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Research Article

Proximate and Phytochemical analysis of Aqueous Leaf Extract of *Solanum nigrum* from Lagos, South-West Nigeria

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ABSTRACT

Solanum nigrum is a vegetable plant belonging to the family of *Solanaceae*. The ability to ascertain the quality and quantity of the chemical composition of a plant provides an insight on the possible optimum exploitation of the plant for ethnomedicinal and pharmaceutical purposes. This study was carried out to determine the phytochemical constituent and proximate composition of *Solanum nigrum* leaf from Ojo area of Lagos, Nigeria. Phytochemical screening and the proximate composition of *Solanum nigrum* leaf was performed using standard procedures. From the study, qualitative analysis of the aqueous extract of *Solanum nigrum* reveals that alkaloid, saponin, flavonoid, tannin, phenol, terpenoids, cardiac glycoside were present while anthraquinone and steroid were not detected. Quantitative phytochemical analysis showed the constituents to be in the following concentrations: phenol (38.17 ±0.33mg/100g), flavonoids (34.78 ± 0.26 mg/100g) and terpenoids (34. 92 ± 0.28 mg/100g), tannin (30.32 ± 0.24 mg/100g), cardiac glycoside (30.23 ± 0.22 mg/100g), saponin (18.06 ± 1.39 mg/100g) and alkaloid (12.61 ± 0.81 mg/100g). Proximate composition included carbohydrate (71.91± 0.43%), protein (2.21 ± 0.06%), crude fat (0.49 ± 0.10), moisture (1.65 ± 0.09%), ash (3.49 ± 0.17%) and crude fibre (20.23 ± 0.19%). Phytoconstituents of *S. nigrum* from Ojo area of Lagos State are comparable to those from other parts of the world. With the exception of steroids, phytoconstituents of *S. nigrum* from Ojo area of Lagos State are comparable to those from other parts of the world. The presence of these phytoconstituents suggests their medicinal value.

Keywords: Proximate Analysis, *Solanum nigrum*, phytochemicals, ethnomedicinal, Vegetable

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INTRODUCTION

The use of plants in ayurvedic and traditional medicine has been as old as man himself. plants play major roles in both traditional and modern health systems and their increasing use, especially among the rural populace, for the treatment of various ailments is partly due to the prohibitive cost and unpleasant effects of pharmaceutical formulations (Raduan *et al*., 2019). the efficacy of many of these medicinal plants and their extracts in treating several disease conditions have been described by many authors (Chauhan *et al*., 2012, Dilip *et al*., 2012, Rani *et al*., 2017).

An important step in determining the usefulness of medicinal plants is the identification of their chemical components. The bioactive chemical components of plants like alkaloids, tannin, flavonoids and phenolic compounds are responsible for their physiological and biochemical actions in animal and human systems (Gogoi and Islam, 2012).

Solanum nigrum is a medicinal plant that belongs to the family Solanacea (Jain *et al*., 2011) and is commonly known as Black nightshade. It is an annual herbaceous plant of 10-60 cm high with a smooth, green and semi-climbing stem. It is usually in wet woods, near river, old field, wasteland, ditches roadside and cultivated land (Gogoi and Islam, 2012, Edeoga *et al*., 2005). *Solanum nigrum* has been reported to possess numerous compound which is responsible for its pharmacological properties. Active components of this plant are numerous to mention a few which are glycoproteins, glycoalkaloids, and polysaccharides, they also contain

polyphenolic compounds such as catechin, gallic acid, protocatechuic acid (PCA), epicatechin, caffeic acid, rutin, and naringenin (Ravi *et al*., 2009, Rani *et al*., 2017). In traditional medicine, *S. nigrum* leaves are utilized in the treatment of rheumatic and gouty joints, skin diseases also exploited in the treatment of nervous disorders, nausea and tuberculosis. The decoction and juice of the berries are useful in the treatment of cough, diarrhoea, inflammatory and skin diseases (Dilip *et al*., 2012), (Chauhan *et al*., 2012). Anti-oxidative (Chinthana and Ananthi, 2012), anti-inflammatory and anti-pyretic effects of *Solanum nigrum* chloroform extract have also been reported (Chinthana *et al*., 2012). The ethanol extract of dried fruits of *Solanum nigrum* showed a notable hepatoprotective effect against CCl_4 induced oxidative damage on liver cells. The most important property of *Solanum nigrum* is its anti-cancerous property (Rani *et al*., 2017), (Lai *et al*., 2016).

However, most of the studies mentioned above were carried out on *S. nigrum* plants from South-Eastern and Eastern Asia. Climatic conditions are known to greatly influence the nutritive and bioactive constituents of plants. This study was therefore intended to determine the proximate and phytochemical composition of aqueous extract of *S. nigrum* from Ojo area of Lagos, South-West Nigeria.

MATERIALS AND METHODS

All reagents and chemicals used are of analytical grade.

Plant collection and identification: Fresh leaves of *solanum nigrum* locally known as "Efo odu" by the Yoruba tribe in Nigeria were purchased from a traditional healer at Iyana iba market, Lagos-Badagry expressway, Lagos. The plant materials were authenticated by Mr. Nodza George of botany department, university of Lagos, using standard voucher University of Lagos herbarium, Lagos, Nigeria (LUH: 7945).

Preparation and extraction of sample material: The leaves were washed in distilled water from that point, air-dried for a week under conceal. The air-dried sample was then grounded into a fine powder. Fluid concentrates of the plants were set up by absorbing 500g of the dry powdered plant material in 2.5 liters of distilled water and afterwards kept at room temperature for 48hours (for intensive extraction). Toward the finish of the 48hours, the concentrate was separated utilizing a Whatman channel paper No. 42 (125mm). Water shower (40ºC) was utilized to focus the filtrate to one-10th its unique volume, and afterwards at last freeze dried with an Ilshin freeze drier. The dried buildup (unrefined concentrate) was then put away at 4ºC. On every day of the investigation, aliquot bits of the unrefined plant removal buildup wasgauged and dissolved in distilled water.

Qualitative analysis of phytochemicals: Standard procedures of (Akinleye *et al*., 1996) was used for the Phytochemical screening to ascertain the secondary metabolites present in the aqueous extract of leaf parts of *Solanum nigrum.*

Test for Alkaloids: Utilizing Mayer's test the filtrates were utilized to test the presence of alkaloids. 2.0ml Mayer's reagent (potassium mercuric iodide) was utilized to treat the plant separate which was sifted. Yellow cream hasten development shows the presence of alkaloids

Test for flavonoids using H_2SO_4 test: To 2.0ml of plant extract, few drops of H_2SO_4 were mixed. Orange colour formation shows flavonoids present.

Test for steroids: A 2.0ml portion of acetic anhydride was added to 0.5ml of the extract, 2ml of H_2SO_4 was then added and mixed. The colour change from violet to blue or green in some samples shows the presence of steroids.

Test for Terpenoids using Salkowski's Test: 5mg of the plant extract was treated with 2ml of chloroform and 3ml of concentrated H_2SO_4 was carefully added to form a layer. Reddish-brown colour formation in the inner face shows the presence of terpenoid.

Test for Anthraquinones using Borntrager's Test: 10% HCl was used to treat 5mg of the plant extract for a few minutes in a water bath. To the filtrate, an equal volume of $CHCl_3$ was added. To the mixture, few drops of 10% NH_3 were added and heated. Pink colour formation shows the presence of anthraquinones.

Test for Phenols using Ferric chloride test: About 2 ml plant extract was placed in water and warmed at 45-50ºC. Then 2ml of 0.3% $FeCl_3$ was added. A green or blue colour formation shows the presence of phenols.

Test for Saponins using Frothing test: 5ml of distilled water were shaken vigorously with about 0.5mg of the plant extract for a stable persistent froth. The appearance of froth (creamy miss of small bubbles) shows saponins present.

Test for Tannins using Ferric chloride test: 20ml of water was used to boil a small quantity of the plant extract in a test tube and then filtered. A few drops of 0.1% $FeCl_3$ was added and the mixture was observed for brownish green black or a blue-black colouration.

Test for carbohydrates using Fehling's test: Fehling solutions A and B were diluted with distilled water and boiled for 1min. To this clear blue solution, 8 drops of plant extract were added. After that, 1ml of Fehling's solution was used to mix it and boiled in a water bath for 5min. A brick red precipitation shows the presence of carbohydrates.

Test for protein and amino acid using Ninhydrin test: A 0.5mg portion of the extract was taken and two drops of freshly 0.2% Ninhydrin reagent were added and heated. Pink or purple colour formation shows the presence of protein, peptide or amino acids.

Quantitative analysis of phytochemicals

Alkaloid determination: In a 250ml measuring beaker, 5g of the sample was weighed into it and 200ml of 10% acetic acid in ethanol was added, covered and was then permitted to fight

for 4hrs. The combination was separated and a water shower was utilized to think the concentrate to one-fourth of the underlying volume, to the concentrate, drops of concentrated NH_4OH was added to finish precipitation. The entire arrangement was permitted to settle, at that point the hasten was gathered from there on washed with weaken NH4OH and afterward sifted (Harborne, 1973). The buildup which is the alkaloid was then dried and gauged. The level of the alkaloid was communicated numerically as:

$$\% \text{ Alkaloids} = \frac{\text{Weight of Alkaloids} \times 100}{\text{Weight of the sample}}$$

Saponin determination: 20 g of each sample grounded were placed into a tapered jar from there on, 100 cm^3 of 20% watery ethanol was added. Water shower was utilized to warm the examples at 55°C for 4 h with consistent mixing. After filtration of the blend, another 200 ml, 20% ethanol was utilized for re-extraction of the buildup. Water shower at about 90°C was utilized to lessen the joined concentrates (Nagai *et al*., 1971). The examples were dried after vanishing in the stove to steady weight; the saponin content was communicated numerically as:

$$\% \text{ Saponin} = \frac{\text{Weight of saponin} \times 100}{\text{Weight of sample}}$$

Flavonoid determination: 100 ml of 80% aq methanol was utilized to extricate 10g of the plant test over and again at room temperature. At that point the entire arrangement was separated. A cauldron was utilized to gather the filtrate and it was vanished to dryness and weighed to a consistent weight (Boham and Kocipai-Abyazan, 1974). The level of flavonoids was determined as:

$$\% \text{ Flavonoids} = \frac{\text{Weight of flavonoids} \times 100}{\text{Weight of the sample}}$$

Tannin determination: In a 50 ml plastic jug, 500 mg of the sample was weighed into it and it was shaken with 50 ml of refined water for 1hr. This was sifted into a 50 ml volumetric cup. 5 ml of the filtrate was blended in with 2 ml of 0.1M FeCl3 in 0.1N HCl and 0.008 M potassium Ferrocyanide in a test tube. The absorbance was taken at 120 nm inside 10 min. Absorbance versus tannic corrosive focus was plotted (Van-Burden and Robinson, 1981). The convergence of tannic corrosive was communicated numerically as:

$$\text{Tannic acid (mg/100g)} = \frac{\text{Con} \times \text{volume of extract} \times 100}{\text{Aliquot volume} \times \text{weight of sample}}$$

Where C is the concentration of tannic acid

Determination of total phenols by the spectrophotometric method (Shaghaghi *et al*., 2008): 50 ml of ether was utilized to heat up the sans fat example for the extraction of the phenolic constituent for 15 min. 5 ml of the concentrate, 10ml of refined water, 2 ml of NH4OH arrangement and 5 ml of concentrated amyl liquor was pipetted into a 50 ml flagon. The shading development was seen inside 30mins. The absorbance was taken at 505 nm

Determination of Cardiac glycoside (Van-Burden and Robinson, 1981): 100mg of the plant removed was hydrolyzed in a bubbling cylinder with 5ml of 2.5 N HCL utilizing a water shower for a time of 3hours. It was then left to cool at room temperature and strong sodium carbonate was added until foam stopped. The subsequent substance was then centrifuged and the supernatant gotten was made up to 1ml with phenol reagent. The cylinder was kept at 25-30OC for 20min and absorbance was perused at 490nm.

Proximate analyses: Drying method was used to ascertain the moisture content of *Solanum nigrum* leaf sample according to the procedure described in (AACC, 2000). Kjeldahl's method was used to analyse the crude protein content according to the method described by (AOAC, 1990). Percentage crude protein in the sample was calculated by multiplying Nitrogen content by 6.2 (AOAC, 1990) Total carbohydrate was described by (OTIENO *et al*., 2019) method. The crude fat analysis was described according to the (AACC, 2000) method while crude fibre and ash contents were also determined by the (AOAC, 1990) methods**.**

Statistical analysis

Each experiment was done in triplicates. The results were presented with their means and standard deviations. All data collected were subjected to a one-way analysis of variance (one-way ANOVA) to test for significant differences and analyzed by Graph pad prism statistical software.

RESULTS

Qualitative analysis of *Solanum nigrum*: The presence or absence of phytochemicals was determined using qualitative tests and the results are shown in Table 1.

Quantitative analysis of *Solanum nigrum:* Quantitative evaluation of phytochemicals in the aqueous extract of *Solanum nigrum* leaf (Table 2) showed phenol to be present in the highest concentration (38.17±0.33mg/100g); followed by terpenoid, flavonoids, tannins, cardiac glycosides and saponins in descending order. Alkaloids had the least concentration (12.61±0.81mg/100g).

Table 1:
Qualitative phytochemical screening of Solanum nigrum leaf

Phytochemical	Result
Alkaloid	+
Saponin	+
Flavonoid	+
Anthraquinone	-
Tannin	+
Steroid	-
Phenol	+
Terpenoid	+
Cardiac glycoside	+

Where; + = presence and - = absence of phytochemical

Proximate analysis of *Solanum nigrum*: Proximate analyses of dried *Solanum nigrum* leaf was carried out using standard methods and results are presented in Table 2. Carbohydrate and crude fibre contents of *S. nigrum* were high (71.91±0.43 and 20.23±0.19% respectively) while, lipid and protein contents were low.

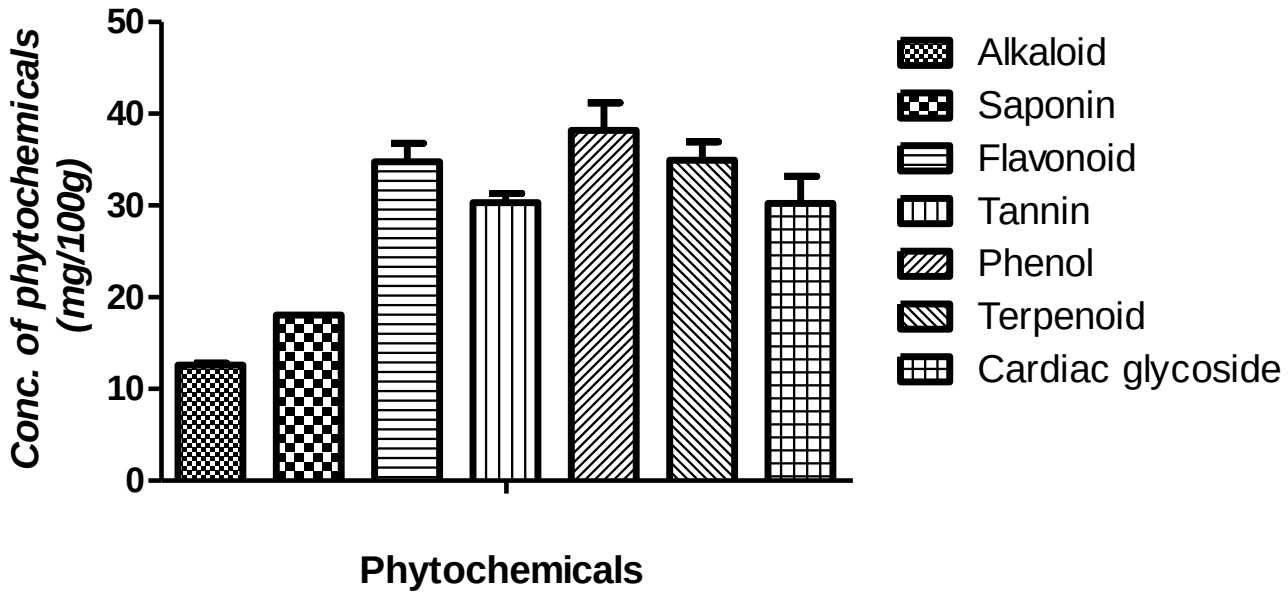

Figure 1:
Quantitative evaluation of phytochemicals in *Solanum nigrum* leaf. The data represents mean of three replicates.

Table 2:
Proximate composition of Solanum nigrum leaf

Parameter	% composition (Dry weight)
Carbohydrate	71.91±0.43
Protein	2.21±0.06
Crude fat	0.49±0.10
Moisture	1.65±0.09
Ash	3.49±0.17
Crude fibre	20.23±0.19

Values are mean ± S.D of triplicate determination.

DISCUSSION

Our study revealed that the phytochemicals-phenols, tannins, flavonoids, glycosides, terpenoids, saponins, and alkaloids-were present in the aqueous extract of *S. nigrum*, but anthraquinine and steroids were not detected. Studies by (Modilal *et al*., 2015) on *S. nigrum* collected from in and around Chennai, India showed the presence of alkaloids, tannins, flavonoids and steroid; whereas, terpenoids, saponnins, phlobatannins and phenol were absent. Another report by (Gogoi and Islam, 2012) on the aqueous extract of the plant from 3 Districts of Upper Assam, India indicated the presence of alkaloid, saponin, tannins and flavonoids with higher quantities of the phytochemicals in plants from shady areas compared to those from dry areas. Aqueous extract of *S. nigrum* from Bhimber, Pakistan (Mazher *et al*., 2016) also contained tannins, flavonoids, saponins, terpenoids and alkaloids, and similar to our finding, anthraquinones were absent. However, contrary to our findings, steroids were present. A study from Bangladesh also showed the presence of tannins, alkaloids, flavonoids and saponins in the plant from all three districts studied (Ashrafudoulla *et al*., 2016). This indicates a high level of consistency in the phytoconstituents of *S. nigrum*. The presence of alkaloids, saponin, flavonoids, tannins, phenol, terpenoids, and cardiac glycosides in *Solanum nigrum* depicts their pharmaceuticals and therapeutic value, these findings correlate with that of (Akinleye *et al*., 2020) and (Warrier *et al*., 2002).

. A quantitative study by (Oduse *et al*., 2012) on vegetables from Abeokuta in Ogun state, South-West Nigeria, reported flavonoids, tannins and alkaloids in the concentrations 29.00, 10.50 and 9.10 mg/Kg respectively. The presence of six different glycoalkaloids- solamargine, solasonine solanine, α- and β-solamagrine, and solasodinsolanidine have been quantified in the fruit of *S. nigrum* (90-650mg/100g) but only the first two compounds were reported in the leaf. Their concentrations were reported to be modified by soil type and climate (Chauhan *et al*., 2012).

The presence of tannin in *Solanum nigrum* leaves accounts for its astringent properties and its physiological role in treating wounds (Sodipo *et al*., 2008). Tannins have been reported to prevent the development of micro-organism through precipitation by aqueous extract of *Solanum nigrum* leaves (Sodipo *et al*., 2008). Phenols in *Solanum nigrum* exhibit antiviral, antimicrobial, hypotensive and antioxidant properties(Štochmaľová *et al*., 2018). Terpenoids in *Solanum nigrum* leaves have shown anti-hepatotoxic properties which may explain the use of the *Solanum nigrum* in the treatment of various diseases (liver diseases, pneumonia, stomach disorder as claimed by various researchers such as(Štochmaľová *et al*., 2018, Saikia *et al*., 2019) Alkaloids stimulate the nervous systems and could raise blood pressure or brings it down while

some alkaloids act as tranquillizers pain, relievers etc. (Rhoades, 2015).

Cardiovascular glycosides in Solanum nigrum are known to repress the Na+/K+ siphon. Expansions in the quantity of calcium particles usable for the compression of the heart muscle is brought about by restraint, which enhances cardiovascular yield and lessens enlargement of the heart; consequently, they are utilized in the treatment of congestive cardiovascular breakdown and heart arrhythmia. Flavonoids render mitigating action (Okwu, 2004). This may clarify why Solanum nigrum is utilized for the treatment of consumes, ulcer and wounds in natural medication.

The determination of the proximate constituents is necessary for assessing the nutritional quality of the leaf which is a commonly consumed vegetable in south-east Nigeria (Akubugwo *et al*., 2007). There are very few reports on the proximate composition of *S. nigrum* leaf. *Solanum nigrum* from South Africa was reported to be low in carbohydrate (20.0%) but high in fibre (26.9 ± 0.0%), ash (12.4 ± 0.5 %) and protein (32.3 ± 1.6%) (Akubugwo *et al*., 2007). *Solanum nigrum* from India (Ali *et al*., 2016) also had higher moisture (9.7%), ash (12.9%) protein (15.12%) and fat (3.98%), but lower carbohydrate (25.4%) and crude fibre (14.32%). In another report from India showed higher protein (12.8%) and fat (4.19%) were reported, but comparative amounts of carbohydrate (71.74%) and crude fibre (20.24%) was similar to our study. Thus, the nutrient composition of *S. nigrum* varies from place to place. Soil type has been shown to significantly affect the nutrient composition of the plant (Ogundola *et al*., 2018). Our study, therefore supports the other reports that *S. nigrum* is a good source of fibre and carbohydrate. Adequate intake of dietary fibre lowers serum cholesterol level, and thus, reduces the incidence of heart diseases, hypertension, constipation, diabetes, and breast cancer (Ishida *et al*., 2000).

From the results of the phytochemical analysis, we can conclude that the leaf of *Solanum nigrum* obtained from Ojo area of Lagos, South-West Nigeria, is an important source of phytochemicals such as alkaloids, saponin, flavonoids, tannins, phenol, terpenoids, and cardiac glycoside which are in accord with their use in ethnomedicine as anti-inflammatory, hepatoprotective, and anti-oxidant agents. This research also shows that *Solanum nigrum* leaf is nutritious. They provide a sufficient amount of nutrients such as carbohydrates, crude fibre, but low in fat. This is justifiable because vegetables are generally a poor source of fat which makes them good for obese people.

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