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Pharmacognostic Evaluation and Phytochemical Screening of Stem Bark of Thespesia Populnea (L.) Sol. Ex Corrêa

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Abstract

Thespesia populnea is large, fast growing, evergreen, shrubby, perennial tree belongs to family Malvaceae. Is a big avenue tree with pantropical distribution located in the steamy regions, tropical regions and in india's coastal forest region. It is widely cultivated in gardens and various agroforestry systems due to its versatile uses. Occasionally, these trees are planted along roadsides for ornamental and shade purposes (Naik, 1988). It often has a short, sometimes crooked trunk and develops a broad, dense crown. The bark is generally pale grey or brown, characterized by deep fissures and a knobby, fibrous texture; younger shoots are covered with peltate scales and ridges (Mika & Guruvayoorappan, 2013; Mallya Suma, 2018). The plant contains secondary metabolites like carbohydrates, tannins, alkaloids, Saponins, Iridoids Phenols and Coumarin. The aim of the present research work is, to develop and standardize different phytochemical analysis for the evaluation of stem bark extract of medicinal plant. The objective of present work is to evaluate various quality control parameters were to lay down pharmacognostical and preliminary phytochemical standards. In this study, the stem bark of titled plant was subjected to microscopic characterization, followed by the preliminary physicochemical and phytochemical evaluations. The microscopic characters of bark were studied by free hand sectioning method. The preliminary phytochemical analysis included dry matter, bulk density, total ash, reducing sugar, extractive values in different solvents, fibre content, fat content etc. The results obtained by using scientific parameters from this research work is used to authentication, identification and standardization of adulteration found in the bark drug.

Keywords: *Thespesia populnea, Malvaceae, Stem bark, Ayurveda, pharmacognosy, pharmacognostic evaluation, Phytochemical Screening, extractive value, Solvents.*

Introduction

It is Large, fast growing, evergreen, shrubby, perennial tree with a short, often crooked stem and a broad, dense crown (Suvarna et. al, 2018); leaves are glossy green above and pale yellow below, heart-shaped, alternate, simple; petioles long; stipules subulate, deciouous. Flowers are hibiscus-like, pale yellow with maroon spot (Hiteksha and Mamta, 2017), bisexual, axillary, solitary, flowers turn dark red, purple or pink as the day progresses (Mika and Guruvayoorappan, 2013; Hiteksha and Mamta, 2017). Calyx cupular, corolla yellow with pink purple centre (Patil and Nitave 2022); petals five (Vasudevan et al., 2007; Saravanakumar et. al, 2009). The Fruits are globose, brittle, pyriform, dry, woody. The Seeds are valuable, ovoid or rounded. Occasionally planted along roadsides. (Naik, 1988; Muthukumar and Veerappa, 2018). It is large avenue tree cultivated in the gardens and in other agroforestry systems for its multifarious uses. It is one of the common plant in the coastal lowlands, coastal stand across old-world tropics and midlands of Kerala (Patil et. al, 2022). The tree grows best under full sunlight and tolerates drought conditions so grows well along warm coastal areas near the mangroves from the east coast of Africa and South and Southeast Asia to Melanesia, Micronesia, and Polynesia (Hiteksha and Mamta, 2017). Currently, it is naturalized in tropical climates throughout the world commonly in Asia, Central America, Caribbean islands, Indonesia, Philippines, India and Pacific Ocean islands. It is also distributed in Indochina, Mauritius and Mozambique (Ilavarasan et. al, 2011). It also naturalized in volcanic, limestone and rocky soils. It propagates easily and grows rapidly (Hiteksha and Mamta, 2017).

Materials and Methods

Plant material collection

The stem bark of *Thespesia populnea* was collected in the month of May Latitude N19o,47',82.57" Longitude E075o,38',70.22" Altitude 102.0 m, from Hutatma Smarak, Court Area, Paithan, Chh. Sambhajinagar.

For the purpose of conducting various pharmacognostical and phytochemical analyses, bark was ground into a fine powder in a mechanical grinder and then preserved in an airtight, tightly sealed container for further investigation.

Physico-chemical Evaluations

Physico-chemical parameters like total ash, water soluble ash, water insoluble ash, acid insoluble ash, acid soluble ash, loss of weight on drying 105^{0}C was established. To determine the properties of contents of drugs and Considering the diversity of chemical nature of drug, different solvents like benzene, petroleum ether, Acetone, chloroform, methanol, alcohol and water extractive values was evaluated as per reported methods (Mukherjee, 2002, Kakate, 1994, Khandelwal, 2005) (Table 2).

Phytochemical screening

Qualitative and quantitative study of *Thespesia populnea* bark was done as per reported methods to determine inorganic matters and of heavy metals.

The dried powder of bark was exposed to preliminary phytochemical screening for qualitative detection of phytoconstituents. The dried powder of bark (100g) was extracted one after another by using hexane, petroleum ether, benzene, chloroform, acetone, methanol, water in Soxhlet Extractor by continuous hot percolation process. Each time before extracting with the next solvent of higher polarity the powdered material was dried in hot air oven below 50^{0}C for 10 minutes. Finally, each extract was concentrated in vacuum on a Rote Evaporator and dried in hot air oven.

The dried extracts were dissolved in respective solvents, with it was extracted, and were subjected to various qualitative phytochemical tests for the identification of chemical constituents present in the plant material (Harborne, 2005) (Table 3 and 4).

Morphology, Anatomy and Maceration

The morphological characters of the plant were studied detail in the field and the prepared herbarium sheets were preserved in the Herbarium of Department of Botany, Pratishthan Mahavidyalaya, Paithan. In the laboratory fresh and dried bark samples were studied morphologically regarding their colour, texture of inner and outer surfaces, splitting and quelling. The anatomical characters of bark were studies by free hand sectioning by using blade. Sections were dehydrated with different alcohol grades and stained with Saffranin and light green. Both double stained and unstained sections were studied and preserved permanently. These permanent preparations were observed under microscope (Khandelwal, 2005) and photographed by microphotographic techniques. The bark was also studied by maceration technique. The pieces of barks were boiled in Jeffery's fluid (Chromic acid 10% and Nitric acid 10% in 1:1 proportion) and the macerated cells were studied in detail (Khandelwal, 2005). Their figures were drawn with the help of camera lucida and inked by rotring pens. Their photographs were taken by micro photographic techniques and with the help of microscope and micrometry, the dimensions of the cells were measured.

Qualitative and Quantitative Analysis

Physical evaluation: Dry matter (DM), Bulk density Chemical analysis

Qualitative evaluation: Tannins, Saponins, Alkaloids, Phenolic acids and flavonoids.

Quantitative evaluation: Nitrogen (N), Water soluble nitrogen (WSN), Crude proteins (CP), Crude fats (CFat), Crude fibres (CF), Total ash (TA), Acid insoluble ash (AIA), Acid soluble ash (ASA), Calcium (Ca), Phosphorus (P), Potassium (K), Total carbohydrates (TC), Cellulose, Hemicellulose, Lignins, Reducing sugar, Non reducing sugar, Total sugar, Gross energy (GE) and Extractive values.

Results and Discussion

Organoleptic Evaluation:

The organoleptic characters of *Thespesia populnea* such as texture, colour, taste, and odour are discussed in (Table 1).

Morphology of bark:

Morphological feature of bark shows, thickness of fresh bark is 6 -10 mm and Thickness of dried bark is 3-7 mm, corrugated with scaly twigs (Priya and Saravanan, 2020). The outer surface is greyish brown (shekshavali & shivkimar hugar, 2012) or grey in younger trees whereas dark brown in larger trees, with fibrous fracture, smooth to highly fissured, rough due to numerous irregular scattered lenticels (Hiteksha and Mamta, 2017). Inner surface is striated and pale yellowish in color. The fractures are short and fibrous. The odour is aromatic or characteristic and taste is slightly bitter. A yellow transude is oozed out from the fractured surface probably mucilage (Suvarna et. al., 2018). Dried bark forming single, channel shaped quilling.

Anatomy of Bark:

Anatomical feature of bark shows Cork consists of 6-7 layers square to rectangular in shape, 8-15×6-9µ. Below the cork cortex consists of 21-26 layers parenchyma cells are arranged vertical, barrel, elongated, square to rectangular in shape, 8-23×6-14µ. Outer cortex consists of 8-12 layers parenchyma cells are arrange vertical cross line, square, rectangular, elongated to barrel in shape, 8-21×6-19µ. Inner cortex consists of 8-12 layers parenchyma cells are arranged vertical as well as horizontal, both are barrel, rectangular, square to elongate in shape, 6-21 × 7-15µ. Below the cortex medullary rays are arranged in several group ovals to irregular in shape. Medullary rays are

arranged horizontal line, thick; double walled, hollow, tangle, rhombus to diamond in shape, 4-10×5-9µ. Medullary rays groups are arranged vertical as well as horizontal. Below each medullary rays group parenchyma cells are arranged horizontal line, compactly arranged, elongated, barrel to rectangular in shape, 8-16×6-12µ.

Maceration of Bark:

The macerated cells of bark shows nine types of fibres; one (a) is single walled, thick, elongated, pointed at both the ends, broad at middle, non-septate, measuring from 10-23 x 170-190µ; second (b) is pointed at both the ends, broad at middle, non-septate, single walled, thick measuring from 9-28 x 670-687µ; third (c) is linear, thick, single walled, pointed at both the ends, broad at middle, non-septate, measuring from 12-17 x 1030-156µ; fourth (d) is short, uniform in shape, thin, single walled, measuring from 12-15 x 210-240µ; fifth (e) is short, linear, thin, single walled, pointed at both the ends, broad at middle, non-septate, hook or triangular shape, measuring from 8-23 x 140-158µ; sixth (f) is long, pointed at both the ends, linear, pointed at both the ends, broad at middle, non-septate, measuring from 9-27 x 499-524µ; seventh (g) is short, rounded at both the ends, linear, broad at middle, septate, divided into several segments, shape of segments were square to rectangular, measuring from 9-13 x 232-243µ; eighth (h) is long, rounded at both the ends, linear, broad at middle, septate, divided into several segments, shape of segments were square to rectangular, measuring from 13-17 x 452-485µ; ninth (h) is long, pointed at both the ends, linear, broad at middle, non-septate, measuring from 8-21 x 1280-1294µ. Cells with yellow inclusion (j), square, rectangle to elongate in shape double walled, thick, measuring from 12-23 x 238-246µ. Sieve elements, (k) is square to rectangle in shape, single walled, thick, and measuring from 48-57 x 326-341µ. Companion cells (l) elongated to rectangle in shape, double walled, thick, and measuring from 29-34 x 227-243µ. Parenchyma cells (n) is oval to round in shape, thin, single walled, measuring from 15-20 x 20-98µ.

Table: 1 Organoleptic characteristic of stem Bark of *Thespesia populnea*

Parameters	
Condition	Dried
Colour	Outer surface of bark is greyish brown to dark brown in colour, with scaly twings, fibrous fracture, smooth to highly fissured, scattered lenticels and Inner surface of bark is striated and pale yellowish in colour, fractures are short and fibrous
Odour	Aromatic or characteristic
Taste	Slightly bitter
Texture	Outer is Rough, inner is striated, smooth and fibrous
Fracture	Fibrous, smooth to highly fissured, rough due to numerous irregular scattered lenticels.
Size	Length 6 -10 mm Thickness 3-7 mm
Quilling	Single, channel shaped quilling (plate No.).

Table: 2 Physico-Chemical Properties of *Thespesia populnea* stem bark

Sr. No.	Quantitative Standards	%	Sr. No.	Quantitative Standards	%
1.	Dry matter	91.9	13.	Non Reducing Sugar	0.56
2.	Bulk Density mg/cm3	137	14.	Total Sugar	3.90
3.	Ash	10.71	15	Crude Fibre	19.14
4.	Acid soluble ash	6.84	16.	Crude Fat	4.78
5.	Acid insoluble ash	3.87	17.	Cellulose	25.70
6.	Water soluble ash	8.26	18.	Hemicellulose	7.50
7.	Water insoluble ash	2.45	19.	Lignin	3.80
8.	Nitrogen	0.43	20.	Tannins	7.90
9.	Water Soluble Nitrogen	0.19	21.	Gross Energy K/cal	3.72
10.	Crude Protein	2.68	22.	Calcium	2.73
11.	Carbohydrates	74.60	23.	Phosphorus	0.123
12.	Reducing Sugar	3.34	24.	Potassium	0.565

Table- 3: Successive Extractive Values of the stem Bark of *Thespesia populnea*

Sr. No.	Solvent	Weight of Drug	Average Extractive Value (%)
1	Water	10gm	4.20
2	Methanol	10gm	9.30
3	Alcohol	10gm	7.20
4	Benzene	10gm	8.38
5	Petroleum Ether	10gm	0.62
6	Chloroform	10gm	0.83
7	Acetone	10gm	3.54

Table- 4: Distribution of Phenolic acids and chemical compounds in bark samples

Sr. No.	chemical compounds	Results
1.	Tannins	+
2.	Phenols	+
3.	Alkaloids	+
4.	Saponins	+
5.	Iridoids	+
6.	Quercetin	-
7.	Kaempferol	-
8.	Catechin	-
9.	Coumarin	+
10.	6,7-Dimethoxy coumarin	-
11.	5-Methoxy genistein	-
12.	Anthocyanin	-
13.	Proanthocyanin	-

Physico-Chemical Evaluation

The physicochemical studies and consecutive extractive values of stem of *Thespesia populnea* are summarized in table 2 and 3 respectively.

Qualitative and Quantitative Analysis:

In Physical evaluation: Dry matter (DM) and Bulk density evalualted. In Quantitative analysis the amount of different phytoconstituents like Tannins, Saponins, Alkaloids, Phenolic acids and flavonoids. Quantitative: Nitrogen (N), Water soluble nitrogen (WSN), Crude proteins (CP), Crude fats (CFat), Crude fibres (CF), Total ash (TA), Acid insoluble ash (AIA), Acid soluble ash (ASA), Calcium (Ca), Phosphorus (P), Potassium (K), Total carbohydrates (TC), Cellulose, Hemicellulose, Lignins, Reducing sugar, Non reducing sugar, Total sugar, Gross energy (GE) and Extractive values are evaluated. In Qualitative analysis presence of different phytoconstituents are evaluated.

Conclusion

Microscopy along with the preliminary phytochemical evaluation of stem bark confirms the quality and purity of plant and its identification. On physico-chemical analysis the stem bark was found with relatively high gross energy (3.72 K/Cal) and low non-reducing sugar and crude fibre content. The preliminary phytochemical screening of stem bark showed the presence of different phyto-constituent groups such as Tannins, Phenols, Alkaloids, Saponins, Iridoids and Coumarin. The bark shows high extractive value in solvent Methanol and low in solvent petro-ether. Here the observations and results obtained useful for further pharmacological and therapeutically evaluation.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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