International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
(A Peer Reviewed, Referred, Indexed and Open Access Journal)
DOI: 10.22192/ijarbs Coden: IJARQG (USA) Volume 11, Issue 9-2024

Research Article

DOI: http://dx.doi.org/10.22192/ijarbs.2024.11.09.002

Morphological evaluation, proximate, vitamin and mineral compositions of black plum (*Vitex doniana* Sweet) in South Eastern Nigeria

Okocha, I. O[1]., Okorie, H. A[2]., Christo, I. E[2]. and Ezeogo, J. I[3].

[1]Horticulture and Landscape Technology Department, Akanu Ibiam Federal Polytechnic, Unwana, P.M.B. 1007, Afikpo, Ebonyi State

[2]Crop Science and Biotechnology Department, Imo State University, Owerri, Imo State

[3]Science Laboratory Technology Department, Federal Polytechnic, Ngodo-Isuochi, P.M.B. 300 Isuochi, Umunneochi, Abia State.

(*gentleokocha@yahoo.com*, +2349132402919, +2348126602676, +2348038715639)

Abstract

The study on morphological evaluation, proximate, vitamin and mineral compositions of black plum (*Vitex doniana* Sweet) was carried out between 2020 to 2021. It evaluated the morphological variations of black plum and also determined the proximate, vitamin and mineral compositions in three States. The characterization studies carried out were in three different States in South Eastern Nigeria (Ebonyi, Abia and Imo States). Data collected were analyzed using Analysis of Variance and differences between treatment means were by Duncans New Multiple Range Test. The mean plant canopy, plant height before branching, total plant height, stem girth, leaf width, leaf length, leaflet width, leaflet length, fruit stalk length, rachis length, number of major branches and number of rachis per branch, constituted vegetative characteristics. Number of fruits per rachis, number of fruits per branch, fruit colour before ripening, fruit colour after ripening, weight of ripe fruits, weight of fruit pulp, weight of fresh seeds and weight of dried seeds constituted the pomological characteristics. The proximate composition, vitamin contents and mineral composition of black plum young leaves and fruit pulps were determined. The results revealed that seed location had no significant ($P \leq 0.05$) effects on most of the parameters measured under vegetative and pomological characteristics except on leaf length, leaflet length and number of rachis per branch. Plants monitored in Ebonyi State produced significantly ($P \leq 0.05$) longer leaf and leaflet than plants monitored in Imo State while plants monitored in Imo State produced number of rachis per branch significantly ($P \leq 0.05$) greater than plants monitored in Abia State. The tallest plant before branching, the total tallest plants, biggest stem girth, greatest number of branches, biggest canopy radius, longest fruit stalk, greatest number of rachis per branch and greatest number of fruit per rachis were recorded on Imo State monitored plants whereas, the widest leaf, longest leaf, widest leaflet, longest leaflet, longest rachis per branch, greatest number of fruits per branch and heaviest dried seeds were obtained from plants monitored in Ebonyi State. The heaviest ripe fruits, fruit pulp and fresh seeds were obtained from plants monitored in Abia State. The mean values for number of fruits per branch were 655.33, 585.00 and 336.67 fruits for Ebonyi, Imo and Abia State, respectively. The mean values of crude fibre, crude protein, ash and carbohydrate contents were 5.40, 5.63, 6.60 and 49.18% respectively, for black plum young leaves and 1.78, 29.82, 1.20 and 17.90% respectively, for the fruit pulps.

Whereas, mean metabolisable energy of the young leaves and fruit pulps were 340.86 and 105.77 Kcal 100^{-1} respectively. The result indicates that the young leaf contains more proximate compositions than the fruit pulps except in crude protein. The results showed that *Vitex doniana* young leaf was good source of vitamin C, B_1 and B_6. The levels of vitamin C, B_1 and B_6 were 34.70, 3.78 and 6.09mg $100g^{-1}$ for the young leaf and 21.14, 2.77 and 3.97mg $100g^{-1}$ for the fruit pulp. The respective mean values of calcium and magnesium contents were 86.16 and 52.73mg $100g^{-1}$ for the young leaves while the fruit pulps calcium and magnesium contents were 32.88 and 27.59mg $100g^{-1}$ respectively. The proximate and nutritional compositions of *Vitex doniana* were higher in the young leaves than in the fruit pulps, which attribute more important to the consumption of the young leaves than the fruit pulps irrespective of State location.

Keywords: Black plum, plant location, proximate, mineral, vitamin compositions.

Introduction

Black plum (*Vitex doniana* Sweet) is a multipurpose plant species that is widespread in tropical Africa. It belongs to the plant family *Lamiaceae*. In Nigeria and many other parts of Africa, black plum is of great socio-economic interest especially for its extensively documented food and medicinal properties (Oladele, 2011; N'Danikou *et al.,* 2015). It is also known as African black plum. In Hausa language, it is called 'dinya', Fulanis call it 'galbihi'. In Yoruba, it is known as 'oriri' or 'orinla' and in Ibo language it is called 'uchakokoro' or 'mbembe' (Ekundayo and Okigbo, 1991; Burkill, 2000). The fruits are eaten or used for juices and jams when ripe. The young leaves, barks and roots of black plum are used in the traditional treatment of several human diseases (Sanogo *et al.,* 2009; Amegbor *et al.,* 2012; Adetoro *et al.,* 2013) as well as animal diseases (Suleiman and Yusuf, 2008; Njidda, 2012). Every part of the plant has one economic use or another and may be harvested in the wild for household use or sale to raise income. Black plum has numerous utilizations with promising economic potential for poverty alleviation in rural and urban areas in Nigeria (Mapongmetsem *et al.,* 2005). African plum can make a great contribution to the local, regional and national economy of many West African countries (Codjia *et al*., 2003). In the past, many indigenous wild species played a crucial role in the food security, nutrition, health, income generation and food culture of the rural poor (Magbagbeola *et al*., 2010). The immature leaves are mostly used and consumed as a leafy peri-vegetable. Hence, it is valued in rural and urban areas as local spinach (Mapongmetsem *et al.,* 2012; Kranjac-Berisavljevic and Gandaa, 2013). Apart from its leaves, which are greatly in demand, the black plum tree also has many other domestic uses. Highly valued as a food and commodity, this pan-tropical tree essence is consumed and sold in all parts of Benin republic (Codjia *et al*., 2003). Okafor, (1980) cited it as being one of Nigeria's nutritionally important savannah trees. Leafy-vegetables represent an important source of nutrients and provide the essential vitamins for a balanced diet, especially vitamins A, B and C, as well as vital minerals, fibres, carbohydrates and proteins (Lewis, 1997; Adejumo *et al*., 2013; Osum *et al*., 2013). Adejumo *et al*., (2013) found that the moisture content in *Vitex doniana* young leaves was high. *Vitex doniana* young leaf is very rich in carbohydrates. Minerals such as sodium, calcium, iron, Magnesium, Zinc, Copper were reported to be present in *Vitex doniana* young leaves. The result on the analysis of mineral content of the *Vitex doniana* young leaves revealed that Calcium (Ca) content is very high and Magnesium was moderate. Sodium was low in *Vitex doniana* young leaf but rich in potassium (Adejumo *et al*., 2013; Osum *et al*., 2013). Reports on the mineral content of *Vitex doniana* fruits showed that Iron, Magnesium, Manganese, Molybdenum, Phosphate, Zinc, Calcium and Sodium are present (Vunchi *et al*., 2011; Osum *et al*., 2013). Glew *et al*. (1997) reported that the most abundant mineral is Calcium. However, according to Vunchi *et al*. (2011), *Vitex doniana* fruit pulp has moderate calcium value. The fruit has also high value of vitamin C, carbohydrate and lipid. They suggested that the species could be promoted as

carbohydrate and lipid supplements for cereal-based diets in rural communities while its moderate calcium value could be used for the management of oesteomalacia.

Black plum is among the neglected and under-utilized species (NUS) known due to their nutritional and medicinal properties (Dadjo *et al*., 2012). Despite the widely known nutritional, medicinal and economic uses of *Vitex doniana* products, the species are still under-utilized and un-improved (Glew *et al*., 1997; Osum *et al*., 2013). There is scarcity of information on black plum in areas of species variability, characterization, proximate, mineral and vitamin compositions of its young leaves and fruit pulps despite the fact that it is a high-value utility crop with promising economic potentials. Hence, the urgent need to evaluate the morphology, proximate, vitamin and mineral compositions of black plum young leaves and fruit pulps.

Objectives of the Study

The major objective of this study is to investigate the morphological variation and nutritional composition of black plum (*Vitex doniana* Sweet).

The specific objectives are as follows, to:

1. evaluate and assess the intra-specific variations in pomological and vegetative characters of the black plum (*Vitex doniana* Sweet).
2. identify the most promising variants in terms of their pomological and vegetative attributes.
3. evaluate the proximate and mineral compositions of both the young leaves and fruit pulps.
4. ascertain the most valuable part to include in our daily dietary.

Materials and Methods

Site Location and Climatic Conditions

Survey work and laboratory experiments were carried out between 2020 and 2021. Field survey trips were undertaken in three (3) different States of South Eastern Nigeria where the species naturally occur. The States selected from the South Eastern Nigeria were Ebonyi, Abia and Imo States. South Eastern Nigeria is situated between latitude 05^0 10^1N and $06^0 45^1$E, longitude 06^0 35^1 E and $07^0 18^1$E and altitude 440m above sea level. South Eastern Nigeria is in the humid tropics characterized by a warm wet season (Mid- March to October) and hot dry season (November to Mid March). Most of the annual precipitation is between 1,810mm to 2,260mm, distributed between March to October which is broken by a short duration drought of about 10 to 14 days in August. Temperature range during the cropping season is 27^0C to 30^0C with a relative humidity of 75% (NIMET, 2021).

Field Characterization Studies of Black Plum (*Vitex doniana* Sweet)

The field studies were carried out during the normal fruiting period of Black plum in South Eastern Nigeria, which is between the months of February and October. Black plum (*Vitex doniana* Sweet) trees growing in the forests, distant and nearby farms were used for the field study.

Materials used for the survey study

The materials used for the survey study were matchet, climbing rope, long graduated pole of 10m (it is an improvise for Relascope machine), electronic weighing balance (S. Mettler model, K-600g/0.1g sensitivity), graduated rule, measuring tape, exercise book, photo camera and pen.

Sampling and Sampling techniques

Morphological and pomological observations and studies were made on a total of 90 black plum trees (uchakokoro or mbembe in Igbo) across the three (3) States. A total of 30 black plum trees were observed, recorded and studied in each State.

Data collection on field characterization studies

Measurements and morphological observations were made on both the vegetative and

pomological characters of the species. The measurements were taken at random while leaf and fruit samples were collected and used for the proximate, vitamin and mineral analysis. The vegetative and pomological characters studied across the three States were radius of plant canopy, stem girth, total plant height, rachis length, leaflet length, leaflet width, leaf length, leaf width, fruit stalk length, number of rachis per branch, number of fruits per rachis, number of fruits per branch, colour of pulp before and after fruit darkening, fruit weight, fresh seed weight, dried seed weight and fruit pulp weight.

Determination of proximate composition

Moisture and crude protein contents were determined by the method adopted by Anhwange *et al*., (2004). Crude fibre, total fat and ash contents were determined by the method of the AOAC, (1990). The carbohydrate was determined by estimation using the arithmetic difference described by Pomeranz, (1971).

Determination of vitamin contents

Titremetric method was used to determined Vitamin C. British Pharmacopoedia (1988) was used for Vitamin B_1 and B_2, and Spectrophotometric method for Vitamin B_6.

Determination of mineral composition

Determination of calcium

Calcium content of the digested sample was determined by EDTA complexiometric titration method as described by Onwuka (2005). 10ml of the sample solution was dispensed into separate conical flasks, pinches of the masking agents (potassium cyanide, potassium ferrocyanide and hydroxyl hydrochloride) were measured into the content of each flask. 20ml of ammonia buffer was added to one of the flasks to raise the pH to 10 while 10ml of sodium hydroxide (NaOH) solution was added to the other to raise the pH to 12. To the flask at pH of 10 (for calcium) a pinch of Erichrome dark indicator was added and titrated against 0.02N EDTA solution. The other flask at pH of 12, a reagent blank was titrated as a control. The calcium content of the samples was calculated as follows:

$$\% \text{ Calcium} = \frac{100}{W} \times \frac{Ew \times N}{100} \times \frac{Vf}{Va}$$

Determination of potassium and sodium

Potassium and sodium were determined by flame photometry method as described by Onwuka (2005). The instrument (Photometer) was set up according to the manufacturer's instruction. 1ml of prepared potassium and sodium standard solutions was aspirated into the machine and sprayed over the non-luminous butane gas flame. The sodium and potassium emissions (having been appropriately filtered) from the different concentrations were recorded and made into standard curve. Subsequently, the optical density emissions recorded from each of the sample were plotted against those in the curve, then using the curve to extrapolate the quality of sodium and potassium in the sample.

Determination of Phosphorous

The phosphorous in the sample was determined by the Vanado-molybdate (yellow) spectrometry described by Onwuka (2005). 1ml extract from the sample was dispensed into a test tube. Similarly, the sample volumes of standard phosphorous solution as well as water were measured into other test tubes to serve as standard and blank respectively. The contents of each tube were mixed with equal volume of the vanado-molybdate colour reagent. They were left to stand for 15 minutes at room temperature before their absorbance were measured in Jenway electronic spectrophotometer at wavelength of 420nm. Measurements were taken with the blank at zero.

Phosphorous content was obtained by the formula:

$$P \text{ (mg/100g)} = \frac{100}{W} \times \frac{Au}{As} \times C \times \frac{Vf}{Va}$$

Determination of Iron and Magnesium

Analysis for iron and magnesium were carried out after wet digestion using the method of AOAC (2010). Ground samples (0.5g) of each samples were boiled (100^0C) with 5ml concentrated nitric acid (HNO_3) and 5ml of 30% perchloric acid solution continuously for about 2 hours in an electric heating mantle (HP 220, LITEC product Inc, Albany, New-York, USA) until clear solutions were obtained. These were cooled, filtered through Whatman no 45 filter papers and then through <0.45 millipor filter papers. Filtrates were made up to the 25ml mark of the volumetric flasks with distilled water and then used to analyze for the individual minerals using Atomic Absorption Spectrophotometer (Buck Scientific AAS Model 210, equipped with single slot burner and airacetylene flame). Working standard solutions of the elements were prepared from the stock standard solutions containing 1000ppm of each element in 2N nitric acid solution. Calibration and measurement of absorbance of each element against a blank at its unique wavelength was done using Atomic Absorption Spectrophotometer (A. Analyst 300, Perkin Elmer, Morwalk, Conn, USA). The calibration curves were prepared separately for each element. Absorbance of each element in the filtrate was read at its wavelength from the spectrophotometer and its concentration in the samples extrapolated from the standard curve. The concentrations of Iron and Magnesium were obtained from the standard curve.

Statistical Analysis

Data collected was subjected to analysis of variance (ANOVA) for Complete Randomized Design using Genstat 2014 release 10.3DE software package (GENSTAT, 2014). Separation of treatment means for significant effects was by the use of Fishers Least Significant Difference (F-LSD) and Standard Deviation (Sd) as described by Obi (2012).

Results

Vegetative characteristics of black plum (*Vitex doniana* Sweet) in three States.

Result of the comparative effects of location on the vegetative characteristics of black plum (*Vitex doniana* Sweet) in three states selected is presented in Table 1. There were significant ($P \leq 0.05$) differences on the leaf length, leaflet length and number of rachis per branch in the three states. All other vegetative characteristics were statistically ($P \leq 0.05$) the same in the three States. The plant monitored at Imo State recorded the highest mean plant height of 2.63m before branch, highest plant height of 7.48m, widest stem girth of 116.00cm, highest branch number of 6.03, widest plant canopy of 4.24m, longest fruit stalk of 10.03cm and highest rachis number of 27.43 per branch. Ebonyi State recorded the widest mean leaf of 11.45cm, longest mean leaf of 23.63cm, widest mean leaflet of 27.97cm, longest mean leaflet of 23.67cm and longest rachis of 31.17cm. However, plants monitored in Abia State produced inter-mediate and least mean values in almost all the parameters monitored (Table 1).

Table 1: Mean vegetative characteristics of black plum (*Vitex doniana* Sweet) in three States

Parameters	States			
	Ebonyi	Abia	Imo	Sd
Plant height before branch (m)	2.43[a]	2.50[a]	2.63[a]	±0.01
Total plant height (m)	7.03[a]	6.94[a]	7.48[a]	±0.29
Stem girth (cm)	115.83[a]	114.77[a]	116.00[a]	±0.67
Number of major branches	5.03[a]	5.07[a]	6.03[a]	±0.57
Radius of plant canopy (m)	3.93[a]	4.16[a]	4.24[a]	±0.16
Leaf width (cm)	11.45[a]	11.20[a]	11.03[a]	±0.21
Leaf length (cm)	23.63[a]	19.97[b]	19.20[b]	±2.37
Leaflet width (cm)	27.97[a]	27.80[a]	27.03[a]	±0.50
Leaflet length (cm)	23.67[a]	22.77[a]	20.97[b]	±1.37
Fruit stalk length (cm)	9.77[a]	9.50[a]	10.03[a]	±0.27
Rachis length (cm)	31.17[a]	29.87[a]	31.13[a]	±0.60
Number of rachis per branch	25.97[a]	22.30[b]	27.43[a]	±2.64

Means having different superscript letters along the column differed significantly ($P \leq 0.05$).
Sd = Standard Deviation

Pomological characteristics of black plum (*Vitex doniana* Sweet) in three States.

The comparative study of pomological characteristics of black plum in the three states monitored is shown in Table 2. The results indicated that the three states monitored had no significant ($P \leq 0.05$) effects on all the pomological characteristics measured. The mean number of fruits per rachis produced were 18.23, 17.67 and 20.53 fruits for Ebonyi, Abia and Imo States respectively. Plants monitored at Imo State recorded the highest fruits of 20.53 fruits per rachis while those monitored at Abia State recorded the least mean value of 17.67 fruits per rachis and they were statistically ($P \leq 0.05$) the same. The mean number of fruits per branch recorded were 655.33, 336.67 and 585.00 fruits for Ebonyi, Abia and Imo States respectively. Ebonyi State produced the highest fruits (655.33 fruits) per branch which had no significant ($P \leq 0.05$) effects on the mean fruits number of 585.00 and 336.67 fruits per branch gotten from Imo and Abia States respectively. The heaviest mean pulp 6.15g, ripe fruits 14.56g and fresh seed 8.38g were obtained from Abia State and the least mean value of pulp weight 6.07g was gotten from Imo State whereas Ebonyi and Imo States recorded the same least mean values of 14.38g and 8.29g for ripe fruits and fresh seed respectively. These were statistically ($P \leq 0.05$) similar. Ebonyi State recorded the heaviest mean dried seed of 3.83 while Abia State had the least mean dried seed of 3.71 and they did not differed statistically ($P \leq 0.05$).

Table 2: Mean pomological characteristics of black plum (*Vitex doniana* Sweet) in three States

Parameters	States			
	Ebonyi	Abia	Imo	Sd
Number of fruits per rachis	18.23[a]	17.67[a]	20.53[a]	±1.52
Number of fruits per branch	655.33[a]	336.67[a]	585.00[a]	±167.41
Weight of ripe fruit (g)	14.38[a]	14.56[a]	14.38[a]	±0.07
Weight of pulp (g)	6.09[a]	6.15[a]	6.07[a]	±0.05
Weight of fresh seed (g)	8.29 [a]	8.38[a]	8.29[a]	±0.05
Weight of dried seed (g)	3.83 [a]	3.71[a]	3.74[a]	±0.06
Colour of fruit pulp before ripening	Green	Green	Green	
Colour of fruit pulp after ripening	Purplish Black	Purplish Black	Purplish Black	

Means having different superscript letters along the column differed significantly ($P \leq 0.05$).
Sd = Standard Deviation

Proximate composition of Back plum (*Vitex doniana* Sweet) in the three States.

The mean moisture content of black plum young leaf was 6.40% while that of the fruit pulp was 72.18%. Mean ash contents of the young leaf and fruit pulp were 6.60% and 1.20%, respectively. For the crude fibre and total fat, the mean values were 5.40% and 2.92% for the young leaf while the fruit pulp crude fibre and total fat were 1.78% and 1.32%, respectively. The mean crude protein value of the young leaf was 5.63% and that of the fruit pulp was 29.82%. The carbohydrate content of the young leaf was 49.18% while the fruit pulp was 17.90%. The metabolisable energy of the young leaf and fruit pulp were 340.86 and 105.77, respectively. However, ash content, crude fibre, total fat, crude carbohydrate and metabolisable energy were higher in the black plum young leaf than in the fruit pulp whereas, the moisture content and crude protein were higher in the fruit pulp than in the young leaf (Table 3).

Table 3: Proximate composition of black plum (*Vitex doniana* Sweet) in three States

Constituents (% of dry matter)	State/Young leaf mg $100g^{-1}$				State/Fruit pulp mg $100g^{-1}$			
	Ebonyi	Abia	Imo	Mean	Ebonyi	Abia	Imo	Mean
Moisture contents	6.20	6.60	6.40	6.40	72.20	72.20	72.15	72.18
Ash contents	6.50	6.70	6.60	6.60	1.00	1.40	1.20	1.20
Crude fibre	5.20	5.60	5.40	5.40	1.80	1.80	1.75	1.78
Total fat	2.80	3.00	2.95	2.92	1.40	1.20	1.35	1.32
Crude protein	5.60	5.60	5.69	5.63	29.50	30.00	29.95	29.82
Carbohydrate	49.80	48.10	49.65	49.18	18.00	17.80	17.90	17.90
Metabolisable energy (Kcal/100g)	342.40	339.40	340.78	340.86	107.00	104.40	105.90	105.77

Mineral composition of Black plum young leaf and fruit pulp in three States

The results in Table 4 shows the mineral composition of black plum young leaf and fruit pulp in the three states. The young leaf of black plum contains relatively much higher potassium, calcium, magnesium, phosphorus and sodium than the fruit pulp. The respective young leaf mean values for potassium, calcium, magnesium, phosphorus and sodium were 103.07, 86.16, 52.73, 48.93 and 19.50mg 100g-^{1} while that of the fruit pulp were 47.91, 32.88, 27.59, 22.36, 8.42mg 100g-^{1} respectively. The corresponding Iron values for the young leaf was 4.04mg 100g-^{1} while the fruit pulp was 3.10mg 100g-^{1} (Table 4).

Table 4: Mineral composition of black plum (*Vitex doniana* Sweet) leaves and fruit pulp in three States

Constituents	State/Young leaf mg 100g^{-1}				State/Fruit pulp mg 100g^{-1}			
(% of dry matter)	Ebonyi	Abia	Imo	Mean	Ebonyi	Abia	Imo	Mean
Calcium	86.40	86.19	85.90	86.16	32.45	33.08	33.10	32.88
Sodium	19.60	19.60	19.30	19.50	8.40	8.45	8.42	8.42
Potassium	102.40	103.91	102.90	103.07	48.32	47.22	48.20	47.91
Phosphorus	49.04	49.02	48.72	48.93	22.11	22.80	22.18	22.36
Iron	4.08	3.92	4.11	4.04	3.20	2.95	3.15	3.10
Magnesium	52.30	52.78	53.10	52.73	27.65	27.60	27.52	27.59

Vitamin composition of young leaf and fruit pulp of Black plum in three States

The results of vitamin composition of young leaf and fruit pulp of *Vitex doniana* in the three states is presented in Table 5. The results revealed that both the young leaf and fruit pulp of black plum are good sources of vitamin C, B_1 and B_6. The young leaf also contains high content of Vitamin B_2. The mean values for the young leaf vitamin C, B_1, B_2 and B_6 were 34.70, 3.78, 1.43 and 6.09mg 100g-^{1} respectively, which were higher than that of the fruit pulp 21.14, 2.77, 0.71 and 3.97mg 100g-^{1}, respectively.

Table 5: Vitamins composition of black plum (*Vitex doniana* Sweet) leaves and fruit pulp in three States

Constituents	State/Young leaf mg 100g^{-1}				State/Fruit pulp mg 100g^{-1}			
(% of dry matter)	Ebonyi	Abia	Imo	Mean	Ebonyi	Abia	Imo	Mean
Vitamin C	34.00	35.22	34.89	34.70	21.40	21.25	20.78	21.14
Vitamin B_1	3.70	3.72	3.92	3.78	2.80	2.72	2.78	2.77
Vitamin B_2	1.45	1.45	1.40	1.43	0.72	0.72	0.70	0.71
Vitamin B_6	6.08	6.10	6.09	6.09	4.01	3.92	3.98	3.97

Discussion

The analyzed results of the field survey revealed that plant locations had no significant ($P \leq 0.05$) effects on most of the vegetative characteristics of black plum measured in the three States. The black plum plants from Ebonyi State had significantly ($P \leq 0.05$) longer leaves and leaflets than those from Abia and Imo States. The plants from Imo State however, had the highest number of rachis per branch, significantly ($P \leq 0.05$) higher than those from Abia State but not those from Ebonyi State (Table 1). Since most of the vegetative characteristics of the species examined in three different locations of these three States showed no significant ($P \leq 0.05$) differences, this suggest that environment has relatively little influence on the species vegetative characteristics when compared to the genotypic effects. This is supported by the fact that species is rarely out-

crossed having both functional male and female floral forms on the same plant (Allard, 1960; Hounkpevi *et al*., 2016).

From the field survey, the results indicated that plant location had no significant ($P \leq 0.05$) effect on all the pomological characteristics of black plum measured. Since all the pomological characteristics of the species examined in three different locations of these three States showed no significant ($P \leq 0.05$) differences, this suggest that environment has relatively no influence on the species pomological characteristics when compared to the genotypic effects. This is supported by the fact that species is rarely out-crossed having both functional male and female floral forms on the same plant (Allard, 1960; Hounkpevi *et al*., 2016).

Both the young leaves and fruit pulps of black plum contains relatively high levels of carbohydrates and crude protein respectively, irrespective of location. Whereas the young leaves are relatively higher in carbohydrates, ranging from 48.10 to 49.80%, the fruits had higher crude protein values ranging from 29.50 to 30.00%. The mean carbohydrates and crude protein values for the fruits and young leaves are 17.90% and 5.63%, respectively (Table 3). The fruits of black plum is relatively higher in crude protein when compared to crude protein values of 11.40 to 12.24% recently obtained from Bush cherry [*Macsobotrya barteri* (Baill) Hutch] (Nwagbaraocha, 2023). Black plum young leaves are also higher in metabolisable energy compared to the fruits. The mean values are 340.86 and 105.77 Kcal 100^{-1} for the young leaves and fruits, respectively.

The analyzed results revealed that both the young leaves and fruits of *Vitex doniana* contains relatively high levels of potassium, calcium and magnesium irrespective of location. Whereas the young leaves are relatively higher in potassium and calcium, ranging from 102.40 to 103.91mg $100g^{-1}$ and 85.90 to 86.40mg $100g^{-1}$ respectively. The mean potassium and calcium values for the young leaves are 103.70 and 86.16mg $100g^{-1}$ and the fruits are 47.91 and 32.81mg $100g^{-1}$, respectively. The young leaves of black plum are higher in potassium and calcium when compared to potassium and calcium values of 73.25 and 71.50mg $100g^{-1}$ obtained from bitter leaf (*Veronia amygdalina* L.) (Asaolu *et al*., 2012). Black plum leaves are also higher in magnesium compared to the fruits. The mean values are 52.73 and 27.59mg $100g^{-1}$ for the young leaves and fruits, respectively.

Both the young leaves and fruits of black plum contains relatively high levels of vitamin B_6 and B_1 irrespective of location. Although, the young leaves are relatively higher in all the vitamins measured. The mean vitamin C, vitamin B_1, vitamin B_2 and vitamin B_6 values are 34.7, 3.78, 1.43 and 6.09mg $100g^{-1}$ for the young leaves and 21.14, 2.77, 0.71 and 3.97 mg $100g^{-1}$ for the fruits respectively. The fruits of black plum (*Vitex doniana* Sweet) is relatively higher in Vitamin B_1, B_2 and B_6 when compared to Vitamin B_1, B_2 and B_6 values of 0.06, 0.04 and 0.00 $mg100g^{-1}$ recently obtained in bush cherry (*Maesobotrya barteri* (Baill) Hutch) (Nwagbaraocha, 2023). The young leaves of black plum is relatively higher in Vitamin C and B6 when compared to Vitamin C value of 31.89mg $100g^{-1}$ obtained from bitter leaf (*Veronia amygdalina* L.) (Asaolu *et al*., 2012).

Conclusion

The results of the nutritional analysis showed that *Vitex doniana* is good source of proximate, vitamin and mineral particularly crude protein, calcium, vitamin B_1, B_2 and B_6. Having noted the importance of black plum to the people of West Africa especially Nigeria and standing on the position of this plant nutritional and genetic resources in cushioning health, food, income and job security of those agrarian rural communities of the country, it becomes imperative to create more awareness on the potentials of black plum (*Vitex doniana* Sweet). However, introducing black plum in our daily dietary will go a long way in improving the economy and food security of Nigeria, and also in enhancing the health status, vitality and longevity of Nigerians.

Recommendations

Based on the results of the study so far;

1. For more healthy living, the daily inclusion and consumption of black plum especially the young leaves in our dietary is recommended.
2. Domestication of *Vitex doniana* is recommended as the species has a lot of nutritional, medicinal and industrial potentials to justify high investment in its improvement, development and commercialization.
3. Further research should be carried out to verify the feasibility of black plum fruit pulps and seeds as animal feed supplement.
4. Great diversity of intra-specific variations was observed within the species in the three States evaluated. Plants sampled from Imo and Ebonyi States gave the most promising vegetative and pomological characteristics. Further research should be concentrated more in Imo and Ebonyi States so as to further explain the environmental and genetic interactions that favoured the species performance in these States.

References

Adejumo, A. A., Alaye, S. A, Ajagbe, R. O., Abi, E. A. and Adedokun, F. T. (2013). Nutritional and Anti-Nutritional Composition of Black Plum (*Vitex doniana). Journal of Natural Sciences Research, 3*(12): 144-148

Adetoro K. O., Bolanle J. D., Abdullahi S. B. and Ahmed O. A. (2013). In vivo antioxidant effect of aqueous root bark, stem bark and leaves extracts of *Vitex doniana* in CCl4 induced liver damage rats. *Asian Pacific Journal of Tropical Biomedicine, 3*(5): 395-400

Allard, R. W. (1960). *Principles of Plant Breeding*. John Wiley and Sons Inc., New York, 90-80.

Amegbor, K., Metowogo, K., Eklu-Gadegbeku, K., Agbonon, A., Aklikokou, K. A. and Napo-Koura, G. (2012). Preliminary evaluation of the wound healing effect of *Vitex doniana* sweet (Verbenaceae) in mice. *African Journal of Traditional, Complementary and Alternative Medicines*. 9(4): 584-590.

Anhwange, B. A., Ajibola, V. O. and Oniye, S. J. (2004). Amino acid composition of the seed of *Moringa oleifera* (Lam), *Detarium microcarpum* (Guill & Sperr) and *Bauhinnia monandra* (Linn). *Chemclass Journal*, 9–13.

AOAC (1990). Official Methods of Analysis (18th edn.). Association of Official Analytical Chemist, Washington DC, USA. Pp. 77.

AOAC (2010). Official Methods of Analysis (18th edn.). Association of Official Analytical Chemist, Washington DC, USA.

Asaolu, S. S., Adefemi, O. S., Oyakilome, I. G., Ajibulu, K. E. and Asaolu, F. M. (2012). Proximate and mineral composition of Nigerian leaf vegetables. *Journal of Food Research*, 1(3):214-218.

British Pharmacopedia (1988). *Recommendation of Medicine*. Vol. 1 & 11.

Burkill, H. M. (2000). Useful plants of West Tropical Africa. *Royal Botanic Garden Kew, 5(2)*:272- 275.

Codjia, J. T. C., Assogbadjo, A. E. and Mensah-Ekué, M. R. (2003). Diversité et valorization au niveau local des ressources végétales forestières alimentaires du Bénin. *Cahiers Agricultures*, 12: 321–331.

Dadjo, C., Assogbadjo, A. E., Fandohan, B., Kakaï, R. G., Chakeredza, S., Houehanou, T., Van Damme, P. and Sinsin, B. (2012). Uses and management of Black plum (*Vitex doniana* Sweet) in Southern Benin. *Fruits*, 67: 239–248.

Ekundayo, C. A. and Okigbo, R. N. (1991). The effect of pathogenic fungi on the nutritional value of the black plum (*Vitex doniana*). *Nigeria Journal of Botany*, 4:6–9.

Genstat (2014). Statistical Software, Release 10.3DE software package.

Glew, R. H., Dorothy, J. V., Cassius, L., Louis, E., Garrett, C. S., Andrzej, P. and Mark, M. (1997). Amino acid, fatty acid, and mineral composition of indigenous plants of Burkina Faso. *Journal of Food Composition and Analysis,* 10: 205–217.

Hounkpèvi, A., Tosso, F., Gbèmavo, D. S. J. C., Kouassi, E. K., Koné, D. and Kakaï, R. G. (2016). Climate and potential habitat suitability for cultivation and in situ conservation of the black plum (*Vitex doniana* Sweet) in Benin, West Africa. *International Journal of Agronomy and Agricultural Research*, *8*(4):67-80

Kranjac-Berisavljevic, G. and Gandaa, B. Z. (2013). Importance of bush grape (*Vitex* spp.) as food and medicinal plant to the Dagarti speaking people of the Upper West Region of Northern Ghana. *Acta Horticulturae*, 979: 669-673.

Lewis, I. (1997). Network vegetable production Africa: its contribution to conservation and use of traditional vegetables. *In: Guarino L. (eds) Traditional African vegetables: promoting the conservation and use of underutilized and neglected crops. Proceeding of IPGRI, Workshop on GRTV in Africa: 29-31August 1995, CRAF-HQ Nairobi, Kenya*. 159-160.

Magbagbeola, J. A. O., Adetoso, J. A. and Owolabi, O. A. (2010). Neglected and underutilized species (NUS): A panacea for community focused development to poverty alleviation/poverty reduction in Nigeria. *Journal of Economics and International Finance., 2*(10): 208 – 211.

Mapongmetsem, P. M., Benoit, L. B., Nkongmeneck, B. A., Ngassoum, M. B., Gu¨bbu¨, K. H., Baye-Niwah, C. and Longmou, J. (2005). Litterfall, decomposition and nutrients release in Vitex doniana Sweet. and *Vitex madiensis* Oliv. in the Sudano–Guinea Savannah. *Akdeniz U¨ niv Ziraat Fak Derg., 18*(1): 63–75

Mapongmetsem, P. M., Kapchie, V. N. and Tefempa, B. H. (2012). Diversity of local fruit trees and their contribution in sustaining the rural livelihood in the northern Cameroon. *Ethiopian Journal of Environmental Studies and Management*, *5*(1): 32 – 46.

N'Danikou, S., Achigan-Dako, E. G., Tchokponhoué, D. A., Agossou, C. O., Houdegbe, C. A., Vodouhè, R. S. and Ahanchédé, A. (2015). Modelling socioeconomic determinants for cultivation and in-situ conservation of *Vitex doniana* Sweet (Black plum), a wild harvested economic plant in Benin. *Journal of Ethnobiology and Ethnomedicine,* 1: 43–52.

Nigeria Meteorological Agency (NIMET) (2021). Annual meteorological report for Owerri.

Njidda, A. A. (2012). In situ degradability of dry matter and neutral-detergent fibre of *Vitex species* as fodder for ruminants in semi arid Northern Nigeria. *Journal of Agriculture, Biotechnology and Ecology*, *5*(1): 84 – 96

Nwagbaraocha, N. T. (2023). Furthering the domestication of bush cherry (*Maesobotrya barteri* [BAILL] Hutch) in South Eastern Nigeria. *A PhD. Thesis*, Imo State University, Owerri. Pp. 1- 148.

Obi, I. U. (2012). *Statistical Methods of Detecting Differences Beteen Treatment Means and Research Methodology Issues on Laboratory and Field Experiments (Second Edition)*. Optimal International Limited, Enugu. Xi + 131pp.

Okafor, J. (1980). Trees for food and fodder in the savannah areas in Nigeria. *Int. Tree Crops Journal*, 1: 131–134.

Oladele, O. I. (2011). Contribution of indigenous vegetables and fruits to poverty alleviation in Oyo State, Nigeria. *Journal of Human Ecology*, *3*(1): 1- 6.

Onwuka, G. I. (2005). *Food Analysis and Instrumentation: Theory and Practice.* Nephthali Print, Lagos. Pp. 133-137.

Osum, F. I., Okonkwo, T. M. and Okafor, G. I. (2013). Effect of processing methods on the chemical composition of *Vitex doniana* leaf and leaf products. *Food Science and Nutrition,* 3: 241–245.

Pomeranz, Y. (1971). *Food Analysis Theory Practice*. An West Port Publisher. 145-149.

Sanogo, R.; Karadji, A. H.; Dembele, O. and Diallo R. (2009). Activité diurétique et sadiurétique d'une recette en médecine traditionnelle pour le traitement de l'hypertension artérielle. *Mali Médical, 23*(4):1-6.

Suleiman, M. M. and Yusuf, S. (2008). Antidiarrheal activity of the fruits of *Vitex doniana* in laboratory animals. *Pharmaceutical biology*, *46*(6): 387–392.

Vunchi, M. A., Umar, A. N., King, M. A., Liman, A. A., Jeremiah, G. and Aigbe, C. O. (2011). Proximate, Vitamins and Mineral Composition of *Vitex doniana* (black plum) Fruit Pulp. *Nigerian Journal of Basic and Applied Science, 19*(1): 97-101.

Access this Article in Online	
	Website: www.ijarbs.com
Quick Response Code	Subject: Agriculture
DOI:10.22192/ijarbs.2024.11.09.002	

How to cite this article:
Okocha, I. O., Okorie, H. A., Christo, I. E. and Ezeogo, J. I. (2024). Morphological evaluation, proximate, vitamin and mineral compositions of black plum (*Vitex doniana* Sweet) in South Eastern Nigeria . Int. J. Adv. Res. Biol. Sci. 11(9): 23-34.
DOI: http://dx.doi.org/10.22192/ijarbs.2024.11.09.002