

A Review on Pharmacognostic, Phytochemical and Biological Potential of *Gmelina Arborea* Roxb (Shivan Plant)

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ABSTRACT

Gmelina arborea Roxb belonging to family Lamiaceae. It is a fast growing deciduous tree, having vast medicinal importance and is one of the ingredients of dashamoola used in Ayurveda. As Dashamoola has kapha vata hara property and is well known in treating vata vyadhi, *Gmelina arborea* being the member of dashamoola is also said to have similar properties. Any plant which is used medicinally requires detailed study prior to its use because for the purpose of identification of the plant, to avoid the admixture of other drugs and also for its therapeutic efficacy the present study was undertaken to lay down pharmacognostical and physicochemical standards for Gambhari leaf. Pharmacognostical study reveals Moisture content, Total ash value, water and Acid insoluble value. Extractive value and alcoholic and aqueous extract respectively. Microscopic and Macroscopic evaluations. Leaf constants like stomatal variety, stomatal index, vein islet number, vein termination variety even have been given. Phytochemical screening showed the presence of Alkaloids, Carbohydrate, coumarins, steroids, Tannins. Medicinal uses of its roots, leaves, flowers, fruit, bark, pharmacological activity The roots, fruits and the leaves of Gambhari have countless medicinal value therefore traditionally it was commonly used as anthelmintic, antimicrobial, anti-diabetic, anti-aging, analgesic, diuretic, hepato-protective and antiepileptic agent. There is lots of medicinal properties present in the

Gmelina arborea plant. The present article gives all necessary information on plant.

Keywords: Dashamoola, *Gmelina arborea*, Physico-chemical screening, Pharmacological activity, Medicinal uses.

INTRODUCTION

Gambhari (*Gmelina arborea*. Roxb) belongs to the family Lamiaceae. *Gmelina arborea* is an unnamed, moderately sized to large deciduous tree, about 30 m or more in height and a diameter upto 4.5m. The genus was named after 18th century German botanist J.C.Gmelin. The name arborea means tree-like, derived from the latin word 'arbor' means tree. In ayurvedic texts, gambhari has numerous synonym like kasmiri means a beautiful tree, sriparni means has a beautiful leaves, madhuparnika means has leaves with sweetish taste, pitarohini means has yellow flowers. Ayurveda is Associate in Nursing ancient system of drugs that uses roughly 1587 species of plants. Among the ayurvedic preparations, Dashamoola is one amongst the foremost vital listed raw drug formulations, with Associate in Nursing annual turnover of >1000 MT. [1]

Dasamula is especially utilized in the preparation of Ayurvedic alcoholic preparation (Dasamularishtam) and boiling (Dasamula kashayam). The most therapeutic uses of Gambhari as mentioned in the

solidification of sotha (inflammation), daha (burning sensation), jvara (fever), trsna (thirst) and arsa (hemorrhoides). The standard uses, phytochemical constituents, pharmacologic activity and marketed formulations of Gambhari reviewed by Chothani. This review covers the uses of bark, leaves, flowers, fruits, stem, wood and root for varied functions like diuretic drug, medicine, tonic, aphrodisiac, hepatoprotective, astringent, anthelmintic and antimicrobial further as within the treatment of anaemia, leprosy, ulcers, emission, alopecia, tumors etc. The review conjointly records the presence of sesquiterpenoids, apiosylskimmmin and gmelofuran from the roots of *G. arborea*. Later Navreet et al. [2] had studied the --pharmacognosy of leaves and stem bark of Gambhari. Some have studied the cardioprotective, analgesic, antipyretic and medication activities of this species. [3,4,5] *Gmelina arborea* Roxb. (Verbenaceae) is mentioned as Gambhari. [6]

Origin

Gmelina arborea is found in wild all over India from the end of Himalayas to Kerala and Andaman, In damp, semi-deciduous and open forests up to an altitude of 1500m msl. It is generally found scattered in mixed forests of moist areas of the country extending up to comparatively dry areas of central India. Rarely it occurs in evergreen as well as in the Sal- forests. In the natural forest, the species is commonly found scattered and in association with other species. It is originate in dehydrated mixed deciduous forest types in Central India.[7]

Growing season and Type

1. It prefers damp fertile valleys with 750–4500 millimetre precipitation. It doesn't thrive on ill-drained soils and remains scrubby on dry, sandy or poor soils.
2. Flowering takes place throughout February to april month once the tree is additional or less aphyllous whereas mature starts from might forward up to June.

3. It's light-weight human, tolerant of excessive drought, however moderately frost hardy.
4. Gamhar trees coppices all right with vigorous growth. Saplings and young plants would like protection from ruminant and cows. [8]

Taxonomical Profile

Taxonomy is the science of scientifically naming and organizing organisms into similar groups. Plant taxonomy is an old science that uses the gross morphology of plants to separate them into similar groups. Taxonomical classification of plant *Gmelina arborea* Roxb.

Kingdom	Plantae.
Division	Magnoliophyta.
Class	Magnoliopsida.
Order	Lamiales.
Family	Lamiaceae.
Genus	Gmelina.
Species	G. arborea.

Vernacular names-

English - Kashmir tree, Beechwood, White teak.

Hindi - Gamhar .

Marathi – Shivan, Siwan.

Cultivation of *Gmelina arborea*

Gmelina arborea Roxb., could be a quick growing plant because of its glorious medicative and wood properties, is rising as a vital plantation species. Most potent and medicinally used half of this plant is its root part. This can be the reason; the total plant is being killed. Natural replica of *Gmelina arborea* Roxb., takes place in time of year presently when the drupes fall to the bottom. Alternate heat and wetness are necessary to stimulate seed germination. Artificial reproductions could also be done out by direct sowing the seeds or by movement vegetative propagation. To breed a healthy issue of *Gmelina arborea* Roxb. There are sure agroclimatic conditions wherever the plant thrive, are to be followed. They embrace wet, fertile soil with sensible voidance. This plant could be a light-weight soul and impatient of shade. It grows in areas receiving downfall starting from 750-

4500mm or a lot of. It doesn't thrive on ill-drained soils and remains scrubby on dry, sandy or poor soils; drought conjointly reduces it to a ligneous plant type. As these necessities plays distinguished role in growth and production of *Gmelina arborea Roxb.*[9]

PHARMACOGNOSTIC STUDY -



FIG :-*Gmelina arborea* leaf.

Leaves –They are opposite, decussate, petioles cylindrical,5-15cm long, leaf blades broadly ovate,10-25cm length & 7-20 cm wide, apically long acuminate or caudate, entire on mature plants but strongly toothed or lobed on young plants, usually cordate or truncate basally, with a short cuneate attenuation into the petiole, densely tomentose above when young, becoming glabrous above when mature, permanently densely fulvous, tomentelloous with stellate hairs beneath, glanduliferous just above the petiole on the basal attenuation.

Flowers – Flowers are abundant, scented, reddish, brown or yellow, in terminal and axillary 1-3 flowered cymes on the panicle branches, which are about 8-40cm long. Flowers is 2-2.5cm in diameter ;bracts 8mm long, linear lanceolate.

Calyx – It is broadly campanulate, about 5mm long, densely fulvous-tomentose externally, the rim with 5 small, triangular, acute teeth.

Corolla – Are large, Showy, varying from yellow to orange or brilliant orange to reddish or brownish yellow, dull yellow brown, tubular below, obliquely funnel shaped at the throat, the tube densely pubescent externally , the limb 2-lipped,the upper lip often orange-pink, deeply divided into 2 oblong, obtuse, backwardly curled lobules, the lower lip often lemon yellow ,,upto twice as long as the upper &3-lobed.

Fruits –It is a drupe,1.8-2.5cm long, obovoid, seated on the enlarged calyx; glossy and yellow when ripe, Exocarp is succulent and aromatic. Endocarp is bony and usually 2-celled .Seeds are 1-3, lenticular and exalbuminous.

Bark –It is smooth, pale ashy-grey or grey to yellow with black patches and corky circular lenticels. Internal surface of bark is brown colour, exfoliates into thick woody plates or flakes.

Stem – Exhausting, woody, sleek aside from a couple of scars of branches, yellow gray outwardly and cream colored internally.

Stem bark – 0.2 to 0.7 cm thick, ribbed, quilled at some places, outer surface yellowish- brown in colour. And rough because of some longitudinal and horizontal cracks, inner surface fairly sleek and achromatic to black in colour.[10]

Root – Cylindrical with uneven surface, dun, fracture somewhat powerful in bark, brittle and predominant in woody portion.

Root bark – Contemporary mature root bark is yellow in color. Dry items hook like and channeled, diluent ones forming single quills, external surface rugged because of presence of vertical cracks, ridges, fissures and diverse lenticels, fracture short and granular.

CHEMICAL CONSTITUENTS –

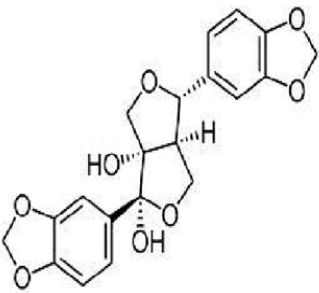
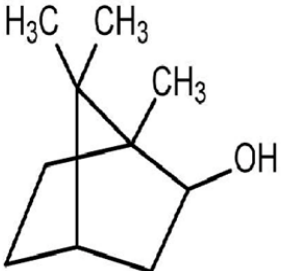
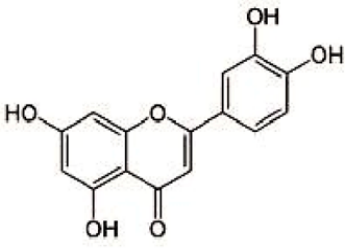
Leaf: luteolin, apigenin, quercetin, hentriacontanol, β -sitosterol, quercetogenin and other flavons. Also contain alkaloid premnazole.

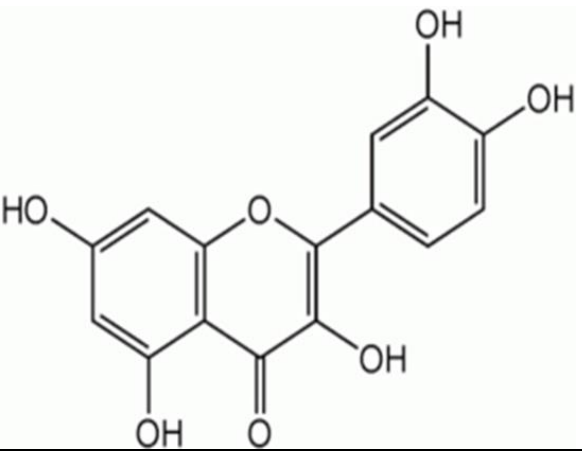
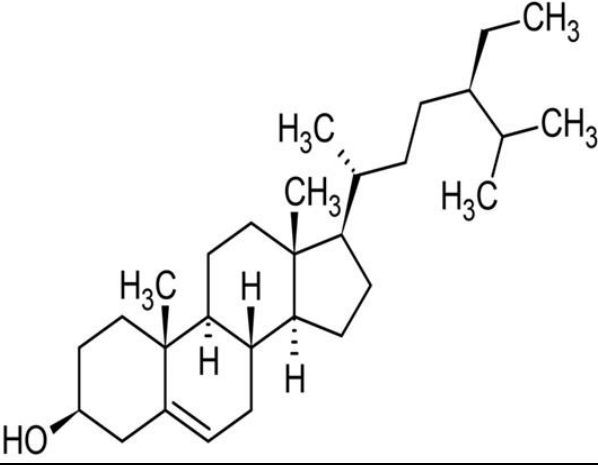
Fruits: Butyric and tartaric acids, saccharine substances and little tannin, β -sitosterol, cetyl alcohol, gmelinol, arborone, arboreal, luteolin, apigenin, quercetin, hentriacontanol, quercetogenin.

Bark: Lignan such as tyrosol[2-(4-hydroxyphenyl)ethanol], 2,6-dimethoxy-P-benzoquinone and 3,4,5-trimethoxyphenol. Arborone and 7-oxo dihydrogmelinol, 4-hydroxyseasamin, 4,8-dihydroxyseasamine, Gummadiol, Quercetagenin, glycosides of kaempferol, apigenin and luteolin.

Roots : Cetyl alcohol, gmelofuran, gmelinol, hentriacontanol, n-octacosanol, Cluetylferulate, n-octacosanol, gmelinol, arboreal, 2-O-methyl arboreal, 2-O-ethylarboreal, isoarboreal, gmelanone, β -sitosterol, paulownin, 6''-bromoisoarboreal, 4-hydroxyseasamin, 4,8-dihydroxyseasamin, 1,4-dihydroxyseasamin(gummadiol), 2-piperonyl-3-(hydroxymethyl)-4(α -hydroxy-3,4-methylenedioxybenzyl)-4-hydroxy tetrahydro furan (1), 4-epigummadiol-4-O-glucoside, 1,4-dihydroxy-2,6-dipiperonyl-3,7-dioxabicyclo[3,3,0]-octane, palmitic, oleic and linoleic acids, stigmasterol, stigmastanol, campesterol, α -2-sitosterol, butulinol.[11]

Table 1: Structure of chief active constitute of *G.arborea*

		
Arboreal	Isoborneol	Luteolin

	
Quercetin	B-sitosterol

Morphological characters of *Gmelina arborea* leaf .[12]

Parameter	Observation
Colour	Dark green
Shape	Broadly ovate or Cordate
Size	7-21cm length & 7-13cm width
Apex	Acuminate or caudate
Margin	Entire on mature plants but strongly toothed or lobed on young leaf
Surface	Smooth
Base	Cordate
Petiole	5-15 cm
Midrib	Prominent on lower surface
Odour	Characteristic & slightly disagreeable
Taste	Bitter



Microscopical character of *Gmelina arborea* leaf

Transverse section of Leaf:

A. Epidermis

- Leaf on either sides covered with Epidermal layers i.e Upper Epidermis and Lower Epidermis.
- Epidermal Layers composed of a single row of rectangular tangentially elongated cells
- On the outside both epidermal layers are enclosed by a thick cuticle
- Lower epidermal layer externally covered with more than a few elongated multicellular, uni-seriate covering trichomes with blunt ends, which make the lower surface pubescent.

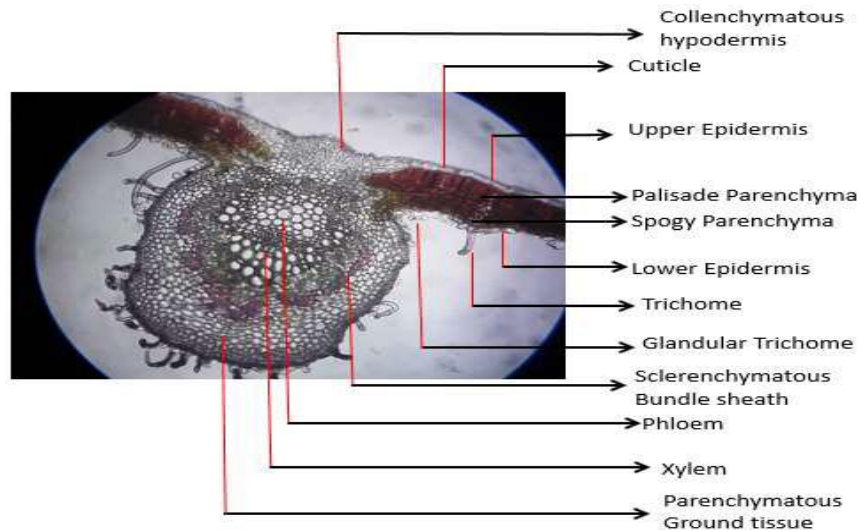
- On the Lower epidermis several Gladular Trichomes with short stalk are also visible
- On the lower epidermal layer few stomata are present here and there.

B. Mesophyll

- In the middle of upper and Lower epidermal layers mesophyll is present.
- Mesophyll is distinguished in to 1 to 2 layers of Palisade parenchyma and 5 to 6 layers of spongy parenchyma.
- Palisade parenchyma cells are radially elongated, arranged compactly without any intercellular spaces and filled with dense chlorophyll pigment
- Cells of spongy parenchyma are egg-shaped to circular in shape, loosely arranged with intercellular spaces and filled with chlorophyll stain comparatively less than palisade parenchyma.
- At the region of midrib the upper epidermis is followed by 10 to 12 layers of collenchymatous hypodermis.
- Below the vascular bundle towards lower epidermis few layers of compactly arranged collenchymatous tissue is present.

C. Vascular Bundle

- vascular bundle composed of xylem towards Lower epidermis and Phloem towards upper epidermis
- The xylem elements are wide, angular, thick walled and arranged compactly in parallel lines.
- Phloem consists of narrow, thick walled sieve elements and phloem parenchyma.
- A discontinuous ring of sclerenchymatous, pericyclic fibre bundle sheath covers the vascular bundle.[13]



Powder Characteristics of Gmelina arborea leaf.

Colour: Green

Odour: Not specific

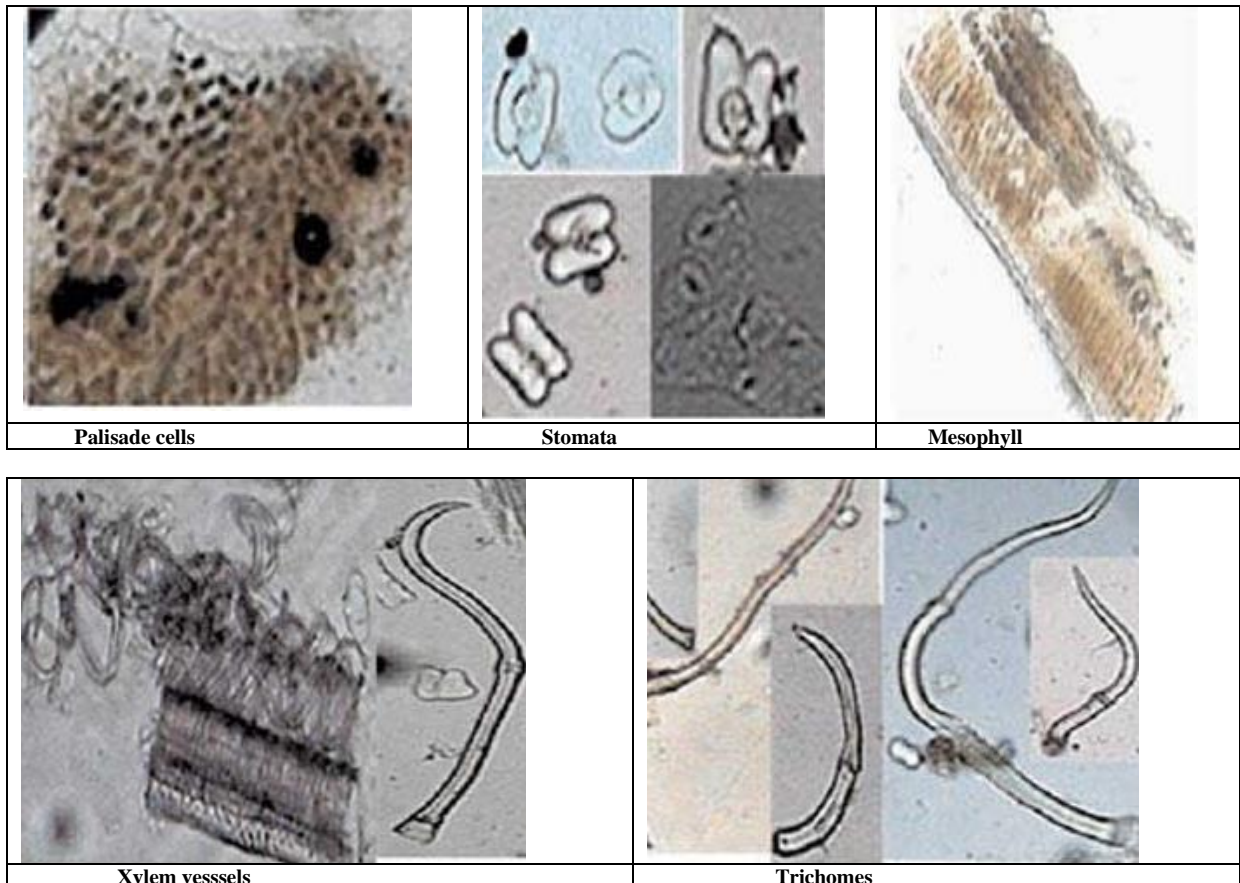
Taste: Slightly bitter and astringent

Texture: Fine Powder

- Glandular Trichomes without stalk.
- fragments of wavy thin walled epidermal cells in surface view
- Starch grains of various shapes and sizes
- Fragments of Xylem elements isolated and in bundles with annular thickenings.
- Lignified xylem fibres in bundles and also isolated.[14]

Microscopic Characters

- Numerous elongated, multi cellular, uni-seriate covering trichomes



Quantitative microscopy of *Gmelina arborea* leaf

Different leaf constant like stomatal number, Stomatal index are given below in table.

Sr.no	Parameter	Values
1.	Stomatal index(Lower epidermis)	205-225
2.	Stomatal number	8-8.17
3.	Palisade ratio	4.25-5,6-6.3
4.	Vein islet no.	30-40
5.	Vein termination number	10-20

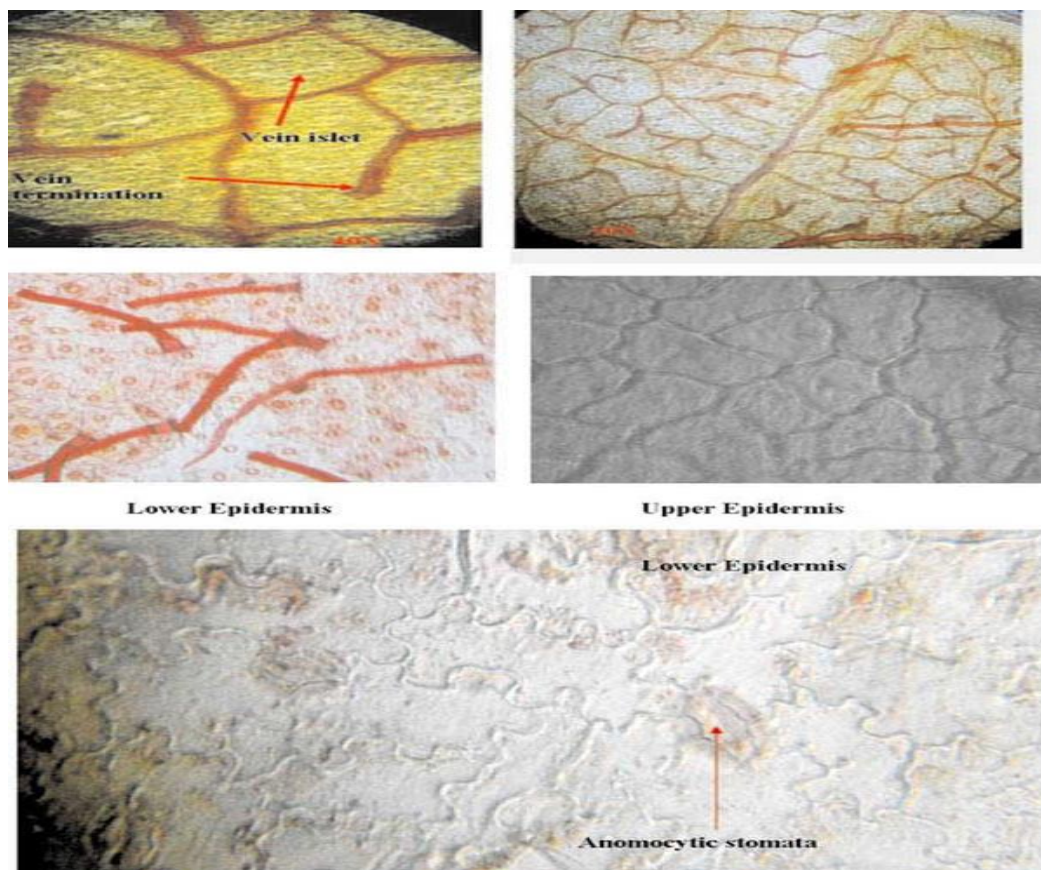


Fig :- Surface preparation *Gmelina arborea* leaf.

PHYTOCHEMICAL SCREENING

A successive solvent extract of leaf was studied for their phytochemical profile.

Extracts	Colour & Consistency	Yield w/w
Petroleum ether	Dark green,sticky	3.76%
Toluene	Dark green,Sticky	1.92%
Chloroform	Dark green,Stichy	1.56%
Ethyl acetate	Dark green,Sticky	2.26%
Methanol	Green,Sticky	19.36%
Water	Brown,non-sticky	26.3%

Fig- Preliminary phytoprofile of *Gmelina arborea* leaf.

A leaf shows various plant constituents and it is subjected by using different solvents. A leaf shows the various phytoconstituents like Alkaloids, Carbohydrates, Steroids, Saponin, Flavonoids, Tannins, is given in table ; [15]

Chemical constituents	Petroleum ether	Toluene extract	Chloroform Extract	Ethyl acetate	Methanol extract	Water extract
Carbohydrates	--	--	--	--	++	++
Proteins	--	--	--	--	--	++
Saponins	--	--	--	--	++	++
Alkaloids	--	--	--	--	--	--
Flavanoids	--	--	--	--	++	--
Tannin & Phenolics	--	--	--	++	++	++
Steroids & Triterpenes	++	++	++	++	--	--

Fig : Qualitative chemical test on extract of leaf of G.a. [-- =Presence , ++ = Absence]

Thin-layer chromatography

Sample preparation

Leaf extract of *Gmelina arborea* of one gram was extracted with 10ml of ethanol (90%) and filtered. The filtrate was created up to 10ml with solvent in a very commonplace flask.

Mobile phase:- Toluene: Ethyl acetate (9.0: 1.0) gave optimum separation in alcohol extract hence was used for the TLC study.

TLC fingerprinting

TLC fingerprint dispensed within the alcoholic extract of leaf below short ultraviolet light showed one spot with the Rf value of 0.87 light green colour, Under long UV eight spots with different fluorescent colour intensities with Rf value of 0.34, 0.41 in Faint Pink colour. 0.48 in Faint aqua blue colour, 0.57, 0.65, 0.78, 0.87 All are in fluorescent red colour, 0.82 Faint blue colour among which 0.87 was detected in both short UV and long UV.

Following derivatisation with vanillin sulphuric acid there were no spots observed.

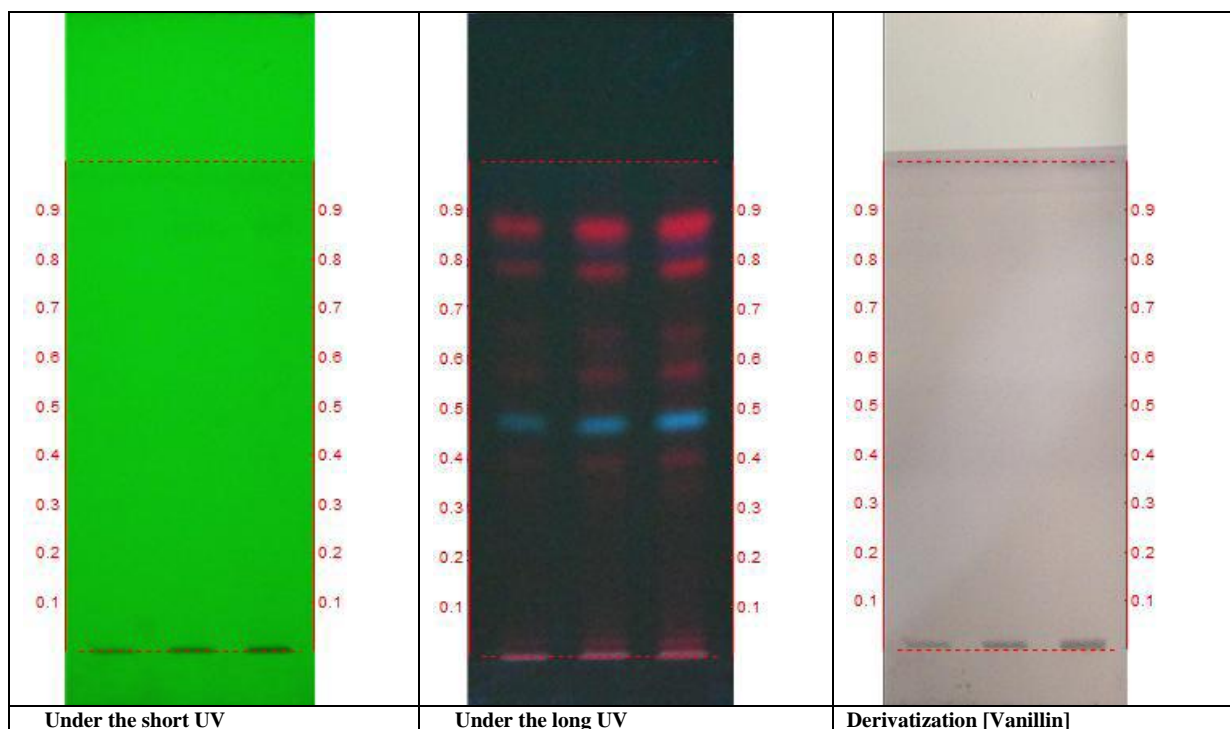


Figure : Photo documentation of HPTLC on ethanol extract of *Gmelina arborea* leaf .

Track 1: *Gmelina arborea* – 3 μ l. Track 2: *Gmelina arborea* – 6 μ l. Track 3: *Gmelina arborea* – 9 μ l

Solvent system – Toluene: Ethyl Acetate. [9.0 : 1.0]

BIOLOGICAL PROPERTIES:

Diuretic activity

Effects of *Gmelina arborea* methanolic extract have shown important drug activity on anomaly rats. The check extracts got within the dose of 250 mg /kg weight. Sodium (Na⁺), K (k⁺) and chloride

output in piddle markedly redoubled as compared to traditional saline. The *Gmelina arborea* extract exerted its drug activity because of synergistic action of the (N⁺/H⁺) antiporter by inhibiting hollow resorption of water and concomitant anions to cause symptom. There was a rise within the quantitative relation of concentration of exerted atomic number 11 and K ions once methanolic extract of *Gmelina arborea* treatment. this means that the extract will increase atomic number 11 excretion to

larger extent than K that ends up in hyperkalemic aspect result [16]

Antiulcer activity

Hydro-alcohol extracts of leaves of *Gmelina arborea* once evaluated exploitation through an experiment elicited ulceration in Wistar rats exploitation totally different experimental models like analgesic elicited ulceration, orifice tying elicited ulcers, and plant product elicited ulcers and cold restrain stress elicited ulcers. The wood spirit extract of *Gmelina arborea* showed anti-ulcer activity in orifice tying and plant product elicited ulceration models in Wistar anomaly rats. Extracts inhibits of the stomachic lesions elicited by orifice tying elicited ulceration and plant product elicited peptic ulcer. The extract showed important reduction in stomachic volume, free acidity and ulceration index as compare to regulate.[17]

Antihyperglycemic activity

Ethanol extract of *Gmelina arborea* leaf in streptozotocin elicited male Wistar anomaly rats exploitation glibenclamide as customary. The lipid profile like TC, TG and low-density lipoprotein levels were considerably redoubled in diabetic management animals whereas lipoprotein levels were ablated in comparison to the management rats.[18]

Wound-healing activity

Alcohol extract of leaves powder of *Gmelina arborea* utilized in incision, excision and dead area wound models in rats. The extract considerably will increase the wound contraction rate, skin breaking strength, neoplasm breaking strength, amino alkanoic acid content and dry neoplasm weight and reduce in epithelization amount was ascertained. [19]

In Vitro Cytotoxic activity

The plant product extracts of *Gmelina arborea* leaf has exhibited in vitro cytotoxic activity. In vitro cytotoxic tested against carcinoma (COLO 201), stomachic

cancer (HT-29) and Human oesophageal cancer (TE-2) cell lines exploitation the thiazolyl blue check (MTT) assay. inhibitor and cytotoxic activities of wood spirit extracts and also the derived sub-fractions of ninetieth wood spirit extract of *G. arborea* leaves exploitation DPPH inhibitor activity and reducing power assay. The cytotoxic activity was applied via branchiopod check and toward human neoplastic cell line; HepG2 exploitation Sulphorhodamine-B assay. [20]

Hepatoprotective activity

Hepatoprotective activity of the binary compound extracts of bark and fruit of *Gmelina arborea* against paraquat- and peroxide elicited aerobic stress exploitation liver slice culture. [21]

Antipyretic and Analgesic Activity:

Gmelina arborea Roxb. bark extract was evaluated and also the ethanolic and binary compound extract found to cut back the physiological state at the speed of 420mg/kg weight 1hrs once the administration and its result is adored that of the quality antipyretic drug paracetamol at the dose of 50mg/kg weight. Whereas chloroform and benzol extract reduced the temperature 3h once their administration however has delicate effects. but the analgesic activity of ethanolic and binary compound extract (test compounds) was found to be additional important on carboxylic acid elicited check than tail flick check as compared to standard Voltaren at a dose of 25mg/kg and so it seems that the check compounds inhibit preponderantly the peripheral pain mechanism.[22]

Anti Diabetic Activity:

Ethanolic extract of *Gmelina arborea* Roxb. bark at dose of 420mg/kg and chlorpropamide at dose of 200mg/kg ($p < 0.05$) was found to reduce the increase of blood sugar in streptozotocin (50mg/kg) induced diabetes due to the increased blood GSH (Glutathione) levels reinforcing the role of GSH as free radical scavenger and in

the repair of free radical caused biological damage.[23]

Immuno Modulatory Activity:

Methanolic extract of *Gmelina arborea* Roxb. and ethyl acetate fraction of methanolic extract have been found to increase the total WBC count, which was lowered by cyclophosphamide, a cytotoxic drug. The drug is also capable of normalizing the levels of neutrophils and lymphocytes. The results indicate that the *Gmelina arborea* Roxb. can stimulate the bone marrow activity. As the drug is capable of reducing the cyclophosphamide induced toxicity, it can be useful in cancer therapy also. [24]

Anti Microbial Activity:

The crude leaf and stem bark extracts of *Gmelina arborea* Roxb. showed significant antimicrobial activities against gram positive and gram negative organisms and the activity could be due to the presence of bioactive compounds such as alkaloids, saponins, carbohydrates, phenolics, tannins and anthraquinone but no cardiac glycosides in leaf while in stem bark possessed alkaloids, saponins, carbohydrates, tannins and anthraquinone but no phenolics. In Vitro study of both stem bark and leaf extracts shown significant activity against *E. coli*, *K. pneumoniae*, *P. dysmetria* and *S. typhi*. [25]

Toxicity Study:

Acute and sub acute toxicity study of powder of fruits of *Gmelina arborea* Roxb (test drug) was conducted in two schedules (Acute and sub acute toxicity studies) with different doses of 300mg, 500mg and 1g/kg for 28 days. None of the doses of this check drug created mortality or activity changes. So, the check drug at a dose of 2g/kg was proved to be non toxic without causing any kind of variations among behavior, hematology, bio-chemistry and histology of vital organs. [26]

Anthelmintic Activity:

Alcoholic and aqueous leaves extracts of *Gmelina arborea* Roxb. exhibited anthelmintic activity in dose dependent manner giving shortest time of paralysis and death compared to piperazine citrate, especially with 100mg/ml concentration for *Pheretima posthuma* and *Ascaridia galii* worms by increasing chloride ion conduction of worm muscle membrane that produced hyper polarization and reduced excitability that led to muscle relaxation and flaccid paralysis. [27]

TRADITIONAL USES:-

External application of paste of the leaves on the forehead relieves the headache, especially in fever. It helps in normalizing the abnormally raised temperature. Flowers have its use in leprosy. Root and bark are beneficial herbal agents in hallucination, piles, abdominal pain, burning sensation, fever, tridoshas diseases and urinary infection. Decoction of roots used for abdominal tumors. It treats thirst, vata disorder, wounds and emaciation. The fruit of this herbaceous plant is found to be a useful natural agent in bleeding disorders like nasal bleeding, heavy periods etc. It is used in improving brain functioning and it has a feature to improve intelligence. Helpful herb to improve digestion and absorption in the body. This herb is capable to suppress pain and inflammation. Natural anti-aging agent. And a natural strength enhancer of the body. It has properties of a good aphrodisiac agent. And it is diuretic in nature. And one of the useful herbs which has features to increase milk secretion in the lactating mother. [28,29]

CONCLUSION

The above review shows the importance of *Gmelina arborea* as one of the classical medicinal plants. It is one of the main ingredients of famous Ayurvedic preparations. Pharmacognostic studies serve as an ideal tool in determining the quality of the raw drug material as morphological and anatomical characters together could

help in distinguishing the original drug plant from their adulterants. Pharmacognostic analysis of *G. arborea* showed many important features useful for the authentication of the medicinal plant. Presence of well-developed wood, lignified elements such as fibers and stone cells may indicate the woody and arboreous nature of the plant. Epidermis is a unique feature of *G. arborea*. U-shaped single 100-150 μm size vascular bundles with parallel lines of angular thick walled xylem elements also assist the identification of the medicinal plant. Anomocytic type of stomata is another useful identification mark of the plant. High stomatal frequency and trichomatous leaf establishes the xerophytic character of *G. arborea*. Trichomes play a role in plant defence to phytophagous insects. Hairs or bristles were considered as specific diagnostic anatomical feature of plants.

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REFERENCES

1. Ved D K and Goraya G S. Demand and supply of Medicinal Plants in India. Bishen Singh Mahendra Pal Singh, Publishers and Distributors of Scientific Books, Dehradun, 2008.
2. Navreet K, Sarabjit K, Bedi P M S, Ravinder, K. Preliminary Pharmacognostic Study of *Gmelina arborea* bark. National Conference on Drug Innovation: Emerging Trends and Challenges, Kapurthala, India. 2012.
3. Vijay T, Dhana M S, Sarumathy K, Palani S, Sakthivel K. Cardioprotective, antioxidant activities and phytochemical analysis by GC-MS of *Gmelina arborea* (GA) in Doxorubicin-induced myocardial necrosis in Albino rats. *Journal of Applied Pharmaceutical Science*, 1(05):198-204, 2011.
4. Pravat K P, Priyabrata P, Paresh M, Manoj K P. An in-vivo study on analgesic and antipyretic activity of bark extract of *Gmelina arborea*. *International Journal of Pharmaceutical Sciences Review and Research*, 10(2):78-81, 2011.
5. Pattanayak P, Parhi P K, Mishra S K, Khandei P K. Screening of anti-Diabetic Activity of Bark Extracts of *Gmelina arborea* in Streptozotacin induced Diabetic Rats. *International Journal of Pharmaceutical Sciences Review and Research*, 8(2):130-132, 2011.
6. Anonymous. The Ayurvedic Pharmacopoeia of India (Formulations). Part I. New Delhi: Department of Indian Systems of Medicine and Homoeopathy, 2003. 13. Chuneekar K C. Bhavaprakasa Nighantu. Chaukhambha.
7. Dr. Ravindra Sharma, Agro-techniques of selected medicinal plants, Department of Ayush, Chandralok Building 36, Janpath New Delhi.
8. <http://www.flowersofindia.net/catalog/slides/Gamhar.html>
9. Method for large-scale propagation of trees of genus *Gmelina arborea* Roxb. by tissue culture, cited on-<http://www.tritechresearch.com>
10. Priya Vrat Sharma, Namarupajnam, Varanasi, Chaukhambha Visvabharati, 2011, p-71
11. Data base on medicinal plants used in Ayurveda, Vol 3, Reprint, New Delhi, CCRAS, dept of ISM & H, 2005, P.217-228
12. Evans WC. Trease & Evans Pharmacognosy. 15th ed. London: Saunders Ltd, :2003, P.545-547
13. Khandelwal KR, Kokate CK, Pawar AP, Gokhale SB. Practical pharmacognosy. Nirali Prakashan, 1988, 2nd edition, P-31-40
14. Kokate CK. Practical pharmacognosy. 4th ed, Vallabh Prakashan, New Delhi 2010, 17-26.
15. Daya L. Chothani, N. M. Patel, Asian pacific journal of tropical biomedicine journal homepage: www.elsevier.com/locate/apjtb-2012.
16. Sravani P, Murali CM, Syed S, Sadik BS, Soubia SN, et al. Evaluation of Diuretic Activity of *Gmelina arborea* Roxb. *International Journal of Advances in Pharmaceutical Research* 2011 Apr;2(4): 157-167
17. Murali CM, Sravani P, Nizamuddin BS, Chitta SK, Syed S, Sadik BS, et al. Evaluation of anti-ulcer activity of methanolic extract of *Gmelina arborea* in

- experimental rats. *Int J Adv Pharm Res.* 2011; 2(3): 81-86.
18. Punitha D, Thandavamoorthy A, Arumugasamy K, Suresh SN, Danya V, Udhayasankar RM. Antihyperglycemic effect of ethanolic leaf extract of *Gmelina arborea* in streptozotocin induced male wistar albino rats, *Inter J Life Sci and pharma Res* 2012;2(3):46-51.
 19. Shirwaikar A, Ghosh S, PGM Rao. Effect of *Gmelina arborea* leaves on wound healing in rats. *J Nat Remed.* 2003;3(1):45-48
 20. David P, Angamuthu T, Karuppanan A, Sreenivasapuram NS. Potent in vitro Cytotoxic effect of *Gmelina arborea* on three human Cancer cell lines, *Int J pharm Sci Res.* 2012;3(4):357-363
 21. Sinha S, Dixit P, Bhargava S, Devasagayam TPA and Ghaskadbi S. Bark and fruit extracts of *Gmelina arborea*. Protect Liver cells from oxidative stress. *Pharm Biol.* 2006;44(4):237-243
 22. Pravat KP ,Priyabrata P.Paresh M, Manoj KP.An in vivo study on analgesic and antipyretic activity of bark extract of *Gmelia arborea*, *International Journal of Pharmaceutical Sciences Review and Research* 2011 sep –oct: 10(2): 78 - 81.
 23. Kaswala Rohith, Patel Vaibhav, Chakraborty Manodeep, Kamath Jagadish V. 2012; 3(2): Phytochemical and Pharmacological profile of *Gmelina arborea*: An overview. *International research journal of pharmacy* 61-64.
 24. Shukla SH,Saluja AK ,Pandya SS.Modulating effect of *Gmelina arborea* Linn.On immunoasuppressed albino rats.*Phcog Res* 2010;2(6);130-132.
 25. Kaswala Rohith, Patel Vaibhav, Chakraborty Manodeep, Kamath Jagadish V. 2012; 3(2): Phytochemical and Pharmacological profile of *Gmelina arborea*: An overview. *International research journal of pharmacy* 61-64.
 26. Ashalatha M, Kuber Sankh. 2014; 2(6): Toxicity Study of Gambhari Phala Churna. *International Ayurvedic MedicalJournal* 959-963.20. Kaswala Rohith,
 27. Kaswala Rohith, Patel Vaibhav, Chakraborty Manodeep, Kamath Jagadish V. Phytochemical and pharmacological profile of *Gmelina arborea*; An overview, *International research journal of pharmacy* 2012; 3(2): 61-64
 28. https://en.wikipedia.org/wiki/Gmelina_arborea.
 29. <http://www.herbalcureindia.com/herbs/gmelina-arborea.html>.

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