Nigerian Research Journal of Chemical Sciences, Vol. 6, 2019

PHYTOCHEMICAL, PHYSICO-CHEMICAL ANALYSIS AND NUTRITIONAL VALUE OF *SOLANUM INCANUM* LEAVES (BITTER GARDEN EGG LEAVES)

*[1]IBRAHIM, D., [1]MUSA, M.H., AND [2]ABDULLAHII, S. U.

[1]National Research Institute for Chemical Technology, Basawa, Zaria, Nigeria

[2]Federal Polytechnic, Offa, Kwara State, Nigeria

*Corresponding author: thrbrhm@gmail.com

ABSTRACT

Chemical analyses were carried out to investigate the nutritional and medicinal values of bitter garden egg leaves when air dried and when fresh. Proximate analysis showed that moisture, protein, lipid, fibre, carbohydrate and ash content decreased when air dried from 93.00 ± 2.1 to 90.14 ± 0.80, 7.9 ± 0.22 to 5.50 ± 0.06, 8.4 ± 0.21 to 7.8 ± 0.07, 6.9 ± 0.30 to 6.00 ± 0.05, 40.56 ± 0.27 to 49.14 ± 0.25 and 20.69 ± 0.92 to 20.26 ± 0.90 respectively. Presence of flavonoids, steroids, tannins, alkaloids, Phenols, saponins, and anthroquinones were observed. The mineral compositions were as well investigated which also decreased from the fresh to air dried leaves- Sodium: 14.11 to 12.07 mg/L, potassium: 3.94 to 3.71 mg/L, phosphorous: 1.57 to 1.53 mg/L, magnesium: 0.031 to 0.03 mg//L, zinc: 0.82 to 0.30 mg/L and calcium: 2.70 to 1.24 mg/L. The temperature also affected the physicochemical properties of the sample such that pH changed from 14.70 to 11.10, conductivity changed from 8.94 to 2.85 µs/Cm, and colour value decreased from 69.40 to 58.00 Pt/Co

Keywords: Turbidity, minerals, physicochemical, phytochemical, proximate analysis.

INTRODUCTION

Solanium incanum are mostly grown in Northern part of Nigeria [1]. In the western and northern parts of Nigeria, they are either eaten raw or cooked in making stew or soups [2]. Bitter garden eggs are highly valued content of Nigerian food which is mostly consumed in both rural and urban area due to their nutritional and medicinal value. In Hausa, it is known as ‘Gauta’; Igbos calls it ‘afufa or anara’; Yorubas call it ‘igbagba’ Babur-Bura ‘targu’ [3]. In some parts of the country, the eggplant is domesticated along with leaves to be used as vegetables or traditional medicine [4, 5]

The uses of the leaves as indigenous medicine ranges from weight loss, treatment of asthma, allergic rhinitis, nasal catarrh, skin infections, rheumatic disease and swollen joint points,

constipation, dyspepsia [6, 7]. These pharmacological properties of the leaves have been attributed to some useful chemicals in the leaves such as phenols, flavonoids, saponins, anthocyanin, fiber, alkaloids, oxalate, tannins, terpenoids, phlobatanins, anthroquinones [8, 9].

In this study, proximate, phytochemical screening and physicochemical properties of bitter garden egg leaves, air dried and fresh, were analyzed in order to assess their potential medicinal and nutritive values

MATERIALS AND METHODS

Sample collection

The *Solanum incanum* leaves were obtained from Sabon Gari Local Government Area, Kaduna State, Nigeria. The sample was immediately transported to National Research Institute for Chemical Technology, Basawa-Zaria for further identification and analysis.

Fig 1: Bitter Garden Egg Leaves

Sample treatment

The sample was first washed thoroughly with distilled water to remove dirty and other impurities that might be present and residual moisture allowed to evaporate at room temperature. The sample was divided in to two portions (Air dry and fresh sample). The first portion was allowed to dry at room temperature for 5 days and ground to fine powder using mortar and pestle. The other portion (fresh sample) was chopped into small pieces with knife in its fresh form and preserved for analysis.

Physicochemical Analysis

Some physicochemical parameter of the bitter garden egg leaves were determined such as the pH, turbidity, conductivity, and colour using standard method according to [4].

Phytochemical Screening

Active compounds such as glycosides, flavonoids, terpenoids, oxalate, saponins, tannins and alkaloids were analyzed using standard methods [3].

Proximate Analysis

The recommended method of Association of Analytical Chemists [5] was used for the determination of moisture, ash, crude lipids, crude fibre and nitrogen content of the bitter garden egg leaves. Crude protein was estimated by multiplying the sample percentage nitrogen content by a factor 6.25. Available carbohydrate was calculated by subtracting sum of crude protein, crude lipid, crude fibre and ash from 100 % DW sample [5]. The sample calorific value was estimated by multiplying the percentages of crude protein, crude lipid and carbohydrate by recommended factors (2.44, 8.37 and 3.57 respectively) used in vegetable analysis [6]

Ashing

About 5 grams of each sample (Air dried and fresh leaves) were weighed and put in to a platinum dish, transferred in to muffle furnace. The temperature was raised to about 550 ºC for 4 – 5 hours. After the sample had turned completely to ash, it was removed and cooled in a desiccator.

Digestion of sample

The ash prepared samples (Air dry and fresh) were placed each in 250 ml beakers. 10 ml of 6 M HCL was added to each beaker containing the sample and covered with a watch glass. It was then heated on hot plate for 15 minutes, removed and cooled. 1 ml concentrated $HN0_3$ was added and were evaporated to dryness in order to dehydrate the silica. 1 ml of 6 M HCL was added, swirled and 10 ml distilled was added, heated again on a hot plate to complete dissolution and allowed to cool [4]. The solution was transferred into sample bottles for further analysis. All chemicals used were of analytical grades

Minerals and heavy metal analysis

Analysis of phosphorous and potassium was determined following the method of [1, 2]: 1 gram of each sample were measured and introduced in to a beaker. 5 ml of concentrated nitric acid and 15 ml of hydrochloric acid were added and heated for 45 minutes on hot plate. 10 ml of distilled water was added and allowed to cool for 45 minutes. After cooling the solution was put into

white bottle through filter paper which was diluted again with distilled water to top in to 100 ml. Atomic Absorption Spectrophotometer (Ultaviolet – 2500S, Shimazu, England) was used to analyze phosphorous, zinc, copper, cadmium, arsenic and chromium contents while potassium, sodium were analyzed using flame photometry method.

RESULTS AND DISCUSSION

Table 1: proximate composition of the air dried and fresh *Solenum incanum* leaves

Nutrient composition (%)	Air dried sample	Fresh sample
Moisture	90.14 ± 0.80	93.00 ± 2.1
Protein	5.50 ± 0.06	7.9 ± 0.22
Lipid	7.8 ± 0.07	8.4 ± 0.21
Fibre	6.00 ± 0.05	6.9 ± 0.30
Carbohydrate	49.14 ± 0.25	40.56 ± 0.27
Ash content	20.26 ± 0.90	20.69 ± 0.92
Estimated calorie	129. 52 Kcal	123.86 Kcal

The data are mean value ± standard deviation (SD) of three replicas

Table 2: Some physicochemical properties of air dried and fresh *Solenum incanum* leaves

Parameters	Air dried sample	Fresh sample
pH	11.10	14.70
Conductivity (µs/cm)	2.85	8.94
Turbidity (FTU)	39.40	15.10
Color (Co)	58.00	69.40

Table 3: Phytochemical Screening of air dried and fresh *Solenum incanum* leaves

Parameters	Air dried sample	Fresh sample
Flavonoids	++	++
Phenols	+	+
Anthroquinones	+	+
Saponins	+	++
Phlobatanins	–	–
Tannins	++	++

Terpenoids	+	+
Steroids	_	_
Alkaloids	+	+
Oxalate	_	_

Absent (-), Slightly present (+), moderately present (++), highly present (+++)

Table 4: Mineral composition in Air dried and fresh *Solenum incanum* leaves

Mineral composition (ppm)	Air dried sample	Fresh sample
Sodium	12.07	14.11
Potassium	3.71	3.94
Phosphorous	1.53	1.57
Magnesium	0.03	0.031
Copper	2.01	2.01
Zinc	0.82	0.30
Chromium	1.10	1.10
Calcium	1.24	2.70
Nickel	0.41	0.22

ppm = part per million

The result of the proximate analysis (Table 1) revealed that the temperature (air drying) affects the contents of the material such as the moisture, protein, lipid, fibre, ash content which were reduced compared to their values when fresh with the exception of the available carbohydrate and the estimated caloric value. The effect of temperature on the content of the sample is similar to the work of [10]. African eggplant and leaves generally have high moisture content. The moisture content of air dried and fresh *Solanum incanum* leaves of 90.14 ± 0.80 % and 93.00 ± 2.1 % respectively was found to be within the ranges of several research works. Moisture content of 88.73 and 92.61% respectively was reported for round green (S. *aethiopicum)* and sweet white (S. *macrocarpon*) variety [11]. Also in the work of [10] and [12] moisture content of 92.50 ± 0.14 (fresh), 87.4 ± 0.23 (dried) and 95.13 ± 0.75 (boiled) was reported for *Solonum Macrocapon* L.

Table 2 shows some physicochemical properties of air dried and fresh bitter garden egg leaves. The results show that the physicochemical parameters were greater in fresh than when it is air

dried: Electrical conductivity, 8.94 µs/cm to 2.85 µs/cm, and colour, 69.40 Co to 58.00 Co, while the turbidity and pH increased from the fresh sample to dry: Turbidity was from 15. 10 FTU to 39.40 FTU, pH increased from 11.10 to 12.47. The effect of the temperature on the turbidity and pH is similar to the work of [13].

Phytochemical screening of *Solanum incanum* leaves (table 3) revealed the presence of flavonoids, phenols, anthroquinones, saponins, phlobatanins, tannins, terpenoids, steroids, alkaloids and oxalate. Flavonoids, tannins and saponins were found to be moderately present (++), while phenols, anthroquinones, phlobatanins, terpenoids, steroids and oxalate were found to be partially present (+) both in the dried and fresh form

Bitterness of eggplants is due to the presence of alkaloids, mainly glycoalkaloids. Glycoalkaloids and saponins are known to exhibit antimicrobial activities and protect plant from microbial pathogen [14]. The presence of flavonoids in eggplants and their leaves is effective antioxidants [15].

Terpenoid exhibit various important pharmacological activities like anti-inflammatory, anti-cancer, anti-malarial, inhibition of cholesterol synthesis, anti-viral and anti-bacterial activities. Alkaloids are used as anesthetic agents and are found in medicinal plant [16].

Tannin compounds are widely distributed in many species of plants, where they play a role of protection from predation (including as pesticides) and might help in regulating plant growth [17]

Mineral contents of the bitter garden egg leaves (table 4) differ among species but sodium and potassium constitute the major mineral contents of *Solanum incanum* leaves which also decreased on air drying effects: sodium: air dried, 12.07 ppm, fresh, 14.11 ppm. Potassium: air dried, 3.71 ppm, fresh, 3.94 ppm, while zinc, manganese and nickel contents were low which is similar to the work of [18]

The physicochemical analysis becomes interesting when the importance of sodium, calcium and potassium is considered in human body. Calcium is necessary for the coagulation of blood, the proper functioning of the heart and nervous system and the normal contraction of muscles. Its most important function is in aiding the formation of bones and teeth. Sodium and potassium are closely related in the body fluids. They regulate the acid-base balance. Sodium remains one of the major electrolytes in the blood [19].

Zinc in traces as it appears is very important for nerve function and male fertility especially for the development of testes and ovaries. Zinc stimulates the activity of vitamins, formation of red and white corpuscles [20].

CONCLUSION

The study revealed some proximate analysis such as moisture, protein, lipid, carbohydrate and ash content in which their values decreased when air dried. This signifies that the temperature has an effect on the nutrient content of the sample. It indicated that the plant leaves have some minerals and essential phytochemicals that made it to have nutritional and medicinal importance

REFERENCES

1. Bjerrum, J. (1958). Stability consistence, part II: Inorganic ligands. *The chemical society, London*. pp. 66
2. Kholhoff, I. M. & Lingane, J. J. (1941). *Polagraphy*. Inter-science, New York publisher. pp 33.
3. Trease, G. E. & Evans, W. C. (2002). Textbook of Pharmacognosy, 14th edition, WB Squander Company limited. 24 – 2800 at road London. NW 7 dx UK and printed by Harcourt brace and company asiapte lead 583 orchard road no -09 -01 from Singapore.
4. Evans, W.C. (2002). In: Trease and Evans, Pharmacognosy, 15th edition. Harcourt publishers limited. China.
5. Association of Official Analytical Chemist (A. O. A. C) (1990). Official method of analysis 15th edition. Washington D. C, USA, pp 124.
6. Asibey –Berko, E. & Taiye, F.A.K. (1999). Proximate analysis of some underutilized Ghanian vegetables. *Ghana Journal of Science.* pp 42.
7. Chinedu, S. N. Olasumbo, A. C. Eboji, O. K & Emilogu, O. C (2011). Proximate and phytochemical analyses of *Solenumaethiopicum* L and *Solenummacrocarpon* L fruits. *Resource Journal of Chemical Science*. 1(3): 63 -71
8. Edem, D. O., Eka, O. U, & Ifon, E.T. (1984). Chemical evaluation of the nutritive value of the fruits of African star apple (*Chrysophyllumalbidum*). Food and chem., 14: 303 – 311
9. Tindal, H. D. (1965). *Fruits and vegetable in West Africa* (London: Oxford University press) 2nd edition

10. Auta, R. James, S.A. Auta, T. & Sofa, E. M. (2011). Nutritive value and phytochemical composition of processed *Sollenum incanum* (Bitter garden egg). *Science world Journal*. 6(3), 564-566.
11. Showemimo, F. A. & Olarewaju, J.D. (2004). Agro-nutritional Determinants of some Garden Varieties (*Solanumgilo*L), *Journal of food technology*. 2(3), 172 – 175
12. Shalom, N. C., Abayomi, C. O., .Okwuchukwu, K. E., Opeyemi, C. E. & Olajumoke, K. (2011). Proximate and phytochemical analyses of *solanumaethiopicum*L. and *solanum macrocarpon*L fruit. *Research Journal of Chemical Science*. 1(3): 63 – 71
13. Asad, J. Bahzad, S.Saeed, D & Afshin, M. (2015). Effect of temperature on pH, turbidity and residual free chlorine in Sanandaj Water Distribution Network, Iran. *Journal of Advances in Environmental Health Research*. 3(3), 188 - 194
14. Sczkowski,C.P., Kalinowska, M. & Wojciechowski, Z. (1988). The 3-o-glycosylation of steroidal saponins and alkaloids in eggplant (*Solanummelongena*): evidence for two separate glycosyltransferences, *Phytochemistry.,* 48, 1151 – 1159
15. Bagchi, M., Milnes, M.Willliams, C., Balmoori, J. Ye, X.Stohs, S. & Bagchi, D. (1999). Acute and chronic stress-induced oxidantive gastrointestinal injury in rats and the protective ability of a novel grape seed proanthocyanidin extract, *Nutr.Res.,* 19, 1189 – 1199.
16. Abosi, A. O. & Rasewka, B. H. (2003). *In vivo* animated activity of *Vernonia amygdalina*. *British J. Biomed.Sci.60*:*89-91*.
17. Katie, E. F. & Thorington, R. W. (2006). *Squirrels: the animal answer guide.* Batimore: Johns Hopkins University Press. pp. 61
18. Chandra, S. S. & Vinod, K. P (2017). The potential of garden cress (*Lepidium sativum*L.) seeds for development of functional foods, Advances seed in Biology. Intechopen. 703555.
19. Edeoga, H.O., Okwu, D.E. & Mbaebie, B.O. (2005). Phytochemical constituents of some medicinal plants. *Afr. J. Biotechnol., 44 (7), 685-688.*
20. Claude, B. & Solomon, P. (1979). The manual of Natural living. 1st Ed. *Biddles Ltd, Guildford, Surrey*, pp: 98-101