crucible was then incinerated in a muffle furnace at 500–550°C for 3 hours, cooled, and weighed as X3. The crude fibre percentage was calculated as:

% Crude Fibre = [(X2 − X3) / Weight of original sample] × 100

Carbohydrate Content

The total carbohydrate content was derived by difference:

% Total Carbohydrate = 100 − (% Moisture + % Protein + % Lipid + % Ash + % Crude Fibre)

Data Analysis

Data collected were subjected to analysis of variance (ANOVA) using SPSS version 24 (2019), and means were separated using Duncan's Multiple Range Test (DMRT). A probability value of $p \leq 0.05$ was used as the benchmark for statistical significance.

RESULTS

The result of the proximate analysis of the six *Sesamum indicum* accessions is presented in table 1.

Proximate analysis

IGBOHO BLACK and E8 have the highest percentage moisture content (3.40±0.10% and 3.38±1.30% respectively), which is significantly different from EXSUDAN (3.18±1.41%) and 02M (3.10±1.10%), while the least percentage moisture content was observed in KENAN 4 (2.68±1.10%) and BOGORO LOCAL (2.04±1.12%) as presented in Table 1. The accession IGBOHO BLACK has the highest percentage ash content of 5.98±1.10% while KENAN 4 has the lowest ash content (4.60±1.11%). EXSUDAN and 02M are not significantly different in their ash contents (4.85±1.20% and 4.84±1.20% respectively). The accession E8 had the highest percentage crude protein (7.40.20%), followed by KENAN 4 and EXSUDAN (6.90±0.10% and 6.80±1.10% respectively), which is not significantly different from each other, while the lowest crude protein was observed in 02M (5.33±1.10%). The crude fibre content in IGBOHO BLACK was the highest (5.77±1.10%) of all the accessions followed by E8 (4.99%) which significantly different from each other. BOGORO LOCAL had the lowest percentage crude fibre (4.47±2.10%). The accession E8 and KENAN 4 has the highest percentage fat and oil content (60.50±1.40% and 60.46±2.13% respectively), which is not significantly different from each other. IGBOHO BLACK had the lowest fat and oil content (53.61±0.90%) which is significantly different from 02M (57.25±3.10%) and BOGORO LOCAL (54.25±1.33%). IGBOHO BLACK and BOGORO LOCAL has the highest carbohydrate content (27.63±1.30% and 27.62±1.18% respectively), followed by 02M (24.79±1.12%) and the lowest carbohydrate content was recorded in E8 (18.81±2.22%) and is significantly different from EXSUDAN (21.33±1.31%) and KENAN 4 (20.79±1.04%) as presented in Table 1.

Table 1: Percentage proximate analysis of six accessions of *Sesamum indicum* L.

ACCESSION	Moisture content (%)	Ash content (%)	Crude protein content (%)	Crude fibre content (%)	Fat & oil content (%)	Carbohydrate content (%)
IGBOHO BLACK	$3.40±0.10^{a}$	$5.98±1.10^{a}$	$5.60±1.20^{d}$	$5.77±1.10^{a}$	$53.61±0.90^{e}$	$27.63±1.30^{a}$
02M	$3.10±1.10^{bc}$	$4.84±1.20^{c}$	$5.33±1.10^{de}$	$4.69±1.10^{cd}$	$57.25±3.10^{c}$	$24.79±1.12^{b}$
E8	$3.38±1.30^{a}$	$5.10±1.21^{b}$	$7.21±0.20^{a}$	$4.99±2.10^{b}$	$60.50±1.40^{a}$	$18.81±2.22^{e}$
EXSUDAN	$3.18±1.41^{b}$	$4.85±1.20^{c}$	$6.80±1.10^{b}$	$4.78±1.21^{c}$	$58.95±1.71^{b}$	$21.33±1.31^{c}$
KENAN 4	$2.68±1.10^{d}$	$4.60±1.11^{d}$	$6.90±0.10^{b}$	$4.49±1.10^{e}$	$60.46±2.13^{a}$	$20.79±1.04^{d}$
BOGORO LOCAL	$2.04±1.12^{e}$	$4.65±1.10^{de}$	$6.58±0.10^{c}$	$4.47±2.10^{e}$	$54.25±1.33^{d}$	$27.62±1.18^{a}$
P – Value	0.001	0.001	0.001	0.001	0.001	0.001

Values with same letter(s) along a column are not significantly different at $p \geq 0.05$

DISCUSSION

The nutrient compositions of the sesame seeds (*Sesamum indicum* L.) vary amongst the six accessions considered in this study. The moisture content in IGBOHO BLACK (3.40±0.10%) and E8 (3.38±1.30%), was the highest and significantly different from the other accession. This is in contrast with Hamdy *et al.* (2020) who reported the highest percentage moisture content of 5.83% amongst the sesame accessions in Upper Egypt. Alege and Mustapha (2013) also reported that moisture content ranged from 0.25 to 3.00% from the study of 23 genotypes of Nigerian sesame which is close to the highest percentage moisture content in IGBOHO BLACK (3.40±0.10%) observed from this study.

The low moisture content of BOGORO LOCAL (2.04±1.12%) and KENAN 4 (2.68±1.10%) is indicative of higher nutrient density in these accessions, and better shelf life. These findings are in conformity with Smita, (2026) who reported that Sesame seeds with lower moisture content are powerful energy source and can be preserved for longer period. Hamdy *et al.* (2020) also reported slight differences in the moisture content between different sesame genotypes, and the lowest moisture content percentage is 4.51% which is higher than the lowest percentage moisture content observed from this study in BOGORO LOCAL (2.04±1.12%). These slight differences could be attributed to difference in environmental conditions, location and genetic compositions.

The ash content which represents the total inorganic residue and mineral content of the sesame accessions was highest in IGBOHO BLACK (5.98±1.30%). This finding is in tandem with Panpan *et al*. (2022) who reported a range of 3.5-8.0% of ash and crude fibre which serves as an important medicinal and homologous constituent that improves human health. Smita (2026) also reported high ash content of 7.2% which is significant in mitigating toxins, and indicates the wholeness of the sesame seed. The highest crude fibre (5.77±1.10%) observed in IGBOHO BLACK is significantly different from other accession, while the lowest crude fibre percentage observed in 02M (5.33±1.10%) falls within the range reported by Panpan *et al.* (2022). This is also similar to the findings of Hamdy *et al.* (2020) who reported no significant difference ($p \leq 0.05$) in ash content that range from 4.78-5.15% with a fibre content of 4.67% as the highest and lowest value of 3.31% which is close in range with the highest ash and fibre percentage value observed from this study.

The highest carbohydrate content was observed in IGBOHO BLACK and BOGORO LOCAL (27.63±1.30% and 27.62±1.18% respectively). This is contrary with the findings of Hamdy *et al*. (2020) who reported carbohydrate content of 13.08% as the lowest while the highest was 31.17%. Similarly, Edwige *et al.* (2025) reported that carbohydrate content of whole, base, and dehulled sesame kernels from both origins ranged from 4.56% ± 2.67% to 7.76% ± 7.64%. Vincent *et al.* (2022) reported that the body breaks down carbohydrate into glucose, which are the main energy source for all cells and the exclusive fuel for the brain and nervous system, which makes IGBOHO BLACK and BOGORO LOCAL important sesame accessions with a favorable carbohydrate percentage. The energy values of sesame seeds ranged from 1945.58 ± 1.48 to 3,109.18 ± 0.00 KJ/100 g/M reported by Edwige *et al.* (2025)

The accession E8 had the highest crude protein (7.4±0.20%) from the accessions analyzed which is contrary to the findings of Hamdy *et al.* (2020) who reported that sesame is characterized by higher protein content of 26.56% in Upper Egypt. Similarly, Edwige *et al.* (2025) reported that protein content of the whole, base and dehulled sesame seeds of the two varieties from Burkina Faso varied from 13.73% ± 7.07% to 18.66% ± 7.07%. These variations in percentage may be due to genetic composition of the sesame seed, environmental factors, cultivation, climate, ripening stage, the harvesting time of the seeds and the analytical method used. Ahmed *et al.* (2018) also reported that variation in oil seeds composition may be due to the influence of diverse environmental factors. The accession E8 is important for its protein content which is in tandem with the findings of Panpan *et al*. (2022) who reported that high value of the in vitro protein digestibility showed that sesame protein isolate could be used to enrich and act as a supplement in some food systems, especially in developing countries where protein deficiency is a major health challenge for children.

The highest percentage fat and oil was observed in E8 and KENAN 4 (60.50±1.40% and 60.46±2.13% respectively). These findings is in tandem with Edwige *et al.,* (2025) who reported that fat content of the whole, base and dehulled sesame seeds of the two varieties ranged from 42.16% ± 1.40% to 73.86% ± 7.007%. The percentage of oil observed in this sesame accession is higher than the findings of Panpan *et al*. (2022) who reported that the lipids in sesame are mainly found in the seeds and are an important component of sesame and the highest oil content among the major oil crops is between 45-57%, which is why it has been known as the “Queen of Oil” since ancient times. Hamdy *et al.* (2020) also reported that crude oil content of sesame genotypes ranged from 39.56 to 54.64% of dry weight which shows a close range in value but with slight differences that affirms the influence of genetic, seasonal and environmental variations amongst sesame accessions.

CONCLUSION

The result of the proximate analysis of the six accessions of sesame has shown that IGBOHO BLACK and E8 had a favorable level of moisture content, crude fibre, protein, fat and oil, and carbohydrates that suggest they are promising accessions for nutritional and economic value, followed closely by KENAN 4 and BOGORO LOCAL. Further evaluation under different environments and yield trials is recommended for breeding and cultivation.

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