FULafia Journal of Science & Technology
ISSN (print) 2449-0954 \ ISSN (online) 2636-4972
https://lafiascijournals.org.ng/index.php/fjst
Sponsored By TETFUND TERTIARY EDUCATION TRUST FUND
Manuscript => Received: Nov., 2025; Accepted: Feb., 2026; Published: March, 2026 https://doi.org/10.62050/fjst2026.v10n1.710

COMPARATIVE EVALUATION OF MORPHOLOGICAL AND NUTRACEUTICAL TRAITS OF GENETICALLY MODIFIED TELA MAIZE AND OTHER MAIZE (*Zea mays* L.) VARIETIES IN LAFIA, NASARAWA STATE, NIGERIA

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ABSTRACT
Maize (*Zea mays* L.) is one of the most significant cereal crops cultivated worldwide and serves as a staple food, animal feed, and industrial raw material. The research was carried out at the Botanical garden of the Federal University of Lafia to evaluate the morph-Nutraceutical compositions of different maize varieties cultivated in Nigeria. The experiment was laid out in a randomly complete block design (RCBD) with replications. Data collected were subjected to analysis of variance (ANOVA) using GenStat software version 18.0. All Morpho-Nutraceutical analysis and procedures were carried out according to AOAC. The result revealed that SAMMAZ 75 had the highest moisture content (9.378 %) while SAMMAZ 51 had the lowest moisture content (6.548 %). The (SAMMAZ 75 had the highest ash content (3.530 %) while SAMMAZ 51 had the least ash content (2.938 %). The % fat content varied significantly, with the highest value of 10.346 % observed in SAMMAZ 75 and the lowest value of 6.475 % in SAMMAZ 51. The percentage crude protein (C.P) ranged from 4.375 % SAMMAZ 52 to 10.937 % (SAMMAZ51). The percentage crude fibre (C.F) ranged from 4.935 % (SAMMAZ 34) to 8.328 % (SAMMAZ 75). The % carbohydrate (CHO) content ranged from 62.168 % SAMMAZ 75 to 70.082 % (SAMMAZ 34). Sammaz 34 sammaz 75 and sammaz 52 are therefore recommended for most of the agronomical, phytochemical and nutritional properties.

Keywords: Morpho-nutraceutical, Genetically modify maize, Varieties

INTRODUCTION
Maize (*Zea mays* L.) is one of the most significant cereal crops cultivated worldwide and serves as a staple food with lots of nutritional benefits. Its global importance is underscored by its adaptability to diverse agro-ecological zones, relatively short growing period, and substantial contribution to food security, particularly in sub-Saharan Africa (Adegbaju *et al*., 2021). According to Adewumi *et al.* (2020), maize accounts for a large portion of caloric intake in many African countries and plays a central role in both household consumption and income generation. In response to challenges such as pest infestation, climatic fluctuations, and plant nutrient deficiencies, concerted efforts have been made to improve maize varieties through conventional breeding and modern biotechnological interventions. One notable advancement in this area is the development of TELA maize, a genetically engineered maize variety designed to possess insect resistance, particularly against stem borers and fall armyworms, and enhanced drought tolerance. Abebe *et al.* (2021) highlight that the deployment of *TELA Maize* in African agriculture, especially in countries like Nigeria, Kenya, and Ethiopia, marks a significant milestone in addressing persistent production constraints.

However, the focus of crop improvement should not only be on yield enhancement and resistance traits but also on the nutritional and health benefits of the produce. The morpho-phytochemical and proximate composition of maize varieties play a critical role in determining their health benefits, industrial applications, and suitability for various diets. Morphological traits such as plant height, ear size, cob weight, and kernel color are essential not only for agronomic performance but also for consumer preference and marketability (Badu-Apraku & Fakorede, 2017). Phytochemicals, including phenolic compounds, flavonoids, tannins, alkaloids, and saponins, are naturally reoccurring bioactive compounds that contribute to the antioxidant properties of maize and have been associated with reduced risks of chronic illnesses such as cardiovascular diseases, diabetes, and certain types of cancers (Olayinka & Etejere, 2018). Similarly, proximate analysis, which involves the measurement of moisture content, crude protein, crude fiber, ash, crude fat, and carbohydrate content, offers invaluable nutritional information crucial for dietary planning, food formulation, and nutritional labeling (Olanipekun *et al.*, 2019).

Despite the introduction and adoption of TELA Maizein Nigeria and several other African countries, comprehensive studies assessing its morpho-

phytochemical and proximate properties relative to other conventional maize varieties remain limited. This study seeks to fill this gap by providing comparative data on the morphological, phytochemical, and nutritional composition of *TELA Maize* and other commonly cultivated maize varieties in Nigeria. Conventional maize varieties, although widely cultivated, are often vulnerable to biotic and abiotic stresses, resulting in suboptimal yields and compromised nutritional value. The introduction of *TELA Maize* was intended to address these limitations by providing a maize variety with improved resistance to pests and drought, thereby ensuring higher yields. Without Nutracentical data, stakeholders including farmers, nutritionists, policymakers, and food processors lack comprehensive information necessary to make informed decisions regarding the adoption, commercialization, and dietary use of *Tela maize*. This research aimed at evaluating the morpho-phytochemical and proximate compositions of *TELA Maize* and other maize varieties cultivated in Nigeria.

MATERIALS AND METHODS

Study Area

The experiment was carried out at the botanical garden of the department of Plant Science and Biotechnology, Federal University of Lafia and Ta'al Laboratory Kwandere Road Lafia Nasarawa State

Source of Planting Materials

TELA Maize (Sammaz 75) and other maize varieties (Sammaz 24, 34, 51 and 52) samples were collected from IAR (Institute for Agricultural Research Zaria) and NADP (Nasarawa State Agricultural Development Programme). These organizations have a solid reputation in the region for helping farmers. They offer all types of agricultural support, including seed production and distribution. This ensures that we have high-quality materials for our study, making our results more reliable (NADP, 2020).

Experimental Design

The experiment was layout in a Randomized Complete Block Design (RCBD) with three replications

Data Collection

Data were collected on the basis of: Days to Germination, Germination Rate, Germination Percentage, Days to Flowering (After 6 weeks after planting), Plant Height (After 9 weeks after planting), Number of Kernel Per Row, Cob Weight, Cob Length, Cob Diameter, Cob Area.

Data Analysis

Data collected were subjected to analysis of variance (ANOVA) using GenStat software version 18.0. mean separation was performed using Fisher's Protected Least Significance Difference test.

RESULTS AND DISCUSSION

Growth and Germination Parameters

Table 1: Present the early growth performance of five maize varieties across key parameters: germination days, germination rate, germination percentage, days to flowering, and plant height. Sammaz75 (Tela maize) germinated late (7.00 days) while Sammmaz 34 had the earliest germination (3.33 days). Sammaz 52 had the highest germination rate (16.00) while Sammaz 75 (Tela maize) had the least germination rate (11.00). Highest germination percentage was recorded in maize variety Sammaz 52 (94.06) while the least was recorded in Sammaz 51 (62.53). Days to flowering 6weeks after planting was observed in maize variety Sammaz 75 (Tela maize) (45.00) while Sammaz 34 had the least days to flowering 6weeks after planting (39.00). Sammaz 75 (Tela maize) had the highest plant height (220.3 cm) while Sammaz 52 had the least plant height (170.03 cm).

Table 1: Means Performance of Maize Growth and Germination Parameter

Varieties	Days to Germination	Germination Rate	Germination Percentage	Days to Flowering 6weeks AP	Plant Height 9weeks AP
Sammaz34	3.33c	15.001	90.20a	39.00c	173.0a
Sammaz51	4.33b	14.00b	62.53b	40.66b	209.6b
Sammaz52	4.33b	16.00a	94.06a	40.66b	170.03
Sammanz75 (Tela maize)	7.00a	11.00b	66.66b	45.00a	165.16a
Sammaz24	4.33b	15.00a	88.20a	41.00b	220.3a
SE	**0.26**	**1.36**	**5.54**	**0.18**	**17.83**
LSD	**0.87**	**4.43**	**18.07**	**0.59**	**58.17**

SE: Standard Error; LSD: Least Significant Difference; AP: After planting

Yield Parameter of Five Maize Varieties

The study compares the growth and yield-related traits of five maize varieties to assess their productivity. The parameters evaluated include kernels per row, cob weight, cob diameter, cob length, and cob area (Table 2). The result showed that there is no significant difference among kernel count in all the maize varieties. Longest cob length (19.02 cm) was observed in Sammaz 51, and largest cob area (48.70 cm²) was observed in Sammaz 52. The variety Sammaz 52 had the heaviest cob weight (250.00 g), while variety Sammaz52 had the widest cob diameter (5.20 cm).

Table 2: Means performance of maize yield parameter

Varieties	No. of Kernel per row	Cob weight	Cob diameter	Cob Length	Cob Area
Sammaz34	36.00a	200.00c	4.06b	17.76a	36.38b
Sammaz51	22.66a	130.00d	3.70c	19.02a	35.22b
Sammaz52	19.66a	250.00a	5.20a	18.50a	48.70a
Sammanz75 (Tela maize)	25.66a	210.00c	3.40c	12.86b	21.85c
Sammaz24	20.00a	230.00b	4.43b	18.23a	40.80a
SE	**5.59**	**0.004**	**0.24**	**0.64**	**2.76**
LSD	**17.92**	**0.01**	**0.79**	**2.11**	**9.02**

SE: Standard Error; LSD: Least Significant Difference

Proximate Composition

The result for proximate composition of the different maize varieties is shown in Table 3. The percentage moisture content (%M.C) of the dried samples ranged from 6.548% (SAMMAZ 51) to 9.378% (SAMMAZ 75), with SAMMAZ 75 having the highest moisture content and SAMMAZ 51 the lowest. The % ash content ranged from 2.938 % (SAMMAZ 51) to 3.530 % (SAMMAZ 75), with SAMMAZ 75 also exhibiting the highest ash content. The % fat content varied significantly, with the highest value of 10.346% observed in SAMMAZ 75 and the lowest value of 6.475% in SAMMAZ 51. The % crude protein (C.P) ranged from 4.375% (SAMMAZ 5) to 10.937% (SAMMAZ 51), with SAMMAZ 51 having the highest protein content. The % crude fibre (C.F) ranged from 4.935% (SAMMAZ 34) to 8.328% (SAMMAZ 75), with SAMMAZ 75 again showing the highest value.The % carbohydrate (CHO) content ranged from 62.168% (SAMMAZ 75) to 70.082% (SAMMAZ 34), with SAMMAZ 34 having the highest carbohydrate content and SAMMAZ 75 the lowest. These results indicate significant variability in the nutritional composition among the maize varieties, with SAMMAZ 75 standing out for its higher moisture, ash, fat, and crude fibre content but lower carbohydrate content compared to the other varieties.

Table 3: Proximate composition of five maize Varieties

Samples Code	Sample No	%M.C	%Ash	%FAT	%C.P	%C.F	%CHO
Sammaz 24	5	7.260	3.220	8.972	9.625	5.326	65.597
Sammaz 34		8.396	3.102	7.836	8.750	4.935	70.082
Sammaz 51		6.548	2.938	6.475	10.937	6.208	66.894
Sammaz 52		8.027	3.326	9.786	4.375	5.773	68.713
Sammaz 75 (Tela Maize)		9.378	3.530	10.346	6.250	8.328	62.168

M.C= Moisture Content; AC= Ash Content; FAT= Crude Fat; C.P= Crude protein; C.F= Crude Fiber; CHO= Carbohydrate content

Table 4: Phytochemical composition of five Maize varieties

Samples Code	Alkaloids (mg/100 g)	Saponnins (mg/100 g)	Tannin (mg/100g)	Steroids (mg/100 g)	Flavoids (mg/100 g)	Phenols (mg/100 g)
Sammaz 24	5.986	1.963	1.563	3.361	6.463	0.968
Sammaz 34	5.721	2.138	1.248	3.203	6.439	0.629
Sammaz 51	5.326	2.326	1.732	3.438	5.782	0.586
Sammaz 52	5.422	2.028	1.946	3.696	5.620	0.322
Sammaz 75 (Tela Maize)	4.234	3.502	1.793	3.823	5.930	0.721

Phytochemical composition of five maize varieties

The study of phytochemical composition of five maize varieties which includesalkaloids, saponins, tannins, steroids, flavonoids, and phenolsin (Table 4). The maize varieties include: (SAMMAZ 24, 34, 51, 52, and 75) as shown in Table 4. SAMMAZ 24 had the highest alkaloid (5.986 mg/100 g) and flavonoid (6.463 mg/100 g) content, along with the highest phenolic levels (0.968 mg/100 g), suggesting strong antioxidant and medicinal potential. In contrast, SAMMAZ 75 (Tela Maize) showed the highest saponin (3.502 mg/100 g) and steroid (3.823 mg/100 g) concentrations, indicating possible cholesterol-lowering and anti-inflammatory benefits. Tannin levels were relatively consistent across samples, with SAMMAZ 52 having the highest (1.946 mg/100 g). The findings highlight distinct phytochemical profiles among the varieties, with SAMMAZ 24 and SAMMAZ 75 emerging as particularly promising for nutritional or therapeutic applications. The variability in phytochemical content underscores the genetic diversity in maize, which could be leveraged in breeding programs to enhance health benefits and stress resistance

The study presents a comprehensive analysis of the Morpho-Nutraceutical composition of TELA Maize(SAMMAZ 75) compared with other maize varieties (SAMMAZ 24, 34, 51, and 52), revealing important insights into their nutritional and agronomic profiles.TELA Maize(SAMMAZ 75) exhibited the highest moisture and ash content. SAMMAZ 51 showed the lowest moisture and ash, suggesting better storage stability. Carbohydrate content varied notably, with SAMMAZ 34 recorded at the highest among all, while TELA Maizehad the lowest. Such variability in carbohydrate levels among maize genotypes reflects genetic diversity, which impacts the energy value and industrial applications of these grains, as reported by Shamsuddeen *et al.* (2012). The result is also in agreement with the study of Ikujenlola (2017) who reported that carbohydrate-rich maize varieties play

pivotal roles in food security and energy Tannins, though sometimes considered antinutrients, also provide defense against pests and confer health provision. In terms of fat, protein, and fiber, TELA Maize had the greatest crude fat (10.346 %) and crude fiber (8.328 %), whereas SAMMAZ 51 excelled in crude protein content. Phytochemical analysis revealed further differentiation. SAMMAZ 24 showed the highest alkaloid, flavonoid, and phenol concentrations. benefits in moderation, as reported by Dykes and Rooney (2006).

Growth parameters revealed that SAMMAZ 34 and SAMMAZ 52 performed well in most of the growth parameters. Sammaz 75(Tela maize) had the lowest germination rate and percentage, despite germinating earliest. These findings suggest that early germination does not necessarily correlate with robust establishment, a phenomenon observed in other crops (Finch-Savage and Bassel, 2016). The superior performance of SAMMAZ 34 AND SAMMAZ 51 in growth traits highlights their suitability for environments requiring high germination success and vigorous early growth. Moreover, Sammaz 75 (Tela maize) to flowering, which may make it suitable for longer growing seasons and adaptation to varied agro ecologies, while SAMMAZ 34 and SAMMAZ 51 exhibited outstanding plant height and yield indices. Comparative agronomic studies reported by Prasanna *et al*. (2010) have shown how such traits confer yield advantages in diverging environments. Collectively, this study emphasizes the phenotypic and biochemical diversity among maize varieties, with TELA Maize standing out for certain functional components but lagging in some agronomic indices. These findings support ongoing breeding initiatives aimed at combining robust phytochemical properties, nutritional value, and field performance a strategy noted as essential in the quest for improved, health-beneficial maize varieties.

Yield parameters further differentiated the varieties, with SAMMAZ 34 excelling in kernel count, cob length, and cob area. TELA Maize SAMMAZ 75 had the heaviest cob weight but underperformed in cob length and area. These results are consistent with studies showing that cob morphology and yield components are highly genotype-dependent (Duvick, 2005). The high kernel count and cob dimensions of SAMMAZ 34 suggest its potential for maximizing yield, while Varieties4's heavier cobs may be advantageous for specific processing needs. The nutritional and phytochemical diversity observed in this study reflects the broader genetic variability in maize, which has been leveraged for breeding programs aimed at enhancing both agronomic and nutritional traits (Prasanna *et al.*, 2020). High protein content in SAMMAZ 51 aligns with efforts to develop protein-rich maize for addressing malnutrition in developing regions. Similarly, the phytochemical richness of SAMMAZ 24 and SAMMAZ 75 supports their use in functional foods or nutraceuticals, as suggested by earlier work on bioactive compounds in cereals (Awika *et al*., 2018). The growth and yield results also highlight the trade-offs between early vigor and establishment, as seen in Tela maize's poor germination despite rapid sprouting. This aligns with studies emphasizing the need for balanced trait selection in breeding programs to ensure both early and late-stage performance (Troyer, 2006).

CONCLUSION

This study comprehensively evaluated the morpho-phytochemical and proximate composition of TELA Maize (SAMMAZ 75) alongside other maize varieties (SAMMAZ 24, 34, 51, and 52), revealing significant variability in their nutritional, biochemical, and agronomic traits which can be harness for future industrial and breeding work.

Conflicts of interest: There are no conflicts of interest relating to the publication of this paper

Acknowledgements: The authors wish to thank the Tertiary Education Trust Fund (TETFund), for providing the funds for the research under the Institutional Based Research grant and the Federal University of Lafia and Department of Science Laboratory Technology for providing support for this research.

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