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Research Paper

Nutritional composition of Sweet Potato Leaves (*Ipomoea batatas* (L) Lam) Grown in Kisangani, D.R. Congo.

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Abstract
Sweet potato leaves (Ipomoea batatas(L) Lam) are a common vegetable in Kisangani. Even though there are many types of sweet potato plants, people here tend to prefer certain varieties. This study aimed to provide consumers with information on the nutrient content of a few local sweet potato leaf varieties to help them make informed food choices.
We studied three varieties:« Matembelabangi, »(bought from the market), « Kilo moya » and«Damu » (harvested from a 2.5-month-old field). After cleaning, the leaves were cut, dried in an oven at 55°C, and then ground into a powder. These powders were used for chemical analysis, except for moisture content, which was measured directly from fresh leaves.
We analyzed: moisture, crude ash, crude protein, total fats, crude fiber, minerals (Calcium, Magnesium, Iron, and Phosphorus), and vitamins (B1, B2, and B6).
Here are the results for « Matembelabangi, »« Kilo moya, » and »« Damu, » respectively:
Moisture (%): 91.3; 84.3; 85.5 and Crude Ash (%): 9.5; 5.1; 3.6 and Crude Protein (%): 24.4; 24.3; 22.3 and Total Fats (%): 5.0; 3.7; 3.7 and Crude Fiber (%): 12.9; 10.0; 10.0 and Iron (mg/100g): 1.675; 0.84; 0.84 and Calcium (mg/100g): 33.0; 28.0; 27.0 and Magnesium (mg/100g): 76.6; 48.8; 50.8 and Phosphorus (mg/100g): 800; 820; 980 and Thiamine (B1): 0.18 mg/100g and Riboflavin (B2): 0.18 mg/100g and Pyridoxine (B6): 0.28 mg/100g
Statistical analysis showed significant differences between the « Matembelabangi» and « Damu»varieties in their crude ash, phosphorus, and iron content.

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I. INTRODUCTION

Fruits and vegetables are a vital part of the human diet worldwide, providing various nutrients like vitamin C, fiber, antioxidants, and different phenolic compounds **(Watumalu et al. 2023).** They are known for many health benefits, including fighting infections, aiding digestion, acting as laxatives, and regulating body processes **(André., 1988; Nyabienda 2002).** They are also effective in preventing cardiovascular diseases, which cause a lot of sickness and death globally **(Watumalu et al. 2023).**

Sweet potato leaves are among the most eaten vegetables in Kisangani. However, different types of sweet potato plants exist, and their leaves are valued differently in various areas. This is why some varieties available locally are not popular with the people of Kisangani. To understand this consumer preference, we decided to study the nutritional potential of leaves from different sweet potato varieties. Our goal is to guide consumer choices and promote these local resources that are currently underused.

II. LOCATION, MATERIALS, AND METHODS

2.1. LOCATION

This study took place in Kisangani city, Tshopo province, Democratic Republic of Congo. The city is in the Congo Basin, located at 0°31'N and 25°11'E, with an average altitude of 360m (Upoki, 1997 in Kasereka, 2015).

2.2. Materials

2.2.1. Biological Material

The study used leaves from three sweet potato varieties:

2.2.1.1. « Matembelabangi » (T1)

This variety is the most popular with local people. We bought these leaves from the local market in Cabine. Its leaves look similar to hemp leaves.

Figure 1: Sweet potato leaves of the MatembelaBangi variety

2.2.1.2. « Kilo moya » (T2)

This variety is easily recognized by its leaves, which are arranged like fingers. We harvested it from an experimental field after two and a half months. It's not very popular.

Figure 2: Sweet potato leaves of the Kilo Moya variety

2.2.1.3. « Damu » (T3)

This variety is less liked in the area and is distinct because of its red veins. We took a photo of this variety

Figure 3: Sweet potato leaves of the Damu variety

2.2.1.2. Non-biological Material

This included all equipment used from preparing the field to harvesting, as well as all tools and machines used for chemical analysis.

2.3. METHODS

2.3.1.Processing

After harvesting and purchasing, the leaves were dried in an oven at 55°C until completely dry. These dried materials were then ground into powders for various chemical analyses. We used a mortar and porcelain pestle to grind the leaves. The results were then analyzed using statistical tests (ANOVA or its equivalent) with R software to determine if differences were significant. We considered a difference significant if the p-value was less than 0.05 (or 5%).

2.3.2. Parameters Analyzed

- Moisture

Measured by drying samples in a GRIFFCHEM TM oven at 105°C until they reached a constant weight (DUFEY, 1958).

- Crude Ash

Determined by burning dry samples in a muffle furnace at 550°C, following the method described by GROEGAERT (1958).

- Crude Protein

Measured using the Kjeldahl method. Protein content was found by multiplying nitrogen content by a factor of 6.25.

- Total Fats

Extracted using a Soxhlet apparatus with petroleum ether as the solvent, following the method by FOUASSIN and FALISE (1981).

- Crude Fiber

Estimated through acid-base digestion with 1.25% H2SO4 and 1.25% NaOH, according to the AOAC (1990) method.

- Mineral Elements

Mineral Elements: (Phosphorus, Calcium, Magnesium, and Iron) Measured from extracts obtained after nitro-perchloric digestion **(**GROEGART, 1958**).** Calcium and magnesium were measured using a complexometric method with EDTA, and phosphorus by complexation with molybdate**(CHARLOT, 1966).** Iron was measured by oxidation with dichromate, using diphenylamine as an internal indicator which turns blue-violet at the equivalence point (DESSART *et al*, 1973).

- *Thiamine*

Vitamin B1: Measured by acid and enzymatic hydrolysis, followed by oxidation of thioamine to thiochrome with potassium ferricyanide, and then thiochrome measurement by fluorimetry(Alexia, 1999).

- *Riboflavin*

Vitamin B2: Measured by fluorimetry after protein hydrolysis under pressure, followed by oxidation of reducing substances with KMnO4. A blank was obtained by removing the solution's fluorescence with Na2S2O4 (Alexia 1999).

- Vitamin B6 (Pyridoxal**)**

Vitamin B6 (Pyridoxal):Measured by fluorimetry after isolating the compound using high-performance liquid chromatography (HPLC) with reverse phase (Alexia 1999).

III. RESULTS

3.1. NUTRITIONAL PARAMETERS

The results for moisture (M), crude ash (CA), crude protein (CP), total lipid (TL), and crude fiber (CF) contents of the leaves of three sweet potato varieties are shown in Figure 4 below.

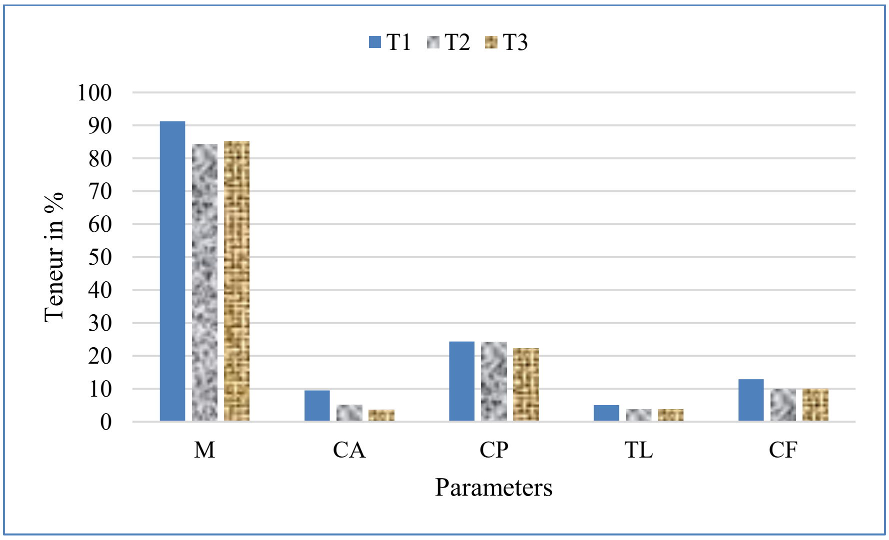

Figure 4: Content of moisture, CB, CP, TL, and CF in the leaves of three sweet potato varieties (%DM)

This figure shows that the moisture content varied between 84.3% for T2 and 91.3% for T1. Statistical analysis (p-value = 0.1456)showed no significant difference. However, the high value for T1 is likely because the sample was from the market and had been soaked in water.Crude ash content ranged from 3.6% for T3 to 9.5% for T1. Statistical tests showed a significant difference (p-value = 0.02651), specifically between Damu and Matembelabangi**(**p-value = 0.02114625)**.**

Crude protein content ranged from 22.3% for T3 to 24.4% for T1 (p-value = 0.0642), indicating no significant difference between the varieties.Lipid (fat) concentration was between 3.7% and 5.0%, with the lowest for T2 (3.4) and highest for T1 (5.0). Statistical analysis (p-value = 0.4127) showed no significant difference.Crude fiber content was between 10% (T2 and T3) and 12.89% (T1). Although there were small numerical differences, these were not statistically significant (p-value = 0.0642).

3.2. MINERALS

The results for calcium (Ca), phosphorus (P), magnesium (Mg), and iron (Fe) concentrations in the leaves of three sweet potato varieties are shown in Figure 5 below.

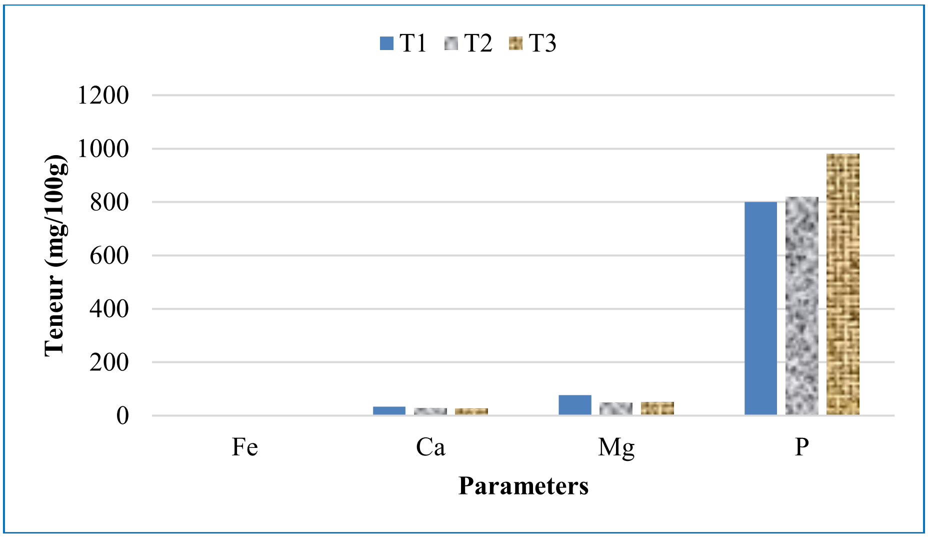

Figure 5: Content of Ca, P, Mg, and Fe in sweet potato leaves (mg/100g DM)

This figure shows that the calcium content ranged from 27% for T3 to 33% for T1, with a p-value of 0.08079, indicating no significant difference.Phosphorus concentrations ranged from 800 to 980 mg/100g dry matter for T1 and T3, respectively. Statistical analysis showed a significant difference between varieties, with post-hoc tests indicating the difference was between Damu and Matembelabangi(p-value = 0.04835).Magnesium concentration ranged from 48.8 (T2) to 76.6 (T1) mg/100g dry matter, with a p-value of 0.05358.Iron concentrations ranged from 0.84 (for T2 and T3) to 1.675 mg/100g dry matter (for T1). Statistical analysis showed a significant difference **(p-**value = 0.0302), with post-hoc tests indicating the difference was between Damu and Matembelabangi.

3.3. B Vitamins

Figure 6 below shows the content of vitamins B1, B2, and B6 in the leaves of three sweet potato varieties.

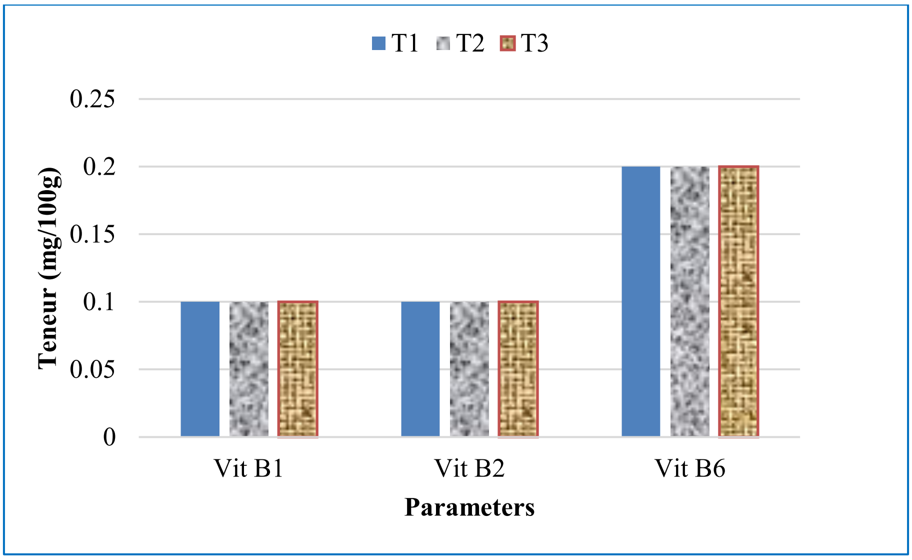

Figure 6: Vitamin B1, B2, and B6 content of sweet potato leaves (mg/100g DM).

This figure shows that the concentrations of vitamin B1 in sweet potato leaves were the same for the three varieties, 0.1 mg/100g. For vitamin B2 concentrations, they were also identical for the three varieties, at 0.1 mg/100g. As for the vitamin B6 content, it was also the same for all three varieties, at 0.2 mg/100g (p-value = 0.1595).

IV. DISCUSSION

4.1.1. Moisture Content

The moisture content was 91.3% for Matembelabangi, 84.3% for Kilo moya, and 85.3% for Damu, with an average of 87%. These values are similar to those found by Ndibualonjii*et al*. (2016), who reported 86% for Matembelabangi and 90% for King of Food. However, the higher 91.3% for Matembelabangi in this study is likely because the sample was purchased from a market where it might have been kept wet.

4.1.2. Crude Ash

Values were 9.5%, 5.1%, and 3.6% for Matembelabangi, Kilo moya, and Damu, respectively. Matembelabangi is clearly richer in crude ash. The 9.5% for Matembelabangi is higher than the 1.0% found by Ndibualonjii*et al*. (2016) for Matembelabangi and King of Food in Lubumbashi. These differences could be due to sample processing or different environmental conditions. The average crude ash content in this study (6.23%) is lower than the 18.33% found by Vodouhe*et al*.(2012) for *Amaranthushybridus*.

4.1.3. Crude Protein

Protein content in sweet potato leaves was 24.4%, 24.3%, and 22.3% for Matembelabangi, Kilo moya, and Damu, respectively. These values are much higher than those reported by Ndibualonjii*et al.* (2016) (4.9% and 3.7% for Matembelabangi and Ki.ng of Food). We believe their values might be based on fresh weight, as converting our dry weight values to fresh weight brings them closer. Our values are higher than those for healthy cassava leaves (12-13.7%) reported by Zinga*et al.* (2016), but are similar to mosaic-diseased cassava leaves (20.98-26.25%).

4.1.4. Total Fats

The average fat content in sweet potato leaves was 4.1%, with individual varieties showing 5%, 3.7%, and 3.7% for Matembelabangi, Kilo moya, and Damu, respectively. These values are higher than those from Ndibualojii*et al.* (2016) (0.5% and 0.4% for Matembelabangi and King of Food), but become comparable when converted to dry weight. Our values are also similar to Devendra's (1977) finding of 4.8% for cassava leaves.

4.1.5. Crude Fiber

Sweet potato leaves had an average crude fiber content of 11.0%, with Matembelabangi at 12.9% and Kilo moya and Damu both at 10%. This indicates that sweet potato leaves are a good source of dietary fiber. These values are lower than the 23.9% found by Mahendranathan (1971) for cassava leaves.

4.1.6. Calcium

Calcium levels in sweet potato leaves were 33, 28, and 27 mg/100g for Matembelabangi, Kilo moya, and Damu, respectively, with an average of 29.3 mg/100g. Our results are close to those of OchoAnain*et al*. (2012) for *Solanumnigrum* (29.9, 37.56, and 34.3 mg/100g). However, our results are lower than GRUBBEN *et al.* (2004) who found 38 mg/100g. Our values fall within the range (9 to 181 mg/100g) reported by Miah *et al*(2015) for vegetables consumed in Bangladesh.

4.1.7. Phosphorus

Phosphorus concentrations in sweet potato leaves were 0.8, 0.8, and 1 mg/100g for Matembelabangi, Kilo moya, and Damu, respectively. These results are much lower than those from Grubben*et al*. (2004), who found 66 mg for amaranth, 43 mg for celosia, and 75 mg for nightshades. Our results are also significantly lower than Ocho-anin*et al.* (2012), who reported 2050 mg/100g for amaranth and 2229 mg/100g for black nightshades sold in Ivory Coast markets. We believe these differences are linked to factors like whether soil amendments were used, the age of harvest, and soil conditions.

4.1.8. Magnesium

Magnesium concentrations in sweet potato leaves were 76.6, 48.8, and 50.8 mg/100g for Matembelabangi, Kilo moya, and Damu, respectively, averaging 58.7 mg/100g. These results are lower than those from OchoAnain*et al.* (2012), who found 682 mg/100g for *Solanumnigrum* and 1820 and 1947 mg/100g for *Amaranthushybridus*.

4.1.9. Iron

Iron concentrations in sweet potato leaves were 0.17, 0.084, and 0.081 mg/100g for Matembelabangi, Kilo moya, and Damu, respectively. These values are lower than those reported by Vodouhe*et al*. (2012) for vegetables grown in Benin (2.1 mg/100g for *Solanummacrocarpum* and 2.2 mg/100g for *Amaranthushybridus*). Our results are also much lower than Mara *et al*. (2018), who found values between 67.2 to 153 mg/100g and 61 to 196 mg/100g. These differences could be explained by soil type, specifically the availability of elements in a form plants can absorb.

For example, ferrous iron (Fe^{+}) absorbed by roots can turn into unabsorbable ferric oxide in calcareous and alkaline soils; most micronutrients become less available as pH increases. Also, the leaching phenomenon might contribute to these low values in our region.

4.1.10. Thiamine (Vitamin B1)

Thiamine concentrations in sweet potato leaves were identical for all three varieties at 0.1 mg/100g. This result is lower than Solomo (2017), who found 0.87 and 2.19 mg/100g for *Solanumnigrum* and *Amaranthusviridus*, respectively. However, our results are higher than Delanoy (2001), who found 0.06 mg/100g for cabbage.

4.1.11. Riboflavin (Vitamin B2)

Riboflavin concentrations were also identical for all three varieties at 0.1 mg/100g. This result is lower than Pamplona (2011), who found 0.159 mg/100g for spinach, but higher than the 0.04 mg/100g found for cabbage.

4.1.12. Pyridoxine (Vitamin B6)

Vitamin B6 levels were also identical for all three varieties at 0.2 mg/100g. This value is similar to Solomo (2017) for *Solanumnigrum* (0.262 mg/100g). However, this result is lower than Akugbugwo*et al*. (2007) for *Amaranthushybridus* (2.33 mg/100g).

V. CONCLUSION

This study aimed to investigate the nutritional potential of sweet potato leaves (*Ipomoea batatas* (L) Lam), as some varieties are favored by the local population over others. We wanted to see if there were significant nutritional differences between the leaves of different sweet potato varieties to provide scientific guidance for consumer preferences.To do this, we harvested leaves from three sweet potato varieties: Matembelabangi (highly appreciated), Kilo moya (less appreciated), and Damu (not appreciated). We then performed chemical analyses on their content of moisture, crude ash, crude protein, crude fiber, total fats, minerals (Ca, P, Mg, and Fe), and vitamins (B1, B2, and B6). The Matembelabangi variety was bought from a local market, while the other two were harvested from a field after two months.

Statistical analysis revealed significant differences between the Matembelabangi and Damu varieties in terms of their crude ash, phosphorus, and iron content. For the other nutrients measured, the statistical analyses did not show significant differences.This study shows that the Matembelabangi variety, which is the most preferred by the population, is also relatively richer in certain nutrients. Nevertheless, the other varieties, even though they are less popular, are almost nutritionally similar to Matembelabangi. Therefore, we can still promote these less-appreciated varieties by exploring different cooking methods or by using them as animal feed.

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