**Phytochemical and Pharmacological activity of Genus Plumeria: An updated review**

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Abstract

Genus Plumeria (Apocynaceae) contain largely of shrubs or flowering trees which are grown throughout the tropical region including many parts of India. These plants are well known for their religious value, cosmetic importance and tremendous potential to be used as medicinal agents to cure infections, digestive diseases, anti-inflammatory and antipyretic action, anti-tumor potential, anti-oxidant properties etc. In this review article various established facts regarding species of *Plumeria* have been compiled. The article highlights the historical findings and present medicinal status of these plants with their potential to be used in the field of drug development in future.

**Keywords:** Plumeria, Herbal Drugs, Frangipani

1. Introduction

Since ancient times, plants have been an extensive source of medicine. Vast Research has been conducted in last few decades on the plants mentioned in ancient literature or used traditionally. Ornamental plants are grown for decorative purposes in gardens and landscape design projects, as house plants, for cut flowers and specimen display. Ornamentals and flowers crops are not only grown for the display of aesthetic features, but also have nutritive and medicinal properties. There has been renewed interest in utilizing garden environments having medicinal value, as therapeutic entities to enhance the process of healing that occurs in healthcare environments. The use of plant compounds for pharmaceutical purpose has gradually increased in India, about 80% of individuals from developed countries use traditional medicine, which involves compounds derived from medicinal plants¹. Flowering trees are now being exploited in the traditional medicine and their curative potentials are well documented.

Genus Plumeria L (Apocynaceae) is well known for topical trees or shrubs which are cultivated as ornamental plants. Various species of this genus are also known for their medicinal importance². Their medicinal properties are often due to their latex which is frequently drastic and corrosive. *P. acuminata, P. alba, P. rubra, P. lancifolia, P. drastic and P. phagidenica* are some of the species with medicinal utility. The plants of *Plumeria* species are used traditionally as purgatives, in rheumatism, asthma, piles, gonorrhea, blood disorders and tumors³.

1.1 Species of Plumeria-a brief overview:

*Plumeria* species are variable in many of their characteristics and numerous hybrids and varities have appeared during the years. Hence, while one author may recognize more than sixty species, another may reduce them all to seven or eight and claim that the rest are merely hybrids and varities⁴.

**Taxonomical classification of genus plumeria⁵:-**

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Plantae – Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subkingdom</td>
<td>Tracheobionta – Vascular plants</td>
</tr>
<tr>
<td>Superdivision</td>
<td>Spermatophyta – Seed plants</td>
</tr>
<tr>
<td>Division</td>
<td>Magnoliophyta – Flowering plants</td>
</tr>
<tr>
<td>Class</td>
<td>Magnoliopsida – Dicotyledons</td>
</tr>
<tr>
<td>Subclass</td>
<td>Asteridae</td>
</tr>
<tr>
<td>Order</td>
<td>Gentianales</td>
</tr>
<tr>
<td>Family</td>
<td>Apocynaceae – Dogbane family</td>
</tr>
<tr>
<td>Genus</td>
<td>Plumeria L – <em>plumeria</em></td>
</tr>
</tbody>
</table>

Each of the species of *Plumeria* bears alternate leaves with different shape, form and growth habits. The leaves of *P. alba* are quite narrow and corrugated while *P. pudica* bear elongated, glossy and dark green colored leaves. *P. pudica* have non-decidious and evergreen leaves. *P. obtuse* also retains leaves and flowers in winter. Plants produce white, yellow, pink or red flowers that range from two to four inches across. *Plumeria* species can be easily propagated from cuttings of leafless stem tips in spring. Tissue culture of cuttings of freshly elongated stems or aseptically germinated seed is also one of the good techniques for propagation of this genus. For deciduous varieties, pruning is best accomplished either in the winter or when cuttings are required. Here are some distinguishing characteristics of some of the medicinally important *Plumeria* species:-
i) *Plumeria obtusa* is a mainly evergreen tree bearing spreading branches and a rounded dome. Although the common name of the plant is "Singapore", but its origin is from Colombia. Its height ranges to 8m and circumference to 4m. Leaves are pointed and oval shaped up to the length of 18cm. During summer-autumn tubular fragrant bearing flowers occur.

ii) *Plumeria acuminata* is an evergreen or partly deciduous tree up to about 6 meters high. Its leaves are light green in color, elliptical in shape with acuminate tips, hence the name. The color of the flowers can vary from white to yellow.

iii) *Plumeria rubra* (*Plumeria acutifolia*) also known as the Common Frangipani is a native of Mexico, Central America, and Venezuela. It is a tree or shrub with a height of about 4m and spread to 4m and more in subtropical regions but can reach up to 10 meters in the tropical region. It produces fragrant yellow, red, orange and pink flowers with 5 spreading petals. Leaves are lance or oval shaped, and about 20cm to 30cm long. Leaves also have many different sizes shapes and colors.

iv) *Plumeria alba* is a small lacticiferous tree or shrub grows 4.5m high, occasionally grown in the gardens. The plant is mainly grown for its ornamental and fragrant flowers. Leaves lanceolate to oblanceolate,narrow and corrugated, flowers white, fragrant in corombose fascicles.

2. Geographical distribution:-

Trees and shrubs belonging to the genus *Plumeria* are native to New Zealand, Central America, Mexico, the Caribbean, and South America as far south as Brazil. *Pl. rubra* is native from Central America and the Caribbean. It is now common and naturalized in southern and southeastern Asia. *P. obtusa* is native from the Greater Antilles, northern Central America and southern Mexico. It is widely cultivated in tropical climates including eastern Africa, Asia, and Hawaii. *P. pudica* originates from Panama, Colombia and Venezuela. *P. rubra* has been widely cultivated in subtropical and tropical climates worldwide. It is mainly used as garden and park plant, as well as also useful in temples and cemeteries in many parts of India.

3. Historical background

Charles Plumier, a 17th Century French botanist coined the name, *Plumeria.* But Plumier was not the first to name *Plumeria.* Francisco de Mendoza, a Spanish priest was the first to give the name in 1522. When the *Plumeria* flowers were discovered, their natural perfume reminded people about the scented colors and so the flowers were named frangipani. Since then Species of *Plumeria* have been used extensively throughout the world, for their medicinal and ornamental value. However the period from early 19th century has been the era of extensive research with regard to extraction, isolation, structure elucidation and establishment of pharmacological activity of chemical constituents of plants of *Plumeria* species. Phytochemical studies on genus of *Plumeria* started as far back as 1870 when Peckolt and reported the isolation of the main iridoidglycoside Plumeride from the stem bark of *P. rubra* and *P. falcataria*.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Scientist</th>
<th>Contribution</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Garcia et. al.(1951)</td>
<td>Studied the bark of <em>P. alba</em> and reported that plumeride present to the extent of 2% is non-toxic, non-irritant to the conjunctiva and have no effect on respiration and circulation even after intravenous injection. The glycoside has no direct action on isolated uterine muscles and is ineffective against genous Staphylococcus. Its purgative action was confirmed in man. Its doses larger than 300 mg are associated with purgation and diarrhoea.</td>
<td><a href="http://www.ssjournals.com">www.ssjournals.com</a></td>
</tr>
<tr>
<td>2.</td>
<td>Hall and coworkers(1951)</td>
<td>Reported that plumericin is bactericidal in high concentrations</td>
<td><a href="http://www.ssjournals.com">www.ssjournals.com</a></td>
</tr>
<tr>
<td>3.</td>
<td>Little et. al.(1951)</td>
<td>Showed that plumericin is somewhat more active in fungals than in bacteria. It inhibits <em>Mycobacterium tuberculosis</em></td>
<td><a href="http://www.ssjournals.com">www.ssjournals.com</a></td>
</tr>
<tr>
<td>4.</td>
<td>Grunbach et al.(1952)</td>
<td>Reported that fulvoplumericin inhibits the growth of various strains of <em>Mycobacterium tuberculosis</em></td>
<td><a href="http://www.ssjournals.com">www.ssjournals.com</a></td>
</tr>
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<td>5.</td>
<td>Siddiqui et al.(1970)</td>
<td>Communicated the pharmacological study of leaves of <em>P. acutifolia</em>. The water soluble portion was a strong relaxant of the smooth muscles of isolated rabbit duodenum and isolated guinea pig p.-. It also relaxed the isolated rat uterine and antagonized the uterine contraction response of oxytocin &amp; acetylcholine.</td>
<td><a href="http://www.ssjournals.com">www.ssjournals.com</a></td>
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<td>6.</td>
<td>Harrison et. al. (1973)</td>
<td>Showed that plumeride has both gram+ve and gram –ve antibiotic activity but no cardiotoxic action on isolated guinea pig preparations</td>
<td><a href="http://www.ssjournals.com">www.ssjournals.com</a></td>
</tr>
<tr>
<td>7.</td>
<td>Ven Den Bergheert et al.(1973)</td>
<td>Found that the extracts of <em>P. rubra</em> are very effective against <em>Coxzeckia</em>, <em>Semliki forest</em> and <em>Polomyelitis</em></td>
<td><a href="http://www.ssjournals.com">www.ssjournals.com</a></td>
</tr>
<tr>
<td>8.</td>
<td>Adam et al.(1979)</td>
<td>Communicated that plumeride inhibits the gibberellic induced growth in dwarf peas, dwarf corn &amp; dwarf rice &amp; also have some inhibitory action on wheat seedlings</td>
<td><a href="http://www.ssjournals.com">www.ssjournals.com</a></td>
</tr>
<tr>
<td>10.</td>
<td>Coppenet et al.(1984)</td>
<td>Showed that isoplumericin, plumicin, plumieride, coumarate&amp;plumericedoucmulate glycoside have algicidal properties</td>
<td><a href="http://www.ssjournals.com">www.ssjournals.com</a></td>
</tr>
</tbody>
</table>
4. Chemical Constituents

Iridoid glycosides were the first medicinally active compounds isolated from the species of Plumeria. Subsequently the latex and oil of some of these species were found to have other medicinally active constituents like sterols, carbohydrates, tannins, triterpenoids and alkaloids. Similar constituents were subsequently isolated from various extracts of roots and aeral parts of these plants in varied compositions. Here is a brief view of bioactive chemical constituents of some of the Plumeria species:

1.1. Plumeria rubra: Bitter glycosides, plumieride, plumeric acid, β-sitosterol, lupeol, plumieride, amyrin and fulvoplumierin. Plumericin, isopomerin, 4-hydroxy acetophenone, plumieride, coumarylplumieride and protooplumericine are found to present in the bark of the plant. Flowers contain essential oil. Roots contain fulvoplumierin, plumericin and three new compounds— isopomerin, β-dihydropumierinic acid and β-dihydropumierinemic acid.

1.2. Plumeria alba: Plumeria alba possesses various bioactive constituents such as sterols, carbohydrates, tannins, triterpenoids and iridoids glycosides. The aerial part of the plant i.e. leaves stems are reported to contain steroids, flavonoids and alkaloids. The plant is reported to contain mixture of amyrins, β sitosterolcosip, iridoiddisopomerin, plumieride, plumeredeceroumatere and plumeredeceroumatereglucoside.

The fresh leaves and bark contain plumieride, resincic acid, and fulvoplumierin, a mixture of terpenoids, sterols and plumieride. Bark of the plant contains cytotoxic iridoids, fulvoplumierin, allamin, allamandin, 2,5-dimethoxy-p-benzoquinone, plumericin and lignanlirodinindrin. The root bark of Plumeria alba shows the presence of iridoids, tannins and alkaloids.

1.3. Plumeria acuminata: Active constituents like steroids, flavonoids, tannins, alkaloids and glycosides are present in Plumeria acuminata. During phytochemical studies of the genus Plumeria, the stigmas-7-enol, lupeol carboxylic acid, lupeol acetate and usorlic acid had been isolated from leaves. Peckolt and Boorsma has successfully isolated Fulvoplumierin, Plumericin along with three new compounds isopomerin, β-dihydropumierinic acid and β-dihydropumierinemic acid from roots of Plumeria acuminata. The steam distillate of Plumeria acuminata yields an essential oil (0.04-0.07 %) which mainly consists of primary alcohols, geraniol, citronellol, farnesol and phenylethylalcohol with little amount of aldehyde and ketones (6.8 %). These oils have acid value (20.2) and saponification value (125).

1.4. Plumeria obtusa: The aerial parts of P. obtusa contain pentacylic tripterpenoids namely kanesoride, oleandrin, α-amyrin, neriurcumarine acid, isomericumarine acid, alpholic acid, oleanic acid, methyl p-E-coumarate and scopoletin hitherto unreported from this source. Two new and threonineoid alkaloids have been isolated from the fresh, whole spring leaves of P. obtusa. The new iridoids have been characterized as 6'-O-acetylpumieride p-E-coumarate and 6'-O-acetylpumieride p-Z-coumarate, while the remaining compounds have been identified as plumieride, plumieride p-Z-coumarate and plumieride p-E-coumarate.

5. Some recent pharmacological activities

Different species of Plumeria are used for the cure of rheumatism, diarrhoea, blennorhea, venereal disease, leprosy, psychosis and diuresis etc. Plumeria species have also been investigated for isolation of irridoids and triterpenoids, which exhibited algicidal, antibacterial and cytotoxic activities.

5.1 Anti-inflammatory activity

The methanolic extract of Plumeria acuminata exhibited significant anti-inflammatory activity on carrageenan-induced edema in both acute and chronic experimental animal model (45). This was further confirmed by Sameer Rastogi et al. (46). A protease Plumerin-R was isolated from the latex of the plant P. rubra by acetone precipitation method and its anti-inflammatory activity was evaluated on carrageenan-induced paw edema in rats. Four hours after treatment, the reduction in carrageenan-induced rat paw edema by 20, 40 and 80 mg/kg body weight of Plumerin-R was 21.6, 33.8 and 48.8% respectively. In another study, saponin extract of P. rubra exhibited a significant reduction in rat’s paw inflammation (47).

The anti-inflammatory activity of a lupine alkaloid Plumieramine isolated from the root bark of P. acutifolia was investigated against the carrageenan-induced edema and cotton pellet granuloma in albino rats. A dose dependent anti-inflammatory response was observed that may be attributed to the early phase and late phase inflammatory action.

5.2 Antibacterial activity

Methanolic extract of leaves of P. acuminata was investigated for their in vitro anti-microbial activities by agar disc diffusion method. The extract inhibited both gram positive (Bacillus subtilis, Staphylococcus aureus and micrococcus luteus) and gram negative (Escherichia coli, Pseudomonas aeruginosa and salmonella typhimurium) microorganisms. The essential oils obtained from the flowers of three Malaysian species of Plumeria, namely P. rubra L., P. acutifolia Poir. and P. obtusa L. were analyzed by GC/MS and 27 components were identified. Seven components were separated and identified from P. rubra, 14 components from P. obtusa and 19 components from P. acutifolia. The major components found in all three species are 2-hydroxybenzoic acid phenylmethy ester and two alkane hydrocarbons (nanodencane and hencicosane). The antimicrobial properties of the essential oils (at 2 μl per disk) were determined using agar diffusion method using eight different strains microorganisms- Escherichia coli (Gram negative bacteria), Staphylococcus aureus and Bacillus cereus (Gram positive bacteria), Candida albicans and C. humicola (yeast), and Trichophytonmenagrophytes, T. rubrum and Microsporum canis (fungi). The broad spectrum inhibition was exhibited by the essential oil of P. obtusa. The extract inhibited all tested microorganisms except for E. coli. The largest inhibition zone was shown by the P. obtusa essential oil against C. humicola. In another study, n-hexane fraction of crude methanolic extract of P. rubra stem bark showed MICs of 13.5, 11.8, 8.5 and 16.9 mg mL⁻¹ and induced a maximum of 91.53, 92.84, 94.69 and 85.29% growth inhibition against S. aureus, E. cloacae, P. aeruginosa and S. marcescens. The essential oil obtained by hydrodistillation of aerial parts of P. alboh using clavenger apparatus possessed significant broad spectrum antimicrobial activity.

5.3 Antioxidant properties

Alloxan diabetic model in rats was used for evaluation of antioxidant and hypolipidemic activity of the flavone glycoside isolated from P. rubra L. The treatment showed a significant reduction in serum triglycerides level, while serum cholesterol and glucose were unaltered. The antioxidant activity of the drug was also confirmed through in vitro studies. In another study the antioxidant activity of methanolic extract of Plumeria acuminata was evaluated and it was found to be in a dose dependent manner.

5.4 Antipyreric Activity

Antipyreric effect of ethanolic extract of the leaf of P. rubra was investigated in an animal study. Pyrexia was induced by intraperitoneal administration of boiled milk at a dose 0.5 ml/kg body weight in albino rabbit. Subsequent intraperitoneal administration of ethanolic extract of the leaf of P. rubra at a dose 200mg/kg body weight significantly reduced the elevated body temperature of rabbit. The results were comparable to the standard anti-pyretic drug Aspirin.

Another study was designed to investigate the antipyretic and antinociceptive activity of methanol extract of P. acuminata leaves in several experimental models. A single oral administration of P. acuminata leaves extract at different doses (100, 250 and 500 mg kg⁻¹) showed significant reduction in brewer’s yeast induced hyperthermia in rats.

5.5 Antitumour activity

Anti tumour property of Plumeria swas known after the isolation of anti-tumor agents namely plumeric acid and methyl plumerate, from the leaves of P. acutifolia. In 2009 it was reported that an endophytic fungus Colletotrichum gloeosporioides isolated from P. acutifolia...
produce a diterpenoid compound namely taxol which possesses anticancer properties. Methanolic extract of *P. alba* leaves was also evaluated for antitumor using in-vitro cytotoxic and mean survival time, a decrease in the tumor volume and viable cell count in the DLA tumor hosts. The animals were observed for improvement in the haematological parameters following MPA treatment of the tumor bearing mice and it was observed that extract exhibited cytotoxicity in the in-vitro model. Extract showed activity by increasing the survival time, dead cell count haematological parameters and solid tumour mass was also significantly reduced.

Ethanol extract of *P. rubra* at the doses of 200 and 400 mg/kg were administered orally to Swiss albino mice and its anti tumor efficacy were compared with 5-Fluorouracil (20 mg/kg/day i.p.) for 9 days by determining the tumor volume, tumor cell in experimental animal models. Extract increased the life span of EAC treated mice and fractions obtained from the leaves of *Plumeria alba* L were performed using the protocols of ulcer induced by non-steroidal anti-inflammatory drugs, ethanol and pyrrolid ligation. The hydroalcohol extract (200 and 400 mg/kg), ethyl acetate and n-butanol fractions (100 and 200mg/kg, p.o.), respectively showed gastric ulcer healing effect in indomethacin-induced ulcer model. Both EPA and BPA showed gastric cytoprotective effect in ethanol-induced gastric ulcer and inhibited gastric secretion in pylorus ligated rats.

### 5.6 gastroprotective activity

The methanolic extract of *Plumeria obtusa* from the stem bark was evaluated for gastroprotective activity by pylorl ligation and indomethacin models. The extract showed activity due to reduction of gastric acid secretion, gastric cytoprotection and proton pump inhibition mechanism. Antiulcerogenic property of hydroalcoholic extract and fractions obtained from the leaves of *Plumeria alba* L were performed using the protocols of ulcer induced by non-steroidal anti-inflammatory drugs, ethanol and pylorl ligation. The hydroalcohol extract (200 and 400 mg/kg), ethyl acetate and n-butanol fractions (100 and 200mg/kg, p.o.), respectively showed gastric ulcer healing effect in indomethacin-induced ulcer model. Both EPA and BPA showed gastric cytoprotective effect in ethanol-induced gastric ulcer and inhibited gastric secretion in pylorus ligated rats.

### 5.7 antiarthritic activity

The anti-arritic potential of ethyl acetate and n-butanol fractions (100 and 200mg/kg, p.o.), respectively of hydroalcoholic extract from leaves of *P. rubra* were evaluated in vivo models of rodents by using formaldehyde-induced acute non-immunological and Freund’s Complete Adjuvant (PFA) induced chronic immunological arthritis in Sprague Dawley rats. Antiarthritic potential of fractions may be due to the protection of synovial membrane, vascular permeability, prevention of cartilage destruction.

### 5.8 Miscellaneous

Ursolic acid from the leaves, plumec acid from the latex and leaves and Fulvoplumerin from the bark of *P. rubra* possess local anesthetic, cardiotonic and becteriotatic activities respectively. *P. rubra* containing fulvoplumerin acts as inhibitors of human immunodeficiency virus type 1 (HIV) reverse transcriptase. Methanolic extract of *P. rubra* showed hepatoprotective action with paracetamol induced liver damage. The in vitro anti-parasitic activity of chloroform extract of *P. bicolor* and isoplumeric acid were tested against promastigote and amastigote forms of *Leishmanialvelli* using 96 well micro titerplates and showed activity with the IC50 of 21±2.2 and 14.6±1.6 μg/ml, respectively. Plumerin showed high activity with the IC50 of 3.1±0.12 and 1.4±0.03 μM whereas isoplumeric acid showed the IC50 of 7.2±0.08 μM and 4.1±0.02 μM against promastigote and amastigote forms, respectively. In a similar study Amelia P et al. isolated four isolates namely stigmast-7-enol, lupeol carboxylic acid, usolic acid and two others whose structures were not fully elucidated, from the ethanolic extract of the green leaves of *P. acuminata* which showed anti-mutagenic activity. The iodide, plumierin, isolated from *P. bicolor* has recently been reported for its anti-fertility activity.

### Table 3: Phytoconstituents isolated from *Plumeras* along with their pharmacological activity

<table>
<thead>
<tr>
<th>Phytoconstituents</th>
<th>Pharmacological activity</th>
<th>Species</th>
<th>Part used</th>
</tr>
</thead>
<tbody>
<tr>
<td>3α,27-Dihydroxyolean-29-ene, Kanavosil, Nericinocoumaric acid, Obustusin, Obtusinin, Obustusin,</td>
<td>Anti-bacterial activity</td>
<td><em>P. obtusa</em></td>
<td>Leaves, Stem and Bark</td>
</tr>
<tr>
<td>Rubrinol</td>
<td></td>
<td><em>P. rubra</em></td>
<td>Bark</td>
</tr>
<tr>
<td>Plumerin (1α,4β,5β,8α,13β)-Stigmast-3,27-dihydroxy-12-ene, (6a)-6-hydroxy-3-epi-oleanolic acid</td>
<td></td>
<td><em>P. rubra</em></td>
<td>Bark</td>
</tr>
<tr>
<td>Demehyoxylupadispumone, Uleine</td>
<td></td>
<td><em>P. rubra</em></td>
<td>Bark</td>
</tr>
<tr>
<td>3α,27-Dihydroxylucen-29-ene, 6a-6-hydroxy-3-epi-oleanolic acid</td>
<td></td>
<td><em>P. rubra</em></td>
<td>Bark</td>
</tr>
<tr>
<td>13-Deoxyplumeride, plumenoside, 8-hoplumideride, 13-O-Caffeoylplumeride</td>
<td></td>
<td><em>P. acutifolia</em></td>
<td>Leaves</td>
</tr>
<tr>
<td>Urs-12-ene-3-ene-(3β)-27-[(Z)-Feruloyloxy]-3,4-hydroxylurs-12-ene-28-oic acid</td>
<td>Anti-mutagenic activity</td>
<td><em>P. obtusa</em></td>
<td>Stem bark</td>
</tr>
<tr>
<td>Uvaol (4α,3β,28-di-epoxy-12-ene)</td>
<td></td>
<td><em>P. acutifolia</em></td>
<td>Leaves</td>
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<tr>
<td>Stem bark</td>
<td></td>
<td><em>P. acutifolia</em></td>
<td>Leaves</td>
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<tr>
<td>Uvaol (4α,3β,28-di-epoxy-12-ene)</td>
<td></td>
<td><em>P. acutifolia</em></td>
<td>Leaves</td>
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<td>(3α,27-Dihydroxylucen-29-ene, 6α-6-hydroxy-3-epi-oleanolic acid</td>
<td>Anti-microbial activity</td>
<td><em>P. rubra</em></td>
<td>Bark</td>
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<td>Smittast-7-ene-3-ol</td>
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<td><em>P. acutifolia</em></td>
<td>Leaves</td>
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<td>(3α)-Cyclotar-22-ene-3,25-diol</td>
<td></td>
<td><em>P. rubra</em></td>
<td>Leaves</td>
</tr>
<tr>
<td>Plumerin</td>
<td>Anti-inflammatory activity</td>
<td><em>P. rubra</em></td>
<td>Laxis</td>
</tr>
<tr>
<td>Allamcin, Allamandin, fulvoplumerin, allamycin, and allamandin, as well as 2,5-dimethoxy-p-benzoxquinone</td>
<td>Cytotoxic activity</td>
<td><em>P. rubra</em></td>
<td>Stem and bark</td>
</tr>
</tbody>
</table>

### 6. Conclusion

Our pharmaceutical industry is focused towards the expansion of new innovative/indigenous plant based drugs through examination of leads from traditional system of medicine. In recent years, traditional uses of natural compounds, especially of plant origin received much attention as they are well tested for their efficacy and generally believed to be safe for human use. It is best classical approach in the search of new molecules for management of various diseases. Plumeria species has wide scope to isolate various phytochemical constituent and evaluate their pharmacological screening to get better therapeutic value.

### References

Choudhary et al.