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Review

An Overview Of The Marvelous Plant: *Caesalpinia Pulcherrima*

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Abstract

The majority of people on earth, particularly those in developing nations, are dependent on the traditional medicine for the management of a variety of illnesses. The present article works on the overview of the most attractive plant *Caesalpinia pulcherrima* which is also known as "Peacock plant" or "Barbados Pride" and "Mayil Kondrai" in Tamil. The variety of blooms of *Caesalpinia pulcherrima L*. Swartz, which include yellow, pink, off white and red with yellow edges, make it an ornamental plant. The *Caesalpinia pulcherrima* tree, which belongs to the Caesalpiniaceae family or Fabaceae family, is a tiny, prickly tree that is 6–9 meters tall as well as 15–25 cm in size, widely distributed in tropics. It has a number of therapeutic uses, including treating cholera, ulcers, fever, tumours, asthma, and abortion; encouraging menstruation; acting as a purgative, or watery evacuation of the bowels; generating energy; relieving chest pains; curing bronchitis; treating malarial fevers and so on. Pharmacologically, the plant has been reported to possess antimicrobial, analgesic, anti-inflammatory activity, antioxidant activity, anthelmintic, antiulcer, cytotoxic, antioxidant, antiviral, anticancer, antidiabetic, immunosuppressive, antimicrobial activities and Vaso relaxing effect. Numerous Phyto active components, including glycosides, rotenoids, benzoic acid, tannins and hydrocyanic acid, isoflavones, flavanones, chalcones, flavanols, flavones and sterols, have been found in *Caesalpinia pulcherrima.*

Keywords: Peacock plant, Mayil Kondrai, Antioxidant, flavanones.

INTRODUCTION

When it comes to the usage of medicinal herbs, India has one of the richest, oldest, and most varied cultural traditions.[1] The majority of people on Earth rely on traditional medicine to treat a variety of illnesses, particularly those who come from developing nations. Thousands of plant species are used medicinally, mostly as herbal preparations in various indigenous medical systems around the world.

These plant sources provide safe, affordable, and potent drugs that have remained popular, successful, and effective for a long time, with many of them remaining unreplaced by modern chemistry. Although many

medical substances found in plants are presumed to be safe, many may also be hazardous. Pharmaceutical businesses and scientists have noticed a notable increase of interest in natural products as possible sources for novel medications in recent times.[2] Numerous components found in plants used in traditional medicine can be employed to treat both widespread and chronic illnesses. The chemical components of plants that have a specific physiological effect on humans are what give them their therapeutic worth.

Among these plant bioactive substances, alkaloids, flavonoids, tannins, and phenolic compounds are the most significant.[3] For thousands of years, people have used plants as therapeutic agents and still depend on them for medical care. An estimated 80% of people on earth receive their primary medical care from plants or their active ingredients, according to WHO estimates.[4] The Fabaceae family's *Caesalpinia pulcherrima*, sometimes known as "Barbados Pride" or “Peacock flower”, is a traditional native medicinal plant.[5] *Caesalpinia pulcherrima*, which equates to "very pretty". [6] The genus Caesalpinia possesses the name of Andreas Caesalpini, a physician, philosopher and botanist who lived in the 16th century. Pulcher, the Latin name of the plant, implies beauty. The blooms bloom in late summer and fall in regions that experience frost. Fruits that resemble pods emerge after flowering. The pods crack open to release the tiny seeds as they ripen. If consumed, the harmful tannic acid found in the seeds may cause gastrointestinal distress.[7]

There are around 500 species in the Caesalpinia genus, and these species' pharmacological activity suggests that they have numerous health advantages. Africa and Asia eventually became home to *Caesalpinia pulcherrima* (L) Swartz, which was first discovered in America. It's a commonly planted decorative plant in Indonesia. It's also widely utilised in Indonesian traditional medicine. In Mexico, *C. pulcherrima* (L) fruit and root sections are utilised as complementary therapies for oral and dental conditions.[8] Originating from South America, this plant is also grown as an ornamental in India. The tree is only 3.7–4.3 meters tall. Its bark is grey in hue, and there are few prickles on the branches. The leaves are abruptly bipinnate, with 13–20 pairs of 1.3–1.9 cm long leaflets. Yellow or red flowers provide a pleasant scent.[9] The primary group of visitors to *C. pulcherrima* flowers were butterflies.[10]

In addition to being used to treat kidney stones, asthma, bronchitis, and malaria, it is also used as an emmenagogue, purgative, stimulant, and abortifacient.[11] People call it as Patag. The tree is grown in gardens for its huge panicles of yellow blooms, but it also grows wild in mountains.

C. pulcherrima is a tree that was once grown in South-East Asia for its heartwood, which is used to make red dye that is sold in Tamil Nadu. West Bengal, Kerala, Karnataka, and Andra Pradesh. *C. pulcherrima* has complex leaves that have small prickles and 8–12 pairs of oblong leaflets. Flowers have yellow terminal and axillary panicles and the fruits are woody pods that are somewhat compressed and have a short, hard beak that recurved. Three to four yellowish-brown seeds.[12]

Fig 1: Represents the whole plant of *Caesalpinia pulcherrima*.[7]

Synonyms

- Guleture plant.[4]
- Dwarf gul- Mohor.[13]
- Mayil Kondrai.[14]
- Barbados Pride.[15]
- Pride of Barbados.[16]
- Dwarf Poinciana.[17]
- Peacock plant.[18]
- Paradise Flower.[19]

- Red bird of Paradise.[20]
- Flower Fence.[21]
- Flamboyant tree.[21]
- Gold Mohur.[21]
- Mexican bird of Paradise.[22]
- Flos Pavonis.[22]
- Poinciana.[23]
- Flamboyant-de-jardin.[23]

Common Names

Tamil	:	Mayirkonrai
Hindi	:	guletura, gulutura
Malayalam	:	Settimandaram
Telugu	:	Pamiditangedu
Manipuri	:	Krishnachura
Gujarathi	:	Sankasur
Kannada	:	Kenjigaegidda
Oriya	:	Krishnochuda
Bengali	:	Krishnachura
Sanskrit	:	Ratnagandhi [24]

Family

It belongs to Fabaceae family [25] or Caesalpiniaceae family.[11]

Biological Source

It is obtained from the dried or fresh leaves of Caesalpinia species (i.e. *Caesalpinia pulcherrima*)

Taxonomic Tree

Table 1: represents the Taxonomic tree of *Caesalpinia pulcherrima.* [26]

Domain:	Eukaryote	Order:	Fabales
Kingdom:	Plantae	Family :	Fabaceae
Phylum:	Spermatophyta	Subfamily:	Caesalpinioideae
Subphylum:	Angiospermae	Genus:	Caesalpinia
Class:	Dicotyledonae	Species:	*Caesalpinia pulcherrima*

Distribution

Caesalpinia pulcherrima (Fabaceae) is native to tropics and subtropics area of the Americas. This plant is widely distributed in Bangladesh and India. It is a common medicinal plant in India, Taiwan and south East Asian and African countries.[27] *C. pulcherrima* is distributed in Tamil Nadu, Kerala, Karnataka, Andra Pradesh and West Bengal.[28] Dwarf Poinciana is thought to originate from Asia and West Indies and it stretches to the tropics. However, this is believed to originate from the tropics and subtropics of America. However, the exact origin of the plant could not be traced since it is widely spread.[17]

Description

Caesalpinia pulcherrima (Caesalpiniaceae) is a small thorny tree, 6-9m in height and 15-25 cm in diameter with a few prickly branches.[28] The leaves are bi pinnate, 20-40 cm long, bearing 3 10 pairs of pinnae, each with 6-10 pairs of leaflets 15 25 mm long and 10-15 mm broad. Each flower has five yellow, orange, or red petals and is carried in racemes up to 20 cm long. The fruit is a pod6-12 cm long. Flowers are red or yellow, fragrant.[29] It is an ever-green shrub growing to 3 m tall. Tropical gardens frequently cultivate this eye-catching decorative shrub.[1] Large cluster of flowers appear on the tips of every branch. The flowers have a bowl shape, and each one opens with a beautiful yellow border before becoming orange on the second day. Although pink and yellow are also available, red-orange is the most popular colour. There are ten long thread like bright red stamens that extend away beyond corolla. The fruits, typical legumes are flat and when ripe they split open noisily to expose the little brown beans.[25]

Table 2: represents the description of different parts of *Caesalpinia pulcherrima.* [21]

Growth Form	**Upright shrub, occasionally small tree, with a height of 3–6 m and a width of 2–4 m.**
Foliage	Small, oblong leaflets on bipinnate leaves
Stems	As the stems get woodier and covered in spines, they transition from green to greyish brown and eventually swell at the base.
Flowers	Combination of orange, yellow, and red; scentless; pistil and long stamens. Flowers are produced in terminal clusters, with one modified petal that is smaller than the other four.
Fruit	Thin, oblong, flat pod that can grow up to 10 cm in length.
Cultivation	This lovely shrub bears flowers all year long. Hard pruning is advised once a year to maintain the plant's vitality. An excessive amount of shade inhibits a plant's capacity to blossom. Seeds are an easy way to proliferate it.

Vegetative Characters

Table 3: Represents vegetative characteristics of *Caesalpinia pulcherrima*

Root	Tap root and branched.	
Stem	1. Erect 2. Woody 3. Herbaceous 4. Cylindrical 5. Branched 6. Glabrous 7. Covered with prickles and spines.	
Leaf	1. Compound 2. Petiolate 3. Alternate 4. Stipulate 5. Leaf base pulvinate	

Fruit	1. Fruit colour: Cream/Tan green 2. Fruit length: > 3 inches 3. Fruit type: Legume 4. Fruit width: < 1 inch 5. Display/ Harvest time: Fall	
Seed	1. Non- endospermic 2. Exalbuminous.	
Flower	1. Flower colour: Gold/ yellow orange red/ Burgundy. 2. Flower inflorescence: Raceme. 3. Flower shape: Cup. 4. Flower value to Gardener: Showy. 5. Flower Bloom Time: Summer. 6. Flower size: 1-3 inches. 7. Flower description: They have bright orangish-yellow petals with 10 prominent 6-inch-long bright red stamens. The blooms are 2-3 inches diameter and come in racemes or clusters of 4-10 inches. Each raceme, which grows on the terminal of the branch, can have up to 40 flowers. 8. Flower petals: 4-5 petals/ rays	

Floral parts

Table 4: Represents the floral parts of *Caesalpinia pulcherrima.*[30]

Calyx	1. Sepals 5 – Polysepalous. 2. Odd sepals – Larger, hooded and anterior in position. 3. Imbricate aestivation. 4. In Tamarindus the two posterior sepals are united. 5. Yellow in colour. 6. Often petaloid	

Corolla	1. Petals 5 – Polypetalous 2. Ascendingly imbricate aestivation. 3. Odd petal – Smaller, clawed and posterior in position. 4. Petals ate absent in Saaca. 5. In Tamarindus there are only three posterior petals.	
Androecium	1. Stamens 10, rarely connate. 2. Anthers- dithecous, two celled, basifixed. 3. Filaments are free and unequal. 4. Dehisce by longitudinal slits o by pores 5. Introrse. 6. Reduction in number of stamens by the formation of staminodes. 7. Tamatindus only 3 stamens and monadelphous.	
Gynoecium	1. Monocarpellary 2. Overy superior or slightly inferior. 3. Ovary – Unilocular. 4. Marginal placentation. 5. Straight or curved. 6. Style long. 7. Stigma simple Capitate.	

Cultivation

Fig 2: The germination and cultivation of *Caesalpinia pulcherrima*

Flowering season of this plant starts from September to November and fruits from March to April.[11] As it is a perennial shrub, it can be planted once and seeds can be collected throughout the year. A proper land area and proper cultivation procedure will result in better yield of seeds.[17]

The tree is grown in gardens for its huge panicles of yellow blooms, but it also grows wild in mountains. The tree was formerly cultivated in South-East Asia for the red dye, obtained from its heartwood.[28] This shrub is one of the most popular summer bloomers. From May through August this tropical looking shrub produces loads of spectacular flower clusters.[31]

Although full sun is preferred for peacock flowers to bloom, they can be planted in partial shade or full sun. Give *C. pulcherrima* as much sunlight as possible; the more it receives, more beautiful the blossoms will be. It will grow gently and not flower nearly as much in full shade. Planting in soil with a sandy texture is the best

way to ensure that the soil drains well, which is crucial for the peacock flower to flourish without developing root rot.[32]

Use a file to scarify seeds so that water can get inside. To improve germination rates, soak seeds in warm water overnight. Plant seeds in potting mix that drains properly, half an inch to a quarter of an inch deep. If necessary, perlite can be added to regular seed starting mix to improve drainage, but our recommended approach is to use an equal mixture of perlite and cactus compost. Keep the growing medium moist but not soggy and if you have a heat pad, place it in a bright area. Although it can take a little longer, germination takes one to two weeks. The seedlings can be repotted after they have produced their second pair of genuine leaves.[33] Flowering season of this plant starts from September to November and fruits from March to April.[11]

Pollination by Insects

Attraction: Insects like bees and butterflies find the Pride of Barbados plant's vibrant, colourful blossoms very appealing. The flowers' colourful petals and delicious nectar draw these insects to them.

Landing: An insect inadvertent the plant's reproductive organ, such as the stigma and stamen, when it lands on the flower. The female reproductive organ that receives the pollen is called the ovary, or stigma, and the male reproductive organ that produces it is called the stamen.

Pollen transfer: The insect may pick up pollen grains from the stamen as it travels around the flower in search of nectar. Some of the pollen grains may be moved from the insect's body to the stigma of another Pride of Barbados flower when it visits that bloom. Pollination is the process by which pollen is transferred from one bloom to another.

Fertilisation: The pollen germinates and develops a tube known as a pollen tube once it reaches the stigma. The style, the tube that connects the ovary and stigma, is where the pollen tube descends. The sperm cells in the pollen can get to the ovary through this tube.

Seed formation: The ovary's eggs are fertilised by the sperm cells in the pollen tube, which results in the development of seeds. These seeds grow inside the ovary before producing new plants.[34]

Chemical constituents

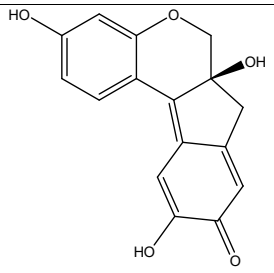
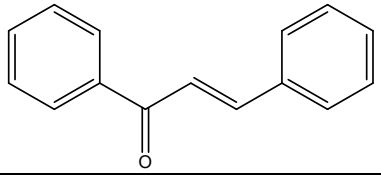
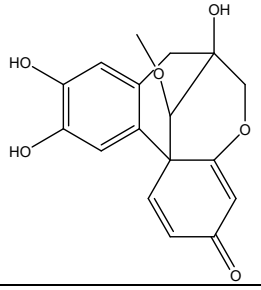
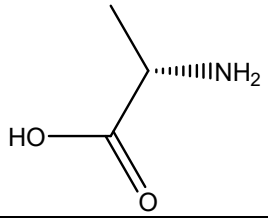
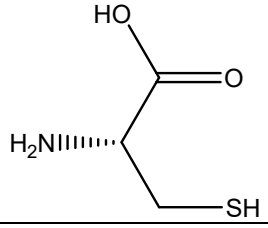
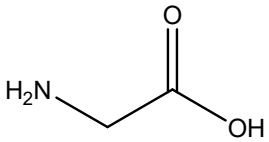
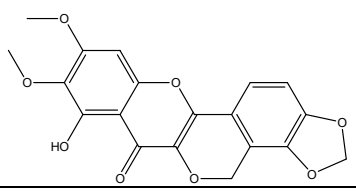
Caesalpinia pulcherrima possesses various bioactive compounds such as steroid, reducing sugar, triterpenoids, sugar, alkaloids, phenolic compounds, flavonoids, catechins, saponins, tannins, anthraquinones and amino acid.[5] The plant is rich in many pharmaceutical active ingredients like flavonoids, carotenoids, glycosides, phenols and steroids.[2] The plant contains various Phyto active constituents such as glycosides, rotenoids, is flavones, flavonone, chalcones, flavanols, flavones and sterols. The leaves of the plant Caesalpinia pulcherrima are reported to contain hydrocyanic acid, tannins and benzoic acid.[5]

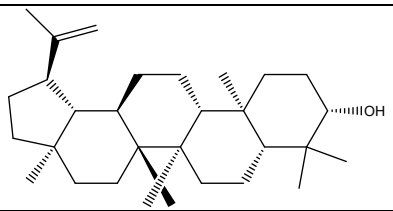
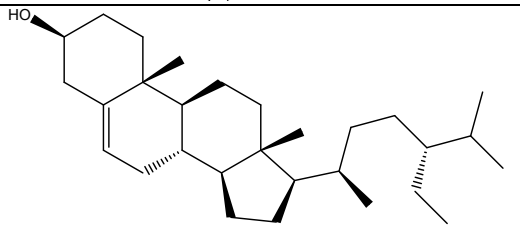
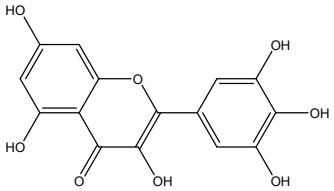
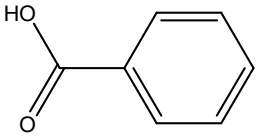
Peacock flower contain essential oils, flavonoids, glycosides and sterols. It contains secondary metabolites such as diterpenids, phenolics, flavonoids, treterpenoids and lactones that cause peacock flowers to have biological activity.[8] The flower of C. pulcherrima contains numerous compounds, such as lupeol, lupeol acetate, myricetin, quercetin and rutin.[35] The stem contains peltogynoidsbhonducellin, 6 methoxypulcherrimin and homo iso flavonoids. The flavonoids are polyphenolic compounds and reported to exhibit various pharmacological activities such as CNS activity, cardiotonic activity, lipid lowering activity, antioxidant activity, hepatoprotective activity, hypoglycaemic activity and so on.[36] The stems contain a cassane-type diterpene ester, pulcherralpin, peltogynoids, bhonducellin, and 6 methoxypulcherrimin, homoisoflavonoids.[2]

The presence of β Sitosterol, myricetin, ellagic acid, gallic acid, quercetin, rutin lupeol, flavonoids, and homoflavonoids, including (E) 7 methoxy 3 (4' methoxybenzylidene)chroman 4 one, (E) 7 hydroxy 3 (3',4',5' trimethoxybenzylidene)chroman4 one, chroman-4-one, (E)-7-hydroxy-3-(3',4',5'-trimethoxybenzylidene) chroman-4-one, isobonducellin, bonducellinand (E)-7-hydroxy-3-(2',4'-dimethoxybenzylidene) chroman-4-one,3-(4'-hydroxy-benzyl)-5,7-dihydroxy-6,8-dimethyl-chroman-4-one, hyperforin, and platycodigenin in its flowers are reported.[37]

Heartwood contains several aromatic compounds, brazilin, C. pulcherrimachalcone, Caesalpin J, Caesalpin P. proto, C. pulcherrimain A, protoC. The lignum is also claimed to contain pulcherrimain B, homoisoflavonoids ß-sitosterol, monohydroxybrazilin, and derivatives of benzyl dihydrobenzofuran. It also contains C. pulcherrimaol, epiC. pulcherrimaol, 3'-deoxyC. pulcherrimaol, 3'-0- methylC. pulcherrimaol, 3'-0-methylepiC. pulcherrimaol, 3'-0- methylbrazilin, 4-0-methylepiC. pulcherrimaol, C. pulcherrimaon ß, 3- deoxyC. pulcherrimaone ß, 3'- deoxyC. pulcherrimaone ß and dibenzoxocin derivative, 10-0-methyl-protoC. pulcherrimaion ß. Presence of 4,4'- dihydroxy-2'-methoxychalcone, 8- methoxybonducellin, quercetin, rhamnetic and ombuin is also reported.[38] The polyphenolic compounds are among the chemical constituents responsible for the antioxidant activity.[3]

Table 5: Represents the chemical structure of *Caesalpinia pulcherrima* phytoconstituents

Brazilin	
C. pulcherrimachalcone	
Caesalpin j	
Alanine	
Cystine	
Glycine	
6 methoxy pulcherrimin	

Lupeol	
Beta sitosterol	
myricetin	
Hydrocyanic acid	
Benzoic acid	

Uses

There are several uses of *Caesalpinia pulcherrima* in herbal medicine. It is used to treat bronchitis, asthma, malaria, kidney stones, and as an emmenagogue, purgative, stimulant, and abortifacient.[1] The bark, blossom, and leaves of this plant have all been used in traditional medicine to treat a variety of illnesses, such as bronchitis, menoxenia, pyrexia, wheezing, antiviral, and malarial infections.[2] Extracts from different plant parts are used in traditional medicine as stimulants, emmenagogues, abortifacients, and to treat skin conditions, tumours, fever, ulcers, and asthma.[3] *C. pulcherrima* is used in traditional Indian medicine to treat tridosha, fever, ulcers, emmenagogues, abortifacients, asthma, tumours, vata, and skin conditions.[4] It has a number of therapeutic uses, including treating cholera, ulcers, fever, tumours, asthma, and abortion; encouraging menstruation; acting as a purgative, or watery evacuation of the bowels; generating energy; relieving chest pains; curing bronchitis; treating malarial fevers; and many more.[5]

Additionally, preliminary medical research showed that *Caesalpinia pulcherrima* may help with weight loss.[5] Essential oils found in peacock plants can be used as a component of medications, nutrients cosmetics, perfume, and aromatherapy.[39] The fruit and root portions of *C. pulcherrima* (L) are utilised as complementary therapies for dental and oral health in Mexico.[9] A fresh and innovative source for the synthesis of biofuels is bio-oil made from dwarf poinciana seeds.[17] It has been observed that plants in the genus Caesalpinia exhibit anticonvulsant properties.[40]

In the past, mothers would make a tea with Pride of Barbados flowers and leaves for their infants to help them fall asleep. In certain situations, this tea would be used as an alternative of milk at night.[41]

Table 6: represents the uses of various parts of *Caesalpinia pulcherrima*

Plant parts	Uses
Leaves	Leaves have antibacterial, antimicrobial, antipyretic, and antioxidant properties.[1] Traditionally, leaves have been used as an emmenagogue, tonic, purgative, and antipyretic.[11]

Flowers	Flowers are used to treat intestinal worms, malaria, pneumonia, and asthma.[11] The plant's blooms are used to make a liquid that is frequently administered topically as an eye wash or as an insecticide.[5] It is renowned that the flower's sap can heal sores.[12]
Pods	Pods of *C. pulcherrima* exhibit strong antioxidant properties.[3]
Seeds	Seeds are used to treat ringworm infections and gum infections.[11] The seeds are supposed to relieve chest pain, breathing problems, and severe coughs.[12]
Bark	Bark is also used as an astringent and abortifacient in folklore.[11]
Roots	Roots are used to treat problems with the skin, lungs, convulsions, and sporadic fevers.[11]
Fruit	The plant's fruit can be given to patients who suffer from severe gastrointestinal conditions, such as dysentery or severe diarrhoea.[5] Its fruit is used to make red and brown colours.[17]

Pharmacological activities

Pharmacologically, the plant has been reported to possess antimicrobial, analgesic, Anti-inflammatory Activity, Antioxidant Activity, anthelmintic, antiulcer, cytotoxic, antioxidant, antiviral, anticancer, immunosuppressive, antidiabetic, antimicrobial activities and vasorelaxing effect.[3] Bark possess Antimicrobial, Cytotoxic activity. Flowers shown Antimicrobial and Antifungal activity, fruits shown Antiviral activity. Leaves shown antitumor activity, antimicrobial activity, Antiviral activity. Its seeds have shown Antiviral activity, stem shown cytotoxic activity. Pods shown in-vivo anti-inflammatory activity, in–vitro antioxidant activity, Cytotoxic activity and in-vitro anthelmintic potency.[42]

Antioxidant Activity

The heartwood of *C. pulcherrima* was investigated for its antioxidant properties using both in vitro and in vivo methods. The significant antioxidant activity of the ethyl acetate, methanol, and water extracts was demonstrated by their low IC50 values in the nitric oxide and 1,1-diphenyl-2-picryl hydroxyl (DPPH) assays. When compared to the CCl4 treated control, administration of the successive methanol and water extracts at 50 and 100 mg/kg body weight given for 4 days prior to carbon tetrachloride (CCl4) treatment caused a significant decrease in the level of thiobarbituric acid reactive substances (TBARS) and a significant increase in the levels of catalase and superoxide dismutase (SOD) in the liver and kidney. These alterations at 100 mg/kg body weight were similar to those found at 50 mg/kg conventional vitamin E treatment.[43] Ethyl acetate extracts of *C. pulcherrima* show the antioxidant activity [44]. Brazilin is an antioxidant that protects against the depressive effect of BrCCl3 on microsomal calcium sequestration activity.[45]

Anticancer Activity

In head and neck cancer cells, the chloroform extract of *C. pulcherrima* causes cell death. In the presence of chloroform extract, the vitality of HNSCC4 and HNSCC31 cells—head and neck cancer cell lines—was significantly lower than that of HaCat cells, the control group. In the HNSCC4 and HNSCC31 cells, exposure to the chloroform extract of *C. pulcherrima* caused nuclei to condense and shrink as well as an increase in the sub-G1 phase of the cell cycle. The HNSCC4 and HNSCC31 cells also have elevated levels of P 53 and P 21 WAF1/CIP1. A higher cellular level of P 53 and P 21 WAF1/CIP13 has been associated to enhanced cell death in HNSCC4 and HNSCC31 cells, suggesting that the chloroform extract of *C. pulcherrima* may be responsible.[46] Methanol extract was found to have an anticancer impact on osteosarcoma (HOS) and oral carcinoma (KB) cells. It appears that the telomerase inhibitory impact contributes to the anticancer effect, at least in part. After the fractions dichloromethane, n-hexane, and ethyl acetate were evaluated for anticancer activity, the dichloromethane fraction showed the strongest anticancer activity against oral carcinoma (KB) cells and osteosarcoma (HOS) cells, with IC50 values of 4.4 and >4.0 ug/ml, respectively.[47] An extract of heartwood made of ethyl acetate *C. pulcherrima* exhibited potent DNA strand –scission activity.[48]

Anti-inflammatory Activity

By preventing the generation of prostaglandins and nitric oxide, *C. pulcherrima* has anti-inflammatory properties.[49] Red pigment found in Brazilin has long been recognized. It demonstrated a dose-dependent inhibitory effect on lipopolysaccharide (LPS)-stimulated NO generation. Brazilin's ability to decrease the expression of a particular isoform of nitric oxide synthase gene may be one potential reason for its anti-inflammatory and cancer-chemo preventive properties.[50] Brazilin and Cu (II) combine to produce a complex both with and without DNA. For the pBR322 supercoiled DNA, the Cu (II)–brazilin complex demonstrated strand cleavage activity, transforming supercoiled forms to nicked form. The complex's cleavage activity is suppressed or reduced in the presence of several oxygen species scavengers, suggesting that the DNA cleavage is oxidative.[51]

Antidiabetic Activity

In diabetic animals, the active ingredient in *C. pulcherrima* wood, brazileiin, lowers blood glucose levels. Brazilein increases the F-2, 6-BP level in hepatocytes, which may be caused by an increase in cellular F6-P/H-6-P levels and PFK-2 activity. This suppresses hepatic gluconeogenesis. The antigluconeogenic properties of braziline may also be influenced by elevated pyruvate kinase activity.[52]

Antiplatelet Activity

Brazilin, the main constituent of *C. pulcherrima*, has been shown to have antiplatelet activity by increasing intracellular free Ca 2+ concentration ([Ca 2+ [i], and inhibiting the activity of phospholipase A2 (PLA2). Its derivatives, such as BRX-018, 6aS, and cis, also exhibit this property. One of the possible antiplatelet drugs was verified to be malonic acid 3-acetoxy-6a9-bis-(2-methoxycarbonylacetoxy)-6,6a,7,11b-etrahydro-indeno[2,1-c]chromen10-ylester methyl ester. Its antiplatelet action might stem from mechanisms that prevent excited platelets from synthesizing TXA2.[53]

Analgesic Activity

Using acetic acid-induced writhing in albino mice, the ethanol extract of heartwood and three crude fractions (petroleum ether (60-80°c), diethyl ether and ethyl acetate) were screened pharmacologically for analgesic efficacy. Three crude fractions and the heartwood ethanol extract were found to have peripheral analgesic efficacy.[54]

Acaricidal Activity

The acaricidal properties of a substance produced from the heartwood of *C. pulcherrima* were evaluated and contrasted with those demonstrated by commercial benzyl benzoate and DEET against Dermatophagoides farinae and Dermatophagoides pteronyssinus. The methanol extracts' LD (50) values against *D. ferinae* and *D. pteronyssinus* were 5.44 µg/cm (3) and 6.31 µg/cm (3), respectively. Additionally, the methanol extract's ethyl acetate fraction was roughly 8.71 times more lethal than DEET against D. farinea and 4.73 times more poisonous against D. pteronyssinus. Juglone (5—hydroxy-1, 4-naphthoquinone) was recovered from the ethyl acetate fraction. This suggested that juglone's actions are the cause of *C. pulcherrima* heartwood's acaricidal activity. Juglone should therefore show to be highly beneficial as a possible control agent, lead compound, and indicator of house dust mites.[55]

Antiproliferative Activity

Water extract of *C. pulcherrima*, methanol and methanol- water (1:1) all shown selective action against the human cervix. Lewis's lung cancer (LLC), HeLa adenocarcinoma, human lung A549 adenocarcinoma, murine colon 26-L5 carcinoma and murine B16-BL6 melanoma cells. DNA fragmentation and distinctive morphological changes suggested that the indication of apoptosis was the cause of the antiproliferative effect.[56]

Antimicrobial Activity

Methicillin-resistant staphylococcus aureus (MRSA) clinical isolates were the subject of studies on the antimicrobial activity of *C. pulcherrima* and the impact of *C. pulcherrima* extract on MRSA invasion of human mucosal fibroblasts (HMFs). Aqueous extracts, n-butanol, methanol and chloroform all exhibited antibacterial efficacy against MRSA and standard methicillin-sensitive *Staphylococcus aureus.*[57] Methanol extract significantly reduced the ampicillin and oxacillin minimum inhibitory concentrations (MICs) against MRSA in the dilution method. Here, methanol extract may possess antibacterial properties and have the ability to prevent MRSA from invading HMFs and to make ß-lactam drugs more effective against MRSA. The antibacterial action is also demonstrated by *C. pulcherrima* [58]

Vaso relaxing Effect

In isolated rat thoracic aortas, the relaxant properties of methanolic extract and two purified components (brazilin and hematoxylin) from *C. pulcherrima* were investigated. Without changing the passive tension in these vessels, the methanolic extract considerably and dose-dependently relaxed the a-receptor against phenylephrine - precontracted aortic rings. The vasorelaxant effect of the herbal extract was eliminated at doses up to 30 µg/mi upon removal of the vascular endothelium, suppression of nitric oxide (NO) synthase with 0.1 mM Nw -nitro-L-arginine, and of cGMP production with 10 µM Methylene blue. Comparable vasorelaxant effects were noted for hematoxylin and brazilin.[59] Human umbilical vein endothelial cells and isolated rat aortas were used to test *C. pulcherrim*a vasorelaxant effects. By raising the intracellular Ca(2+) concentration in blood vessel endothelial cells and so triggering Ca(2+)/calmodulin-dependent NO production, brazilin causes vasorelaxation. Vasorelaxation is the result of NO being released and then entering smooth muscle cells, where it activates guanylyl cyclase and raises the level of cGMP.[60]

Miscellaneous

C. pulcherrima wood reduces blood stasis, increases blood flow, causes swelling to go down, and eases discomfort. When 5-hydroxy-1, 4-naphthoquinone was tested with Clostridium perfringens, it produced moderate (++) inhibition at 1, 0.5, and 0.25 mg/disk and strong (+++) inhibition at 5 and 2 mg/disk. The chemical was extracted from *C. pulcherrima* heartwood. Additionally, at 5 and 2 mg/disk, this isolate showed a weak (+) growth inhibition against *Lactobacillus casei*. It suggests that naphthoquinone's hydroxyl fractional group may be necessary for its specific growth-inhibiting action against *C. Perfrings*.

As a result, the substance extracted from the heartwood of *C. pulcherrima* may have value as a defence against illnesses brought on by *C. perfringens*. *C. pulcherrima* extract from a screening investigation. It has been discovered that Chinese herbal remedies are an effective means of inactivating human sperm in vitro. Sperm motility was significantly decreased when this chemical was exposed to sperm from healthy donors. About 2.5 mg/ml of *C. pulcherrima* is needed to suppress motility to 50% of the control medium (EC50), as the antimotility effect of the compound is concentration-dependent. This finding implies that the traditional Chinese herbal remedy has an antimotility impact on human sperm in vitro and may eventually develop into a novel and widely used oral contraceptive for men. Brazilin demonstrates how glucose transport affects rat epididymal adipocytes that have been isolated. By recruiting GLUT4 from intracellular pools to the plasma membrane of adipocytes through the activation of PI3-kinase51, it may enhance glucose transport. Brazilin promoted the absorption of [3H] 2-deoxyglucose in rat epididymal adipocytes that were isolated. Brazilin may also need calcium for its glucose transport-stimulating function, given that calcium may be necessary for the stimulatory effects of insulin on glucose transport. Therefore, the stimulatory effect of brazilin on glucose transport may depend on maintaining intracellular calcium content rather than increasing it.[61]

CONCLUSION

Caesalpinia pulcherrima is a conventional plant used for the management of a largest variety of disorders such as rheumatism, haemorrhages, atonic diarrhoea, dysentery, sore throat, lung disease, liver problems, fevers and ulcers. It has so many ancient values in treating number of disorders has been confirmed by a pharmacological screening of high range of plant part includes Antioxidant activity, Anticancer activity, Anti-inflammatory activity, Antidiabetic activity, Antiplatelet activity, Analgesic activity, Acaricidal activity, Antiproliferative activity, antimicrobial activity and Vaso relaxing effect. With all these potential benefits, this plant is not widely utilized. This review mostly discusses the plant's pharmacological effects, phytochemistry and traditional applications.

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