



Biological potentials and nutrient capability of *Vitex doniana* fruit syrup

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ABSTRACT

The phytochemical constituents, proximate composition, antioxidant activity and acute toxicity profile of *Vitex doniana* fruit syrup were investigated to ascertain its biological potentials and nutrient capability. The antioxidant activity was done by measuring the scavenging effect of the syrup and ascorbic acid on 2, 2-diphenyl-1-picrylhydrazyl (DPPH) radical. The IC₅₀ value of the syrup was found to be 245.8 µg/ml and that of ascorbic acid 2.175 µg/ml, indicating that the syrup has antioxidant activity comparable to ascorbic acid. The study revealed that the syrup contains tannins, saponins, cardiac glycosides, alkaloids, flavonoids, terpenoids and steroids. The study further presented the syrup as a highly nutritious food that contain moisture of about, 9.90%, ash content: 21.5%, fat: 0.75%, fibre: Not detected (ND), protein: 0.006% and carbohydrate: 67.84%. For the acute toxicity studies of the syrup, twenty mice were randomized based on body weight into five groups of four mice each. Three mice in the first, second, third, fourth and fifth group were given volumes of the 100, 200, 300, 400 and 500 mg/mL respective syrup corresponding to 1000, 2000, 3000, 4000 and 5000 mg/kg doses. While mice in the control group received potable water (10 mL/kg). The mice in all the groups were observed for signs of toxicity closely at 15 min, 30 min, 1, 2, 4 and 8 h, and then once daily for 14 days. Based on the model used the syrup is acutely safe in mice, since none of the mice died within 24 hours after oral treatment and on extrapolation gives a high predictive value in human.

Keywords: Antioxidant, phytochemical, acute toxicity, proximate composition, *Vitex doniana*.

INTRODUCTION

With increasing emphasis on upgrading traditional plant food resources in Nigeria, there is the need for better understanding of available plants including the severally underutilized species. Black plum (*Vitex doniana*) is a plant widely used by several communities in Nigeria for many purposes, including production of wine and jam. Ripe mature black plum fruits for food use, usually are collected from the ground instead of plucked (Okigbo, 2001).

Vitex doniana represents one of our neglected underutilized forest resources. Although major research on the health benefits of plant-rich diets has placed emphasis on established vitamins, the current data are controversial and the drive towards identification of more constituents and plant food sources continues (Ochieng and Nandwa, 2010). In addition, the economic value of *Vitex doniana* has not been exploited to its maximum despite the documented uses. Black plum of the family verbanaceae is a tree crop that grows in open woodland and savannah regions of tropical Africa; it is the commonest of the *Vitex* species in West Africa. It produces fruits which are plum like, sweet and edible. The fruit is green when mature and changes to dark brown when fully ripe, with the pulp surrounding a hard stone containing 1 to 4 seeds. It is a savannah species and therefore can be found in northern, western and eastern Nigeria. Plants and other components of natural origin have been applied throughout the world for human and animal health care for age-long time. This is especially in Africa where underdevelopment and poverty have made a large percentage of the people depend almost totally on traditional medical practices and folkloric application of plants (Enzo, 2006).

The efficacy of some of these traditional herbal remedies has been shown by several researchers. One of such plants popular for its wide use in Africa native folklore is *V. Doniana* Sweet. The plant is indigenous to Nigeria, Botswana, Ethiopia, Kenya, Lesotho, Namibia, Niger, Senegal, Somalia, South Africa, Sudan, Tanzania, Uganda, Zambia. It is locally known as Vitex (English), dinya (Hausa), ucha koro (Igbo) and oori-nla (Yoruba) (4). In folkloric medicine, various parts of the plant are used as a remedy for infectious conditions such as infertility, anaemia, jaundice, leprosy, dysentery, colic, gonorrhoea, backaches, headaches, febrifuge, conjunctivitis and other eye troubles, stiffness, measles, rash, fever, chickenpox, hemiplegia, as a tonic galactagogue to aid milk production in lactating mothers, anodyne, ankylostomiasis (ancylostomiasis), rachitis, leprosy and liver disease, kidney troubles and dearth of vitamin A and B. The twigs are used as chewing sticks for cleaning teeth. The blackish extract gotten by boiling the leaves, bark, root and/or fruits is applied as ink and dye for clothes (Burkill, 2000). The generic name, 'Vitex', is an ancient Latin name for the genus. Apart from the commercial relevance of this plant in timber and wood production, not much

research on its chemical and antioxidant activity has been done. It is in the light of the above, that this work aims to link scientific findings with some of these folkloric uses with the intentions of attracting more research interest to plant in trending lead/hit prospects in drug discovery. Black plum are branded as juicy seed bearing structure of flowering plant that may be consumed as food (Hyson, 2002). Fruits are not given the place they deserve in the diet of Nigerians due to lack of awareness of their nutritive value, cost and challenges in storage and distribution (Sai, 1997). The diet of most rural and urban dwellers is deficient in protein resulting in increased incidence of malnutrition and rise in dietary diseases; a situation in which children and especially pregnant and lactating women are most susceptible (Black, 2003). In developing nations, various types of edible wild plants are exploited as sources of food to give supplementary nutrition to the inhabitants (Aberoumand and Deokule, 2009).

MATERIALS AND METHODS

Plant Collection and Identification

The fresh fruits of black plum (*Vitex doniana*) were collected from several randomly selected trees in a farm site in Uromi metropolis, Esan-North East Local Government Area of Edo state. The plant was identified by the Ethnobotanist and registered with a voucher specimen number NIPRD/01/03/CCPF/384/3 and deposited at the herbarium of the National Institute for pharmaceutical research and development (NIPRD), Idu Industrial area, Abuja.

Extraction of the Syrup from *Vitex doniana* Fruit

Extraction was done using a modified method described by Aiwonegbe *et al.* (2018). The fruits were kept under ambient temperature in the laboratory. The fruits were sorted to select the fresh ones and then cleansed to remove sand and other debris. Thereafter, washing with potable water and removal of the thin epicarp. The fruits were then milled through a 90 µm sieve to press out the succulent mesocarp and separate the stony seed from the pericarp. The pulp was blended in a waring blender for a few seconds and warm water at 30°C was added to the mixture. The mixture was then stirred continuously for five minutes with a wooden paddle to obtain the syrup.

Phytochemicals Screening

The Presence of some secondary metabolites in the *Vitex doniana* fruit syrup were determined using standard methods (Sofowora, 2008).

Antioxidant Activity Determination

The scavenging effect of the syrup of *Vitex doniana* on DPPH radical was estimated with the method described by Adamu *et al.* (2018). A solution of 0.1 mM DPPH in methanol was prepared, and 1.0 mL of this solution was mixed with 3.0 mL of extract in methanol containing 0.01-0.02 mg/mL of the extract. The reaction mixture was vortexed thoroughly and left in the dark at room temperature for 30 minutes. The absorbance of the mixture was measured spectrophotometrically at 517 nm. Ascorbic acid was used as a reference standard. The ability to scavenge DPPH radical was calculated by the following equations:

$$\text{DPPH radical scavenging activity (\%)} = [(A_0 - A_1) / (A_0)] \times 100.$$

Where; A_0 was the absorbance of DPPH radical + methanol

A_1 was the absorbance of DPPH radical + sample extract.

The 50% inhibitory concentration value (IC_{50}) is indicated as the effective concentration of the sample that is required to scavenge 50% of the DPPH free radical.

Proximate Analysis

Proximate composition of the ash, moisture, crude Protein, carbohydrate, crude fibre and fat content of

the sample (syrup) was determined using standard methods AOAC (2000).

Acute Toxicity Determination

The acute toxicity of the extract (syrup) was determined using standard methods OECD (2008). Swiss albino mice (17 – 22 g) were administered orally using intra-gastric cannula. The syrup was dissolved in water to obtain 100, 200, 300, 400 and 500 mg/mL concentrations. Twenty mice were randomized based on body weight into five groups of four mice each. Three mice in the first, second, third, fourth and fifth group were given volumes of the 100, 200, 300, 400 and 500 mg/mL respective syrup corresponding to 1000, 2000, 3000, 4000 and 5000 mg/kg doses respectively. While mice in the control group received potable water (10 mL/kg). The mice in all the groups were observed for signs of toxicity closely at 15 min, 30 min, 1, 2, 4 and 8 h, and then once daily for 14 days.

RESULTS AND DISCUSSION:

Table 1: Phytochemical composition of *Vitex doniana* Syrup

Phytochemical	<i>Vitex doniana</i>
Alkaloids	+
Flavonoids	+
Saponins	+
Tannins	+
Steroids	+
Terpenoids	+
Cardiac glycosides	+

KEY: + = present, - = absent

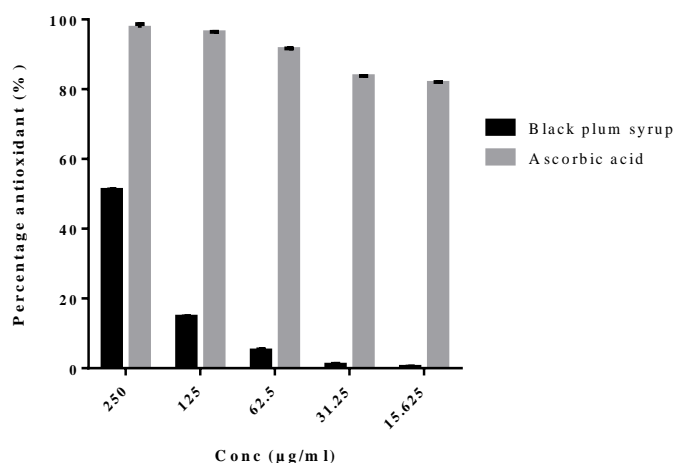


Figure 1: Result showing the antioxidant activity at different concentrations of *Vitex doniana* Fruit Syrup and the control (ascorbic acid)

Table 2: Proximate Composition of *Vitex doniana* Fruit Syrup

Parameter	Results obtained
Moisture content	9.90 ± 0.00
Ash content	21.50 ± 1.41
Crude protein	0.006 ± 0.00
Crude fibre	ND
Crude fat	0.75 ± 0.07
Carbohydrate content	67.84 ± 1.06

To verify its folkloric use, there is the need to screen this plant for known bioactive secondary metabolites. Results of phytochemical analysis showed that *Vitex doniana* fruit syrup contained tannins, flavonoids, steroids, terpenoids, cardiac glycosides, saponins and alkaloids. Many similar chemical groups have also been found in the *Vitex doniana* leaves (Ejikeme and Henrietta, 2010). Among these compounds, the tannins, flavonoids, steroids and terpenoids are already known for their antimicrobial activities (Owoseni *et al.*, 2010).

Oxidative stress is implicated in the pathophysiology of many diseases and conditions including diabetes, cardiovascular disorders, inflammatory conditions, liver diseases, cancer and ageing. Antioxidants may offer resistance against the oxidative stress by scavenging the free radicals and reactive oxygen species or by inhibiting the lipid peroxidation and thus preventing damage. In the present study, the antioxidant potential of *V. doniana* fruit syrup was evaluated. From the results in figure 1, the antioxidant activity of both the fruit syrup and ascorbic acid (control) showed increasing scavenging activity against DPPH with increase in concentration. The excellent antioxidant activity of the fruit syrup is attributed to the volatile constituents that may be present abundantly in *Vitex doniana* fruit syrup. These components could change free radicals such as DPPH to non-radical DPPH-H. Capacity of phytochemical compounds scavenging free radical involved donating hydrogen atom or electron (Leopoldini *et al.*, 2011). After the assay, the IC₅₀ value of the syrup was found to be 245.8 µg/ml and that of ascorbic acid 2.175 µg/ml, indicating that the syrup has antioxidant activity comparable to ascorbic acid.

The proximate composition analysis revealed important findings and results obtained as presented

in table 2. The data are Mean values ± Standard deviation (SD) of three replicates. The moisture content of *Vitex doniana* fruit syrup was 9.90%. The value is slightly higher than 4.68% and 3.5% reported for *Vitex doniana* fruit pulp and *Detarium microcarpum* (Nnamani *et al.*, 2009) respectively. Therefore, the high moisture content of *Vitex doniana* syrup provides for greater activity of water soluble enzymes and co-enzymes needed for metabolic activities of these plants (Iheanacho and Ubebani, 2009). Ash content is a measure of the total mineral content of a food sample analysed and had a value of 21.50%. The high ash content indicates that the *Vitex doniana* syrup is rich in mineral elements.

Crude protein of *Vitex doniana* fruit syrup was 0.006%, which is lower than the 10.0% reported by Nnamani *et al.* (2009) for *Vitex doniana* leaf, 8.24% for *Vitex doniana* fruit pulp (Vunchi *et al.*, 2011). Crude fat of the edible portion of *Vitex doniana* fruit syrup was 0.75%. Dreon *et al.* (1990) showed that most fruits had high carbohydrate content depending on the fruit type, maturity and environment. However, *Vitex doniana* fruit syrup had a value of 67.84%. Carbohydrates are one of the most important components in many foods, and the digestible carbohydrates are considered as an important source of energy. Crude fibre was not detected in *Vitex doniana* fruit syrup compared to (0.58%) reported for *Vitex doniana* fruit pulp (Vunchi *et al.*, 2011). Thus *Vitex doniana* fruit syrup is a poor source of dietary fibre for humans. Crude fibre helps to prevent constipation, bowel problems and piles

At a dose of 1000, 2000 and 3000 mg/kg, the fruit syrup produced mostly CNS (central nervous system) stimulating signs such as tail erection, paw licking, mouth scratching and increased grooming within 1 hour after administration.

In the 4000 and 5000 mg/kg group however, these parameters were not obvious and grooming was most evident. In the 1000, 2000, 3000, 4000 and 5000 mg/kg groups, the fruit syrup also appeared to cause abdominal distress characterized by contortion and abdominal writhing that lasted for up to 1 hour in the 1000, 2000 and 3000 mg/kg and 2 hours in 4000 and 5000 mg/kg group. No mortality was recorded in all mice throughout the 14 days duration of the study. 'Black plum fruit syrup' is acutely safe in mice based on the model used since none of the mice died within 24 hours after oral treatment. Abdominal distress may

however be produced with high doses based on the model used. The model can predict toxicological effects, and on extrapolation gives a high predictive value in human. (Tugwood *et al.*, 2003). The LD₅₀ value is greater than 5000 mg/kg body weight (Assob *et al.*, 2011). This then means that *V. doniana* fruit syrup extract is assumed to be safe (non-toxic) as suggested by OECD (2008).

CONCLUSION

Vitex doniana fruit should be considered as a source of edible syrup and their cultivation should be encouraged as it is recommended for continuous use for nutritional purpose, considering the amount and diversity of nutrients it contains. The study also established that *Vitex doniana* fruit is yet another route out of the nutritional “wilderness” presently experienced by many in Nigeria and perhaps West Africa. *Vitex doniana* is highly exploited traditionally for ethnomedicinal purposes and this study actually justify its wide traditional application.

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Conflict of Interest

The author declares that there is no conflict of interest.

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