

Physico-chemical and Nutraceutical Profiling of *Sauropus androgynus* Leaves.

Devi Priya M.^{1*} Vinod Kumar T.G.¹, Francis Mathew¹

¹*Department of Botany, St. Thomas College, Pazhavangadi PO, Ranni, Pathanamthitta, Kerala, India -689673

*Corresponding author: devi.priya.m@gmail.com

ABSTRACT

Vegetables are an important source of protective foods, which are highly beneficial for maintaining good health and preventing diseases. Leafy vegetables enjoys a supreme position in our diet, as they provide an adequate quantity of vitamins and minerals. Leafy vegetables can be raised comparatively at lower management cost and on poor marginal soil. Unfortunately, these nutritive treasures are often remains underutilized because of ignorance and lack of promotion of appropriate technologies for their effective utilization. *Sauropus androgynus* is an underutilized leafy vegetable commonly grown as hedges across Kerala and is the richest source of nutrients and phytochemicals. The present study revealed that the smooth leaf powder has a characteristic forest green colour, pungent odour, smooth texture and bitter taste. Quantitative analysis showed high moisture content (87.6 ± 1.85 %), ash value (11.6 ± 0.19 %), and significant levels of carbohydrate, protein, and fat in 6.88 ± 2.40 mg/g, 3.4 ± 0.05 mg/g, and 1.90 ± 0.05 %, respectively, and have about 6.39 ± 0.11 % crude fiber and 39.6 ± 3.31 caloric energy further implying its dietary significance. However, a notable amount of anti-nutrients such as phenols (27.24 ± 0.63 mg/g dw) and tannins (9.98 ± 0.63 mg/g dw) were also detected, which may interfere with nutrient absorption and palatability. The findings underscore the nutritional potential of *S. androgynus* while stressing the need for further nutraceutical exploration and toxicological assessment.

Key words: *Sauropus androgynus*, leafy vegetable, phytochemical, nutritional, antinutritional

INTRODUCTION

Green leafy vegetables are a diverse group of plants comprising several different taxonomic groups. Leafy vegetables occupy an important place among food crops, as they provide adequate amounts of vitamins and minerals along with the required roughage to our diet. They are among the most nutritious vegetables on a fresh weight basis and are among the world's most productive plants in terms of nutritional value per unit area. The nutritive value of vegetables varies with the season, type of chemical used, and the variety used for cultivation. They grow rapidly, allowing several crops or harvests in a season; but due to the lack of awareness and the promotion of appropriate technologies, they remain underutilized.

Leaf vegetables are commonly known as greens and potherbs, as they are grown for their tender, succulent and normally green leaves and are usually cooked before eating. Additionally, there are certain plants, which are eaten as leafy vegetables, although the leaves are a secondary crop. Some indigenous leafy vegetables are readily available in the field as wild because they do not require formal care and cultivation practices. These species are robust, adaptive and more enduring than the exotic species (Raghuvanshi and Singh 2001). Although they can be raised at with comparatively lower management costs and on poor marginal soil, they have remained underutilized because of a lack of awareness of their nutritional values (Chweya and Eyzaguirre, 1999). Recently, a resurgence of interest has developed in wild species for their possible medicinal values in diets (Nnamani *et al.*, 2007). The calorie content of vegetable foods is uniformly low, making them ideal foods for any

healthy weight loss diet. The leafy vegetables represent a veritable natural pharmacy of minerals, vitamins, and phytochemicals, even though the bulk of their weight is water. Additionally, they have antibacterial, hepatoprotective and anticarcinogenic properties, and therefore have medicinal value (Green, 1992). The fiber content provides bulk in the diet, contributes to the feeling of satisfaction, and prevents constipation (Noonan, 1999) and thus the incidence of metabolic diseases.

Sauropus androgynus is an erect shrub that can reach up to 500 cm in height and belongs to the Euphorbiaceae family. It grows in humid, high-temperature conditions as an indigenous vegetable. The plant has many vernacular names viz., Star gooseberry, Sweet leaf bush, Cekurmanis, Katuk, Binahian, Dom nghob (Khare, 2004). The plant has either cylindrical or angled branches. The leaves are ovate or lance-shaped and obtuse or acute. The inflorescence is greenish to yellowish with partly red staminate flowers. The flowers are unisexual and solitary. The fruit is nearly globular, white, inflated, and fleshy (Kritikar and Basu, 1988). The plant is known as a multigreen vegetable due to its perceived superior nutrition and vitamin content (Singh et al., 2011). A large array of phytochemicals present in the leaves viz., sterols, resins, tannins, saponins, alkaloids, flavonoids, terpenoids, glycosides, phenols, catechol, cardiac glycosides, and acidic compounds (Selvi and Baskar, 2012). Also, the bioactive compounds like kaempferol, quercetin, myricetin, luteolin, chlorogenic acid, caffeic acid, and ferulic acid were identified (Andarwulan et al., 2010). In Indonesia and Malaysia, the plant is used to increase lactation (Soka et al., 2010). As per Benjapak et al. (2008), tribals of Thai used the root of the plant as an antiseptic and febrifuge. People in Taiwan used this as a potential slimming agent to combat obesity. In India and Southeast Asia the leaves are used as antidiabetics and to improve vision. The antibacterial (Paul and Anto, 2011; Gayathamma et al., 2012; Ariharan et al., 2013). as well as the antifungal activity (Selvi et al., 2011) of the plant is well documented. Despite its use as a medicinal and food product, several studies have reported pulmonary dysfunction ranging from difficulty in breathing and respiratory failure as a side effect of consuming *S. androgynus*. Hence, we undertake this study to determine the nutritional and antinutritional characterization of *S. androgynus* leaves.

MATERIALS AND METHODS

The fresh leaves of *Sauropus androgynus* were collected from a wide population at Ranni. The materials were washed with distilled water. The leaves were then shade-dried for 15 days, and with the help of a mixer grinder, the dried materials were powdered and were kept in an airtight glass jar till usage. Shade-dried, coarsely powdered raw drug was used for powder analysis, which includes the identification of organoleptic characters and determination of physico-chemical characters, according to methods described in Indian Pharmacopeia (Anon, 1985).

Organoleptic Characters: It refers to the evaluation of powdered sample by colour, odour, taste, size, shape and texture. These were identified by using the crude powder samples using the sense organs. The powdered samples were examined under diffuse light to identify the colour using a standard colour identification chart. By touching the material, the texture can be identified, and with the help of sieve, the size is determined. The crude powder is tasted to identify the taste, and smelling the power helps to identify the odour

Promimate Analysis : Total ash content was analyzed by taking a 0.5 g portion of the samples, weighing it into the crucible, and putting it in the furnace. Heating was started gradually until the carbon-less ash was obtained. The crucible was then put inside a desiccator and cooled. After cooling, the sample was reweighed, and the percentage ash with reference to the air-dried drug was calculated.

% of moisture content: By using IUPAC method the moisture present in powder samples was determined (Paquot and Hautfenne, 1987). 5 g of the leaf samples were taken in a pre-weighed petri dish. The petri dish was placed without a lid into an oven at 110°C for three hours. The petri dish was taken out and closed immediately with a lid. The petri dish was cooled weighed to get a constant weight. % of moisture was calculated from the difference in weight of the petri dish.

% of crude fiber: 2 g of moisture- and fat-free material was taken to identify the crude fiber. 200 ml of 1.25% H_2SO_4 was treated over the sample. After filtration and washing, the residue was treated with 1.25% NaOH followed by distilled water and with 1% HNO_3 . The residue was ignited, and the ash was weighed after filtration and washing the residue. The loss in the amount of crude fiber present in the sample.

Nutritional and Antinutritional analysis: For the analysis of nutritional content, the total amount of carbohydrate, crude protein, crude fat was estimated as per prescribed procedures. Moisture content was also, and metabolic energy was determined.

Total carbohydrate: The amount of total soluble carbohydrate of the leaf were extracted and estimated Anthrone method (Roe, 1955). 1 g of fresh sample was homogenized with 10 ml distilled water, using a mortar and pestle. The homogenate was filtered and centrifuged at 10,000 rpm for 10 minutes, and the supernatant was taken. The volume was made up to 10 ml using distilled water. An aliquot of the sample was taken and made up to 1 ml with distilled water. 4 ml of anthrone reagent was added to each sample and mixed thoroughly. The tubes were kept in boiling water for 6 minutes and cooled. The absorbance was recorded colorimetrically at 620 nm against a proper blank. The carbohydrate content was calculated from the standard graph.

Total protein: The amount of total soluble proteins of the leaf was extracted, and estimated using the method of Lowry et al. (1951). 1 g of fresh sample was homogenized with 5 ml of 0.1 M phosphate buffer of pH 7, using a mortar and pestle. The homogenate was filtered and centrifuged at 10,000 rpm for 10 minutes, and the supernatant was taken. An aliquot of the protein was taken and made up to 1 ml with phosphate buffer. 5.0 ml of reagent C was added to each sample mixed thoroughly, and kept for 30 minutes. Then 0.5 ml Folin's reagent was added and kept for 40 minutes. The absorbance was recorded colorimetrically at 650 nm against a proper blank. The protein content was calculated from the standard graph.

Total lipid: The extraction was repeated 3 times. The extract was pooled, centrifuged, and the supernatant was transferred into a separating funnel, followed by the addition of chloroform, and distilled water, and a saturated solution of sodium chloride. The lower layer was separated and collected in a clean pre-weighed petri dish. The solvent made to evaporate in a hot air oven at 60°C until a constant weight was obtained. The petri dish with lipid was weighed, and the amount presented as percentage values (Bligh and Dyer, 1959).

Nutritive value: For calculating nutritive value, an appropriate amount of crude sample was taken and weighed. Protein, carbohydrate, and fat were analyzed, and the nutritional value of the plant was calculated as per the standard formula.

Determination of phenol: Phenol content was estimated based on the method by AOAC (1975). Phenols was extracted from 0.5 g powdered sample, and was extracted in 10 ml of 80% ethanol. The homogenate was filtered and centrifuged at 10,000 rpm for 20 minutes, and the supernatant was made up to 10 ml using distilled water. An aliquot was taken from the sample and made up to 3 ml using distilled water. To this 0.5 ml Folin's reagent was added and incubated for 3 minutes, and then 2 ml of 20% sodium carbonate solution was added and boiled for 1 minute and the absorbance was read at 650 nm, and the concentration was calculated from standard graph.

Determination of tannins: Tannins was extracted from 0.5 g powdered sample and was boiled in 75 ml distilled water for one hour. The supernatant was collected and made up to 100 ml in a volumetric flask. Colour development was done with 5 ml of Folin's reagent, 10 ml of 10% sodium carbonate solution along with 1 ml sample extract, and 75 ml of distilled water, and the volume was made up to 100 ml. Absorbance was measured colorimetrically at 700 nm after 30 minutes. The tannic acid concentration was calculated from the tannic acid standard curve (AOAC, 1975).

RESULT AND DISCUSSION

Sauropus androgynus is a leafy vegetable grown as hedges in all around Kerala. The plant is an under-utilized leafy vegetable, and the leaves are the richest source of various nutrients and phyto-compounds. The present study revealed much new information, which is discussed below.

The powdered leafy samples were analyzed for the organoleptic properties, moisture content, and different classes of phytochemicals. The organoleptic characters were identified through sense organs. The colour of the powder was identified through Pantone colour chart. The powder showed the characteristic forest green colour, with a pungent odour. The powder appeared to be fine and smooth with an acrid bitter taste (Table 1). The characteristic odour of the leaf powder is due to the presence of various non-volatile phytochemicals. These organoleptic characters functions as a reference to identify the uniqueness of the plant in powdered form.

Table 1: Organoleptic character of *Sauropus androgynus* leaf powder

Character	Sauropus leaves
Colour	Forest green
Odour	Pungent
Size	Fine
Taste	Bitter
Texture	Smooth

The quantitative estimation *S. androgynus* leaf was done for proximates, viz., ash value and moisture content, and nutritional evaluation viz., protein, carbohydrate, and lipid, along with the anti-nutritional content like phenol and tannins.

As part of physico-chemical studies, proximate analyses were done and compiled (Table 2). The proximate analysis showed the moisture content of *S. androgynus* is 87.60% (w/w). It indicates a low shelf life of the fresh plant, and hence long storage would lead to spoilage due to its susceptibility to microbial attack. Moisture content is among the most vital and mostly used measurements in the processing, preservation, and storage of food. The leaves have moisture content ranging between 69.9% and 89.9%, as reported earlier and ash value ranging from 1.4 to 12.9% (Khoo et al., 2015). In the present study ash value ($11.6 \pm 0.19\%$) and moisture content ($87.6 \pm 1.85\%$) were found to be within the limit (Table 2). The ash value determination is a crucial step in the determination of the purity of powdered drugs. Singh et al. (2011) reported 5.25 g/100 g of protein content in the leaves.

Table 2: Proximate, nutritional, and antinutritional screening of *Sauropus androgynus*

Proximates	Composition
Ash content (%)	11.6 ± 0.19
Crude fat (%)	1.90 ± 0.05
Crude fiber (%)	6.39 ± 0.11
Moisture content (%)	87.6 ± 1.85
Carbohydrate mg/g	6.88 ± 2.40
Crude protein (mg/g)	3.4 ± 0.05
Energy (Cal)	39.6 ± 3.31
Phenol (mg/g dw)	27.24 ± 0.63
Tannin (mg/g dw)	9.98 ± 0.63

To analyze the nutritional value, carbohydrate, crude protein, and fat were determined as per prescribed procedures. The result suggested that the fresh leaf sample was a rich source of protein (3.4 ± 0.05 mg/g), carbohydrate (6.88 ± 2.40 mg/g), and lipid ($1.90 \pm 0.05\%$). But the protein (6.4 mg/g), carbohydrate (9.9 mg/g) and lipid content (1.0%) varied with habitat, as reported by Khoo et al.

Research paper © 2022 IJFANS. All Rights Reserved, UGC CARE Listed (Group -I) Journal Volume 12, Iss.01, 2023 (2015). The high amount of carbohydrate and protein observed in the study suggests that the species can be used as a good source of carbohydrate and protein. The main role of carbohydrates is to provide energy for the body, especially the brain and nervous system, and proteins from plant sources have lower quality, but their combination with many other sources of protein, result in adequate nutritional value. However, the fat content was found to be relatively low (<2%) when compared with their concentrations in other plants as reported by Hussain (2013). Vegetables are poor sources of fat that make them good for obese people. The result revealed that the amount of lipid content in this plant was moderate, and a diet providing 1-2% of its calorific value as fat is said to be sufficient for human beings. The nutritive value of the leaves was also evaluated and it was found to be 39.6 ± 3.31 cal.

As plant foods contain some natural compounds that act as anti-nutritional factors that interfere with the absorption of some of nutrients. One of the widespread forms of antinutrients are the flavonoids and polyphenolic compounds like tannins and saponins. Phenolic compounds inhibit the activity of digestive as well as hydrolytic enzymes such as amylase, trypsin, and lipase (Salunkhe, 1982). The phenolics and tannins were water-soluble compounds that can be eliminated by soaking followed by cooking (Shanthakumari et al., 2008). In the present study the antinutrients like phenol and tannins were estimated, and an amount of tannin (9.98 ± 0.63 mg/g dw). The phenol content was (27.24 ± 0.63 mg/g dw) relatively higher as reported (12.38 mg/g dw) by Huda-Faujan et al.(2015). Tannins are chemicals that bind with protein and make them unavailable to animals by making it unavailable for digestion, while phenols require energy and materials from the animal in order to excrete them after they are ingested. The present study revealed the lower level of tannin as well as phenols, questioning the palatability of *S. androgynus*

CONCLUSION

The proximate analysis revealed a high moisture content (87.6%), making the fresh leaves perishable, while significant ash value (11.6%) indicate the high amount of mineral content. Nutritional evaluation confirmed the presence of substantial amounts of carbohydrate (6.88 mg/g), protein (3.4 mg/g), and moderate amount of lipid content (1.9%), validating its role as a wholesome dietary component. However, the presence of considerable antinutritional factors like phenols (27.24 mg/g) and tannins (9.98 mg/g) may hinder the nutrient absorption.

Intake of fresh leaves of *S. androgynus* for the potential health benefits is not advisable as the past evidence reveals several outbreaks of bronchiolitis. Pulmonary toxicity. Traditional methods like, proper cooking of leaves is needed prior to consumption can make the leaves safer. Based on the results of the present investigation, it can be concluded that the leaves of *S. androgynus* contain a substantial amount of nutrients that could be used in a diet, but the high levels of anti-nutrient content should be obliterated through cooking. In-depth studies help to optimize its utilization while ensuring consumer safety. It also throw light on the nutraceutical significance of the species, which in turn will focus the investigation of drugs with multifaceted effects.

ACKNOWLEDGEMENT: We are grateful to the Principal in Charge, St. Thomas College, Ranni for providing all the facility to do the research work.

CONFLICT OF INTEREST: Nil

FUNDING AGENCY: Nil

REFERENCES

1. Andarwulan, N., Kurniasih, D., Apriady, R. A., Rahmat, H., Roto, A. V., & Bolling, B. W. (2012). Polyphenols, carotenoids, and ascorbic acid in underutilized medicinal vegetables. *Journal of Functional Foods*, 4(1): 339-347.
2. Indian Pharmacopeia (1985). Ministry of Health and Family Welfare, Govt. of India, Controller of Publication, New Delhi
3. AOAC (Association of Official Analytical Chemist (1975). Official methods of analysis of the association of Official Analytical Chemist, Washington, DC.
4. Ariharan, V. N., Devi, V. M., & Prasad, P. N. (2013). Antibacterial activity of sauropus and rogynous leaf extracts against some pathogenic bacteria. *Rasayan J. Chem*, 6(2): 134-137.
5. Benjapak, N., Swatsitang, P., & Tanpanich, S. (2008). Determination of antioxidant capacity and nutritive values of Pak-Wanban (*Sauropus androgynus* L. Merr.). *Khon-Kean University Science Journal*, 36: 279–289.
6. Bligh EG, & Dyer WJ. (1959) A Rapid method of Total Lipid Extractions and Purifications. *Canadian Journal of Biochemistry and Physiology*, 37: 341-344.
7. Chweya, J. A., & Eyzaguirre, P. B. (1999). The biodiversity of traditional leafy vegetables. University of Nairobi, IPGRI Publication, Rome, Italy
8. Gayathramma, K., Pavani, K. V., & Raji, R. (2012). Chemical constituents and antimicrobial activities of certain plant parts of *Sauropus androgynus* L. *International Journal of Pharma and Bio Sciences*, 3: 561–566.
9. Greene, C. (1992). An overview of production and supply trends in the US specialty vegetable market. In II International Symposium on Specialty and Exotic Vegetable Crops 318 (pp. 41-48).
10. Huda-Faujan N.H.N., Rahim, Z.A.Z.A., Rehan, M.M.R.M.M., & Ahmed F.H.A.F.H. (2015) Comparative analysis of phenolic content and antioxidative activities of eight Malaysian traditional vegetables. *Malaysian Journal of Analytical Sciences*, 9: 611 - 624.
11. Hussain, J., Rehman, N. U., Al-Harrasi, A., Ali, L., Khan, A. L., & Albroumi, M. A. (2013). Essential oil composition and nutrient analysis of selected medicinal plants in Sultanate of Oman. *Asian Pacific Journal of Tropical Disease*, 3(6), 421-428.
12. Khare CP. (2004) *Encyclopedia of Indian Medicinal Plants*. Springer, Germany.
13. EKhuo, H.E., Azlan, A., & Ismaila, A. (2015). *Sauropus androgynus* leaves for health benefits: hype and the science. *The Natural Products Journal*, 5(2), 115-123.
14. Kirtikar, K. R., & Basu, B. D. (1918). *Indian medicinal plants* (Vol. 2). International Book Distributor, Dehradun, India
15. Lowry, O. H., Rosebrough, N. J., Farr, A. L., & Randall, R. J. (1951). Protein measurement with the Folin phenol reagent. *J biol Chem*, 193(1), 265-275.
16. Nnamani, C. V., Oselebe, H. O., & Okporie, E. O. (2007, November). Ethnobotany of indigenous leafy vegetables of Izzi Clan. In Ebonyi State, Nigeria. In: Proceeding of 20th Annual National Conference of Biotechnology Society of Nigeria. Abakaliki, November 14th-17th (pp. 111-114).
17. Noonan, S.C., & Savage, G.P. (1999) Oxalate content of foods and its effect on humans. *Asia Pacific Journal of Clinical Nutrition*, 67: 64-74.
18. Paquot, C., & Hautfenne, A. (1987). Standard methods for the analysis of oils, fats and derivatives. *Analytica Chimica Acta*, 201, 373.
19. Paul M.M.P., & Anto, K.B. (2011) Antibacterial activity of *Sauropus androgynus* (L.) Merr. *International Journal of Plant Sciences*, 6: 189–192
20. Raghuvanshi RS, Singh R., & Singh R.R. (2001) Nutritional composition of uncommon foods and their role in meeting in micronutrient needs. *International Journal of Food Science and Nutrition*, 52 (4): 331-335
21. Roe, J. H. (1955). The determination of sugar in blood and spinal fluid with anthrone reagent. *Journal of Biochemistry*, 212:335-343
22. Salunkhe, D. K. (1982). Legumes in human nutrition: current status and future research needs. *Current Science*, 51(8), 387-394.

23. Selvi, S. V., & Basker, A. (2012). Phytochemical analysis and GC-MS profiling in the leaves of *Sauropus androgynus* (L) MERR. *International Journal of Drug Development and Research*, 4(1), 162-167.
24. Selvi, V. S., Govindaraju, G., & Basker, A. (2011). Antifungal activity and phytochemical analysis of *Cympogon citratus*, *Sauropus androgynus* and *Spilanthes acmella* plants. *World Journal of Fungal and Plant Biology*, 2(1), 6-10.
25. Shanthakumari, S., Mohan, V. R., & de Britto, J. (2008). Nutritional evaluation and elimination of toxic principles in wild yam (*Dioscorea* spp.). *Tropical and Subtropical Agroecosystems*, 8(3), 319-325.
26. Shetty, K. (1997). Biotechnology to harness the benefits of dietary phenolics; focus on Lamiaceae. *Asia Pacific journal of clinical nutrition*, 6, 162-171.
27. Singh, S., Singh, D. R., Salim, K. M., Srivastava, A., Singh, L. B., & Srivastava, R. C. (2011). Estimation of proximate composition, micronutrients and phytochemical compounds in traditional vegetables from Andaman and Nicobar Islands. *International Journal of Food Sciences and Nutrition*, 62(7), 765-773.
28. Soka, S., Alam, H., Boenjamin, N., Agustina, T. W., & Suhartono, M. T. (2010). Effect of *Sauropus androgynus* leaf extracts on the expression of prolactin and oxytocin genes in lactating BALB/C mice. *Lifestyle Genomics*, 3(1), 31-36.