Review Article

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PHARMACOGNOSTIC AND PHARMACOLOGICAL PROPERTIES OF GAMBHARI FRUIT (*GMELINA ARBOREA* ROXB.): A REVIEW

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ABSTRACT

Gmelina arborea Roxb. is one of the famous medicinal plants of the family Lamiaceae, which different Ayurvedic physicians widely prescribed as a drug of choice for treating many diseases. This drug is commonly named "Kashmarya" and is one of the popular medicinal plants mentioned in all classical textbooks of Ayurveda. It is also known as "Gambhari" because of its fast-growing property, and it is a widely propagated and cultivated tree that grows throughout India. In the Dashamoola groups of herbs, Gambhari (*Gmelina arborea* Roxb) is one of the components. In Ayurvedic classical textbooks, different plant parts, like roots, fruit, leaf, flower, and bark, can be used medicinally. The edible fruits of Gambhari bear rejuvenating, brain tonic and aphrodisiac qualities. The leaf of Gambhari has been mentioned in the diseases like vrana (wounds) and Kushtha (Skin diseases). The classical part of the plant Gambhari is the root. The present article provides insight into the literature review of the Gambhari fruit. The current manuscript compiles extensive information about Gambhari (*Gmelina arborea* Roxb.) fruit which is well-mentioned in most Ayurvedic classics textbooks like Brihatrayee, Laghutree and Nighantu.

Keywords Ayurvedic drug, Kashmarya, Gambhari fruit, *Gmelina arborea* Roxb., Pharmacognostic, Pharmacological, Dashamoola

INTRODUCTION

Gambhari *(Gmelina arborea* Roxb.*)* belongs to the family Lamiaceae. It is a medium-sized to rarely large deciduous tree attaining a height of 15-20 m found scattered in deciduous forests throughout the more significant part of the country up to an altitude of 500 m.[1] Gambhari root is one of the ingredients of commonly used Ayurvedic preparation Dashmoola and particularly in Brihat Panchamoola. Mostly Gambhari root is used by the researcher for their research work irrespective of Gambhari fruit, so, in the present study, we highlight the importance of Gambhari fruit with different classical references.

Taxonomical Classification: Taxonomical classification of the plant *Gmelina arborea* Roxb. is tabulated in Table 1.

Vernacular Names: The names based on the regional language of everyday life and often contrasted with the scientific name for the same organism, Latinized, are known as vernacular names. They are tabulated in Table 2.

Synonyms: Names and synonyms are the tools to specify the salient features of the plants. Likewise, Gambhari also has synonyms which are tabulated in Table 3.

Ayurvedic classification of Gambhari fruit: Classical categorization of Gambhari in different Ayurveda textbooks is tabulated in Table 4.

Botanical Description

Habitat: Found throughout India, from the foot of northwest Himalaya to Chittagong and throughout the Deccan peninsula.

Habit: A moderate-sized unarmed deciduous tree with greyish-yellow bark.

Leaves: broadly ovate, acuminate, entire, glabrous above when mature, fulvous, tomentose beneath, base cordate and shortly cuneate. Petiole cylindric, glandular at the top.

Flowers: Usually in small cymes of about 3 flowers arranged along the branches of a densely fulvous hairy panicle, buds clavate, angular, bracts linear–lanceolate.

Calyx: Broadly campanulate, teeth 5, triangular acute.

Corolla: Brownish yellow, densely hairy outside, 5-lobed, 2-lipped.

Part Used: Root, bark, leaf, flower and fruit. [24]

Table 1: Taxonomical Classification of Gambhari Plant *(Gmelina arborea* Roxb.)[2]

Kingdom	Plantae
Sub kingdom	Viridiplantae
Infrakingdom	Streptophyta
Super division	Embryophyta
Division	Tracheophyta
Subdivision	Spermatophytina
Class	Magnoliopsida
Superorder	Asteraceae
Order	Lamiales
Family	Lamiaceae
Genus	*Gmelina*
Species	*arborea*

Table 2: Vernacular Names of Gambhari (*Gmelina arborea* Roxb.).[3]

English	Coomb teak, Cashmeri tree.
Hindi	Gamari, Gambhari, Gambhar, Gamhar, Khambhari, Sewan.
Bengali	Gamari, Gambar, Gambargachha.
Gujrati	Seevan
Kannada	Kumbalamara, Seevani, Shivani, Hannu, Kasmiri marci.
Malayalam	Kumilu, Kumpil, Kumil, Kumizhu, Kumbil.
Tamil	Perumkumbil, Kumadi, Perunkurmizh, Komizhpazham.
Telegu	Gummadi, Gumaditeku.
Assam	Gomari.
Oriya	Gambhari, Bhodroparnni.
Urdu	Gambhari.

Table 3: Synonyms of Gambhari (*Gmelina arborea* Roxb.).[4]

Synonyms	Nirukti
Bhadraparni	It has attractive leaves.
Hira	Fruits have rejuvenation properties.
Kashmiri	Its habitat is in Kashmir.
Kashmari	Gambhari tree is as beautiful as Kashmir.
Krishnavrinta	Petiole of Gambhari is Black.
Mahakumbhi	It's a large tree that looks like kumbhi.
Mahakusumak	Its inflorescence is long.
Madhuparni	Leaves are sweet or glowing like honey
Pitarohini	Its stem bark is yellowish.
Shriparni	It has attractive leaves.
Sarvatobadhra	Every part has its medicinal properties.
Suphala	Fruits are good for health.
Sthulatwak	Stem bark is thick.
Vatahrit	It is used to treat diseases caused by Vata Dosha.

Table 4: Classical Categorization of Gambhari (*Gmelina arborea* Roxb.) in different Ayurveda textbooks

Classical textbooks	Varga/Gana
Charaka Samhita[5]	Sothahara,Dahaprasamana, Virecanopaga
Sushruta Samhita[6]	Sarivadi, Brihatpanchamoola
Ashtanga Hridaya[7]	Sarivadi
Sushruta Nighantu[8]	Brihatpanchmoola
Ashtanga Nighantu[9]	Sarivadi Gana
Madanadi Nighantu[10]	Tritya Gana
Dhanvantri Nighantu[11]	Guduchiyadi Varga
Shodhal Nighantu[12]	Anekarth Varga
Madhav Dravyaguna[13]	Phala Varga
Abhidhan Ratnamala[14]	Swadu Skandh
Hridya Deepak Nighantu[15]	Dvipada Varga
Madanpala Nighantu[16]	Abhayadi Varga
Kaiyaideva Nighantu[17]	Aushadhi Varga
Bhavprakash Nighantu[18]	Guduchyadi Varga
Raj Nighantu[19]	Prabhadradi Varga
Laghu Nighantu[20]	Auoshadinaam Mala
Mahaoshadh Nighantu[21]	Bilvadi Varga
Nighantu Adarsh[22]	Nirgundyadi Varga
Saraswati Nighantu[23]	Mahavraksh Varga

Description of *Gmelina arborea* Roxb. fruit

Macroscopic

Fruits: A drupe, ovoid, crinkled, black, 1.5-2.0 cm long, sometimes with the portion of the attached pedicel, two-seeded, sometimes one-seeded, taste sweetish sour.

Seed: Ovate, 0.5-1 cm long, 0.4-0.6 cm wide, light yellow, surface smooth, seed coat thin, papery, taste, oily.

Microscopic

Fruits: Shows pericarp differentiated into single-layered epicarp, multilayered, fleshy mesocarp, hard and stony endocarp, epicarp consisting of single-layered, thin-walled cells, mesocarp a wide zone consisting of isodiametric, thin-walled, parenchymatous cells, endocarp consisting of multilayered sclerenchyma cells.

Seeds: Shows outer integument consisting of 3 -5 rows of crushed, parenchymatous cells followed by inner integument composed of 2-3 rows of thin-walled, tangentially elongated, parenchymatous cells, cotyledons of single-layered, radically elongated epidermal cells, mesophyll consisting of thin-walled cells, filled with oil globules and aleurone grains. [24]

Pharmacological Properties: The pharmacological properties mentioned by different Samhita and Nighantu are tabulated in Table 5.

Table 5: Pharmacological Properties of Gambhari Fruit (*Gmelina arborea* Roxb.)

Property	C.S[25]	Su.S[26]	C.N.[10]	M.P.N[16]	K.N. [17]	B.P.N.[18]	G.R.M[27]
Rasa							
Madhura	-	-	+	-	+	+	+
Amla	-	-	-	-	+	+	+
Kashaya	-	-	+	-	+	+	+
Guna							
Guru	-	-	-	+	+	+	+
Sheeta	-	-	-	-	+	+	+
Snigdha	-	-	-	-	+	+	+
Virya - Sheeta	-	-	-	-	+	+	+
Vipaka Madhura	-	-	-	-	+	+	+
Dosha							
Tridosha shamaka	-	-	+	-	-	-	-
Vata shamaka	-	+	-	+	+	+	+
Pitta shamaka	-	+	-	+	+	+	+
Rakta shamaka	-	+	-	+	+	+	+
Rasayana	-	+	+	+	+	+	+
Keshya	-	+	+	+	+	+	+
Medhya	-	+	+	-	+	-	+
Raktapitta	+	-	+	-	-	+	-
Raktasangrahika	+	-	-	-	-	-	-
Bhedana	-	-	+	-	-	-	-
Vishudhikar	-	-	-	-	-	+	-
Hridya	-	+	-	-	+	-	+
Brihyan	-	-	-	+	+	+	+
Balya	-	-	-	-	-	-	+
Virsya	-	-	-	+	+	+	+
Kshaya	-	-	-	+	+	+	+
Murtavibandha	-	+	-	+	+	+	+
Trishna	-	-	-	+	+	+	+
Daha	-	-	-	-	+	+	-
Kshata	-	-	-	-	+	+	-
Raktamurta	-	-	-	+	-	-	-

C.S.- Charaka Samhita, Su.S.- Sushruta Samhita, C.N.- Chandra Nighantu, M.P.N.- Madanpala Nighantu, K.N.- Kaiyaideva Nighantu, B.P.N.- Bhavprakash Nighantu, G.R.M.- Guna Ratnamala.

Ethnomedicine Uses

- Fruits as purgative, aphrodisiac, cough, diuretic, and tonic to promote hair growth, cooling in anaemia, ulcer, vaginal discharge, leprosy, difficulty in urination, rheumatism, discharge from the female genitals, dysentery, fever, skin disease, urticaria on itching skin, against dandruff and in biliousness.[24]
- Administering 5-6 fruits of Gambhari, boiled and then pasted -taken with a bit of sugar twice daily for two weeks, promotes growth and better health of fetus among pregnant women.[28]
- Taking juice of 2-3 fruits of Gambhari along with two teaspoons of juice of Anar (*Punica granatum*) twice daily for a week cures hemorrhagic dysentery. In case of unavailability of fresh fruits of Gambhari, one can use a decoction of dried fruit and prepare the decoction.[28]
- Administering 2-3 fruits of Gambhari (pasted after boiling) with water twice daily at six hourly intervals for three weeks improves the general health of an infant and promotes growth.[28]
- Administering paste of 5-6 Gambhari fruits (pasted after boiling) after making it into sherbat by mixing little honey controls the appearance of blood in cough or stool. It controls the tendency of nasal bleeding, too.[28]
- Blood disorders and diseases like Tuberculosis (Blood coming in cough) can be cured by taking ripe fruits to extract twice daily for 10 to 15 days. This extract is prepared by boiling one fistful of ripe fruits with one glass of milk and one glass of water.[29]
- Traditional people use half a glass of fruit extract for fetal growth by boiling one fistful of Gambhari fruits with 20 g of honey, two glasses of milk and two glasses of water until it gets reduced to one glass. This preparation (half glass) can be taken twice a day on an empty stomach during morning and night time.[29]
- Tribal peoples were using ripe fruits juice as antidiabetics.[29]
- Traditional people are used to getting relief from post-delivery weakness.[29]

- To cure fever due to a cold, boil *Gmelina arborea* Roxb. bark, stem and fruits in 500 ml water. Take 20 ml of this decoction each time orally twice daily for three to four days.[29]

Therapeutic Uses

- Fruits are acrid, sour, bitter, refrigerant, diuretic, astringent, aphrodisiac, tracheogenic and tonic. They promote hair growth, anaemia, leprosy, ulcers, constipation, strangury, leucorrhea, intrinsic haemorrhage, fevers, and bilious affections.[3]
- Kashmarya Phala Yusa (soup) may be given with water and sugar in Atisar (Diarrhea).[30]
- The fruits are acrid, sour, bitter, sweet, cooling, diuretic, tonic, aphrodisiac, alternative, astringent to bowels, promote the growth of hair, useful in Vata disorder, thirst, anaemia, leprosy, ulcers, consumption, strangury, vaginal discharge.[31]
- Dried fruit was reported useful in Ksata (lacerated wounds), Ksaya (immunosuppressive / emaciating disease), Mutrakrcchra (dysuria) and Hridroga (cardiac disease), Raktapitta (hemorrhagic disorders), Daha (burning sensation) and Trishna (polydipsia).[24]
- Fruit is an ingredient of refrigerant and decoction for fevers and bilious affections.[24]
- According to Chakradatta, ripe fruits are helpful for bleeding disorders with honey. In urticaria, dried fruits are cooked with milk. Fruits have action towards dysuria and hemorrhagic disease. The fruits have properties of hepatoprotective, antibacterial, antioxidant and antidiabetic.[24]
- In folk medicine, various parts of Gambhari tree bark, wood, leaf, root and fruits are used in treatment. Urticaria treats with dried and cooked Gambhari fruits in cow's milk. Fruits are useful in hair growth, menorrhagia, burning sensation, diuretic, nutritive, tuberculosis and shortness of breath, swelling of the body, fever and bilious disorders. It is highly effective in pregnancy for fetus settlement. Antioxidant, antipyretic, antibacterial, antiepileptic, antidiabetic, hepatoprotective and diuretic activities are present in *Gmelina arborea* fruits.[32]

Chemical Constituents

Fruits contain Butyric and tartaric acids, saccharine substances and little tannin, β- sitosterol, gmelinol, arboreol, luteolin, apigenin, quercetin, hen-triacontanol, quercetogenin.[3]

The seed oil was found to contain the fatty acids palmitic (14.7%), oleic (48.2%), linoleic acid (22.6%) and stearic (4.2 %).[24]

Fruits contain alkaloids, gums, resin, mucilage, tannins, waxes and quinones.[24]

Pharmacological and Biological Studies

Antioxidant Activity: Aqueous extracts of bark and fruit at 1, 5 and 10 % concentrations inhibited the H_2O_2 And paraquat-induced oxidative stress in mice liver slices *in vitro* in a concentration-dependent manner. The presence of extracts in the incubation medium significantly reduced the H_2O_2 and paraquat-induced rise in liver cells' LDH, SOD, CAT and GR activities.[24]

Anabolic Effects: The fruits administration at 0.5 g/animal/d p.o. dose to normal rabbits, increased the levels of α_2 and γ – globulin in serum, gain in body weight and alertness in physical behaviour compared to control groups. These observations indicated the anabolic (Rasayana) activity of the fruit powder.[24]

Hemagglutination Activity: The saline extract of the seeds showed hemagglutination activity against the erythrocytes of monkeys.[24]

Antibacterial Activity: *In vitro* antibacterial activity was determined against gram-positive (*Bacillus subtilis* and *Staphylococcus aureus*) and gram-negative bacteria (*Pseudomonas aeruginosa*). Coarse powder of dried fruit of *Gmelina arborea* was made and extracted by Soxhlation method using ethanol, ethyl acetate, n butanol and petroleum ether as solvent.

The minimum inhibitory concentration for each extract was also determined using the disk diffusion technique. Only ethanol extract showed significant antibacterial activity against gram-positive and gram-negative bacteria, and the activities shown by ethanol extract were comparable with the standard drug streptomycin. The n-butanol extract showed no activity against test organisms, whereas ethyl acetate and petroleum ether extracts showed inhibitory action against *P. aeruginosa*. Among different organisms, *S. aureus* is more sensitive to ethanolic extract, while *P. aeruginosa* is sensitive to ethyl acetate and petroleum ether extracts.[33]

Acute and Subacute Toxicity Study: With doses of 300 mg, 500 mg, and 1 g/kg, acute and subacute toxicity of fruits powder of *Gmelina arborea* Roxb. was determined in 28 days. No behavioural and mortality changes are noticed in different test doses. Hence, the test drug at a dose of 2 g/kg was nontoxic for the human body because there were no variations in the biochemistry, haematology, behaviour and histology of vital organs.[34]

Antidiabetic Activity: In this study, ethanol, ethyl acetate, n butanol and petroleum ether were tested in single doses in each group of experimental animals (300 mg /kg bw) *in vivo* study of antidiabetic activities of fruits extracts of *Gmelina arborea* by alloxan induced diabetic model conducted on healthy Wistar rats of either sex.

Coarse powder of dried fruit of *Gmelina arborea* was made and extracted by Soxhlation method using ethanol, ethyl acetate, n butanol and petroleum ether as solvent. The extracts of *Gmelina arborea* were tested in single doses in each group of experimental animals (300 mg/Kg b.w). Glibenclamide was used as the standard drug in the alloxan-induced diabetic model at a dose of 5 mg/Kg of the body weight of the rat. The extracts produced a significant antidiabetic effect and are comparable with the standard drug (Glibenclamide). All the extracts were able to reduce sugar levels in the blood. The antidiabetic activity of the extracts are in the order of ethanol> n-butanol> petroleum ether> ethyl acetate. The ethanol extract was found to have good antidiabetic activity in comparison to other extracts.[33]

Diuretic Activity: The diuretic activity of different fruit extracts of the plant *Gmelina arborea* using ethanol, ethyl acetate, n-butanol and petroleum ether as solvents. Urea (1 g/kg) was used as the standard drug, and saline water was 0.9 % w/v used as the standard control. All the extracts (highest in n- butanol extract) significantly increased urine volume compared to standard control groups.[35]

Hepatoprotective and Antioxidant Activity: The effect of *Gmelina arborea* fruit aqueous extracts on paraquat and hydrogen peroxide–induced oxidative stress was investigated using liver slice culture. Adding fruit extracts and these cytotoxic agents led to a decrease in lactate dehydrogenase release. The addition of the fruit extracts, along with the pro-oxidants, suppressed the enzyme

activities. The extract also displayed antioxidant activity *in vitro* radical scavenging assays (DPPH, FRAP, ABTS).[36]

Biochemical Evaluation: An experiment was conducted to evaluate the influence of *Gmelina arborea* fruits meal on haematology and certain biochemical parameters, including blood enzyme profile and urine analysis of wean pigs. A significant difference was recorded in the percent of lymphocytes and neutrophils of the leucocytes and uric acid production in urine analysis.[37]

Anti-inflammatory Activity: The anti-inflammatory activity of all the extracts of *Gmelina arborea* fruit was found in the order of ethanol > n butanol >petroleum ether >ethyl acetate.[38]

DISCUSSION

According to taxonomical science, Gambhari is *Gmelina arborea* and belongs to the family Lamiaceae. In Ayurveda science, Gambhari root is classified into Brihtpanchmoola, Gambhari phala (fruit) is classified into Sarivadi gana in Brihatrayee, and most of the Nighantus Gambhari phala is classified as phala varga and Guduchiyadi varga. Among the various texts maximum raspanchaka of Gambhari fruit are madhura kashaya rasa, sheeta virya, madhura vipaka, guru, snigdha, sheeta guna with Vata-Pitta-Rakta dosha shamaka, rasayana, keshya, mutravibhandana, medhya, brihyan, vrisya, kshaya, trishna karma. Ethnobotanical reports show Traditional people use Gambhari fruits to treat bleeding disorders and promote fetal or infant growth. The main therapeutic uses of Gambahri fruit are in Raktapitta (bleeding disorders), Daha (burning sensation) and Trishna (polydipsia). Acute and subacute toxicity studies confirmed that *Gmelina arborea* fruit extract would be nontoxic in the living body. Gambhari fruits have reported antioxidant, anabolic, hemagglutination, antibacterial, antidiabetic, diuretic, anti-inflammatory and hepatoprotective activity.

CONCLUSION

The importance of *Gmelina arborea* Roxb. (Gambhari) fruit is indicated in the present review as one of the classical medicinal plants. It highlights the hidden knowledge about one of the essential and mainly prescribed Ayurvedic plant drugs. The current review will be encouraged the researcher and physicians to properly therapeutic uses Gambhari fruit instead of Gambhari root/bark. Provided data will help understand adulteration, substitution and availability of the genuine plant part and remove the controversy of the plant. The pharmacological and biological actions proved through clinical trials are yet to be further verified and re-established.

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