IJPSR (2025), Volume 16, Issue 10 (Research Article)

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 16 April 2025; received in revised form, 07 May 2025; accepted, 23 May 2025; published 01 October 2025

SENSORY AND NUTRITIONAL PROFILING OF *SAUROPUS ANDROGYNUS* LEAVES BY MEANS OF DRYING TECHNOLOGIES

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Keywords:

Sauropus androgynous, Sensory analysis, Nutritional analysis, Drying methods

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ABSTRACT: Objective: The purpose of this study was to compare the impact of various drying methods, such as sun drying, Sunshade drying, hot air oven drying, and Deep freeze-drying technologies, on the elucidation of sensory and nutritional profiles in *Sauropus androgynous* leaves. **Methods:** Fresh *Sauropus androgynous* leaves were used for various drying techniques, such as Sunshade, sun drying, hot air oven, and Deep freeze drying. The leaves were analyzed for changes in nutritional composition, mineral composition, and vitamin concentration. The study involved various drying analysis methods based on the AOAC protocols to evaluate their impact on the leaves' nutritional and medicinal properties. **Results:** Sun-dried leaves retained a higher proportion of essential nutrients compared to those dried in a sun shade, hot air oven, or Deep freeze method. The sensory evaluation demonstrated that sun-dried leaves were preferred in color, taste, antioxidants, and overall acceptability compared to leaves dried in a hot air oven. **Conclusion:** Sun drying is the best technique for maintaining the sensory qualities, nutritional value, and antioxidants of *Sauropus androgynus* leaves. While sun shade, Sun drying, Hot air ovens, and deep freeze-drying methods effectively reduced microbial contamination, the sun-drying process exhibited advantages in maintaining the overall quality of the leaves.

INTRODUCTION: Plants are a good source of medicinal compounds. Medicinal plants are used to cure a variety of illnesses in both humans and animals [1]. Micronutrients and vitamin deficiencies have spread across the world. Vegetable consumption is often deficient in many countries, leading to malnutrition among women and children. Green leafy vegetables (GLVs) are high in vitamins and minerals, yet underutilized for human nutrition.

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.16(10).2753-59

This article can be accessed online on www.ijpsr.com

DOI link: https://doi.org/10.13040/IJPSR.0975-8232.16(10).2753-59

Since green leafy vegetables are perishable due to their high water content, preparing vegetables to boost their value and promote their inclusion in our daily diet is essential. Chekurmanis, a nutritious green leafy vegetable, remains neglected [9]. *Sauropus androgynus L.* Merr., one of the medicinal plants in South Asia and Southeast Asia, is an underexploited perennial shrub that belongs to the Phyllanthaceae family [2].

It is known for its high yields and palatability [3]. SA leaves are a highly nutritious food source, rich in micronutrients and protein [4]. *Sauropus androgynous* (SA) contains a high antioxidant potential, traditionally used in certain diseases. It contains a sufficient amount of macronutrients and micronutrients, essential minerals, and

carbohydrates. SA leaves contain minerals like potassium, sodium, calcium, iron, magnesium, copper, phosphorus, cobalt, and, Zinc. Fresh SA leaves 70%-90% moisture, 3%-8% protein, 1%-4% fat, 1%-2% fiber, and 2% ash [5]. SA leaves have been reported to have high antioxidant properties and also contain vitamins C and E [6]. This plant is used in traditional medicine to treat urinary problems, relieve fever, and increase breast milk production. It is consumed as salad, prepared as curry, or stir-fried [7]. In India, it is also known as a "Multivitamin Plant" as it contains an excellent source of vitamins A, B, C, and carotenoids has high nutritive value, and contains phytochemicals that can act as antioxidants. Several phytochemicals are found in *S. androgynous*, such as tannins, alkaloids, sterols, terpenoids, phenols, resins, saponins, flavonoids, glycosides, catechol, and acidic compounds. *S. androgynous* leaves, when fully matured, are recognized as having a high content of β-carotene and fat-soluble vitamin E, both of which have antioxidant properties [8].

Sauropus androgynus leaves are rich in vitamins, minerals, fiber, lipids, carbs, and bioactive compounds such as flavonoids, phenols, and tannins. *Sauropus androgynus* leaves have higher levels of phytosterols. Because of its estrogenic hormonal effects, phytosterols can enhance prolactin and milk production. Another component of *Sauropus androgynus* leaves is papaverine. Papaverine can cause the secretion of prolactin. Papaverine, which is found in *Sauropus androgynous* leaves, relaxes smooth muscle and widens blood arteries, raising levels of the hormones prolactin and oxytocin. Katuk leaves are rich in a greater amount of phytosterols than other types of vegetables. Due to its estrogenic hormonal effects, phytosterols can raise prolactin and milk production. Another substance found in *Sauropus androgynus* leaves is papaverine. Papaverine can cause the secretion of prolactin. Papaverine, which can be identified in *Sauropus androgynus* leaves, relaxes smooth muscle, and dilates blood arteries, raising the hormone prolactin and oxytocin [27]. Several individuals in Taiwan and Malaysia frequently consume the leaf extract of SA, which has been reported to lower body weight due to the bioactive substance 3-O-β-D-glucosyl-(1-6)-β-D-glucosyl-kaempferol (GGK) is present in SA plants [28].

An alkaloid Papaverine is found in fresh SA leaves (580 mg/100g). According to reports, 200 mg of papaverine has antispasmodic properties, 200 mg of papaverine has antispasmodic properties, and eating excessive amounts of it in its raw fresh SA leaves can result in sleepiness and respiratory issues (Kalpana *et al.,* 2017). The adverse effects of the plant alkaloid are reduced in its processed form, which makes it suitable for consumption to reduce the moisture content of food products, thereby inhibiting microbial growth and enzymatic activity, and consequently, extending their shelf life. This study explores the influence of drying processes (sun, sun shade, Hot air oven and Deep freeze) on the nutritional value of SA leaves [9].

Objectives: The drying methods used for *Sauropus androgynous* leaves to achieve maximum antioxidant and phytochemical retention.

METHODOLOGY:

Selection of Plant: The leaves of the *Sauropus androgynous* plants are taken for research as they contain the highest amount of nutrients, Microminerals, and Macronutrients. The leaves were thoroughly washed in tap water and then dried.

Procurement of Raw Material: Fresh leaves of *Sauropus androgynus* were collected from Charmadi ghat section, Mudigere taluk, Chikkmangalore district.

Plant Authentication: The targeted *Sauropus androgynus* plant is authenticated by the plant taxonomist from Mangalore's Botanical Research Institute.

Drying of *Sauropus androgynous* Leaves: Drying is an ancient method for preserving foodstuffs by reducing moisture and microbial, enzymatic, and chemical reactions in agricultural products. Sun and shade drying are the natural drying methods and the deep freeze and hot air-drying methods are commonly used because of their lower cost [10]. Basic and necessary way of food preservation. Moisture is removed from food components during drying, which inhibits the growth of various microorganisms Drying is an extremely metabolic change, and provides a longer shelf life with minimal degradation of quality. Each drying technique has its advantages, and the highest

retention of quality depends on the kind of dried materials [11]. *Sauropus androgynous* leaves are dried using Sunshade, sun drying, Hot air oven, and Deep freeze drying. Fresh SA leaves initial moisture content was calculated (AOAC, 2000) [12].

The sensory profile of Katuk leaves was assessed through sensory analysis, focusing on appearance, aroma, flavor, and texture [13]. Evaluating the safety and quality of the human diet requires determining the nutritional profile of plant materials [14].

Sun Drying: Sun or solar drying is the ancient drying method in this process fresh herbs are placed on the proper ventilated drying rack and exposed directly to the sunlight. On an aluminium tray, 100 grams of fresh SA leaves were spread out, where they would get as much sunlight as possible during the day [5].

Sunshade Drying: In Sunshade drying, heat is produced by sunlight, but materials should be preserved dry and well-ventilated to avoid direct exposure. The herbs are dried through hot surrounding air and low relative humidity [11].

Hot air Oven Drying: Oven drying, also known as "hot-air drying," is the most widely used technique of herb drying. This technique is mainly used in non-tropical countries where sunlight is not sufficient for sun and shade drying. 100 grams of SA leaves are spread as a single layer on an aluminium tray and kept in a hot-air oven with a temperature of 170. F [15].

Deep Freeze Drying: Freeze drying, also known as lyophilization, is a safe and effective approach to dry materials. Freeze drying protects sensitive biological things by removing water without harming them.

These products can be preserved easily. To dry the material, use a condenser that removes moisture from a surface refrigerated to -40 to -80°C (-40 to -112°F).

It has some disadvantages like high operational cost and energy-intensiveness. Freeze-drying is the gentlest method for preserving plant material for investigation into its organic components. However, according to the instrument, this technique can be time-consuming and costly [16].

Fresh *Sauropus androgynous* leaves were used for various drying techniques like sun drying and hot air oven drying.

The leaves were analysed for changes in nutritional composition, mineral composition, vitamins, and antioxidant concentration [9]. The targeted sample was analysed using standardized operating procedures using the AOAC protocol to evaluate properties. A Further sample analysis technique is to estimate the DPPH radical using the Spectroscopy method.

Sensory Analysis: The sensory evaluation of the sample was done by 25 semi-trained panel members using a point Hedonic scale, three samples-standard and Experimental named Sun drying, Sunshade drying, Hot air drying, and subjective Sensory evaluation, Appearance, colour, flavour/aroma, taste, and Overall Acceptability.

TABLE 1: SENSORY PROFILE ESTIMATE USING DESCRIPTIVE HEDONIC SCALE

S. no.	Scale
1	Like extremely
2	Like very much
3	Like moderately
4	Like Slightly
5	Neither like or dislike
6	Dislike Slightly
7	Dislike moderately
8	Dislike very much
9	Dislike extremely

Proximate Analysis: The dried and powdered *Sauropus androgynus* leaves are taken for proximate examination. The standard methods of the Association of Official Analytical Chemists (AOAC, 2000) were used to determine the quantities of moisture, ash, and crude fiber [25].

Determination of Moisture [17, 18]:

$$\text{Moisture (\%)} = W_1 - W_2 / W_2 \times 100$$

W_1 = weight of the sample before drying; W_2= weight of the sample after drying.

Determination of Total Ash:

$$\text{Ash content (g/100g)} = \text{Weight of the ash} / \text{Weight of the sample taken} \times 100$$

Determination of Crude Fiber:

Crude fibre (g/100g sample) = 100-(moisture*+fat)] x (We-Wa) / Wt. of sample taken (moisture and fat-free)

We = pre-weighed ashing dish, Wa = weight of the dish after ashing.

Macronutrient Analysis:

Determination of Energy [19, 20]: The energy content of the samples was computed using the below equation.

Energy (kcal) = [Protein (g) x 4] + [Carbohydrate (g) x 4] + [Fat (g) x 9

Determination of Carbohydrate: 0.2 ml of the ash solution contains gamma of carbohydrate:

Therefore, 100 ml of the ash solution will contain = 100 ml of the ash solution was made from a 0.1 g sample ×100/ 0.2 = gamma carbohydrates

Therefore, 0.1 g sample contains = -------- gamma of carbohydrates

Therefore, 100 g sample will contain= (--------× 100) (0.1×100) mg of carbohydrates

= ---------- g of carbohydrates.

Determination of Protein

Per cent nitrogen (% N) = (Va- Vb) × 0.0014 × V1 100 V2W

Where, Va = Titre value of sample, Vb = Titre value of blank, V1 = Volume to which digested sample was made up to 100 ml, V2 = Volume to aliquot used in distillation, W = Weight of samples taken for digestion.

Determination of Fat:

Percent Fat content (g/100g) = Weight of the ether extract (g) / Weight of the sample taken (g) x 100

Micronutrients Analysis [21]: The concentration (C) of each element, in mg/kg, is calculated as follows:

a x V x F / C= m

Where, C = concentration in the test portion sample (mg/kg), a = concentration (mg/L) of the element in the digest solution as obtained from the instrument;

V = volume (mL) of the test solution after being made up (i.e., 50 mL for MDC and 100 mL for MDO); F = dilution factor of the test solution;

m = weight of the test portion (g). (AOAC Official Method 2011.14)

Determination of Antioxidants: The 2,2′-Diphenyl-1-picrylhydrazyl (DPPHradical dot) technique is commonly used to estimate the antioxidant activity of single and combined materials. The spectrophotometric analysis of DPPH radical dot concentration variations carried on through the DPPH radical dot reaction with an antioxidant provides the basis of the technique [24, 22, 23].

RESULT AND DISCUSSION:

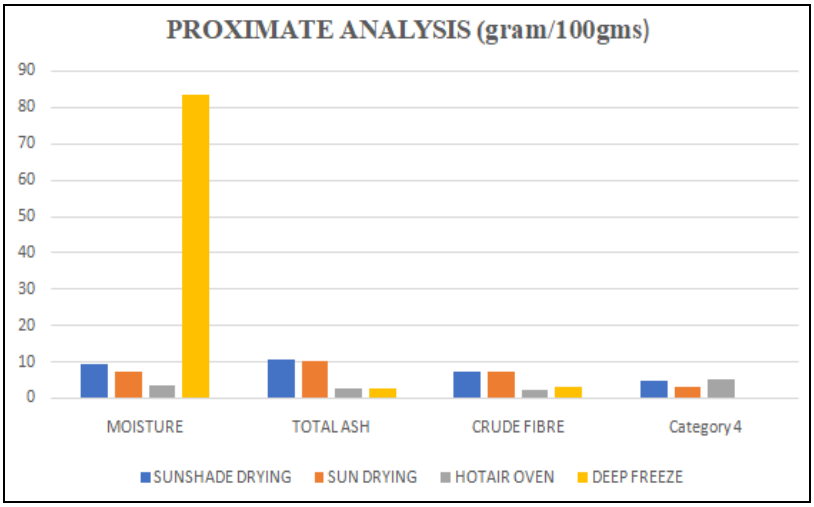

FIG. 1: PROXIMATE ESTIMATES OF *SAUROPUS ANDROGYNUS* DRIED LEAVES USING DEEP FREEZE, SUN DRYING HOT AIR OVEN, AND SUNSHADE TECHNIQUES

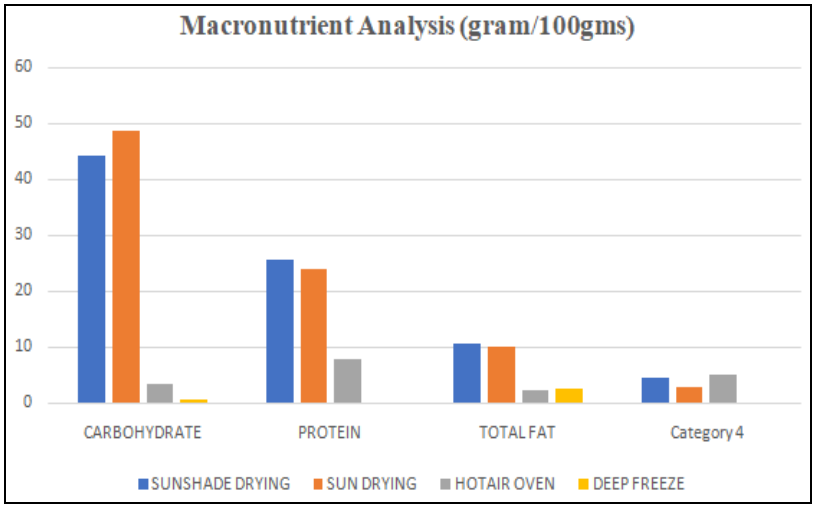

FIG. 2: MACRONUTRIENT ESTIMATES OF *SAUROPUS ANDROGYNUS* DRIED LEAVES USING DEEP FREEZE, SUN DRYING, HOT AIR OVEN, AND SUNSHADE TECHNIQUES

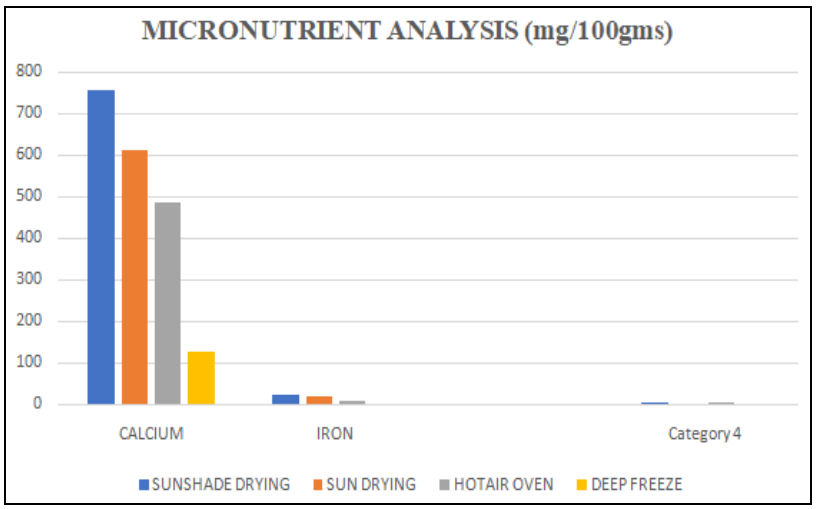

FIG. 3: MICRONUTRIENT ESTIMATES OF *SAUROPUS ANDROGYNUS* DRIED LEAVES USING DEEP FREEZE, SUN DRYING, HOT AIR OVEN, AND SUNSHADE TECHNIQUES

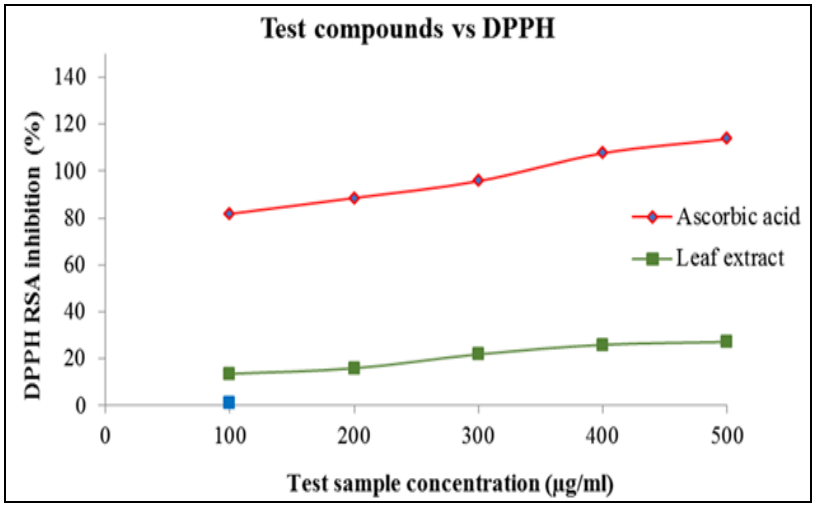

FIG. 4: FREE RADICAL SCAVENGING ACTIVITY USING DPPH ASSAY [22, 23]

DISCUSSION: Any food's acceptance and consumer preference are greatly influenced by its sensory Characteristics. Colour, texture, flavour, and Odor are all perceptions that are affected by the method of drying used. Due to its delicate structure and moisture content, *Sauropus androgynous*

leaves are exposed to significant sensory changes once they dry. A sun-dried sample of 100gms of *Sauropus androgynus* leaves comprises 48.63 gms of Carbohydrates, 23.76 gms of protein, 7.29 gms of moisture, 10.12 gms of fat, 10.20gms of total ash, 381 Kcal of energy, 610mg of Calcium, 20 mg of iron, and 7.10 gms of fiber. A hot air oven of 100gms of *Sauropus androgynus* leaves provided the following results: 113.3gms of carbohydrates, 7.67gms of proteins, 3.3133gms of moisture, 2.10gms of fat, 72gms of total ash, 119.67 Kcal of energy, 6mg of Calcium, 8.673mg of iron, and 2.18gms of fiber. A sun shade drying of 100gms of SA leaves provides 44.09 gms of carbohydrates, 25.46 gms of protein, 9.35 gms of moisture, 10.61 gms of fat, 10.49 gms of total ash, and 374 Kcal of energy. A deep freeze sample of 100 gms SA comprises 0.533 gms of carbohydrates, 15.84 gms of protein,0.021 gms of moisture, 2.7 gms of moisture, 2.7 gms of total ash, and total antioxidant capacity 0. 158 gm. The sensory evaluation demonstrated that sun-dried leaves were more preferred in colour, taste, retention of antioxidants, and overall acceptability compared to leaves dried in a hot air oven, Sunshade, or Deep freeze technique.

CONCLUSION: Based on above mentioned results of the study, it can be concluded that the sun-drying method was the best method of drying SA leaves. Sun drying retained more minerals, vitamins, and micronutrients than hot air oven drying, deep freezing, or the Sunshade technique. While all of the mentioned drying procedures efficiently decreased microbial contamination, the sun-drying approach showed benefits in maintaining the overall quality of the leaves. The findings of this study provide significant drying process applications by using *Sauropus androgynous* leaves in establishing a promising nutraceutical formulation in the context of health management applications. Further research is needed to explore the long-term storage stability and the bioavailability of bioactive compounds in the dried leaves for practical health intervention.

Credit to Authors: Data curation and writing-original draft preparation by Dr. Swapna. S, Conceptualization by Dr. Sushma BV**,** Validation by Dr. Anita. C, Methodology by Dr. Thanmaye Krishna, Supervision by Bhargavi.M.

ACKNOWLEDGEMENTS: The authors would like to thank my guide, Dr. Sushma B V, Assistant Professor, Department of Nutrition and Dietetics JSSAHER, Mysuru, Dr. Anita C, Assistant Professor, Department of Studies and Research in Food Science & amp; Nutrition Karnataka State Open University, Muktagangotri, MYSORE, and all the persons who participated in the study, which would not have been possible without them.

Funding: No funding sources.

Ethical Approval: The study was approved by the Institutional Ethics Committee.

CONFLICT OF INTEREST: None declared

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How to cite this article:
Suresh S, Sushma BV, Anitha C, Krishna T and Bhargavi M: Sensory and nutritional profiling of *Sauropus androgynus* leaves by means of drying technologies. Int J Pharm Sci & Res 2025; 16(10): 2753-59. doi: 10.13040/IJPSR.0975-8232.16(10).2753-59.