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Characterization of Nutritional and Phytochemical Compositions of Locally Consumed Leafy Vegetables from Afikpo, Ebonyi State, Nigeria

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ABSTRACT

Vegetables are an important part of human and animal diets worldwide. This is because veggies contain crucial protective nutrients for good health and illness prevention. Many vegetables, on the other hand, have yet to be described to determine their nutritional value. We used standard analytical methods to analyze the nutritional and phytochemical contents of four traditional leafy vegetables (P. soyansii, P. santalinoides, V. doniana, and C. esculenta) consumed in the South-East (Ebonyi), Nigeria. Data were analyzed using Graph Pad Prism 7.0 set at $p<0.05$ statistically significant level. We presented results in graphs accordingly. The maximum magnesium content was found in Vitex doniana while the lowest was found in P. santalinoides. Calcium concentration was highest in Colocasia esculenta and lowest in P. soyansii. Zinc was high in V. doniana but was not significant ($p<0.05$) in P. santalinoides. Vitamin C was the most abundant in C. esculenta, followed by vitamin B1. V. doniana has greater amounts of vitamins B3 and E than other veggies. A considerable number of bioactive compounds were found in the leaves of P. soyansii, P. santalinoides, V. doniana, and C. esculenta. The alkaloid content of P. soyansii was the greatest, while that of P. santalinoides was the lowest. C. esculenta has a high saponin content, while P. soyoansii has a low saponin content. In addition, tannins and phenol are both abundant in C. esculenta, but not phenol. Therefore, we reported that these vegetables have a significant dietary role in human nutrition, particularly in the prevention of malnutrition illnesses by micronutrients and bioactive supplementation.

Keywords: ***Leafy vegetables, Nutritional, Phytochemicals, Minerals, Vitamins***

Introduction

Vegetables are important protective foods that are highly beneficial for the maintenance of good health and the prevention of diseases. They contain valuable food nutrients, which can be successfully utilized to build up and repair the body. They are rich sources of carotene, ascorbic acid, riboflavin, folic acid, and minerals like calcium, iron, and phosphorous as well as amino acids (Nnamani *et al.,* 2010). They also contain photochemical with numerous potential health benefits. Traditional leafy vegetables are vegetables of legality which originated from an area and may or may not be confined to that particular region (Okwu and Ekeke, 2003). They account for about 10% of the world's higher plants often regarded as weeds. Vegetables are generally succulent parts of plants grown in gardens and consumed as a side dish with starchy staples. Green leafy vegetables constitute an indispensable constituent of the human diet in Africa generally and West Africa in particular (Chima and Igour, 2007).

African padauk or African coral wood in the English language, oha in the Igbo language is native to central and tropical west Africa from east Nigeria to Congo-Kinshasa and south to Angola (Glew *et al.,* 1997). The leave of *Pterocarpus soyansii* is used for making the popular oha soup in the southeastern part of Nigeria. Some tribes in southeastern Nigeria use the leaf extract in the treatment of headaches, pains, fever, convulsions, and respiratory disorders and as an antimicrobial agent (Edeoga *et al.,* 2005; Nwali *et al* 2018). In addition, green leafy vegetables are used in the diets of postpartum women during which time it is claimed that they aid the contraction of the uterus (Adeniran *et al.,* 2013). The powdered wood, baked with a slice of lime, is used on wounds and mixed with palm oil, raffia oil, or vegetable butter to treat skin diseases, ringworms, and yaws. It is also used in ritual ceremonies for circumcision initiation widowing (Edeoga *et al.,* 2005). The bark contains kino-type resin which is very astringent and used to ward off skin parasites in ethnoveterinary medicine (Adeniran *et al.,* 2013).

Nturukpa (*Pterocarpus santalinoides*) is locally known as *Mututi*. It has a remarkable bicontinental distribution, as a shade tree commonly found along with riverine forests in Africa and tropical South America (Boham and Kocipai, 1974). The plant can help in erosion control because of the type of root system as well as nitrogen fixation (Gruda, 2005). In Nigeria, many indigenous plants including *Pterocarpus santalinoides* are used as food or medicine (Ezeh *et al* 2017). The tender leaves are used as a vegetable in soup making, while the stem bark is used in making pepper soup. The plant is used in treating rheumatism, diarrhea, dysentery, cough, asthma, diabetes, malaria, elephantiasis, cold, and others (Okwu and Ekeke. 2003). In southern Nigeria, particularly, the tender stem bark and leaves extract of *Pterocarpus santalinoides* is usually called Nturukpa or Uturukpa. It is used to stop stooling and vomiting, hence, anti-diarrhea and anti-entero-pooling activity in traditional medicine (Abafor and Nwachukwu, 2011). It has also been utilized in treating skin diseases such as eczema, candidiasis, and acne (Adeniran *et al.,* 2013). The anti-malaria activity has been reported as well as the use of stem decoction in treating infertility in females. The leaves are used in veterinary medicine to reduce abdominal pains in goats (Chima and Igour, 2007).

Black-plum or African Olive (*Vitex doniana*), known by the local names: Hausa-dinyar; Fulani-galbi; Yoruba-Oriala; Igbo- uchakoro, 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, particularly in Northern, Eastern, and Western Nigeria (Glew *et al*., 1997). It has been reported that syrup similar to honey was produced from the fruit and that physicochemical and sensory results showed that it can be substituted for other syrups as a nutritive sweetener (Egbekun *et al*., 1996; Ezeh *et al* 2018). The stem bark extract of the tree is used for the control of hypertension and its anti-hepatotoxic effect and treatment of stomach aches, pains, disorders, and indigestion (Ladeji and Okoye, 1996). In Ghana, it is used for the treatment of colds and coughs in children, and its bark is

for the treatment of sterility (Abbiw, 1990). Various parts of the plant are used by traditional medicine practitioners in Nigeria in the management and treatment of several disorders which include rheumatism, hypertension, cancer, and inflammatory diseases (Fafunso and Basser, 1987;Ezeh *et al* 2016).

Cocoyam (*Colocasia esculent*) is a well-known food plant that has a long history of cultivation (Edeoga *et al.,* 2005). Its corns are an important source of starch and the leaf can also be eaten (Haddad *et al.,* 1999). It has been reported that leaves from cocoyam are rich in vitamins and minerals (Irma *et al.,* 2010) but poorly utilized.

Notwithstanding the numerous reports showing varying levels of nutritional and chemical potentials of vegetables, a lot is still needed to evaluate the underutilized ones. Therefore, this research is aimed at investigating the nutritional and chemical value of the leaves of *Pterocarpus Soyansii, Pterocarpus Santalinoides, and Colocasia esculenta* to determine their safety and wholesomeness.

Materials and Methods

Sample collection

The vegetable was obtained from farmlands in Unwana, Afikpo North L.G.A Ebonyi State, Nigeria and was taken to the biology/microbiology of the Department of Science Laboratory Technology, where it was authenticated by a plant taxonomist/polytechnic curator.

Sample preparation

Thereafter, the leaves were removed from the stem, washed, and rinsed with de-ionized water. The residual moisture was allowed to evaporate at room temperature before drying (sun drying) for 5-6 days. In addition, the sundried samples were ground into a fine powder using a Mortar and Pestle before it was stored in an air-tight container for further analysis.

Determination of mineral compositions

Following standard methods, the major elements (calcium, phosphorus, sodium, potassium, magnesium) and trace elements (iron and zinc) were determined according to the method of Shahidi *et al* (1999).

Determination of vitamin compositions

Standard analytical methods were used to determine the vitamins present in the vegetables as follows; vitamins B_1, B_2, and B_3 (Okwu and Josiah, 2006), and vitamins C and E (AOAC, 1990).

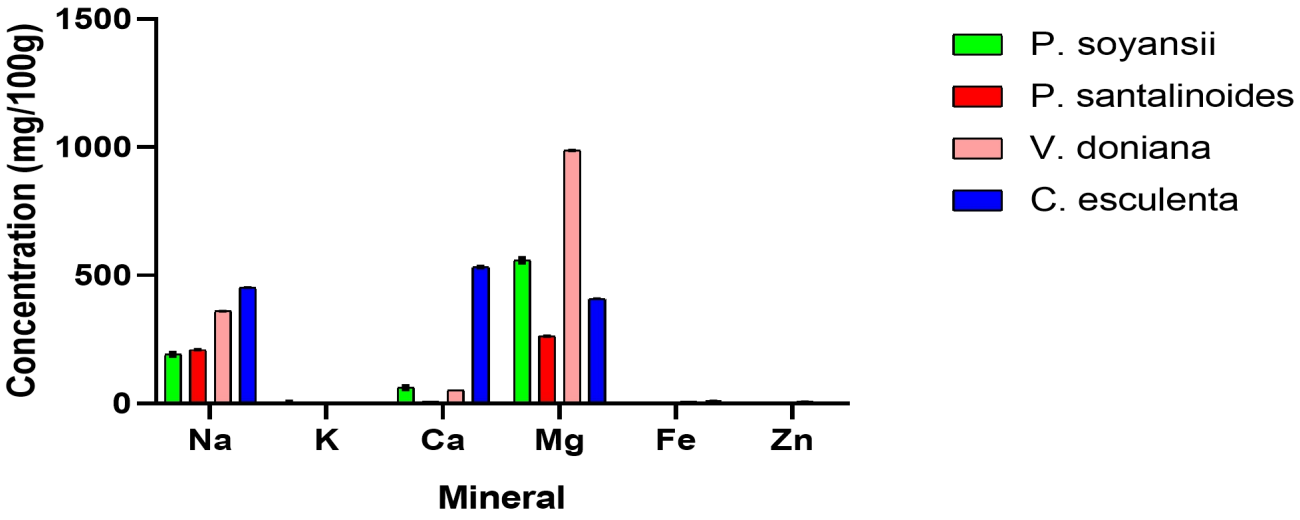
Determination of phytochemical compositions

The quantitative values of phytochemicals present in the vegetable samples were determined using established methods. The alkaloids, Flavonoids, Tannins, and Saponin were determined according to the methods of Boham and Kocipalabyazan (1994), Kittakoop *et al.* (2014), and Harborne (1973), respectively.

Results

Figure 1 showed the result of the analyzed minerals at the $p<0.05$ statistically significant level. *Vitex doniana* has the highest value of magnesium while *P. santalinoides* has the lowest, respectively. The content of calcium in *Colocasia esculenta* is the highest whereas in *P. santalinoides* it is the lowest. Zinc appears to be high in

Vitex doniana whereas it is absent in P. *santalinoides*. The sodium content is highest in *Colocasia esculenta* whereas it is the lowest in *P. soyansii*, respectively. The iron content is almost invisible in *P. santalinoides* although slightly present in *Colocasia esculenta*.



Figur

e 1: Mineral compositions of the leafy vegetables

Results in Figure 2 showed that vitamins (B1, B2, B3, C, and E) were significantly ($p<0.05$) present in the leaves of *P. soyansii*, *P. santalinoides*, *v.doniana,* and *C. esculenta*. The result shows that vitamin C has the highest value in *Colocasia esculenta* followed by vitamin B_1. When compared to others, *V. doniana* contains higher vitamins B_3 and E, respectively. *P. santalinoides* have the lowest value of vitamin E and P. soyansii in vitamin B_3, respectively. *C. esculenta* has the highest value of vitamin B_2 with *vitex doniana* having the lowest value.

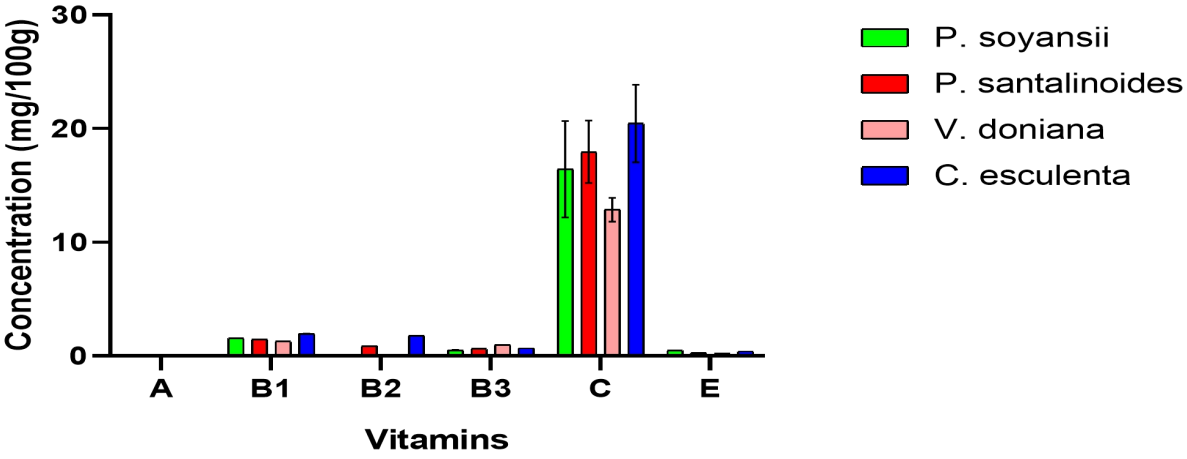


Figure 2:

Vitamin compositions of the leafy Vegetables

Figure 3 represents the result of a quantitative phytochemical analysis of the leaves; *P.soyansii, P.santalinoid, Vitex doniana,* and *C. esculenta.* This result shows that the leaves contained statistically significant ($p<0.05$) numbers of bioactive chemicals. *P. soyansii* has the highest alkaloid while *Colocasia esculenta* has the highest

in flavonoids while *P.soyansii* have the lowest. Saponins content is high in *colocasia esculenta* and low in *P. soyansii*. Also, tannin content is high in *Colocasia esculenta* (0.62±0.06) and low in *P. santalinoides*, and phenol is high in *colocasia esculenta* and low in *P. santalinoides.*

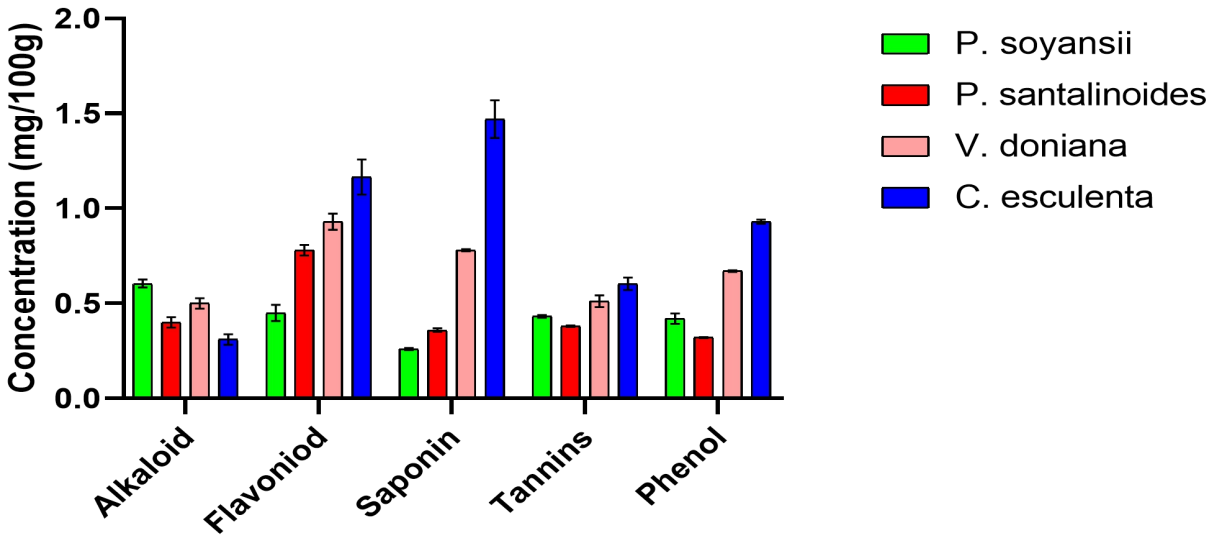


Figure 3:

Phytochemical compositions of the leafy Vegetables

Discussion

Vegetables as critical components of the human diet require to be characterized for insight into their nutritional value and wholesomeness. George (2003) stated that even though the bulk of their weight is water, leafy vegetable represents a veritable natural pharmacy of mineral, vitamins, and phytochemicals. In the current study, four leafy vegetables from *P. soyansii, P. santalinoides, V. doniana,* and *C. esculenta* consumed in southeast Nigeria were investigated for mineral, vitamins, and phytochemical compositions (Figures 1-3). At $p<0.05$; Sodium, Magnesium, and Calcium were found to be high whereas Iron, Potassium, and Zinc are in traces (Figure 1).

Sodium is an essential nutrient and is needed by the body in relatively small amounts (provided that substantial sweating does not occur) to maintain a balance of body fluids and keep muscles and nerves running smoothly. Magnesium is an essential mineral and a cofactor for hundreds of enzymes. Magnesium is involved in many physiologic pathways, including energy production, nucleic acid, and protein synthesis. Iron transport, cell signaling, and also have structural functions. Calcium is a major factor sustaining strong bones and plays a part in muscle contraction and relaxation, blood clotting, synaptic transmission, and absorption of vitamin B_{12}. The relatively high content of calcium in *C. esculenta* suggests that it may be a therapeutic value in a hypocalcaemic state like osteoporosis. The iron level of *C. esculenta* was also high. Irons have been reported as an essential trace metal and play numerous biochemical roles in the body, including oxygen binding to hemoglobin and acting as an important catalytic center in many enzymes.

Various minerals such as Zn, Mg, and K are also co-enzymes in certain biochemical reactions in the body which underscores the importance of leafy vegetables in metabolic reactions. Zinc is absent in *P. santalinoides* but present in a traced amount in *P. soyansii, V. doniana,* and *C. esculenta.* Zinc has been reported to have an

essential component of a large number of enzymes participating in the synthesis and degradation of carbohydrates, lipids, protein, and nucleic acids as well as in the metabolism of other micronutrients. The potassium content of leafy vegetables is good in the control of diuretics and hypertensive complications because of their lower arterial blood pressure. From the result of the study, it is clear that these vegetables, though lesser-known, have enormous nutritional potential and thus can be favorably used as alternative good sources of minerals.

Figure 2 showed that all the vegetables have very high significant ($p<0.05$) contents of Vitamin C whereas there are traces of other vitamins. Ascorbic acid (Vitamin C) is an antioxidant that helps to protect the body against cancer and other degenerative diseases such as arthritis and type-2 diabetes mellitus (Adeniran, *et al.,* 2013). It also strengthens the immune system. Green vegetables with a high ascorbic acid content, such as *Colocasia esculenta* may enhance the absorption of non-heme iron. The antioxidant activity of *Colocasia esculenta* may be due to its chemical constituents. Additionally, ascorbic acid may potentially act as an anticancer agent (Haddad *et al*., 1999; Jimoh *et al*., 2009). Vitamin E contents of the samples revealed that *C. esculenta* has the highest while the lowest is *P. santalinoides.* Vitamin E is an integral part of cellular membranes whose main role is to defend the cell against oxidation.

Vegetables contain secondary metabolite constituents such as alkaloids, flavonoids, saponins, tannins, and phenol. The result indicates that some of the phytochemicals and nutritive constituents vary significantly at $p<0.05$ (Figure 3). Various studies have shown that saponins although nontoxic can generate adverse physiological responses in animals that consume them. They exhibited growth inhibition against a variety of cells making them have anti-inflammatory and anti-cancer properties. They also show tumor-inhibiting activity in an animal. Tannins exhibited antimicrobial activities by iron deprivation, hydrogen bonding, or specific interactions with vital protein interaction. Leaves that have tannins are used for the treatment of intestinal disorders such as diarrhea and dysentery (Akindahunsi and Salawu, 2005). Tannins have astringent properties that hasten the healing of wounds and inflamed mucous membranes. Phenols protect plants from predators and pathogens. They produce poisons that protect the plants. The presence of phenolic compounds in the plant indicates that these plants may be an anti-microbial agent (Sofowora, 1993).

Conclusion

In conclusion, the findings of this research work showed that the lesser-known vegetables *p. soyansii, p. santalinoides, V. doniana,* and *C. esculenta* are good sources of micronutrients concerning high vitamin C, Vitamin B_1, B_2, B_3, and E; Potassium, Zinc, Calcium, Magnesium, and Iron. They are useful as possible sources for combating mineral or micronutrient deficiencies. Also, their phytochemical contents reveal their potential use in ethnomedicine.

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