

ETHNOMEDICINAL PROPERTY OF FOUR O’CLOCK PLANT -A REVIEW

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Abstract:

Mirabilis jalapa L. recurrently known as the Four O'clock plant is a perennial herbaceous medicinal plant adroitly known for its traditional uses. Traditionally, the plant is worn in the treatment of a diversity of human ailments like skin diseases, cathartic, purgative, stomachic, tonic, anti-dysenteric, anti-parasitic, wound healing properties, digestive, stimulant etc. The dynamic constituents delineated in this plant encompass alkaloids, flavonoids, phenols, glycosides, tannins, saponins, lignin and carbohydrates. A quota of pharmacological pursuits is outlined in this plant like anti-diabetic, anti-inflammatory, anti-oxidative, anti-bacterial, anti-microbial, anti-fungal, anti-spasmodic, antinociceptive, anti-viral, diuretic, anthelmintic and urinary tract disorder. The contemporaneous appraisal is, therefore, sight on condition that a review of the literature on its ethnomedicinal, phytochemical and pharmacological possessions.

Keywords: *Mirabilis jalapa*, ethnomedicinal, phytochemical and pharmacological.

Introduction

Mirabilis jalapa L. commonly known as the Four O'clock plant (Nyctaginaceae) is a perennial herbaceous bushy plant which grows up to 1-meter height and is just as wide ^[1]. It has numerous branches; leaves are Pointed, 5-10 cm long which are ovate and cordate. Tubers are large, black carrots shaped can be a foot or more long ^[2]. In warmer regions, the roots can weigh up to 40 lb. (18 kg.) or more. Stems are swollen at the nodes. Fruits are nut ellipsoid, rugose and single-seeded ^[2, 3]. The fragrant flowers are borne singly or in clusters and vary from red, magenta, pink, yellow or white, sometimes with more than one colour on the same plant. Bicolor flowers are also possible ^[4, 5]. Individual flowers are trumpet-shaped, about an inch across at the end and about two inches long ^[6]. They open in the evening and wilt the next morning. The plants continue to produce new flowers from late spring till fall ^[2, 3]. Flowers are subtended by an involucre of 5 ovate, connate bracts ^[7, 8], striped or blotched ^[9]. The perianth is funnel-shaped and 5-lobed. Stamens are 3-6 in number. Anthocarpous are globose and black at maturity ^[10]. The black seeds are twice the size of pepper corn ^[11]. Medicinal plant research received much attention as it brings to light the numerous unknown medicinal virtues, especially of plant origin which need evaluation on modern scientific lines such as chemical analysis, pharmacological investigation, pharmacokinetic and pharmacodynamic studies and clinical trials ^[12, 13]. *Mirabilis jalapa* was

used traditionally in the treatment of kidney infections, as a diuretic, tonic, cathartic, purgative and emetic [14]. The phytochemical screening of the extracts of the leaves and stems of the *Mirabilis jalapa* revealed the presence of tannins, alkaloids, flavonoids, phenolic compounds, carbohydrates, terpenes, glycosides, saponins, protein, cardiac glycosides, steroids and emodin [14,15]. The previous pharmacological studies revealed that *Mirabilis jalapa* possessed a wide range of pharmacological and therapeutic effects including antimicrobial, antiparasitic, dermatological, anticancer, anti-inflammatory, analgesic, antidiabetic, antihistaminic, immunomodulatory, antispasmodic and many other pharmacological effects [16, 17]. The current review will highlight the chemical constituents, and nutritional, pharmacological and therapeutic effects of *Mirabilis jalapa* [18, 19].



Flowers

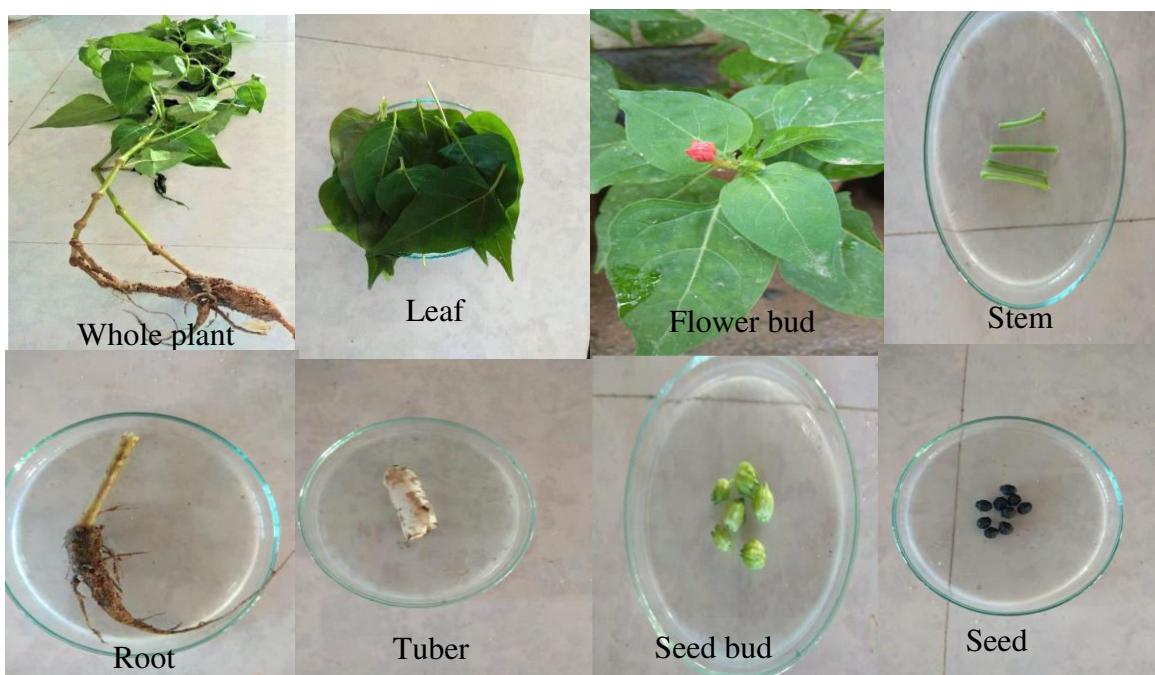


Fig 1: Morphology of different parts of *Mirabilis jalapa*

Synonyms

Jalapa congesta, *Jalapa officinalis*, *Mirabilis ambigua*, *Mirabilis jalapa* var. *jalapa*, *Mirabilis jalapa* subsp. *lindheimeri*, *Mirabilis lindheimeri*, *Mirabilis jalapa* var. *lindheimeri*, *Mirabilis pedunculata*, *Mirabilis planiflora*, *Mirabilis pubescens*, *Mirabilis suaveolens*, *Mirabilis xalapa* and

Nyctagojalapae ^[20, 21].

Taxonomic classification

Kingdom: Plantae, Subkingdom: Viridiplantae, Infrakingdom: Streptophyta, Superdivision: Embryophyta, Division: Tracheophyta, Subdivision: Spermatophytina, Class: Magnoliopsida, Superorder: Caryophyllanae, Order: Caryophyllales, Family: Nyctaginaceae, Genus: *Mirabilis*, Species: *Mirabilis jalapa* ^[22,23].

Common Vernacular Names

Arabic: Shab Al-Leil, Al-Shab A-ldhareef, Lala Abbas; Chinese: zimo li; English: beauty-of-the-night, false jalap, four-o'clock; French: belle-de-nuit, Italian: bella di note; Japanese: oshiroi-bana; Persian: Lalehabbasi; Spanish: buenastardes; Swedish: underblomma; Turkish: Akşamsefas ^[10, 24]. Bengal- Krishnakeli, Sarpamani, Sandhyamaloti. Gujrati- Gubbaji. Hindi- Gul-abbas. Sanskrit - Krishnakeli, Sandhykali. Tamil-Andhimalligai, Andhimandhaarai, Antinaralu, Patharachi ^[5, 7, 15, 25].

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 ^[26, 27].

Ethnomedicinal information

The whole plant as well as individual parts of *Mirabilis jalapa* Linn. *is* used traditionally to cure a variety of human ailments. The Whole plant is extensively used for muscular pain, diarrhoea, and abdominal colic by people from different countries ^[28]. The decoction of the entire plant is taken orally to treat kidney infections ^[29] for diuresis ^[30, 31]. The infusion of the leaves was applied topically to reduce swelling in bone fractures or twisting ^[32]. The leaves are used in inflammation, boils, and Purgative and emetic properties ^[33]. The leaves are crushed and mixed with salt to Sprain and bruise ^[34]. The leaves are fried in clarified butter and fastened on the abscess. Boiled Leaves are eaten to reduce body pains ^[35]. The Paste of leaves is used in amenorrhoea and dysmenorrhoea in women ^[36], Skin eruption and also has emollient properties ^[37]. The leaf juice is taken orally for the treatment of Hepatitis ^[38, 39]. The leaf juice is slightly warmed and used as a poultice over abscesses which helps in healing wounds. Leaf juice is used as an eye drop to soothe eye inflammation ^[40]. The decoction of leaves is used for genitourinary system disorders and treating injuries ^[41]. The Stem and leaves are used for depigmentation ^[42]. Leaves and roots are used medicinally in Ayurveda, Siddha and other traditional systems of medicine for curing various ailments ^[43]. The decoction of the root and leaves can be used for treating pain and inflammation in arthritis ^[44]. Roots are used as aphrodisiacs and are good for syphilitic sores ^[45]. The root paste is applied for inflammation ^[38, 46]. The natives of Shivalik Hills, Himachal Pradesh use root tubers which are consumed as a pickle for their nutritive value. The paste of the root tuber is applied to check the growth of old tumours in Tribal areas of Rajasthan ^[47]. The tuber is administered in minute quantities to cure piles ^[48]. The fruit paste made with coconut oil is applied externally, for relief from headaches of folk as well as domestic animals at Bhadra Wild Life Sanctuary area in Karnataka ^[49]. Flowers are used in food colouring; an edible crimson dye is used to colour cakes and jellies ^[50]. The inhabitants of Tehsil Kabal, Swat District, Pakistan, use the juice of the whole plant for relief from pain and also provide a cure for typhoid

^[51]. Mexican people use various decoctions and preparations for the treatment of dysentery ^[52]. In China, this plant has been used as traditional Chinese medicine and ethnic drug to treat diabetes ^[53]. It is reported that the powdered seed is used as a cosmetic powder by the natives of Japan ^[54]. In Latin America and South Africa, roots of *Mirabilis jalapa* L. were traditionally used for its purgative, emetic and cathartic properties ^[26, 55]. In Malagasy, the *Mirabilis jalapa* plant was used to treat intestinal pains ^[56].

Description

Herbs annual, to 1 m tall. Roots are tuberous, black or black-brown. Stems are erect, branched, glabrous, cylindric, or slightly pubescent, inflated on nodes. Petiole 1-4 cm, leaf, 3-15 × 2-9 cm, blade ovate or ovate-triangular, base truncate or cordate, margin entire, apex acuminate. Flowers are several clustered at the apex of branches, fragrant; pedicel 1-2 mm. Perianth red, purple, white, yellow, or variegated, tube 2-6 cm, limb 2.5-3 cm in diameter, opening in the late afternoon, closing the next morning. Stamens 5, filaments slender, exserted; anther globose. Fruits are globose, black, diameter 5-8 mm, coriaceous, ribbed and plicate. Endosperm white mealy ^[57, 58, 59].

Traditional uses

Leaves were employed for poulticing abscesses and boils. Juices of the leaves were used in the treatment of skin allergies, and in earaches in children. Leaves infusion was applied topically to reduce swelling in conditions like bone fractures or twisting ^[60,61]. Decoction of *Mirabilis Jalapa* was used orally as a diuretic and in the treatment of kidney infections ^[62]. Stems were used as a tonic. The root of *Mirabilis Jalapa* was used traditionally as cathartic, purgative, and emetic, in the treatment of abnormal accumulation of pus and or liquid and for inflamed and enlarged lymph nodes ^[63, 64].

The seed powder was used in Zaire externally for infected wounds. In Latin America, the roots were used as a purgative and emetic ^[65]. In Malagasy, the plant was used to treat intestinal pains. In South Africa, the roots were used as a purgative and the flowers were reputed to emit an odour at night which stupefies or drives away mosquitoes ^[66, 67].

Part used

Leaves, stems, flowers and roots were used medicinally ^[68, 69].

Physicochemical characteristics

Aerial parts: Triterpenes, flavonoids, Beta-sitosterol, Stigmasterol, ursolic acid, oleanolic acid and brassica sterol are present in aerial parts of the plant ^[55, 70].

Roots: The roots contain 3% resin, trigonelline, astragal side-VI, flazin ^[71], 4'-hydroxy-2,3-dihydroflavone-7- beta-D-glucopyranoside, ginger glycolipid-A ^[72], 3,4- dihydroxy benzaldehyde, p- hydroxybenzaldehyde, β - sitosterol, dauco sterol and Stigmasterol, proteins, rotenoids mirabijalone A, B, C ^[73, 74], 9-O-methyl-4- hydroxy boeravinone-B, boervinone-C and F. 1, 2, 3, 4- tetrahydro-1-methyl isoquinoline-7, 8-di-diol, alkaloids, glycosides, carbohydrates, and phytosterols ^[73]. Studying of physicochemical parameters of the ethanolic extracts of the leaf of *Mirabilis jalapa* showed that the per cent (w/w) of the total ash was 15.15, acid insoluble ash 4.57, water-soluble ash 3.75, water-soluble extractive value 26.22, alcohol soluble extractive value 21.81 and ether soluble extractive value 24.94% ^[74]. The physicochemical parameter of powder of the whole *Mirabilis jalapa* was: loss on drying 12.41% \pm 0.005, total ash 11.81% \pm 0.001, water-soluble ash 5.06% \pm 0.001, acid insoluble ash 0.41% \pm 0.001, alcohol soluble 11.02% \pm 0.007, water-soluble materials 18.63% \pm 0.007 and ether soluble materials 7.17% \pm 0.007 ^[75,76]. The seeds

produced 3.0% oil, of 0.70 g/ml density, 26.10 dynes/cm surface tension, and 169.5 milli poise viscosity at 20.5° C. The determined iodine value was 80 and the saponification value was 172^[77].

Leaves: The leaves contain Flavonoids, quercetin, D- pinitol, an *o*-methyl inositol present^[34, 78], C-glycosyl flavonoid Tricosan-12-one, *n*-hexagonal, β - sitosterol, tetracosanoic acid tartaric acid, citric acid, leucine, valine, tryptophan, alanine and glycine polyphenolic amide N-trans-feruloyl-4'-O-methyl dopamine^[78, 80].

Stems: The aqueous and methanolic extract of the stem shows the presence of a large number of alkaloids, carbohydrates, tannins, unsaturated hydrocarbons and flavonoids^[81].

Seeds: A fatty acid was reported as a minor component in the seed oil and was designated as 8-hydroxy-octadeca-cis- 11, 14-dienoic acid. Arginine, glycine, histidine, threonine, tyrosine, aspartic acid and glutamic acid. D-glucan, a polysaccharide from seeds of cotyledons was reported to contain 38 glycosyl units. β -sitosterol, β -amyirin, β -sitosterol-D- glucoside and β -amyirin-3-O- α -L-rhamnosyl-O- β -D-glucoside were also isolated from seeds^[82, 83].

Flowers: Miraxanthins I-III, Miraxanthins IV, indicaxanthin, vulgoxanthin I and Betaxanthins were isolated from flowers^[84].

Chemical constituents

The preliminary phytochemical screening of the extracts of the leaves and stems revealed the presence of tannins, alkaloids, flavonoids, phenolic compounds, carbohydrates, terpenes, glycosides, saponins, protein, cardiac glycosides, steroids and emodin^[85, 86, 87]. (Z)-3-hexenyl acetate, β -myrcene, (Z)-ocimene, benzyl benzoate, and monoterpene (E)- β -ocimene were the major fragrance component in the plant volatiles. Investigation of the emission of (E)- β -ocimene, showed an evening-specific maximum (1700-2000 pm), while, the emission of (Z)-3-hexenyl acetate reached its maximum 3 h later^[88, 89]. The *Mirabilis jalapa* leaves extract contained hydrocarbons 17.8%, ketones 18.0%, alcohols 12.1%, sterols 21.2% and acids 7.0%, oxy methyl anthraquinone, trigonelline, arabinose, galactose and beta-sitosterol [23-24]. The number of essential elements in *Mirabilis jalapa* leaves (mg/kg) were: Mn 0.42, Fe 5.02, Zn 1.19, Pb 0.04, Cr 0.14 and Cu 0.067 and in the stems were: Pb 0.13, Zn 1.74, Cu 0.58, Cr 0.13, Mn 0.72 and Fe 4.88^[90, 91]. The seeds showed high protein content (11.0 \pm 0.75 g/100 seed). Amino acid analyses of the total protein isolates showed that it consisted of 17 amino acids of which 9 were essential^[92]. The analysis of fatty acids constituents of the seed oil showed that they included palmitic acid 18.3%, oleic acid 55.3%, linoleic acid 11.5% and linolenic acid 14.9%^[93]. Many betaxanthins pigments (indicaxanthin, vulgoxanthin-I, miraxanthin-I, -II, -III, -IV, -V and -VI) were identified in the flowers of *Mirabilis jalapa*^[27,92]. The compounds isolated from the dichloromethane extract of *Mirabilis jalapa* tubers powder were (%): 2-butoxy ethyl acetate 0.47; 2,3,5,6-tetramethylpyrazine 0.20; 3,6-dioxane-2,7-disiloxane 1.83; 2-butanediol acid 0.88; urea 1.52; 3,7-dioxane-2,8-disiloxane 2.98; 4-hydroxyquinoline 4.68; pyrimidine 1.09; is steviol 5.22; n-pentadecanoic acid 0.83; hexadecanoic acid 10.98; octadecan-1-ol 0.83; linoleic acid 10.47; oleic acid 24.74; Cyclopentasiloxane 0.90; Golestan-16-one 1.08; Luciano 1.29; pregn-5-en-20-one 1.15; dihydro stigmaterol 3.15 and benzene 1.23%. However, the compounds isolated from the methanol extract of *Mirabilis jalapa* tubers powder were (%): 9,12-octadecadienoic acid 0.83; 9,17-octadecadienoic 0.18; 2-methyl-Z, Z-3,13-octadecadienoic 0.84; 1,5,9,13-tetradecatetraene 0.61; coolest-5-en-24-one 10.58; stigmaterol 18.29, β -sitosterol 60.73 and cholestane 4.32%^[93,94,95,96]. 3,3'-Methylenebis(4-hydroxycoumarin); N-D-alpha-phenyl glycine; laminaribiitol and 3-(4-(dimethylamino) cinnamoyl)-4-hydroxycoumarin were isolated from the *Mirabilis jalapa* whole

plant methanol extract ^[97]. Rotenoids (mirabilalone A, B, C and D, 9-O-methyl-4-hydroxyboeravinone B, boeravinone C and F, 1,2,3,4-tetrahydro-1-methylisoquinoline-7,8-diol), 9-O-methyl- 4-hydroxyboeravinone B, boeravinone C and F, and 1,2,3,4-tetrahydro-1-methylisoquinoline-7,8-diol were identified in the roots of *Mirabilis jalapa* ^[98, 99].

Antiparasitic effect

The anthelmintic activity of aerial parts extracts (20%, 40%, 60%, 80%) of *Mirabilis jalapa* was studied using *Pheretima Posthuma* as a test worm. The methanolic extract of *Mirabilis jalapa* caused paralysis in 12.6 min and death in 13.5 min. Albendazole showed the same effect (at 2.3 min and 3.24 min), respectively ^[59, 100]. The larvicidal activity of crude chloroform, benzene, methanol and ethyl acetate leaf extracts of *Mirabilis jalapa* was investigated against the larvae of three important vector mosquitoes (*An. stephensi*, *Ae. Aegypti* and *Cx. Quinque fasciatus*).

Antioxidant effect

The total antioxidant capacity of the acetone, ethyl acetate, petroleum ether and ethanol extracts of leaves of *Mirabilis jalapa* was measured by the ferric reducing antioxidant power (FRAP) assay. Ethanolic extract showed more antioxidant potential compared to other extracts ^[19, 100]. DPPH test was used to determine the antioxidant activity of petroleum ether, chloroform and methanol extracts of both the leaves and bark of *Mirabilis jalapa*. The methanol extract of the plant bark showed antioxidant activity with IC₅₀ value of 598.02 µg/ml compared to ascorbic acid (IC₅₀ 70.985µg/ml) ^[57, 100].

Anticancer effect

Brine shrimp lethality bioassay technique was applied to determine the cytotoxic property of petroleum ether, chloroform and methanol extracts of both the leaves and bark of *Mirabilis jalapa*. The petroleum ether extract of the bark showed significant cytotoxic activity with LC₅₀ value of 8.12 µg/ml compared to vincristine sulphate (LC₅₀ value: 0.33 µg/ml) ^[59, 99]. *Mirabilis jalapa* protein was tested for anticancer effects against different cell lines. It showed cytotoxicity against T47D and SiHa cell lines while it was relatively less cytotoxic to mononuclear cells. It showed more specific cytotoxic activity against cancer cell lines such as MACF-7, A549, and HCT 116 than the normal cell line (Vero) ^[97,98].

Anti-inflammatory effect

The total alcoholic extract (300 mg/kg) and petroleum ether fractions (200 mg/kg) of leaves of *Mirabilis jalapa* were screened for their anti-inflammatory activity using carrageenan-induced rat paw oedema and cotton pellet-induced granuloma models. The total alcoholic extract and petroleum ether fraction possessed significant anti-inflammatory activity (P<0.01). They also inhibited granuloma formation significantly (P<0.05) in the cotton pellet granuloma model, they inhibited the increase in the number of fibroblasts and synthesis of collagen and mucopolysaccharides during granuloma tissue formation ^[68, 100]. The anti-inflammatory activity of the aqueous leaf extract of *Mirabilis jalapa* was evaluated using carrageenan and formalin-induced paw oedema models in rats.

Other effects

The aqueous and alcoholic *Mirabilis jalapa* leaves extracts were examined for their inhibitory effects on hyaluronidase. The percentage of inhibition for aqueous extract was 7.5%, and for alcoholic extract was 6.25% with respect to control assays ^[98,100].

Conclusion

Mirabilis jalapa L. is used conventionally to restore a heterogeneity of human affliction.

The unbridged plant is enormously cast-off for the therapy of muscular pain, diarrhoea, inflammation, boils, Purgative etc. which are correlated with plenty of phytoconstituents including triterpenes, flavonoids, alkaloids, carbohydrates, tannins etc. From the ethnomedicinal, Phytochemical and pharmacological review it may be deduced that this plant has an assemblage of folklore profess which requires to be scientific authentication. This will in revolve conduct to the uncovering of a novel medicinal negotiator from *Mirabilis jalapa* L. *Mirabilis jalapa* subdue numerous bioactive metabolites. It takes over the outspread gamut of pharmacological and therapeutic effects embracing antimicrobial, antiparasitic, dermatological, anticancer, anti-inflammatory, analgesic, antidiabetic, antihistaminic, immune-modulatory, antispasmodic and many other pharmacological sequels. The contemporary review spotlighted the chemical elector, traditional application and pharmacological reaction of *Mirabilis jalapa*.

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Disclosure of conflict of interest

The authors confirm that this paper's content has no conflict of interest.

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