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THESPESIA POPULNEA: AN UNDERUTILIZED COSMETOLOGICALLY POTENT PLANT: A REVIEW

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ABSTRACT

Thespesia populnea (Linn.) Soland ex Correa, commonly known as the Indian Tulip Tree, is an underutilized plant with significant potential in cosmetology. This review article explores the diverse phytochemicals present in Thespesia populnea, which have been reported to exhibit various beneficial activities relevant to cosmetic applications. Despite its rich phytochemical profile, the plant remains inadequately studied in the context of its cosmetic potential. The review further highlights the need for comprehensive research to fully understand and harness the cosmetological benefits of Thespesia populnea. Key phytochemicals identified in the plant include flavonoids, tannins, saponins, and phenolic compounds, which are known for their antioxidant, anti-inflammatory, and antimicrobial properties. These attributes suggest that Thespesia populnea could serve as a valuable resource for developing natural and effective cosmetic products.

Furthermore, the review discusses the traditional uses of the plant across various cultures, emphasizing its historical significance and potential for modern applications. By shedding light on the underexplored cosmetic potential of Thespesia populnea, this review aims to encourage further scientific investigation and utilization of this promising plant in the cosmetic industry. The findings underscore the importance of integrating traditional knowledge with modern scientific research to discover new, sustainable sources of cosmetic ingredients.

KEYWORDS: Thespesia populnea, Indian Common Tulip, Cosmetology, Psoriasis.

A. INTRODUCTION

The escalating demand for natural ingredients in cosmeceutical and cosmetic formulations has led to a significant increase in the utilization of plants as sources of active principles in recent years.[1] This surge is primarily driven by growing industrial and market demand, coupled with increasing concerns regarding the adverse effects often associated with synthetic alternatives. Consequently, the scientific community has re-focused its efforts on natural ingredients, many of which have been traditionally employed for skincare and related treatments over centuries. This renewed interest stems from the notable safety profiles and effectiveness of plant-derived compounds in both pharmaceutical and cosmetic applications.[2][3]

Extensive research over the years has highlighted the therapeutic and cosmetic potential of numerous bioactive substances and natural plant products. Prominent examples include Betulin and Betulinic acid from birch tree bark[2] Paclitaxel from Taxus species[4] Tea Tree oil from Melaleuca alternifolia,[5][6] and Chamomile oil.[7] The examples provided represent only a small fraction of the botanical realm's vast contributions to cosmetology. The extensive and ever-expanding list of plants utilized for cosmetic applications spans centuries, with a rich history of traditional use and a burgeoning body of modern scientific research. This wide-ranging adoption underscores a fundamental shift towards sustainable and naturally derived ingredients, reflecting a growing appreciation for their efficacy, safety, and multifaceted benefits in personal care formulations. One such highly promising plant of the Indian Continent is Thespesia populnea.

Thespesia populnea (Linn.) Soland ex Correa, an evergreen tree native to coastal and tropical regions of India, belongs to the Malvaceae family. It boasts a rich history of traditional use within various medical systems, including Ayurveda and Unani schools of medicine. The plant is recognized for its diverse medicinal properties, encompassing anti-diabetic effects, anti-psoriatic activity, anti-cancer potential, and applications in managing Alzheimer's disease.[8],[9] The bark and fruits of the plant, in particular, are reported to be highly valued for their cooling, depurative, anti-inflammatory, hemostatic, and anti-diarrheal properties.[8] Furthermore, Ayurvedic literature documents the potential of various plant parts such as the roots, leaves, flowers, fruits, and bark of this plant to treat a wide array of ailments.[10] Thus, contemporary research corroborates the necessity for further exploration of Thespesia populnea as a valuable natural resource for cosmetic applications.[11]

Thus, this review article aims to comprehensively investigate the potential of Thespesia populnea for cosmetic and cosmeceutical applications. It will delve into the plant's chemical properties, its traditional uses, and modern scientific findings relevant to its integration in cosmetology.

B. PHARMACOGNOSY

Figure 1: Thespesia populnea.

Thespesia populnea, commonly known as the Indian Tulip Tree or Portia Tree, is an evergreen species native to the coastal regions of India and other tropical zones. This medium-sized tree typically reaches a height of 6 to 10 meters (20 to 33 feet), with a characteristic short and sometimes crooked trunk, supporting a broad, dense canopy.[12],[13] The tree shows an alternate phyllotaxy, with petiolate dark coloured leaves, generally measuring 8 to 16 cm in length.[14]

The bark of this tree is fibrous and typically around 4 mm in thickness, exhibiting a grey to brown coloration.[14] Flowers are necessarily the most striking features of the plant, with vibrant yellow petals that display a purple ‘eye’ at its base. These petals are reported to transition into a rich brick-red or pinkish hue as they mature.[15] The calyx is green and cup-shaped, while the petals themselves are elegantly fringed and crinkled.[15] The stamens form a long, tubular structure with golden anthers, and the style branches into five distinct segments.[8] The fruit of the tree is a flattened, spherical brown capsule containing approximately ten hairy seeds, alongside a sticky yellow sap that is known for its medicinal properties.[14] The natural habitat of Thespesia populnea spans across coastal regions of the Indian subcontinent, specifically from Konkan southward to Chittagong, and includes the Andaman and Nicobar Islands. Beyond India, it is also reported from several tropical locations, including Myanmar, various Pacific islands, and as far west as East Africa.[15]

In the context of pharmacognosy, Thespesia populnea has garnered distinct attention for its wide array of bioactive compounds, which contribute to its myriad therapeutic applications. Studies have demonstrated that various parts of the plant, including the bark, leaves, and flowers, possess significant antioxidant, antimicrobial, and anti-inflammatory properties.[16],[12],[17] These properties have led to the use of Thespesia populnea in traditional medicine systems across several cultures, particularly for treating skin ailments, respiratory issues, and digestive disorders. The bioactive compounds reported from the plant, such as alkaloids, flavonoids, and glycosides, further support its potential for pharmacological applications.[17]

Given its diverse pharmacological properties, Thespesia populnea is a subject of increasing interest in modern pharmacological research. Continued studies on the chemical composition of the plant and its potential clinical applications are essential for fully understanding the therapeutic benefits it may offer. The ecological and extensive medicinal significance of Thespesia populnea solidifies its status as a valuable asset not only in the field of pharmacognosy but also in the broader development of novel plant-based therapies. It is this established pharmacological foundation that distinctly warrants a comprehensive cosmetological review, underscoring the pressing need to synthesize the available literature and explore its promising applications in the cosmetic industry.

C. LITERATURE ANALYSIS

A comprehensive literature review on Thespesia populnea reveals a pronounced disparity in research focus, particularly concerning its cosmetological and nutraceutical potential. The data, visually represented in Figure 2, indicates an overwhelming emphasis on the chemical constituents present in the plant (2,130 results), followed by its broad medicinal properties (1,710 results) and pharmacological actions (1,560 results).

In stark contrast, a search using Google Scholar over the past five years reveals that research into the cosmetic applications of this plant remains significantly under-represented. Specifically, studies on its cosmeceutical applications (312 results) and nutraceutical properties (247 results) constitute only a small fraction of the total literature. The number of studies directly related to cosmetology is a meagre 16 results, collectively representing only about 8% of the total findings.

This critical research gap underscores a substantial opportunity for further exploration. The review of the rich chemical profile of the plant and its established traditional uses, particularly in addressing skin conditions like psoriasis and for general dermal health, provides a compelling foundation. These traditional applications warrant rigorous scientific validation through modern empirical research and established methodologies to fully unlock the considerable promise presented by Thespesia populnea as a natural and sustainable resource for the cosmetic industry.

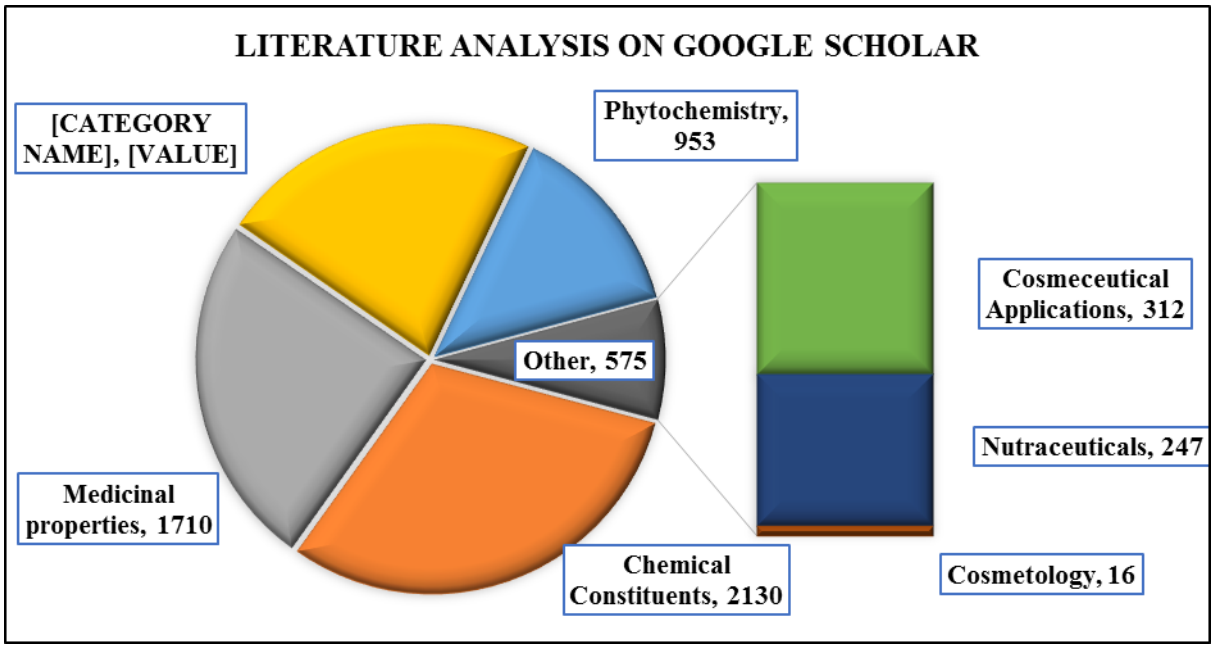

Figure 2: Literature Analysis of Search Results on Googel Scholar.

D. CHEMICAL CONSTITUENTS

Thespesia populnea is rich in several cosmetologically important compounds. The following is the analysis of the chemicals present in Thespesia populnea and its possible cosmetic application. Various chemicals found in the plant parts have been reported for their cosmetological applications.[18] The most promising plant part with respect to cosmetic application is certainly the flowers of the plant. The flowers of Thespesia have been used as both a dried resource and fresh resources in numerous studies over the years. These flowers have also been reported to be rich in a wide variety of phytochemicals.

The flowers have been reported to be rich in Kaempferol which has been well established for its antioxidant properties. Kaempferol has also been reported to help protect the skin from oxidative stress and may reduce the appearance of aging.[19],[20] Another important chemical from the flowers is β-Sitosterol which has been reported to be useful for a range of

pharmacological conditions including cancer. It has also been reported to possess anti-inflammatory properties and can help soothe irritated skin.[20],[21],[22]

Gossypetin has also been reported from the flowers. This phytoconstituent, due to its anti-inflammatory properties has been reported to be beneficial for skin health. Other important phytochemicals from the flowers include Quercetin which has been scientifically reported to be capable of protecting the skin from damage caused by free radicals and also has anti-inflammatory properties and a wide range of Glucosides such as kaempferol-3-glucoside, quercetin 3-glucoside, etc., which have been reported individually and in combination for their antioxidant properties and skin hydration and skin protection capacities.[23],[24] Gossypol is one of the most important components widely researched from the flowers of Thespesia. Gossypol has been reported to be potent against skin infections.[25]

The fruits of Thespesia populnea are a rich source of two highly promising phytoconstituents, namely Herbecetin and Thespesin. Herbecetin is a well-documented antioxidant with a notable ability to shield the skin from UV-induced damage. Similarly, thespesin exhibits potent cosmetic properties, underscored by its significant antioxidant potential. These powerful chemicals collectively establish the fruit as a highly promising resource for advanced cosmetological applications.[9],[20]

The Heartwood of Thespesia has also been significantly research with respect to its chemical profile. Certain chemical such as Sesquiterpenoids (Populene A to H), Sesquiterpenoid quinones (Mansonones C, D, E, F), and Thespesone I and Thespone II from the heartwood are highly promising components for cosmetic applications.[26],[27] Populenes have been reported to possess promising, antioxidant, anti-inflamatory and anti-microbial properties, making them highly beneficial for skin health. Similarly, Mansonones have also been reported to be useful in the treatment microbial and fungal skin infections.

The bark of the plant has been reported to be rich in alkaloids, carbohydrates, proteins, tannins, phenols, flavonoids, mucilage, saponins, terpernoids and a wide range of phytoconstituents making it a valuable resource for cosmetic applications. Bark also contains betasitosterol, stigmasterol, daucosterol etc phytosterols which have been reported previously for cosmetic applications.[28],[8] Finally, the leaves of the plant are also reported to be promising cosmetic resources. Leaves are scientifically reported to posses skin beneficial properties. They are reported to be rich in betulins, lupeol, betasitosterol, lupenone, and other

alkanes.[29] Table 1.1 enlists the chemical constituents found in the plant along with their cosmetological significances.

Table 1.1 Chemical constituents in Thespesia populnea.

S. no.	Chemical Category	Chemical Constituents	Cosmetological Significance	References
1.	Alkaloid	Gossypol	Anti-oxidant, Anti-psoriatic, Anti-tyrosinase	[8], [14], [30].
2.	Flavonoids	Kaempferol, Kaempferol -3-glucoside, Quercetin, Quercetin 3-glucoside, 5, 8-dihydroxy-7-methoxyflavone	Anti-oxidant, Anti-psoriatic, wound healing activity, Anti-tyrosinase, Anti-stress	[8], [14], [31], [32], [33].
3.	Terpenes	Lupenone, Lupeol, Mansonone D, Mansonone E, Mansonone F, Thespone, Thespesin	Anti-oxidant, Anti-psoriatic, Anti-acne	[8], [14], [34].
4.	Steroids	β-sitosterol, β-sitosterol-β-D-glucoside	Anti-oxidant, Anti-psoriatic, wound healing activity	[8], [14], [35].
5.	Glycosides	Populneol	Anti-oxidant, Anti-psoriatic	[8], [14].
6.	Fatty Acids	myricyl alcohol	Anti-oxidant, Anti-psoriatic	[8], [14].
7.	Alkanes	Nonacosane	Anti-oxidant, Anti-psoriatic	[8], [14].

E. TRADITIONAL MEDICINAL PROPERTIES

While its modern cosmetic applications remain underexplored, Thespesia populnea has a profound and extensive history of use in the traditional medical systems of India. Within the classical tenets of Ayurveda, various parts of the plant are revered for their efficacy in addressing a wide spectrum of skin ailments. For centuries, the expressed juices from the leaves, roots, seeds, and flowers have been historically applied to manage conditions such as acne, a practice that strongly suggests inherent anti-inflammatory and antimicrobial properties. This rich traditional knowledge provides a robust, empirical foundation for its promising role in contemporary cosmetology, bridging ancient therapeutic wisdom with modern scientific inquiry.[34]

A traditional preparation using the bark of the tree reports involving a process of scalding and crushing followed by infusion into coconut oil. This formulation has been reported to yield a therapeutic oil for topical application. This remedy is traditionally employed to treat

conditions such as psoriasis and scabies.[29] The synergistic preparation of any such formulation likely harnesses the inherent anti-parasitic and anti-inflammatory potential of the plant and its phytocompounds. The efficacy of these compounds has been reported to be positively enhanced by the emollient properties of the coconut oil.[14],[13] Furthermore, this oil is a traditional remedy for a broad spectrum of dermatological conditions, including diverse skin infections, vitiligo, and the chronic xerosis associated with eczema, highlighting its wide-ranging therapeutic utility.[3]

The mashed bark of Thespesia populnea is traditionally applied as a poultice or hot fomentation to promote wound healing and minimize scarring.[18] This practice may be attributed to the potential of the bark of the plant to stimulate tissue regeneration and modulate inflammation. Similarly, a poultice prepared from the fruits is used to treat various skin conditions, including wounds, suggesting a comprehensive skin-healing capacity.[18]

The leaves and bark are valued for their potent antimicrobial and antifungal properties, making them effective wound-cleaning agents. Bandages soaked in extracts prepared from the leaves of the plant are also reported to be used in the treatment of eczema, further emphasizing the plant's therapeutic potential in managing inflammatory skin conditions[36],[29],[17] The presence of compounds such as gossypol, flavonoids, and tannins, known for their antimicrobial, anti-inflammatory, and antioxidant properties, may contribute to these observed effects. Further phytochemical and pharmacological studies are warranted to validate these traditional uses and elucidate the specific mechanisms of action. The list of major formulations involving the use of Thespesia populnea has been tabulated in Table 1.2.

Table 1.2: Formulations made using the plant Thespesia populnea.

S. no.	Marketed Ayurvedic Product	Uses
1.	Poovarasam Pattai Tablet	Treatment of ringworm, scabies and psoriasis, sprains, bruises and cutaneous diseases.
2.	Kamilari Capsules	Treatment of acute jaundice, and chronic inflammatory liver disorders, dyspepsia, loss of appetite, alcoholism, in various heptatocellular and heptocanalicular conditions.
3.	Poovarasam Pattai Powder	Treatment of dysentery, cholera, haemorrhoids, urethritis, gonorrhea, migraines, and headaches. It is also believed to help balance the body's ‘vata’ and ‘pitta’ doshas, and is utilized as a tonic, aphrodisiac, and remedy for body heat and heart-related conditions.

F. MODERN COSMETIC POTENTIAL

The compelling evidence from the diverse chemical profile of this plant, its well-documented traditional applications, and its historical use in traditional medicine collectively underscore the immense, yet significantly underutilized, modern cosmetological and cosmeceutical potential of Thespesia populnea. By leveraging advanced extraction and formulation techniques, the bioavailability of its active compounds can be substantially enhanced, thereby paving the way for innovative and efficacious cosmeceutical products. To fully realize this potential, further scientific validation through rigorous in vitro, in vivo, and clinical studies is not only essential but also critically warranted to integrate this promising botanical into the modern cosmetic industry. The current research work, further presents a compilation of empirical research published for this plant.

Antioxidant Activity

Different components of Thespesia populnea such as the stem bark, leaves, fruits, and flowers have been assessed for their antioxidant properties using various in-vitro and in-vivo models.[37] Literature survey suggests that the maximum DPPH free radical scavenging activity of green synthesized silver nanoparticles from the ethanolic extract of Thespesia populnea leaves was observed to be 92.77 ± 0.72% at a concentration of 120 µg/mL. The IC50 value has also been reported to be around 83.88 µg/mL.[37] Such promising results for antioxidant potential, proposes significant skin cleaning and skin beneficial activity of the extracts of these plants.

Similarly, Phosphomolybdenum Assay as well as Assay for Ferric (Fe3+) Reduction Activity are also reported for these extracts wherein the highest rate of reduction was determined to be 51.47 ± 0.39% and 28.78 ± 0.60% respectively at 120 µg/mL concentration. The IC50 values were 56.35 µg/mL and 125.31 µg/mL respectively. Once again proposing the usage as cosmetic product.[23],[22]

Kokou et al., in 2023 has also investigated the antioxidant properties of ethanolic extracts from the bark and leaves of the Thespesia populnea plant using DPPH free radical scavenging assay using quercetin as a reference molecule. Reported IC50 value was observed to be 70.27 mg EQ/g ES. The free radical scavenging assay also indicated that the bark exhibits strong free radical scavenging activity, with an IC50 value of 77.45 mg EQ/g ES. In contrast, the leaves show a lower scavenging activity, with an IC50 value of 158.22 mg EQ/g ES.[38]

Sintupachee et al., in 2020 has reported conclusive evidence regarding antioxidant properties of leaf and fruit extracts of the Thespesia populnea using thin-layer chromatography (TLC) based bioautography method. The reaction of DPPH with fingerprint TLC plate was analyzed using ImageJ software. The analysis revealed that bands indicating DPPH-positive (antioxidant reaction) activity were prominent at Rf of 0.42 and 0.59 in both leaf and fruit extracts, but absent in the flower extract. Specifically, the leaf extract showed areas of 436.67±25.12 and 504.33±31.57 at Rf 0.42 and 0.59, respectively, while the fruit extract showed areas of 300.67±30.61 and 388.67±6.35 at these Rf values.[39]

Thus, numerous such studies have comprehensively reported the potential applications of parts of Thespesia populnea with reference to its anti-oxidant potential.

Wound Healing Activity

Literature review on Thespesia populnea also further demonstrates its potential for promoting wound healing. Halim et al., in 2024 conclusively reports that the ethanolic bark extract of Thespesia populnea along with its bioactive fractions, effectively stimulates wound contraction in an excision wound model. This effect is primarily attributed to their antioxidant activity, which promotes healing, and their ability to stimulate collagen amino acid production. Additionally, the anti-inflammatory potential of the extracts has also been looked upon to contribute to the strong healing action presented by the plant extracts.[35]

A topical gel with wound healing and antibacterial properties has also been developed by Asif et al in 2022 using an alcoholic extract of the leaves of Thespesia populnea.[40] The gel was optimized with propylene glycol and carbopol. Its antimicrobial activity and in vivo wound healing efficacy were found to be comparable to those of Soframycin gel.

Anti-psoriatic Activity

Thespesia populnea has also been reported scientifically for its anti-psoriatic properties. Kulawik-Pioro and Miastkowska in 2021 have determined that the ethanolic extract of the leaves of Thespesia populnea, applied topically using the Mouse-Tail model for 14 days, led to significant increases in orthokeratosis and relative epidermal thickness compared to the control group. This suggests that the extract has notable anti-psoriatic activity.[41]

Through a study reported in 2021, the extract of the bark of Thespesia populnea has been used to isolate three compounds: TpS-2, TpF-1, and TpF-2. Various extracts and isolated

compounds were tested for their anti-psoriatic effects using Perry's scientific mouse tail model. Among them, TpF-2 and the petroleum ether extract showed the most promising results when applied topically.[42]

Anti tyrosinase Activity

The demand for skin lightening products has driven research into new compounds with potential skin-lightening effects. Perera et al., in 2018 has explored the tyrosinase inhibitors from eight medicinal plants traditionally used for skin conditions. L-DOPA has been utilized as the substrate in in-vitro tests, with kojic acid serving as the positive control. The bark extract of Thespesia populnea has been reported to possess the highest tyrosinase inhibition with an IC50 value of 190 µg/mL, though kojic acid showed a substantially lower IC50 value of 3.4 µg/mL.[43]

Antimicrobial activity against skin infection causing micro-organisms

There are numerous reports of antimicrobial and antifungal properties of the plant parts of Thespesia populnea over decades. In some of the papers, aqueous bark extract of T. populnea combined with copper metal has been used against skin infection-causing microbes, namely Staphylococcus aureus (MTCC 3160), Pseudomonas aeruginosa (MTCC 358), Streptococcus pyogenes (MTCC 102), Candida albicans (MTCC 183) and Trichophyton rubrum (MTCC 296). The results revealed that the mixture had high antimicrobial activity. Furthermore, the fungal strain Trichophyton rubrum (MTCC 296) exhibited a larger zone of inhibition compared to other microbial strains.[44] Thus, suggesting potent antimicrobial property in the plant.

G. CONCLUSION

Thespesia populnea (Linn.) Soland ex Correa, with its diverse and synergistic array of bioactive phytochemicals, stands as a resource of immense and compelling potential within the field of modern cosmetology. While its long and successful history of traditional use in dermatological care is well-established, its application in modern cosmetic science remains a significant and largely untapped frontier of scientific exploration. This review emphatically underscores that given the plant's well-documented antioxidant, anti-inflammatory, and antimicrobial properties, each of which directly addresses key skin concerns from aging to infection. Thus, the utilization of this plant in cosmetic applications is not merely promising, it represents a vast, multi-faceted, and critically underexplored opportunity.

The findings of this analysis highlight a profound and urgent gap in scientific research, presenting a clear call to action for further investigation. By rigorously bridging traditional ethnobotanical knowledge with cutting-edge scientific methodologies and advanced extraction techniques, Thespesia populnea has the capacity to transition from an underutilized resource to a cornerstone of natural and efficacious cosmetology. This paradigm shift promises to offer sustainable and innovative solutions to the cosmetic industry, providing a rich, plant-based foundation that can meet and exceed the growing global demand for natural, safe, and effective alternatives.

H. NO CONFLICT OF INTEREST

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