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Phytochemical and pharmacological evaluation of medicinal plants with diuretic activity: A systematic review of experimental evidence

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Abstract
Diuretics are substances that enhance the excretion of water and electrolytes through the kidneys and are essential in managing conditions such as hypertension, edema, and heart failure. Although synthetic diuretics are effective, their prolonged use is often linked with adverse effects like electrolyte imbalance and renal toxicity. This has increased interest in medicinal plants as safer, cost-effective alternatives rooted in traditional medicine systems. This review highlights 30 medicinal plants with reported diuretic activity, detailing their botanical identity, ethnomedicinal uses, phytochemical content, experimental design, dosage, and pharmacological findings. The diuretic potential of these plants is primarily due to the presence of flavonoids, alkaloids, tannins, glycosides, saponins, and triterpenoids that modulate renal ion transport. The mechanisms of herbal diuretics are also compared with conventional drugs, underlining both shared and unique actions. The review underscores the importance of further scientific validation to support the standardized, safe use of herbal diuretics in clinical settings.

Keywords: Diuretic activity; medicinal plants; herbal diuretics; phytochemicals; flavonoids; natriuresis; renal function

Introduction
Diuretics are substances that help the body to remove excess water and salts, primarily through increased urine output. They are widely used in modern medicine for managing health conditions such as high blood pressure, congestive heart failure, kidney disorders, and fluid retention. By promoting the excretion of sodium and water from the kidneys, diuretics reduce blood volume and lower the workload on the heart and blood vessels, making them important in cardiovascular and renal therapy [1, 2].

Despite their effectiveness, synthetic diuretics like furosemide, hydrochlorothiazide, and spironolactone often cause side effects such as electrolyte imbalance (especially low potassium), dehydration, muscle cramps, and kidney damage with prolonged use. This has led to increased interest in natural diuretic agents derived from medicinal plants, which are believed to be safer, more affordable, and culturally acceptable, especially in traditional medicine systems like Ayurveda, Unani, and Siddha medicine [3-5].

Traditional medicine systems have utilized plants for centuries to manage urinary disorders, edema, and cardiovascular conditions. Contemporary scientific studies are now increasingly supporting and validating these ethnomedical practices. Herbal diuretics work by mechanisms similar to synthetic ones such as increasing sodium excretion, reducing water reabsorption in the kidneys, or improving renal blood flow but they often do so with fewer side effects. Many of these effects are attributed to plant-derived bioactive compounds known as phytochemicals, such as flavonoids, alkaloids, tannins, saponins, glycosides, and triterpenoids, which act at different sites in the nephron [6].

Given the growing global trend toward natural health products, it becomes essential to scientifically explore, review, and document the diuretic potential of medicinal herbs. This review aims to summarize the mechanism of action of diuretics, explore key phytochemicals responsible for their activity, and highlight plants that have shown significant diuretic effects in experimental and traditional settings.

Mechanism of Action of Diuretics

Diuretics work by acting on the nephrons, the filtering units of the kidneys. Normally, the kidneys reabsorb most of the water and essential salts like sodium and potassium back into the bloodstream after filtration. Diuretics interfere with this process by blocking the reabsorption of sodium, chloride, and water at different parts of the nephron, resulting in more fluid being excreted as urine. Loop diuretics, such as furosemide, act on the thick ascending limb of the Loop of Henle by inhibiting the $Na^+/K^+/2Cl^-$ transporter, leading to high sodium and water loss. Thiazide diuretics inhibit the Na^+/Cl^- transporter in the distal convoluted tubule, while potassium-sparing diuretics act on the collecting duct, blocking sodium channels or aldosterone receptors to prevent potassium loss. Other types, such as carbonic anhydrase inhibitors, act in the proximal tubule, and osmotic diuretics increase the osmotic pressure in the nephron, pulling more water into the urine. Herbal diuretics are thought to mimic some of these mechanisms, either directly by affecting ion channels or indirectly by improving blood flow, reducing oxidative stress, or altering hormonal regulation [7-12].

1. *Carica papaya*

Carica papaya L., widely referred to as papaya, is a member of the *Caricaceae* family. Originally native to Central America, this soft-wooded, tropical species is now extensively cultivated across various regions of the world. It is widely used in traditional medicine across cultures for its therapeutic properties, including anti-inflammatory, anthelmintic, and diuretic uses. Herbal medicine often incorporates multiple parts of a single plant, including its fruits, foliage, seeds, and roots, owing to their diverse pharmacological properties. The root, in particular, has been investigated for its diuretic potential in experimental pharmacology [13].

A study evaluating the diuretic activity of *C. papaya* root extract in adult male Sprague-Dawley rats reported that oral administration of aqueous root extract at doses of 5 and 10 mg/kg significantly increased urine volume compared to the control group. The diuretic effect was found to be comparable to standard drugs such as furosemide and hydrochlorothiazide. The extract produced a dose-dependent increase in urinary potassium excretion, suggesting a kaliuretic effect, with lesser impact on sodium and chloride levels. This indicates a mechanism distinct from classical loop or thiazide diuretics. Serum analysis revealed elevated blood urea nitrogen and creatinine, raising concerns of possible nephrotoxicity at higher doses or with prolonged use. The presence of flavonoids, saponins, and high potassium content in the root extract likely contributes to the observed diuretic activity [13].

2. *Mangifera indica*

Mangifera indica, popularly known as mango, is a tropical fruit-bearing species classified under the *Anacardiaceae* family. Indigenous to India, it is a vigorous, fast-growing tree now widely propagated across tropical and subtropical climates globally. Recognized as the tallest fruit tree, it can grow up to 100 feet in height with a trunk circumference of 12-14 feet. Beyond its fruit, various parts of the plant including bark, leaves, and seeds are used in traditional medicine for their anti-inflammatory, antioxidant, and antimicrobial properties [14].

The diuretic activity of *M. indica* bark was evaluated, using ethanol, ethyl acetate, and aqueous extracts administered orally at a dose of 250 mg/kg in Wistar rats. Urine output and electrolyte levels were recorded at various intervals over 24 hours. Among the extracts, the aqueous extract showed the most significant increase in urine volume and Na^+/K^+ ratio, indicating potent natriuretic and diuretic activity. This suggests that the polar compounds present in the aqueous extract contribute effectively to diuresis, supporting the traditional use of *Mangifera indica* as a natural diuretic agent [15].

3. *Mimosa pudica*

Mimosa pudica, often referred to as the "sensitive plant" or "touch-me-not", is a low-growing herbaceous species of the *Fabaceae* family. Native to Central and South America, it may grow as an annual or perennial creeper depending on environmental conditions. This plant is notably recognized for its rapid leaf-folding response upon tactile stimulation, which serves as a natural defense mechanism against herbivores. *M. pudica* typically grows in shaded and humid environments beneath trees or shrubs. Apart from its ornamental and ethnobotanical significance, it has been traditionally used for its antimicrobial, analgesic, and wound-healing properties [16].

The diuretic activity of *Mimosa pudica* was assessed using the Lipschitz method in albino rats. Aqueous leaf extracts were administered orally at doses of 100, 200, and 400 mg/kg, while the control group received 0.9% NaCl and the standard group was treated with furosemide. Urine volume and electrolyte levels were measured via colorimetric analysis. The extract at 100 mg/kg showed significant diuretic activity, with increased excretion of sodium (Na^+, $p<0.01$), chloride (Cl^-, $p<0.01$), and potassium (K^+, $p<0.05$). Interestingly, higher doses did not enhance the diuretic effect, suggesting a dose-dependent plateau. These results indicate that *M. pudica* possesses mild yet significant diuretic properties at lower doses, potentially useful in managing fluid retention [17].

4. *Lepidium sativum:* *Lepidium sativum*, commonly known as garden cress, belongs to the *Brassicaceae* family and is widely cultivated as a culinary and medicinal herb. This annual herb exhibits rapid growth and is originally distributed across regions of southern Europe and certain areas of Asia. Traditionally, *L. sativum* seeds and leaves are used for their therapeutic benefits, including antiasthmatic, expectorant, galactagogue, antihistaminic, and diuretic properties. The seeds contain a rich source of phytochemicals such as flavonoids, glycosides, glucosinolates (e.g., glucotropaeolin), sterols, triterpenes, and alkaloids, which contribute to its diverse pharmacological effects [18].

The diuretic activity of *Lepidium sativum* (garden cress) was evaluated in Wistar rats using aqueous and methanolic seed extracts at doses of 50 and 100 mg/kg body weight. Rats were divided into six groups (n=6): control (5 mL/kg deionized water), aqueous extract (50 and 100 mg/kg), methanolic extract (50 and 100 mg/kg), and standard hydrochlorothiazide (10 mg/kg). All treatments were administered orally at a volume of 5 mL/kg after 18 hours of fasting, with free access to water, followed by an oral preload of 0.9% saline at 0.05 mL/g body weight. Each extract produced a marked diuretic effect, characterized by enhanced urinary output and elevated sodium excretion. The aqueous extract also enhanced potassium excretion, while the methanolic extract exhibited a potassium-sparing effect. The diuretic response was comparable to that of hydrochlorothiazide, supporting the traditional use of *L. sativum* seeds as a natural diuretic in the management of fluid retention and renal disorders [19].

5. *Coriandrum sativum*

Coriandrum sativum L., commonly known as coriander and belonging to the family *Umbelliferae (Apiaceae)*, is an aromatic annual herb widely cultivated in tropical and subtropical regions including India, Egypt, and Europe. The plant grows up to 30-60 cm tall with finely divided leaves and compound umbels of small white or pinkish flowers. Its dried fruits (seeds) are spherical, yellow-brown schizocarps, widely used as a spice and in traditional medicine. Coriander is valued for its digestive, anti-inflammatory, antiseptic, and tonic properties and contains bioactive compounds such as flavonoids, caffeic acid derivatives, sesquiterpene lactones, coumarins, and essential oils which contribute to its pharmacological effects [20, 21].

The diuretic potential of *Coriandrum sativum* has been studied using aqueous seed extracts administered intravenously at doses of 40 and 100 mg/kg body weight in Wistar rats, with furosemide (10 mg/kg) as a standard. The extract induced a significant, dose-dependent increase in urine volume and electrolyte excretion (Na^+, K^+, and Cl^-), although its diuretic efficacy was lower than furosemide by approximately 10 to 21 fold. The results suggest that coriander acts similarly to a loop diuretic by inhibiting the $Na^+/K^+/2Cl^-$ symporter in the thick ascending loop of Henle, leading to natriuretic and kaliuretic effects. This supports its traditional use as a natural diuretic and saluretic agent with a relatively balanced sodium-potassium excretion profile [22].

6. *Foeniculum vulgare*

Foeniculum vulgare, commonly known as fennel, is a perennial or biennial herbaceous plant belonging to the family Apiaceae (Umbelliferae). It typically grows up to 2.5 meters in height and has glabrous, glaucous stems. The leaves are pinnate with triangular, filiform lobes that end in cartilaginous tips. The plant produces small yellow oblong flowers arranged in umbels, and its fruit are oblong, measuring 4 to 10.5 mm in length. Native to the Mediterranean region, fennel is now widely found across Europe, India, Japan, Egypt, and other parts of the world [23, 24].

The diuretic activity of *Foeniculum vulgare* has been investigated using ethanolic extracts of dried ripe fruits administered orally at a dose of 500 mg/kg body weight in male Wistar rats, with urea (960 mg/kg) used as a reference standard. Results showed a significant increase in urine output sustained for approximately 24 hours, indicating a long-acting diuretic effect comparable to that of urea. Notably, this diuresis was not associated with increased sodium or potassium excretion, suggesting an osmotic diuretic mechanism similar to urea. Phytochemical analysis identified sterols, triterpenes, flavonoids, coumarins, and volatile oils, which likely contribute to the observed diuretic effect. These findings validate the traditional use of *Foeniculum vulgare* as a safe, effective diuretic agent free from significant saluretic or kaliuretic effects [25, 26].

7. *Taraxacum officinale*

Taraxacum officinale, commonly known as the common dandelion, is a flowering herbaceous perennial plant belonging to the family *Asteraceae.* It has a basal rosette of deeply toothed, lance-shaped leaves and a hollow, leafless flower stalk that can grow up to 40 cm tall, topped with bright yellow composite flower heads. The plant produces a milky latex and a taproot system that is often used as a coffee substitute when roasted. Widely distributed across temperate regions, the leaves are commonly consumed fresh in salads or brewed as tea, while the roots are occasionally used for their medicinal properties. Traditionally, the leaves and roots have been employed in treating liver, gallbladder, kidney, and joint ailments, and the plant is also considered a natural remedy for conditions such as eczema and cancer [23, 24].

The diuretic potential of *Taraxacum officinale* has been confirmed in experimental studies. Oral administration of a high dose (2 g/kg body weight) of aqueous extract from the dandelion leaves in mice produced diuresis comparable to the loop diuretic furosemide. Moreover, *T. officinale* is rich in potassium, which may help to counteract potassium loss during increased urine output, a common side effect of many synthetic diuretics. This potassium-replenishing property, along with its diuretic activity, supports the traditional use of dandelion as a safe and effective natural diuretic agent [27].

8. *Aerva lanata*

Aerva lanata, locally known as Pasanabheda, is a vertically growing herbaceous species belonging to the *Amaranthaceae* family. It is characterized by its clusters of small flowers that range in colour from white to light pink. It is widely distributed across India, Sri Lanka, Africa, and Southeast Asia. Traditionally used in Ayurveda as a decoction for urinary infections and kidney stones, it also exhibits diuretic, analgesic, anti-inflammatory, antidiabetic, and anti-venom properties. It is employed in the management of bronchitis, nasal bleeding, scorpion stings, and for postpartum uterine cleansing [28-30].

The diuretic activity of Aerva lanata extracts was evaluated using graded oral doses of 200, 400, 800, and 1600 mg/kg, with furosemide (25 mg/kg) used as the standard reference. Extraction was carried out using the aerial components, including stems and foliage. The extracts significantly increased urine volume and promoted enhanced excretion of key electrolytes sodium (Na^+), potassium (K^+), and chloride (Cl^-) demonstrating dose-dependent natriuretic and saluretic effects. At the highest dose of 1600 mg/kg, the diuretic response was comparable to that of furosemide, indicating strong efficacy. Phytochemical analysis revealed the presence of steroids, alkaloids, flavonoids, glycosides, and carbohydrates, which may contribute to the observed pharmacological actions. No adverse effects or mortality were observed in acute toxicity tests conducted up to a dose of 3000 mg/kg, indicating a favorable safety margin for the extracts. Furthermore, chronic administration of test solutions at 18 ml/kg/day for 30 days maintained diuretic activity, suggesting sustained renal electrolyte elimination and fluid clearance. These findings support the potential of Aerva lanata as a natural diuretic agent with natriuretic and saluretic properties [31-33].

9. *Achyranthes aspera Linn.*

Achyranthes aspera Linn, referred to as Apamarga in Ayurveda and Latjeera in Hindi, is a species of the *Amaranthaceae* family characterized by its upright or sprawling growth habit. It may exhibit either annual or perennial life cycles depending on the environment. It is widely distributed throughout India, growing along roadsides, field boundaries, and waste places up to an altitude of 2100 meters. The plant is traditionally used in Ayurvedic medicine for its diverse pharmacological properties, including antiparasitic, hypoglycemic, hepatoprotective, anti-inflammatory, analgesic, antipyretic, spermicidal, and antiarrhythmic activities [34, 35].

The diuretic activity of *Achyranthes aspera* has been

scientifically investigated using methanolic extracts of the whole plant. Using the Lipschitz method with furosemide (100 mg/kg body weight) as a standard, oral administration of the extract at 400 mg/kg body weight in rats showed significant diuretic effects. Although the diuretic action was less potent compared to furosemide, treated rats exhibited increased renal clearance and excretion of sodium (Na^+), potassium (K^+), and chloride (Cl^-) ions, confirming the plant's traditional use as a natural diuretic agent [36, 37].

10. *Bixa Orellana:* *Bixa orellana,* commonly known as the lipstick tree, is a shrub or small tree belonging to the family *Bixaceae*. It is widely cultivated in the West Indies, tropical Asia, and Africa, valued both for its seeds and ornamental use. The plant gets its common name from its traditional use by indigenous American tribes to produce body paint, especially for lips. The leaves of *Bixa orellana* exhibit potent antibacterial activity, particularly against Gram-positive bacteria such as *Bacillus pumilus*, and have been used in folk medicine to treat diseases like leishmaniasis and malaria [38, 39].

The diuretic activity of *B. orellana* has been scientifically evaluated by administering methanolic leaf extracts (500 mg/kg) to Wistar rats. This treatment resulted in a significant increase in urine volume and enhanced excretion of Na^+, K^+, and Cl^- ions when compared to furosemide-treated controls Acute toxicity assessments conducted in Wistar rats (n = 6 per group) showed that oral doses up to 1000 mg/kg of petroleum ether, methanolic, or aqueous extracts suspended in groundnut oil produced no mortality over 72 hours; animals were monitored intensively during the first 6 hours and at 24-hour intervals thereafter These findings suggest that *Bixa orellana* leaf extracts are relatively safe at these doses and exhibit potent diuretic effects [40].

11. *Euphorbia thymifolia Linn*

Euphorbia thymifolia Linn., commonly known as laghududhika or choti-dudhi, is a small-branched, pubescent, perennial herb belonging to the family *Euphorbiaceae.* This prostrate-growing plant is characterized by its milky latex, which is typical of many species in the genus Euphorbia. Traditionally, *E. thymifolia* holds significant importance in Ayurvedic medicine, where it is valued for its stimulant, astringent, and anthelmintic properties. It has been widely used in the treatment of various ailments, including helminthic infestations (worm infections), respiratory disorders such as cough and bronchitis, and a range of dermatological conditions like eczema and wounds. The plant's pharmacological actions are attributed to its diverse phytochemical constituents, which include flavonoids, tannins, diterpenoids, and phenolic compounds, contributing to its broad therapeutic potential [41].

Pharmacological studies have evaluated the diuretic effects of this plant using ethanolic extracts. In dose-dependent experiments, albino rats received oral doses of 100, 200, and 400 mg/kg body weight of the crude extract and its fractions. The treatments resulted in significant increases in both urine volume and electrolyte (Na^+, K^+, Cl^-) excretion compared to controls, with the 400 mg/kg dose producing the most pronounced effect comparable to or exceeding standard diuretic drugs in some measures. These findings strongly support the role of phenolics, flavonoids, and steroidal constituents in mediating the observed diuretic action and validate the traditional use of *E. thymifolia* as a natural diuretic agent [42].

12. *Raphanus sativus Linn*

Raphanus sativus Linn., widely recognized as radish and traditionally called "Muli" in India, belongs to the *Brassicaceae (Cruciferae)* family. It is widely cultivated throughout India as well as in tropical and temperate regions worldwide, thriving at altitudes up to 5000 meters. Various plant parts including roots, seeds, and leave are traditionally employed in Ayurvedic and folk medicine for their therapeutic benefits. Classified as *ushna virya* (hot potency), radish is valued for its digestive properties and its ability to balance the three doshas (Vata, Pitta, and Kapha). Medicinally, it is used to improve voice quality, reduce fever, relieve respiratory difficulties such as dyspnea, and treat throat and eye disorders. The seeds exhibit emmenagogue, diuretic, laxative, and lithontriptic activities, contributing to their traditional use in menstrual regulation, urinary tract health, and kidney stone management. Additionally, the fresh root juice is recognized for its potent antiscorbutic action, making it useful in the prevention and treatment of scurvy [43, 44].

The diuretic potential of *Raphanus sativus* Linn. (radish) has been scientifically validated through pharmacological studies using its aqueous root extract in Wistar albino rats. Administered at graded doses of 100, 300, and 400 mg/kg body weight, the extract significantly increased urine output and sodium excretion, indicating a prominent natriuretic effect comparable to standard diuretics. This suggests its action may involve enhanced glomerular filtration and modulation of renal tubular electrolyte transport. The presence of phytoconstituents such as flavonoids, glycosides, alkaloids, and essential oils is thought to contribute to its diuretic activity by promoting renal vasodilation, increasing urine flow, and facilitating electrolyte elimination. These results scientifically support the traditional use of *Raphanus sativus* in Ayurvedic medicine for the treatment of urinary disorders, edema, and hypertension [45, 46].

13. *Dolichos biflorus Linn*

Dolichos biflorus Linn., commonly known as Horse Gram and locally called Kulti or Kulthi, belongs to the *Fabaceae (Leguminosae)* family. It is an annual herb that is branching, suberect or twining in nature and is cultivated across India for both culinary and medicinal purposes. The dried seeds of *D. biflorus* are traditionally used in Ayurveda for their pungent, astringent, diuretic, and tonic properties. Described as hot in potency (Ushna Virya), the seeds are known to alleviate Kapha and Vata disorders, and are used in the treatment of dyspnea, cough, renal calculi, seminal disorders, flatulence, rhinitis, and fever. They are also reputed to induce perspiration, reduce fat, and correct metabolic imbalances involving Pitta and Rakta doshas [44].

The aqueous and alcoholic seed extracts of *Dolichos biflorus* have been scientifically studied for their diuretic properties. In an experimental study Wistar rats were administered *D. biflorus* seed extract at doses of 100, 250, and 500 mg/kg body weight, resulting in a significant increase in urine volume and urinary electrolyte excretion (Na^+, K^+, Cl^-) compared to control animals. The study supports traditional claims of its diuretic and antiurolithiatic properties, which are attributed to bioactive constituents such as flavonoids and phenolics [47, 48].

14. *Xanthium strumarium L*

Xanthium strumarium L., commonly known as Gokh or Kutta Zad in India and referred to as Shankeshwara or Arishta in

Ayurveda, belongs to the *Compositae (Asteraceae)* family. It is a widely distributed annual herbaceous weed, found predominantly in wastelands throughout India. The whole plant, especially the roots and fruits, are traditionally used in Ayurvedic and Unani systems of medicine. According to traditional knowledge, the plant acts as a blood purifier, and is used in the management of skin diseases such as scabies, epilepsy, leucoderma, and insect bites. Ayurvedic texts also describe it as an anthelmintic, antipyretic, diuretic, cooling agent, laxative, alexiteric, tonic, digestive, and complexion enhancer [44, 49].

The diuretic potential of *X. strumarium* was scientifically investigated in albino rats. The petroleum ether extract was administered at doses of 250 and 500 mg/kg body weight, and compared with the standard drug furosemide (5 mg/kg b.w.). Results showed a dose-dependent increase in urine volume, natriuresis (Na^+ excretion), kaliuresis (K^+ excretion), and chloride excretion (Cl^-), along with enhancement in glomerular filtration rate (GFR). The observed diuretic activity was attributed to the presence of flavonoids, saponins, and organic acids. It was suggested that either direct renal effects or secondary changes in physiological parameters may be responsible for the increased diuresis [50].

15. *Nyctanthes arbor-tristis Linn.*

Nyctanthes arbor-tristis Linn. belonging to the *Oleaceae* family, is a prominent plant in traditional medicine, extensively grown in tropical and subtropical areas of India and nearby countries. Commonly identified as Harsingar, Parijat, or Night-flowering Jasmine, this species holds a significant place in Ayurvedic medicine due to its broad range of therapeutic applications. The plant is a small tree or shrub with fragrant white flowers that bloom at night and fall by morning hence the name "Tree of Sadness" (*arbor-tristis*). Various parts of the plant such as the leaves, bark, flowers, and seeds have been used in traditional medicine for treating fever, arthritis, skin infections, helminthiasis, and more. Its pharmacological properties include antioxidant, antibacterial, anti-inflammatory, hepatoprotective, antileishmanial, and immunomodulatory activities [51].

The diuretic activity of *Nyctanthes arbor-tristis* was studied using ethanolic extracts of the plant's flowers, seeds, bark, and leaves. Wistar albino rats received the extracts by oral route in varying concentrations of 200, 400, and 600 mg/kg to evaluate dose-dependent effects. Results showed a significant increase in urine output and electrolyte excretion (Na^+, K^+, Cl^-), particularly in the groups treated with seed and leaf extracts. The extracts were found safe up to 2 g/kg, suggesting a good safety profile. The diuretic effects were attributed to the presence of bioactive phytochemicals such as flavonoids and glycosides [52].

16. *Elettaria cardamomum*

Elettaria cardamomum (L.) Maton, commonly known as Cardamom or Chhoti Elaichi in Hindi, belongs to the family *Zingiberaceae*. It is a perennial herb cultivated widely in tropical regions, particularly in India and Sri Lanka. The dried fruits (capsules) and seeds are the primary medicinal parts used. In traditional systems like Ayurveda and Unani, cardamom has been valued for its carminative, stomachic, diuretic, antibacterial, antiviral, antifungal, and abortifacient properties. It is also employed in the treatment of ailments such as constipation, diarrhea, epilepsy, and cardiovascular disorders. Phytochemical analysis has revealed that the plant contains a wide range of bioactive compounds including alkaloids, flavonoids, tannins, saponins, and essential oils, which may contribute to its therapeutic actions [53].

The diuretic property of *Elettaria cardamomum* was evaluated in a study using Wistar rats, where crude aqueous, petroleum ether, chloroform, and ethyl acetate extracts of the fruit were administered. Among these, the crude extract (400 mg/kg body weight) showed significant diuretic activity, as evidenced by an increase in urine output and excretion of electrolytes such as sodium (Na^+) and potassium (K^+). These effects were comparable to the standard loop diuretic, furosemide (10 mg/kg). The presence of flavonoids and saponins in the extracts is believed to play a major role in the observed diuretic and saluretic effects. These findings support the ethnopharmacological use of cardamom as a natural diuretic agent in traditional medicine [54].

17. *Cola nitida*

Cola nitida, commonly known as kolanut, belongs to the family Sterculiaceae and is traditionally valued across tropical Africa for its medicinal properties. It is used in the treatment of migraines, morning sickness, cough, asthma, malaria, and various metabolic disorders. Phytochemical investigations have identified the presence of alkaloids, flavonoids, tannins, phenolics, and notable levels of caffeine and theobromine, which are primarily responsible for its stimulant and therapeutic actions. These bioactive constituents contribute to its anti-inflammatory, bronchodilator, and central nervous system stimulant properties, supporting its widespread ethnomedicinal applications [55].

The diuretic activity of *Cola nitida* was assessed using methanolic extracts administered orally to male Wistar rats at doses ranging from 100 to 600 mg/kg over a 14-day period, with furosemide serving as the standard diuretic control. The treatment produced a significant increase in urine output and electrolyte excretion (Na^+, K^+, Cl^-) compared to the control group. These effects were dose-dependent, with 300-600 mg/kg showing higher potency than furosemide. Additionally, treated rats exhibited enhanced water intake and body weight gain, while food intake remained unchanged. Notably, reductions in plasma and renal ALT, AST, creatinine, and urea concentrations were observed, indicating a possible nephroprotective effect. The diuretic and natriuretic actions are primarily attributed to caffeine, which at an effective dose of 250 mg promotes natriuresis and increased urine volume. Another component, theophylline, has been reported to elevate glomerular filtration rate (GFR) and renal blood flow, thereby inhibiting tubular reabsorption of sodium and water [56-58].

18. *Opuntia ficus-indica*

Opuntia ficus-indica (L.) Mill., commonly known as prickly pear, belongs to the family *Cactaceae* and is native to the Americas but now widely distributed across Africa, Asia, and Australia. It is one of the most extensively cultivated and domesticated *Opuntia* species, particularly abundant in Mexico, where it is referred to as *nopal* (cladodes) and *tuna* (fruit). The plant is highly valued for its nutritional and medicinal properties. It contains a wide spectrum of bioactive compounds, including carotenoids, betalains, flavonoids (quercetin, kaempferol, isorhamnetin), phenolic acids (ferulic, coumaric, gallic), essential fatty acids, In traditional medicine, *Ficus-indica* has been employed to address various ailments, including dermatological conditions, ulcers, inflammatory disorders, and metabolic issues like diabetes [59, 60].

Opuntia ficus-indica has demonstrated notable diuretic

activity in both rats and rabbits using cladode gel and aqueous extracts. Oral administration in rats significantly increased urine volume, sodium and potassium excretion, and creatinine clearance, without markedly affecting serum creatinine or blood urea levels. The observed outcomes closely resembled those produced by furosemide, suggesting that the extract may act through a comparable pharmacological pathway. The diuretic response is attributed to flavonoids, particularly isorhamnetin glycosides, which modulate renal tubular ion transport. In experimental studies, rats treated with 100 mg/kg of extract or gel showed significant diuretic responses over 24 hours and during an 8-day subacute protocol involving daily urine collection and electrolyte analysis. On day eight, plasma electrolytes and creatinine were assessed, and renal function was evaluated through creatinine clearance, osmolar clearance, and free water clearance The results support the classification of *Ficus-indica* as a natural agent with diuretic activity resembling that of standard loop diuretics [61, 62].

19. *Urtica dioica*

Urtica dioica, commonly known as stinging nettle, belongs to the family *Urticaceae* and is native to Africa, Asia, Europe, and North America. It is an herbaceous perennial plant that grows up to 2 meters tall during the summer and regresses in winter. The plant is easily recognized by its soft, serrated leaves, which are 3-15 cm in length and covered in hollow, silky, brittle hairs containing formic acid, a defense compound causing the characteristic sting upon contact. Traditionally, *U. dioica* has been widely used for its anti-inflammatory properties, as well as for managing benign prostatic hyperplasia, diabetes, hypertension, and urinary tract disorders, particularly in countries like Mexico, Morocco, and Guatemala [63].

The diuretic potential of *Urtica dioica* has been evaluated in two studies. In the first, which screened 67 medicinal plants, no significant change in urine volume (UV) was observed within 6 hours of administration, and hence urinary solute measurements were not pursued. However, a second study in anesthetized rats provided more conclusive evidence. *U. dioica* was infused intravenously at doses of 4 and 24 mg/kg, which resulted in a dose-dependent reduction in arterial blood pressure by 17 and 43 mmHg, respectively (baseline 114 mmHg), and increased urine production. The hypotensive effect at the higher dose was comparable to that of furosemide (2 mg/kg), which reduced pressure by 31 mmHg. These findings suggest that direct infusion of *U. dioica* exerts vasodilatory, diuretic, and natriuretic effects, likely due to its influence on arterial tone and renal excretory function, although further studies with standard controls are required for validation [64, 65].

20. *Olea europaea*

Olea europaea, a member of the Oleaceae family, is widely recognized for its medicinal and nutritional importance. It is an evergreen tree or shrub that typically grows to a height of 8-15 meters, with silver-green oblong leaves (4-10 cm long, 1-3 cm wide) and a gnarled trunk. The tree bears drupe-shaped fruits (1-2.5 cm in length), widely recognized for their culinary and medicinal value. Native to Europe, Asia, and Africa, it is cultivated extensively in Mediterranean and subtropical regions for its fruits and oil. Traditionally, *O. europaea* has been used in various systems of medicine as a diuretic, antihypertensive, emollient, febrifuge, and for treating urinary tract infections, bladder issues, headaches, and cardiovascular conditions [66].

The diuretic activity of *Olea europaea* has been demonstrated through the evaluation of various plant extracts, including the triterpenoids ursolic acid and oleanolic acid, in experimental models using rats. Test animals received intraperitoneal injections of the extracts, and urine output was measured at 5 and 24 hours post-administration. Results were compared with a placebo control (urea, 1 g/kg) and a standard diuretic (hydrochlorothiazide, 25 mg/kg). A significant increase in urine volume was observed with both the plant extract and its active constituents, indicating diuretic efficacy comparable to that of the standard drug. The observed activity is attributed primarily to oleanolic acid, which is known to enhance natriuresis and diuresis, supporting the traditional use of *O. europaea* in the management of fluid retention and hypertension [67].

21. *Sambucus Mexicana*

Sambucus mexicana, belonging to the family *Caprifoliaceae*, is a fast-growing shrub or small tree native to Central America and Mexico. It typically grows up to 10 meters in height, bearing pinnate leaves with serrated leaflets and producing clusters of small red to black berries. Unlike the more commercially popular *S. mexicana* has remained largely underutilized in global markets. However, in traditional Mexican medicine, it has been employed for its antipyretic, anti-inflammatory, and urinary therapeutic properties, particularly for treating urinary tract disorders, fever, and respiratory conditions. Despite its limited commercialization, the ethnomedicinal value of *S. mexicana* is significant in indigenous healing systems of Guatemala and surrounding regions [68].

The diuretic potential of *Sambucus mexicana* was investigated using ethanolic extracts of its leaves in laboratory rats. The extract was administered orally at a dose of 500 mg/kg body weight, and urine output was measured and compared to that of the control group. Results indicated a substantial rise in urinary volume, aligning with and validating the plant's longstanding use in traditional medicine for promoting diuresis. The observed activity is attributed to the presence of bioactive secondary metabolites such as flavonoids, glycosides, and phenolic compounds, although the specific active constituents responsible for the diuretic effect were not isolated. These findings suggest that *S. mexicana* exhibits diuretic efficacy comparable to established herbal diuretics, making it a promising candidate for further pharmacological and phytochemical evaluation [69].

22. Spergularia purpurea

Spergularia purpurea, commonly known as "Ghazal al-bahr" in Moroccan traditional medicine, is a small herbaceous plant belonging to the family *Caryophyllaceae*. It may be glabrous or pubescent and typically thrives in sandy soil habitats. The plant grows to a height of about 5-15 cm with a stem width of 2-2.5 cm. Its leaves are rosette-arranged, measuring 8-40 mm in length, and it bears rose-purple flowers approximately 3-4.5 mm long. Native to Asia and Europe, *S. purpurea* has been traditionally used in Moroccan herbal medicine. A water-based extract of the whole plant is commonly prepared and employed in the treatment of renal disorders, diabetes, and hypotension, highlighting its importance in folk medicinal systems [70].

The chronic diuretic activity of the aqueous extract of *Spergularia purpurea* was evaluated in normal rats administered orally at doses of 100, 200, and 400 mg/kg for 4 weeks. Urinary output and electrolyte excretion were assessed

weekly. The extract produced a clear dose-dependent increase in urine volume and urinary levels of sodium, potassium, and chloride. At the highest dose (400 mg/kg), urine output increased from 7.15 mL to 23.01 mL over the study period. The extract also enhanced the excretion of urinary electrolytes and reduced urine osmolality, while a mild increase in glomerular filtration rate was noted at both low and high doses. These findings indicate that *S. purpurea* possesses significant diuretic properties, likely through mechanisms involving improved renal elimination of fluids and electrolytes [71].

23. *Elephantopus scaber*

Elephantopus scaber, a member of the *Asteraceae* family, is an erect, rough-textured herbaceous species, locally referred to as "Mayurasan" or "Gojihva" in Hindi. It is commonly found across tropical and subtropical areas of India, Southeast Asia, and parts of the Americas.It typically reaches a height of 20-40 cm and is distinguished by a basal rosette of rough, ovate leaves with serrated margins, covered in fine hairs. The stem is often hairy and branched, and the plant produces small, purplish to lavender flower heads arranged in terminal clusters. *E. scaber* is traditionally used in various folk systems of medicine for its analgesic, anti-emetic, anti-inflammatory, and antimicrobial properties. It is employed in the treatment of bronchitis, smallpox, diarrhea, and has also shown potential cytotoxic and anti-tumoral effects in preliminary studies [72].

The diuretic potential of *Elephantopus scaber* has been recognized in traditional medicine, particularly in Brazil, for promoting urination and aiding in the elimination of bladder stones. However, experimental studies have reported inconclusive outcomes. In an animal study, aqueous and hydroalcoholic extracts of the whole plant were administered orally to conscious rats at doses ranging from 0.3 to 6 g/kg. Urine output was monitored over a 3-hour period, but no significant increase in urine volume was observed compared to control animals. Moreover, urinary sodium excretion (UNa^+) was not assessed, limiting evaluation of any natriuretic effect. Intraperitoneal administration at the same dose range also failed to produce a diuretic response. The outcomes suggest that despite the longstanding ethnomedicinal use of *E. scaber* for promoting diuresis, scientific evidence from this study remains inconclusive [73].

24. *Boerhavia diffusa Linn*

Boerhavia diffusa Linn., commonly known as *Punarnava*, belongs to the *Nyctaginaceae* family and is a well-known medicinal herb extensively used in Ayurvedic, Unani, and folk medicine. It is distributed throughout India, tropical Asia, Africa, and the Americas. This species grows as a low-lying, perennial herb with a trailing habit, characterized by reddish stems and delicate pink flowers.Traditionally, *B. diffusa* has been used for a variety of therapeutic purposes including as a diuretic, hepatoprotective, anti-inflammatory, anti-asthmatic, and antioxidant agent. The roots are especially valued for their renoprotective and urogenital applications, being used in the management of edema, ascites, kidney stones, and hypertension [74].

The diuretic activity of *Boerhavia diffusa* has been evaluated in several experimental models. In one study, an aqueous extract of the plant was administered orally to Wistar rats at doses ranging from 100 to 400 mg/kg, and the diuretic effect was compared with furosemide (10 mg/kg). Results demonstrated a significant increase in urine volume, urinary sodium (Na^+) and potassium (K^+) excretion, and chloride (Cl^-) content without causing electrolyte imbalance. The bioactive compound punarnavine, an alkaloid, along with flavonoids and rotenoids, is believed to contribute to its natriuretic and aquaretic properties. The findings support the ethnomedicinal claim of *Boerhavia diffusa* as an effective natural diuretic agent, particularly useful in conditions requiring controlled diuresis and fluid regulation [74].

25. *Cyclea peltata*

Cyclea peltata (Lam.), belonging to the family *Menispermaceae*, is a perennial, twining climber widely distributed in the tropical and subtropical regions of India and Southeast Asia. Commonly known as "Velvety Moonseed", and locally referred to as "Rajapatha" in Ayurveda and "Patha" in Hindi and Malayalam, it holds significant value in traditional medicinal systems. The plant is recognized for its therapeutic applications, particularly in polyherbal formulations. Botanical parts used include the roots, leaves, and stems, which are traditionally employed for their anti-inflammatory, antipyretic, hepatoprotective, and diuretic effects. Phytochemical analyses have identified the presence of alkaloids, flavonoids, terpenoids, and glycosides, which are believed to contribute to the pharmacological activities of the plant [75].

The diuretic potential of *Cyclea peltata* has been scientifically validated through experimental studies using Wistar rats. Ethanolic root extract administered orally at doses of 250 and 500 mg/kg produced a dose-dependent increase in urine output along with significant elevation in urinary sodium and potassium excretion, effects that were comparable to the standard diuretic furosemide (10 mg/kg). Another study evaluated both petroleum ether and ethanolic leaf extracts using the Lipschitz method, where rats received 200 mg/kg and 300 mg/kg of extract, respectively. Furosemide (20 mg/kg) served as the reference drug, and saline (2.5 mL/100 g) as control. Urine was collected over a 5-hour period in metabolic cages, and urinary electrolytes (Na^+, K^+, Cl^-) were estimated using flame photometry and titration methods. Both extracts led to a significant increase in urine volume and electrolyte excretion, supporting the plant's traditional use in managing renal and urinary disorders. The observed activity is likely attributable to the presence of polar phytochemicals, including alkaloids and flavonoids, which influence renal ion transport and promote natriuresis and kaliuresis [76, 77].

26. *Geranium seemannii Peyr*

Geranium seemannii Peyr., belonging to the *Geraniaceae* family, is a perennial herb traditionally used in Mexican herbal medicine. In Hindi, it is locally referred to as Sher ki Panja. It is commonly employed for the treatment of renal and urinary tract disorders, as well as for managing inflammation and dysentery. The plant contains a wide range of secondary metabolites, including tannins, flavonoids, and phenolic compounds, which contribute to its pharmacological actions. Ethnobotanical records highlight its use in herbal infusions aimed at promoting diuresis and detoxification [78].

The diuretic potential of *Geranium seemannii* was evaluated in Wistar rats using ethanolic extracts administered orally at doses of 25 mg/kg and 50 mg/kg. The study, based on the Lipschitz method, demonstrated a significant increase in urine volume and urinary sodium excretion compared to controls, indicating both diuretic and natriuretic effects. Although less potent than the standard drug furosemide (20 mg/kg, i.p.), the

extract produced a dose-dependent enhancement in urinary output. The mechanism is attributed to flavonoid-mediated inhibition of renal tubular sodium reabsorption. Urinary electrolytes (Na^+, K^+, Cl^-) were measured using an ion-sensitive electrode analyzer, and no significant alterations in serum electrolyte balance were observed, supporting the renal safety of the extract. The experimental outcomes reinforce traditional claims regarding the diuretic effects of *G. seemannii* and suggest its relevance as a candidate for further development in plant-based diuretic formulations [78].

27. *Diospyros malabarica*

Diospyros malabarica (Desr.) Kostel, also known as *Diospyros peregrina*, belongs to the family Ebenaceae and is native to India, Sri Lanka, and Southeast Asia. It is a medium-sized deciduous tree, commonly found in tropical forests and riverine regions. Traditionally, various parts of this plantparticularly the bark, unripe fruit, and seeds are used in Ayurvedic and folk medicine for treating fever, diarrhea, dysentery, ulcers, wounds, and urinary disorders. Phytochemical studies have revealed that the plant contains tannins, triterpenoids, saponins, flavonoids, and phenolic compounds, which are responsible for its therapeutic activities, including astringent, antimicrobial, and anti-inflammatory effects [79].

The diuretic activity of *Diospyros malabarica* was investigated using aqueous and methanolic extracts in experimental models. In one animal study, rats administered aqueous extract at doses of 200-400 mg/kg body weight exhibited a significant increase in urine output, sodium excretion, and urinary electrolyte balance when compared to the control group. The increase in Na^+ and K^+ excretion, along with elevated urine volume, indicates both natriuretic and diuretic effects. Although not as potent as furosemide, the extract displayed statistically significant activity, suggesting a mild to moderate diuretic potential, likely mediated through flavonoid-induced renal tubular effects and polyphenol-driven modulation of renal function [80].

28. *Orthosiphon stamineus*

Orthosiphon stamineus Benth., commonly known as “Cat’s Whiskers”, belongs to the family Lamiaceae and is a medicinal herb native to Southeast Asia, especially Malaysia, Indonesia, and Thailand. It is a fast-growing, bushy plant with purple or bluish-white bilabiate flowers and long, filamentous stamens resembling a cat’s whiskers. The aerial parts, particularly the leaves and flowering tops, are used in traditional medicine to prepare decoctions or teas. These preparations are popularly consumed for managing renal calculi, hypertension, edema, urinary tract infections, and metabolic disorders such as diabetes. Phytochemical studies have revealed the presence of numerous bioactive constituents including flavonoids (e.g., sinensetin, eupatorin), polyphenols, diterpenes, and rosmarinic acid, which are thought to mediate its diuretic, antioxidant, anti-inflammatory, and antihypertensive actions .The plant’s wide range of therapeutic effects has made it a staple in both ethnomedicinal and modern herbal pharmacopoeias [81, 82].

The diuretic activity of *Orthosiphon stamineus* has been demonstrated in experimental animal studies where aqueous or ethanolic leaf extracts were administered to rats. Aqueous extracts administered orally at 5 and 10 mg/kg resulted in increased urine output in a dose-dependent manner in Sprague-Dawley rats. Control groups received standard diuretic drugs such as furosemide or hydrochlorothiazide at 10 mg/kg for comparison. Parameters such as urine volume, pH, density, and electrolyte content were evaluated hourly over a four-hour period. The extract significantly enhanced urinary excretion of potassium, while sodium and chloride levels showed a less marked increase. Additionally, *O. stamineus* treatment led to slight elevations in serum blood urea nitrogen (BUN), creatinine, and blood glucose levels, which remained within physiological norms despite being statistically significant. These effects are believed to be mediated through the inhibition of renal tubular reabsorption of water and electrolytes, likely due to the plant’s rich flavonoid content. The observed pharmacological effects reinforce its traditional role in herbal medicine as a promoter of urinary output and a protector of kidney health [83].

29. *Erica arborea L*

Erica arborea L., also referred to as tree heath or heather, is an evergreen shrub classified under the *Ericaceae* family. It is native to the Mediterranean region, parts of Europe, and North Africa. The plant typically features woody stems with small, needle-like leaves and delicate bell-shaped flowers that bloom mainly in spring. The aerial parts, particularly the leaves and flowers, are rich in bioactive compounds such as flavonoids, tannins, saponins, and phenolic acids. Traditionally, Erica arborea has been used in folk medicine for its diuretic, anti-inflammatory, and antimicrobial properties, owing to these phytochemicals. In some regions of India, it is locally referred to in Hindi as "Jhaari Tulsi" or "Heath ka Paudha", although standardized vernacular naming is limited due to its non-native status [84].

Scientific investigations on the diuretic effect of *Erica arborea* were conducted in Swiss albino mice using oral doses of 100, 200, and 400 mg/kg of both crude aqueous and hydro-methanolic extracts, as well as n-hexane, ethyl acetate, and aqueous fractions. The results demonstrated a significant, dose-dependent increase in urine volume and marked enhancement in sodium and chloride excretion, indicating strong natriuretic activity. Potassium loss was moderate, suggesting a favorable safety profile compared to standard diuretics like furosemide (10 mg/kg). Among the tested samples, the ethyl acetate fraction showed the most potent diuretic effect, likely due to its high content of flavonoids and phenolic compounds. These findings validate the traditional use of *Erica arborea* in treating conditions like edema and hypertension and highlight its potential as a natural diuretic agent [85].

30. *Ocimum gratissimum*

Ocimum gratissimum, commonly known as Ram Tulsi in Hindi and also referred to as African basil or clove basil, belongs to the Lamiaceae family. It is a perennial aromatic herb or shrub that typically grows up to 1-2 meters in height. The plant features ovate to lanceolate leaves that are opposite, slightly hairy, and emit a strong clove-like aroma due to the presence of essential oils. Its square-shaped stems are a characteristic trait of the mint family, and it produces small, white to pale purple flowers arranged in terminal spikes. With a broad distribution in tropical parts of Africa, Asia, and South America, *O. gratissimum* is recognized for its therapeutic, culinary, and aromatic applications in folk traditions [86].

The study involved thirty male Wistar rats, which were evenly distributed into five groups, with six rats in each group. The control group received distilled water, while the treatment groups received aqueous extracts of *Ocimum gratissimum* at

doses of 0.4, 0.8, 1.6, and 3.2 g/kg body weight orally for 15 days. In a separate 28-day study, methanolic leaf extract was administered at doses of 100-400 mg/kg. No adverse effects were observed on body weight, hematological, biochemical, or histological parameters, indicating the extract's safety. A dose-dependent increase in urine output and significant enhancement in sodium and potassium excretion were noted, supporting its traditional use as a natural diuretic [86].

Table 1: Diuretic Activity of Selected Medicinal Plants in Animal Models

Botanical Name	Common Name	Dose (mg/kg)	Animal Model	Diuretic Response
Carica papaya L.	Papaya	5, 10	Male Sprague-Dawley rats	Significant dose-dependent diuresis with increased K^+ excretion; mild nephrotoxicity at higher doses.
Mangifera indica	Mango	250	Wistar rats	Aqueous extract showed strongest diuresis and natriuresis
Mimosa pudica	Sensitive plant	100, 200, 400	Albino rats	Significant at 100 mg/kg; enhanced Na^+, Cl^-, K^+ excretion; plateau at higher doses
Lepidium sativum	Garden cress	50, 100	Rats	Aqueous: kaliuretic; Methanolic: K^+-sparing; comparable to HCTZ
Coriandrum sativum	Coriander	40, 100 (IV)	Wistar rats	Na^+, K^+, Cl^- excretion dose-dependent; 10-21× lower than furosemide
Foeniculum vulgare	Fennel	500	Wistar rats	Long-lasting diuresis without electrolyte loss; suggests osmotic mechanism
Taraxacum officinale	Dandelion	2000	Mice	Urine output comparable to furosemide; high potassium content supports safety
Aerva lanata	Pasanabheda	200-1600	Wistar rats	Dose-dependent natriuretic and saluretic activity; comparable to furosemide
Achyranthes aspera	Apamarga	400	Rats	Significant diuresis and electrolyte excretion; lower potency than furosemide
Bixa orellana	Lipstick tree	500	Wistar rats	Enhanced urine output and electrolyte excretion
Euphorbia thymifolia Linn.	Choti Dudhi / Laghududhika	100, 200, 400	Albino rats	Dose-dependent increase in urine volume and electrolyte excretion; 400 mg/kg showed effects comparable to standard.
Raphanus sativus Linn.	Muli (Radish)	100, 300, 400	Wistar rats	Significant increase in urine output and Na^+ excretion; comparable to standard diuretics.
Dolichos biflorus Linn.	Kulthi / Horse gram	100, 250, 500	Wistar rats	Significant increase in urine volume and Na^+, K^+, Cl^- excretion; supports antiurolithiatic claims.
Xanthium strumarium L.	Gokh / Kutta Zad	250, 500	Albino rats	Dose-dependent diuresis with increase in Na^+, K^+, Cl^-; enhanced GFR observed.
Nyctanthes arbor-tristis Linn.	Harsingar / Parijat	200, 400, 600	Wistar rats	Significant increase in urine volume and electrolyte excretion; seed and leaf extracts most effective.
Elettaria cardamomum	Chhoti Elaichi	400	Wistar rats	Crude extract showed significant diuresis and electrolyte excretion; comparable to furosemide.
Cola nitida	Kolanut	100-600 (oral), 250	Wistar rats	Dose-dependent increase in diuresis and natriuresis; reduced renal markers; caffeine and theophylline implicated.
Opuntia ficus-indica	Prickly Pear / Nopal	100	Rats, Rabbits	Increased urine output, electrolyte excretion, creatinine clearance; comparable to loop diuretics; sustained effects over 8 days.
Urtica dioica	Stinging Nettle	4 and 24	Anesthetized rats	Increased urine output and reduced BP; high dose comparable to furosemide; vasodilatory and natriuretic action observed.
Olea europaea	Olive	-	Rats	Significant increase in urine volume at 5 and 24 hrs; oleanolic acid responsible for natriuresis; comparable to hydrochlorothiazide.
Sambucus mexicana	Mexican elderberry	500	rats	Significant increase in urine output; attributed to flavonoids and phenolics
Spergularia purpurea	Ghazal al-bahr	100,200, 400	rats	Dose-dependent increase in urine volume and electrolyte excretion over 4 weeks
Elephantopus scaber	Mayurasan / Gojihva	0.3-6 g/kg	rats	No significant diuretic activity observed
Boerhavia diffusa	Punarnava	100 - 400	Wistar rats	Increased urine volume and Na^+, K^+, Cl^- excretion; effective and safe
Cyclea peltata	Rajapatha	200, 250, 300, 500	Wistar rats	Increased urine volume and electrolytes; comparable to furosemide
Geranium seemannii	Sher ki Panja	25, 50	Wistar rats	Dose-dependent urine output and Na^+ excretion; safe electrolyte profile
Diospyros malabarica	Kendu	200-400	Rats	Significant diuretic and natriuretic activity; moderate potency
Orthosiphon stamineus	Cat's Whiskers	5, 10	Sprague-Dawley rats	Enhanced urine volume and K^+ excretion; mild increases in Na^+ and Cl^-; nephroprotective
Erica arborea	Tree heath	100, 200, 400	Swiss albino mice	Dose-dependent increase in urine and Na^+, Cl^- excretion; ethyl acetate most potent
Ocimum gratissimum	Ram Tulsi	0.4-3.2 g/kg, 100-400	Wistar rats	Dose-dependent urine output; increased Na^+ and K^+ excretion; no adverse effects

Discussion

This review highlights the diuretic potential of 30 medicinal plants, many of which have been validated through preclinical studies. Extracts from plants like *Boerhavia diffusa*, *Lepidium sativum*, *Dolichos biflorus*, and *Nyctanthes arbor-tristis* significantly increased urine output and electrolyte excretion, supporting their traditional use in managing conditions like edema and hypertension.

Phytochemicals such as flavonoids, saponins, tannins, and alkaloids are likely responsible for these effects, acting through mechanisms involving renal ion transport and glomerular filtration enhancement. Some plants showed loop diuretic-like action, while others acted more mildly, suggesting a range of possible clinical applications.

Although most extracts showed no signs of acute toxicity, further research is needed to isolate active constituents, determine safe long-term doses, and standardize formulations. Overall, these findings support the therapeutic promise of herbal diuretics and encourage further pharmacological and clinical investigation.

Conclusion

Medicinal plants offer promising alternatives to synthetic diuretics, with many demonstrating significant diuretic activity in experimental studies. Their therapeutic efficacy is supported by bioactive compounds such as flavonoids, saponins, alkaloids, and phenolic acids, which modulate renal physiology and promote the excretion of water and electrolytes. While traditional knowledge has long advocated the use of these plants, recent scientific evaluations affirm their pharmacological potential and safety. However, challenges remain in identifying active constituents, standardizing extracts, and determining optimal dosages. Continued research through well-designed clinical and pharmacological studies is essential to fully establish the efficacy and safety of these herbal diuretics, paving the way for their integration into modern therapeutic protocols.

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