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## Nutritional Composition, Fatty Acid Profile, and Biochemical Characteristics of Six Varieties of Cotton (*Gossypium hirsutum* L) Seed, and Cottonseed Oil Cultivated in Northern Nigeria

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**ABSTRACT:** Although *Gossypium hirsutum* oil is ranked among the top six vegetable oils globally, however, in Nigeria, *G. hirsutum* oil remains underexploited and underutilized. Consequently, the objective of this paper was to evaluate the nutritional composition, fatty acid profile, and biochemical characteristics of six varieties of cotton (*Gossypium hirsutum* L) seed, and cottonseed oil cultivated in northern Nigeria using appropriate standard procedures. The results revealed notable differences in the characters examined among the six varieties. SAMCOT-8 had the highest ( $p < 0.05$ ) seed protein content (22.17 %), while SAMCOT-12 recorded significantly higher fibre (17.00 %), carbohydrate (60.87 %), and magnesium (72.46 %) contents. SAMCOT-13 revealed the highest arachidic (1.76 %) and palmitic acid (10.74 %) levels, and SAMCOT-11 had the highest ( $p < 0.05$ ) oil content (18.00 %), oxalic acid (5.71 %), and linoleic acid (12.72 %) contents. Significant variability was also observed in the physical properties of the oil across the six cotton varieties, except for specific gravity, which showed no significant difference ( $p > 0.05$ ). These attributes could be exploited for the improvement of various traits by cotton breeders and researchers in future cotton breeding programs.

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The two most extensively cultivated cotton species are *Gossypium hirsutum* L. and *Gossypium barbadense* L. (Chen *et al.*, 2007), both of which are tetraploid varieties from America. Among these, *G. hirsutum* (upland cotton) leads the global cotton

market, with an estimated 35 million hectares planted annually in various countries and a share global production of about 90 % (Turley *et al.*, 2019). Cottonseed oil is unique as it is rich in unsaturated fatty acids with nearly 2:1 of polyunsaturated to

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saturated fatty acid, and contains 16-27 % monounsaturated fatty acid (oleic) and 40 – 55 % polyunsaturated fatty acid (linoleic). While saturated fatty acids (palmitic acid and stearic acid) constitute up to 25 % of total fatty acids (Ye *et al.*, 2022). *G. hirsutum* L. oil also contains a diverse variety of plant steroids (Zia *et al.*, 2021) and bioactive phytochemicals (Zeb, 2021). Though cottonseed oil is gaining increased attention and has earned a strong reputation in the global edible oil market due to its high fibre content, stability against auto-oxidation, unique fatty acid profile, and anti-inflammatory and cardio-protective properties (Riaz *et al.*, 2023), cotton breeding has primarily focused on fibre yield and quality, with little research interest in the improvements of cotton seed traits and oil characteristics. In Nigeria in particular, the cotton plant has largely remained under-utilized and cottonseed oil is still low in production and is largely under-exploited, possibly, due to a dearth of information on its biochemical attributes. Therefore, the objective of this paper is to evaluate the nutritional composition, fatty acid profile, and biochemical characteristics of six varieties of cotton (*Gossypium hirsutum* L) seed, and cottonseed oil cultivated in northern Nigeria.

## MATERIALS AND METHODS

*Source of research materials:* Exactly six (6) *G. hirsutum* L. varieties representing cotton varieties cultivated in northern Nigeria were obtained from the Institute of Agricultural Research (IAR), Ahmadu Bello University Zaria, Nigeria. The varieties are SAMCOT-7 (NGGS 91-7), SAMCOT-8 (NGGS 91-8), SAMCOT-9 (NGGS 06-12), SAMCOT-10 (NGGS 06-13), SAMCOT-11 (NGGS 03-9), SAMCOT-12 (NGGS 03-10) and SAMCOT-13 (NGGS 03-10). Each of these varieties have outstanding characteristics and a potential yield ranging between 1.5-2.5 t/ha.

*Study area and design of experiment:* The field trial was conducted at the Department of Plant Biology's experimental garden at the Federal University of Technology, Minna, Nigeria (latitude 9°36' N, longitude 6°34' E), while laboratory tests were performed at the Centre for Genetic Engineering and Biotechnology, Federal University of Technology Minna. Seeds were planted under uniform environmental conditions between May and December 2019, using a completely randomized design (CRD) replicated thrice. Five seeds from each variety were sown at a depth of 1–2 cm in experimental bags of 20-litre bucket size. Two weeks after sowing, the emerged seedlings were thinned to two plants per bag. The planting spacing was

maintained at 75 cm × 40 cm for inter- and intra-row spacing (Baloch *et al.*, 2014). All cultural practices, including weeding and irrigation, were uniformly followed throughout the growing period, as outlined by Abdullahi (2015), to minimize environmental variation.

*Proximate composition analysis:* Following harvest, the seeds were manually separated from the lint, sorted, and sun-dried. The cotton seeds were then blended using a Vitamix 7500 model and dried at 103°C until a constant weight was achieved. The moisture, total ash, crude protein, crude fibre, and crude fat of the cottonseed varieties were analysed following the methods outlined by the Association of Analytical Chemists (AOAC, 2019). The carbohydrate content was calculated by differencing according to Muller and Tobin (1980).

*Mineral composition analysis:* The mineral analysis of cottonseed was performed following the procedure outlined by AOAC (2019). Sodium (Na) and potassium (K) levels were assessed using a flame emission photometer, while phosphorus (P) was quantified colourimetrically through the vanadomolybdate method. Calcium (Ca), iron (Fe), and copper (Cu) concentrations were measured using an atomic absorption spectrophotometer as per Aziz *et al.* (2018).

*Fatty acid composition and physical properties analysis of cottonseed oil:* Crude oil extraction was done using the Soxhlet extraction method. Recovered crude oil was taken to a rotary evaporator at 35 °C as described by Konuskan *et al.* (2017). The oil samples were filtered and stored at 4 °C in dark bottles before analysis. The fatty acid contents were determined through gas chromatography/Mass spectrometry (GC/MS). The iodine value was determined according to Gunstone *et al.* (2007), saponification value was determined according to Okwonko and Okafor (2016), acid value was determined following the method of Dinda *et al.* (2011), peroxide value was quantified according to Basra *et al.* (2004), moisture content was determined according to Agarwal *et al.* (2003), viscosity and specific gravity were determined using the method of Anand *et al.* (2009).

*Data analysis:* The collected data were analysed using a One-way Analysis of Variance (ANOVA) in SPSS version 23.0, followed by Duncan's Multiple Range Test (DMRT) to identify significant differences between the means. Results were considered statistically significant at  $p < 0.05$ .

## RESULTS AND DISCUSSION

*Proximate composition of six (6) cottonseed varieties cultivated in northern Nigeria:* Significant variations were observed in the proximate composition of cottonseeds of the six cotton varieties (Table 1). Results obtained revealed a significantly higher ( $p < 0.05$ ) moisture and fat content in SAMCOT-11 (3.50 and 18.00 %, respectively) with the significantly ( $p < 0.05$ ) least moisture content in SAMCOT-13 (2.00 %) and least fat content in SAMCOT-9 (11.33 %). SAMCOT-10 was observed to have a significantly lower ash content (3.00 %), with the highest in SAMCOT-9 (5.33 %) (Table 1). In terms of seed protein content, the significant ( $p < 0.05$ ) highest was recorded in SAMCO-8 (22.17 %) while the least was recorded in SAMCOT-9 (11.66 %). Results revealed significantly ( $p < 0.05$ ) higher levels of fibre and carbohydrate in SAMCOT-12 (17.00 and 60.87 %, respectively), with the least fibre content in SAMCOT-10 (11.67 %) and least carbohydrate content in SAMCOT-8 (41.80 %) (Table 1).

This result shows that cottonseed possesses a significant amount of carbohydrate, protein, fat, fibre and ash contents that vary among varieties. Regardless of these quality attributes, previous researchers have shown that cottonseed is unsafe for direct human consumption due to its inherent association with gossypol (Kumar *et al.*, 2021). However, cottonseed meal can be utilized in animal feed production to reduce the feed-food competition between animals and humans as it is a sustainable source of plant protein. According to Ahmad *et al.* (2021), cottonseed meal is remarkable for its high level of protein and has been one of the most important sources of protein (22-53 %) for animal feed production. The protein content recorded in this study aligns with the dietary requirements of certain livestock species. Specifically, it meets the 12 % crude protein requirement for sheep and goats, and also the 18% crude protein requirement for rabbits and chicken (Zubair *et al.*, 2021). The cotton varieties with high protein content can be exploited and utilized as food ingredients, especially, in animals (Manoj *et al.*, 2019). Cottonseed meal can be used in feed formulation in fish and has been reported to significantly improve their growth, aids in weight gain and improves the proximate composition of fish (Ahmad *et al.*, 2021). According to Zaboli and Miri (2013), crude fibre content is an essential factor in assessing cottonseed quality, as higher fibre content leads to lower protein digestibility. Numerous research findings have demonstrated that properly processed cottonseed can serve as a cost-effective alternative to soybean, maize and groundnut as a source of dietary protein and energy in animal nutrition. The moisture, ash and crude protein content

obtained from this study were lower than the values (6.80, 7.47 and 56.80 %, respectively) reported by Kumar *et al.* (2021). However, the cottonseed fibre and crude fat content obtained from this study were higher than the values of (8.10 and 0.78 %) reported by Kumar *et al.* (2021). The cottonseed protein and fibre contents obtained from this study were slightly lower than the values (25.34 and 16.74 %) reported by Canikli *et al.* (2023), while the ash and protein contents in this study were consistent with the findings of the National Research Council (NRC, 2001). The results align with those of Yu *et al.* (2012), who has previously reported that cottonseed protein content could range from 12–32 %, which contrasts with Xiong *et al.* (2016), who found that the protein content varied from 23.67 % to 50.67 %. These differences reveal significant variabilities in the proximate composition of cottonseed genotypes from different regions. These variabilities could be attributed to variations in the genetic makeup of the cultivars and differences in environmental factors. This supports the views of He *et al.* (2013), who suggested that genetic factors, environmental conditions, and farming practices can significantly influence the composition of cottonseed.

*Mineral composition (%) of six (6) cottonseed varieties cultivated in northern Nigeria:* Notable ( $p < 0.05$ ) variations were observed in the mineral composition of the cottonseeds obtained from the six cotton varieties (Table 2 and Table 3). The highest ( $p < 0.05$ ) Ca and Mn contents were observed in SAMCOT-10 (21.72 and 1.73 %, respectively) while the least was recorded in SAMCOT-12 (10.41 and 1.21 %, respectively). SAMCOT-12 was observed to have the significantly highest Mg and K content (72.46 and 56.45 %, respectively) while the least Mg was recorded in SAMCOT-9 (35.43 %) and the least K was recorded in SAMCOT-11 (44.43 %), but was not statistically ( $p > 0.05$ ) different from SAMCOT-10 (44.60 %) (Table 2). The highest Na was recorded in SAMCOT-13 (1.90 %) but was not different ( $p > 0.05$ ) from SAMCOT-12 (1.81 %). SAMCOT-9 was observed to have the significantly highest P content (5.61 %), while the least was recorded in SAMCOT-8 (3.27 %) (Table 3). The significantly highest Fe content was recorded in SAMCOT-10 (3.84 %) while the least was observed in SAMCOT-9 (2.54 %). In terms of seed Cu content, the highest was recorded in SAMCOT-8 (2.28 %) while the least was recorded in SAMCOT-13 (1.38 %) (Table 3).

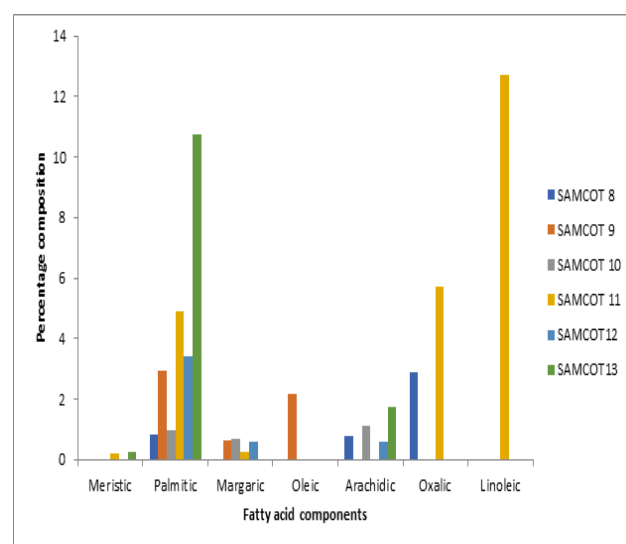
The levels and ranges of macro- and micro-elements were in line with the findings of He *et al.* (2020a). The observed Mn, Cu, and Fe levels in the six cotton varieties align with the ranges reported by Bellaloui *et al.* (2015) and He *et al.* (2020b) in 21 cotton varieties. These values were, however, higher than

the values reported by Ikorior and Fetuga (1987), this could be due to varietal or environmental differences. All these mineral elements are vital for plant growth, animal nutrition, and human consumption. However, certain elements, such as Cu and Mn, can be toxic at high concentrations (Bellaloui *et al.*, 2019). The variations in mineral composition among the varieties may be attributed to differences in their genetic makeup. This aligns with the findings of Ustaoglu (2007) who has reported significant differences in the nutrient composition of cotton seeds from different cultivars grown in Turkey.

*Fatty acid composition (%) of six (6) cottonseed varieties cultivated in northern Nigeria:*

The results of fatty acid analysis revealed significant ( $p < 0.05$ ) variations in the fatty acid compositions of the six cotton varieties (Fig. 1). SAMCOT-13 had the significantly ( $p < 0.05$ ) highest palmitic, myristic and arachidic acid content (0.26, 10.74 and 1.76 %, respectively). SAMCOT-10 had the significantly highest Margaric acid (0.68 %), while SAMCOT-9 was revealed to have the significantly highest Oleic acid content (2.17 %). The significantly highest ( $p < 0.05$ ) oxalic and linoleic acid content was observed in SAMCOT-11 (5.71 and 12.72 %, respectively) (Fig. 1). GC-MS analysis revealed higher levels of palmitic, oxalic and linoleic acid, as compared to other fatty acids examined. However, the values of oleic, palmitic and linoleic acid obtained from this study were much lower than the values (14.36, 25.34 and 55.55 %) previously reported by Sharma *et al.* (2009), Mahesar *et al.* (2017), Riaz *et al.* (2023) and Canikli *et al.* (2023) and this could be attributed to the differences in the cotton genotypes studied and also variations in the plant's growing conditions. Due to the presence of these fatty acids, cottonseed oil is used in the cooking and treatment of many ailments and skin diseases. It is naturally hydrogenated because of the presence of oleic, palmitic and stearic acid, and does not need complete hydrogenation like other vegetable oils (Riaz *et al.*, 2023). These fatty acids account for the stability of the oil during the frying process without forming trans-fatty acids (Jeje, 2020). Varieties with high levels of palmitic and linoleic acids (SAMCOT-13 and SAMCOT-11, respectively) will have oils with enhanced nutritional profile that makes them more suitable for functional foods and nutraceuticals. While oxalic acids are beneficial in small amounts, high oxalic acid levels can form insoluble complexes, potentially reducing mineral bioavailability in the diet and as such, must be monitored in oil intended for human or animal consumption to prevent antinutritional effects. The notable variations observed in the fatty acid composition between the varieties could be attributed to environmental factors as they greatly affect the oil

yield and properties of cottonseed oil. Similar variations in cottonseed oil yield have been reported by Kumar *et al.* (2023) and were attributed to the differences in cotton species, environmental factors and season of cultivation. By selecting and breeding varieties with superior oil content and desirable fatty acid profiles, such as SAMCOT-11 for its high oil, oxalic, and linoleic acid contents, SAMCOT-13 for its superior palmitic and arachidic content and SAMCOT-9 for its superior oleic acid content, cotton breeders can improve both the yield and quality of cottonseed oil. This, in turn, can support the development of more efficient and sustainable cottonseed oil production practices, meeting both nutritional and industrial demands.



**Fig. 1:** variability in fatty acid composition (%) of six (6) cottonseed varieties cultivated in northern Nigeria. This figure shows the variability observed in the fatty acid composition of six *Gossypium hirsutum* L. varieties cultivated in northern Nigeria.

*Physical properties of oil from six (6) cottonseed varieties cultivated in northern Nigeria:* Notable variations were also recorded in the physical characteristics of the cottonseed oil (Table 4). The significantly highest ( $p < 0.05$ ) peroxide and acid values were recorded in SAMCOT-8 (3.17 and 2.73 %, respectively), while the least peroxide and acid values were recorded in SAMCOT-9 (1.26 and 1.91 %, respectively). The highest iodine value was recorded in SAMCOT-11 (84.28 %) but was not significantly ( $p > 0.05$ ) different from that of SAMCOT-8 (83.60 %) (Table 3). SAMCOT-9 had the significantly ( $p < 0.05$ ) highest saponification value (2.10 %) and the significantly ( $p < 0.05$ ) least viscosity and moisture content (16.22 and 1.44 %, respectively). No significant difference ( $p > 0.05$ ) was observed in the specific gravity of oil obtained from the six cotton varieties (Table 4).

The acid and iodine values obtained from this study were higher than the values of 0.11 mg/100g and 100 g/100/sg reported by Dinda *et al.* (2011) and Gunstone *et al.* (2007), respectively. The saponification values, peroxide values and specific gravity values obtained from the six cotton varieties were similar to the reports of Dinda *et al.* (2008), Talpur *et al.* (2014) and Anand *et al.* (2009), respectively. However, the moisture contents of the oil extracted were quite higher than the values of 0.10 % reported by Agarwal *et al.* (2003). The acid and iodine values are important quality indicators for cottonseed oil, reflecting its free fatty acid (FFA)

content and degree of unsaturation (Dunford, 2016). Varieties with higher acid values, such as SAMCOT-8 indicate poor oil quality, reduced shelf life and potential health concerns unless refined while varieties with a higher iodine value, such as SAMCOT-11 possess enhanced nutritional benefits but reduced oxidative stability, requiring careful storage and processing. Fan and Eskin (2015) opined that the primary use of cottonseed oil is food related; for frying, salad oil, manufacturing shortenings used in biscuits and margarine manufacture. However, gossypol must be removed from oil for edible purpose.

**Table 1:** proximate composition (%) of six (6) cottonseed varieties cultivated in northern Nigeria

Varieties	Moisture	Ash	Fat	Protein	Fibre	Carbohydrate
SAMCOT-8	2.83 ± 0.17 <sup>d</sup>	5.00 ± 0.29 <sup>c</sup>	14.00 ± 0.50 <sup>c</sup>	22.17 ± 0.58 <sup>c</sup>	14.50 ± 1.00 <sup>c</sup>	41.80 ± 1.45 <sup>a</sup>
SAMCOT-9	2.33 ± 0.17 <sup>b</sup>	5.33 ± 0.17 <sup>f</sup>	11.33 ± 0.17 <sup>a</sup>	11.66 ± 0.17 <sup>a</sup>	15.50 ± 0.29 <sup>d</sup>	53.88 ± 0.85 <sup>b</sup>
SAMCOT-10	2.17 ± 0.17 <sup>ab</sup>	3.00 ± 0.29 <sup>a</sup>	12.50 ± 0.58 <sup>b</sup>	17.56 ± 0.15 <sup>c</sup>	11.67 ± 0.17 <sup>a</sup>	54.91 ± 1.61 <sup>c</sup>
SAMCOT-11	3.50 ± 0.00 <sup>c</sup>	4.83 ± 0.17 <sup>d</sup>	18.00 ± 0.29 <sup>c</sup>	15.93 ± 0.10 <sup>b</sup>	14.67 ± 0.44 <sup>c</sup>	55.75 ± 0.34 <sup>d</sup>
SAMCOT-12	2.67 ± 0.33 <sup>c</sup>	4.50 ± 0.29 <sup>b</sup>	15.83 ± 0.17 <sup>d</sup>	20.88 ± 0.12 <sup>d</sup>	17.00 ± 0.00 <sup>c</sup>	60.87 ± 0.70 <sup>e</sup>
SAMCOT-13	2.00 ± 0.50 <sup>a</sup>	4.67 ± 0.60 <sup>c</sup>	13.83 ± 0.44 <sup>c</sup>	21.79 ± 0.43 <sup>c</sup>	13.33 ± 0.44 <sup>b</sup>	55.62 ± 0.57 <sup>d</sup>

Values are mean ± standard error of the mean. Values followed by the same superscript along the same column are not significantly different at  $p > 0.05$ .

**Table 2:** mineral composition (%) of six (6) cottonseed varieties cultivated in northern Nigeria

Varieties	Ca	Mg	Na	K
SAMCOT-8	21.00±0.57 <sup>c</sup>	47.50±0.08 <sup>a</sup>	1.44±0.06 <sup>c</sup>	49.21±0.35 <sup>c</sup>
SAMCOT-9	12.70±0.17 <sup>b</sup>	35.43±0.40 <sup>d</sup>	1.14±0.02 <sup>a</sup>	52.52±0.24 <sup>c</sup>
SAMCOT-10	21.72±0.16 <sup>c</sup>	44.73±0.24 <sup>b</sup>	1.30±0.01 <sup>b</sup>	44.60±0.31 <sup>a</sup>
SAMCOT-11	12.65±0.44 <sup>b</sup>	63.71±0.60 <sup>d</sup>	1.30±0.02 <sup>b</sup>	44.43±0.30 <sup>a</sup>
SAMCOT-12	10.41±00.21 <sup>a</sup>	72.46±0.32 <sup>c</sup>	1.81±0.04 <sup>a</sup>	56.45±0.28 <sup>b</sup>
SAMCOT-13	10.74±0.14 <sup>ab</sup>	65.60±0.32 <sup>d</sup>	1.90± 0.01 <sup>a</sup>	50.28±0.01 <sup>b</sup>

Values are mean ± standard error of the mean. Values followed by the same superscript along the same column are not significantly different at  $p > 0.05$ .

**Table 3:** mineral composition (%) of six (6) cottonseed varieties cultivated in northern Nigeria

Varieties	P	Fe	Cu	Mn
SAMCOT-8	3.27 ± 1.33 <sup>a</sup>	2.74 ± 0.05 <sup>b</sup>	2.28 ± 0.01 <sup>d</sup>	1.60 ± 0.01 <sup>e</sup>
SAMCOT-9	5.61 ± 10.01 <sup>d</sup>	2.54 ± 0.03 <sup>b</sup>	1.55 ± 0.01 <sup>b</sup>	1.59 ± 0.0 <sup>e</sup>
SAMCOT-10	3.70 ± 0.88 <sup>b</sup>	3.84 ± 0.02 <sup>a</sup>	2.06 ± 0.03 <sup>b</sup>	1.73 ± 0.0 <sup>e</sup>
SAMCOT-11	4.88 ± 1.73 <sup>c</sup>	2.89 ± 0.05 <sup>c</sup>	2.18 ± 0.01 <sup>c</sup>	1.64 ± 0.0 <sup>d</sup>
SAMCOT-12	3.58 ± 0.50 <sup>ab</sup>	2.91 ± 0.02 <sup>a</sup>	2.10 ± 0.09 <sup>c</sup>	1.21 ± 0.0 <sup>a</sup>
SAMCOT-13	4.68 ± 1.71 <sup>c</sup>	2.89 ± 0.03 <sup>c</sup>	1.38 ± 0.01 <sup>a</sup>	1.31 ± 0.02 <sup>b</sup>

Values are mean ± standard error of the mean. Values followed by the same superscript along the same column are not significantly different at  $p > 0.05$ .

**Table 4:** physical properties of cottonseed oil of six Nigerian cotton varieties

Varieties	PV	IV	AV	SPV	SG	V	MC
SAMCOT-8	3.17±0.06 <sup>d</sup>	83.60±0.04 <sup>cd</sup>	2.73±0.15 <sup>c</sup>	2.04±0.01 <sup>d</sup>	0.91±0.00 <sup>a</sup>	16.60±0.01 <sup>b</sup>	1.66±0.01 <sup>c</sup>
SAMCOT-9	1.26±0.02 <sup>a</sup>	76.24±0.02 <sup>b</sup>	1.91±0.02 <sup>a</sup>	2.10±0.02 <sup>c</sup>	0.91±0.00 <sup>a</sup>	16.22±0.01 <sup>a</sup>	1.44±0.03 <sup>a</sup>
SAMCOT-10	2.15±0.01 <sup>b</sup>	78.40±0.02 <sup>c</sup>	2.19±0.01 <sup>b</sup>	1.92±0.01 <sup>b</sup>	0.91±0.00 <sup>a</sup>	17.42±0.02 <sup>c</sup>	1.65±0.01 <sup>c</sup>
SAMCOT-11	2.37±0.02 <sup>c</sup>	84.28±0.02 <sup>d</sup>	2.13±0.01 <sup>b</sup>	1.90±0.01 <sup>a</sup>	0.91±0.00 <sup>a</sup>	16.80±0.01 <sup>c</sup>	1.77±0.02 <sup>d</sup>
SAMCOT-12	2.38±0.01 <sup>c</sup>	78.60±0.01 <sup>c</sup>	2.21±0.02 <sup>b</sup>	1.94±0.01 <sup>c</sup>	0.91±0.00 <sup>a</sup>	17.25±0.02 <sup>d</sup>	1.58±0.02 <sup>b</sup>
SAMCOT-13	2.21±0.01 <sup>b</sup>	74.51±0.02 <sup>a</sup>	2.10±0.01 <sup>b</sup>	1.92±0.01 <sup>b</sup>	0.91±0.00 <sup>a</sup>	16.90±0.02 <sup>c</sup>	1.53±0.02 <sup>b</sup>

Values are mean ± standard error of the mean. Values followed by the same superscript along the same column are not significantly different at  $P > 0.05$ . Keys: PV -peroxide value (meq/kg), IV -iodine value (g/100/sg), AV -acid value (mg/100g), SPV - saponification value (mg/100), SG - specific gravity, V -viscosity (m/s<sup>2</sup>), MC -moisture contents (%).

The variations observed in the physical properties of cottonseed oil among the cotton varieties studied could be a result of variations in their genetic

information (Zia *et al.*, 2021), while the discrepancies observed with previous reports could be a result of variations in environmental factors or the oil

extraction process. Riaz *et al.* (2023) have previously reported variations in cottonseed oil properties extracted following different procedures.

**Conclusion:** This study revealed significant variations in the proximate and nutritional attributes of cottonseed of six cotton varieties cultivated in northern Nigeria. SAMCOT-12 was found to have the highest fibre, carbohydrate, and magnesium content. SAMCOT-9 exhibited the highest ash, phosphorus, potassium, and oleic acid contents. SAMCOT-10 contained the highest levels of manganese, calcium, and iron. SAMCOT-8 showed the highest seed protein content, while SAMCOT-11 possessed the highest oil, oxalic, and linoleic acid contents. These findings could be exploited for the improvement of various traits by cotton breeders and researchers.

**Declaration of Conflict of Interest:** The authors declare that no known conflict of interest or personal relationships that could have influence the work reported in this paper.

**Declaration of Data Availability:** Data are available upon request from the first author.

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