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# Assessment of the Phytochemical, Proximate, Vitamin and Mineral Composition of *Solanum gilo* L.

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***Author's contributions***

*This work was carried out in collaboration between the two authors. Author SOE designed the project, wrote the protocol, managed the analyses and wrote the final draft of the manuscript while author CQK performed the experiments, statistical analysis and wrote the first draft of the manuscript. All authors read and approved the manuscript.*

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## ABSTRACT

Assessment of the phytochemical, proximate, vitamins and mineral composition of *S. gilo* L was undertaken using standard methods. The phytochemical screening revealed that the plant contained tannins, saponins, phenols, cyanogenic glycosides, alkaloids and flavonoids, The results showed that *S. gilo* L had alkaloid content of 6±2.23%, flavonoid 19.5±0.02%, saponin 5±0.3%), tannin 1±0.24%, phenol 1.8±0.02%, and cyanogenic glycosides 4.7±0.21%. The proximate analysis showed a moisture content of (6±1.41%),ash (14.8±0.02%) crude fiber (29.33±0.02%), lipid (37.61±0.01%), protein (0.18±0.02%) and carbohydrate (13.03±0.01%). *S. gilo* L. also showed high level of vitamins incuding vitamin B1 (1.2±0.16µg), vitamin B2 (10.71±0.16 µg) vitamin C (264±2.15 mg/g), vitamin B3 (7.33±0.02 µg). It also showed trace amounts of vitamin E (0.52±0.02 µg), high mineral contents of potassium (4150±2.14mg/g) and sodium (270±1.41 mg/g), and trace amounts of other elements including lead (0.04±0.01 mg/g) and cadmium (0.025±0.002 mg/g). The result show that *S. gilo* L is endowed with appreciable amounts of bioactive substances and nutritive components which justifies its wide use in ethnomedicine and as stew condiment as well as being used food.

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## 1. INTRODUCTION

*Solanum gilo* is a species of the African egg plant or garden egg as it is commonly called in many parts of Nigeria where they are used for hospitality in place of kola nuts and as stew condiments with other *Solanum species* in traditional medicine as antioxidants and laxatives [1,2,3]. The species is *Solanacaea* and the plant genus *solanum* which have over 1000 species worldwide of which about 25 species are known in Nigeria including those domesticated and wild ones with their leaves, fruits or both used as vegetables or in traditional medicine [4]. *Solanum gilo* is cultivated in Africa including Nigeria [5] as an annual crop and is usually called "afufa" in Igbo, where there are many other Nigerian and other African species and varieties [6].

The garden egg species are commonly consumed almost on daily basis by both rural and urban families. The eggplants form part of the traditional Sub-Saharan African culture. The fruits, said to represent blessings and fruits, are offered as a token of goodwill during visits, marriages and other social events.

There are wide variations existing within and between the African eggplant species including variation in characters like diameter of corolla, petiole length, leaf blade width, plant branching, fruit shape, color [7].

*Solanum gilo* is grown in areas of high rainfall. The fruits are around with the top and bottom flattened out and have grooved portions with a length of 5-6cm and a width of 6-7cm. It possesses very tiny seeds and its stalk is curved or erect. [8].This species of garden egg have bitter taste and is cultivated in the same way with other species. The fruit turn red or orange in colour when ripened.

The use of the African egg plant in indigenous medicine range from weight reduction to treatment of several ailments including constipation, weight loss, obesity, diabetes, glaucoma, rheumatic disease and swollen joint pains [9]. These pharmacological properties have been attributed to the presence of certain chemical substances in the plants such as crude fiber, phenols, ascorbic acid, and alkaloids [10].

In this study, nutritive and phytochemical, vitamin and mineral analyses were carried out on an indigenous egg plant *S*. *gilo* L. because of its nutritive and medicinal benefits.

## 2. MATERIALS AND METHODS

### 2.1 Collection and Identification of Sample

Unripe fruits of *S*. *gilo L*. were collected from a local farm in Isiala-Ngwa North L.G.A of Abia State Southeast Nigeria. The fruits were identified in the Department of Plant Science and Biotechnology, Abia State University, Uturu.

### 2.2 Preparation of Samples

Healthy fruits were selected and thoroughly washed with water to remove dirt and unwanted particles. The stalks were removed and unwanted with particles. The edible part was cut in pieces, dried at 105ºC and ground into powder before being used for analysis. The pulverized sample was stored in an air-tight container at room temperature.

## 3. PHYTOCHEMICAL SCREEENING

Aqueous extract of the sample was prepared by soaking 100g of the powdered samples in 200ml of distilled water for 12 hours. The extracts were filtered using whatman filter paper No. 42 (125mm). Chemical tests were carried out on the aqueous extracts and on the powdered samples to identify the constituents using standard procedures.

Colour intensity was used to categorize the presence of each photochemical into present moderate or slightly present.

### 3.1 Test for Tannin

The determination of the presence of tannin in the test sample was carried out using ferric chloride test described by Harbone [11] as reported by Osagie [12].

2g of the powdered sample was added into 10mls of distilled water. The mixture was shaken for 30 minutes and the filterate used as aqueous extract. 2mls of the aqueous extract was added into a test tube and 3mls of distilled water was added to it and shaken very well for homogenate, two drops of dil. Ferric chloride ($FeCl_3$) was

added to the mixture. The formation of a very dark precipitate indicated the presence of tannin.

### 3.2 Test for Saponin

The presence of saponins in the test sample was done using the Harbone [11], as reported by Osagie [12]. The test for saponin is known as Froth test. In froth test, 2mls of the aqueous extracts were mixed with 6mls of distilled water in a test tube. The mixture was shaken well and the formation of froth indicated the presence of saponins.

### 3.3 Test for Alkaloids

The presence of alkaloids in each sample was investigated using the method described by Okwu [13]. 2g of sample is shaken with 5ml of 2% HCl on a steam bath and filtered with Whatmann filter paper no. 42.

To 1ml of filtrate, 0.5ml of Wagner's reagent (2g of iodine and 3g of potassium iodine were dissolved in 20ml of distilled water and made up to 100ml with distilled water). A reddish brown precipitate indicates the presence of alkaloids.

### 3.4 Test for Flavonoids

The determination of the presence of flavonoids in the sample was done using the acid-alkaline test by Osagie [12]. 2mls of the aqueous extract was added into a test tube and a few drops of concentrated ammonia were added. The formation of a yellow colouration shows the presence of flavonoids.

### 3.5 Test for Phenols

This was investigated using Okwu [13] methods. The free fat sample was boiled with 50ml flask and 10ml of distilled water was added to it. To the solution, 2ml of ammonium hydroxide and 5mls of conc. Amyl alcohol was added. The mixture was allowed to react for 30 minutes for colour development.

### 3.6 Test for Cyanogenic Glycosides

The presence of cyanogenic glycosides was carried out by putting 20g of sample in $50cm^3$ conical flask. A dry drip of alkaline picrate paper (prepared by soaking in equal volumes of 10% $Na_2CO_3$ and 1% picric acid solution) is hung from the mouth of the flask, without touching the sample. The mouth of the flask is plugged highly with cotton wool or tissue paper. The set up is then heated up to one hour in a water bath. A change of colour from yellow (of the picrate paper) to orange, then brick red colour indicates the presence of cyanogenic glycosides Harbone [11] as modified by Okwu [13].

### 3.7 Proximate Analysis

Proximate (nutritive) composition of the fruits were determined, this include: moisture, protein, lipid, crude fiber, ash, carbohydrate composition of the sample.

Moisture, lipid, protein, carbohydrate, crude fiber and Ash contents were determined using the Official Method of the Association of Official Analytical Chemists (A.O.A.C) [14] as reported by Asibey-Berko [15].

### 3.8 Mineral Analysis

Mineral composition of sample was determined using the official method of the Association of official Analytical Chemists A.O.A.C [14].

Two grams (2g) of the sample was dry ashed with a porcelain crucible in a muffle furnace at 500ºC for 24 hours. The resulting ash was cooled in a desiccator and weighed. The ash was treated with 10ml of 50% HCL.

The quantification was carried out using 5 series atomic absorption spectrophotometer.

### 3.9 Vitamin Analysis

Determination of Vitamins B, (thiamine) and Vitamin B2 (riboflavin) was carried out using spectrophotometric method as described by Okwu [13]. Determination of vitamin B3, Vitamin C, and Vitamin E, content of the sample was investigated using spectrophotometric methods as described by Rukowski [16].

## 4. RESULTS AND DISCUSSION

Table 1 shows Qualitative Analysis of Phytochemicals present in *S. gilo*. The result revealed that the fruit of *S. gilo* contain a significant amount of Alkaloids which is known to give plant a bitter taste [17]. The presence of this alkaloid makes this fruit highly nutritional and medicinal.

Flavonoids were found to be present in both fruits, flavonoid have a wide range of biological and pharmacological activities including anti-oxidant, anti-inflammatory and anti-microbial activities [18]. Flavonoids are also responsible for the colour of most fruits.

**Table 1. Qualitative analysis of phytochemicals present in *S. gilo***

| Phytochemical | *S. gilo* |
|---|---|
| Alkaloid | + |
| Flavonoid | + |
| Saponin | + |
| Tannin | (+) |
| Phenol | + |
| Cyanogenic glycoside | + |

*+ Present; (+) slightly present*

Saponins were found present in both species. Saponins are known by their froth foaming which they produce when shaken in aqueous solutions [19]. They are being promoted as adjuvants in vaccines [20].

Tannins were found to be slightly present in both species. The astringency from tannin is known to cause the dry and pucker feeling in the mouth following the consumption of unriped fruits food rich in tannin can be used in treatment of hemochromotosis [21].

Phenol used as conversion to precursors to plastic but can be corrosive to the eyes, skin and respiratory tract when prolonged exposure occurs. They are used in the preparation of cosmetics like sunscreen [22]. This species of eggplant *S. gilo*. contained a significant amount of phenol making it useful when used as phenol source.

Cyanogenic glycosides found in some food cause increase in blood glucose and lactic acid levels. They are toxic and often present in small quantities which may not be a significant dosage for medicinal purposes. This species of eggplant showed significant amount of this phytochemical making its consumption harmful to the body but the toxicity can be reduced by boiling [23,24].
Table 2 shows quantitative analysis of the photochemicals present in *S. gilo*.

Alkaloid content of *S. gilo* was 6±2.23% and compared very well with 4.5% value reported by Jaegeer and Hepper [25]. Alkaloids are very important in medicine, they uniformly invoke bitter taste in plants such alkaloids include codeine which is used in cough medicine and as an analgesic. The alkaloid content of *Solanum gilo L.* is a moderate value for consumption of the fruit and this makes the plant very beneficial medicinally.

Flavonoids generally possess anti-bacterial and antifungal activities [18]. They are potential sources of natural preservatives, and also known to have anti-inflammatory and anti-oxidants activities [26,27]. Flavonoid than the 22% reported by many researchers on different species of garden egg including The flavonoid content of *S. gilo* (19.5±0.02%) was found to be lower than the value of 22% reported by many researchers on different species of garden egg incuding *solanum melongena*, Osei et al. [28] but compared well with the 18.50% obtained by Irunyole and Akmyole [29].

Saponins are promoted as dietary supplements and nutriceuticals. They are also adjuvants in vaccine production [20]. From the result *S. gilo* contained 5±0.37% saponin content which was lower than the 10% reported by Xur et al. [30] for another species of garden egg and so *S. gilo* is a moderate source of saponins.

Tannins have shown anti-viral, anti-bacterial and antiparasitic effects. The tannin content of *S. gilo* (1±0.24) is slightly lower than the 2.5% value reported by Lambent and Yang [31].

Phenols are beneficial as they are versatile precursor to large collection of drugs e.g. Aspirin and many pharmaceutical drugs known to be corrosive to the eyes, skin and respiratory tract on prolonged exposure [32]. *S. gilo* contained (1.8±0.02) which compare well with 2% as reported by Vinson et al. [33].

Cyanogenic glycosides are phyto-toxins, that causes a decrease in the utilization of oxygen in the tissues. Cyanogenic-glycoside content of *S. gilo* (4.7±0.29) compared very well with 6% as reported by Clark [34]. This signifies that raw consumption of these species of egg plant can cause some element of toxicity to the body but this can be prevented by boiling before consumption.

Table 3 shows the proximate (nutritive) composition of *S. gilo*. The moisture content of fruits is related to its dry matter content. It can be used as an index of stability and susceptibility to fungal infection. It determines quality and freshness of fruits [5]. From the result this

species is not a good source of moisture. The moisture content of *S. gilo* is 6±1.41% and this result is far lower than the report of several researchers of 80-85% moisture content for most fruits [35] but this is an advantage for longer storage than many other fruits.

**Table 2. Qualitative analysis of the phytochemicals present in *Solanum gilo* L.**

| Phytochemical | *S. gilo* |
|---|---|
| Alkaloid | 6.00±2.23 |
| Flavonoid | 19.50±0.02 |
| Saponin | 5.00±0.37 |
| Tannin | 1.00±0.24 |
| Phenol | 1.80±0.02 |
| Cyanogenic glycoside | 4.70±0.21 |

**Table 3. Proximate composition of *S. gilo***

| Parameters | *S. gilo (mg/g)* |
|---|---|
| Moisture | 6.00±1.41 |
| Ash | 14.80±0.02 |
| Crude fiber | 29.33±0.02 |
| Lipid | 37.61±0.01 |
| Protein | 0.18±0.02 |
| Cyanogenic glycoside | 13.03±0.01 |

The ash is important fruit content because it determines the mineral composition of the fruit [36]. *S. gilo* contains (14.8±0.02) ash which showed that of this species have and appreciable amount of minerals which compare well with other species [37].

Crude fiber found in fruits such as pectins reduces rate of sugar uptake and plays vital role in gastric emptying. *S. gilo* has a high crude fiber content (29.33±0.02) and this makes it beneficial in reducing constipation and hence a lower possibility of incidence of colon cancer as it will help in easy emptying of the bowels. The value for the fibre content is also higher than reported by Norman [38].

The lipids in fruit serve both structural and metabolic functions like: energy production and also promoting healthy cell function. *S. gilo* contained a reasonable amount of lipids (37.61±0.01) which compared well with that reported by Ekpeyong in [39] but a bit higher than 35% reported by Edijala et al. [40] *in* but far greater than that reported for the fruit of *Nauclear latifolia* [41].

Proteins are not general known to e higher in fruits, but they are of primary importance because they are enzymes that catalyze chemical reactions and accelerate some chemical reactions [42]. *S. gilo* showed a low protein content (0.18±0.22) which is lower than the value of 3.5% reported by Grubben and Denton [34] as well as 1% reported by Gbile and Adesina [43] and that reported for the fruits and leaves of *Nauclear latifolia* [41].

Carbohydrates are important due to their nutritional and metabolic functions. They serve as natural sweeteners as well as raw materials for various products [21]. *S. gilo* contained 13.03±0.01% carbohydrates and this makes it a good source of carbohydrate and this compared well with the value of 14.5% as reported by Leung et al. [35] but lower than that reported by Eze and Ogbuefi in [41].

Table 4 showed the vitamin content of *S. gilo*. Vitamins B1, B2, B3, C and E were found to be contained in it. Vitamins are associated with energy production in the body, as well as essential for breakdown of fat and protein and keeping the mucus membrane healthy, Vitamin B1 content of *S. gilo* (1.2±0.16) was higher than 0.18mg reported by Duel and Sturtz [10] but compared well with 1.5mg reported by Rice et al. [44] which showed that it is not really good as a source of Vitamin B1 (Riboflavin).

**Table 4. Vitamin content of *S. gilo***

| Parameter | *S. gilo* (µg/g) |
|---|---|
| Thiamine (B1) | 1.20±0.16 |
| Riboflavin (B2) | 10.71±0.16 |
| Nicotinamide (B3) | 7.33±0.02 |
| Ascorbic Acid(c) (mg) | 264±2.15 |
| ∞-tocopherol (E) | 0.52±0.02 |

Vitamin B2 plays a supportive role in the treatment of sickle-cell anaemia. It is also the precursors for enzyme w-factors that help in their work as catalysts in metabolism [8]. Vitamin B2 content of *S. gilo* (10.71±0.4) compared with the value of 12.20mg reported by Rice et al. [44] and so a good source of vitamin B2.

Vitamin B3 (Nicotinamide) is also a precursor for enzyme co-factors that help in their work as catalyst in body metabolism. Its deficiency causes pellagra [10]. Vitamin B3 content of *S. gilo* (7.33±0.02) is less than 10.58mg obtained by Dobson, [23] with that of also compared very well with 8.50mg reported by Osei et al. [28]

Vitamin C (Ascorbic acid) are always found in fruits in high amounts. It is a very import anti-

oxidant [8]. Ascorbic acid content of *S. gilo* (264±2.5) correlated with the results reported by Szeto et al. [45], which reported 400mg and 258mg respectively for the eggplants.

### 4.1 Vitamin E (Tocopherol)

This is an important anti-oxidant used for the preparation of various kinds cosmetic products ranging from soaps, creams, etc. This species contained very low amount of Vitamin E of *S. gilo* were low (0.52±0.02), but compared very well with the 0.5mg reported by Rice et al. [44].

Table 5 shows the amount of trace minerals found in *S. gilo*. This species of garden egg showed the presence of trace minerals. They are needed by the body in very little amount though they are also useful. These trace minerals include Pd, Zn, Cu, Cd, Fe and Se, they are important for immune system function, energy metabolism and anti-oxidant function [21]. From the result, *S. gilo* contained appreciable amount of these minerals and so a rich source of these minerals. The amount of minerals found in these species compared well with the NAFDAC [46] standard of trace minerals found in food including Pd and Zn which should not be above 5mg/g. therefore consumption of these species of garden egg will not be toxic since these minerals are found in trace amounts.

Table 6 shows the macro-mineral composition of *S. aethiopicum* and *S. gilo*. These minerals are minerals needed by the body in large moderate amounts. They are important in daily function and processes which include formation of bone and teeth and health[19] e.g. Ca, Mg, P [36] also energy production, nerve and muscle function [20] e.g. k, Na. both species contained very high amounts of potassium (4250±3.91 and 4150±2.14) respectively. *S. gilo* contained high amount of sodium (270±1.41) as compared *S. aethiopicum* containing (0.63±0.03). the macro-minerals content of *S. aethiopicum* and *S. gilo* were comparatively lower than the amount required except for potassium contents of 20 (4250±3.91 and 4150±2.14) respectively by NAFDAC[40] which requires that food should contain up to 20-30 mg/g of this minerals. Therefore these two species of eggplants are not good sources of Ca, P, Mg and Na.

## 5. CONCLUSION

*S. aethiopicum* is enriched with important phytochemical and nutritional constituents in significant amounts including vitamins and minerals in appreciable high levels. The results of the nutritional and phytochemical analyses justify the therapeutic use and consumption of this species of eggplant and recommends it as a good fruit.

**Table 5. Trace mineral content of S. *aetheopicum* and *S. gilo***

| Parameters (mg/g) | S. *gilo* (mg/g) | NAFDAC standard (mg/g) |
|---|---|---|
| Pd | 0.04±0.01 | 0.30 |
| Zn | 0.13±0.02 | 5.00 |
| Fe | 0.65±0.02 | 5.00 |
| Cu | 0.04±0.01 | 5.00 |
| Cd | 0.025±0.002 | 0.01 |
| Se | 0.01±0.007 | 0.01 |

**Table 6. Macro-mineral content of *S. aethiopicum* and *S. gilo***

| Parameters (mg/g) | *S. gilo* (mg/g) | NAFDAC standard (mg/g) |
|---|---|---|
| Ca | 0.135±0.02 | 30.00 |
| K | 4150±2.14 | 25.00 |
| P | 1.16±0.02 | 25.00 |
| Mg | 0.55±0.02 | 20.00 |
| Na | 270±1.41 | 30.00 |

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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