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Phyto-pharmacognostical and physicochemical evaluation of *Gmelina arborea* Roxb. flower

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Abstract
Flowers are the essential chunk of the plant. It becomes pretty simple to identify the plant on the basis of flowers. They are widely used in system of medicine. The *Gmelina arborea* Roxb. is one of the most significant plant reputed for its different properties and uses in the *Ayurvedic* scriptures. The flowers of the plant are very attractive, bell shaped and brownish yellow in color and about 2.5–3.5 cm long, opposite decussately arranged three flowers along with the axis of a densely fulvous-hairy terminal panicles. Almost all the parts of the plant are used as medicine like the root one of the ingredient of *Dashmoola*, bark in fever and dyspepsia, leaves as paste for headache, juice for wash ulcers, fruits for the hair growth, anaemia, leprosy, ulcers etc. Likewise the other parts of plant flowers are also used to treat leprosy and blood disorders. Thus the aim of this research work is to carryout pharmacognosical and phyto-physicochemical investigation of the flowers of G. *arborea*. Roxb.
The results shows key characters for identification like the presence of various glandular and non-glandular trichomes, spiral vessels, epidermal cells etc. microscopically and presence of alkaloids, tannins, flavonoids, glycosides, saponins etc. phytochemically. Flower microscopy brings scientific knowledge and understanding of floral characters helps in identification in the crude drugs in the powder form also. Till date no any detailed pharmacognostical, pharmaceutical work has been done on this flower.

Keywords: *Gmelina arborea* Roxb., gambhari, flower, pharmacognosy, quantitative estimation

1. Introduction
Plants are the most fascinating creatures on the earth. From the ancient science to the modern era plants and various plant parts are used to prepare medicines for different ailments. The existing era believes on evidences and facts, in which pharmacognosy plays an important role in the identification of the plant. Taxonomy, identification, microscopic study includes the quality parameters which help in identifying the adulteration of crude drugs even in dry powder form also. This is again necessary because once the plant is dried and made into powder form, it changes its morphological identity and easily prone to adulteration. Pharmacognostical study make sure plant identity, lays down standardization parameters which will help and prevents adulterations [1].
G*melina arborea* Roxb. (Family: Verbenaceae) is locally known as '*Gambhari'*. In English it is known as 'Candahar tree' or 'White teak'. It is also known as '*Pitarohini'* due to 'beautiful flowers', '*Shreeparni'* for 'leaves are very beautiful' and '*Sarvotabhadra'* for using 'each parts of plant having medicinal value' [2]. The roots, bark, leaves, flower and fruits of *Gambhari* have great medicinal value [3]. Almost all parts of this tree are used in folk medicine for treating various stomach disorders, fever and skin problems [4]. It is mainly used in the treatment of diarrhoea, inflammation, sexual debility in male, Leprosy, astringent, coolant, ulcer, dysurea, anaemia, vaginal discharges, burning sensation and headache [5]. Thus Gambhari have the potential for the development of effective medicine for the treatment of various diseases. It promotes digestive power and improves memory. Roots are useful in fever, dyspepsia, hemorrhoids, stomachalgia, heart diseases, nervous disorders, piles and burning sensation. Bark is used in fever and dyspepsia [6].
Acc. to *Madanpal Nighantu*: Its flower is said to be *vathara, grahi, pittahara and raktapradarhara* [7] and in *Kaiydeva Nighantu* [8] the flowers are *madhur*, *sheeta*, *tikta*, *vatakara*, *kashaya* and *madhurvipaka* and used in *pittahara* and *raktapradarhara*. Acc. to *Charaka Samhita* [9] its flowers and bark is used in the preparation of *Chandanadi taila*.
This attempt is made to present the research on the floral parts of the plant with pharmacognostic characters and phyto-physicochemical parameters which are not revealed till now.

2. Method and Materials
The fresh flowers of plant *G. arborea* was collected from surroundings of Jamnagar in the month of April and authenticated by Pharmacognosy Laboratory under the authentication number IPGT & RA Phm. 6262/18-19 deposited in the departmental herbarium of IPGT & RA, GAU, Jamnagar for future reference.

(a) **(b)**

Fig 1: Collection and authentication: A. Natural habitat, B. Herbarium

The flowers were washed thoroughly, some of them were stored in FAA (Formalin90: Acetic acid 7: Alcohol 3) solution [10] for microscopic investigation and others shade dried and then pulverized by mechanical grinder as coarse powder of 60 #, and stored in an air tight container. This powder is used to carry out various pharmacognostical, phyto-physicochemical and quantitative estimations of the flower of *G. arborea.* Roxb.

The macroscopical characters of flower were observed with naked eye. Free hand sections were taken and observed as such to see their cell contents and then stained with phloroglucinol and hydrochloric acid to observe the lignifications of the cell wall [11]. Photographs of sections and diagnostic characters of the powder were taken by using camera. Powder drug treated with different reagents and were examined for fluorescence analysis under visible and UV light of long and short wavelengths for various color radiations [12] preliminary qualitative tests were also performed to detect primary and secondary metabolites [10]. The powder was subjected to determine various physico-chemical constants by the standard procedures mentioned in API [13]. Powder microscopical study by microscopy carried out by methods prescribe in as per standard methods.

3. Results and Discussion

3.1 Organoleptic characters

The plant initially identified by its appearance, color, ordour, shape, dimensions etc. here showed in table 1:

Table 1: Shows morphological characters of the flower and organoleptic characters of powder of *G. arborea*

Sr. no.	Parameters	Fresh Flower	Dry flower	Powder
1.	Color	Dark yellowish brown	Brownish yellow	Brownish grey
2.	Odor	Sweet	Slight sweetish	Characteristic/ sweetish
3.	Taste	Astringent, sweet	Astringent	astringent
4.	Shape	Bell shape	Shrinked	Powder form
5.	Touch	Soft	Soft	Soft
6.	Surface	Smooth with hairs	Smooth with prominent hairs	Smooth
7.	Dimentions	5 x 3.5cm	2.4 x 2cm	-

Fig 2 Morphological characters of *Gmelina arborea* Roxb. flower: A. Fresh flowers, B. Dried flowers, C. Powdered flowers

3.2 Flower

3.2.1 Morphology

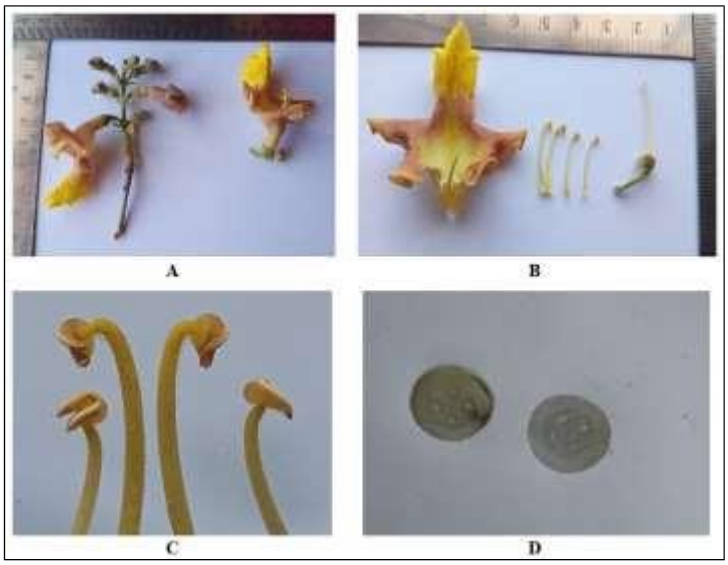

Fig 3: Morphology of flower: A. Flowering twig, B. Dissected flower, C. Anthers, D. Placentation

Inflorescence: Panicle bracteolate Flower complete hermaphrodite bisexual, short stalked or sub sessile.
Calyx: 1/5 in. long, broadly campanulate, densely fulvous-hairy; teeth 5, small, triangular, acute.
Corolla: Brownish yellow, smooth, densely hairy outside, reaching 1.5 inch. long, 5-lobed, 2-lipped; upper lip rather more than 3/8 in. long, deeply devided into 2 oblong, obtuse lobes; lower lip nearly 1 in. long, 3- lobbed, hypocrateriformis. The middle lobe projecting forward, ovate subobtuse, with irregularly crenulated margin, much longer and broader.
Androecium: 4 stamens, polyandrous, epipetalous, dorsifixed attachment, dithecous and filaments hairy. **Gynoecium:** superior ovary, axile placentation, long tubular style, bifid stigma. Monocarpellary ovary.

3.2.2 Microscopy

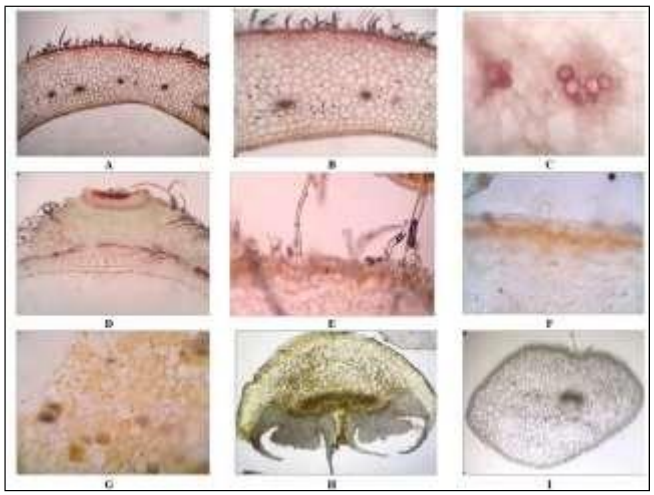

Fig 4: Microscopy of *Gmelina arborea* Roxb. flower: A. Diagrammatic section of petal, B. 10X section of petal, C. Vascular bundles, D. Section of Sepal, E. Simple multi and unicellular hook and glandular trichome, F. Glandular trichome with bicellular head, G. Yellow colored thin walled pigmented parenchyma, H. TS of Anther, I. TS of Filament

Petal (Corolla): The diagrammatic section of a petal almost curved in outline shows outermost epidermis at both sides and centrally located vascular bundles in parenchymatous ground tissue.
The detail section of petal shows outermost upper cuticularized epidermis at places having outgrowth of simple multicellular lignified trichomes followed with 12-15 layers of oval to roundish simple thin walled brownish yellow colored pigments. Parenchymas embedded with centrally located groups of vascular strands and lower cuticularized epidermis at places having outer layer of uni and bi-cellular headed glandular trichomes. Both the epidermal cells lignified made up of oval to transversely elongated parenchymas in which lower lower one are bigger in size than the uppers.
Sepal (Calyx): The diagrammatic section of a sepal almost curved in outline shows, outermost epidermis at both sides and centrally located vascular bundles in parenchymatous ground tissue.
The detail section of sepal shows outermost upper cuticularized epidermis at places having outgrowth of simple multicellular lignified trichomes. Parenchymas embedded with centrally located groups of vascular strands and lower cuticularized epidermis at places having outer layer of uni and bi-cellular headed glandular trichomes. Both the epidermal cells lignified made up of oval to transversely elongated parenchymas in which lower one are bigger in size than the uppers.

3.2.3 Powder characters

Fragments of epidermis cells with stomata (surface view), yellowish brown colored pigmented parenchyma cells, fragments of spiral vessels, pollen grains, epidermis cells with simple multicellular trichomes, multicellular and unicellular simple trichome and yellow colored pigmented parenchyma cells.

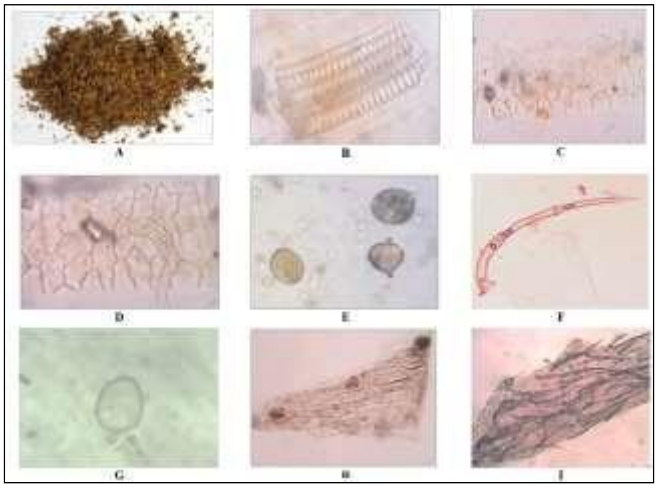

Fig 5: Powder microscopy: A. Flower powder, B. Fragments of spiral vessels, C. Fragments of epidermis cells with stomata (surface view), D. Epidermis cells with simple multicellular trichome, E. Pollen grains, F. Multicellular simple trichome, G. Starch grain, H. Fragment of elongated parenchyma in surface view, I. Fragment of epidermal cells with trichomes in surface view

3.3 Physico-Chemical Parameters

Various physicochemical tests were performed as per the standard procedures mentioned in Ayurvedic Pharmacopoeia of India and the results are shown in table - 2.

Table 2: Physicochemical parameters.

Sr. No.	Parameters	Gambhari flower powder (% w/w)
1.	Total ash value	4.70±0.146
2.	Acid insoluble ash	0.462±0.027
3.	Water soluble ash	4.27±0.0927
4.	Loss on drying	2.48±0.119
5.	Water soluble extractive value	14.78±0.208
6.	Alcohol soluble extractive value	23.25±0.213

Values are expressed as mean± SD of three values

3.3.1 Preliminary Qualitative Analysis

Preliminary qualitative analysis for the presence of various functional groups was carried out on alcoholic and aqueous extracts of flower of Gmelina arborea Roxb. and the result is shown in Table – 3.

Table 3: Preliminary Qualitative Analysis of flower extracts.

Test/ Reagent	Functional group	Observation	Flower	
			Alcoholic extract	Aqueous extract
Mayer's reagent	Alkaloids	Brown ppt	+	-
Wagner's reagent		Reddish brown ppt	+	-
5% fecl3	Tannin & Phenolic compd.	Deep blue-black color	+	-
Lead acetate		White ppt	+	-
Conc. H2SO4	Glycosides	Reddish brown ppt at junction and upper layer bluish green	+	+
Biuret reagent	Protein	No color change	+	+
Molisch's test	Carbohydrate	Violet ring was observed at the junction	+	+
Fehling's test	Carbohydrate	First yellow, then brick red ppt observed	+	+
Salkowoki	Steroids	Greenish yellow fluorescence	+	+
Shinoda	Flavonoids	Yellow ppt	+	+
Shaking in test-tube	Saponins	Frothing with honeycomb appearance	+	+

3.3.2 Quantitative estimations

Flowers of the *G. arborea* are evaluated for quantitative estimation of flavonoids, tannin and sugars. The results are given below in table no. 4

Table 4: Quantitative estimations of flower

Sr. no.	Secondary metabolite	Percentage
1.	Total Flavonoids	0.179 %w/v
2.	Total Tannins	3.355%w/w
3.	Sugar estimation	
	Reducing sugars	18.2%w/w
	Non reducing sugars	16.8%w/w
	Total sugar	35%w/w

In the given sample 0.179 %w/v total flavonoids, 3.355%w/w total tannins and total sugars 35% w/w, Reducing sugars 18.2%w/w and Non reducing sugars 16.8 %w/w, are present respectively.

4. Conclusion

The present study encapsulates the morphological and anatomical findings of the plant along with its preliminary phytochemical investigations with qualitatively and quantitatively estimations. The key pharmacognostical characters of *Gmelina arborea* Roxb. flowers are the presence of abundant verbenaceous - type glandular and simple unicellular and multicellular trichomes, yellow pigmented parenchymas and spiral vessels etc. and phytochemical qualitative tests shows the presence of alkaloids, tannins, glycosides, flavonoids and saponins while quantitative estimation shows 3.355% w/w tannin, 0.179 %w/v, flavonoids, and 35% total sugars in the sample. This will help the future investigators for proper identification of the plant and also helpful in preparing different marketed formulation based on its chemical constituents as desired action can only achieve by genuine drugs. Due to seasonal variations, when the plant is deciduous; only available with flowers, standards for the same must be existed. So in any condition the plant can be accessed easily for its genuine identity and further use.

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