

Chapter 1

Qualitative phytochemical analysis of *Senna alata* (L.) Roxb.: an important medicinal shrub

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Abstract

Senna alata (L.) Roxb., commonly known as candle bush belongs to Fabaceae family, stands as an important medicinal shrub. The study employs qualitative phytochemical analysis and reveals the presence of tannins, flavonoids, phenolic compounds, and carbonyl groups shedding light on the plant's potential therapeutic applications. The investigation focuses on the medicinal importance of the shrub, providing a scientific base for traditional knowledge. The findings presented herein, holding implications for conservation, awareness, and sustainable utilization.

Keywords: *Senna alata*, therapeutic applications, traditional knowledge, conservation, sustainable utilization

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Introduction

Senna alata (L.) Roxb. is an important medicinal and ornamental flowering plant of the family Fabaceae (Nadirah *et al.*, 2023). *S. alata*, commonly known as “Candle bush” or “Cassia alata” has been recognized for its therapeutic properties across various cultures (Gritsanapan and Mangmeesri, 2009). It thrives in tropical and subtropical climates and commonly found in open areas and along roadsides (Figure 2). This species is native to central America and Africa, has gradually spread to other tropical regions worldwide (Isah *et al.*, 2015). The plant’s distinctive yellow flower clusters and elongated green leaves contribute to its recognizable appearance (Abubakar *et al.*, 2018). It is an annual and occasionally biannual herb, with an average height of 1 to 4 m (Doty *et al.*, 2020). The leaves are oblong, with 5 to 14 leaflet sets, robust petioles, caduceus bracts. The most striking feature of *S. alata* is its showy inflorescence (Srinivasan 2018). The fruit exists as a 10 to 16 × 1.5 cm tetragonal pod, thick, flattened wings, coffee brown when ripe with many diamond-shaped seeds (Figure 1). The flowering and fruiting period is September-December (Oladeji *et al.*, 2020). Historically, *S. alata* has been employed in traditional medicine for a wide range of ailments (Hennebelle *et al.*, 2009). Its effectiveness in addressing skin conditions, such as fungal infections and dermatitis, has earned it a reputation as a valuable herbal remedy (Silalahi, 2022).



Figure 1: Seeds of *Senna alata*

Moreover, its prevalence in folk medicine is often attributed to its diverse pharmacological compounds, making it a subject of interest in modern scientific research. The flower, root, leaves, seed, and bark displayed diverse biological activities include antimicrobial (Ehiowemwenguan *et al.*, 2014), antifungal, antibacterial, antioxidant (Priya *et al.*, 2021) and antidiabetic (Adedayo *et al.*, 2008; Sule *et al.*, 2011). Despite of having significant medicinal properties, somewhere this species is still less known to local people in surroundings due to lack of inheritance of traditional knowledge from the indigenous people to next generations. Furthermore, increasing urbanisation, industrialization and anthropogenic disturbances leading towards the destruction of plant population in large quantities. With these objectives, an attempt has been made to find out the phytochemical constituents present in this plant to highlights its food values, medicinal uses and pharmacological properties for the sustainable utilization, conservation, and awareness purposes.



Figure 2: Collection of fruits of *S. alata* from Cuttack, Odisha

Methodology

The field survey was conducted during the month of January- February and the plant species was identified by the authors. To investigate the local knowledge, some people were asked about *S. alata* by the team members of APRF (Ambika Prasad Research Foundation). For qualitative phytochemical analysis, the Soxhlet method of extraction was adopted to obtain the plant extracts. Fresh and mature *S. alata* fruits were collected from the roadsides of the nearby Mahanadi River area in Cuttack, Odisha (Figure 2). The fruit seeds were separated and thoroughly washed with distilled water, dried at room temperature under shed conditions, and powdered after drying using machinery devices. The powder was kept in a close container for extraction (Misra *et al.*, 2012; Kumar *et al.*, 2013; Kumar *et al.*, 2017; Sahoo *et al.*, 2021).

Qualitative analysis of bioactive compounds

Phytochemical analysis was carried out on aqueous extract of *S. alata* seeds using standard procedure to identify the bioactive compounds present in the plant (Figure 3; Devi *et al.*, 2023).

Test for tannin

1 ml of filtrate of the extract was taken, 2-3 drops of 0.1% lead acetate solution was added to it. The creamy gelatinous precipitate provides the positive result of the presence of tannins.

Test for saponin

1 ml of the filtrated plant extract was mixed with 1 ml of distilled water and shaken vigorously. The persistent froth formed after shaking provide the evidence of the presence of saponin.

Test for flavonoids

1 ml filtrate of the plant extract was added with 2 ml of 2% NaOH solution and 3 drops of sulphuric acid. The colour initially turned an intense yellow colour with NaOH solution and later became colourless. This change in colour confirmed the presence of flavonoids.

Test for terpenoids

2 ml of the filtrate of plant extract was used and 6 drops of chloroform was added and placed it in the water bath for few minutes. Then, 6 drops of

conc. Sulphuric acid were added. The reddish-brown interface confirmed the positive result for the presence of terpenoids.

Test for phenolic compounds

1 ml of the filtrated plant extract was taken. Few drops of 5% ferric chloride solution were added. The dark bluish black colour provides the positive result for the presence of phenolic compounds.

Test for reducing sugar

1 ml of the filtrate of plant extract was taken and 2 drops of Fehling's solution A followed by Fehling's solution B were added and kept it in water bath for some time. The formation of red orange precipitate confirmed the presence of reducing sugar.

Test for steroids

1 ml of the filtrate of the plant extract was used. 1 ml chloroform and 1 ml of concentrated sulphuric acid was added into it. The presence of upper red and lower yellow with green fluorescence provide the positive result of the test of steroid.

Test for alkaloid

1 ml of the filtrate of the plant extract was taken and added 3 to 4 drops of Dragendroff's reagent. The formation of reddish-brown precipitate confirmed the presence of alkaloids.

Test for carbonyl compounds

1 ml of the filtrate of the plant extract was taken. Added 3 to 4 drops of 2,4-DNPH (Dinitrophenylhydrazine) reagent. The formation of yellow crystal confirmed the presence of carbonyl compounds.

Results and discussion

The present investigations indicate the presence of different bioactive compounds in the aqueous extract of seeds of *S. alata* such as tannins, flavonoids, phenolic compounds, and carbonyl groups which contributes to its therapeutic activities (Table 1). In this regard, some literature findings are also discussed with the food values, ethnomedicinal uses and pharmacological potentials.

Food values

In 2018, Abdulwaliyu and his team investigated the nutrients present in the seed of *S. alata* and revealed high content of carbohydrate, minerals like Calcium, Magnesium, iron, zinc, copper, and potassium (Abdulwaliyu *et al.*, 2018). These mineral constituents could help in formulation of herbal drugs and dietary supplements. The high nutrient content in the seed of this plant suggest it could be as an alternative source for livestock.

Ethnomedicinal uses

In Ayurvedic, and traditional practices, various parts of *S. alata* have shown diverse therapeutic activities in disease control. Some studies reported the stem, leaf and root decoctions are used in the treatment of wound healing, skin infections, respiratory tract infection, burns, diarrhoea and constipation (Adedayo *et al.*, 2008). The leaf decoction serves as an antidote to body and abdominal pain, stress, and toothache (Benjamin and Lamikanra, 2008). It also cures dermal infections, convulsion, and act as purgative (Ogunti and Elujoba, 1995). The stem, bark, and leaves were reported to be used as a remedy for gastroenteritis, hepatitis, ringworm etc. (Oladeji *et al.*, 2020). *S. alata*'s stem, bark and leaf decoction was found to be effective in treating haemorrhoids, syphilis, intestinal parasitosis and diabetes (Varghese *et al.*, 2012).

Pharmacological values

Researchers continuous discovering the new species of Fabaceae family (Devi *et al.*, 2023; Sethi *et al.*, 2024) which lead to provide new source of pharmaceutical from this family. Medicinal plants belonging to the Fabaceae family have extensively been investigated for their pharmacological activities. Plants produced various secondary metabolites which contribute to its therapeutic activities (Behera *et al.*, 2019; Gyanvarsha *et al.*, 2020). The methanol extracts of leaves, flowers, stem, and root barks of *S. alata* showed a broad spectrum of antibacterial activity. Anthraquinone and flavonoid glycosides detected in *S. alata* extracts significantly inhibited the growth of *E. coli* and *S. aureus* (Khan *et al.*, 2001; Somchit *et al.*, 2003). The crude extracts isolated from purified fractions of *S. alata* flower extract displayed strong inhibitory activities (Adedayo *et al.*, 2008). The aqueous leaf extract significantly reduced lipid peroxidation, blood glucose level (Kazeem *et al.*, 2015). Quinones isolated from *S. alata* significantly displayed in vitro antiplasmodial activity, against *Plasmodium falciparum* (Kayembe *et al.*, 2012).

Table 1: List of secondary metabolites present in aqueous extracts of seeds of *Senna alata*

Phytochemicals	Seeds
Tannin	+
Saponin	~
Flavonoids	+
Terpenoids	~
Phenolic compounds	+
Reducing sugars	~
Steroids	~
Alkaloids	~
Carbonyl compounds	+

The comprehensive screening revealed the presence of flavonoid, known for their antioxidant properties, implicates *S. alata* as a source of natural antioxidants (Priya *et al.*, 2021). Tannins, phenolic compounds, and carbonyl groups contribute to the plant's potential medicinal value, encompassing antimicrobial, anti-inflammatory and antiviral properties (Adedayo *et al.*, 2008).

**Figure 3:** Phytochemical screening of aqueous extract of seeds of *S. alata*

Conclusion

The present study of *Senna alata* contributes to the broader goals of conservation efforts, awareness, and sustainable utilization of medicinal plants by providing insights into the plant's food values, several traditional uses and pharmacological significance. The presence of different bioactive compounds can hold promising potential for the development of novel pharmaceutical products. This documentation serves as a base for promoting a balance between sustainable utilization and the preservation of biodiversity.

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