

A Review of *Mirabilis Jalapa* : Traditional Ayurvedic Herbal Remedies

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ABSTRACT

A stunning decorative plant native to tropical South America, the Four O'Clock Flower plant (scientifically known as *Mirabilis jalapa*) is now found across most of the world. Its trumpet-shaped blooms often emerge in the late afternoon, at around four o'clock, and remain open until the following morning, thus the name "Four O'Clock Flower." It is utilized worldwide in traditional medicine to treat a wide range of illnesses. Inflammations, genitourinary diseases, boils, diarrhea, muscle soreness, aphrodisiac, and stomach colic are just a few of the many conditions for which it is utilized. Numerous phytochemical products, including alkaloids, brassicasterol, carbohydrates, flavonoids, glycosides, phytosterols (beta-sitosterol and stigmasterol), oleanolic acid, trigonelline, and ursolic acid, have been identified from this plant's constituent parts. The anti-inflammatory, antimicrobial (antiviral, antibacterial, and antifungal), antioxidant and cytotoxic, antitumor, antinociceptive, antihistamine and immune modulatory, anti-tubercular induced hepatotoxic effect, antiparasitic, dermatological, hypoglycemic, and antihyperlipidemic qualities of this plant have all been investigated. In the process of creating gold nanoparticles, it is also employed as a reductant.

Keywords : *Mirabilis jalapa*, Four O' clock flower plant, Traditional medicine, Phytochemical product

I. INTRODUCTION

For thousands of years, people have used aromatic and medicinal plants, particularly those with ethnopharmacological applications, as a natural source of cures and medical care. These widely used drugs

were first crude mixtures of powders, tinctures, macerations, teas, infusions, percolation products, poultices, decoctions, tinctures, inhalations, and other herbal preparations. Traditional pharmacopeia ultimately recorded knowledge of medicinal plants, and oral tradition has passed down the exact dosage of

the plant and the method of administration for certain conditions from one generation to the next. Drug development from medicinal plants has incorporated a variety of research techniques and academic fields. The plants of interest are often collected and identified by botanists, ethnobotanists, ethnopharmacologists, and plant ecologists. The study of medicinal plants by scientists has been essential in the discovery of early medications, each with unique pharmacological properties. Taxus brevifolia yields paclitaxel, which is used to treat breast, ovarian, and lung cancer. Malaria, which is resistant to many medications, is treated using the chemical artemisinin, which is extracted from the traditional Chinese herb Artemisia annua. Hepatic problems are treated with silymarin, which is extracted from Silybum marianum seeds. The foxglove plant's constituent, digitoxin, has been used to treat heart conditions, including congestive heart failure. Originally discovered for its anesthetic properties, cocaine has long been utilized for blood vessel constriction and local anesthesia. The jaborandi plant yields pilocarpine, which has been utilized in medicine because it increases sweating and salivation. Codeine, an opioid alkaloid that comes from the opium poppy, became quite popular because it suppresses coughing and pain. Quinine was a key component in the battle against malaria and was extracted from the bark of the cinchona tree. The fact that several of these early medications, such as quinine and digitoxin, are still used in modern medicine is noteworthy and shows the ongoing importance of these compounds derived from plants. The ongoing efforts of scientists to identify and characterize pharmacologically active chemicals from medicinal plants have also led to the discovery of other molecules that show promise for treatment. To create medications derived from natural products that the medical community can use to treat life-threatening conditions like asthma, influenza, cancer, tuberculosis, diabetes mellitus, coronary artery disease, and diarrhea, biotechnology is creatively applied to plants to create plant-made pharmaceuticals. A safe,

economical, and successful substitute for traditional methods involving animal cell cultures or microbial fermentation is the development of pharmaceuticals by plant-based methods. Consequently, pharmaceuticals made from natural substances found in plants may provide patients with easier and faster access to prescription treatments. Natural products' mostly undiscovered structural diversity is their most striking feature in terms of their ongoing importance in medication research. (1)

PLANT PROFILE



TAXONOMIC CLASSIFICATION

Kingdom: Plantae

Class: Dicotyledons

Subclass: Caryophyllidae

Order: Caryophyllales

Family: Nyctaginaceae

Genus: *Mirabilis*

Species: *jalapa* (2)

SYNONYMS: *M. dechotoma*, *M. longiflora*, *M. lindheimeri*, *M. odorata* (2)

COMMON/VERNACULAR NAMES

Bengal- Krishnakeli, Sarpamani, Sandhyamaloti.

Gujrati- Gubbaji.

Hindi- Gul-abbas.

Sanskrit - Krishnakeli, Sandhykali.

Tamil- Andhimalligai, Andhimandhaarai, Antinaralu (2)

DESCRIPTION

It is a bushy, herbaceous, perennial plant that typically grows to a height of one meter, although it can occasionally grow to two meters. In the temperate zone, it may also be cultivated as an annual. The single-seeded fruits begin greenish-yellow and mature

into spherical, wrinkled, black fruits. Thick, full, quadrangular stems with many ramifications and roots at the nodes are characteristic. It is frequently in a prostrate position. The fact that blooms of all hues develop on the same plant at the same time is an interesting feature of *M. jalapa*. Furthermore, a single bloom might be splattered with many hues. Sectors (whole portions of the flower), flakes (stripes of different lengths), and dots are the terms used to describe floral designs. (3)

DISTRIBUTION

Mirabilis jalapa is a plant that is used as an ornamental in tropical regions worldwide. In the tropic regions of France, India, Latin America, and South America, this plant has become indigenous. In India, it mostly grows in the Western Himalayas, West Bengal, and Manipur. (2)

II. TRADITIONAL USES

Many individuals from many nations utilize the whole plant to treat gastrointestinal colic, diarrhea, muscle discomfort, kidney infections, and diuresis. The leaf decoction was administered topically to lessen swelling in cases of twisting or bone fractures. It is utilized for its purgative, emetic, inflammatory, and boiling effects. After being cooked in clarified butter, the leaves are attached to the abscess. The leaf paste is used to treat skin eruption, amenorrhea, and dysmenorrhea in women, and it also has emollient properties. The leaf juice, which aids in wound healing, is used as a poultice over abscesses after being gently warmed. Leaf juice is used as an eye drop to reduce irritation in the eyes. Leaf decoction is used to treat injuries and illnesses of the genitourinary system. Depigmentation is accomplished using the stem and leaves. Ayurveda, Siddha, and other ancient medical systems employ leaves and roots medicinally to treat a variety of illnesses. (2)

III. PHYTOCHEMISTRY

The presence of alkaloids, flavonoids, phenols, steroids, triterpenes, glycosides, tannins, saponins, and lignins was discovered by chemical examination of several components of *Mirabilis jalapa*. Alanine,

arabinose, campesterol, daucosterol, d-glucan, hexacon-1-ol, indicaxanthin, C-methyl abron isoflavones, n-dotriacontane, n-nonacosane, n-pentacosane, and n-triacontane were among the chemicals that were visible using TLC. Flavonoids and anthocyanins are the main components of flowers. The ether compound-3, 3'-methylene-bis-(4-hydroxycoumarin), ND-alpha phenyl glycine, laminaribitol, and 3-(4-(dimethylamino) cinnamoyl) 4-hydroxycoumarin were identified by GC-MS study of *Mirabilis jalapa* L.

The roots of *Mirabilis jalapa* were used to extract rotenoids known as mirabijalone A-D1, boeravinone C and F, 9-Omethyl-4-hydroxyboeravinone B, 1, 2, 3, 4-tetrahydro-1-methylisoquinoline-7. (4)

IV. REPORTED ACTIVITIES

In vitro, aqueous and different organic solvent (methanol, dichloromethane, and hexane) extracts of *Mirabilis jalapa* tuberous roots were tested for their anti-inflammatory properties using the heat-induced egg albumin denaturation inhibition assay and hypotonicity-induced human red blood cell (HRBC) membrane stabilization techniques. Using *Escherichia coli*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*, the antibacterial potential was assessed in vitro using both disc diffusion and well diffusion techniques. The methanolic extract of *M. jalapa* demonstrated the strongest anti-inflammatory activity ($IC_{50} = 137.9 \mu\text{g/ml}$) in the heat-induced egg albumin denaturation inhibition assay, whereas the aqueous extract of *M. jalapa* demonstrated the strongest anti-inflammatory activity ($IC_{50} = 197.4 \mu\text{g/ml}$) in the HRBC membrane stabilization method. All four extracts lacked any discernible antibacterial action.

The well diffusion approach did, however, show some inhibitory zones against *S. aureus*. The dichloromethane extract, at 400 mg/mL, demonstrated the largest inhibitory zone against *S. aureus*, measuring 15.33 ± 0.33 mm. At the same dose, the hexane extract showed an inhibitory zone of 14.00 ± 2.08 mm. At a dosage of 200 mg/mL, the

dichloromethane extract displayed an inhibitory zone of 11.00 ± 0.58 mm. (5)

Abelmoschus esculentus leaves and *Mirabilis jalapa* flowers anti-inflammatory extracts are assessed using a variety of in vitro tests. Heat-induced membrane stabilization of the extracts of *Abelmoschus esculentus* leaves and *Mirabilis jalapa* flowers revealed that the hydroethanolic extracts of the former exhibited a greater inhibition of 80.83% than that of *Abelmoschus esculentus*, which showed an inhibition of 52.76%. When 0.1g/ml of regular Diclofenac sodium was used, an 83.63% inhibition was seen. The suppression of albumin denaturation revealed The usual aspirin concentration of 0.1g/ml was found to suppress albumin denaturation by 82.61%. In comparison to *Abelmoschus esculentus*, which exhibited a maximum inhibition of 53.40% at a dose of 0.1 g/ml, *Mirabilis jalapa* had a maximum inhibition of 78.90%. The proteinase inhibition data verified that, at a dosage of 0.1g/ml, the highest proteinase inhibition was seen in *Mirabilis jalapa* (79.88%), followed by *Abelmoschus esculentus* (59.37%), and conventional aspirin (80.70%). (6)

The study used HPLC to identify qualitative phenolic and flavonoid compounds and gallic acid and kaempferol were used as standards for phenolic and flavonoid identification, respectively. The flower of *M. jalapa* was evaluated for its phenol and flavonoid content and its role in antioxidant, antibacterial, cytotoxic, and thrombolytic qualities. The ascorbic acid equivalent in crude methanol extract (MSF), petroleum ether fraction (PSF), carbon tetrachloride fraction (CTF), chloroform fraction (CSF), and ethyl acetate fraction (ESF) was found to be 334.78 ± 0.62 , 142.53 ± 0.51 , 398.04 ± 0.81 , 470.29 ± 0.55 , and 480.90 ± 0.59 mg, respectively. According to evaluations, the DPPH radical scavenging IC₅₀ values for MSF, PSF, CTF, CSF, and ESF are 13.70 ± 0.32 , 49.05 ± 0.47 , 6.76 ± 0.22 , 9.30 ± 0.41 , and 6.94 ± 0.31 µg/mL, respectively. MSF, PSF, CTF, CSF, and ESF cytotoxicity was assessed using the brine shrimp lethality bioassay, and the LC₅₀ values were $11.83 \pm$

0.32 , 35.50 ± 0.54 , 5.00 ± 0.18 , 11.30 ± 0.30 , and 4.61 ± 0.15 µg/mL, respectively, in contrast to a standard vincristine sulfate 2.50 ± 0.11 µg/mL. *E. coli*, *Salmonella typhi*, *Vibrio parahemolyticus*, *Vibrio mimicus*, *Sarcina lutea*, *Shigella dysenteriae*, *Bacillus subtilis*, *Bacillus cereus*, and *Staphylococcus aureus* were all tested for antibacterial activity in crude methanol extracts and their fractionates. Using 200.0 µg of each extraction, a distinct zone of suppression of bacterial growth was detected, ranging from 11 mm to 22 mm. The inhibitory zone widths of CTF, CSF, and ESF extracts against both gram-positive and gram-negative bacteria were noticeably larger. Mild to moderate thrombolytic activity was shown by the petroleum ether, carbon tetrachloride, chloroform, ethyl acetate, and crude methanolic extracts. Compared to streptokinase (SK), which showed clot lysis activity of $41.74 \pm 0.34\%$, ESF showed the greatest clot lysis activity ($53.81 \pm 0.52\%$), followed by CSF, CTF, MSF, and PSF. There was a statistically significant difference in the clot lysis activity between the positive and negative controls. TPC and TFC were also significantly correlated with thrombolytic activity, according to Pearson correlation analysis. (7)

The plant's seeds were gathered, allowed to air dry, ground into powder, and then exposed to gradient extraction using a soxhlate apparatus (100 g). 70% ethanol was employed as the solvent. Three different concentrations were prepared: 50% (500 mg/ml), 25% (250 mg/ml), and 12.5% (125 mg/ml). Agar well diffusion, disc diffusion, and dilution methods using distilled water as negative control were used in the extract's in-vitro antibacterial experiment. The well diffusion method's largest zone of inhibition against *Staphylococcus aureus* was 29 mm at 500 mg/ml, 18 mm at 250 mg/ml, and 12 mm at 125 mg/ml. However, the disc diffusion technique showed results against *Staphylococcus aureus* of 24 mm at 500 mg/kg, 9 mm at 250 mg/ml, and 7 mm at 125 mg/ml at the same dosages, and against *Escherichia coli*, 20 mm at 500

mg/ml, 14.3 mm at 250 mg/ml, and 8.3 mm at 125 mg/ml. (8)

The study is to perform the following tests: phytochemical screening, HPTLC fingerprint profile, and in vitro antibacterial activity of *Mirabilis jalapa* aqueous floral extract. The presence of alkaloids, anthraquinones, glycosides, flavonoids, tannins, terpenes, etc. was established by preliminary phytochemical screening. Quercetin bands were detected in the sample chromatogram (5 and 10 μ l) in HPTLC analysis. This was verified by comparing the retention factors of quercetin (R_f - 0.51) value from the sample and standard solution, as well as by the chromatogram derived from the standard quercetin. Plant extracts at concentrations of 50, 100, and 150 μ g/ml were also tested for in vitro antimicrobial activity using the disc diffusion method against harmful bacteria like *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, and *E. coli*, as well as harmful fungi like *Candida albicans* and *Trichoderma viride*. A 150 μ g aqueous floral extract demonstrated efficacy against both fungal and bacterial species. Additionally, tests for the antibacterial and antifungal properties of the common antibiotics gentamicin and amphotericin-B were also conducted. (9)

The extract of *Mirabilis jalapa* flowers (1-1000 μ g/mL) promotes the contraction of rabbit aortic muscle ($EC_{50}=11.60\pm0.26$ μ g/mL) in a concentration-dependent manner, whereas it inhibits the contractility of gut smooth muscle ($IC_{50}=18\pm0.7$ μ g/mL). The inhibition of ACh or HIS receptors, IP(3), cAMP, cGMP, intracellular storage of Ca^{2+} , or contraction-relaxation pathways mediated by protein kinase were not responsible for these effects. A serotonergic pathway that interacts with other adrenergic systems may be involved in the effects induced by the extract from *Mirabilis jalapa*. To determine the extract's active ingredients and clarify its mode of action, more research is required. (10)

The current study was conducted to examine the protective effect of ethanolic extract of *Mirabilis*

Jalapa leaves on hepatotoxicity induced by anti-tubercular drugs. Anti-tubercular drugs were used to induce hepatotoxicity in rats, and ethanolic extract of leaves of *Mirabilis Jalapa* (250 & 500 mg/kg p.o.) was administered once daily for 35 days, one hour before the administration of anti-tubercular drugs. Liver biomarkers such as SGOT, SGPT, ALP, TB, total cholesterol, and total HDL were elevated and decreased upon administration of anti-tubercular drugs. The administration of ethanolic extract of *Mirabilis Jalapa* Linn leaves at 250 mg/kg and 500 mg/kg with anti-tubercular drugs resulted in a significant reduction of liver biomarker enzymes. (11)

Mirabilis jalapa roots are used to test the hydroethanolic extract's aphrodisiac properties in vitro, in silico, and in vivo using healthy male rats. β -D-glucopyranoside, methyl-1,9-benzyl-2,6-dichloro-9H-purine, and bis-(2-ethylhexyl)-phthalate were detected by spectroscopic characterization; these substances significantly inhibit the phosphodiesterase-5 (PDE-5) enzyme in silico evaluation and minerals (such as zinc, cadmium, and magnesium). Flavonoids and phenolic substances were detected by other phytochemical studies. These minerals and phytochemicals could be involved in the extract's aphrodisiac effects. Furthermore, as compared to the normal protocol, the administration of *M. jalapa* root extract (300 mg/kg) considerably increased the rates of mount, intromission, and ejaculation while dramatically reducing the latencies of mount and intromission as well as the post-ejaculatory interval duration. Sildenafil and ginseng improved the rats' erection and sexual performance. Additionally, the extract raised testosterone and luteinizing hormone levels and considerably improved penile reflexes. In an in vitro investigation, the extract (300 mg/kg) markedly suppressed the PDE-5 enzyme. In conclusion, the thorough results of this investigation indicate that male rats' erectile dysfunction and early ejaculation are reduced by a standardized herbal extract made from *M. jalapa* roots. (12)

The purpose of this study was to assess the bioactive components of Dragonhead and *Mirabilis Jalapa* leaves and seeds. In the *Mirabilis Jalapa*, carbohydrates make up the majority (75.20%). In comparison to *Mirabilis Jalapa*, which had a protein level of 4.5–10.4%, Dragonhead had a greater Lipids and protein content of 28.5%–23.9%. Unsaturated fatty acids are abundant in *Mirabilis Jalapa* and Dragonhead oil. *Mirabilis Jalapa* and Dragonhead oils have unsaturated fatty acids that account for 79.21 and 88.55 percent of total fatty acids, respectively. While the overall concentration of saturated fatty acids in *Mirabilis Jalapa* was 17.87%, the main unsaturated fatty acids were linoleic acid (31.48%), oleic acid (20.38%), and γ -linolenic acid (18.39%). The main unsaturated fatty acids found in dragonhead seed oil are oleic acid (12.16%), linoleic acid (23.38%), and α -linolenic acid (51.88%). Investigations were conducted into the scavenging radical effect on DPPH, total phenolic and total flavonoid compounds, and ABTS radical-scavenging activity. HPLC was used to quantify the ethanolic extract's precise phenolic and flavonoid composition. The main phenolic components in the ethanolic extract of *Mirabilis jalapa* were pyrogallol, catechin, salicylic, chlorogenic, ellagic, and benzoic acid. In contrast, the phenolic compounds in the dragonhead ethanolic extract were ellagic, benzoic, salicylic, ferulic, iso-ferulic, and catechin. Hesperidin, rutin, apig-6-arbinose, apigenin, kamp-3, luteolin-7-glucose, naringin, and (2-p-comaroyl) glucose. The main flavonoids in dragonhead ethanolic extract were -7-d-neohes and quercetrin, but the main flavonoids in *Mirabilis jalapa* were naringin, hesperidin, kamp-3, (2-comaroyl) glucose, and rutin. (13)

This study set out to ascertain the chemical makeup of the methanolic leaf extract of *Mirabilis jalapa* and assess its anti-vibriocidal properties. According to the preliminary qualitative analysis, steroids, coumarins, alkaloids, tannins, glycosides, and phenols were found in the methanolic extract of *M. jalapa* leaves. With a zone of inhibition of 18.66 mm at a concentration of

100 $\mu\text{g/mL}$, the antibacterial activity against *Vibrio parahaemolyticus* was assessed, and the Minimum Inhibitory Concentration (MIC) was discovered to be 62.5 mg/mL. The molecular weights (m/z) derived from gas chromatography-mass spectrometry chromatograms were used to determine the chemical components or secondary metabolites of plants. The National Institute Standard and Technique (NIST) library's stored database was compared with the GC-MS analysis's produced spectrum peaks. GC-MS analysis revealed 29 chemical components in total; Mome Inositol (46.89%) had the greatest peak area percentage, followed by Decanoic acid (16.64%) and its derivatives. In addition, two Phthalic Acid Esters (PAEs), which are thought to be produced by bacteria, fungus, algae, and plants based on current research, were also discovered in this investigation. (14)

The study's objective is to evaluate the antiviral effectiveness of plant extracts, namely those from *Andrographis paniculata*, *Mirabilis jalapa*, and *Bougainvillea spectabilis*, against GBNV in cowpea indicator hosts. The glasshouse condition was used for the screening tests. Compared to inoculated control plants, which had 6 lesions/cm² and a 2.76 ± 0.038 OD value in DAC-ELISA, the co-inoculation spray of 6% root extract of *Mirabilis jalapa* effectively reduced the local lesions in cowpea plants to 1.50 lesions/cm² and the viral titre (0.28 ± 0.001). Gas chromatography-mass spectrometry was used to identify the bioactive compounds—cyclohexane, 1, 3, 5-trimethyl-2-octadecyl-, and dodecanoic acid—in the *M. jalapa* root extract. Using Fourier-transform infrared spectroscopy, the alcohol, halogens, and phosphorus content of *M. jalapa* was determined. (15)

The current study assesses the methanolic extract of *M. jalapa* aerial parts' phytochemical components and anti-stress properties. The presence of phenols, tannins, alkaloids, flavonoids, and saponins was determined by phytochemical analysis. This study used *Drosophila melanogaster* to report on the anti-stress properties of *M. jalapa*. SOD and CAT, two stress-related marker enzymes, were measured in

several groups. When compared to control flies, stress-induced flies are more active. The amount of these protective enzymes decreased when the plant extract was added, which improved their capacity to scavenge ROS and decreased the number of free radicals in the stressed flies. (16)

The purpose of this study is to confirm that *Mirabilis jalapa* is an effective anthelmintic, one of its ethnomedical claims. Alkaloids, carbohydrates, tannins, flavonoids, and other phytochemicals were found in the methanolic extract of leaves and aerial parts, according to preliminary phytochemical analyses. On the earthworm *Phertima prosthuma*, an anthelmintic effect has been demonstrated by the leaf and aerial component extract in a dose-dependent manner. It has taken less time to paralyze earthworms at a dosage of 30 mg/ml and a little longer to kill them, which is equivalent to the standard drug albendazole at a concentration of 10 mg/ml. (17)

Grinding was used to create nano-quercetin. The findings of this material's examination using FTIR, XRD, and FE-SEM were on the nanoscale, with diameters ranging from 13.40 to 44.66 nanometers. The materials made from nanoparticles and the *Mirabilis Jalapa* plant were tested in the living body and on laboratory mouse skin wounds at varying dosages (10, 50, and 100 mg). The study's findings demonstrated the efficacy and rapidity of healing of laboratory mice's skin injuries when a Nano-Quercetine formulation backed by *Mirabilis Jalapa* plant extract was used. The study demonstrated how a Nano-Quercetine preparation backed by *Mirabilis Jalapa* plant extract may repair lesions that harm laboratory mice's skin. In contrast to the second day of the experiment, when the average and standard deviation of wound healing were (28.00 ± 0.005 , 26.96 ± 0.398 , 25.07 ± 0.887) for concentrations of 10 mg, 50 mg, and 100 mg, respectively, the eighth day of the experiment showed a significant result in wound healing, with the average and standard deviation of healing being (1.66 ± 0.577) for the concentration of 10 mg, (0.00 ± 0.000) for the

concentration of 50 mg, and (0.00 ± 0.000) for the concentration of 100 mg. Utilizing the nano-complex of the alcoholic extract of the *Mirabilis Jalapa* plant fortified with quercetin, the results demonstrated efficient action and quick healing of lesions affecting the mice's skin. (18)

The current study set out to assess the neuroprotective potential of *Mirabilis jalapa* (MJ) fractional floral extracts (acetone, petroleum ether, methanol, and aqueous) against aluminum hydrochloride-induced neurotoxicity in male Wister rats. Out of the several fractional flower extracts of *Mirabilis jalapa* (MJ), two dosages (250 and 500 mg/kg body weight) of each extract were first chosen and given orally to the various animal groups once daily for 45 days, 30 minutes before to the administration of aluminum hydrochloride. During the nine days used to estimate the marker enzymes, a decrease in marker was noted. To determine the amounts of nitrite, thio-barbituric acid reactive substances (TBARS), superoxide dismutase (DOS), catalase, reduced glutathione, and acetylcholinesterase (AChE), the rats were decapitated and their whole brains were examined. These finding complements histopathology research and suggests that *Mirabilis jalapa* has a notable neuroprotective impact on aluminum hydrochloride-induced neurotoxicity. The cerebral cortex was extracted on the day the Wister rats were slaughtered. Half of the cerebral cortex samples from the various groups of rats treated with aluminum hydrochloride were kept for histological examination in an FAM mixture, which contains 40% formaldehyde, acetic acid, and methanol in a 1:1:8 ratio. The study found that while petroleum ether, acetone, and aqueous fractional flower extracts of MJ significantly lower the levels of nitrite, TBARS, and AChE in aluminum hydrochloride-treated groups, doses of 250 and 500 mg/kg of MJ methanolic extract significantly raise the levels of reduced glutathione, superoxide dismutase, and catalase. This finding suggests that *Mirabilis jalapa* significantly reduced the neurotoxicity caused by aluminum hydrochloride,

and histological investigations corroborate this finding. (19)

The study objectives are to identify and characterize the constituent found in the methanolic extract of *Mirabilis jalapa* tuber and assess the extract's and the isolated compound's cardioprotective qualities. Using a solvent system consisting of methanol and ethyl acetate, the bioactive component flavonoid was separated from the methanolic extract using the flash chromatography method. Based on the spectroscopic investigation, the compound's chemical structure was verified and determined to be 2-(3', 4'-dihydroxy phenyl)-3,5,7-trihydroxy chromen 4-one. Serum biomarker enzymes were significantly reduced and serum lipid profiles were returned to normal when *Mirabilis jalapa* extract and the isolated compound were administered to doxorubicin-intoxicated rats at higher doses of 200 and 400 mg/kg b.w. Additionally, compared to rats given doxorubicin as a control, there was a notable alteration in the endogenous non-enzymatic (GSH), enzymatic (SOD and CAT), and malondialdehyde (MDA) antioxidant and detoxification systems. This was accomplished because the methanolic extract of *Mirabilis jalapa* tuber contained flavonoids. (20)

The primary goal of this work was to determine through laboratory experimentation and field survey if *M. jalapa* is a Cd hyperaccumulator. The findings indicated that while *M. jalapa* did not show any obvious signs of harm while growing on soil that had 139 mg of Cd kg⁻¹, its leaves did have a low quantity of Cd (11.85 ± 3.45 mg kg⁻¹). While the bioconcentration factor (BCF) was only 0.13 ± 0.07, the translocation factor (TF) reached 3.24 ± 0.42. The Cd accumulation in the leaves of the Kunming (KM, clean site) and Lanping (LP, polluted site) populations was 81.76 and 93.88 mg kg⁻¹, respectively, when the soil Cd was artificially spiked to 175 mg kg⁻¹. The two populations' TFs were 3.98 and 4.15, respectively, and their BCFs were 0.55 and 0.48 for the KM and LP populations. Young leaves of the LP and KM populations under hydroponic conditions had Cd

concentrations of 78.5 ± 0.8 and 46.3 ± 1.2 mg kg⁻¹ at 5 mg L⁻¹ Cd treatment, respectively. Additionally, it was shown that the concentration of Cd in tissue was strongly positively correlated with the levels of total Cd, CaCl₂-extractable Cd, and TCLP-Cd (toxicity characteristic leaching procedure) in soil. *M. jalapa* was not a Cd hyperaccumulator, although it did have constitutional traits for Cd accumulation and tolerance. (21)

The roots of *Mirabilis jalapa* were used to isolate rotenoids known as mirabijalone A–D, 9-O-methyl-4-hydroxyboeravinone B, boeravinone C and F (7), and 1,2,3,4-tetrahydro-1-methylisoquinoline-7,8-diol.

These compounds' HR-EI-MS, IR, UV, 1H- and 13C-NMR (DEPT), and 2D NMR (HMQC, HMBC, NOESY) data were used to identify their structures. One of them, 1,2,3,4-tetrahydro-1-methylisoquinoline-7,8-diol inhibited HIV-1 reverse transcriptase by 48% at 210 µg/ml. (22)

Investigating lactate dehydrogenase, A (LDHA) inhibitors made from *Mirabilis jalapa* was the goal of this investigation. The protein data library provided the molecular structures of oxamate and LDHA for this investigation. Using Autodock Vina 1.1.2 software, oxamate was molecularly re-validated as a standard ligand inhibitor. Its binding energy was -4.26 ± 0.006 kcal/mol, and it interacted with LDHA at the residues Gln99, Arg105, Asn137, Arg168, His192, and Thr247. Using molecular docking, the interaction between LDHA and phytochemicals was shown. Miraxanthin-III (-8.53 ± 0.006 kcal/mol), Vulgaxanthin-I (-8.46 ± 0.006 kcal/mol), Miraxanthin-II (-7.9 ± 0.2 kcal/mol), and Miraxanthin-V (-7.96 ± kcal/mol) were the phytochemicals with the lowest binding energy and residues that were identical to those of the standard ligand. It was hypothesized that LDHA activity would be better inhibited by lower energy binding to LDHA and binding sites at these residues than by typical ligands. In silico, *Mirabilis jalapa* secondary metabolites exhibit LDHA inhibitory properties. This conclusion needs to be confirmed by more in vitro research. (23)

The systemic accumulation of a plant RNA virus in *Nicotiana benthamiana* was decreased by crude protein fractions from *Mirabilis jalapa* that included Mirabilis Antiviral Protein (MAP). To create an experimental system that would temporarily express the protein in the cell cytosol through agroinfiltration and concurrently elicit a response to investigate its antiviral effects, a MAP gene was amplified by RT-PCR from total RNAs isolated from these Iranian *M. jalapa* plants (MAP-Tehran) without the 5'-end signal peptide sequence. The amplified fragment's nucleotide and amino acid sequences were ascertained and compared to existing MAP sequences after it was initially cloned into a high-copy plasmid without promoters flanking the cloning site. The N-terminal and C-terminal portions of the protein were revealed to contain two putative ribosome inhibitor domains, respectively. For agroinfiltration, the cloned MAP-Tehran was moved to binary vectors. For bimolecular fluorescence complementation tests, only constructs expressing MAP-Tehran coupled to the N- or C- half of the monomeric red fluorescent protein were produced. On the third day following infiltration (dai), confocal microscopy revealed evidence of cell plasmolysis in *N. benthamiana* leaves agroinfiltrated with these constructs, and on the fourth day, necrotic lesions were apparent. Reduced accumulation of both a mechanically injected virus and a co-expressed reporter gene was seen in agroinfiltrated patches at 2-3 days, before the commencement of cell death. All of these effects were eliminated by simply substituting a double-alanine (Glu → Ala, Arg → Ala) in the C-terminal area inhibitor domain of the MAP constructs. The buildup of an RNA virus injected on higher, non-infiltrated leaves was not significantly impacted by agroinfiltration of either the necrosis-inducing or non-inducing MAP types. (24)

V. CONCLUSION

For thousands of years, people all around the world have utilized plants to cure, prevent, and manage a wide range of illnesses. The first advantage of taking medication produced from plants is that it is generally

safer than alternatives made of artificial materials. Among the plants used for medical and therapeutic reasons for thousands of years is *Mirabilis jalapa* Linn. (Nyctaginaceae). Originally from America, this perennial bushy plant is known as "four-o'clock" and is propagated by blooms or leaves. Ancient Mexico, Japan, China, and Brazil have all utilized it historically to treat diarrhea, gastrointestinal issues, muscular soreness, and stomach colic. According to the literature study, *M. jalapa* is used extensively as a cytotoxic, anti-inflammatory, anti-microbial, anti-diabetic, anti-oxidant, and antinociceptive medication, among other medications. *M. jalapa's* aerial parts include flavonoids and triterpenes. Flavonoids and anthocyanins make up the majority of flowers. Roots include alkaloids, resin, and carbohydrates. The leaves of *M. jalapa* were used to isolate tetracosanoic, β -sitosterol, n-hexacosanal, and tricosan-12-one. β -sitosterol, β -myrin, and β -sitosterol-D-glucoside are all found in seeds. For different medical professionals, the presence of many bioactive components justifies the entire plant. It has been widely utilized to cure a wide range of ailments in practically all folk treatments around the world. Additionally, it has been employed as a reducing agent in the synthesis of gold nanoparticles.

VI. REFERENCES

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