NUTRITIONAL VALUES OF WATERMELON (*Citrullus lanatus*) FRUITS IN RESPONSE TO DIFFERENT NUTRIENT SOURCES IN OGBOMOSO, NIGERIA

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Abstract

Watermelon (*Citrullus lanatus*) is an economically and nutritionally valuable fruit crop widely cultivated in tropical and subtropical regions. However, its productivity and fruit quality are often constrained by declining soil fertility and the overreliance on inorganic fertilizers. This study investigated the effects of different nutrient sources on nutritional composition of watermelon under field conditions at the Ladoke Akintola University of Technology (LAUTECH) Teaching and Research Farm, Ogbomoso, Nigeria in years 2022 and 2023. Eight fertilizer treatments (no fertilizer, 100% NPK, 100% compost, Supergrow, poultry manure, 75% NPK + 25% compost, 50% NPK + 50% compost, and 25% NPK + 75% compost) were arranged in a randomized complete block design with three replications. The fruit elemental composition, bioactive compounds, vitamin Content and proximate composition were all determined. Results showed that nutrient sources significantly affected fruit elemental, proximate, and bioactive composition ($p \leq 0.05$). The fruit Nitrogen (N) content ranged from 6.43 g kg^{-1} in the unfertilized control to 16.60 g kg^{-1} in the 50% NPK + 50% treatment. Phosphorus (P) peaked at 8.30 g kg^{-1} under 100% compost, while potassium (K) reached 6.40 g kg^{-1} in 75% NPK + 25% compost. Calcium (Ca) and magnesium (Mg) were highest in 75% NPK + 25% compost (0.50 g kg^{-1} and 33.00 g kg^{-1}, respectively). Poultry manure improved crude fibre (0.34%) and protein (0.60%), whereas integrated fertilizers increased total sugar (16.47%) and total solids (6.13%). Lycopene and carotenoid contents were enhanced by Supergrow (10.88 mg 100 g^{-1} and 8.57 mg 100 g^{-1}, respectively), while vitamin B_6 was highest (19.73 mg 100 g^{-1}) under 50% NPK + 50% compost. The study concludes that integrating organic and inorganic fertilizers, particularly 75% NPK + 25% compost and 50% NPK + 50% compost, optimizes watermelon fruit nutritional quality and supports sustainable soil fertility management.

Keywords: Watermelon, fertilizers, super grow, nutritional values, nutrient sources.

Introduction

Watermelon (*Citrullus lanatus*) is an economically important fruit crop cultivated across tropical and subtropical regions for its refreshing taste, high water content, and valuable nutritional and bioactive compounds. The fruit is rich in lycopene, β-carotene, vitamin C, and essential minerals, which contribute to its health-promoting and antioxidant properties (Ali *et al.,* 2024). In Nigeria and other sub-Saharan African countries, watermelon has become a major cash crop, yet its productivity and fruit quality are often constrained by declining soil fertility and unbalanced fertilizer use in smallholder systems (Ter, Ugoo, and Bar-Nyam, 2024). The continuous and sole application of inorganic fertilizers such as NPK can improve yield but often leads to nutrient leaching, soil acidification, and organic matter depletion, ultimately reducing soil productivity (Rahman *et al.,* 2023). In contrast, organic fertilizers such as compost and poultry manure enhance soil structure, improve microbial activity, and provide a slow but sustained nutrient release, thereby improving soil health and crop nutritional quality (MDPI Agriculture, 2024). However, organic sources alone may not supply sufficient nutrients to meet crop demands within a short growing season. Therefore, the integration of organic and inorganic nutrient sources has been recommended as an efficient and environmentally sound approach for sustaining soil fertility and improving crop productivity (Ali, Niu, Masabni, Ferrante, and Cocetta, 2024).

Integrated Nutrient Management (INM) practices have been reported to enhance nutrient-use efficiency, yield, and fruit quality in several horticultural crops, including tomato, cucumber, and okra (Frontiers in Sustainable Food Systems, 2024; Horticulturae, 2023). In watermelon, organic amendments and biostimulant-based fertilizers have improved fruit yield and nutritional composition, though comprehensive assessments of their combined effects on mineral composition, proximate content, and vitamin profiles remain scarce, particularly under field conditions in West Africa (Ter *et al.,* 2024; Horticulturae, 2023). Given this knowledge gap, the present study was conducted to evaluate the effects of different nutrient sources on the nutritional quality of watermelon fruits under field conditions in Ogbomoso, southwestern Nigeria.

Materials and Methods

Experimental Site

The experiment was conducted at the Teaching and Research Farm of the Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Oyo State, Nigeria in year 2022 and 2023 (latitude 8°10′ N, longitude 4°10′ E, and altitude 340 m above sea level). The area lies within the Southern Guinea Savanna agro-ecological zone of Nigeria, characterized by a bimodal rainfall pattern with an annual average of 1,200 mm and mean temperature ranging between 25 °C and 34 °C. The soil of the experimental site is classified as an Alfisol, sandy loam in texture, moderately well-drained, and low in organic matter and available nutrients.

Experimental Materials

Seeds of watermelon Kaolack variety and NPK 15-15-15 fertilizer used were obtained from the Irorun Agbe farmer shopping complex, Ogbomoso, Nigeria. The compost was obtained from physiology unit

of Department Crop Production and Soil Science, LAUTECH, Ogbomoso. The fertilizer materials were analyzed before use to determine their nutrient compositions.

Experimental Design and Treatments

The treatments assessed were: No fertilizer (Control); 100% NPK 15:15:15 (at the rate of 400kg /ha; Akanbi et al; 2010); 100% Compost (at the rate of 5.0 tons/ha, Akanbi et al; 2010), Supergrow (at the rate of 5.0litre per hectare), Poultry manure (at the rate of 5.0 tons/ha); 75% NPK + 25% Compost, 50% NPK + 50% Compost, and 2% NPK + 75% Compost. The treatments were laid out in a Randomized Complete Block Design **(RCBD)** with eight treatments and replicated three times. Each plot measured 4 m × 4 m, with 1 m spacing between plots and 2m between blocks. Watermelon seeds were sown directly into the field at a spacing of 1 m × 1 m, giving plant population of approximately 10,000 plants ha^{-1}.

Application of Nutrients

Compost and poultry manure were applied two weeks before sowing and thoroughly incorporated into the soil to allow mineralization. The NPK fertilizer was applied at two weeks after planting (WAP). Supergrow was applied as a foliar spray at the manufacturer's recommended rate at two-week intervals starting from two WAP.

Crop pot Management

Manual weeding was done twice to ensure weed free pot while insect attach was prevented by application of cypermethrin at the rate of 40ml/15L of water. Insecticides application started from two weeks after plating, repeated fortnightly till two weeks starting from two weeks after planting.

Data Collection

Fruit Elemental Composition: Fresh fruit pulp samples were oven-dried at 70°C to constant weight, ground, and analyzed for elemental contents. Nitrogen (N) was determined using the micro-Kjeldahl method (AOAC, 2019). Phosphorus (P) was determined colorimetrically using the vanado-molybdate method. Potassium (K), Calcium (Ca), Magnesium (Mg), Iron (Fe), Zinc (Zn), and Sodium (Na) were determined using an atomic absorption spectrophotometer (AAS).

Proximate Composition: Proximate analysis of fruit pulp was carried out following standard procedures of the Association of Official Analytical Chemists (AOAC, 2019). Parameters determined included: Crude Fibre (%), Crude Protein (%), Fat (%), Ash (%), Total Sugar (%) and Total Solids (%).

Bioactive Compounds and Vitamin Content: Fruit lycopene and total carotenoid contents were estimated spectrophotometrically following the methods of Nagata and Yamashita (1992), Total phenol was determined using the Folin–Ciocalteu method (Singleton et al., 1999). Vitamin B_2 and B_6 contents were analyzed using the fluorometric method described by Okwu and Ndu (2006), while Vitamin C was quantified by titration with 2, 6-dichlorophenol indophenol (AOAC, 2019).

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Data Analysis

Data collected over two years were pooled and subjected to Analysis of Variance (ANOVA) using the Statistical Analysis System (SAS) software (Version 9.4). Treatment means were separated using the Duncan's Multiple Range Test (DMRT) at the 5% probability level ($P \leq 0.05$).

Results

Effects of nutrient sources on fruit elemental contents of watermelon was shown in table 1. Nutrient sources significantly influenced the elemental composition of watermelon fruits as shown in table (Table 1). The nitrogen (N) content ranged from 6.43 g in the unfertilized control to 16.60 g in plants treated with 50% NPK + 50% compost, which recorded the highest N concentration. Phosphorus (P) content was highest (8.30 g) under 100% compost, while the lowest (6.50 g) was obtained from the 50% NPK + 50% compost treatment. Potassium (K) content varied significantly among treatments, with Supergrow and 75% NPK + 25% compost recording the highest values (6.00 g and 6.40 g, respectively), whereas the least (2.20 g) occurred in the control. Calcium (Ca) content was most abundant (0.50 g) in fruits from 75% NPK + 25% compost, followed by Supergrow (0.44 g), while the control recorded the least (0.11 g). Magnesium (Mg) content was also enhanced by the combined fertilizer treatments, with 75% NPK + 25% compost (33.00 g) and 50% NPK + 50% compost (29.40 g) producing the highest concentrations. Iron (Fe) content ranged from 62.27 mg in the control to 80.90 mg in Supergrow-treated fruits, while zinc (Zn) was significantly highest (0.49 mg) in the 75% NPK + 25% compost treatment. Sodium (Na) concentration followed a similar trend, being highest (5.60 mg/100 g) under Supergrow and lowest (1.87 mg/100 g) in the control. Overall, integrated nutrient management involving NPK and compost combinations, particularly 75% NPK + 25% compost and 50% NPK + 50% compost, markedly improved the mineral composition of watermelon fruits compared to sole fertilizer sources or the unfertilized control.

Effects of nutrient sources on the pulp proximate content in the pulp of watermelon

The proximate composition of watermelon pulp was significantly influenced by the different nutrient sources as shown in Table 2. Crude fibre content ranged from 0.13% in the unfertilized control to 0.34% in fruits from plants treated with poultry manure, which recorded the highest value. Treatments with Supergrow, 75% NPK + 25% compost, and 50% NPK + 50% compost also produced relatively high fibre contents (0.20% each). Crude protein content was highest (0.60%) under poultry manure, followed closely by 25% NPK + 75% compost (0.58%), while the lowest (0.43%) occurred in 100% compost. Fat content varied slightly among treatments, with the control and Supergrow producing the highest values (0.06% each), and the least (0.04%) observed in 100% NPK and 75% NPK + 25% compost. Ash content differed significantly among treatments, with 75% NPK + 25% compost producing the highest value (1.39%), while other treatments, including the control, recorded lower but comparable values ranging from 1.11% to 1.22%. Total sugar content was highest (16.47%) in fruits treated with 75% NPK + 25% compost and 25% NPK + 75% compost, whereas the lowest (13.50%) was found in the control. Similarly, total solid content was enhanced by integrated fertilizer treatments, with 75% NPK + 25% compost (6.13%) and 25% NPK + 75% compost (6.00%) showing the highest

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values compared to 5.20% in the unfertilized plants. Overall, the combined application of NPK and compost, particularly 75% NPK + 25% compost and 25% NPK + 75% compost, significantly improved the nutritional quality of watermelon pulp in terms of sugar, solid, and ash content compared with sole fertilizer applications or the control

Main effect of fertilizer types on the nutrient content of watermelon fruit pulp on Pulp lycopene, pulp carotenoids, pulp phenol, and pulp vitamins

The application of different fertilizer types significantly affected the bioactive and vitamin composition of watermelon pulp as shown in Table 3. Lycopene content ranged from 10.46 mg/100 g in the unfertilized control to 10.88 mg/100 g in fruits treated with Supergrow, which produced the highest value. Fruits from plants treated with poultry manure (10.85 mg/100 g) and 25% NPK + 75% compost (10.81 mg/100 g) also recorded relatively high lycopene contents.

Carotenoid concentration was highest (8.63 mg/100 g) in fruits from poultry manure, closely followed by Supergrow (8.57 mg/100 g) and 25% NPK + 75% compost (8.40 mg/100 g), while the least (7.33 mg/100 g) was observed under 100% NPK. Phenol content remained statistically similar across all treatments, ranging between 0.11 and 0.12 mg/100 g, indicating that fertilizer type had minimal influence on fruit phenol accumulation. Vitamin B_2 content was highest (0.03 mg/100 g) under 100% compost, Supergrow, poultry manure, and 75% NPK + 25% compost, whereas other treatments maintained slightly lower but comparable levels (0.02 mg/100 g). Vitamin B_6 concentration was enhanced by fertilizer application, with Supergrow (19.60 mg/100 g) and 50% NPK + 50% compost (19.73 mg/100 g) producing the highest values, while the control recorded the lowest (11.07 mg/100 g). Vitamin C content ranged between 0.01 and 0.02 mg/100 g, with Supergrow and poultry manure maintaining the upper range, though differences were not statistically significant.

Discussion

Nutrient sources exerted significant effects on the elemental, proximate, and bioactive composition of watermelon fruits. The integration of organic and inorganic fertilizers consistently enhanced fruit nutritional quality compared to sole applications or the unfertilized control. The combined application of NPK and compost notably increased the accumulation of N, K, Ca, Mg, Zn, and Na in watermelon fruits, with the 75% NPK + 25% compost and 50% NPK + 50% compost treatments showing the greatest improvement. This finding suggests that integrated nutrient management enhances nutrient uptake efficiency through improved soil structure, microbial activity, and cation exchange capacity. Similar observations were reported by Hou *et al.* (2024), who reported that partial substitution of mineral fertilizer with organic amendments improved fruit nutrient content and overall quality in watermelon. Likewise, Abou El-Goud *et al*. (2020) demonstrated that organic fertilizer combinations significantly increased mineral accumulation in fruit tissues compared with sole inorganic fertilizer application.

The proximate composition of the watermelon pulp was also strongly influenced by fertilizer source. Poultry manure significantly increased crude protein and fibre content, while integrated fertilizer treatments enhanced sugar, ash, and total solids. The improvement in sugar and total solid content under

75% NPK + 25% compost and 25% NPK + 75% compost indicates a synergistic interaction between organic and inorganic nutrient sources, resulting in enhanced carbohydrate metabolism and improved sweetness and pulp texture. Comparable results were reported by Hou *et al.,* (2024), who found that a 50:50 mix of mineral fertilizer and vermicompost increased soluble solids and sugar concentration in watermelon. In addition, organic manures are known to stimulate enzymatic activity and promote nitrogen assimilation, contributing to higher crude protein content (Song *et al.,* 2022).

The concentration of bioactive compounds and vitamins varied with fertilizer type. Lycopene and carotenoids were highest in fruits from Supergrow and poultry manure treatments, while vitamins B_2 and B_6 were enhanced by compost-based and integrated applications. These findings suggest that fertilizer type can modulate antioxidant compound synthesis in watermelon. Meghwar *et al.* (2024) reported that the availability of essential nutrients, particularly nitrogen and potassium, promotes lycopene and carotenoid biosynthesis, which are key contributors to fruit color and antioxidant potential. Similarly, Hossain et al. (2025) observed that adjusting nutrient availability in hydroponic watermelon influenced lycopene accumulation and vitamin content. The stable phenolic concentration across treatments in this study indicates that phenol biosynthesis may be less sensitive to fertilizer regime, possibly being more genotype- or stress-dependent. Integrating organic and inorganic fertilizers particularly in ratios such as 75% NPK + 25% compost or 50% NPK + 50% compost proved superior in enhancing fruit nutritional composition and bioactive quality. This integrated approach not only ensures balanced nutrient supply but also improves soil fertility and microbial function, aligning with sustainable production goals. These results corroborate previous findings emphasizing that the combination of mineral and organic fertilizers optimizes yield and nutritional quality while minimizing environmental impact (Hou *et al.,* 2024; Song *et al.,* 2022).

Conclusion

This study demonstrated that nutrient sources have significant influence on the elemental, proximate, and bioactive composition of watermelon fruits. Integrated nutrient management particularly the combinations of 75% NPK + 25% compost and 50% NPK + 50% compost consistently enhanced fruit mineral content (N, K, Ca, Mg, Zn, Na), improved pulp proximate composition (sugar, ash, total solids), and boosted key bioactive compounds such as lycopene, carotenoids, and vitamins B_2 and B_6. Organic fertilizers, especially poultry manure, also improved crude protein and fibre content. These findings highlight the complementary role of organic and inorganic fertilizers in improving soil conditions, nutrient uptake, and fruit biochemical quality. Overall, integrating organic materials with mineral fertilizers offers a sustainable strategy for optimizing watermelon fruit nutritional value and supporting environmentally friendly

Recommendation

The findings of this study underscore the importance of adopting Integrated Nutrient Management (INM) strategies for optimal watermelon production. Farmers are encouraged to apply a combination of organic and inorganic fertilizers particularly 75% NPK + 25% compost or 50% NPK + 50% compost to enhance fruit nutrient density and overall quality. Incorporation of organic amendments such as compost and

poultry manure should be emphasized, as these inputs improve soil structure, stimulate microbial activity, and enhance nutrient retention. Reliance on sole NPK application should be reduced, given that integrated nutrient sources consistently produced superior fruit nutritional quality while supporting environmentally sustainable production practices. Furthermore, the continuous use of compost in combination with mineral fertilizers is recommended to promote long-term soil fertility, increase cation exchange capacity, and minimize nutrient leaching. These combined approaches offer a sustainable pathway for improving both soil health and watermelon quality.

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Appendix

Table 1: Effects of nutrient sources on fruit elemental contents of watermelon

Fertilizer type	N	P	K	Ca	Mg	Fe	Zn	Na
			(mg/100g)					
No fertilizer	6.43g	7.00ecd	2.20f	0.11e	11.67f	62.27e	0.22d	1.87e
100% NPK	9.50d	7.50pc	3.50d	0.20d	12.00f	66.30d	0.30c	3.20d
100% Compost	11.73c	8.30a	4.30c	0.24d	15.10d	73.07c	0.30c	3.90c
Supergrow	6.67g	6.70ed	6.00a	0.44b	27.90b	80.90a	0.43b	5.60a
Poultry manure	7.87e	7.87ba	4.93b	0.20d	12.80e	65.90d	0.30c	3.90c
75% NPK + 25%C	14.67b	7.87ba	6.40a	0.50a	33.00a	77.33b	0.49a	5.40a
50% NPK + 50%C	16.60a	6.50e	4.90b	0.30c	29.40b	77.33b	0.40b	4.13b
25% NPK + 75%C	7.13f	7.20bcd	2.67e	0.20d	12.07fe	64.80d	0.20d	2.07e

Means with the same letter(s) in a column are not significantly different (P ≤ 0.05; DMRT).

Table 2: Effects of nutrient sources on the pulp proximate content (g/100g) watermelon fruit

Treatments	Crude Fibre	Crude Protein	Fat	Ash	Total Sugar	Total Solid
No fertilizer	0.13e	0.52d	0.06a	1.12b	13.50e	5.20c
100% NPK	0.14d	0.51d	0.04c	1.12b	15.10b	5.67a
100% Compost	0.16c	0.43e	0.05b	1.11b	14.91cb	5.13c
Supergrow	0.20b	0.55c	0.06a	1.22b	15.50b	5.47ba
Poultry manure	0.34a	0.60a	0.05b	1.21b	14.20d	5.40ba
75% NPK + 25%C	0.20b	0.51d	0.04c	1.39a	16.47a	6.13a
50% NPK + 50%C	0.20b	0.52d	0.05b	1.17b	14.40d	5.30b
25% NPK + 75%C	0.14d	0.58b	0.05b	1.21b	16.47a	6.00ba

Means with the same letter(s) in a column are not significantly different (P ≤ 0.05; DMRT).

Table 3: Effects of nutrient sources on the watermelon fruit pulp vitamins and phyto nutrients (mg/100g)

Treatment	Lycopene	Carotenoid	Phenol	Vitamins B2	Vitamins B6	Vitamins C
No fertilizer	10.46g	7.41e	0.12a	0.02b	11.07e	0.02a
100% NPK	10.63e	7.33f	0.11a	0.02b	13.30d	0.02a
100% Compost	10.56f	7.54d	0.12a	0.03a	14.73c	0.01b
Supergrow	10.88a	8.57b	0.12a	0.03a	19.60a	0.02a
Poultry manure	10.85b	8.63a	0.12a	0.03a	13.07d	0.02a
75% NPK + 25%C	10.63e	7.44c	0.12a	0.03a	16.60b	0.01b
50% NPK + 50%C	10.70d	7.41e	0.12a	0.02b	19.73a	0.01b
25% NPK + 75%C	10.81c	8.40c	0.12a	0.02b	10.80e	0.01b

Means with the same letter(s) in a column are not significantly different (P ≤ 0.05; DMRT).

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