

A STUDY ON CHEMICAL AND BOTANICAL STANDARDS OF A TRADITIONAL DRUG SOURCE- *SPATHODEA CAMPANULATA* BEAUV.

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ABSTRACT

Natural product based therapies require authentication and their quality control measures would enable improved recognition and approval of these products. *Spathodea campanulata* Beauv. is an important plant widely used in traditional medicine in Africa and the therapeutic uses include aids, anti-inflammatory and hypoglycemic activities. With a view to aid the development of medicinal products of this plant, macroscopic, microscopic properties, chemical and biochemical characteristics of *Spathodea campanulata* have been studied. The investigation revealed the presence of gray colored bark surface containing thick flakes of uneven shape having circular cushion shaped spots. Smooth, shining cream colored inner surface of the Bark was observed. Periderm or Rhytidome, the outer zone consists of multiple dark wavy zones alternating with light bands in a successive manner. Inner zone has faint parallel vertical bands. Distinct features of this plant are the presence of collapsed phloem and non-collapsed phloem in outer zone and inner zone, respectively. Abundant calcium oxalate crystals of spindle and prismatic shape seen in phloem parenchyma cells. Elemental analysis, organic content, biochemical and phyto constituent analysis revealed the presence of iron at more than 56% while alkaloids and flavanoids such as are present in 1.5 and 2 %, respectively and starch as much as 1.36%. Data obtained through the present study will help in utilizing the extracts for disease management effectively.

Keywords: Traditional Drug Source, *Spathodea Campanulata* Beauv.

INTRODUCTION

Modern drugs cure several diseases through precise mechanisms. However the toxicities associated with these drugs limit their use on a long term therapy. Although many drugs have originated from natural sources, serious efforts are on to find new drugs from the rich source of nature combined with the traditional knowledge our forefathers have created in disease management using the herbs. Ayurveda, Siddha medicine in India and folklore medicine in China and various other countries have a great source of many drugs. *Spathodea campanulata* Beauv. which is native to Africa and distributed in various parts of South America and also in India has been used in African traditional medicine¹. It is mainly cultivated for ornamental purposes and useful in checking soil erosions. Wood forms a good source for paper industry, while bark is useful in ulcer and skin related diseases as well finds use in gastrointestinal disorders. But there is a lacuna existing in the standardization of these herbs and herbal medicine leading to inconsistency therapeutic effects. Hence, there is a need for standardization of these herbal drugs before using. Proper identification and authentication of herbal drugs along with the presence of therapeutic constituents is to be ensured for the safety and efficacy. Hence need of the hour is botanical standardisation, which includes macroscopic and microscopic studies, chemical standardization including analysis of active ingredients and evaluation of mechanism of action of the ingredients. This kind of study will enable traditional drugs gain recognition and acceptance worldwide and help in the healthcare of mankind in an eco-friendly way without producing serious side effects. In the present study, *Spathodea campanulata* Beauv. belonging to family Bignoniaceae is studied from botanical and chemical standardization point of view. The salient botanical and chemical standards determined in the present work will enable proper identification and authentication of this herbal drug and will promote proper usage of this drug which has immense therapeutic potentials like anti-microbial, wounding healing, anti-ulcer, anti-diabetic, anti-oxidant and anti-HIV. This could also be used in alleviating renal complications.

The plant drug selected for this study has a broad spectrum of proven biological activity² and chemically interesting compounds³ such as iridoid glucoside and phenolic benzoic acids. Prominent activities include hypoglycemic⁴, anticonvulsant⁵ and anti-HIV

activity. Various therapeutic uses of *Spathodea campanulata* Beauv stem bark as per traditional practice are scientifically validated. Toxicity studies⁶ analgesic action and antifungal activities² have also been reported.

MATERIAL AND METHODS

Bark of *Spathodea campanulata* Beauv. belonging to family Bignoniaceae is collected from SASTRA campus and botanically identified by Dr. N.Ravichandran, Pharmacognosist, CARISM, SASTRA University employing Floras of South India⁷.

Source taxon is a beautiful tree with large reddish flowers and pinnately compound attractive leaves. For botanical studies this specimens were fixed, dehydrated was infiltrated and sectioned⁸ with Rotary Microtome to the thickness of 10 µm.

Section was stained⁹ with Toluidine blue (0.25%). Photomicrographs prepared with NIKON microscope and NIKON digital camera. Preliminary phytochemical screening, Elemental analysis quantitative analysis of the drug were carried out as per the procedures given in Ayurvedic Pharmacopoeia of India, Part-I, Vol.II. Protein was estimated employing Lowry's method¹⁰. Carbohydrate analysis was followed by the procedure of Yemm and Willis¹¹ and fat analysis carried out using the method of Osborne *et al*¹². Energy values were also calculated¹³.

RESULTS

Description of the Source Taxon

A tree reaching a height up to 22m and is commonly known as Tulip tree. Leaves imparipinnately compound with elliptic leaflets and scarlet-red flowers in terminal racemes (Fig. 1). In this paper, bark of the selected drug which finds much use is studied from botanical and chemical standardisation of view.

Botanical studies

Macroscopic Features

Bark surface gray colored with thick flakes of irregular shape and circular cushion shaped spots (Fig 2). Bark inner surface smooth, shining and cream colored. Salient features are presence of outer zone of two or three successive dark wavy zones alternating with light bands and Inner zone with faint parallel vertical bands.



Fig. 1: Habit



Fig. 2: Bark

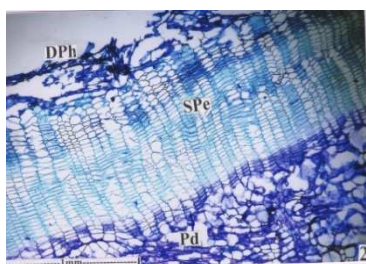


Fig. 3: Periderm layers

DPh: Dead Phloem; SPE: Sequent Periderm Pd: Phelloderm

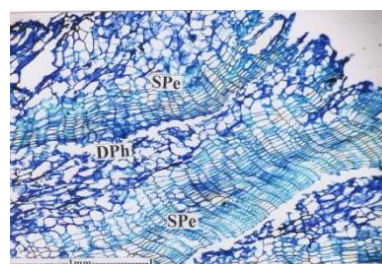


Fig. 4: Dead phloem seen in between periderm layers

DPh: Dead Phloem; SPE: Sequent Periderm

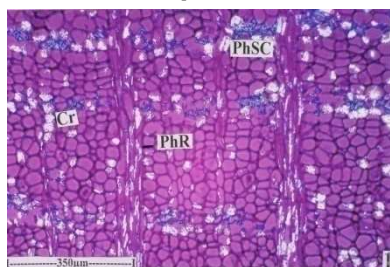


Fig. 5: Phloem Ray and Phloem Sclerenchyma

PhSC: Phloem Sclerenchyma; PhR: Phloem Ray Cr: Crystal

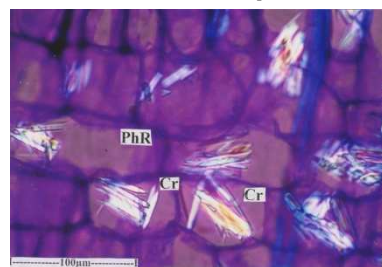


Fig. 6: Crystals and phloem Ray cells enlarged

PhR: Phloem Ray; Cr: Crystal

Microscopic Features

Bark shows characteristic Outer zone of compound periderm or Rhytidome. Inner portion of secondary phloem comprises of dead and non- collapsed phloem.

Rhytidome includes 2 or 3 successive zone of homogeneous, suberised tabular phellem cells alternating with wide included dead phloem (Fig 3 & 4).

Outer zone of collapsed phloem consists of

- Dilated curved Rays
- Thin tangential bands of sclerenchyma
- Dark, thin tangential lines of crushed sieve elements

- Inner zone of non-collapsed phloem comprises narrow rays, wide intact sieve tubes with simple sieve plates.

Tangential longitudinal and Radial longitudinal sectional views: Phloem rays- multi-seriate wide, high, non-storied homocellular. Sieve tube with simple horizontal sieve plates (Fig 5).

Crystal distribution: (Fig 6)

Calcium oxalate crystals of spindle shaped and prismatic types abundant in the rays and phloem parenchyma cells.

Chemical and biochemical studies

Preliminary phytochemical screening revealed the presence of Alkaloids, reducing sugars, carbohydrates, flavones, glycosides, and phenolic compounds.

Table 1: Data on Elemental Analysis

Sl. No.	Name of the Minerals	Quantity
1.	Organic Carbon (%)	1.82
2.	Total Nitrogen (%)	1.12
3.	Total Phosphours (%)	0.36
4.	Total Potassium (%)	3.89
5.	Total Sodium (%)	0.18
6.	Total Calcium (%)	3.25
7.	Total Magnesium (%)	2.56
8.	Total Sulphur (%)	0.32
9.	Total Zinc (ppm)	1.02
10.	Total Copper (ppm)	0.11
11.	Total Iron (ppm)	56.23
12.	Total Manganese (ppm)	5.36
13.	Total Boron (ppm)	0.08
14.	Total Molybdenum (ppm)	0.03

Table 2: Major Phytoconstituents

Sl. No.	Name of the Phytoconstituents	Quantity
1.	Alkaloids (mg kg ⁻¹)	1.92
2.	Flavonoids (mg kg ⁻¹)	2.50
3.	Tannin (mg kg ⁻¹)	0.35
4.	Lignin (mg kg ⁻¹)	0.29
5.	Glycosides (mg kg ⁻¹)	0.05
6.	Serpentines (mg kg ⁻¹)	0.05
7.	Terpenoids (mg kg ⁻¹)	0.03
8.	Saponins (mg kg ⁻¹)	0.01
9.	Phenols (mg kg ⁻¹)	0.12

Table 3: Major Nutrients

Sl. No.	Nutraceuticals	Values
1.	Carbohydrates (mg kg ⁻¹)	1.36
2.	Protein (mg kg ⁻¹)	0.32
3.	Fats (mg kg ⁻¹)	0.03
4.	Energy (K Cal g ⁻¹)	5.69

DISCUSSION

Bark is more complex tissue systems than any other systems in plants with reference to both structure and functions. Study of bark is a rewarding task as it offers vistas of medicinal compounds localization and also helps in the diagnosis of the original bark from its adulterants. *Spathodea campanulata* - bark with high pharmaceutical potentials, has not received much attention as it deserves to achieve. In the present investigation attempts were to determine salient botanical and chemical standards which could be useful in the identification and authentication of the selected drug source. Important macroscopic characters observed are presence of greyish bark with irregular and circular cushion shaped spots. Inner surface shining and cream coloured. Microscopically rhytidome type of outer bark present with thin scanty phloem sclerenchyma. Rays multi-seriate, homocellular and non-storied rays. Non collapsed phloem is unique with narrow rays wide intact sieve tubes with simple sieve plates. Spindle shaped Calcium oxalate crystals are brought to light as characters of diagnostic values of the bark.

Preliminary phytochemical screening revealed the presence of alkaloids, reducing sugars, carbohydrates, flavones, glycosides, and phenolic compounds. Of these, alkaloids, flavonoids and carbohydrates and total iron are at higher level. The results of these findings are supplementary evidences in support of the determination of the identification of the bark samples.

Botanical standards

Macroscopic

1. Presence of greyish bark with irregular and circular cushion shaped spots.
2. Inner surface shining and cream coloured.

Microscopic

1. Presence of rhytidome type of outer bark and thin scanty phloem sclerenchyma.
2. Rays multi-seriate, homocellular and non-storied rays.
3. Non collapsed phloem is unique with narrow rays wide intact sieve tubes with simple sieve plates.
4. Presence of spindle shaped Calcium oxalate crystals.

Chemical standards

Alkaloids, reducing sugars, carbohydrates, flavones, glycosides, and phenolic compounds.

Nutraceutical values

Iron - 56.23%	Magnesium - 2.56%	Alkaloids - 1.92 mg/kg
Potassium - 3.89%	Manganese - 5.36%	Flavonoids - 2.50 mg/kg
Calcium - 3.25%	Zinc - 1.02%	

CONCLUSION

The above botanical and chemical standards determined in the present work could be highly useful for herbal researchers and industrialists in the identification of this therapeutically potential traditional drug sources. Further the data indicates that the presence of 56% of iron, 2.5 mg/Kg of flavonoids could be responsible for its nutraceutical property.

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