International Journal of Pharmaceutical Science and Research
www.pharmacyjournal.net
ISSN: 2455-4685
Received: 10-12-2025, Accepted: 25-01-2026, Published: 12-02-2026
Volume 10, Issue 1, 2026, Page No. 52-55

Thespesia populnea linn: A comprehensive review of its phytochemistry and pharmacological potential

Sadhan S*, Dr. T Balasubramanian, Dr. Suresha B S, Ahalya Devi K H
Department of Pharmacology, Bharathi College of Pharmacy, Bharathinagara, Mandya, Karnataka, India

Abstract
Thespesia populnea Linn. (Family: Malvaceae), known as the Portia tree or Indian tulip tree, is a widely distributed evergreen coastal plant with important uses in traditional medicine. Different parts of the plant, such as bark, leaves, flowers, fruits, and seeds, have been used to treat skin issues, wounds, inflammation, liver problems, diarrhea, diabetes, and neurological conditions. Research has shown that it contains bioactive compounds like flavonoids, tannins, alkaloids, sesquiterpenoids, saponins, phenols, and sterols, which add to its healing properties. Pharmacological studies have revealed various effects, including antiulcer, antidiabetic, antimicrobial, antidiarrheal, analgesic, antioxidant, and memory-boosting properties, confirming its traditional applications. This review covers the plant's description, distribution, phytochemical compounds, and pharmacological effects, showcasing its potential as a valuable medicinal plant and stressing the need for more clinical and pharmacological research.

Keywords: *Thespesia populnea*, traditional medicine, phytochemistry, bioactive compounds, pharmacological activities

Introduction

Thespesia populnea Linn. (Family: Malvaceae) is a small evergreen tree that typically grows 6–10 m (20–33 ft) tall. It has a short, often crooked trunk and a broad, dense canopy, with glossy green, heart-shaped leaves and yellow, hibiscus-like flowers [1]. It is widely distributed in the coastal forests of India and the southeastern regions. The plant is traditionally used for medicinal purposes in the treatment of various ailments, including skin infections as well as brain and liver disorders [2]. The name *Thespesia* originates from the Greek word *thespesios*, meaning divine or sacred [3]. The plant is known for its wide range of medicinal properties, including antidiabetic effects, anti-psoriatic activity, anticancer potential, and its use in the management of Alzheimer's disease [4].

Thespesia populnea is effective in treating scabies, psoriasis, various skin conditions, eczema, ringworm infections, and guinea worm infestations. The plant contains numerous therapeutically active compounds, such as sugars, fatty acids, tannins, alkanes, flavonoids, sesquiterpenoids, saponins, and antioxidants [5].This medium-sized evergreen avenue tree is characterized by distinctly heart-shaped leaves and yellow flowers. Its fruit is a somewhat flattened, leathery sphere. Various parts of the tree, including the leaves, flowers, bark, fruits, and seeds, have been traditionally used to treat several ailments. The bark is crushed and used for hot fomentation in wound treatment. Traditionally, the bark and leaves of Portia have also been used to produce oil for treating fracture wounds and to prepare anti-inflammatory poultices applied to boils and ulcers [6].

Thespesia Populnea Tree

Common Names
Portia tree, Pacific rosewood, Indian tulip tree, Cork tree, Umbrella tree [7].

Kingdom	Plantae
Sub Kingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Dilleniidae
Order	Malvales
Family	Malvaceae
Genus	Thespesia.Sol.ex.Correa.

Taxonomical classification [8]

Distribution
The species has been widely planted throughout the tropics and is now naturalied in tropical climates worldwide. It is a typical coastal species of South Asia, Africa, and the Pacific Islands. It is naturalized in Florida and the West Indies and is occasionally cultivated in Central and South America.
In India, the species is common along the coastal tracts of the peninsula and in mangrove swamps. It is especially abundant—and possibly wild—in South Kanara, Malabar, the deltas of the Godavari and Mahanadi rivers, and in Cuttack. It also occurs in the Sundarbans of West Bengal and in the Andaman Islands.
The species is frequently cultivated as an avenue tree in coastal cities such as Kolkata, Mumbai, and Chennai. It has been successfully grown as an avenue tree around Bangalore and has also been extensively planted in Chandigarh [3].

Phytochemical Constituents
- Air-dried flowers of *Thespesia populnea* contain kaempferol, β-sitosterol, gossypetin, and quercetin.
- The heartwood is reported to contain sesquiterpenoids known as populnea A–H. It also includes six sesquiterpenoid quinones of the mansonone group with a cadalene skeleton. Four of these have been identified as mansonone C, D, E, and F, while the remaining two are newly identified natural compounds named thespesone I and thespesone II.
- The stem bark of *Thespesia populnea* contains carbohydrates, tannins, alkaloids, phenols, flavonoids, proteins, saponins, gums and mucilage, as well as terpenes.
- The leaves of *Thespesia populnea* contain lupeol and β-sitosterol as major constituents, along with lupenone and quercetin [8].

Medicinal Uses
The ethnomedicinal uses of *Thespesia populnea* (Linn.) Soland. Indicate its significant role in the treatment of a wide range of diseases. The leaves and fruits are commonly used to manage inflammation. Various parts of the plant, including the leaves, roots, fruits, and bark, are employed in treating skin infections such as ringworm, warts, psoriasis, scabies, as well as sprains, bruises, and other cutaneous disorders. The fruits and bark are also used in the treatment of urethritis and gonorrhea, while the fruits are utilized for relieving migraine headaches. The bark is traditionally used to treat hemorrhoids and chronic dysentery. In Ayurveda, the roots are believed to balance *vatta* and *pitta* and are used as a tonic, aphrodisiac, and for treating burning sensations in the body and heart-related ailments. The flowers are used to alleviate itching [9].

Pharmacological Activities
Anti-Ulcer Activity
The antiulcer activity of the bark of *Thespesia populnea* was assessed using an ethanolic extract in rat models of acute gastric lesions induced by ethanol and pylorus ligation. Animals were pretreated with the extract at doses of 100, 200, and 400 mg/kg. In both experimental models, the extract produced a significant reduction in lesion index, total affected area, and percentage of lesions compared with the control group. These results suggest that the bark extract of *Thespesia populnea* possesses notable antiulcer activity, supporting its traditional use and contributing to its pharmacological validation [10].

Anti Diabetic Activity
Thespesia populnea, a well-known evergreen tree of the family Malvaceae, is commonly referred to as the Indian tulip tree. It is distributed across tropical regions and coastal forests of India and is widely used in the Indian system of medicine. Various parts of the plant are traditionally employed for their astringent, antibacterial, hepatoprotective, haemostatic, antidiarrheal, and anti-inflammatory properties. In a study, the ethanolic extracts of the bark (TPBE) and leaves (TPLE) were evaluated for their effects on blood sugar in streptozotocin (STZ)-induced diabetic rats and compared with the standard drug glibenclamide. The results indicated that both extracts possess significant antidiabetic activity, potentially through the inhibition of free radical generation [11].

Anti-Microbial Activity
Many medicinal plants have been traditionally used worldwide to treat microbial infections. In this study, the *in vitro* antibacterial activity of aqueous and ethanolic root extracts of *Thespesia populnea* Linn. Was investigated. The antimicrobial activity was tested against five pathogenic bacteria and two fungi using the disc diffusion method, while the minimum inhibitory concentration (MIC) was determined by the broth serial dilution method. Ciprofloxacin (5 µg/ml) and fluconazole (100 units/disc) served as positive controls for bacteria and fungi, respectively. Various concentrations (50, 100, 150 µg/ml) of the extracts were tested for dose-dependent antibacterial activity.
The results demonstrated that *T. populnea* exhibited broad-spectrum antimicrobial activity against both Gram-positive and Gram-negative bacteria, with the ethanolic extract showing the maximum inhibition of 27 ± 0.2 mm at a higher dose (250 µg/ml). The MIC of the ethanolic extract was 10 µg/ml for *Staphylococcus aureus* and 750 µg/ml for *Candida albicans*. Antibacterial activity against *S. aureus* was stronger with the ethanolic extract compared to the aqueous extract. The study concluded that the antimicrobial activity of *T. populnea* is dose-dependent, with higher concentrations producing larger zones of inhibition. Flavonoids and tannins present in the extracts are likely responsible for this antimicrobial effect [12].

Anti-Diarrheal Activity
The objective of this study was to evaluate the antidiarrheal activity of aqueous (AQTP) and alcoholic (ALTP) extracts

of the stem bark of *Thespesia populnea* (Malvaceae) in rodents. The stem bark was successively extracted with water and alcohol, and preliminary phytochemical screening was conducted. AQTP was found to contain alkaloids, carbohydrates, glycosides, saponins, proteins, flavonoids, tannins, and phenolic compounds, while ALTP contained alkaloids, carbohydrates, glycosides, saponins, proteins, steroids, flavonoids, tannins, and phenolic compounds.

Acute oral toxicity studies conducted according to OECD guidelines 425 indicated that both extracts were safe up to 2000 mg/kg. The antidiarrheal activity was assessed using three experimental models: castor oil-induced diarrhea, prostaglandin E2 (PG-E2)-induced enteropooling in rats, and the charcoal meal test in mice. In the castor oil-induced model, both ALTP and AQTP produced a significant, dose-dependent reduction in cumulative wet fecal mass. In the PG-E2-induced enteropooling model, ALTP (100, 200, and 400 mg/kg, p.o.) and AQTP (50, 100, and 200 mg/kg, p.o.) inhibited PG-E2-induced intestinal secretions. Similarly, in the charcoal meal test, both extracts reduced intestinal motility, indicating antimotility activity. Among the two, AQTP exhibited more potent antidiarrheal effects than ALTP across these models [13].

Analgesic Activity

Pain is a common and distressing condition that significantly affects both individuals and society. Conventional pain management treatments are often either insufficiently effective or associated with undesirable side effects. The present study aimed to evaluate the analgesic potential of stem bark extract of *Thespesia populnea*.

Methods: Thirty Swiss albino mice were divided into five groups: control, standard, and three test groups receiving different doses of *Thespesia populnea* bark extract. Analgesic activity was assessed using the hot plate-induced paw withdrawal, acetic acid-induced writhing, and formalin-induced paw licking models.

Results: In the hot plate test, the percent increase in paw withdrawal latency for the test extract (10 mg/kg) reached a peak of 136% at 180 minutes, compared to 125% for the standard drug pentazocine at the same time point. In the acetic acid-induced writhing test, the maximum percent inhibition of writhing for the test extract (30 mg/kg) was 68%, while for diclofenac it was 80%. In the formalin test, the percent inhibition of paw licking in the early and late phases for the test extract (30 mg/kg) were 81% and 91%, respectively, compared to 56% and 94% for diclofenac. These results indicate that the test extract exhibited superior analgesic activity in the early phase and comparable activity in the late phase relative to the standard drug.

Conclusions: *Thespesia populnea* bark extract at a dose of 10 mg/kg demonstrates significant peripheral and central analgesic effects, highlighting its potential as a natural analgesic agent.

Keywords: Pain, Analgesic, *Thespesia populnea*, Bark extract [14].

Memory-Enhancing Activity

Thespesia populnea Soland ex. Correa (Malvaceae) is a large tree native to the tropical regions and coastal forests of India. Various parts of the plant have demonstrated medicinal properties, including antifertility, antibacterial, anti-inflammatory, antioxidant, purgative, and hepatoprotective activities. The present study aimed to evaluate the effects of Thespesia populnea bark on memory in rats.

Memory assessment was conducted using exteroceptive behavioral models, including the elevated plus-maze and Hebb-Williams maze, and interoceptive models, such as diazepam-, scopolamine-, and ageing-induced amnesia. The ethanol extract of Thespesia populnea (TPE) was administered orally at doses of 100, 200, and 400 mg/kg for seven consecutive days to different groups of young and aged rats.

Administration of TPE at 200 and 400 mg/kg significantly improved memory performance in both young and aged rats. Moreover, TPE effectively reversed amnesia induced by scopolamine (0.4 mg/kg, i.p.) and diazepam (1 mg/kg, i.p.). The memory-enhancing effects of TPE may be attributed to its cholesterol-lowering, anticholinesterase, anti-inflammatory, and antioxidant properties.

These findings suggest that Thespesia populnea bark is a promising candidate for memory enhancement and warrants further investigation for its potential in the management of Alzheimer's disease [15].

Anti-Oxidant Activity

Introduction: Antioxidants are crucial compounds that protect the body from damage caused by free radical-induced oxidative stress. There is growing interest in natural antioxidants, such as polyphenols found in medicinal and dietary plants, which may help prevent oxidative damage.

Methods: This study evaluated the preliminary phytochemical profile, total phenolic and alkaloid content, and *in vitro* antioxidant activity of hexane, ethyl acetate, 70% ethanol, and methanol extracts of *Thespesia populnea* seeds.

Results: Phytochemical screening of the seeds revealed the presence of steroids, flavonoids, alkaloids, glycosides, tannins, quinones, and carbohydrates. Amino acids and oils were absent in all extracts, and the hexane fraction lacked triterpenes and tannins. Among the extracts, the ethyl acetate extract had the highest phenolic content, while the methanolic extract contained the highest alkaloid content. All extracts exhibited concentration-dependent inhibition of superoxide radicals, with maximum activity observed at 160 µg, which further increased gradually at higher concentrations.

Conclusion: Of the four seed extracts tested, the methanolic extract demonstrated superior antioxidant activity compared to the aqueous extracts at a concentration of 160 µg [16].

Conclusion

Thespesia populnea is an important coastal tree species with wide geographical distribution and significant ethnomedicinal value. Traditionally, different parts of the plant have been used to treat a variety of ailments, which is supported by numerous pharmacological studies demonstrating its anti-ulcer, antioxidant, analgesic, antidiabetic, and anti-diarrheal activities. The presence of bioactive compounds such as flavonoids, phenols, and terpenoids contributes to its therapeutic potential. Given its

traditional importance, pharmacological relevance, and adaptability to diverse tropical environments, *T. populnea* represents a valuable medicinal plant. However, further clinical studies, standardization, and conservation efforts are necessary to fully explore and utilize its medicinal potential.

Acknowledgement
I want to sincerely thank Bharathi College of Pharmacy at Bharathinagara, Mandya, and Karnataka, for all of your help. For their assistance, I am also grateful to Dr. T. Balasubramanian, Dr. Suresha B S, and Ahalya Devi K H.

Conflict Of Interest: No conflict of interest.

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