

Original Research Article

Comparative Phytochemical Studies and Proximate Analysis of Five Commonly Consumed Vegetables of Southern Nigeria

ABSTRACT

A comparative qualitative phytochemical screening and proximate analysis were carried out on the leaves of five commonly consumed vegetables of southern Nigeria. These vegetables and families were *Telfairia occidentalis* (Cucurbitaceae), *Gnetum africanum* (Gnetaceae), *Hagenia abyssinica* (Rosaceae), *Vernonia amygdalina* (Asteraceae) and *Piper guineense* (Piperaceae). The study revealed the presence of bioactive constituents; tannin, flavonoid, alkaloid, and saponin in the five plant samples except for tannin which was absent in *P. guineense*. It was observed that anthraquinone was absent in all the five samples. Proximate composition of the five samples revealed that the moisture content were 74.27%, 78.37%, 87.94%, 84.84%, 86.47% for *G. africanum*, *H. abyssinica*, *P. guineense*, *T. occidentalis* and *V. amygdalina* respectively. It was observed that *G. africanum* had the highest protein, carbohydrate, and ash content at 11.16%, 11.46% and 2.35% respectively when compared with the other plants. *H. abyssinica* had the highest fibre content at 7.81%, while *V. amygdalina* had the highest lipid content at 0.50%.

Keywords: Proximate, Phytochemical, *Telfairia*, *Gnetum*, *Hagenia*, *Vernonia*, *Piper*

1. INTRODUCTION

Plant materials generally feature as one of the dietary constituents serve as food in most homes as meal. It is believed to contain secondary metabolites in the form phytochemicals, vitamins and minerals. Vegetables are the edible parts of herbaceous plants that are consumed wholly or in parts, raw or cooked, as part of main dish or salad. They may be bitter, sweet, or tasteless [1]. Foods containing an abundance of fruits and vegetables give protection against a variety of diseases, particularly cardiovascular diseases [2]. Leafy vegetables are sources of essential and trace elements which play a major role in the normal functioning of the body system, maintaining regular metabolic processes and repair of worn out cells and tissues in man [3]. Many rare and useful herbs occur in Nigeria, from which important drugs could be prepared or agents which may serve as starter materials for the partial synthesis of some useful drugs [4]. Vegetables are included in meals mainly for their nutritional value and some are used to treat most illness because of their medicinal properties. The usefulness of these plant materials medicinally is due to the presence bioactive constituents such as phenols, flavonoids, tannins and alkaloids [5].

The primary benefits of using medicine derived from plant are that they are relatively safer than synthetic alternative, offering profound therapeutic benefits and more affordable treatment [6]. The use of medicinal plants in developing countries as a basis for the maintenance of good health has been widely observed [7]. More so, the increasing reliance on the use of medicinal plants in the industrialized societies has been traced to the extraction and development of several herbs and drugs and chemotherapeutics from these plants as well as from traditionally used rural remedies [8].

In southern Nigeria, *Telfairia occidentalis* (Cucurbitaceae), *Gnetum africanum* (Gnetaceae), *Hagenia abyssinica* (Rosaceae), *Vernonia amygdalina* (Asteraceae) and *Piper guineense* (Piperaceae) are mostly cultivated and used as a vegetable for soups and stews by millions of people, including the Effik, Igbos, Ikweres, Ibibio, Urhobo, Ijaw etc. These plants are indigenous to southern Nigeria, and

used primarily in soups and herbal medicine [9]. The cooked leaves are staple vegetable in soups and stews of various cultures throughout equatorial Africa [10, 11]. The aim of this study is to qualitatively compare some of the secondary metabolites inherent in these five commonly consumed vegetables in southern Nigeria and ascertain their nutritional content.

2. MATERIAL AND METHODS

2.1. COLLECTION OF PLANTS

The leaves of *G. africanum*, *T. occidentalis*, *V. amygdalina*, *P. guineense*, and *H. abyssinica* used for this research were purchased from a local market in Choba community. They were properly identified by the Curator at the University of Port Harcourt Herbarium.

2.2. PROXIMATE ANALYSIS

2.2.1. Determination of Crude Protein (Kjeldahl method):

Plant samples weighing 0.1g were put into different conical flasks, 3g of digestion catalyst and 20 ml of concentrated sulphuric acid was added into the flask. The flasks were then heated gently to boil in a fume chamber, until charred particles disappeared and clear greenish grey solution was obtained. The resulting solution in the conical flask was heated for an additional 20 minutes and allowed to cool. The digest was diluted with water to 100ml capacity and 20ml was then measured into a distillation flask and this was connected to a condenser adapted to a receiver beaker containing 10ml of 2% boric acid with 2 drops of double indicator. NaOH (40%) was added to the digest, the distillation flask was then heated to distil the nitrogen present as ammonia. The boric acid in the receiver was titrated with standard 0.1N hydrochloric acid. The volume of HCl used was recorded as titre value. The formula for the calculation of total Nitrogen is:

$$\%N_2 = \frac{\text{Titre value} \times 1.4 \times 100}{1000 \times 20 \times 0.1}$$

Titre value = Volume of Hydrochloric acid used.

1.4 = Nitrogen equivalent in relation to the normality of HCl used in titration.

100 = Total volume of digest dilution

100 = Percentage factor

1000 = Conversion factor from gram to milligram.

20 = Integral volume of digits analyzed or distilled

0.1 = The weight of sample in gram digested

$$\% \text{ Crude protein} = \%N_2 \times 6.25$$

2.2.2. Determination of Carbohydrate (Clegg Anthrone method):

Plant samples weighing 0.1g were put into a 25ml volumetric flask. Distilled water (1ml) and 1.3ml of 62% perchloric acid was added and the mixture was shaken in order for it to homogenize completely. The flask was made up to 25ml with distilled water; the solution formed was filtered through a glass filter paper. Filtrate (1ml) was collected and transferred into a 10 ml test tube; this was also diluted to volume with distilled water. The hydrolyzed solution was pipetted into a clean test tube and 5 ml of Anthrone reagent was added, they were then mixed together. The whole mixture was read at 630 nm wavelength using the 1ml distilled water and the 5 ml anthrone prepared as blank. Glucose solution of 0.1ml was also prepared and this was treated with the anthrone reagent. Absorbance of the standard glucose was calculated using the formula below:

$$\%CHO = \frac{25 \times \text{Absorbance of sample}}{\text{Absorbance of standard glucose} \times 1g}$$

2.2.3. Determination of Moisture Using the Air Oven Method:

Samples weighing 1g were placed in a clean dry porcelain evaporation dish. This was placed in an oven to maintain a temperature of 105°C for six hours. The evaporating dish was cooled to room temperature in a desiccator and re-weighed.

$$\% \text{ Moisture} = \frac{\text{weight of fresh sample} - \text{weight of dried sample}}{\text{weight of fresh sample}} \times 100$$

Weight of sample used 1

2.2.4. Determination of Lipid by Soxhlet Extraction Method:

Samples weighing 2g was inserted into a filter paper and placed into the soxhlet extractor. The extractor was fitted into a pre-weighed round bottomed dry distillation flask and the solvent acetone was added into it through the condenser. The extractor and the flask were held in place with a retort stand clamp. Cold water was passed into the condenser via the rubber tubing and the flask was heated such that the solvent refluxed continuously within the enclosure. The lipid in the solvent chamber was extracted through this process of continuous refluxing. After the lipid had been extracted completely from the sample, the condenser and the extractor were disconnected, the acetone solvent was distilled off and the lipid concentrate was cooled in the oven and re-weighed.

$$\% \text{ Lipid} = \frac{\text{Weight of flask and extract} - \text{Weight of empty flask} \times 100}{\text{Weight of sample extracted}} \quad 1$$

2.2.5. Determination of Ash by Furnace Method:

The dried sample weighing 1g was placed into a porcelain crucible which had been preheated and weighed. The crucible was inserted into a muffle furnace and regulated to a temperature 630°C. After three hours it was removed from the furnace and allowed to cool to room temperature, and then it was re-weighed.

2.2.6. Determination of fibre:

The fibre content was determined by difference. The other five proximate were summed and the value gotten was subtracted from 100% giving the fibre content.

2.3. PHYTOCHEMICAL SCREENING:

The standard methods were used to qualitatively determine the phytochemical (tannin, flavonoid, alkaloid, saponin and anthraquinone) present in the leaves of five commonly consumed vegetables (*G. africanum*, *T. occidentalis*, *V. amygdalina*, *P. guineense*, and *H. abyssinica*) in southern Nigeria [4, 12, 13].

3. RESULTS AND DISCUSSION

3.1. Phytochemical screening:

Qualitative phytochemical analysis carried out on each plant sample showed the presence of bioactive constituents. The study showed that flavonoid, tannin, saponin, and alkaloid were present in *G. africanum*, *T. occidentalis*, *V. amygdalina*, *P. guineense*, and *H. abyssinica*. But tannin was absent in *P. guineense* while anthraquinone was absent in all the samples (Table I).

Table I: Qualitative phytochemical screening of five commonly consumed vegetables of southern Nigeria.

Phytochemical	<i>T. occidentalis</i>	<i>G. africanum</i>	<i>V. amygdalina</i>	<i>P. guineense</i>	<i>H. abyssinica</i>
Flavonoid	+	+	+	+	+
Tannin	+	+	+	-	+
Saponin	+	+	+	+	+
Alkaloid	+	+	+	+	+
anthraquinone	-	-	-	-	-

3.2. Proximate analysis:

The result showed the moisture content of the analyzed samples as 74.27%, 78.37%, 87.94%, 84.84%, 86.47% respectively for *G. africanum*, *H. abyssinica*, *P. guineense*, *T. occidentalis* and *V. amygdalina* (Table II). The ash content of *G. africanum* is higher than all the above reported

vegetables. The crude fibre content of *H. abyssinica* is the highest of all the samples (7.81%). The proximate compositions of the five plants are shown in Table II and Table III.

Table II: Proximate composition (moisture, ash, and carbohydrate) of five common vegetables in southern Nigeria.

S/No	Sample identity	Moisture (%)	Ash (%)	CHO (%)
1.	<i>G. africanum</i>	74.27 ± 2.07	2.35 ± 22.18	11.46 ± 1.5
2.	<i>H. abyssinica</i>	78.37 ± 0.01	1.51 ± 0.09	3.36 ± 0.05
3.	<i>P. guineense</i>	87.94 ± 0.25	2.79 ± 0.26	2.50 ± 0.00
4.	<i>T. occidentalis</i>	84.84 ± 1.10	1.27 ± 0.12	6.46 ± 0.33
5.	<i>V. amygdalina</i>	86.47 ± 0.54	1.410 ± 0.00	5.416 ± 1.18

Results are presented as Mean ± standard deviation

Table III: Proximate composition (protein, lipid, and fibre) of five common vegetables in southern Nigeria.

S/No	Sample identity	Protein (%)	Lipid (%)	Fibre (%)
1.	<i>G. africanum</i>	11.16 ± 1.55	0.3 ± 0.00	1.455 ± 0.60
2.	<i>H. abyssinica</i>	8.75 ± 0.00	0.2 ± 0.00	7.809 ± 0.09
3.	<i>P. guineense</i>	5.69 ± 0.00	0.30 ± 0.00	0.77 ± 0.51
4.	<i>T. occidentalis</i>	5.47 ± 0.31	0.60 ± 0.00	1.355 ± 1.22
5.	<i>V. amygdalina</i>	3.94 ± 0.62	0.50 ± 0.00	2.263 ± 1.09

Results are presented as mean ± Standard deviation

DISCUSSION

The presence of tannins in *T. occidentalis*, *G. africanum*, *H. abyssinica*, and *V. amygdalina*, suggests that they could be useful for the prevention of cancer as well as treatment of inflamed or ulcerated tissues. Alkaloids have been with medicinal purpose as agents possessing analgesic, antimalarial, antiseptic, anti-inflammatory, anti-carcinogenic, and bactericidal activities; therefore the presence of alkaloid in the plant samples tested, could suggest that these vegetables could be useful in these areas. Saponin in medicinal plants are responsible for most biological effects related to cell growth and division in humans and have inhibitory effects on inflammation [14]. Tannin was not found in *P. guineense*, while anthraquinone was not found in these plant samples. A variety of herbs and herbal extracts contain different phytochemicals with biological activity that can be of valuable therapeutic index. Phytochemicals have been found to possess a wide range of activities, which may help in protection against chronic diseases. For example flavonoids, tannins and alkaloids have hypoglycemic activities; steroids and saponin are responsible for central nervous system activities [15]. Anti-diarrheal and anti-dysenteric properties were found to be due to presence of tannins, alkaloids, saponins, flavonoids, steroids and terpene in some extracts [16, 17].

Proximate composition showed that *P. guineense* had the least fibre content of 0.77%, suggesting that it is not a good source of fibre. Vegetables like *H. abyssinica* which showed the highest fibre content of 7.81% when compared with the other vegetables tested, will be a better source of fibre. Adequate intake of dietary fibre can lower the serum cholesterol level, risk of coronary heart disease, hypertension, constipation, diabetes, colon and breast cancer [18, 19]. *Gnetum africanum* had the highest crude protein and carbohydrate content of 11.16% and 11.46% respectively, and could be said to be a better source of protein and carbohydrate when compared with the other vegetables tested. The crude lipid composition showed that vegetables are deficient in lipids and this makes them good for health. It is required that vegetables should be used frequently as they are good for health and provide most of the essential nutrients for normal body functions when consumed in appropriate combination.

4. CONCLUSION

In this study, we have found that some of the biologically active phytochemicals were present in *T. occidentalis*, *G. africanum*, *V. amygdalina*, *P. guineense*, and *H. abyssinica*. It has been shown that vegetables are nutritious foods that provide sufficient amount of nutrients needed for normal body

function, maintenance and reproduction. It was found that nutrient composition in all the selected vegetables were different. Vegetables are poor sources of lipid, this makes them good food for obese people. They are good sources of fibre and can decrease the concentration of high cholesterol level in the body.

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