

# AN EXTENSIVE REVIEW ON THE GENUS PLUMERIA.

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## ABSTRACT

Medicinal plants exhibit significant importance in today's medicinal science and with the pandemic people's inclination towards plant-based medicines and herbal drugs have accentuated the overall importance of medicinal plants. Apocynaceae family is a plant family in which majority of the species have great medicinal properties and hold pharmacological importance. This review focuses on the phytochemical properties, anti-oxidant properties, pharmacological, antimicrobial and ethnomedicinal properties of five species of genus *Plumeria* namely, *Plumeria obtusa* Linn, *Plumeria alba* Linn, *Plumeria rubra* Linn, *Plumeria pudica* Jacq, *Plumeria acutifolia* Poir.

**KEYWORDS:** pharmacological, medicinal, antioxidant, phytochemical, antimicrobial.

## 1. INTRODUCTION

The medicinal applications of different plants involve the usage of these plants not only for treatment of diseases but also as the potential material for the maintenance of good health and conditions for primary healthcare as 2/3 of world's countries depend on the herbal medicines and many attributions to this are the better cultural acceptability, better compatibility and adaptability with human body and the lesser risk of the side effects [1]. So for the treatment of diseases, for discovery of new drugs and for the large proportion of the world's population, medicinal plants continue to show dominant role in the healthcare system and for this the developing countries are responsible where the medicines have continuous history of long use. All the medicinal properties of the plants are due to the phytochemicals and bio compounds present in the plant. Ayurveda, the ancient Indian scripture has been serving as a source for indigenous plant-based drugs, medicines and their applications for the treatment of vast array of diseases. In the traditional Ayurvedic system the greater part of the medicines and drugs are totally dependent on the herbal origins. In recent years also, the interest in medicinal plants has been greatly increased, more so after the pandemic. With numerous characteristics and varieties of hybrids, *Plumeria* species are variable, thus many varieties have appeared over the years. Hence one may recognize more than 60 species, another may reduce them to eight or nine and claim the rest to be hybrids or varieties in traditional system of medicine in India, different species belonging to genus *Plumeria* are being used for many purposes such as a cure for itching, bronchitis, bleeding, fever, asthma, piles, dysentery, blood disorders, diarrhea and tumors [2].

Taxonomical classification of genus *Plumeria* [3].

<b>Kingdom:</b>	Plantae
<b>Subkingdom:</b>	Tracheobionta
<b>Super division:</b>	Spermatophyta
<b>Division:</b>	Magnoliophyta
<b>Class:</b>	Magnoliopsida
<b>Sub class:</b>	Asteridae
<b>Order:</b>	Gentianales
<b>Family:</b>	Apocynaceae
<b>Genus:</b>	<i>Plumeria</i>

### General information about the plants

1. *Plumeria obtusa*: *Plumeria obtusa* Linn is a deciduous, ornamental, tropical plant grown in premises, parks, gardens, graveyards, because of its attractive and fragrant flowers. The different parts of the plant are used to treat various diseases such as diabetes mellitus, wounds and skin diseases also, it is used as purgative, abortion and it is also used in cosmetics, aromatherapy and different other applications [4].
2. *Plumeria alba*: *Plumeria alba* Linn commonly called as white Champa is a small lactiferous tree or shrub. It is native of tropical America. It is having the height of 4.5 meters and it is grown in gardens. The plant is mainly grown for its ornamental and fragrant flowers. *Plumeria alba* is used in the treatment of ulcers, scabies, herpes and the seeds contain hemostatic properties [5].
3. *Plumeria rubra*: *Plumeria rubra* Linn is a deciduous, commonly ornamental, tropical plant grown in the home premises, parks, graveyards, gardens because of its beautiful and attractive flowers of different colors and sizes. The various parts of plant are used traditionally to treat various diseases and conditions such as inflammation, diabetic mellitus, ulcers, wounds, leprosy, itching, acne, toothache, pain asthma, constipation, infertility [4].
4. *Plumeria pudica*: *Plumeria pudica* Jacq is commonly known as Nag Champa is a fast growing, medium sized tree. The plant attains the height of around 5 to 6 feet with many branches on upper part. The plant is used to treat rheumatism, diarrhea, blenorhea, venereal disease, leprosy, psychosis and diuresis [6].
5. *Plumeria acutifolia*: *Plumeria acutifolia* Poir is an ornamental plant, used in traditional medicine and known to have a variety of constituents as alkaloids, flavonoids, iridoids. Extracts of these plants are proved to be having antimicrobial and anticancer activities [7].

## 2.PHYTOCHEMICALS FOUND IN DIFFERENT SPECIES OF GENUS PLUMERIA

The different extracts of various species of genus *Plumeria* are analysed for the presence of various phytochemicals such as alkaloids, glycosides, terpenoids, flavonoids, reducing sugars, saponins, tannins, carbonyls, phlobatannins and steroids.

### *Plumeria obtusa*

➤ The phytochemical screening conducted by [8] showcased that the leaves of *P. obtusa* contains alkaloids, steroids, cardiac glycosides, saponins, terpenoids, tannins, coumarin, phenols, anthocyanins, quinones and volatile oils. Whereas the flowers of *P. obtusa* contained alkaloids, steroids, cardiac glycosides, saponins, terpenoids, tannins, coumarin, phenols, anthocyanins, quinones, anthraquinones, fatty acids and proteins. Also, it was concluded by [4] that the stem bark of *P. obtusa* contained terpenoids, steroids, fatty acid esters, cardenolide. This concludes that *P. obtusa* exhibit excellent phytochemical potency.

### *Plumeria alba*

➤ With the help of gas chromatography mass spectrometry (GC-MS) and phytochemical screening assays the phytochemical constituents of *Plumeria alba* flower were investigated by [9]. The phytochemical screening of dichloromethane, hexane, butanol, ethyl acetate and aqueous extracts of *P. alba* flowers showed various concentrations of saponins, flavonoids, tannins, steroids, phenolic compounds and volatile oils. The preliminary phytochemical screening carried out on methanolic extracts of leaves of *P. alba* by [10] showed the presence of alkaloid, cardiac glycosides, reducing sugar, saponin, flavonoids, tannins and terpenoids. The stem bark of *P. alba* contains alkaloids, carbohydrates, flavonoids, phenolic compounds and tannins [11].

### *Plumeria rubra*

➤ Phytochemical screening of methanolic extracts of flowers and leaves of *P. rubra* done by [12] showed the presence of tannins, flavonoids, terpenoids, reducing sugars, alkaloids in the flower extracts and presence of tannins, phlobatannins, saponins, flavonoids, steroids, terpenoids, reducing sugars, carbonyl and alkaloids in the leaf extract.

### *Plumeria pudica*

➤ The preliminary phytochemical analysis for the presence of the overall phytochemicals present in the chloroform and methanolic leaf extracts of the *Plumeria pudica* plant by [13] showed the presence of alkaloids, carbohydrates, glycosides, proteins, phenolics and tannins, flavonoids, saponins, fixed oils and fats, steroids, cardiac glycosides, terpenoids.

### *Plumeria acutifolia*

➤ The phytochemical analysis conducted by [14] indicated the presence of carbohydrates, alkaloid, glycoside, phenolics and tannins, flavonoid, proteins and amino acids in the various extracts of the stem bark.

➤ The study for phytochemicals present in the ethanolic extract of the root bark of *P. acutifolia* by [15] showed the presence of carbohydrate, glycosides, saponins, tannins, steroids, triterpenoids.



### 3. ANTI-OXIDANT ACTIVITY OF DIFFERENT SPECIES OF GENUS PLUMERIA

Free radicals are unstable atoms that are naturally formed during metabolism or by exposure to environmental toxins. Free radicals can damage cells, cause diseases and accelerate aging and cause oxidative stress. Thus, the plant extracts are evaluated for their antioxidant potentials and one of the antioxidant assays is DPPH assay which is dependent on the scavenging capacity of antioxidants towards it.

#### *Plumeria obtusa*

➤ The studies of [16] concluded that when the leaf extract and fractions of *P. obtusa* were subjected to anti-oxidant analysis in spectrophotometer the absorbance of the organic upper layer was around 532 nm which showed moderate anti-oxidant activity.

#### *Plumeria alba*

➤ The studies of [17] for the anti-oxidant activity of *P. alba* illustrated that all the petroleum ether, methanolic and chloroform extracts of the leaves are effective free radical inhibitor or scavenger. The methanolic extract of leaves demonstrated the most active free radical scavenging potential followed by chloroform and petroleum ether extracts. Thus, this study concluded excellent in vitro free radical scavenging activity of *P. alba* leaves against DPPH. But further studies are needed to be made to evaluate the true potential of this plant for the anti-oxidant activity.

➤ [18] have reported that the white firangipani (*P. alba*) exhibit the antioxidant activity by testing the antioxidant potential of the ethanolic and acetic acid extract of the flower of *P. alba*. The ethanolic extract showed 18.19% antioxidant activity against DPPH, and the acetic acid extract showed 12.74% of its antioxidant activity. The antioxidant capacity of the flowers of *P. alba* are due to the presence of vitamin C.

#### *Plumeria rubra*

➤ With the help of two methods namely FRAP and DPPH assays [19,20] have conducted the evaluations of the anti-oxidant potential of *Plumeria rubra* flower extracts. Antioxidant activity test with DPPH method illustrated the excellent antioxidant activity was found in *P. rubra* flowers with an IC<sub>50</sub> value of 150,20 ppm while in the FRAP method the *P. rubra* flower extract showed the antioxidant activity value of 79.75 mg AAE/g extract. The most flavonoid content was found in the extract of leaves of *P. rubra* with 117.83 mg quercetin equivalent/g extract, while the most phenolic content found in the extract of flower of *P. rubra* are found to be about 108.85 mg gallic acid equivalent/g extract. The antioxidant activity in *P. rubra* leaves is due to flavonoid compounds while in *P. rubra* flowers is due to phenolic compounds.

#### *Plumeria pudica*

➤ The antioxidant activity of *Plumeria pudica* leaf extract was tested by [13] with radical scavenging activity by DPPH assay. The results showed moderate antioxidant activity by the leaf extract as the IC<sub>50</sub> value of the standard ascorbic acid was found to be around 133.422±0.464 µg/mL and the IC<sub>50</sub> value of the plant extract was evaluated to be 491.124±1.97 µg/mL (The IC<sub>50</sub> shows the concentration of the sample required to inhibit 50% of the free radicals. If this value is low; the antioxidant activity of the extract is said to be high).

**Plumeria acutifolia**

➤ *P. acutifolia* samples were evaluated by [7] for their antioxidant activities on the basis of the scavenging of DPPH free radical. The prepared concentrations of each fraction were 250, 500, 1000, 1500, 2000 and 2500 µg/mL. Also, the antioxidant evaluations of leaf extracts of *P. acutifolia* done by [21] showed the activity of 0.55 mg quercetin/g extract in nitric oxide scavenging assay, 2.20 mg ascorbic acid/g extract, 2.30 mg EDTA/g extract in metal chelating assay and 28.5 mg ascorbic acid/g extract in the phosphomolybdenum antioxidant assay.

**4.PHARMACOLOGICAL APPLICATIONS OF DIFERENT SPECIES OF GENUS PLUMERIA**

Different plants of genus *Plumeria* exhibit great importance as they contain ethnomedicinal, pharmacological and antimicrobial applications. Tables below illustrate various applications of selected five species of genus *Plumeria*.

**Plumeria obtusa**

Pharmacological activity	Part	Result	Reference
Ethnomedicinal uses	Plant	In South Africa it is used to treat diabetes mellitus.	[22]
		In Asia its latex and bark are used as diuretic and purgative.	[23]
		In Thailand the decoction of wood of this plant is used to treat leprosy and ulcers and also in Thailand its essential oils are being used for cosmetics and aromatherapy applications.	[24]
	Leaves	In Indonesia the leaves sap is used to treat Herpes zoster boils and toothaches.	[25]
Anti-inflammatory activity	Bark	The activity of 400mg/kg showed good anti-inflammatory potential.	[26]
Antiproliferative activity	Leaves	There was inhibition of MCF-7 by the hexane extracts of leaves and the HeLa cells were	[23]



	<p>Stem bark</p>	<p>Different parts of plant are believed to be useful in the treatment of various diseases such as malaria, leprosy, abdominal tumors and rheumatism. The sap of leaf and stem is used to treat skin diseases such as herpes, scabies, ulcers etc.</p> <p>The bark of this plant is used as plaster on hard tumors and the latex is used as diuretic, purgative, hypotensive, cardiotoxic.</p> <p>The stem bark has been used in traditional medication to treat malaria in Ghana. Also, the fragrant smell of this plant has been used as aromatherapy. This smell comes from essential oils having high value in cosmetics industry. And it has been reported that the essential oil of this plant can be used as anti-repellant.</p>	<p>[33]</p> <p>[34]</p>
<p>Agent for metabolic and degenerative diseases</p>	<p>Leaves</p> <p>Flowers</p>	<p>Hydroalcoholic extracts from leaves tested to show potency to be used as antiarthritic agent.</p> <p>Anti-cholesterol assay of the extracts of flower showed 52% activity and were proven to be potent hypolipidemic agent.</p>	<p>[35]</p> <p>[36]</p>
<p>Anti-tumor activity</p>	<p>Leaves</p>	<p>Methanolic leaf extract of plant exhibit cytotoxic activity against Ehrlich ascites carcinoma (EAC) and Dalton lymphoma ascites (DLA).</p>	<p>[37]</p>



Anti-diabetic activity	Root	Total extracts and fractions of <i>P. alba</i> exhibit antidiabetic and hypolipidemic properties in streptozotocin induced diabetic animals.	[38]
Anti-malarial activity	Stem bark	Antiplasmodial and the survival time enhancing activity concentrated in the n-hexane and ethyl acetate with butanol partitioned fractions of the extracts of stem bark confirmed antimalarial potential.	[20]
Antimicrobial activity	Flower	Antibacterial activity against <i>E. coli</i> , <i>P. vulgaris</i> , <i>S. aureus</i> , <i>Klebsiella pneumoniae</i> , <i>P. aeruginosa</i> , <i>S. saprophyticus</i> , <i>Enterococcus faecalis</i> .	[39]
	Essential oils of flower	Flower extract was tested for minimum inhibitory concentration (MIC) against <i>Candida albicans</i> , <i>A. niger</i> , <i>Oenocillium chrysogenum</i> , <i>Ralstonia entrophia</i> and the extract was found to be fungistatic in its action.	[40]

Table 2. various applications of *Plumeria alba*

***Plumeria rubra***

Pharmacological activity	Part	Result	Reference
Hepatoprotective activity	Flower pod	The alcoholic pod extract of <i>P. rubra</i> at 200mg/kg and 100mg/kg possess significant hepatoprotective activity.	[41]
Anti-pyretic activity	leaves	A dose of 200mg/kg of ethanolic extract significantly reduced the elevated temperature of rabbit	[42]



		which is comparable to drug Aspirin.	
Anti-inflammatory activity	Leaves	The dose of 200mg/kg of saponin extract of <i>P. rubra</i> leaves showed a significant reduction in the volume of inflammation.	[43]
Anthelmintic activity	leaves	25mg/ml concentration of leaf extract showed significant anthelmintic effect.	[43]
Anti-cancer activity	leaves	The dose of 200mg/kg showed anti-cancer activity of ethanolic extracts of leaves of <i>P. rubra</i> against Ehrlich Ascites Carcinoma (EAC).	[44]
Analgesic activity	Whole plant	The acetic acid extract of the plant produced significant writhing inhibition at the dose of 500mg/kg-body.	[43]
Anti-viral activity	Plant	<i>P. rubra</i> contains fulvoplumierin which acts as inhibitor for human immunodeficiency virus type (HIV)	[45]
Anti-microbial activity	Flower	Methanolic extract of flower showed inhibition of growth of 14 indicator bacteria with zone of inhibition between 12-28mm.	[12]
	Leaves	Methanolic extract of leaves showed significant activity against several bacterial species. And the aqueous extract was active against fungal strains as compared with standard Fluconazole.	[46]
Anti-viral activity	Plant	<i>P. rubra</i> contains fluvoplumerin which acts as inhibitors of human immunodeficiency virus type 1 (HIV) reversal transcriptase.	[45]

Table 3. various applications of *Plumeria rubra*.

*Plumeria pudica*

Pharmacological activity	Part	Result	Reference
Ethnomedicinal uses	Plant	<i>Plumeria pudica</i> Jacq has been described in the old literacy texts as laxative, anti-allergic, carminative and also for possessing anti-inflammatory, cytotoxic, anti-microbial, anti-ulcer, diuretic activity and also for the treatment of ulcer and ascites.	[47]
Anti-inflammatory activity	Latex	Different doses of latex were able to reduce the paw edema induced by carrageen in a dose dependent manner which showed moderate anti-inflammatory activity.	[48]
Antidiarrheal activity	Latex	Different doses of <i>P. pudica</i> latex significantly inhibited the percentage of diarrheal stools induced by castor oil.	[49]
Antileishmanial activity	Leaves	The petroleum ether, chloroform and methanolic extracts evaluated against <i>Leishmania donovani</i> showed the inhibition of growth of <i>L. donovani</i> .	[50]
Inhibition of Pancreatic lipase activity	Leaves	The plant extract of <i>P. pudica</i> analysed for the inhibitory activity showed the plant source acting as the inhibitor of lipase, by enzyme assay performed at different stages.	[51]
Treatment of Gynecological disorders	Leaves	The lead extract of <i>P. pudica</i> have optimum anti <i>Candida</i> activity and may be used for the treatment of gynecological disorders.	[52]

Antimicrobial activity	Leaves	The ethyl acetate extract of <i>P. pudica</i> showed highest inhibition zones in <i>Escherichia coli</i> (MTCC 739).	[53]
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Table 4. various applications of *Plumeria pudica*.

***Plumeria acutifolia***

Pharmacological activity	Part	Result	Reference
Ethnomedicinal uses	Plant	The plant <i>Plumeria acutifolia</i> has been mentioned in ancient literature as anti-inflammatory, anti-allergic, diuretic, carminative, laxative, anti-ulcer, and useful in treating leprosy and ascites, and possess cytotoxic activity and anti-microbial activity.	[54]
Anti-anaphylactic activity	Root bark	Due to the presence of different inflammatory mediators, the Plumerianine compound present in root bark extract showed Anti-anaphylactic activity.	[55]
Antimicrobial activity	Stem bark	The ethyl acetate fraction was active against <i>Syncephalastrum racemosum</i> and <i>Escherichia coli</i> .	[7]
	latex	The latex of <i>P. acutifolia</i> showed antifungal properties against <i>Acremonium kiliense</i> , <i>Myrothecium roridum</i> , <i>Penicillium expansum</i> and <i>Rhizoctonia solani</i> .	[56]

Table 5. various applications of *Plumeria acutifolia*.

## 5.CONCLUSION

As illustrated in the above review different species of plants belonging to family Apocynaceae exhibit great medicinal and pharmacological importance. Various phytochemicals and bio compounds present in the various plants of Apocynaceae family. Thus, the plants of this family are known to have various ethnomedicinal, pharmacological applications and are used for their ornamental values for over centuries. But much research is needed to be done regarding finding out the greater potential of these plants. And those discoveries will pave the way for the enhanced uses of plant-based drugs and increase in the usage of plant materials in the pharmaceutical and medical industries.

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