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Research Article

Evaluation of Proximate and Phytochemical Constituents of *Pentadiplandra brazzeana* Baill ("Osumada") Roots

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ABSTRACT

Pentadiplandra brazzeana Baill (Pentadiplandraceae) root is an ethnobotanical food spice used traditionally in the management of several disorders. However, the proximate and phytochemical constituents of *P. brazzeana* roots from Nigeria are not well documented. Therefore, this study was designed to evaluate the proximate and phytochemical constituents of *P. brazzeana* roots obtained from Agbor, Delta State, Nigeria. Proximate and quantitative phytochemical analysis of *P. brazzeana* roots were determined using standard procedures. Proximate analysis showed that *P. brazzeana* roots contained ash (3.27 ± 0.42 %), crude fat (6.87 ± 0.31%), crude fibre (9.41 ± 0.34%), moisture (10.66 ± 0.23%), crude protein (18.00 ± 0.51%) and carbohydrate (51.81 ± 0.82%). Quantitative phytochemical evaluation revealed the presence of alkaloids (0.02 ± 0.01%), saponins (0.41 ± 0.02%), flavonoids (10.14 ± 0.06%), tannins (1.54 ± 0.10 g TAE/100 g) and total phenolic (2.28 ± 0.01 g GAE/100 g) contents. Thus, the study showed that *P. brazzeana* roots could serve as an important source of nutritional and medicinal compounds. Further studies are recommended to investigate *P. brazzeana* root as potential source of food supplement and medicine to justify its ethnobotanical applications.

Keywords: *Pentadiplandra brazzeana, Proximate, Phytochemicals, Nutrients.*

INTRODUCTION

Plants are endowed with nutritional and medicinal properties that are used ethnobotanically in the management of several disorders (Alagbe *et al*., 2019; Pathy *et al*., 2021). Understanding the phytochemical constituents of potentially prophylactic or therapeutic medicines gives an evidence-based insight into their true medicinal value. This helps stakeholders take full advantage of the medicinal benefits of such plants (Pathy *et al.*, 2021).

Medicinal principles of plant origin are mainly phytochemicals including flavonoids, saponins, alkaloids, tannins, phenols and terpenoids. These phytochemicals act through a number of diverse mechanisms to elicit their medicinal effects (Aba and Asuzu, 2018).

The search of novel therapeutics for drug discovery by pharmaceutical industries and research scientist still rely on investigating ethnomedicinal plants, since about 80% of the global population still depends on phytotherapy (Pathy *et al*., 2021). Several medicinal food plants contain nutrients such as fibres, fats and proteins (Aili Hamzah *et al*., 2021) and antinutrients including phytic acid (Abdulwaliyu *et al*., 2019) and tannins (Carbas *et al*., 2020) that are of significant importance to health and diseases. The nutrients and phytochemicals in medicinal food plants could be used as nutraceuticals for human body development and protection against non-communicable inflammatory disorders including rheumatoid arthritis (Al-Awwadi, 2017; Anyasor *et al*., 2019), diabetes, cancer, and cardiovascular disorders (Okoduwa *et al*., 2017; Ogbonna *et al.*, 2018). Active compounds in medicinal food plants have been isolated from parts of plants and explored for antiproliferative, anticancer

and anticytotoxic functions (Lee *et al*., 2009; Okoro *et al.*, 2019). Some edible food plants contain nutrients, antinutrients, phenolic compounds and antioxidant properties that can act as functional ingredients in food products (Carbas *et al*., 2020). Hence, medicinal food plants can be beneficial in nutraceuticals, functional foods, beverages and nutracosmetics industries (Nwachukwu *et al*., 2017; Oladele *et al*., 2021).

Pentadiplandra brazzeana is the specie in the genus Pentadiplandra that belongs to the Pentadiplandraceae family. *P. brazzeana* is commonly called J´oublie in French and joy perfume tree in English (Kitamura *et al*., 2015; Wansi *et al*., 2019). *P. brazzeana* (Figure 1) is called "osumada" or "uhuadan" in Ika speaking parts of Edo and Delta States, South-South, Nigeria. It exists as a shrub with many branches that grow up to five meters tall, or as a climbing plant with stems up to 20 meters long. The root system in shrubs is a branched complex of bulging roots, while the climbing type of the plant has large, fleshy tubers (Cimanga *et al*., 2018; Ngbolua *et al*., 2018).

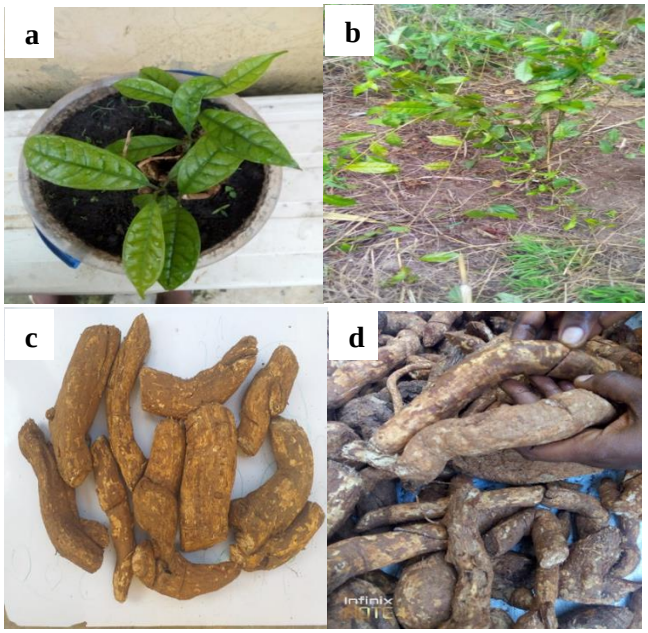

Figure 1. *Pentadiplandra brazzeana* Baill ("Osumada") mature roots and its young plant grown in South-South, Nigeria**.**

Note: (a): The young plant growing in a nursery **(b):** The plant in its natural habitat **(c):** Freshly harvested roots of the plant **(d):** Partially dried roots of the plant

P. brazzeana root is used in traditional medicine in Nigeria, Cameroon, Central African Republic, Equatorial Guinea, Northern Angola, Gabon, Democratic Republic of the Congo, where it is obtained for local use and trade (Burkill, 1985; Cimanga *et al*., 2018). It is used in Delta State, Nigeria as food spice (Okonji *et al*., 2017). Amongst the Ika people of Edo and Delta States, *P. brazzeana* ("osumada" or "uhuadan") is used as a soup spice by postpartum mothers for uterine cleansing, managing cold and fever. It is also used for managing headaches, dislocation and inflammation.

Aqueous extract of *P. brazzeana* roots has been demonstrated to possess androgenic activity (Kamtchouing *et al*., 2002). *P. brazzeana* root is reported to possess *in vitro* alpha-amylase inhibitory activity (Okonji *et al*., 2014) as well as cyanide detoxifying potential (Okonji *et al*., 2017; Ehigie *et al*., 2019). Traditionally, *P. brazzeana* has been used to manage pain and disorders such as arthritis, rheumatism, diarrhoea, dysentery, pulmonary disorder, subcutaneous parasitic infection. It has also been used as an abortifacient, diuretics (Burkill, 1985; Cimanga *et al*., 2018; Ngbolua, *et al*., 2018), aphrodisiac and for stimulating lactation (Cimanga *et al.*, 2018). The roots can also be used for flour preservation (Nyegue *et al*., 2009).

Some compounds that have been isolated from *P. brazzeana* roots include; N-Benzyl-N^1-(4-methoxybenzyl) urea, N, N^1-di-(4-methoxybenzyl) urea, N, N^1-dibenzyl urea and p-methoxythiobenzaldehyde (Tsopmo *et al*., 1999). Three of the synthesized urea-based compounds were demonstrated to have potent soluble epoxide hydrolase (sEH) inhibitory activity. The compound, 1, 3-bis (4-methoxybenzyl) urea was shown to effectively reduce inflammation pain in animal models (Kitamura *et al*., 2015).

The essential oil from *P. brazzeana* roots has been determined to contain benzyl isothiocyanate and benzyl cyanide (Ndoye Foe *et al*., 2016). Studies showed that the essential oil obtained from *P. brazzeana* roots was more potent in inhibiting the growth and germination of *Bacillus cereus, B. substilis, B. megaterium* and *B. stearothermophilus* than *Aframomum sulcatum* and *Polyalthia suaveolens* plants. Hence, it can be used for preventing foodborne intoxication (Nyegue *et al*., 2014). Ethanol extract of fresh roots of *P. brazzeana*, popularly known as Arredoul Jaune, is a phytomedicine reportedly used as an antidiarrhoeal drug by locals in Kisangani-Zaire, Democratic Republic of Congo (Cimanga *et al.*, 2018).

Studies have shown the presence of alkaloids, quinones, saponins, tannins and triterpenoids in both the leaves and roots of *P. brazzeana*, while anthocyanins, flavonoids and leuco-anthocyanins are present in the leaves from the Nord-Ubangi Province in Democratic Republic of the Congo (Cimanga *et al*., 2018; Ngbolua *et al*., 2018). Despite studies showing pharmacological benefits of *P. brazzeana* plant, there is still a paucity of data concerning the phytoconstituents of *P. brazzeana* roots from Nigeria. Therefore, this study was designed to determine the

proximate and phytochemical components of *P. brazzeana* roots from Nigeria.

MATERIALS AND METHODS

Reagents and Chemicals

Sodium hydroxide (NaOH), sodium carbonate, sodium chloride, formaldehyde (37%), diethyl ether, hydrogen peroxide, (Loba Chemie Pvt. Ltd., Jehangir Villa, 107, Wadehouse Road, Colaba, Mumbai, India), boric acid (BDH Chemicals Ltd, United Kingdom) and selenium dioxide (Nexchem Ltd., United Kingdom) were of analytical grade.

Plant Collection, Identification and Preparation

Pentadiplandra brazzeana roots were obtained during the dry season, in the month of January, 2021, from local Ika farms in Agbor (6° 15' 50.7312" N and 6° 12' 6.7788" E), Delta State, Nigeria. The plant with its root was identified and authenticated at the Herbarium, Obafemi Awolowo University, Ile-Ife, Nigeria and a voucher number Ife-17935 was assigned. Fresh root samples were washed with clean tap water to remove dirt and sand. The soft fibrous layers were removed from the hard layer and subsequently oven-dried at 40°C. Dried samples were pulverized using a mixer grinder and stored at 4°C for future analysis.

Proximate Analysis of *P. brazzeana* Roots

Proximate analysis of ash (AOAC, I990), crude fat (AOAC, I990), crude fibre (AOAC, I990), moisture (AOAC, I990), crude protein (Pearson, 1976), and carbohydrate (James, 1995) contents of *P. brazzeana* roots were determined on dry weight basis.

Ash content determination of *P. brazzeana* roots:

Crucible was placed in a muffle furnace for 15 minutes, removed and placed in a desiccator for 30 minutes to cool off and weighed *(W1*). Five grams of each sample was weighed into a crucible *(W2*) and placed on a hot plate under a fume chamber. The temperature was increased slowly until smoking ceased and the sample became thoroughly charred. Thereafter, the crucible was placed at the center of the muffle furnace at 550°C for six hours to allow proper ashing. Crucible with ash was immediately transferred into the desiccator to cool, then the final weight *(W3*) was taken and percentage ash calculated as:

$$\% \, Ash = \frac{W2 - W3}{W2 - W1} \times 100$$

Where;

W1 = Weight of empty crucible

W2 = Weight of crucible plus sample before ashing

W3 = Final weight of crucible and sample after ashing.

Crude fat content determination of *P. brazzeana* roots

Five grams of dry sample was weighed after moisture determination and transferred into the thimble. Round bottom flask (250 mL) was washed and dried at 105°C for 30 minutes, then cooled at room temperature in a desiccator and weighed (W_1). Thimble with the sample was placed in an extractor, 150 mL of ethyl ether was measured into the round bottom flask and the Soxhlet extractor was set up. The condenser was connected to the Soxhlet extractor and connected to cold water. The heating mantle was turned on to extract the crude fat content. The heating was regulated until the solvent refluxed at a steady rate for 6 hours and then solvent (ethyl ether) recovered. The round bottom flask was placed in an oven at 105°C for 30 minutes and later placed in the desiccator to cool, then the weight (W_2) of flask with the oil was taken. Thereafter, the percentage weight of fat was calculated as:

$$\% \, Fat \; content = \frac{W2 - W1}{W3} \times 100$$

Where: W1= Weight of round bottom flask; W2 = Weight of round bottom flask with oil. W3: Weight of sample

Crude fibre content determination of *P. brazzeana* roots

Five grams of sample was weighed into a round bottom flask, 100 mL of 0.25 M sulphuric acid solution was added and the mixture boiled for 30 minutes and quickly filtered. The insoluble matter was washed several times with water to remove the acid. It was put into the flask and 100 mL of 0.31M sodium hydroxide solution was added and the resulting mixture boiled for 30 minutes and filtered. The residue was washed with water until it was free of base, then dried to constant weight in an oven, and weighed after cooling in a desiccator (W1). The weighed sample was incinerated in muffle furnace at 550°C, cooled in a desiccator and reweighed (W2).

Percentage crude fibre was calculated using:

$$\% \, Crude \; fibre = \frac{W1 - W2}{W3} \times 100$$

Where;

W1= weight of sample before incineration

W2 = weight of sample after incineration

W3= weight of initial sample

Moisture content determination of *P. brazzeana* roots:

Porcelain crucible was washed, and dried for 15 minutes at 105°C. It was allowed to cool in the desiccator for 15 minutes and weighed *(W_1).* Five grams of pulverized sample was weighed into the crucible *(W_2).* The crucible was cleaned and placed in the oven at 105°C for 4 hours. Thereafter, it was removed and placed immediately in the desiccator and allowed to cool for 15 minutes then weighed as fast as possible *(W_3).*

The percentage moisture content was calculated using:

$$\%\ Moisture = \frac{W2 - W3}{W2 - W1} \times 100$$

Where;
W1 = Initial weight of empty crucible
W2 = Weight of crucible with 5 g of sample before drying
W3 = Final weight of crucible with 5 g of sample after drying.

Crude protein/nitrogen content determination of *P. brazzeana* roots

Crude protein was determined using the Kjeldahl method according to Pearson, (1976).

Digestion: P. brazzeana root sample (0.5 g) was weighed onto a quarter-size filter paper and transferred to a Kjeldahl digestion flask. One-gram tablet of the catalyst mixture (S_2O_2) and 15 mL of concentrated H_2SO_4 was added into the flask a little at a time, swirling well in between, to mix up the sample. A blank containing only concentrated H_2SO_4, catalyst and quarter-size filter paper was used. The flask with samples and blank was heated gently in an inclined position under a fume cupboard until frothing ceased, then boiled briskly until the digest was clear under a fume cupboard for about five hours. The digestion flask was swirled gently once in a while to facilitate uniform digestion and to bring down samples clinging to the sides of the flasks. They were cooled repeatedly under running water to bring down the heat of reaction and made up to 100 mL volume using distilled water in a 100 mL volumetric flask. The 100 mL constituted digest was set aside for later distillation.

Distillation: Ten millilitres of the digest was transferred into the distillation flask, 10 mL of 40% sodium hydroxide solution was added. The flask was then connected to a distillation apparatus before making alkaline. Ammonia was steam distilled into 5 mL boric acid indicator in a 100 mL conical flask, 50 mL of the distillate was collected.

Titration: Standard HCl (0.01N) was titrated. A blank titration was carried out using a quarter size filter paper.

% Crude protein = % N × protein factor;

Where;
Nitrogen factor (N) = 1.4 and Protein factor = 6.25

$$\%\ Nitrogen = \frac{Sample\ Titre - Blank\ Titre\ \times\ N\ of\ Acid\ \times 1.4}{Weight\ of\ Sample\ in\ 10\ mL}$$

Carbohydrate content determination of *P. brazzeana* roots

Total carbohydrate content of *P. brazzeana* roots was obtained by subtraction method of James, (1995) using the equation below:

Total Carbohydrate = 100 – [% Crude Protein + % Crude Fat + % Crude Fibre + % Crude Total Ash].

Phytochemical Analysis of *P. brazzeana* Roots

Phytochemical analysis of *P. brazzeana* roots was done following standard procedures.

Alkaloids content determination

Alkaloids content was determined using the method described by Edeoga *et al.*, (2005). Five grams of pulverized *P. brazzeana* roots was weighed into a 250 mL beaker and 200 mL of 20% acetic acid in ethanol was added. This was covered and allowed to stand for 4 hours. The resulting mixture was filtered and the extract was concentrated using water bath to obtain 1/4th of the initial volume. Concentrated ammonium hydroxide was added drop wise to the extract until complete precipitation. The whole solution was allowed to settle and the collected precipitates were washed with dilute ammonium hydroxide and was then filtered. The residue was oven dried at 60ºC and weighed. The alkaloid concentration was determined using the formula below;

$$\%\ Alkaloid\ Composition = \frac{W1 - W2}{W1} \times 100$$

Where: W1= Initial weight of sample, W2: Final weight of sample

Saponins content determination

Saponins content was determined using the method described by Edeoga *et al*., (2005). Twenty grams of pulverized *P. brazzeana* roots was put into a conical flask and 100 mL of 20% aqueous ethanol was added. The sample was heated in hot water bath at 55°C for 4 hours with continuous stirring. The mixture was filtered and the residue re-extracted with fresh 200 mL 20% ethanol. The combined extracts were concentrated to 40 mL over hot water bath at about 90°C. The concentrate was transferred into a 250 mL separating funnel and 20 mL of diethyl ether was added and shaken vigorously. The aqueous layer formed was recovered while the ether layer was discarded. The purification process was repeated. Then, 60 mL of n-butanol was added. The combined n-butanol extract was washed twice with 10 mL of 5% aqueous sodium chloride. The whole mixture was then evaporated on hot water bath and was later oven dried at 40ºC to obtain a constant weight. The percentage saponins content in the sample was calculated using the formula below;

$$\%\ \text{Saponins concentration} = \frac{\text{Weight of Final Filtrate}}{\text{Weight of Sample}} \times 100$$

Total flavonoids content determination

Total flavonoids content was determined using the method described by Edeoga *et al*., (2005). Ten grams of pulverized *P. brazzeana* was extracted repeatedly using 100 mL of 80% aqueous methanol at room temperature. The whole solution

was filtered through Whatman No 52 filter paper. The filtrate was later transferred into a crucible and evaporated into dryness over a water bath and weighed to a constant weight. The percentage flavonoid content in the sample was calculated using the formula below;

$$\% \text{ Flavonoids concentration} = \frac{\text{Weight of final filtrate}}{\text{Weight of sample}} \times 100$$

Tannins content determination

Tannins content was determined using the method described by Edeoga *et al*., (2005). *P. brazzeana* roots (500 mg) was weighed and put into a 50 mL plastic bottle. Then, 50 mL of distilled water was added into the bottle and shaken using mechanical shaker for one hour. The solution was filtered into a 50 mL volumetric flask and made up to the mark. Thereafter, 5 mL of the filtrate was pipetted out into a test tube. Then, 2 mL of 0.1 M $FeCl_3$ in 0. I N HCl and 0.008 M potassium ferrocyanide was added. The absorbance was measured at 120 nm within 10 minutes. The concentration was extrapolated from tannic acid standard curve with R^2 = 0.9959. The tannic acid content of the *P. brazzeana* was expressed as g tannic acid equivalent (TAE)/100 g dry weight. All samples were analyzed in triplicates.

Total phenolic content determination

Total phenolic content was determined using the modified method described by Edeoga *et al*., (2005).

Preparation of fat free sample: Two grams of the pulverized *P. brazzeana* roots were defatted with 100 mL of hexane using a Soxhlet apparatus for two hours. The fat free sample was boiled with 50 mL of ether to extract the phenolic content for 15 minutes. Thereafter, 5 mL of the extract was pipetted into a 50 mL flask, and 10 mL of distilled water was added. Subsequently, 2 mL of ammonium hydroxide solution and 5 mL of concentrated amyl alcohol were also added. The samples were made up to mark and left to react for 30 minutes for colour development. This was measured at 505 nm.

The total phenolic content in the *P. brazzeana* extract was extrapolated from a gallic acid standard curve with R^2 = 0.9662 and expressed as g gallic acid equivalent (GAE)/100 g dry weight. All samples were analyzed in triplicates

Statistical Analysis

Data was analyzed using descriptive statistics with Microsoft Excel package. Values are expressed as Mean ± SD (Standard deviation) of triplicate determinations.

RESULTS AND DISCUSSION

Table 1 shows the percentage ash, fat, crude fibre, moisture, protein and carbohydrate contents of *P. brazzeana* roots.

Table 1. Proximate Composition of *P. brazzeana* Roots

Parameters	Percentage (%)
Ash	3.27 ± 0.42
Crude Fat	6.87 ± 0.31
Crude Fibre	9.41 ± 0.34
Moisture	10.66 ± 0.23
Crude Protein	18.00 ± 0.51
Carbohydrate	51.81 ± 0.82

Where indicated, values are expressed as mean ± SD (standard deviation of mean) percent; n = 3

Table 2 shows the quantitative alkaloids, saponins, flavonoids, tannins and total phenols composition of *P. brazzeana* roots.

Table 2. Phytochemical Composition of *P. brazzeana* Roots.

Phytochemical	Quantity ± SD
Alkaloids	0.02 ± 0.01%
Saponins	0.41 ± 0.02%
Flavonoids	10.14 ± 0.06%
Tannins	1.54 ± 0.10 g TAE/100 g
Total Phenols	2.28 ± 0.01g GAE/ 100 g

All values are expressed as Mean ± SD (Standard deviation); n = 3
GAE: Gallic acid equivalent; TAE: Tannic acid equivalent

Discussion

Table 1 shows the proximate composition of *P. brazzeana* roots and revealed the ash content (3.27 ± 0.42%) of *P. brazzeana* root was found to be lower than the ash content (9.60 ± 0.10%) reported by Bouba *et al*., (2012). However, it was higher (12.11 ± 0.00%) in *P. brazzeana* stem bark (Alagbe *et al*., 2019). This research reports higher ash content than earlier literature (1.51 ± 0.05%) on *Zingiber officinale* rhizome (Lawal *et al*., 2018). The presence of ash in *P. brazzeana* root indicates it contains minerals. Minerals are important substances required for enzyme activation, bone formation, red blood cell regeneration and macronutrients metabolism for proper body homeostasis (Alagbe *et al*., 2019).

Crude fat content (6.87 ± 0.31%) of *P. brazzeana* root in this study, was slightly higher than previous value in *P. brazzeana* root (6.2 ± 0.2%) (Bouba *et al*., 2012) and *Z. officinale* (4.29 ± 0.06%) (Lawal *et al*., 2018). Dietary fats consist of different types of fatty acids, possesses a relative

energy density of 9 kcal/g which helps contribute to weight gain. Consuming natural and whole diets high in carbohydrates or fats, has shown equal amount of weight loss by participants that consumed them. (Forouhi *et al*., 2018). This suggests that *P. brazzeana* root from Nigeria could contribute to dietary energy supply, function in fat-soluble vitamins transport or help retain food palatability.

The crude fibre content in *P. brazzeana* roots (9.41 ± 0.34%) in this study was lower than crude fibre content (41.03%) reported earlier in *P. brazzeana* stem bark (Alagbe *et al.*, 2019). This difference could be attributed to the larger structural thickness of the stem compared with the roots. In addition, crude fibre being the non-digestible carbohydrates that are not digested by mammalian enzymes but by rumen of microorganisms, increases with the age of the plants. It consists of cellulose, semicellulose, lignin and other soluble fibres that impact on the structural composition of plants (Zainuddin *et al*., 2014). Dietary fibres when ingested, act as non-caloric bulking agents, enhancing water and oil retention, while improving emulsion and oxidative stability in humans and animals (Elleuch *et al*., 2011; Alagbe *et al*., 2019). The presence of fibre in *P. brazzeana* root ssuggests it could serve as a dietary fibre source for preventing gastrointestinal disorder, breast cancer, and cardiovascular diseases.

In this present study, moisture content of *P. brazzeana* root (10.66 ± 0.23%) was slightly higher than previously reported values in *P. brazzeana* root (9.5 ± 0.1%) by Bouba *et al*. (2012) and *P. brazzeana* stem (8.75 %) documented by Alagbe *et al*., (2019). Moisture could improve solvation of cellular metabolites through hydrogen bonding to improve the optimum performance of water-soluble metabolic enzymes (Asaolu *et al.,* 2012). Furthermore, moisture could improve the hydroxyl radical scavenging ability of dietary polyphenols, thereby improving the overall well-being of the body (Qu *et al*., 2018). Moisture content of *P. brazzeana* roots is not as high as in leafy vegetables such as *Telfairia occidentalis* (fluted pumpkin) *Vernonia amygdalina* (bitter leaf L), *Ocimium grastissimum* (scent leaf), *Basella alba* L (India spinach*)* which gives an indication of its longer shelf life for its proper storage (Alagbe *et al*., 2019; Oladele *et al*., 2021).

The protein content (18.00 ± 0.51%) in this study was higher than previous protein content in *P. brazzeana* roots (11.3 ± 0.1%) reported by Bouba *et al*., (2012) and in *P. brazzeana* stem bark (6.43%) demonstrated by Alagbe *et al*., (2019). Proteins contribute to the vital repair of worn-out tissues and oxygen transport in the body (Alagbe *et al*., 2019). The higher protein content observed could have resulted from thiourea, urea compounds and other non-protein nitrogenous compounds found in *P. brazzeana* roots (Ngbolua *et al*., 2018).

The carbohydrate content (51.81 ± 0.82%) of *P. brazzeana* roots in this study, was higher than previous values (22.2%) reported in *P. brazzeana* roots by Bouba *et al.,* (2012) and lower than carbohydrate content (77.47 ± 0.01%) of *Carpolobia lutea* root reported by Olayinka *et al.,* (2019). The reason for the higher content could be due to differences in geographical locations, weather and analytical method used. Carbohydrate content was determined by the dinitrosalicylic acid (DNS) method as against the subtraction method employed in this study. Soil type could have also contributed to the differences in values. *P. brazzeana* accumulates dietary sugars in its roots and can contribute to dietary energy, though, not as much as tubers and cereals (Bouba *et al*., 2012). Roots and tubers such as cassava and potatoes processed into cassava-sweet potato garri, contain high amount of carbohydrates ranging from 78.11 ± 0.01% – 83.59 ± 0.01% (Karim *et al*., 2016) while cereals including millet, maize and rice contain carbohydrate in an amount between 70.41 ± 1.03% - 77.94 ± 0.32% (Yankah *et al*., 2020).

Table 2 showed that quantities of phytochemicals detected were as follows: alkaloids (0.02 ± 0.01%), saponins (0.41 ± 0.02%), flavonoids (10.14 ± 0.06%), tannins (1.54 ± 0.10 g TAE/100 g) and total phenols (2.28 ± 0.01g GAE/100 g). Alkaloids, phenols and tannins have been suspected to be responsible for the antimicrobial, spasmolytic and antiamoebic activities of *P. brazzeana* based herbal medicine (Cimanga *et al*., 2018). Alkaloids have been reported to exhibit stimulatory effect on nerves, act as anticonvulsant and muscle relaxant. (Bernhoft, 2010; Doughari, 2012).

Saponin content (0.41 ± 0.02%) in this study was lower than values (1.25 ± 0.71 – 1.49 ± 1.0%) previously reported in *Ceiba pentandra* (L) Gaertn and *Bombax buonopozense* (P) Beauv roots (Chisom *et al*., 2014). The presence of saponins suggests *P. brazzeana* root could possess saponin emulsifying property which could justify its usage as hypocholesterolemic, immunomodulatory, anti-inflammatory (Murthy *et al*., 2020), antifungal, antiparasitic, antitumour (Kang *et al.,* 2005), antiviral, antibacterial and antiparasitic agents (Cimanga *et al*., 2018; Oleszek and Oleszek, 2020).

This study further revealed that flavonoids content in *P. brazzeana* roots was 10.14 ± 0.06%, a value higher than in stem and root back (1.02 ± 0.04% and 0.51 ± 0.05%) of *Vernonia amygdalina* respectively (Eyong *et al*., 2011).

Dietary flavonoids possess anticancer properties against different types of cancer, such as gastric, breast, prostate, and colorectal cancer (Rodríguez-García, *et al.*, 2019) and this could be due to their radical scavenging properties (Adetayo *et al*., 2020). Hence, flavonoids could contribute to improving the overall antioxidant status and body wellbeing (Okoro *et al*., 2019).

Tannins composition (1.54 ± 0.10 g/100 g) in *P. brazzeana* roots was higher than aqueous tannins content (0.26 ± 0.00 g/100 g) in root plant sections reported by Sani *et al*., (2014). The presence of tannins in *P. brazzeana* roots suggests it could be used as an antiseptic in wound healing. More so, tannins could act as anticancer, antioxidant, anti-inflammatory and antimicrobial compounds (Ogawa and Yazaki, 2018).

In the present study, the total phenolic content of *P. brazzeana* roots (2.28 ± 0.01 g GAE/100 g) was slightly higher than the previous total phenolic content (2.2 ± 0.1 g GAE/100 g) of *P. brazzeana* roots reported by Bouba *et al*., (2012). Phenols have been demonstrated to exhibit anti-inflammatory, anti-thrombotic and vasoprotective properties (Galasso *et al*., 2019). Total phenolic contents in foods could increase antioxidant status of the body and invariably mitigate oxidative stress-related diseases (Fu *et al*., 2011; Ly *et al*., 2015).

CONCLUSION

Findings from this research suggest that *P. brazzeana* root could be a potential source of nutrients and bioactive compounds for promoting human well-being. It is therefore recommended that further studies be carried out on *P. brazzeana* root to scientifically validate its ethnobotanical use in the management of inflammatory and oxidative stress-related disorders.

AUTHORS' CONTRIBUTIONS

Authors MNE, OSS and GNA conceptualized and designed the study. MNE executed the experiment and collected data while data analysis and interpretations were done by MNE and GNA. MNE, OSS and GNA drafted and finalized the manuscript. Final version was approved by all authors.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest

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