



Plumeria Acuminata – An Overview

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ABSTRACT

Plumeria acuminata is commonly known as 'perungalli' in Tamil and belongs to the family Apocynaceae. This plant is widely distributed all over the world among tropical regions, especially in the southern part of India. In the traditional medicine system, different parts of the plant have been useful in the treatment of a variety of diseases as the decoction of the bark is used as purgative and febrifuge, the latex is used for itching with coconut oil, the flower is used as contraceptive, etc. This plant is also used for ornamental purposes. It contains various phytoconstituents belonging to alkaloids, Carbohydrates, carotenoids, curcumins, flavonoids, glycosides, lignans, phenolics, phthalides, polyphenols, saponins, sterols, Steroids, sulfides, tannins, and terpenoids. Extracts of the plant possess pharmacological actions like antidiabetic, Cytotoxicity and antimicrobial, anti-inflammatory, antipyretic and antinociceptive activity, Mutagenic, Abortification, Antifertility, Antibacterial, Chronic toxicity, Antitumor, Anti ovulatory and Anti-implantation, Antioxidant and free radical scavenging activity.

Keywords: *Plumeria acuminata*, distribution, treatment, phytoconstituents, pharmacological actions.

Introduction

Traditional medicine is an essential component of healthcare in developing countries, including India. It plays a major role in the treatment of diseases, and the use of complementary alternative medicine is rapidly increasing worldwide. Medicinal plants have been found to be effective in treating a range of illnesses, and nearly 50% of the medicines on the market are made from natural materials. Medicinal herbs demand is expected to remain high, as many active ingredients cannot yet be synthesized. (1)

The World Health Organization (WHO) estimates that about 80% of people in developing countries rely on traditional medicine for primary healthcare needs. Medicinal plants form the backbone of almost all traditional medical systems, including Indian materia medica, which includes about 2000 drugs of natural origin.

India has a rich heritage of traditional medicine, and the use of herbal medicine has increased in recent years. Traditional plant therapies, as prescribed in Ayurvedic and other indigenous systems of medicine, are commonly used in India. The use of herbal medicines throughout the world has provided an excellent opportunity for India to look for therapeutic lead compounds from ancient systems of therapy like Ayurveda, which can be utilized for the development of new drugs. (2)

Over 50% of all modern drugs are of natural product origin, and they play an important role in drug development programs of the pharmaceutical industry. (3) However, the cultivation of medicinal plants with laboratory- generated species is being attempted based on chemical composition, and this may have a profound impact on the safety and efficacy of Ayurveda drugs in the market. The worldwide revolution for the improvement of patient safety is gaining momentum, and drug safety has become even more prominent in the present-day scenario. (1)

Vernacular names in India:-(7)

English : Frangipani

Hindi : Golainchi

Bangali : Gorur champa, Dalan phul

Sanskrit : kshira champa

Malayalam : Velachampakan

Marathi : Sonachampa

Gujarati : Rhada champa



Oriya : Kat champa

Tamil:- Perungalli

Taxonomical classification of genus plumeria: - (6)

Kingdom : Plantae – Plants

Subkingdom : Tracheobionta – Vascular plants

Superdivision : Spermatophyta – Seed plants

Division : Magnoliophyta – Flowering plants

Class : Magnoliopsida – Dicotyledons

Subclass : Asteridae

Order : Gentianales

Family : Apocynaceae – Dogbane family

Genus : Plumeria L. – plumeria

Species : Acuminata



Morphological description: -

Plumeria acuminata is a smooth-stemmed evergreen or partly deciduous tree that can grow between 3 to 7 meters tall. It has a shining succulent with abundant white latex that easily breaks.⁽⁴⁾

Leaves - Leaves are simple, opposite, rarely whorled or alternate, stipules absent or rarely present.⁽⁵⁾ Its leaves are light green in color, elliptical in shape with acuminate tips, hence the name.⁽⁶⁾ Crowded at the terminal end of the branch, commonly oblong in shape, reaching a length of 40cm and a width of 7cm. It is simple, opposite, rarely whorled or alternate, stipules absent or rarely present. Leaves are simple and light green in color. They grow opposite each other, but can rarely be found in whorls or alternate arrangements. The leaves are elliptical in shape and have acuminate tips, which is where the name comes from.

Inflorescence- The inflorescence is cymose, has bracteoles and is either terminal or axillary. The stamens are located inside the corolla tube.

Flowers- The flowers are fragrant and bisexual. The upper portion is whitish, while the inner lower portion is yellow. They are 5-6cm long.

Fruits- The fruits are oblong or ellipsoid follicles which are brownish black in color with oblong seeds.

Distribution- This plant is considered to be a native to Mexico. It is reported to have been introduced from the Philippines and has become naturalised in India.⁽⁷⁾ This plant is widely distributed across the world among tropical region especially in southern part of India.

This plant is believed to be native to Mexico, but it was introduced from the Philippines and has now become naturalized in India. It is widely distributed throughout tropical regions around the world, particularly in the southern part of India.⁽¹⁾

Traditional uses: -

From ancient times, the plant material has been widely used as a purgative, remedy for pain, fever, diarrhea, and a cure for itch.⁽⁸⁾ The plant is also used in folk medicine for the treatment of rheumatism, pruritic skin lesions, toothache, asthma, cracks on the feet, heart stroke, constipation, fever, dysentery, and diarrhea. This plant is also used as ornamental purpose.⁽⁹⁾

Bark bruise is applied as plaster over hard tumors and used as a cure for gonorrhea. Leaves made into a poultice are used to dispel indolent swellings; milky juice is employed as a rubefacient in rheumatism. Internally, the root bark is a strong purgative. The bark of the tree is given with coconut, ghee, and rice as a remedy for diarrhea. Flower heads are eaten with betel leaves in ague. Milky juice which is a gastrointestinal irritant like gamboge is in minute doses an effectual purgative, the dose is as much as a grain of parched rice will absorb, the grain being administered as a pill. Externally, juice with sandalwood oil and camphor is employed as a cure for itch. Root is a violent cathartic. Its branches are used like those of chitraka to procure abortion.

The flower's essential oil exhibits antifungal properties. In Unani medicine, this herb is utilized to treat rheumatic pains and tumors. Various parts of the plant have been employed in traditional medicine to treat an array of diseases. The bark decoction is used as a purgative and febrifuge, the latex is employed to alleviate itching when mixed with coconut oil, and the flower has been used as a contraceptive.⁽¹⁰⁾

Phytochemical constituents: -

Steroids, tannins, alkaloids and glycosides, phenolics, flavonoids, terpenoids, lignanas, sulfides, polyphenols, carotenoids, curcumins and phthalides has been identified from methanol extract of *Plumeria acuminata*.⁽¹¹⁾⁽¹²⁾ Carbohydrates, alkaloids, phenolics, sterols, flavonoids, saponins, and terpenoids

was tested to positive in both extracts. Proteins and amino acids are absent in both extracts whereas tannins were detected from root but absent in leaves of ethanol extract. ⁽¹³⁾ Plumericin (terpene lactone), sterols, and lupeols are detected in leaves and roots. ⁽¹⁴⁾

Monoterpenes, sesquiterpenes, diterpenes and apocarotenoids are present. In addition, alkanes, aldehydes, alcohol, ketones, amide, ester, fatty acid and aromatic compounds of non-terpene derivatives were present. The major components in the leaf essential oil were linalool (16.1%), phytol (6.8%), (E)- β -ionone (6.1%) and (E)-hexadecatrienal (5.4%). Linalool, nonanal (20.5%) and eicosanal (10.6%) are abundant component in floral essential oil (12.6%). In contrast, the root essential oil was dominated by β -eudesmol (43.0%), palmitic acid (27.6%) and 11-hydroxy-(8E)-dodecenoic acid lactone (14.9%) were investigated by hydrodistillation. ⁽⁹⁾

Pharmacological actions: -

Anti-inflammatory activity: - According to a study, combining ethanol extract of white Frangipani flower (EFF) and ethanol extract of Bitter Grape stem (EBS) showed a synergistic effect on antimicrobial activity but had an antagonistic effect on antioxidant activity. The study tested the combinations of EFF and EBS at different concentrations and found that EFF 3% and EBS 3% showed the highest inhibition index against *Staphylococcus aureus* growth (2.02±0.06). The highest antioxidant activity was observed from 1% EFF alone (57.5 ± 0.60%), while the lowest was from the combination of EFF 1% and EBS 3% (23.4±0.30%). ⁽¹²⁾

Antipyretic and antinociceptive activity: - The present study was designed to investigate the effectiveness of methanol extract of *Plumeria acuminata* leaves (MEPA) as antipyretic and antinociceptive activity in several experimental models. On administration of MEPA at different doses (100, 250 and 500 mg kg⁻¹) significantly reduced brewer's yeast induced hyperthermia in rats. In addition, MEPA also exhibited a strong inhibitory effect on tail flick and tail immersion responses in mice, acetic acid-induced writhing response, hot plate, indicating its potential as an antinociceptive agent. Alkaloids, flavonoids, tannins, terpenes, and steroids, which are the phytochemical constituents responsible for the observed antipyretic, antinociceptive activities. ⁽⁸⁾

Antioxidant and free radical scavenging activity: - The study aimed to analyze the antioxidant and free radical scavenging potential of the methanolic extract of *Plumeria acuminata* leaves. The extract was tested for its ability to scavenge DPPH radical, superoxide anion radical, nitric oxide radical, and hydroxyl radical. The results indicated that the antioxidant activity of the extract increased with the increase in concentration. The extract showed a dose-dependent increase in inhibitory activity on peroxidation of linoleic acid emulsion at 50, 100, 200, 300, 400 and 500 µg of Methanol Extract of *Plumeria acuminata* (MEPA), exhibiting 46.01, 52.83, 57.43, 61.38, 68.27 and 73.14% inhibition, respectively. The reducing power of MEPA also increased with an increase in concentration. MEPA was found to be the most effective in DPPH radical and nitric oxide radical scavenging assays, exhibiting maximum activity of 60.42% and 56.38% inhibition at a concentration of 125 µg mL⁻¹. Besides, MEPA was able to scavenge the superoxide generated by the PMS/NADH-NBT system and inhibit the hydroxyl radical generated by Fenton's reaction. The study also revealed the presence of total phenolic compounds in MEPA. Based on the results, it can be concluded that the MEPA could be a potential natural source of antioxidants. ⁽¹¹⁾

Mutagenic activity: - Four isolates, A1, C1, D3, and F2, which were extracted from the green leaves of *Plumeria acuminata* Ait. These isolates showed antimutagenic activity and were obtained using a bioactivity-directed fractionation scheme from the bioactive hexane and carbon tetrachloride fractions. To monitor the antimutagenic activities, the micronucleus test was used. Among these four isolates, C1 is stigmast-7-enol, D3 is lupeol carboxylic acid and F2 is ursolic acid. The structure of A1 is not fully elucidated, but MS data suggested that it contained a long hydrocarbon chain. These four isolates, A1, C1, D3, and F2 reduced the number of micronucleated polychromatic erythrocytes (MPCE) induced by the mutagen, mitomycin C, by 75%, 80%, 57%, and 76%, respectively, at a dosage of 2 mg isolate/25 g mouse. Additionally, a compound A2 was also isolated, but it was inactive and identified as lupeol acetate. ⁽¹⁵⁾

Antifertility activity: - This research aims to explore the fertility regulatory potential of ethanolic extracts prepared from the leaves and roots of *Plumeria acuminata*, a plant from the Apocynaceae family. The extracts were prepared using a cold maceration process, and were subjected to qualitative phytochemical analysis and acute toxicity testing. Based on the LD50 values, doses of 100, 200, and 400 mg per kg of both extracts were determined for antifertility activity in adult female Wistar rats. The test-item treatments were orally administered from day 1 to 28. After administration of the extracts, the hormonal intensities up to ~7%–99%, including a decrease in estrogen, luteinizing hormone levels, progesterone, as well as an increase in follicle-stimulating hormone levels significantly altered. Cystic follicles and atrophied squamous cells are observed for anatomical alterations in reproductive system during histopathological evaluation. I'm sorry to hear that the vaginal smear evaluation confirmed a disturbance in the estrous cycle, with an increase in the estrous cycle length and a decrease in the number of estrous cycles and each phase. It's possible that hormonal imbalance may have contributed to these results, which could have been caused by certain phytochemicals i.e., Alkaloids, flavonoids, saponins and stigmasterol found in the leaves and roots ethanolic extracts. ⁽¹³⁾

Chronic toxicity: - Medicinal plants and their extracts as dietary supplements, nutraceuticals, functional foods, and herbal medicinal products has gained popularity in developing countries. It is crucial to assess the potential harmful effects of these plants and their preparations. This study aimed to determine the safety of methanol extracts of *Galega purpurea* (MEGP) and *Plumeria acuminata* (MEPA) through long-term administration in mice through oral route. The chronic toxicity study involved male mice being orally fed with MEPA and MEGP continuously for 270 days at doses of 300, 600, and 1,200 mg/kg body weight. The results of the study showed no significant abnormalities in the test groups compared to the control group. The hematological and blood chemical values in the treated groups were normal compared to the control group. The study also found no changes in body weight, internal organ weight, and general behavior, indicating non-toxicity effects of MEPA and MEGP. Additionally, the macroscopic or microscopic

analysis of internal organs or tissues in treated mice showed no changes. Thus, the oral administration of MEPA and MEGP to male mice did not produce acute or chronic toxicity. ⁽¹⁶⁾

Cytotoxicity, antimicrobial and antioxidant activity: - This study aimed to extract essential oils from the leaf, flower, and root of *P. acuminata*, analyze the oils, and evaluate their cytotoxicity, antimicrobial, and antioxidant activities. Essential oils were obtained from the different parts of *P. acuminata* through hydrodistillation and analyzed using the Gas Chromatography-Mass Spectrometry technique. The oils antimicrobial, toxicity, and antioxidant activities were evaluated using agar well-diffusion, brine shrimp lethality, and DPPH free radical-scavenging assays, respectively. The analysis showed that the oils contains 26, 85, and 12 constituents in the leaf, flower, and root, respectively, corresponding to 70.0%, 99.8%, and 97.4% of the whole oils. The major components of the oils were β -eudesmol, nonanal, palmitic acid, and linalool. The oils exhibited high toxicity with LC50 less than 100 ppm, indicating their biological activity. They also showed potent antimicrobial activities compared to standard drugs such as Gentamycin and ketoconazole. However, the oils exhibited low antioxidant activities compared to α -tocopherol and butylated hydroxyanisole. In conclusion, this study suggests that *P. acuminata* essential oils are biologically active and could be a natural source of antibiotics. ⁽⁹⁾

Abortifacient:- To evaluate the abortifacient potential of *P. acuminata*, researchers prepared ethanolic extracts of the plant's leaves and roots using a cold maceration process. The extracts were then subjected to phytochemical analysis and acute toxicity tests to determine safe doses for rats. Pregnant rats were given doses of the extracts or a standard abortion-inducing drug, Misoprostol, from gestation day 7 to 14. On gestation day 20, the rats were euthanized and their reproductive organs were examined for morphological, hematological, hormonal, and histological change. Results showed that the extracts significantly altered the rats' hormonal levels, decreasing estrogen and progesterone while increasing PGE-1 and acetylcholine. Histopathological evaluation revealed anatomical changes in the reproductive organs, including atrophied squamous cells and cystic follicles. Visual examination of the uterine horns showed that 25% of the fetuses were alive, 28% had undergone early resorption, and 30% had undergone late resorption, resulting in a post-implantation loss of 75%. The researchers attributed these abortifacient effects to the presence of lupeol triterpene, plumericin, and sterol groups of phytochemicals in the ethanolic extracts of the leaves and roots of *P. acuminata*. These findings suggest that *P. acuminata* could be a potent candidate for natural abortifacient medicines. ⁽¹⁴⁾

Antiovarulatory and Anti-implantation: - The objective of this study was to investigate the anti-ovulatory and anti-implantation activities of the ethanolic extract from *P. acuminata* leaves and roots in Wistar rats. They used immature female rats to explore the anti-ovulatory characteristics of the plant by administering HCG as a standard ovulation-inducing drug. Mated female rats were used to study the anti-implantation characteristics of the plant, with Levonorgestrel and Ethinylestradiol administered as standard for anti-implantation activity. The acute oral toxicity test showed an LD50 value of 2000 mg/kg, which resulted in the selection of 100, 200, and 400 mg/kg dose values for both leaf and root extracts. Treatment with these doses resulted in changes of approximately 2-54%, 5-48%, and 1-68% respectively in the hormonal, growth factors, and cytokines profiles. The ovarian histology revealed restricted follicle maturation and ovulation, while the uterine histology revealed a decrease of approximately 5-28% in the endometrium thickness, making it unreceptive for implantation after treatment with PAL and PAR extracts. In conclusion, the anti-ovulatory and anti-implantation results obtained in this study can be attributed to the presence of plumericin, sterol, and triterpene groups of phytochemicals from the ethanolic extracts of leaves and roots. This makes them potential candidates for future studies on contraceptive medicines. ⁽¹⁷⁾

Antioxidant and Antitumor Activity: - The study aimed to investigate the effects of a crude methanol extract of *Plumeria acuminata* leaves on Ehrlich Ascites Carcinoma (EAC) in Swiss albino mice. The extract was administered at different doses for 14 days, and the antitumor activity and antioxidant properties were evaluated. The results showed that the extract significantly decreased packed cell volume, tumor volume, and viable count, while prolonging the life span of EAC-tumor bearing mice. Additionally, the extract was found to modulate lipid peroxidation and augment the antioxidant defense system in mice. The study shows that the methanol extract of *Plumeria acuminata* leaves had antitumor effects and could potentially use in cancer treatment. ⁽¹⁸⁾

Antidiabetic activity: - The aim was to assess the initial screening for natural chemicals and the in vitro antidiabetic potential of *Plumeria acuminata* leaves. Different solvents were used to extract the *Plumeria acuminata* leaves, and phytochemical tests were conducted for all extracts using standard protocols. The anti-diabetic activity of the ethyl acetate extract of *Plumeria acuminata* (MEPA) was assessed using the α -amylase inhibition assay. The percentage inhibition increased in a dose-dependent manner. This study concluded that *Plumeria acuminata* has significant in vitro anti-diabetic potential. Keywords: *Plumeria acuminata*, in vitro, antidiabetic, phytochemical screening, alpha amylase, dose-dependent. ⁽¹⁹⁾

Combination of antibacterial and antioxidant activity: - The study conducted by the researchers found that the Frangipani flower and Bitter Grape stem extract have antimicrobial and antioxidant properties when used individually. However, their combined effect has not been extensively researched. The study aimed to measure the inhibition of *Staphylococcus aureus* growth and DPPH free radicals by testing combinations of ethanol extracts of White Frangipani Flower (EFF) and Bitter Grape Stem (EBS) at concentrations of 0%, 1%, 2%, and 3%. The researchers used 200 mL of absolute ethanol to produce 3.17 g of EFF and 2.62 g of EBS from 100 g of dried powdered White Frangipani Flower and Bitter Grape Stem. The antimicrobial activity was tested using a 10% stock solution of extract diluted in water. The results showed that the combination of EFF and EBS had a synergistic effect on antimicrobial activity but an antagonistic effect on antioxidant activity. The combination of EFF 3% and EBS 3% exhibited the highest inhibition index on *S. aureus* growth, which was higher than the inhibition index of Amoxicillin 2%. On the other hand, 1% EFF alone exhibited the highest antioxidant activity, while the lowest was observed from the combination of EFF 1% and EBS 3%. ⁽²⁰⁾

Conclusion: -

It is quite evident from this review that *Plumeria acuminata* contains a number of phytoconstituents which reveals its uses for various therapeutic purposes. The Plant or its individual parts can be used as antidiabetic, Cytotoxicity and antimicrobial, anti-inflammatory, antipyretic and antinociceptive, Mutagenic, Abortification, Antifertility, antibacterial, Chronic toxicity, Antitumor, Anti ovulatory and Anti-implantation, antioxidant and free radical scavenging activity. More research is needed to isolate the constituents responsible for the biological actions. It was also observed that no clinical trials have been done so far. So, from the current review of literature, it was concluded that the plant is having high medicinal value. The traditional and ethnomedicinal literatures showed that the plant is very effective and safe for medicinal uses. By using the reverse pharmacological approaches in natural drug discovery, a potent and safe drug can be investigated from the plant for various chronic diseases.

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