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Elemental and Phytochemical Screening of *Vitex Doniana* Leaves and Stem Bark in Hong Local Government Area of Adamawa State, Nigeria

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Plant parts are consumed as vegetables or herbs in most of African countries. The study was carried out to determine some elemental and phytochemical contents in *Vitex doniana* leaves and the stem bark in Hong local Government Area of Adamawa. The samples were collected from 10 locations in the month of April, 2012 and dried under shade. Atomic Absorption Spectroscopy (AAS) was used for elemental determination. The results revealed some essential elements (Na, K, Mg and Ca) and heavy metals (Cu, Zn and Cd). Pb was below the detectable limit (0.06 µg/g) of the instrument used. Qualitative method was used for the phytochemical screening. The results obtained showed the presence tannins, alkaloids and saponins. The phytochemicals recorded have medicinal properties while the essential elements are dietary minerals.

Keyword: Element, Phytochemical, Leaves, Stem bark, *Vitex doniana.*

1. Introduction

Vitex doniana belongs to the family of verbenaceae. The Hausa name is dinya. It is widely distributed in the Savannah region of Borno and Adamawa states [1]. *Vitex doniana* is a medium-sized deciduous tree, 8–18 m high, with as heavy rounded crown and a clear bole up to 5 m. Bark is rough, pale brown or greyish-white, rather smooth with narrow vertical fissures. The leaves are opposite, glabrous, 14–34 cm long, usually with 5 leaf lets on stalks. It is dark green above and pale greyish-green below. The flower petals are white except on largest lobe, which is purple. The flowers are small, blue or violet, 3–12 cm in diameter. The fruits are oblong, about 3 cm long. They are green when young and purplish black when ripen.

The various parts of the plant are used by traditional medicine practitioners in Nigeria in the treatment and management of ailment like rheumatism, hypertension, cancer and inflammatory diseases [2]. The fruit is used to improve fertility and to treat anaemia, jaundice, leprosy and dysentery. The root is used for gonorrhea treatment and backaches. The young tender leaves are pounded and the juice squeezed into the eyes to treat eye troubles [3]. The leaves are often eaten as salad and herb for cooking. The fruit is sweet and tasted like prunes. It contains vitamin A and B. The fruit can also be made into wine. The bark yields a dyestuff for cloths. Plant leaves are generally eaten as vegetable or salad in many African countries. They are eaten at least once daily in many areas and some of them have been found to have high crude protein content [4]. Vegetables are good sources of oils, carbohydrates, minerals, and vitamins depending on the vegetable consumed [5].

Throughout the years, even in the absence of famine, edible plants play an important role in every day cooking. A study carried out by Humphery *et al.,*[6] showed that a variety of leaves are used as seasonings and in sauces at every meal in Southern Niger. They found that the midday meal often centres on cooked wild leaves from *Corchorus tridens, Leptadenia hastate, Hibiscus sabdarifa and Moringa oleifera* flavoured with groundnuts. The side-dish of soup at the evening meal relies on gathered leaves for its flavour. Leaf-bundle snacks are made as well from variety of leaves.

Until recently, little attention has been given to the role of plant foods [7]. By learning more about the protein, fat and mineral content of each plant, one can better assess their importance in nutritional well-being of the communities. The ability to inform nutritionists and public health workers as to which plants can offer the population these nutrients is important.

The nutritional content of vegetables varies considerably though they contain a small proportion of proteins and fats and a relatively high proportion of vitamins, provitamins, dietary minerals, fibres and carbohydrates [8]. Many vegetables also contain phytochemicals which may have antioxidant, antibacterial, antifungal, antiviral and anticarcinogenic properties [9]. Phytochemicals have the capacity to modulate one or more metabolic processes that result in the promotion of better health [10]. Phytochemicals give plants natural defense against diseases and they perform similar function for humans. It is most common to find mixtures of phytochemicals within a plant food. Some plant foods have nutritional and medicinal properties because of the interaction between their nutrients and phytochemical constituents [11].

Diet-related non communicable diseases like obesity, diabetes, hypertension, cardiovascular diseases are increasingly becoming public health problems in Nigeria. This is partly due nutrition transition, which essentially has to do with changes in food consumption patterns associated with modernization, urbanization, economic development and market globalization [11]. There is a shift away from the traditional foods towards overconsumption of processed foods high in saturated fats and sugar but low in fiber, vitamins, phytochemicals and minerals. Some traditional foods like green leafy vegetables contain a lot of promoting bioactive substances. There is contrasting information on some nutritional status of some many vegetables in the tropics [12,4]. The fight against malnutrition and undernourishment continues to be a basic goal of development and a variety of strategies are being applied. The strategy on nutrient-rich food like vegetable is considered essential [13]. Because of this need, we were motivated to analyze some elements (Na, K, Ca, Mg, Cu, Zn, Pb and Cd) and phytochemicals (Alkaloids, Tannin, Saponins, Flavonoids and Glycosides) in the leaves and stem bark of Vitex doniana in Hong Local Government area of Adamawa State. This is with the hope that the result obtained may provide additional information on both the nutritional and medicinal values of this plant.

2. Materials and Methods

2.1 Sampling and Sample Preparation

2.1.1 Sampling

Sampling was done according to the method of Ayoola *et al.,*[16]. Fresh tender leaves and the stem bark of *Vitex doniana* were collected from 10 locations (Pella, Hong, Hildi, Uba, Gashala, Gaya, Garaha, Mugili, Fa'a and Pubba) in April, 2012 in Hong Local Government area of Adamawa State. Each plant parts were dried under shade.

2.1.2 Sample Preparation

Each dried sample was ground to powder and sieved. Representative samples were obtained from each sample by coning and quartering techniques as described by Crosby and Patel [14]. This method involves making a cone shape of the sample, flattened it and divides it into four equal parts; take the opposite two quarters and discard the other two quarters. This was repeated until the sample was reduced to the size required for final analysis and stored in an air tight container.

2.1.3 Sample digestion.

The digestion process was carried out as described by Onwunka[15] as follows: 3.0 g of each of the powdered sample was weighed and pre-treated with 20 cm^3 nitric acid and allowed to stay overnight. A 10 cm^3 perchloric acid was added and heated gently, then vigorously until clear solutions were obtained. The solutions were allowed to cool and then transferred to

100 cm^3 volumetric flask and made up to mark with distilled water. The solutions were filtered and stored in plastic bottles for the analysis of Na, K, Ca, Mg, Cu, Zn, Pb and Cd using Atomic Absorption Spectrophotometer (AAS).

2.2 Phytochemical Determination

10 g each of the powered plant leaves and stem bark were soaked in ethanol for 24 hours. The extracts were filtered through a Whatman filter paper. The filtrates were then concentrated using a rotary evaporator with the water bath set at 40 ^{0}C [16]. The phytochemical analyses of the extracts were carried out according to the methods described by Trease and Evans [17].

2.3 Statistical Analysis

Data generated was subjected to Analysis Of Variance (ANOVA) to determine the level of significance using statistical software (CROPSTAT 7.2.3 International Rice Research Institute IRRI, Philippine). Significant means were separated using least significant difference (LSD) technique as described by Gomez and Gomez, [18]. Differences were considered significant if probability is less than 5% ($p \leq 0.05$) for all the data.

3. Results and Discussion

3.1 Phytochemical Screening

Table 1 shows the results for the phytochemical screening. Tannin was recorded in the entire samples investigated. The samples also demonstrated the presence of saponin, except the stem bark around Gaya and Gashala area. The leaves demonstrated the presence of alkaloids in all the samples. Glycosides and flavonoids were not recorded in the entire samples by the methods used.

Table 1: Phytochemical screening of the plant extracts

Location	Plant parts	Tannin	Alkaloid	Glycoside	Flavonoid	Saponin
Pella	Leaves	+	+	-	-	+
	Stem bark	+	-	-	-	+
Hong	Leaves	+	-	-	-	+
	Stem bark	+	-	-	-	+
Hildi	Leaves	+	+	-	-	+
	Stem bark	+	-	-	-	+
Uba	Leaves	+	+	-	-	+
	Stem bark	+	-	-	-	+
Gaya	Leaves	+	+	-	-	+
	Stem bark	+	-	-	-	-
Fa'a	Leaves	+	+	-	-	+
	Stem bark	+	-	-	-	+
Garaha	Leaves	+	+	-	-	+
	Stem bark	+	-	-	-	+
Gashala	Leaves	+	+	-	-	+
	Stem bark	+	-	-	-	-
Mugili	Leaves	+	+	-	-	+
	Stem bark	+	-	-	-	+
Pubba	Leaves	+	+	-	-	+
	Stem bark	+	-	-	-	+

+ = present, - = absent

3.2 Elemental Determination

Mean levels of essential elements and heavy metals in Vitex doniana leaves in ten locations in Hong Local Government Area is presented in Table 2.The results revealed that Na varies from 0.326 and 1.01 µg/g with an overall mean value of 0.810 µg/g. For K, the value is between 0.110 to 0.640 µg/g with a total mean of 0.566 µg/g. Mg was recorded in all the locations with an overall average of 0.111 µg/g. Highest amount for Ca was recorded in Hong (0.170 µg/g and Uba (0.170 µg/g) areas. No significant difference ($p \leq 0.05$) was observed in Na and Ca contents among the locations, but there was significant difference ($p \leq 0.05$) in terms of K and Mg contents. The result also showed the presence of Cu in the locations with a total mean value of 1.508 µg/g. Highest amount for Zn was recorded in Gashala area (0.570 µg/g).The value for Pb was below the detectable limit (<0.06 µg/g) of the instrument used, but in terms of Cd, the mean values ranged between 0.220 to 0.300 µg/g. There was no significant difference ($p \leq 0.05$) observed in terms of Cu, Zn and Pb contents among the locations.

Table 3 shows the mean levels of essential elements and heavy metals in *Vitex doniana* stem bark in Hong Local Government among ten locations.

Table 2: Mean levels of Elements in Vitex doniana Leaves (µg/g dry weight)

				Elements				
Location	Na	K	Mg	Ca	Cu	Zn	Pb	Cd
Pella	0.326	0.6	0.12	0.16	1.5	0.15	<0.060	0.24
Hong	0.980	0.61	0.12	0.17	1.52	0.16	<0.060	0.27
Hildi	0.970	0.62	0.11	0.16	1.51	0.15	<0.060	0.26
Uba	0.960	0.63	0.1	0.17	1.53	0.14	<0.060	0.25
Gaya	0.970	0.61	0.1	0.16	1.52	0.16	<0.060	0.26
Fa'a	0.940	0.62	0.12	0.14	1.5	0.16	<0.060	0.24
Garaha	0.980	0.61	0.1	0.16	1.52	0.15	<0.060	0.25
Gashala	1.010	0.64	0.1	0.15	1.51	0.57	<0.060	0.27
Mugili	0.900	0.61	0.11	0.16	1.49	0.21	0.06	0.22
Pubba	0.830	0.11	0.13	0.14	1.48	0.33	<0.060	0.3
Mean	0.810	0.566	0.111	0.202	1.508	0.218	0.06	0.256
SE	1.000	0.005	0.006	0.14	0.019	0.132	0.006	0.007
LSD (5%)	0.290	0.014	0.017	0.416	0.055	0.391	0.018	0.021

Any two mean having difference greater than LSD are significantly different at 5% level of probability.

Table 3: Mean levels of Elements in *Vitex doniana* Stem Bark (µg/g dry weight)

				Elements				
Location	Na	K	Mg	Ca	Cu	Zn	Pb	Cd
Pella	3.200	<0.008	0.200	0.160	0.150	1.650	<0.060	0.300
Hong	3.300	<0.008	0.200	0.140	0.160	1.680	<0.060	0.210
Hildi	3.200	<0.008	0.220	0.160	0.140	1.690	<0.060	0.220
Uba	3.400	<0.008	0.210	0.160	0.170	1.700	<0.060	0.230
Gaya	2.310	<0.008	0.180	0.150	0.140	1.680	<0.060	0.210
Fa'a	3.350	<0.008	0.200	0.160	0.160	1.690	<0.060	0.210
Garaha	3.100	<0.008	0.210	0.140	0.150	1.670	<0.060	0.210
Gashala	2.970	<0.008	0.220	0.180	0.170	1.680	<0.060	0.200
Mugili	3.350	<0.008	0.170	0.670	0.180	2.030	<0.060	0.200
Pubba	2.980	0.777	0.220	0.170	0.170	0.093	<0.060	0.210
Mean	3.116	0.085	0.204	0.209	0.159	1.556	0.060	0.220
SE	0.314	0.003	0.015	0.164	0.010	0.023	0.004	0.007
LSD (5%)	0.930	0.008	0.044	0.488	0.030	0.07	0.011	0.021

Any two mean having difference greater than LSD are significantly different at 5% level of probability.

Na content was recorded highest in the samples around Uba (3.400 µg/g with an overall mean of 3.116 µg/g. K was only recorded in the samples around Pubba (0.777 µg/g). Significant difference ($p \leq 0.05$) was observed among the locations in terms of K content. Mg and Ca were recorded in the entire samples with total average values of 0.393 µg/g and 0.390 µg/g respectively. There was no significant difference ($p \leq 0.05$) with regard to Mg and Ca compositions among the locations. For heavy metals, Cu was recorded in all the locations with highest amount in sample around Mugili (0.180 µg/g). The value for Zn was also recorded highest in sample around Mugili area (2.030 µg/g). Pb was the detectable limit (0.06 µg/g) of the instrument used. The value for Cd ranged between 0.200 to 0.300 µg/g. There was no significant difference ($p \leq 0.05$) in terms of Zn and Cd contents among the locations investigated.

3.3 Phytochemical Compositions

Tannin: The entire samples observed recorded the presence of tannins. Tannins are widely distributed in many plants species. They have astringent properties which are important anti-oxidant and in wound healing [19].

Alkaloid: The leaves demonstrated the presence of alkaloid in all the locations screened. Alkaloids are produced by large variety of organisms, plants and animals. They almost uniformly invoke bitter taste [20]. They have pharmacological effects and often used as medications and recreational drugs.

Saponin: The samples showed the presence of saponin from all the location except the stem bark from Gaya and Gashala areas. Saponins have the potential to lower cholesterol levels in humans due to their hypocholesterlemetric effect. They form complexes with cholesterol to reduce plasma cholesterol [11].

Glycoside and Flavonoid: Glycosides and flavonoids are not recorded in the entire samples by the methods employed. Phytochemical content of plants depend to high degree on the soil type and plant species. Glycosides play important roles in living organisms. They are used as medications for treatment of congestive heart failure and cardiac arrhythmia [21]. Flavonoids are the most common group of polyphenolic compounds in the human diet and are found in plants[22]. The widespread distribution of flavonoids and their low toxicity compared to other active plant compounds means that many animals, including humans, ingest significance quantities in their diet. Flavonoids have anti-allergic, anti-inflammatory, anti-bacterial, anti-cancer, anti-diarrhea and anti-oxidant properties [23,24].

3.4 Elemental Compositions

Sodium: The overall mean values for sodium recorded in the leaves and stem bark were 0.810 µg/g and 3.11 µg/g respectively. The values observed for sodium in the samples were lower than the World Health Organization (WHO) permissible limits range of 400 to 500 µg/g in plants as reported by Mustapha *et al*., (2011). Sodium is one of the chief extracellular ions in the body. It involves in the production of energy, transport of amino acids and glucose into the body cells and its deficiency results in hyponatremia [25].

Potassium: The mean values observed for potassium in the leaves and stem bark were 0.566 µg/g and 0.08 µg/g respectively. The amounts of potassium in the samples investigated are within the safety limits of 10 to 100 µg/g recommended by WHO (1996). Potassium is the principal intracellular cation. It helps to regulate osmotic pressure and pH equilibrium. The recommended daily intake is 4700 mg [26]. Its deficiency causes muscles weakness, decrease reflex responses and respiratory paralysis.

Magnesium: The leaves and the stem bark investigated from the 10 locations contained average values of 0.111 µg/g and 0.204 µg/g magnesium respectively, which was lower than the amount (103 µg/g), reported in the stem-bark of *Vitex doniana* by Mustapha *et al*.,[19]. The variations in the results may be due to soil differences. Magnesium plays important role in maintaining electrical potential in nerves and membranes. It improves insulin sensitivity, protect against diabetes and its complications and also reduce blood pressure [27].

Calcium: The average concentration of calcium in the leaves and stem bark were 0.113 µg/g and 0.517 µg/g respectively which was lower than the safety limits of 3600 µg/g as reported by WHO (1996). Calcium is needed for muscles development, heart and digestive System. It is also essential for the normal development and maintenance of bones [26].

Zinc: Zinc was recorded in the entire samples investigated with average values of 0.218 µg/g in the leaves and 1.556 µg/g in the stem bark. Zinc is essential constituents of enzymes involve in carbohydrate and protein metabolism and nucleic acid synthesis. Its deficiency results in impaired growth and development, skin lesion and loss of appetite [26].

Copper: The values obtained for copper in the leaves and stem bark were 1.508 µg/g and 0.159 µg/g respectively. Copper plays important role in treatment of chest wound and prevent inflammation arthritis and similar diseases. It is also essential for the formation haemoglobin of the red blood cells. It is required by trace quantity by humans [27].

Cadmium: The mean values for cadmium observed in the leaves and stem bark of the samples investigated were 0.256µg/g and 0.220µg/g respectively, which were lower than the values obtained in *amaranthus* (15.83 µg/g) by Shagal *et al*., [28] and in kenaf (2.04 µg/g) and roselle (2.07 µg/g) by Yahaya *et al*.,[29]. However, the concentrations of cadmium in the samples investigated were slightly higher than 0.20 µg/g fresh weight recommended as the maximum permissible level of cadmium in vegetables as reported by FAO/WHO[30].

Lead: The value for lead was below the detectable limit (<0.06 µg/g) of the instrument used in the entire samples. Pb has low geochemical mobility and bioavailability. Its transportation to aboveground tissues in plants is minimal due to its retention in roots and precipitation [31]. An ultra-structural study using transmission electron spectroscopy revealed the retention of Pb in the cell wall of roots, particularly around intercellular spaces [32]. This explains why Pb is not observed in the leaves and stem bark of the plants investigated by the analytical instrument used. Lead is toxic metal and non-essential element for human body as it causes a rise in blood pressure, kidney damage and miscarriage [27].

4. Conclusion

The phytochemical screening results obtained showed the presence of tannins and alkaloids. Phytochemicals give plants natural defence against diseases and they also perform similar function for humans. The results for elemental analysis revealed the presence of Na, K, Mg, Ca, Cu, Zn and Cd. The concentration of the elements are within the permissible limits of WHO except Cd whose concentrations were slightly above the recommended safety limit (0.2 µg/g), but lower than the results reported in *roselle* (2.07 µg/g) and *kenaf* (2.04 µg/g) by Yahaya *et al.*,[29]. The essential elements revealed by this leafy vegetable plant are required by our bodies for biological and physiological functions.

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