

Proximate and Mineral Composition of Selected Sweet Potato (*Ipomoea batatas* L.) Genotypes Grown in Lesotho

Puleng Letuma^{1*}, Thabang Mkhelane¹, Marealeboha Mofube¹, Ntsoaki Moeketsi², Monica Lephole²

¹Crop Science Department, Faculty of Agriculture, The National University of Lesotho, Roma, Lesotho

²Department of Agricultural Research, Ministry of Agriculture, Food Security and Nutrition, Maseru, Lesotho

Email: *pm.letuma@nul.ls

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Abstract

Malnutrition and micronutrient deficiencies remain significant public health challenges in Lesotho, largely driven by dietary diversity and the underutilization of nutritionally valuable indigenous crops. Sweet potatoes play a vital role in strengthening food security and promoting better nutrition in vulnerable areas. This study evaluated the proximate and mineral composition of four sweet potato genotypes (Khumo, Monate, Ndou, and W119) collected from South Africa and cultivated in the Berea District of Lesotho. A field experiment was arranged in a randomized complete block design, with three replications. At maturity, the root samples were harvested, cleaned, crushed, pooled, and analyzed at the Crop Science Laboratory of the National University of Lesotho. AOAC methods were used to analyze the proximate composition, while ultraviolet-visible (UV-Vis) and atomic absorption spectroscopy (AAS) were used to analyze mineral content. The following proximate compositions were determined, including carbohydrates, crude protein, crude fiber, crude fat, ash, total soluble solids (TSS), and moisture content. Mineral elements analysed included potassium, phosphorus, calcium, magnesium, sodium, zinc, iron, manganese, and copper. The proximate composition varied across genotypes, with values ranging from 0.12% - 0.80% (crude protein), 0.16% - 0.46% (crude fat), 0.83% - 1.43% (crude fibre), 64.94% - 70.62% (moisture content), 28.13% - 32.71% (carbohydrates), 0.87% - 1.27% (ash), and 2.00% - 6.00% (TSS). Mineral concentrations ranged from 0.70% - 1.05% (potassium), 0.52% - 0.94% (calcium), 2.52% - 5.89% (sodium), 0.22% - 0.43% (magnesium), 0.40% - 0.76% (phosphorus), 0.16% - 1.40% (copper), 0.27% - 0.63% (zinc), 0.54% - 1.10% (manganese), and 0.19% - 0.30% (iron). Findings from this preliminary investigation reveal that the Khumo and W119 sweet

potato genotypes possess notable nutritional value with promising potential for incorporation into sustainable dietary strategies in Lesotho. However, further research is required for comprehensive elucidation of their efficacy and adaptability across diverse agro-ecological zones.

Keywords

Berea, Agro-Ecological Zones, Composition, Maturity, Crude Fiber

1. Introduction

Sweet potatoes are an important staple food crop in the underdeveloped and developing world due to their significant role in the human diet [1]. Based on the recent statistical evidence regarding production trends and nutritional value, as well as the documented health benefits of sweet potato, this crop has strong potential to contribute to the realization of the United Nations 2030 Agenda for Sustainable Development Goals (SDGs), mainly by addressing the persistent challenge of food insecurity, malnutrition, and health challenges worldwide [2]. Sweet potatoes are a highly produced crop, ranking seventh after rice, wheat, maize, potatoes, barley, and cassava in global food production, and the fifth most important food crop in the tropics, contributing more than 119 million tons annually worldwide [3]. Moreover, sweet potato is a versatile crop that can help combat food insecurity in sub-Saharan African (SSA) countries due to its high yield and nutritional value [1] [4].

Furthermore, sweet potato is an important crop to tackle the current problems of food insecurity and malnutrition in developing countries like Lesotho, due to its multi-nutritional benefits, such as having high energy content, protein, fiber, vitamin B, β -carotene, and minerals, such as iron, calcium, magnesium, and zinc, and other dietary bioactive compounds that are essential for human health [5]. Sweet potato leaves are rich in protein, which is essential for growing children. According to [6] sweet potatoes are used in various forms, including bread, breakfast items, French fries, syrup, starch, and beverages. Beyond human consumption, this crop is also used as animal feed, especially in pig production, where the vines and tubers contribute significantly to nutrition and feed efficiency [7].

Likewise, Cao [7] reported that sweet potato has sufficient fiber necessary to prevent constipation in human beings and improve rumination and microfauna in ruminant animals. The orange-fleshed sweet potato contains β -carotene [8], which has important antioxidant and provitamin A properties that inhibit metabolic oxidative stress and reduce the risks of cancer and heart attack. Whereas those that are purple-fleshed are associated with anti-carcinogenic effects, anti-inflammatory properties, immunomodulatory activity, and liver and kidney protection [9]. Moreover, beyond their nutritional value, sweet potatoes also offer clear economic benefits. A study by FAO [10] showed that the crop contributes to income and financial stability, thereby supporting local economies. Therefore,

growing sweet potatoes in Lesotho offers a practical way to strengthen the country's economy, while also supporting the health and nutrition of the Basotho people.

A previous study by [11] indicated that sweet potato was introduced in Lesotho in 1992 to reduce poverty; however, a considerable proportion of households continue to rely predominantly on staple crops such as maize, sorghum, and wheat. This is due to a lack of public awareness on the composition and nutritional benefits of the sweet potato and its contribution to the well-being of Basotho, which remains underexplored. Given its dual role, nutritional and economic, the cultivation of sweet potatoes presents a compelling case for further research. This study aimed to evaluate the proximate and mineral composition of sweet potato genotypes grown in Lesotho.

2. Materials and Methods

2.1. Sample Collection and Preparation

The experiment was conducted in Berea District ($-29^{\circ}10'0.01''\text{S}$ $27^{\circ}55'0.01''\text{E}$), located in the northern lowlands of Lesotho. The Berea district has mean temperatures ranging from 26.4°C to 30.5°C and an annual rainfall of 600 mm. The soils are classified as Vertisols [12]. These are dark brown clays that are neutral in reaction, highly fertile, and characterized by marked swelling during wet periods and substantial shrinkage in dry seasons. Genotypes were arranged using a randomized complete block design, with three replicates. A compound fertilizer (2:3:2) +Zn was applied at the rate of 400 kg/ha at planting. Irrigation was applied daily during the first four weeks of crop establishment, after which the frequency was reduced to once a week until flowering. Weeding was done once during the growth cycle.

Upon reaching physiological maturity, all genotypes were harvested and then transported to the Crop Science Laboratory at the National University of Lesotho for further analysis. For the individual genotypes, fourteen storage roots were used, each weighing 2 grams. These were manually cleaned by hand, removing all foreign materials, especially soil. Then they were washed thoroughly with distilled water to remove the dirt. Then the tubers were spread on a clean surface covered with soft absorbent paper to be air-dried at room temperature to remove excess moisture. The dried tuber samples were first cut into smaller pieces, pooled, and subsequently ground and homogenized into a fine powder using a grain crusher before analysis.

2.2. Macro Nutrient Profile

2.2.1. Proximate Analysis

Standard methods were used to determine moisture content, ash, crude fat content, crude fiber content, protein content, and total carbohydrates using the Association of Official Analytical Chemists (AOAC) [13] [14] with slight modifications. Total soluble solids were determined using a digital refractometer (0% - 85%

Brix). These tests were all performed in the National University of Lesotho crop science laboratory.

2.2.2. Moisture Content

The AOAC method used to determine moisture content was AOAC 925.10. The clean moisture cans were dried in an air oven at 110°C for 2 hours, then cooled in a desiccator, and their weight was recorded (W_1). Additionally, 2 g of finely pulverized samples were weighed in the moisture cans and then reweighed (W_2). The moisture cans and their contents (samples) were then dried in an oven for 12 hours. The moisture cans and the samples were then taken out of the oven, cooled in the desiccator for 30 minutes, and their weight was recorded (W_3). The moisture percentage was then determined using the following formula:

$$\% \text{Moisture content} = \frac{W_3 - W_2}{W_2 - W_1} \times 100$$

2.2.3. Ash Content

The ash content was estimated according to the AOAC, 923.03. Firstly, the clean crucibles were dried in the muffle furnace for 2 hours at 550°C, cooled for 30 minutes in the desiccator, and weighed (W_1). 2 g of finely pulverised sample was transferred into the crucibles and weighed (W_2). The crucibles and their contents (samples) were then ashed in the muffle furnace for 8 hours at 550°C to remove all carbon. They were then cooled in a desiccator and weighed (W_3). Percentage ash content was computed using the formula below:

$$\% \text{Ash content} = \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

2.2.4. Crude Fat (Ether Extract)

Crude fat was determined using the AOAC 920.39 method. Two grams of each treated sample were ground in the thimble, weighed, and recorded (W_1). The 2 g of the sample was weighed into a 500 mL round-bottom flask containing a few anti-bumping granules and then weighed (W_2). Then, 300 mL of petroleum ether for extraction was added to the flask, which was fitted with a Soxhlet extraction unit. The round-bottom flask and condenser were connected to the extractor, and cold-water circulation was turned on. The heaters were switched on, and the heating was adjusted until the solvent was refluxed at a steady rate. Afterwards, the extraction process began and lasted for 4 hours. Then the solvent was recovered, and the oil was dried in the oven at 70°C for an hour. The round-bottom flask and oil were cooled and then weighed (W_3). The formula below was used to estimate fat content.

$$\% \text{fat content} = \frac{W_3 - W_2}{W_1} \times 100$$

2.2.5. Crude Fiber

The AOAC, 962.09, was used in the estimation of crude fiber content. Two grams of finely pulverized sample was weighed and recorded (W_1), then transferred into

a 600 mL beaker, and 200 mL of boiling 1.25% H_2SO_4 and 1 drop of diluted anti-foam were added. The beaker was placed on a digestion apparatus with a pre-set hot plate and boiled for 30 minutes, periodically rotating the beaker to prevent solids from adhering to the sides. The beaker was then removed, and the contents filtered through a Buchner funnel. Afterwards, the beaker was rinsed with 50 to 75 mL of boiling water and washed through a Buchner. Rinsing was repeated three times with 50 mL portions of water and sucked dry. Likewise, the mat and residue were removed from the Buchner. Then, 200 mL of boiling 1.25% NaOH was added and boiled for 30 minutes. After filtering, washing was done using 200 mL of boiling 1.25% H_2SO_4 , three 50 mL portions of H_2O , and 25 mL of alcohol. Lastly, the mat and residue were transferred into the ashing dish for 2 hours at $130^\circ\text{C} \pm 2^\circ\text{C}$, cooled in a desiccator, weighed (W_2), ignited at 600°C for 30 minutes, cooled in a desiccator, and reweighed (W_3). Finally, the percentage crude fiber was computed using the following formula:

$$\% \text{Crude Fiber} = \frac{W_3 - W_2}{W_1} \times 100$$

where:

W_1 = weight of the sample

W_2 = weight of crucible and residue after drying

W_3 = weight of crucible and residue after ashing

2.2.6. Crude Protein (CP)

The protein content was determined using a method of AOAC 2001.11. It was determined by a modification of a technique originally devised by Kjeldahl over 100 years ago. 2 g of finely pulverized sweet potato sample was added to a 50 mL digestion flask (Kjeldahl flask). Then, 8 mL of concentrated sulphuric acid (H_2SO_4) was added to 2 g of a catalyst (copper and potassium sulphate mixture). The samples were digested until a colourless solution formed. The digested samples were heated and distilled using a Kjeldahl distiller, and ammonia gas (distilled steam) was collected with 25 mL of 2% boric acid containing 3 mL of mixer indicator. Furthermore, the distillates were titrated with 0.01 N hydrochloric acid to the end-point (the endpoint was achieved when the green distillate turned to the original pink colour of the boric acid/indicator). Lastly, the percentage of crude protein was calculated using the formula below:

$$\% \text{Crude Protein} = \frac{a \times b \times 14 \times 6.25}{\text{Weight of sample}} \times 100$$

where:

a = normality of acid

b = volume (mL) of standard acid corrected for the blank.

14 = Atomic weight of N

6.25 = factor to convert N to protein

2.2.7. Carbohydrate Content

Carbohydrate content was calculated by difference, following the formula below:

Total Carbohydrate = $100 - [\% \text{ Protein} + \% \text{ Fat} + \% \text{ Ash} + \% \text{ Moisture} + \% \text{ Fiber}]$.

2.2.8. Total Soluble Solids (TTS) Determination

TTS content was determined by a digital refractometer, 0% - 85% Brix. The sweet potato storage roots were cut into small pieces using a knife. The cut pieces were transferred to a single beaker, and each sample was homogenized in a blender to extract sweet potato juice. Afterwards, the liquid extract from each sample was drawn from the beaker using a pipette, then small drops were dropped on the refractometer to determine the Brix value, and the results were recorded. After each reading, the refractometer and the blender were cleaned. Blank was also used as the control by dropping droplets of distilled water onto the refractometer, which gave a constant reading of 0.3% Brix.

2.3. Mineral Content Composition

The concentration of potassium, sodium, magnesium, calcium, manganese, zinc, iron, and copper was estimated according to the AOAC, 985.35, while phosphorus was determined according to AOAC, 965.17. The wet digestion method was used, whereby 2 g of finely pulverized sweet potato sample was added to the digesting glass tube. Then 12 mL of concentrated nitric acid (HNO_3) was added, and the mixture was kept overnight at room temperature. Subsequently, 4 mL of perchloric acid (HClO_4) was added to digest the mixture. The temperature increased gradually, starting from 50°C, until the white fumes appeared. Thereafter, the mixture was cooled and then transferred to the 100 mL volumetric flasks, and the volume of the mixture was made to 100 mL with distilled water. Lastly, the wet digested solution was transferred to labeled plastic bottles. The concentrations of potassium, sodium, magnesium, calcium, manganese, zinc, iron, and copper were quantified using an atomic absorption spectrophotometer (PerkinElmer, PinAAcle 500), whereas phosphorus content was measured employing a UV-visible spectrophotometric method.

2.4. Data Analysis

The data collected were subjected to one-way analysis of variance (ANOVA) using the Statistical Package for Social Sciences (SPSS Version 20). Descriptive analysis was performed to explore the general trend of the data. Furthermore, multivariate analysis was executed to compare the means. Significant difference was established at $p < 0.05$. Duncan multiple range tests were done to separate the means at $p < 0.05$. The data were expressed as mean values derived from three replicates, and statistically significant differences among the treatments were denoted by distinct superscript letters.

3. Results and Discussions

3.1. Proximate Composition

The proximate analysis of four sweet potato genotypes is summarized in **Table 1**.

The proximal composition varied significantly among genotypes at $p < 0.05$ according to the Duncan multiple range test. In this current study, protein ranged from 0.12% to 0.80%. Among all the genotypes, W119 had the highest protein content of 0.80%, followed by Khumo (0.76%), Monate (0.22%), and Ndou (0.12%). The higher protein content was recorded with the orange-fleshed genotypes (Khumo and W119). The results are in line with the findings reported by [15], suggesting that yellow- and orange-flesh sweet potatoes are a good source of protein. In contrast, white-flesh sweet potatoes, such as Ndou and Monate, generally had low protein content. The results presented in this study, however, are lower than those of [16] [17], who reported 0.93% - 1.63% and 0.58% - 2.53%, respectively. Comparable results have been reported by [18], who observed protein levels ranging from 0.11% to 0.91% in Rwanda, and by Zulkifli *et al.* [19], who documented values between 0.32% and 0.86% in Malaysia.

Table 1. The percentage proximate composition of the four sweet potato genotypes.

Variety	Protein	Fats	Ash	Crude fiber	Moisture content	Carbohydrates	TTS
Ndou	0.12 ^b	0.16 ^a	1.10 ^a	0.93 ^a	64.94 ^b	32.71 ^{ab}	2.00 ^b
Khumo	0.76 ^a	0.46 ^a	1.27 ^a	1.43 ^a	69.02 ^{ab}	28.78 ^b	4.33 ^{ab}
Monate	0.18 ^b	0.17 ^a	0.87 ^a	0.99 ^a	70.62 ^a	28.13 ^b	4.33 ^{ab}
W119	0.80 ^a	0.31 ^a	0.93 ^a	0.83 ^a	68.16 ^{ab}	30.54 ^{ab}	6.00 ^{ab}
Mean	0.36	0.28	1.04	1.05	68.19	30.04	1.74
Standard deviation	0.10	0.02	0.32	0.27	2.67	2.44	0.30
CV%	26.77	7.14	31.93	25.25	3.91	8.13	17.04

Values with different superscripts within a column are significantly different ($p < 0.05$).

The fat content observed in the present study ranged between 0.16% and 0.46% (Table 1). These values exceed those reported by [20], who documented fat levels of 0.10%. On the contrary, the results are comparatively lower than those obtained by Do Nascimento *et al.* [16], where crude fat content varied from 0.19% to 4.50%. Such differences may be attributed to varietal differences arising from genetic variation. Nevertheless, given that starch constitutes the principal byproduct, the relatively low-fat content is unlikely to pose a significant limitation.

The ash content of sweet potato measures the presence of minerals or inorganic residues left over from acid-facilitated oxidation of organic matter in foods [21]. Moreover, [22] emphasized that the more the ash content, the higher the chances of a greater amount of mineral element content. In this study, the ash content ranged from 0.87% to 1.27% (Table 1). [16] [23] reported similar ranges, between 0.85% - 1.29% and 0.40% - 2.35%, respectively. Nevertheless, the results are lower than the range of 2.56% to 4.70% found on different sweet potato genotypes by [24]. One of the factors that contributes to the variation could be fertilizer appli-

cation, as suggested by [25], that an increase in fertilizer application can significantly promote an increase in mineral content.

Dietary fiber plays a significant role in human health, such as regulating blood sugar levels and lowering cholesterol, together with adding bulk to human stool, thereby promoting regular bowel movements. Including sweet potatoes in diets can help meet daily fiber needs and support a healthy digestive system [4] [26]. The dietary fiber of the tested sweet potato genotypes varied from 0.83% to 1.43%. These results suggest that the genotypes are within the range of dietary fiber obtained by previous researchers [17]. In addition, [18] [26] reported fiber content of 0.30% and 0.11% to 0.14%, respectively.

Moisture content, which represents the proportion of water present in sweet potato, plays a critical role in determining its shelf life, sensory attributes, and overall quality [22]. In the present study, the genotypes analyzed showed moisture levels ranging from 64.94% to 70.62%. These values are consistent with those reported by Ukom [27], who documented a range of 61% - 70%, and are comparable to the findings of [28], where the moisture content reached 70.95% and 72.96%. Such variability among genotypes largely depends on agronomic practices, including irrigation regimes, soil management strategies, and harvest timing, highlighting the fundamental role of cultivation methods in shaping crop composition.

Carbohydrates are a good source of energy and act as substrates in the production of aromatic and phenolic compounds [27]. **Table 1** displays carbohydrates ranging from 28.13% to 32.71%. [28] stated that fresh sweet potatoes contain 21% and 25%, while [26] reported 20.1% for fresh samples. Thus, both researchers found less carbohydrate than in the current study. Nevertheless, the range observed in the present study is lower than the 41.08% - 73.43% reported by [17] across diverse sweet potato genotypes. Such divergences may be attributed to differences in genetic background and the maturity stage at which the storage roots were harvested. Collectively, these findings emphasize the adaptability of sweet potato as a valuable crop in Lesotho and highlight its potential to contribute to hunger alleviation through the provision of adequate dietary energy.

Our findings revealed that the total amount of soluble solids ranged from 2% to 6%. According to Zhao [29], the yellow or orange-fleshed sweet potato genotypes exhibit higher TTS content than the white-fleshed. Thus, it is proven in this study that the orange-fleshed genotypes obtained the highest TTS content (W119 and Khumo), while the white-fleshed variety (Ndou) obtained the minimum solids level, except Monate (white-fleshed), which obtained the same TTS concentration as Khumo, which could be attributed to its genetic makeup.

Minerals constitute essential inorganic elements that play a major role in metabolic processes; consequently, maintaining their concentrations within appropriate physiological ranges is critical to avoiding the adverse effects related to either deficiency or excess [30]. Sweet potatoes contribute meaningfully to daily caloric intake and hence serve as an important source of dietary energy. Although they are primarily rich in carbohydrates, overall energy intake is influenced by the rel-

active proportions of other macronutrients, including protein and lipid. Even so, the contribution of sweet potatoes to meeting daily energy requirements, especially in cases where food resources are limited, remains important [31]. The macronutrient minerals analyzed in this study included potassium, phosphorus, calcium, magnesium, and sodium, with corresponding results summarized in **Table 2**. No statistically significant differences were observed among the genotypes in macronutrient mineral composition. This implies that the genotypes were similar in their ability to accumulate macronutrient minerals. Meanwhile, the micronutrient profile, comprising zinc, iron, manganese, and copper, is presented in **Table 3**.

Table 2. The macro mineral nutrients of the four sweet potato genotypes (mg/kg).

Variety	K	Ca	Na	Mg	P
Ndou	0.70 ^a	0.82 ^a	2.52 ^a	0.38 ^{ab}	0.40 ^a
Khumo	1.00 ^a	0.94 ^a	4.82 ^a	0.43 ^{ab}	0.43 ^a
Monate	1.05 ^a	0.59 ^a	2.76 ^a	0.28 ^{ab}	0.72 ^a
W119	0.89 ^a	0.52 ^a	5.89 ^a	0.22 ^b	0.76 ^a
Mean	0.91	0.72	4.08	0.33	0.58
Standard deviation	0.29	0.26	1.66	0.12	0.26
CV%	31.70	36.69	40.59	35.31	45.38

Values with different superscripts within a column are significantly different ($p < 0.05$).

Table 3. Trace mineral elements content of sweet potato genotypes (mg/kg).

Variety	Cu	Zn	Mn	Fe
Ndou	0.88 ^{abc}	0.43 ^{ab}	1.10 ^a	0.19 ^a
Khumo	0.50 ^{bc}	0.63 ^a	0.54 ^a	0.22 ^a
Monate	0.16 ^c	0.27 ^b	0.66 ^a	0.28 ^a
W119	1.4 ^{ab}	0.52 ^{ab}	0.74 ^a	0.30 ^a
Mean	0.74	0.46	0.76	0.25
Standard deviation	0.28	0.18	0.24	0.07
CV%	38.51	38.96	31.72	29.21

Values with different superscripts within a column are significantly different ($p < 0.05$).

3.2. Macro Mineral Nutrients

Potassium remains an important macronutrient, playing a vital role in maintaining fluid balance and supporting the optimal functioning of key physiological systems, including the cardiovascular, respiratory, neuromuscular, and digestive systems [32]. The potassium content observed in the present study ranged from

0.70% to 1.05%, which is comparable to the findings of [26], who reported values between 0.21% and 1.04%. However, considerably higher ranges (15% - 51%) have been reported by Do Nascimento [16]. In addition, Nicanuru [33] reported potassium concentrations of 138 - 334 mg/100g, which are higher than those reported in the current investigation. Such differences may be due to variations in genotype, environmental conditions, soil mineral composition, analytical methods, and post-harvest handling methods.

In the current study, phosphorus content was between 0.40% - 0.76% (Table 2). Previous studies [8] [34] reported 0.23% - 0.31% and 0.31% - 0.57%, respectively. Accordingly, the values observed fall within the range reported in our study. However, they differ significantly from the phosphorus levels documented by [33] [35], who reported concentrations ranging from 15% to 51% in orange-fleshed sweet potato. Similarly, [36] reported that sweet potato contains approximately 47 mg·100g⁻¹ of phosphorus, representing about 7% of the recommended daily intake, which is higher than that observed in the current investigation. However, according to McKillop [37], grains such as maize, wheat, and rice contain the highest phosphorus content, ranging from 115 to 288 mg/100g.

The present study recorded calcium values ranging from 0.52% to 0.94% (Table 2). Previous studies have reported substantially higher calcium contents, ranging from 24.40% - 45.54% [31] and 21.98% - 27.35% [37]. Variations in calcium content may be attributed to genotypic differences, as mineral composition is largely influenced by varietal characteristics and environmental factors [35].

Magnesium is one of the vital minerals that the human body uses for metabolic functions and to maintain optimal blood pressure [38]. Magnesium concentration ranged from 0.22% to 0.43% in the present study. Laurie *et al.* [39] stated that magnesium content ranged from 3% to 37%; these values exceeded those recorded in the present study. In contrast, [34] recorded a magnesium content of 0.37% ± 0.0058%, and [29] reported levels between 0.373% and 2.16%, both of which fall within the range observed in the current study. In another study, genotypes exhibited amounts ranging between 0.571% ± 0.053% [40]. However, based on the recommended daily requirements for magnesium (350 mg/100g in adults and 170 mg/100g in children), the levels reported in the study are lower, thereby necessitating supplementation.

Sodium contributes to several essential physiological processes, including maintenance of osmotic balance, regulation of pH, and facilitation of glucose absorption [40]. In addition, sodium is integral to the regulation of body fluids and vital for maintaining the electrical potential across cell membranes [41]. Our findings indicated that sodium ranged from 2.52% - 5.89%, which is far from the 23 - 59 mg/100g reported by Lyimo [42]. Nonetheless, [34] [40] reported a lower range of 0.558% ± 0.058% to 0.609% ± 0.043% and 0.0168% ± 0.0058% to 0.0167% ± 0.002%, respectively. Amagloh *et al.* [43] stated that the mineral composition of sweet potato varies substantially due to both environmental conditions and genetic factors.

3.3. Trace Mineral Elements

The iron content recorded in this study ranged from 0.19% to 0.30% (**Table 3**). Comparable findings were reported by Alam *et al.* [44], who documented values ranging from 0.25% to 0.67%. In contrast, [8] measured an average of $0.32\% \pm 0.02\%$, which is slightly below the levels obtained here. On the other hand, [37] reported considerably higher concentrations, ranging from 0.63% to 15.26%, indicating substantial variability across studies and contexts. From a physiological viewpoint, iron plays a key role in human health. It is essential for cellular respiration, thereby supporting energy supply to muscles and efficient blood circulation [45].

Our results further indicated a range of 0.16% - 1.4% for copper. A previous study reported a range of 0.027% - 0.156% in sweet potato [46], which is lower than our findings presented here. However, [47] a similar range of $0.67\% \pm 0.07\%$. Copper is a beneficial element, as it is associated with the formation of red blood cells and the maintenance of connective tissues [45]. In addition, it is also involved in the absorption and utilization of iron [47]. Hence, the selection of genotypes with high copper content (Ndou and W119) will keep the nation healthy.

Manganese content in the study ranged from 0.54% to 1.10%. The results are in line with the previous study by [39], which reported a range of 0.45% - 1.36%. In addition, [48] [49] reported similar findings to those of the current study, 0.22% and 1.22%, respectively. Manganese plays an important role in bone formation and metabolism [50]. Therefore, having genotypes with manganese within reasonable ranges, like the ones in the present study, will improve bone formation in the country, especially for children.

4. Conclusion

The findings of this study emphasize the considerable nutritional value of sweet potato genotypes cultivated in Lesotho, supporting their promotion as a strategic crop for improving household food and nutrition security. Proximate analysis indicated that the Khumo and W119 genotypes had relatively higher protein levels compared to the others. In contrast, no statistically significant differences were noted among the genotypes with respect to macro mineral composition, while variations in micromineral content were not sufficiently pronounced to be detected; however, W119 and Ndou showed a higher Cu content than the others. Together, these findings provide an important foundation for future product development and varietal improvement efforts and may serve as a reference point for successive breeding programmes. It is therefore recommended that agricultural extension services and national nutrition initiatives promote the cultivation and consumption of nutritionally superior genotypes, especially the orange-fleshed varieties such as Khumo and W119. Owing to their comparatively enriched nutritional profiles, these genotypes hold promise as valuable dietary resources for mitigating protein-energy malnutrition and micronutrient deficiencies, especially among vulnerable populations.

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Authors Contribution

PL and TM: Conceived the Idea and designed the experiment; PL, TM, NM, and ML: Writing, Review, Editing; TM, MM and NM: performed the experiment, gathered literature; TM, PL, MM, ML, and NM: analyzed the data, and helped in the interpretation of results; PL: Critically revised the manuscript; All authors approved the final version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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