

Original Research Report



Assessment of Proximate, Minerals and Amino Acids Content of Black Plum (*Vitex doniana*) Young Leaves as Dietary Vegetable Substitute

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Abstract: Vegetables have been widely used for their health-promoting properties, as they have been found to be rich in minerals, and phytochemicals. The utilization of available leaves rich in essential nutrients is limited in the northern part of Nigeria; this may probably be due to ignorance. The specific objective of this work was to assess the proximate, mineral, and amino acid content of *Vitex doniana*'s young leaves as dietary vegetable substitutes. The leaves sample was analyzed for proximate, minerals, and amino acids content using established procedures. The result for proximate content revealed the following values 11.83 ± 0.21 , 21.16 ± 0.11 , 15.73 ± 0.01 , 12.83 ± 0.08 , and 12.73 ± 0.01 and $41.31 \pm 0.05\%$ for moisture, ash, crude protein, crude lipid, crude fibre, and carbohydrate respectively. Calcium had the highest concentration (23.53 ± 0.35) while iron, potassium, magnesium, zinc, and copper were 18.87 ± 0.21 , 13.89 ± 0.47 , 12.71 ± 0.33 , 4.74 ± 0.23 and 0.92 ± 0.09 (mg/100g) respectively. The amino acid content of the black plum young leaves was 47.87, 18.21, 10.14, 18.26, 8.29, 1.49, and 1.02 for cysteine, leucine, tyrosine, proline, threonine, lysine, and methionine respectively. Based on the results obtained, it can be concluded that these leaves contain essential nutrients that could complement well-known vegetables to enhance food security in Nigeria.

Keywords: Amino acids, Black-plum, Leaves, Minerals, Proximate

1. Introduction

Vegetables are edible portions of herbaceous plants that serve as key sources of micronutrients needed for good health and are most affordable source of vitamins and minerals needed for good health (Sedani et al., 2019). Inadequate intake of vegetable has been reported to cause about 31% of ischemic heart disease and 11% of stroke worldwide (Dias, 2012). Determination of proximate composition gives a useful splitting of food substance into different part such as moisture, ash, crude fibre, crude protein, crude lipid and carbohydrate. Ash is a measure of mineral content of food items and it is the inorganic residue after organic matter in foods has been burnt off (Olagunju et al., 2012). Dietary fibre helps in lowering concentration of blood sugar and reduces the chance of health challenges such as diarrhoea and constipation. Proteins are essential for growth, repairs of worn-out tissues, optimal pH maintenance, and synthesis of important body components such as hormones. Proteins are the basis for the major structural components of both animal and human tissues. Amino acids are important in the production of proteins and secondary metabolites that take part in cell signaling, gene expression, homeostasis control, synthesis of hormones and various physiological functions such as skeletal muscle function, sarcopenia and cancer (Moran-Palacio et al., 2014).

Carbohydrates are plant products which are synthesized as by-products of photosynthesis processes. The digestible carbohydrates are considered as important sources of energy and are required for synthesis of glycogenic amino acids and incorporated in RNA and many nucleotides. Dietary lipid functions to increase food palatability by absorbing and retaining flavor. They are carbon chains with a methyl group at one end of the molecule and a carboxyl group at the other end.

Iron is a very important mineral that is required by human body for its proper functioning, it has been found that vegetables are very important sources of dietary non-heme iron (Slavin & Lloyd, 2012). The use of vegetables as source of dietary iron has many advantages because there is less risk of iron overload and there will be no problem with the compliance to drug regiment as the iron is consumed as part of diet (Bakhshayesh et al., 2014). Iron help in prevention of anaemia and other related diseases (Suchdev et al., 2016). Magnesium is required in the plasma and extracellular fluid, where it helps to maintain osmotic equilibrium (Gafar et al., 2011). Zinc boosts the health of our hairs and plays a role in the proper functioning of some sense organs such as ability to taste and smell.

Vitex doniana belongs to a family of *Lamiaceae* and is one of the most abundant wide spread species of fruit tree that are small to medium size found in savanna regions. The fruit is known as “Dinya” in Hausa, “Ucha koro” in Igbo and “Orinla” in Yoruba languages (Merrick et al., 2019). It is an indigenous fruit tree species that is important for the livelihood of rural population; the tree produces fruits which are sweet. Like other vegetables, the young leaves of *Vitex doniana* can form part of the regular diet for human as it may serve as important source of micronutrients for maintenance of good health and prevention of diseases (Rubatzky & Yamaguchi, 2012). Therefore, this research aimed at assessing the proximate, minerals and amino acids content of *Vitex doniana*’s young leaves as dietary vegetable substitute.

1.1. Statement of Problem

Despite the use of this vegetable as food in the northern part of Nigeria, studies on its nutritional constituents have been limited especially its amino acids compositions. However, little information was documented on the nutritive values of the fruits. Critically, lack of adequate investigation into

the nutritional content of the black plum leaves may limit its use as substitute for other dietary vegetables. Poor knowledge on the nutritional composition of this vegetable may limit its consumption.

1.2. Purpose of the Study

The general purpose of this research was to assess some nutritional compositions of *Vitex doniana*'s young leaves as dietary vegetable substitute. Investigation into the nutrients content of this (*Vitex doniana*) underutilized indigenous vegetable can contribute to dietary diversities, thereby improving rural and urban households' nutrition, hence boosting food security. Specifically, the research sought to:

- (a) Analysis the proximate composition of the young leaves of *Vitex doniana*
- (b) Quantify the minerals composition of the young leaves of *Vitex doniana*
- (c) Determined the concentration of some specific amino acids in the young leaves of *Vitex doniana*

1.3. Research Questions

The following research questions guided the study.

- (a) What is the percentage of each proximate component present in the young leave of *Vitex doniana*?
- (b) What is the concentration of some mineral elements present in the young leave of *Vitex doniana*?
- (c) What is the concentration of some amino acid present in the young leave of *Vitex doniana*?

2. Materials and Methods

2.1. Sources of Materials

Sample was collected from a farm in Giwa Local Government Area Kaduna State, Nigeria. The plant was identified and registered in the Herbarium unit of Department of Biological Sciences Ahmadu Bello University Zaria.

2.2. Sample Preparation

The sample was air dried under shade for 5 days and weighed until three constant weights were recorded. The air-dried sample was grinded into powder and kept in an air tight container until needed for further analysis. The grounded samples were examined for its proximate, minerals and amino acids composition.

2.3. Proximate Analysis procedure

The moisture, ash, crude protein, crude lipid, crude fibre and carbohydrate contents were determined using the basic method of AOAC (2016) procedure.

2.4 Minerals Quantification

Calcium (Ca), Magnesium (Mg), Zinc (Zn), Iron (Fe) and Copper (Cu) was determined using Atomic Absorption Spectroscopy (AAS Model SP9) with standard air-acetylene according to the method described by (AOAC, 2016). Potassium (K) was determined using standard flame emission photometer using KCl to prepare the standard according to the method described by (AOAC, 2016).

2.5 Amino acids Content Determination

Cysteine, Leucine, Tyrosine, Proline, Threonine, Lysine and Methionine content of the black plum young leaves was determined according to the method of salt/alkaline extraction as described by Mæhre et al. (2016) with minor modifications.

2.6. Data Analysis Technique

Data collected in triplicate were analyzed using Statistical Package for Social Sciences (SPSS), version 23. The results were expressed as percentage and mean $\pm$ standard deviation (SD).

3. Results and Discussion

3.1 Research question one: What is the percentage of each proximate component is present in the young leave of *Vitex doniana*? Page | 173

Table 1: Mean Analysis of Proximate Content of Black Plum Young Leaves

Parameter	Composition (%)
Moisture	11.83 $\pm$ 0.21
Ash	21.16 $\pm$ 0.11
Crude fibre	15.73 $\pm$ 0.01
Crude protein	12.83 $\pm$ 0.08
Crude lipid	12.73 $\pm$ 0.01
Carbohydrate	41.31 $\pm$ 0.05

3.2 Research question two: What is the concentration of some mineral elements present in the young leave of *Vitex doniana*?

Table 2: Mean Analysis of Mineral Concentration of Black Plum Young Leaves

Mineral	Concentration (mg/100g)
Ca	23.53 $\pm$ 0.35
Fe	18.87 $\pm$ 0.21
K	13.89 $\pm$ 0.47
Mg	12.71 $\pm$ 0.33
Zn	4.74 $\pm$ 0.23
Cu	0.92 $\pm$ 0.09

3.3 Research question three: What is the concentration of some amino acid present in the young leave of *Vitex doniana*?

Table 3: Mean Analysis of Amino Acids Content of Black Plum Young Leaves

Amino Acid	Concentration (mg)
Cysteine	47.87
Leucine	18.21
Tyrosine	10.14
Proline	18.26
Threonine	8.29
Lysine	1.49
Methionine	1.02

Table 1 shows the proximate content of black plum leaves. The results showed that 11.83 $\pm$ 0.21, 21.16 $\pm$ 0.11, 15.73 $\pm$ 0.01, 12.83 $\pm$ 0.08, 12.73 $\pm$ 0.01 and 41.31 $\pm$ 0.05% were for moisture, ash, crude fibre, crude protein, crude lipid and carbohydrates respectively, with carbohydrate having the highest followed by ash content. In this present study, the result obtained for proximate analysis shows that

the leaves showed appreciable amount of all the parameters investigated. The leaves presented high proportions of carbohydrate, crude protein and crude lipid compared to other vegetables (*Remomastax polysperma*, *Brillantaisia owariensis* leaves and *Sorghum vulgare* leaf-sheath) reported by Akuru et al. (2018) and this shows that the young leaves of *Vitex dodiana* can serve a good source of energy. The result obtained for moisture content in this study is slightly higher than 10.23 ± 0.06 and 10.71% reported for *Corchorus olitorus* and *Melochia corchorifolia* respectively (Musah et al., 2014; Jacob et al., 2016).

The result obtained in our study for ash content was higher compared to 1.63% reported by Adejumo et al. (2013); the difference might be due to sources of samples and or environmental factors. Again, the result the present result for ash content was higher than 1.74 ± 0.03 , 3.39 ± 0.01 and $3.91 \pm 0.01\%$ for *Remomastax polysperma*, *Brillantaisia owariensis* leaves and *Sorghum vulgare* leaf-sheath respectively as reported by Akuru et al. (2018). Result for fibre content is higher compared to 3.75 ± 0.01 , 14.41 ± 0.01 and $3.23 \pm 0.01\%$ respectively for *Remomastax polysperma*, *Brillantaisia owariensis* leaves and *Sorghum vulgare* leaf-sheath (Akuru et al., 2018). Adejumo et al. (2013) also reported a lower value of 2.75% for fibre content. This indicates that the fibre content of this leaf is high which may aid digestion and reduces the chance of constipation when consumed.

The value obtained for crude protein in this study was higher compared to 0.006% , 8.24% and 8.10% reported by Imoisi and Iyasele (2020); Vunchi et al. (2011) and Adejumo et al. (2013) respectively while working on fruits of *Vitex dodiana*. The crude lipid content obtained was higher compared to 0.75% reported by Imoisi and Iyasele (2020) while working on fruits of *Vitex dodiana*. Therefore, it indicates that the young leaves investigated in this study may be more palatable than the fruit itself. A lower carbohydrate content was recorded in the present study compared to 67.84% reported by Imoisi and Iyasele (2020), but higher than 7.57% as reported by Adejumo et al. (2013).

Result for mineral content of black plum young leaves is presented in Table 2. It revealed that 23.53 ± 0.35 , 18.87 ± 0.21 , 13.89 ± 0.47 , 12.71 ± 0.33 , 4.74 ± 0.23 and 0.92 ± 0.09 (mg/100g) were recorded for Ca, Fe, K, Mg, Zn and Cu respectively, with Ca having the highest value followed by Fe. The result for mineral analysis shows that beside copper, all other minerals elements investigated were high in concentrations. The concentration of calcium in the sample was lower compared with 30.27 ± 0.30 reported by Vunchi et al. (2011) while working on the edible part of *Vitex doniana* fruit. The calcium content in this present study was considerably higher than 0.21 and 0.22% as reported by Marcel and Bievenu (2012) while working with *U. trinervis* and *V. ferruginea*. The result for iron content in the present study is higher compared to 5.20 ± 0.36 as reported by Vunchi et al. (2011).

The result for potassium content is low compared to 15.7 ± 0.26 mg/100g respectively reported by Vunchi et al. (2011). Black plum fruit was also reported to contain 15.70 mg/100g potassium (Vunchi et al., 2011). The concentration of magnesium in the sample was higher compared to 0.41 mg/100g reported by Adejumo et al. (2013). The concentration of zinc found in this present study was lower compared to 18.36 mg/100g reported by Adejumo et al. (2013). The concentration of copper in the leaf (0.921 mg/100g) is lower compared to 6.224 and 2.70 mg/100g reported Adejumo et al. (2013). Also, on the contrary, Nnamani et al. (2007) reported higher amount (65.0 mg/100g) of copper in black plum young leaves.

The result for amino acids content of the leaf is presented in Table 3. The result shows that 47.87 , 18.21 , 10.14 , 18.26 , 8.29 , 1.49 and 1.02 mg were recorded for Cysteine, Leucine, Tyrosine, Proline, Threonine, Lysine and Methionine respectively, with cysteine having the highest value. The amino acid peak area of the samples was calculated to determine the amino acid concentration shown in

Table 3. It shows that, cysteine has the highest concentration (47.87mg) followed by Leucine, Tyrosine, Proline, Threonine, Lysine and Methionine (18.26, 18.21, 10.14, 8.29, 1.49 and 1.02mg) respectively. This result is not in agreement with the work of Edgar et al. (2014). The present study has some limitations. Critically, some components that maybe present in the sample such as anti-nutrients (phytate, oxalate and cyanide) were not included in our present investigation, which might affect the absorption of the nutrients investigated. Further limitations involve the lack of data on other important amino acids that may be present in the young leaves of black plum as found in other vegetables that play critical roles in human development. Future studies should endeavor to examine these amino acids in the young leaves of black plum.

4. Conclusion

Based on the results obtained, it is concluded that *V. doniana* young leaves is a nutritious vegetable that contains sufficient amount of nutrients which can be harnessed for the promotion of good health and food security. It is therefore, recommended that the young leaves of *Vitex dodiana* should be consumed in every household. Also, further studies on bioavailability of important mineral elements such as iron from the young leaves of *Vitex dodiana* should be carried out.

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Conflict of Interest

The authors declare that there is no conflict of interest.

Author Contributions

Conceptualization: SA, CBD, AA and CA.

Sample collection: SA, ID and CA

Formal analysis: SA, ID and CA

Funding acquisition: SA, CBD, AA, ID and CA

Investigation: SA, CBD, AA and CA.

Methodology: SA, CBD, AA, ID and CA

Data analysis: SA, ID and CA

Writing – original draft, review & editing: SA, CBD, AA and CA.

Data Availability Statement

The original contributions presented in the study are included in the article. Further enquiries can be directed to the corresponding author.

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