PRINT ISSN 1119-8362
Electronic ISSN 2659-1499

Full-text Available Online at
https://www.ajol.info/index.php/jasem
https://www.bioline.org.br/ja

J. Appl. Sci. Environ. Manage.
Vol. 28 (10) 3097-3102 October, 2024

Evaluation of Phytochemical, Proximate and Mineral Contents of Leaves and Stem of Potato Tree (*Solanum erianthum*) sourced from Botanical Garden in Ibadan, Oyo State, Nigeria

ALAWODE, TT

Department of Chemistry, Federal University Otuoke, Bayelsa State, Nigeria

**Corresponding Author Email: onatop2003@yahoo.com*
**ORCID: http://orcid.org/0000-0002-8671-8632*
**Tel: +234-7056712384*

ABSTRACT: The objective of this paper is to evaluate the phytochemical, proximate and mineral contents of leaves and stem of Potato tree (*Solanum erianthum*) sourced from Botanical Garden in Ibadan, Oyo State, Nigeria using appropriate standard methods. The phytoconstituents detected in the hexane, ethyl acetate, and methanol extracts included alkaloids, saponins, flavonoids, tannins and glycosides. The crude protein contents of the leaves and the stem were 25.52% and 15.31 %, respectively. The crude fibre content of the leaves was 33.5% while that of the stem was 73.5%. The carbohydrate contents of the leaves and the stem were 29.68 % and 4.62%, respectively. The potassium content obtained for the leaves was 1128 mg/100g while that of the stem was 528 mg/100g. The magnesium contents of the leaves and stem were 356 mg/100g and 216 mg/100 g, respectively. The calcium content of the leaves and stem of the plant were 300 mg/100g and 191 mg/100, respectively. In addition, the iron content of the leaves and the stem were22.46mg/100g and 16.89 mg/100g, respectively. The results show that apart from their medicinal uses, the leaves and stem of the plant are potential food sources.

DOI: https://dx.doi.org/10.4314/jasem.v28i10.18

License: CC-BY-4.0

Open Access Policy: All articles published by **JASEM** are open-access articles and are free for anyone to download, copy, redistribute, repost, translate and read.

Copyright Policy: © 2024. Authors retain the copyright and grant **JASEM** the right of first publication. Any part of the article may be reused without permission, provided that the original article is cited.

Cite this Article as: ALAWODE, T. T. (2024). Evaluation of Phytochemical, Proximate and Mineral Contents of Leaves and Stem of Potato Tree (*Solanum erianthum*) sourced from Botanical Garden in Ibadan, Oyo State, Nigeria. *J. Appl. Sci. Environ. Manage.* 28 (10) 3097-3102

Dates: Received: Received: 07 July 2024; Revised: 15 August 2024; Accepted: 19 August 2024 Published: 05 September 2024

Keywords: *Solanum erianthum*; phytochemical; proximate; minerals; Potato Tree

Traditional medicine has continued to play an important part in the health systems of many countries in the world. A large percentage of the world's population (especially in developing countries) relies on traditional medicine to treat various diseases(Msomi and Simelane, 2019). *Solanum erianthum* is commonly found in parts of South America, the United States, and the tropical regions of the world. Traditionally, leaf extracts are used to treat malaria, leprosy, liver disorders and infectious diseases. The volatile oils from the plant's leaves inhibited human breast (Hs578T) and prostate (PC-3) tumour cells (Sharifi-Rad *et al*., 2017). The oils also demonstrated antimicrobial activity (Essien*et al*., 2012). Various compounds have been isolated from the hexane fraction of the root of the plant(Chen *et al*., 2013). Despite their usefulness in treating diseases, medicinal plants have inherent nutritional values. Therefore, the objective of this paper is to evaluate the phytochemical, proximate and mineral contents of the leaves and stem of Potato tree (*Solanum erianthum*) sourced from Botanical Garden in Ibadan, Oyo State, Nigeria

MATERIALS AND METHODS

Sample Collection and Extraction: Fresh leaves and stem samples of *Solanum erianthum* were collected from the Botanical Gardens of the University of

**Corresponding Author Email: onatop2003@yahoo.com*
**ORCID: http://orcid.org/0000-0002-8671-8632*
**Tel: +234-7056712384*

Ibadan, andwere authenticated by Mr. Owolabi, a taxonomist working with the Garden. The samples were air-dried under gentle sunlight for three weeks. A 1kg portion ofeach of the leaves and stem was extracted sequentially using hexane, ethyl acetate and methanol. The extracts were concentrated to dryness using a rotary evaporator. The percentage yields of the concentrated extracts were calculated.

Phytochemical Screening on Extracts: Standard protocols were employed in carrying out phytochemical screening of the extracts. A brief description of each test is below:

Test for Tannins: Two (2) drops of 5% $FeCl_3$ were added to 1 ml of each extract. A positive test was indicated by the formation of a dirty green precipitate (Dubale*et al*., 2023).

Test for Glycosides: To 1 ml of each extract in a test tube, 10 ml of 50% H_2SO_4 was added and the mixture was heated for 5 minutes. Subsequently, 10 ml of Fehling's solution was added and the mixture was boiled. A brick-red precipitate signified a positive test (Dubale *et al*., 2023).

Test for Resins: To 2.5 ml of each extract was added to an equal volume of Copper (II) Sulphate solution. The solution was shaken and was then left to settle. A positive test was indicated by a green colour (Edeoga *et al*., 2005).

Test for Saponins (Frothing Test): Each extract (2 ml) was vigorously shaken with water in a test tube for two minutes. The formation of froth indicated a positive test (Dubale *et al*., 2023).

Test for Phlobatannins: Five (5) ml of each extract was added to an equal volume of distilled water and then boiled with 1% HCl for a few minutes. A deep green colour indicated a positive test (Edeoga *et al*., 2005).

Test for Flavonoids: Each extract (2 ml) was added to 10 ml of ethyl acetate. The mixture was heated and then allowed to cool. After the layers separated, a red colouration in the ammonia layer indicated a positive test (Dubale *et al*., 2023).

Test for Sterols (Salkowski's Test): To 2 ml of each extract, 2 ml of concentrated H_2SO_4 was added. The formation of a red precipitate indicated a positive test (Dubale *et al*., 2023).

Test for Phenols: Each extract was mixed with an equal volume of $FeCl_3$. A deep bluish-green solution confirmed the presence of phenols (Dubale*et al*., 2023).

Test for Carbohydrates: Five (5) ml of a mixture of Fehling's solution A and B was added to 2 ml of each extract, and the resultant mixture was boiled. A brick-red precipitate of copper oxide indicated a positive test (Ekpo and Etim, 2009).

Test for Alkaloids: To 3 ml of each extract, 1 ml of concentrated H_2SO_4 was added, followed by a few drops of Wagner reagent. A reddish-brown precipitate indicated a positive test (Dubale *et al*., 2023).

Test for Terpenoids (Salkowski's Test): Each extract (0.2 g) was mixed with 2 ml of chloroform ($CHCl_3$), and 3 ml of concentrated H_2SO_4 was carefully added to form a layer. A reddish-brown colouration at the interface indicated a positive result for terpenoids (Dubale *et al*., 2023).

Proximate and Mineral Analysis of Plants: Proximate analysis (total ash, moisture, crude fibre, protein and fat contents) was conducted by standard methods of the Association of Official Analytical Chemists (AOAC, 1990). A description of the procedures adopted is given below:

Determination of Moisture Content: A crucible was dried in an oven and then allowed to cool in a desiccator. The weight of the crucible was measured and recorded as W_1.A 1g sample was placed in the crucible, and the combined weight of the sample and crucible was recorded as W_2.The crucible containing the sample was then placed in an oven set to 105°C and left for 2-3 hours, or until a constant weight was achieved.After drying, the combined weight of the dried sample and crucible was recorded as W_3.The percentage of moisture content in the sample was calculated using the following formula (Equation 1)

$$\% \, Moisture \ Content = \frac{W_2 - W_3}{W_2 - W_1} \times 100 \qquad (1)$$

Determination of Ash Content: A crucible was dried in an oven, cooled in a desiccator, and its weight was recorded as W_1.A 2g portion of the sample was placed in the crucible, and the combined weight of the sample and crucible was recorded as W_2.The crucible containing the sample was heated in a muffle furnace at a temperature between 500°C and 600°C for 4-5 hours, until the sample turned slightly whitish.The weight of the crucible and the sample after ashing was recorded as W_3.The percentage of ash content was calculated using the following formula (Equation 2):

$$\% \, Ash = \frac{W_3 - W_1}{W_2 - W_1} \text{x } 100 \quad (2)$$

Determination of Crude Protein Content: A 2g sample was placed in a heating tube and mixed with 10 ml of concentrated sulfuric acid (H_2SO_4).One selenium catalyst tablet was added to the mixture, and the tube was heated inside a fume cupboard.The resulting digest was transferred into distilled water.A 10 ml portion of the digest was combined with an equal volume of 45% sodium hydroxide (NaOH) solution and then poured into a Kjeldahl distillation apparatus. The mixture was distilled, and the distillate was collected into a solution of 4% boric acid containing three (3) drops of methyl red indicator.A total of 50 ml of distillate was collected and titrated.The procedure was duplicated for accuracy, and the average value was used.The nitrogen content of the sample was calculated and then multiplied by 6.25 to obtain the crude protein content (Equation 3)

$$\% \, Nitrogen = \frac{(100 \times N \times 14 \times VF)T}{100 \times V_a} \quad (3)$$

Where: N= Normality of the titrate (0.1N); VF= Total volume of the digest= 100 ml; T= Titre Value; Va= Aliquot Volume distilled

Determination of Fat Content: A 0.5 g sample was placed into Whatman filter papers and securely positioned inside a Soxhlet extractor. The initial weight of a 250 ml round-bottom flask was recorded as W_1. Petroleum ether, with a boiling point range of 40-60°C, was added to the flask until it reached approximately two-thirds of the flask's volume. The combined weight of the flask and petroleum ether was noted as W_2. The extraction setup was then heated on a mantle, allowing the solvent to reflux for 4-6 hours. Following extraction, the condenser was removed, and the final weight of the flask was measured and recorded as W_3 (Equation 4).

$$\% \, Fat = \frac{W_3 - W_2}{W_2 - W_1} \text{x } 100 \quad (4)$$

Determination of Crude Fibre Content: A 0.4 g portion of the defatted sample was placed in a pre-weighed conical flask. To this, 25 ml of dilute sulfuric acid was added, and the mixture was boiled for 30 minutes. The mixture was then filtered through filter paper, and the residue was collected into another conical flask.

The residue was treated with 100 ml of dilute sodium hydroxide solution and boiled for an additional 30 minutes. The mixture was again filtered, and the residue was washed thoroughly with hot distilled water, followed by rinsing four times with distilled water, once with 10% HCl, and then again with hot distilled water. The residue was further rinsed twice with ethanol and three times with petroleum ether. After draining off the liquid, the residue was transferred to a pre-weighed crucible, and the initial weight was recorded as W_1. The sample was then dried in an oven at 105°C until a constant weight was achieved. After drying, the sample was placed in a desiccator to cool, and the weight was measured as W_2. Finally, the sample was subjected to ashing in a muffle furnace at approximately 300-400°C for 1 hour. The crucible containing the ash was allowed to cool, and the final weight was recorded as W_3 (Equation 5).

$$\% \, Crude \, Fibre = \frac{W_2 - W_3}{W_1} \text{x } 100 \quad (5)$$

Determination of Carbohydrate Content: The carbohydrate content was calculated by subtracting the measured amounts of protein, fat, ash, and water from the total weight of the sample.

Mineral Analysis of the Leaves and Stem of Solanum erianthum: Eleven (11) grams of each sample were weighed and placed in crucibles. The samples were then ashed in a muffle furnace at 550°C for 3 hours and allowed to cool in a desiccator.

The resulting white ash was dissolved in 5 ml of 20% v/v HCl solution with gentle heating for 30 minutes. The clear solution obtained was filtered and diluted to a concentration suitable for analysis. The mineral content of the samples was determined using an Atomic Absorption Spectrophotometer, as described by Akintelu and Amoo (2016).

RESULTS AND DISCUSSION

The leaves and bulbs of the plant were extracted sequentially using hexane (a non-polar solvent), ethyl acetate (a solvent of medium polarity) and methanol (a polar solvent). Owing to differences in the polarities of the solvents, the phytoconstituents in the leaves and stem samples would be distributed among the three solvents according to their polarities.

The percentage yields of the different extracts obtained from the leaves and stem samples of *Solanum erianthum* are shown in Table 1. Table 2 shows the results obtained on carrying out phytochemical analysis on the extracts.

Phytochemicals are responsible for the biological activities observed in plants and are known to confer various health benefits.

Table 1: Percentage yield of Extracts

Extract	Yield (%)
SELHE	0.56
SELEE	1.25
SELME	2.88
SESHE	0.04
SESEE	0.48
SESME	0.56

SELHE- S. erianthum Leaves Hexane Extract; SELEE - S. erianthum Leaves Ethyl acetate Extract; SELME - S. erianthum Leaves Methanol Extract; SESHE - S. erianthum Stem Hexane Extract; SESEE - S. erianthum Stem Ethyl acetate Extract; SESME -S. erianthum Stem Methanol Extract

For instance, saponins are recognized as anti-nutritional compounds that can reduce the absorption of cholesterol and glucose, in the digestive tract, indicating potential applications in the treatment of diabetes and cardiovascular diseases. Alkaloids, on the other hand, demonstrate antioxidant, muscle relaxant, antimicrobial, anticancer, and amoebicidal properties (Ibrahim *et al*., 2022).

The findings of the proximate and mineral analyses for the various plant parts are presented in Table 3. The percentage of moisture, crude protein, ash and carbohydrate contents obtained for the leaves are 0.48%, 25.52%, 10.80 %, and 29.68%, respectively. These values are higher than those obtained for the stem which had values of 0.10%, 15.31%, 6.91%, and 4.62% for moisture, crude protein, ash, and carbohydrates contents, respectively. However, the stem had a higher crude fibre content (73.5%) than the leaves (33.5%). A previous study reported the moisture, crude protein, ash, crude fibre, and carbohydrate contents of the leaves of *Solanum erianthum* as 21.87%, 13.55%, 19.23%, 9.56% and 33.00%, respectively (Uzoekwe *et al*., 2021). These values are different from those obtained in the present study. Literature has shown that the same plant growing in different geographical locations have differing phytochemical, proximate and minerals contents (Khattak *et al*., 2015; Lamidi *et al*., 2017; Okeke *et al*., 2021).

Table 2: Phytoconstituents of Extracts

TESTS	SESHE	SESEE	SESME	SELHE	SELEE	SELME
Tannins	-	+	-	+	+	+
Glycosides	-	-	+	+	-	-
Resin	-	+	+	+	+	+
Saponins	+	+	-	+	+	+
Phlobatannins	-	-	-	-	+	+
Flavonoids	+	-	+	+	+	-
Sterols	-	-	-	+	+	+
Phenols	+	+	+	+	+	+
Carbohydrates	-	-	+	+	-	-
Alkaloids	+	+	-	+	+	+
Terpenoids	-	+	-	+	-	+

+ = Present; - = Absent; SELHE- S. erianthum Leaves Hexane Extract; SELEE - S. erianthum Leaves Ethyl acetate Extract; SELME - S. erianthum Leaves Methanol Extract; SESHE - S. erianthum Stem Hexane Extract; SESEE - S. erianthum Stem Ethyl acetate Extract; SESME - S. erianthum Stem Methanol Extract

Table 3: Proximate and Mineral Analysis of the Plants Parts

Compositions	SEL ± SD	SES ± SD
Moisture (%)	0.48 ± 0.01	0.10 ±0.02
Crude protein (%)	25.52 ± 0.00	15.31 ± 0.02
Ash (%)	10.80 ± 0.02	6.19 ± 0.01
Crude Fibre (%)	33.50 ± 0.02	73.50 ± 0.02
Crude Fat (%)	0.02 ± 0.00	0.28 ± 0.00
Carbohydrate (%)	29.68 ± 0.02	4.62 ± 0.03
K (mg/100 g)	1128.00 ± 0.32	528.00 ±0.12
Ca(mg/100 g)	300.00 ± 0.30	191.00 ± 0.03
Mg (mg/100 g)	356.00 ± 0.18	216.00 ± 0.15
Fe (mg/100g)	22.46 ± 0.01	16.80 ± 0.02
Cu (mg/100g)	0.88 ± 0.01	0.48 ± 0.01
Zn (mg/100g)	7.36 ± 0.02	2.24 ± 0.02

**Data are mean duplicate results ± standard deviation (SD); SEL-S. erianthum leaves; SEL-S. erianthum stem*

The results show that the leaves and stem contained high amounts of carbohydrate and crude fibre, respectively. The leaves could be a good energy source; energy is required to drive cellular metabolism. The stem, which is high in dietary fiber, can help lower the risk of cardiovascular disease and arteriosclerosis, as well as increase intestinal transit time (Soliman, 2019). The ash content is a measure of the mineral content of the sample. The leaves likely have a higher mineral content than the stem. The moisture content of the dried leaves is slightly higher than that of the dried stem, indicating that the shelf life of the leaves might be lesser compared to the stem. The crude fibre and protein contents of the leaves and

the stem indicate that they might be useful as dietary and protein food supplements.

The Calcium, Potassium, Magnesium, Zinc, Iron and Copper contents of the leaves are 1128 (mg/100g), 300 (mg/100g), 356 (mg/100g), 22 (mg/100g), 0.88(mg/100g) and 7.36 (mg/100g), respectively. These values are higher than those obtained for the stem: 528 (mg/100g), 191 (mg/100g), 216 (mg/100g), 16.8 (mg/100g), 0.48 (mg/100g), and 2.24 (mg/100g), for Potassium, Calcium, Magnesium, Iron, Copper and Zinc contents, respectively (Anyasor *et al*., 2014).

Minerals play a crucial role in maintaining the body's normal physiological functions (Aliyu *et al*., 2008). Potassium, in particular, is essential for regulating osmotic pressure and maintaining the body's acid-base balance (Phetrittikun *et al*., 2023). Magnesium helps promote biological structure and is a cofactor for enzyme activation (Ahmed *et al*., 2023). Copper is a catalyst for oxidizing ascorbic acid and unsaturated fats and oils (Hamada, 1995). Iron is important for its role in oxygen and electron transport, while Zinc is vital for the production of hormones (Irabor *et al*., 2023).

Conclusion: The results show that the leaves and stem of *Solanum erianthum* contain different phytochemicals. These chemicals are likely responsible for the medicinal properties of the plant. In addition, the leaves and stem of the plant are rich in crude fibre, crude protein and carbohydrates. Both parts also have high mineral content. The results from this study show that apart from their medicinal properties, the leaves and stem of *Solanum erianthum* could be food sources.

Declaration of Conflict of Interest: The authors declare no conflict of interest

Data Availability Statement: Data are available upon request from the corresponding author.

REFERENCES

Ahmed, N; Zhang, B; Bozdar, B; Chachar, S; Rai, M; Li, J; Li, Y; Hayat, F; Chachar, Z; Tu, P (2023). The power of magnesium: unlocking the potential for increased yield, quality, and stress tolerance of horticultural crops. *Front. Plant. Sci.* 14: 1285512.

Akintelu, MT; Amoo, IA (2016).Proximate, Characterisation and Physicochemical Properties of Raw and Boiled Milk Bush (*Thevetia peruviana*) Seed. *Int. J. Sci*. 5(3).

Aliyu, AB; Musa, AM; Oshanimi, JA; Ibrahim, HA; Oyewale, AO (2008). Phytochemical analyses and mineral elements composition of some medicinal plants of north Nigeria. *Niger J Pharm Sci*. 7:119–25.

Anyasor, GN; Onajobi FD;Osilesi, O; Adebawo, O (2014) Proximate composition, mineral content and in vitro antioxidant activity of leaf and stem of *Costusafer* (Ginger lily). *J. Inter. Ethnopharmacol*. 3(3): 128–134.

Association of Analytical Chemists. (1990). Official Methods of Analysis, 15th ed.; AOAC: Washington, DC, USA, pp. 1121–1180.

Chen, Y; Lee, H; Chen, H; Wen, C; Kuo, Y; Wang, G (2013). Anti-Inflammatory componentsfrom the root of *Solanumerianthum*. *Int. J. Mol. Sci*.14:12581-12592

Dubale S; Kebere, D; Zeynudin, A; Abdissa, N; Suleman, S (2023). Phytochemical Screening and Antimicrobial Activity Evaluation of Selected Medicinal Plants in Ethiopia. J. Exp. Pharmacol. 15:51–62.

Edeoga, HO; Okwu, DE; Mbaebie, BO (2005). Phytochemical constiuents of some Nigerian medicinal plants. *Afr. J.Biotechnol*. 4(7): 685-688.

Ekpo, MA; Etim, PC (2009). Antimicrobial activity of ethanolic and aqueous extracts of *Sida acuta* on microorganisms from skin infections. *Journal of Medicinal Plant Research*. 3(9):621-624.

Essien, EE; Ogunwande, IA; Setzer, WN; Ekundayo, O (2012). Chemical composition, antimicrobial, and cytotoxicity studies on *S. erianthum* and *S. macranthum* essential oils. *Pharm. Biol.* 50(4):474–480

Hamada, T (1995). Antioxidant and prooxidant roles of copper in Tween 20-induced hemolysis of hamster and pig erythrocytes containing marginal vitamin E. *Experientia*. 51:572–6.

Ibrahim, TA; Hassen, A; Apostolides, Z (2022). The Antimethanogenic Potentials of Plant Extracts: Their Yields and Phytochemical Compositions as Affected by Extractive Solvents. *Plants*. 11(23): 3296.

Irabor, EEI; Eze, PN; Unuigbe, CA; Imafidon, MI; Omoruyi, U; Emmanuel, V (2023). Proximate Analysis and Mineral Determination of *Calliandra surinamensis* Seed. *J. Chem. Soc. Nigeria*,

48(1):183 - 191.

Khattak KF; Rahman TR. (2015). Effect of geographical distributions on the nutrient composition, phytochemical profile and antioxidant activity of Morusnigra. *Pak J Pharm Sci*. 28(5):1671-8.

Lamidi, WA; Murtadha, MA; Ojo, DO (2017). Effects of Planting Locations on the Proximate Compositions of *Moringa oleifera* leaves. *J. Appl. Sci. Environ. Manage.* 21(2): 331-338.

Msomi, NZ; Simelane, MBC (2019). Herbal Medicine. IntechOpen. doi: 10.5772/intechopen.72816

Okeke, HC; Okeke, O; Nwanya, KO; Offor, CR; Aniobi, CC (2021). Comparative Assessment of the Proximate and Mineral Composition of *Cucumissativus* L. and *Solanumaethiopicum* L. Fruit Samples Grown in South Eastern and North Central Regions of Nigeria Respectively. *Nat.Resour*. 12(8): 237-249.

Phetrittikun, R; Suvirat, K; Horsiritham K; Ingviya, T; Chalchulee, S (2023). Prediction of Acid Base and Potassium Imbalances in Intensive Care Patients Using Machine Learning Techniques. *Diagnostics*. 13(6): 1171

Sharifi-Rad, J; Sureda, A; Tenore, GC; Daglia, M; Sharifi-Rad, M; Valussi, M; Tundis, R; Sharifi-Rad, M; Loizzo, MR; Ademiluyi, AO; et al. (2017.)Biological Activities of Essential Oils: From Plant Chemoecology to Traditional Healing Systems. *Molecules*. *22*, 70. https://doi.org/10.3390/molecules22010070.

Soliman, GA (2019). Dietary Fiber, Atherosclerosis, and Cardiovascular Disease. *Nutrients*. 11(5):1155. doi: 10.3390/nu11051155.

Uzoekwe, NM; Ukhun, ME; Ejidike, P (2021). Proximate Analysis, Vitamins, Moisture Content and Mineral Elements Determination in Leaves of *Solanum erianthum* and *Glyphae abrevis*. *J. Chem. Soc. Nigeria*. 4(6): 0149 - 0159