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CULTIVATION AND HYBRIDS, PHARMACOGNOSTIC AND PHARMACOLOGICAL REVIEW ON MIRABILIS JALAPA

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ABSTRACT

Herbal plants have been used for thousands of years to treat, prevent, cure and control a variety of diseases throughout the world. Mirabilis is a Genus of plants in the Family Nyctaginaceae and Kingdom who have various pharmacognostic properties. *Mirabilis Jalapa* (*M. Jalapa*) is widely used as a traditional medicine in the treatment of various ailments. Studies have evidenced its anti-bacterial, anti-viral, anti-fungal, anti-microbial, anti-inflammatory, anti-stress, diuretic and anti-oxidant activities. Chemical analysis of various parts of *M. Jalapa* revealed the presence of alkaloids, flavonoids, phenols, steroids, triterpenes, glycosides, tannins, saponins and lignins. The complete study of these compounds from TLC visualized alanine, arabinose, campesterol, daucosterol and dopamine, d-glucan, hexacon-1-ol, indicaxanthin, isobetanin, 6-methoxyboeravinone, C-methylabronisoflavones, miraxanthins, n-dotriacontane, n-nonacosane, n-pentacosane, n-triacontane. The present review article focused on pharmacognostic, pharmacological, cultivations and hybrids and other essential aspects of *Mirabilis Jalapa.*

KEYWORDS: *Mirabilis Jalapa*, Pharmacognostic, Pharmacological.

INTRODUCTION

Mirabilis is a Genus of plants in the Family Nyctaginaceae and Kingdom Plantae known as the four-o'clocks or umbrellaworts. The best known species may be *Mirabilis Jalapa,* the plant most commonly called four o'clock. There are about 60 species in the world. It is commonly known as Sanje mallige (Karnataka); marvel of Peru / four-o'clocks (English); Gulabakshi (Maharastra); Naalumani poovu (Kerala).[1] Its flowers come in pink, red, yellow,

white, and some bi-colors and have a slight vanilla scent.[2] Leaves of *Mirabilis Jalapa* has Purgative and emetic properties[3] and also used for treating gastrointestinal disorders, including dysentery,diarrhea, muscle pain and abdominal colic,[4] constipation,[5] amenorrhea and dysmenorrhea in women,[6] jaundice,[7] hepatitis,[8] and Juice of leaves is used as eyedrop to soothe eye inflammation. Boiled Leaves are consumed to reduce body pains. Tuber is administered in small quantities to cure piles.[9] Stem with leaves are utilized for depigmentation.[10] Extract of roots has Hypolipidemic and hypoglycemic activity,[11] Leaves of *Mirabilis Jalapa* are applied on external wounds until recovery.[12] The flowers are used in food coloring. The leaves may be eaten cooked as well, but only as an emergency food. An edible crimson dye is obtained from the flowers to color cakes and jellies.[13] The seeds are considered poisonous.[14]

General description

Mirabilis Jalapa L. (Nyctaginaceae) is a perennial herbaceous bushy plant which grows upto 1 meter height. Roots are thick, tuberous and 10cm or more in diameter. Stems are swollen at nodes. Leaves are ovate and cordate. Fruits are nut ellipsoid, rugose and single seeded. Flowers are shortly stalked funnel shaped found in clusters, subtended by an involucre of 5, ovate, connate bracts, striped or blotched, fragrant, white, yellow, purple or red coloured. Perianth is funnel shaped and 5-lobed. Stamens are 3-6 in numbers and exserted. Anthocarps are globose and black when ripped. The black seeds are twice thesize of pepper corn.[15]

Parts used: Leaves, stems, seeds, flowers and roots were used medicinally.

Morphology

Flowers

Seeds **Leaves** **Roots**

Pollen grains

Figure 01: Morphology of different parts of *mirabilis jalapa.*

Table 1: The morphological features of *mirabilis jalapa.*

Plants part	Morphological features
Flowers	Tubular, cluster, funnel-shaped, single or double, fragrant, color usually purple and white, yellow or pink, arranged in group three flowers with five green bracteols, surrounding the perianth, usually yellow crimson, white or variegated and opening in the evening.
Seeds	Olive, brown or black in color.
Leaves	Opposite, 3.5-7.5 cm wide, 5-10 cm long, unequal, ovate to sub cordate.
Roots	Perennial tuberous roots, fairly thickened, stem swollen at Nodes.[16]

Pollen morphology

Mirabilis Jalapa L.: Pollen grains spheroidal, oblate-spheroidal, 125-140 µm diam. (smaller ones 70-85 µm diam.), pantoporate; pores 95-112, circular, ± 5 µm diam., margin ornate, membrane provided with spinules and granules. Exine 10-15 µmthick, spinulose; spines 0.5-1 µm high, randomly distributed, punctitectate; sexine equals to nexine. Pollen dimorphism is frequently found in this species (white-pink, mixed and mixed radiated); occasional giant, dimorphic anomalous, deformed and joint grains. All these anomalous pollen grains except

giant pollen grains are sterile.[17]

Synonyms: *M. Dechotoma* Lin. (in Brazil), *M. dechotoma* Lin. and *M. longiflora* Lin. (in tropical America), *M. lindheimeri* Lin. and *M. odorata* Lin.[18]

Table 02: Taxonomical classification.

Plant name	***Mirabilis jalapa***
Kingdom	Plantae
Sub kingdom	Tracheobionta
Division	Angiosperms
Class	Dicotyledons
Subclass	Caryophylidae
Order	Caryophyllales
Family	Nyctaginaceae
Genus	*Mirabilis*
Species	*Jalapa*[18]

Table 03: Vernacular name.

Language	**Vernacular Name**
Kannada	Sanje mallige
English	Marvel of Peru / Four-o'clocks
Sanskrit	Krishnakeli, Sandhykali
Bengal	Krishnakeli, Sarpamani, Sandhyamaloti.
Hindi	Gul-abbas
Gujrati	Gubbaji
Tamil	Andhimalligai, Andhimandhaarai, Antinaralu, Patharachi[18,19,20]

Phytochemistry

Aerial parts: Triterpenes, flavonoids, Beta-sitosterol, Stigmasterol, ursolic acid, oleanolic acid and brassicasterolare present in aerial parts of plant.[21]

Roots: The roots contain 3% resin, trigonelline, astragaloside-VI, flazin [, 4'- hydroxy-2,3-dihydroflavone-7- beta-D-glucopyranoside, ginger glycolipid-A, 3,4-dihydroxybenzaldehyde, p- hydroxybenzaldehyde, βsitosterol, daucosterol and Stigmasterol, proteins, retinoids mirabijalone A, B, C, 9-O-methyl-4- hydroxyboeravinone-B, boervinone-C and F. 1, 2, 3, 4- teterahydro-1-methyl isoquionoline-7, 8-di-diol, alkaloids, glycosides, carbohydrates, and phytosterols.[22]

Leaves: The leaves contain Flavonoids, quercetin, Dpinitol, an o-methyl inositol present, C-

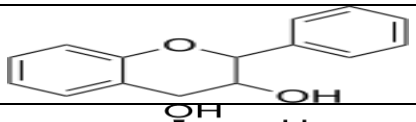
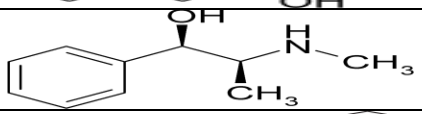
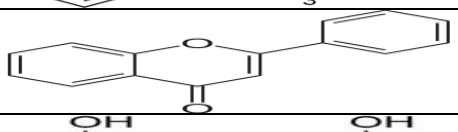
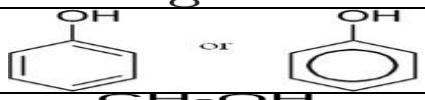
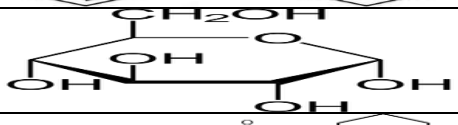
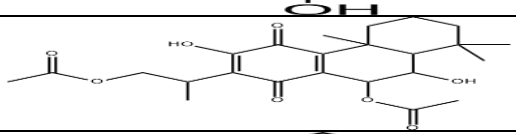
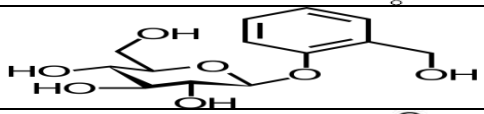
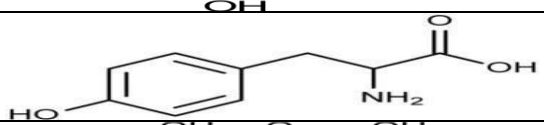
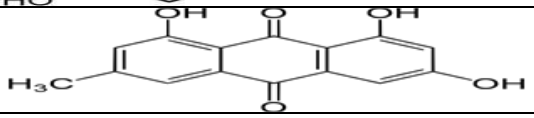
glycosyl flavonoid Tricosan-12-one, n-hexacosanal, β- sitosterol, tetracosanoic acid tartaric acid, citric acid, leucuine, valine, tryptophan, alanine and glycine polyphenolic amide N-trans-feruloyl-4'- O-methyldopamine.[23,24]

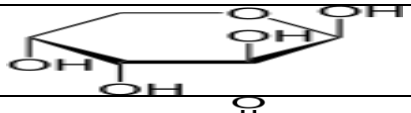
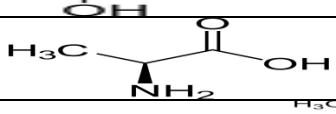
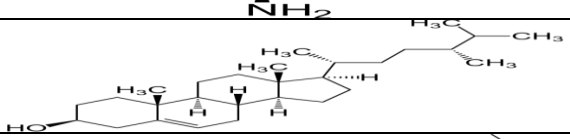
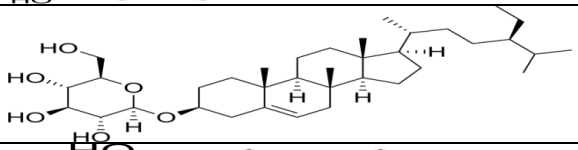
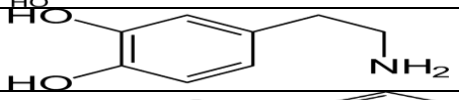
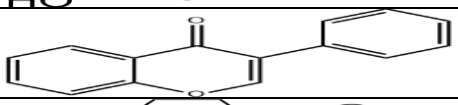
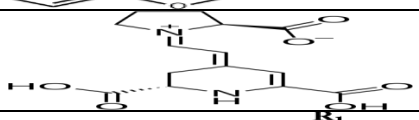
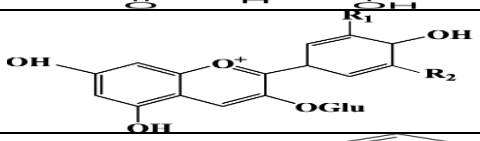
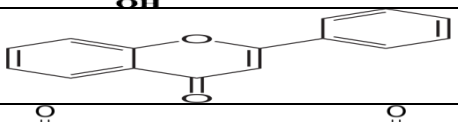
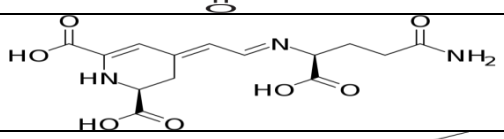
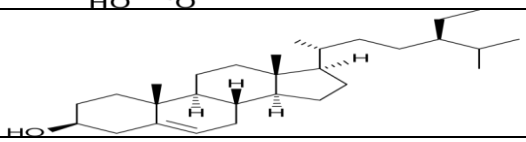
Stems: The aqueous and methanolic extract of stem shows the presence of large amount of alkaloids, carbohydrates, tannins, unsaturated hydrocarbon and flavonoids.[24]

Seeds: A fatty acid was reported as a minor component in the seed oil and was designated as 8- hydroxy-octadeca-cis11, 14-dienoic acid. Arginine, glycine,histidine, threonine, tyrosine, aspartic acid and glutamic acid. D-glucan, a polysaccharide from seeds cotyledons was reported to contain 38 glycosyl units. B- sitosterol, β-amyrin, β-sitosterol-Dglucoside and β-amyrin-3-O-α-L-rhamnosyl-O-β- D-glucoside were also isolated from seeds.[23, 25]

Flowers: Miraxanthins I-III, Miraxanthins IV, indicaxanthin, vulgoxanthin Land Betaxanthins were isolated from flowers.[25]

Table 06: Chemical structure of some active constituents in *mirabilis jalapa*.

Name	Structure
Tannin	
Alkaloid	
Flavonoids	
Phenols	
Carbohydrates	
Terpenes	
Glycosides	
Proteins	
Emodin	

Arabinose	
Alanine	
Campesterol	
Daucosterol	
Dopamine	
Isoflavones	
Indicaxanthin	
Anthocyanins	
Flavonoids	
Vulgaxanthin-i	
Beta-sitosterol	

Bioactivity

Table 04: Scientific Work and Pharmacognostic approaches of *mirabilis jalapa.*

Pharmacologicalactivity	Part of plantused	Process of extraction	Impression
Antidiabetic activity	Root	Ethanolic extraction	This study was designed to investigate the anti-diabetic activity of an ethanolic extract of the root of *mirabilis jalapa*. Ethanolic extract of *m. Jalapa* (eemj) (10mg/kg & 20mg/kg) were administered as a single dose per day to the streptozotocin-induced diabetic rats for 12 days. Ethanolic extract of m. Jalapa root was found to lower blood glucose significantly. The ethanolic extract was also found to reduce the

			increased level of triglycerides, total cholesterol and ldl-cholesterol.[11]
Antinociceptive activity	Leaves and stems	Hydroethanolic extraction	The effect of crdl (crude extract from leaves) and crds (crude extract from stems) on the nociception induced by acetic acid. Both crdl and crds treatments (1–100 mg kg, p.o.) Reduced the number of abdominal writhes induced by acetic acid. Crdl and crds had similar efficacy to produce antinociception (maximal inhibitions of 65 ± 13 and 77 ± 6%, respectively), but crdl was more potent than crds with calculated id_{50} values of 5.5 (2.3– 13.1) and 18.0 (11.3–28.5) mg/kg, Respectively. The results show that the crdl or eta from mirabilis jalapa administered orallyto mice, produces antinociceptive action.[26]
Antioxidant and cytotoxic activity	Tubers, seed bark, leaves, and roots	Ethanol, hexane, petroleum ether, chloroform, methanolic extraction	The aqueous, ethanolic and hexane extracts of tubers,[28] seed epicarp extract,[29] bark,[30] shows anti-oxidant activity.[31] Methanolic extract exhibits anti-oxidant potential on both roots and aerial parts. Methanolic extract ofleaves exhibits significant anti-oxidant, anti-microbial and anti-fungal activity. The petroleum ether, chloroform and methanol crude extracts of the different plant parts (leaves root and bark) showed cytotoxic Activity.[32]
Anti-microbial activity	Leaves	Alcoholic extraction	Alcoholic extract of leaf showed anti-microbial effect against pseudomonas aeruginosa, salmonella typhi, staphylococcus areas and bacillus subtilis.[33]
Antifungal activity	Leaves	Methanolic extraction	The methanol extracts of leaves showed Antifungal activities against aspergillus niger,candida albicans and daedalea flavida.[34,35]

Anthelmintic activity	Aerialparts	Methanolic extraction	The methanolic extracts of m.jalapa linn weremore potent as anthelmintic probably because of flavonoids, glycosides and tannins in dose-dependent manner giving shortest time of paralysis and death with 80% w/v concentration. The methanolic extract of m.jalapa linn caused paralysis in 12.6 minand death in 13.5 min. The reference drug albendazole showed the same at 2.3 min and 3.24 min. The results shows that methanolic Extract possess vermicidal activity and foundto be effective as an anthelmintic.[36]
Anti-tubercular drugs induced hepatotoxicity	Leaves	Ethanolic extraction	The study investigating the protective effect of ethanolic extract of mirabilis jalapa linn leaves on anti-tubercular drugs inducedhepatotoxicity.anti-tubercular drugs were usedto induce hepatotoxicity. Ethanolic extract of leaves of mirabilis jalapa linn (250 & 500mg/kg p.o.) Was administered with one hour prior administration of anti-tubercular drugs Once daily for 35 days. Silymarin was used as
			Standard drug (100 mg/kg p.o.). Liver biomarkers such as sgot, sgpt, alp, tb, total cholesterol were elevated and total hdl were reduced on anti-tubercular drugsadministration. Pretreatment of ethanolic extract of leaves of mirabilis jalapa linn 250 mg/kg and 500 mg/kg with anti-tubercular drugs were significantly reduced liver biomarker Enzymes.[37]
nalgesic and musclerelaxant activity	Leaves	Ethanolic extraction	It is reported that ethanolic extract of the leaves of mirabilis jalapa has analgesic andmuscle relaxant activity on swiss albino mice[38]
Anti-asthmatic activity	Root	Acetone and ethanolic extraction	It is reported that ethanol and acetone root extract have antiasthmatic activity using a guinea pig tracheal chain preparation and clonidine-induced mast cell granulation in Mice.[39]

Anti-viral activity	Roots	Homogenizing 0.1 g of lyophilized tissue in 2.5 ml Of ice-cold extraction buffer	Extracts of *mirabilis jalapa* (nyctaginaceae), containing a ribosome inactivating protein (rip) called mirabilis antiviral protein (map),were tested against infection by potato virus x,potato virus y, potato leaf roll virus, and potato spindle tuber viroid. Root extracts of *m. Jalapa* sprayed on test plants 24 h before virus or viroid inoculation inhibited infection by almost 100%, as corroborated by infectivityassays and the nucleic acid spot hybridization test. Antiviral activity of map extracts wasobserved against mechanically transmitted viruses but not against aphid-transmitted viruses. Purified map showed the same Antiviral effect as the crude extracts.[40]
Anti-bacterial activity	Flowers	Ethanolic and methanolic extraction	The research showed that red-flowered *m. Jalapa* plant has strong antibacterial activities and active against a wide range of Microorganisms. Alcoholic extracts of
			M. Jalapa has potential activities against bacteria. Antimicrobial activities of ethanolic extract of the red color flower of *m. Jalapa* have been examined in vitro against staphylococcus aureus salmonella typhi, escherichia coli, bacillus subtilis, vibrio cholera, serratia marcescens and pseudomonas aeruginosa. It showed the highest inhibitionagainst b. Subtilis almost 47%. The plant extracts possess antibacterial activity, thus this plant is a good source of agents for bio-control and chemotherapy.[16]

Traditional uses

From ancient times, the whole plant as well as individual parts of *M. Jalapa* Linn. used traditionally to cure a variety of human ailments. It has been reported that indigenous Mexican people use various decoctions and preparations of *M. Jalapa* Linn. for the treatment of dysentery.

- It is used for muscular pain, diarrhea, and abdominal colic by people from different

countries.

- The decoction of the entire plant is taken orally to treat kidney infections for dieresis.
- The infusion of the leaves was applied topically to reduce swelling in bone fractures or twisting. The leaves are used in inflammation, boils, Purgative and emetic properties.
- The leaves are crushed and mixed with salt in Sprain and bruise.
- Leaves are having sharp tastes and generally used for inflammation also used to apply on boils, phlegmons as a maturant.
- The leaves are fried in clarified butter and are fastened on the abscess.
- The paste of leaves is used in amenorrhea and dysmenorrhea in women, skin eruption, and also has emollient property. A cosmetic powder is made in Japan from powdered seeds.
- In the south of Brazil, leaves were also used in traditional folk medicine to treat inflammations, pain-related diseases and as a laxative.
- A cosmetic powder was also made in Japan from the powder of seeds.[16]

Cultivation and Hybrids

Seedlings of Mirabilis Jalapa (L) and with first true leaves (R)

Grow four o'clock in full sun in almost any type of soil but they do best in a humus- rich, well-drained spot. Plants can be started from seed sown outdoors after the danger of frost has passed or indoors up to 8 weeks ahead of time. Soaking the seeds in water overnight will speed up germination. Show the seeds no more than ¼ inch deep as light aids germination. They should germinate in 1-3 weeks. Transplant seedling when large enough to handle, if needed, into individual. Thin seedling or place transplants 12-24 inches apart. As these are tender plants, put transplants outside after all risk of frost, about the same time you would plant tomatoes. Provide moderate moisture and fertilize periodically for the best growth.

They have few pestsand are not favored by deer. Tubers can be dug in the fall to store indoors and plant again in spring after the last frost. Treat the tubers like dahlias by digging them before the first freeze, shaking off the soil and storing them in dry, cool but frost-free conditions. This sturdy plant can be used as an annual hedge if planted close together. They are right at home in a cottage garden, in borders and beds, or can be added to large containers. If possible place them along on lighted walkways where the night-blooming flowers and fragrance can be appreciated. They combine nicely with Asiatic lilies, creating an interesting contrast of large and small flowers. [41]

Geographical distribution: *Mirabilis Jalapa* Linn. (Family Nyctaginaceae) was officially botanically recorded in 1753 although it already had long been distributed as an ornamental plant throughout the tropics of the world. This plant is naturalized throughout the tropics of South America, Latin America, France and India. In India, grows mainly in West Bengal, Manipur, and Western Himalayas.[20]

CONCLUSION

Mirabilis Jalapa contained many bioactive metabolites. It possessed wide range of pharmacological and therapeutic effects included antimicrobial, antiparasitic, dermatological, anticancer, anti-inflammatory, analgesic, antidiabetic, antihistaminic, immune-modulatory, and antispasmodic and many other pharmacological effects. The current review highlighted the cultivation and hybrids, chemical constituents, traditional uses and pharmacological effects of *Mirabilis Jalapa*.

Conflict of interest statement

We declare that we have no conflict of interest.

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