Available online on 15.11.2024 at http://jddtonline.info

Journal of Drug Delivery and Therapeutics

Open Access to Pharmaceutical and Medical Research

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Review Article

Traditional Plants Based Treatment for Kidney Stones: Insight into Herbal Drugs

Shruti *, Ritu Rani, Ajeet Pal Singh, Amar Pal Singh

Department of Pharmacology, St. Soldier Institute of Pharmacy, Lidhran Campus, Behind NIT (R.E.C.), Jalandhar –Amritsar by pass, NH-1, Jalandhar - 144011, Punjab, India

Article Info:

Article History:

Received 11 Aug 2024
Reviewed 03 Oct 2024
Accepted 21 Oct 2024
Published 15 Nov 2024

Cite this article as:

Shruti, Rani R, Singh AP, Singh AP, Traditional Plants Based Treatment for Kidney Stones: Insight into Herbal Drugs, Journal of Drug Delivery and Therapeutics. 2024; 14(11):141-145 *DOI: http://dx.doi.org/10.22270/jddt.v14i11.6865*

*Address for Correspondence:

Shruti, Department of Pharmacology, St. Soldier Institute of Pharmacy, Lidhran Campus, Behind NIT (R.E.C.), Jalandhar –Amritsar by pass, NH-1, Jalandhar -144011, Punjab, India

Abstract

The deposition of hard crystals created by mineral or salt buildup in the urine canal leads to kidney stones, a frequent urinary tract issue. Urine flow obstruction and excruciating discomfort can be caused by kidney stones. Numerous processes can lead to oxidative stress, which raises the probability of kidney stones developing. The inflammatory response that results from kidney stones forming exacerbates oxidative stress further, creating a vicious cycle. This urological condition, which affects both male and female populations, is becoming more widespread worldwide. Planning the volume of urine produced is a crucial stage in the elimination of kidney stones. Surgery such as shock wave lithotripsy (SWL) and ureteroscopy (URS) is used to treat conditions when the stone has ceased passing through and is causing excruciating discomfort. Because of their medicinal and antioxidant properties, as well as their active substances, medicinal plants have positive benefits on human health. Regrettably, end-stage renal disease is frequently the consequence of side effects brought on the traditional medications used to treat nephrolithiasis. Kidney stones can be avoided by controlling nutrition intake, medication usage, and diet. Agents that are urolithotriptic are medicinal herbs. Examining the natural plants that are utilized to treat the illness is the goal of this review. Finding natural plants that can be used to cure kidney stones was made easier by this review.

Keywords: Kidney stones, Urolithiasis, diuresis, herbal drug, calcium oxalate stone

Introduction

Toxins, heavy metals, chemotherapy drugs, and other metabolites are always present in the kidney and can lead to a variety of renal disease events.[1] Kidney stone disease (KSD) reduces a person's years of healthy life expectancy and places a heavy financial strain on healthcare systems, both of which greatly lower an individual's quality of life.[2] The most often occurring related stone is calcium oxalate, mostly seen at the surfaces of the renal papillaries. Another name for this crystal formation is urolithiasis. An estimated 12% of all people on the planet suffer with kidney stones each year. The age range of 20 to 50 years old is where the incidence is most prevalent.[3] Around the world, kidney stones are a prevalent urinary tract issue. [4]

The burden of urolithiasis varies depending on the area and the nation.[2] Research indicates that traditional medicine, including herbal medications, is used by individuals in various cultures and countries to treat kidney stones. A frequent clinical condition, kidney stones can arise for a variety of reasons, including changes in lifestyle, geography, racial or ethnic background, and other factors.[5]

A large percentage of kidney stones are caused by calcium nephrolithiasis, which is mostly composed of calcium phosphate (CaP), calcium oxalate (CaOx), or a mix of the two. Furthermore, struvite, cystine, and uric acid stones are other common forms of kidney stones.]

Research indicates that men experience more stone development than women do.[3] Kidney stones come in several forms, but calcium stones are the most common kind.[4]

It has been demonstrated that natural active ingredients are very effective at lowering the oxidative stress and inflammation linked to kidney stones. These active substances can reduce kidney stone damage because they have anti-inflammatory and antioxidant qualities that can prevent oxidative stress and inflammatory reactions. [2]

There are two types of calcium oxalate: monohydrate and dihydrate. Furthermore, cystine and uric acid are also present. The majority of disorders include type 2 diabetes mellitus, hypertension, blood pressure, and in rare cases, obesity and arthritis are linked to kidney stones.[3]

Natural substances, particularly those with antioxidant qualities, provide a viable therapy for urolithiasis by reducing inflammation by lowering the generation of ROS and improving mitochondrial dysfunction. [2]

In addition to consuming large amounts of oxalate and phosphate, other risk factors for the development of stones include kidney and/or urinary tract abnormalities, relative dehydration, a history of family history, especially first-degree relatives, obesity, gout, hypertension, diabetes mellitus, and high salt intake.[4]

The main component of kidney stones are crystals of calcium oxalate. Between 75 and 85 percent of the calcium oxalate is found in the forms of Weddellite and Whewellite monohydrate and dihydrate.[1]

Patients who have surgery almost invariably experience a recurrence of the stone. Thus far, no ideal cure has been discovered. Since several plants have been demonstrated to have individual anti-urolithiasis action, herbal medicine has been employed in this treatment continuously.[3]

A stone that lodges in the ureters can obstruct the flow of urine, which can lead to kidney enlargement and excruciatingly painful ureter spasms. This is due to the urinary duct's comparatively small size, measuring just 2 to 3 mm in diameter and 10 to 12 inches in length. The ureter wall is torn and torn when large kidney stones produce friction as they pass down the ureters.[4]

Preclinical and clinical research support the potential of natural active components in kidney stone therapy, as shown by the data given. These substances have anti-urolithiatic effects via improving urine parameters, lowering inflammation, and changing the shape of stones. [2]

Urine is formed by three main mechanisms. The first occurs in the renal corpuscles and is known as glomerular filtration. The renal tubules are the site of the second and third processes, which are tubular reabsorption and tubular secretion.[3]

One specific strategy to therapy is the isolation of chemicals that, for example, alter urine chemistries or block important processes in the development of stones. Furthermore, by utilizing cutting-edge pharmaceutical technologies like nanotechnology, these natural chemicals' effectiveness and transport may be further improved, increasing their bioavailability and stability and, ultimately, their therapeutic potential. [2]

Kidney stones are treated with both surgical procedures and medical therapy. For ages, pharmacological qualities of natural plants have been utilized. This is due to the fact that they are cheap, easily accessible, and occasionally provide a safer source of the active component in medications.[4]

Nonetheless, Ayurveda mentions a number of readily accessible, scientifically supported popular herbal herbs that exhibit strong protection against this illness. While some of these herbs may be used either way, combination treatment is the most usual way to utilize them.[1]

Types of kidney stones

Calcium stones

The most frequent types of stones are either phosphate or oxalate forms of calcium. The hydrated forms of calcium stones, such as monohydrate or dihydrate forms, are seen. Even following surgery, these kinds of stones have a higher recurrence rate than other stones.[3]

Uric acid stones or urate

The stone is entirely diet-based, with a higher purine percentage. Hyperuricosuria and a drop in urine volume and pH are caused by a high purine diet. [3]

Cystine stones

Cysteine stones are mostly caused by cystinuria, which is the result of cystine being detected in urea. Bladder area is one of the prime sites for this kind of stone. Such a stone cannot be healed. [3,6]

Drug-Induced stones

The development of stones is entirely dependent on medications such as atazanavir, triamterene and glafenine, sulfonamides, and indinavir. Protease inhibitors have mostly functioned as agents that cause stone formation. A family history of urolithiasis, hypercalciuria, urinary tract infections, acidic or alkaline urine, and hyperuricosuria are the conditions that may contribute to drug-induced stones.

The four stages of stone formation include crystal nucleation, growth, aggregation, and interaction between crystals and cells. Kidney stones can occur for a variety of reasons, including low urine volume, dehydration, food, bowel disorders, obesity, medical disorders, medication, and family history. [3]

HERBS

Shilapushpa (*Didymocarpus pedicellata* R.Br.)

A significant medicinal plant belonging to the Gesneriaceae family, *Didymocarpus pedicellate* R. Br. is also known by the names stone flower, shilapushpa, shantapushpi, and pasanbheda. It has historically been used to treat kidney diseases, particularly stones. This plant is chemically composed of flavonoids, such as didmyocarpin, pashanone, and chalcones. The component of cystone pills, shilapushpa, has been shown to be beneficial in controlling the body's absorption of calcium. The herb is well-known for its diuretic qualities, which also aid to dissolve kidney stones and preserve a healthy urinary system.[1,7]

Asparagus Racemosus

Most of the beneficial substances found in asparagus are steroidal saponins belonging to the genus Shatavarins (Liliaceae), popularly referred to as satavar. These saponins have a wide spectrum of biological activity and are beneficial in the treatment of diabetic retinopathy. Besides being an antioxidant, antimicrobial, and diuretic, its root is utilized to treat a variety of clinical ailments.[4]

Apamarga (*Achyranthes aspera*)

The plant Achyranthes aspera, sometimes referred to as apamarga, is a member of the Amaranthaceae family and has long been utilized in Ayurvedic medicine. The plant's effectiveness against nephrolithiasis, capacity to maintain renal function, and defense against renal damage have all been scientifically demonstrated. A. aspera contains alkaloids such as betaine and acanthine, as well as triterpenoid saponins with oleanolic acid.[1]

***Tanacetum parthenium**:*

Tanacetum parthenium is a member of the Gramineae family, whose leaves and blooms are dry and warm.[5]

Solanum xanthocarpum

The Solanaceae family includes yellow-fruit nightshade. Numerous urinary illnesses, including as urolithiasis, urinary retention, urinary tract infections, and nephrotoxicity, are treated with it. Renal hyperoxaluria, crystalluria, and calcium oxalate supersaturation are reduced by Solanum xanthocarpum. [4,8]

Gaozaban (*Onosma bracteatum*)

Gojihva, or *Onosma bracteatum*, is a member of the Boraginaceae family. The leaves have tiny nodules covered in thin hair-like structures that give them a rough, cow-tongue-like look. Alkaloids have a low concentration, which reduces their toxicity. The plant Onosma bracteatum is used as a diuretic and spasmolytic to treat renal illness and lung infections; it is included in the International Union for Conservation of Nature's (IUCN) danger category.[1]

Cincer arietinum: The Fabaceae family's cider seeds are dry and warm in nature.[5]

Giloy (*Tinospora cordifolia*) The heart-leaved moonseed, *Tinospora cordifolia*, is a member of the Asclepiadaceae family. This plant extract possesses anti-inflammatory, lithotriptic, diuretic, and lipoxygenase inhibitory properties.

Punica granatum

Punica granatum peel, oil, and juice are used to treat kidney failure and prevent nephrotoxicity, including renal arteries. The seeds of the plant have been used to regulate urine flow and the burning feeling that is associated with it.[4]

Barberry (*Berberis vulgaris* Linn.)

Known by most as "barberry," Berberis vulgaris Linn. (F. Berberidaceae) is a plant. The most recommended treatment for removing the kidney stone on the left side is B. vulgaris. B. vulgaris has been utilized for a variety of urinary system abnormalities, including stones and other urinary tract diseases, in accordance with the homeopathic medicine method. The primary therapeutic ingredient used to treat kidney stone illness is berberine, an isoquinoline alkaloid.[1]

Cynodon dactylon

The aerial portions of the Gramineae family's *Cynodon dactylon* are naturally dry and chilly.[5]

Bergenia ligulate

This perennial herb belongs to the Saxifragaceae family. Elephant ears and Bergenia are synonyms. Many ailments, including as kidney stones, urinary tract infections, inflammation, and wounds, are treated using the plant's roots and foliage. Bergenia ligulate is a useful medicine plant because its many active chemicals interact with one another to provide a variety of medicinal effects. Bergenin can lessen kidney and urinary tract inflammation, which is linked to the development and proliferation of kidney stones, in the treatment of urolithiasis.

Bergenia ligulata has significant amounts of arbutin, which has been demonstrated to prevent the crystallization of calcium oxalate. Furthermore, the majority of plants contain catechins, a kind of flavonoid, whereas gallic acid is a phenolic acid. Due to its high mucilage content, this plant provides a calming effect. Additionally, it calms and shields irritated tissues. This plant helps to expel little stones since it is a diuretic.[4,1]

Laurus nobilis

Laurus nobilis, a member of the Lauraceae family, with warm, dry leaves and bark.[5]

***Crataeva nurvala* (varuna)**

For millennia, *Crataeva nurvala* has been utilized in traditional Ayurvedic medicine to treat a wide range of illnesses, especially those involving the urinary system. Due to the tree's well-known diuretic qualities, its leaves and bark are frequently used to treat infections of the urinary system, kidney and bladder stones, and enlarged prostates. Because it can stop calcium oxalate crystals from forming, which is the primary cause of urinary stones, *Crataeva nurvala* has an antilithiatic action. It has been demonstrated that *Crataeva nurvala* extracts have diuretic and urinary alkalizing properties, which may aid in the removal of minerals that cause stones from the urinary system and delay their precipitation.[4,9]

Hydrangea root bark (*Hydrangea arborescens*)

The flowering plant Hydrangea arborescens, sometimes called smooth and wild hydrangea or seven barks, is a member of the Hydrangeaceae family. Minerals and chemicals include resins, soda, lime, potassium, magnesia, phosphoric and sulfuric acids, and a proto-salt of iron are abundant in the roots. The Native Americans and subsequently the early immigrants also employed the root of the H. arborescens plant to treat kidney and bladder stones. In cases of acute discomfort from kidney stones, khella, lobelia, kava, horse chestnut, and yucca root are recommended for genitourinary spasm.[1]

Lithos permum

The Boraginaceae family includes *Lithos permum*, whose leaves are arid and frigid.[5]

Boerhaavia diffusa

Boerhaavia diffusa, sometimes referred to as Punarnava or Spreading Hogweed, is a herbaceous plant that is a

member of the Nyctaginaceae family and is used extensively in Indian Ayurvedic medicine to treat a variety of illnesses, including urolithiasis. Punarnavine is one of the alkaloids that *Boerhaavia diffusa* contains. There have been reports of punarnavine's diuretic and anti-inflammatory properties.[4,10]

Visnaga (*Ammi visnaga*)

Ammi visnaga is a member of the Umbelliferae family of flowering plants. Toothpick-plant, toothpick weed, visnaga, and khella are only a few of the well-known names. Ananda visnaga is commonly used to treat a variety of illnesses, including kidney stones. The active ingredients include derivatives of coumarins, such as khellin, visnagin, and visnadine, which are extracted from the seeds of A. visnaga and have anti-nephrolithiasis properties.[1]

Carum copticum

The Umbelliferae family's *Carum copticum* seeds are warm and dry in nature.[5]

***Herniaria hirsute* L.**

One species of flowering plant in the Caryophyllaceae family is *Herniaria hirsuta*. This plant could facilitate the crystallization of calcium oxalate. It may thus lead to a rise in number or a fall in size. The treated herb extract promoted more crystallization, particularly at high dosages.[4,11]

Cucumis melovar

The Cucurbitaceae family's Cucumis melovar fruit, flexuosus, is cooler and wetter in climate.[5]

Tribulus terrestris

Gokhru (Zygophyllaceae family), The Mediterranean plant Tribulus terrestris is covered with spines and bears fruit. Likewise called perforated vine. The considerable influence of T. terrestris on the treatment of ischemic stroke, inflammation, pulmonary fibrosis, liver cancer, and urolithiasis is highlighted by its neuroprotective, anti-inflammatory, anti-fibrosis, anti-cancer, and anti-lithiatic qualities. The formation of CaOx stones can be successfully avoided by flavonoids because of their diuretic, antioxidant, anti-inflammatory, antibacterial, and other preventative properties. Thus, flavonoid-rich plant extracts or extracts containing flavonoids have anti-urolithiasis properties. These work by blocking GOX, which in turn prevents oxalate synthesis from occurring. The primary active ingredient of Cystone pills, which are used to treat kidney stones, bladder infections, and other UTIs, is gokhru.[1,4]

Origanum majorana

Origanum majorana, a member of the Labiatae family, has warm, dry leaves.[5]

Trachyspermum ammi

The plant *Trachyspermum ammi* produces little, seed-like fruits. It is a member of the family Apiaceae. Calcium oxalate (CaOx) crystallization was inhibited by *Trachyspermum ammi*'s diuretic effects, which were concentration-dependent. Renal damage can be minimized and renal functions preserved by *Trachyspermum ammi*. It can therefore continue to be retained in renal tissues.[4]

Arnebia euchroma

The Boraginaceae family's *Arnebia euchroma* root is chilly and moist in nature.[5]

Apium (*Apium graveolens*)

The plant has little white flowers in compound umbels and leaves that are pinnate to bipinnate. The volatile oil apiol, phenolic, apigenin, lunular, and apiin are the active chemical elements that obstruct urine.[1]

Chanca Piedra (*Phyllanthus niruri* L)

Urolithiasis, or kidney stone illness generally, is curable with it. It serves as a substitute alkalizing agent for potassium citrate and sodium bicarbonate. It has been demonstrated that by interfering with the complexation of calcium in the urine, it can reduce the size of kidney stones. Phyllanthin and quercetin are two of the primary constituents found in Chanca Piedra.[4,12]

Cantharis (Cantharis sp.)

Cantharidin is a terpene found in the homeopathic remedy cantharis. When there is noticeable, significant burning in the urethra during urine, it produces the best outcomes in situations of kidney stones. Cantharis, a wonderful homeopathic kidney stone remedy, is beneficial for patients who have burning in the urethra due to kidney stones.[1]

***Salvia hispanica* L**

The plant seed known as chia seed is extracted to yield two compounds that have anti-urolithiasis properties: quercetin and mycertin. lower the urine's concentrations of uric acid, urea, urea nitrogen, and creatinine. It prevents kidney stones from growing and aggregating, as well as the early phases of calcium oxalate crystal formation, such as nucleation and crystallization. The lowering of calcium and phosphate levels in the urine prevents the development of urolithiasis. The antioxidant qualities of quercetin help prevent the formation of calcium oxalate stones by inducing the release of antioxidant enzymes. It has the ability to absorb heavy metals and poisons from the body, which reduces the amount of calcium oxalate that accumulates.[4]

M. longifolia

One possible natural kidney stone remedy is M. longifolia. Moreover, its nephroprotective qualities offer a holistic approach to lessen renal damage and prevent the recurrence of kidney stones. Scientific evidence has shown that TCM is helpful in easing symptoms, promoting stone removal, and lowering the likelihood of urolithiasis recurrence. The seeds of M. longifolia contain sapogenin as well as additional basic acids, such as saponin A and saponin B. Treatment for kidney stones may be done comprehensively with TCM, emphasizing the body's restoration of balance and harmony. A common belief is that kidney stones result

from an energy imbalance in the body, namely in the kidney and bladder meridians.[13]

Nigella sativa

A frequent name for black cumin or black seed, Nigella sativa, has been used to treat urolithiasis (Family Ranunculaceae). According to conventional sources, black seed can be used either by itself or in conjunction with honey and water to dissolve kidney stones. The primary component, thymoquinone, is present in the seed grain and is crucial in the treatment of kidney stone illness. An active quinone inhibits the endocytosis of calcium oxalate and tampers with the calcium oxalate deposits. By dissolving kidney stones, it has an anti-urolithiasis action by decreasing the buildup of calcium oxalate crystals in the urinary system.[4]

Lycopodium (*Lycopodium clavatum*)

These are prostrate, erect, branching, flowerless stalks covered with needle-like leaves. L. clavatum modulates protein metabolism, treats kidney stones and gout, and impacts the overall fat metabolism—a troubling one, it turns out. Alkaloids such as lycodoline, lucidioline, alpha obscuring, lycopodine, lycoposerramine-L, lycopo-serramine-M, des N-methyl-a-obscurine, clavolonine, and 11alpha-O-acetyl-lycopodine are found in L. clavatum.[1]

Conclusion

Because they are long-lasting and less hazardous, herbal medicines are becoming more and more popular. Kidney stones have been treated using natural and ayurvedic botanicals, which have gained popularity. Numerous plants with active components have been demonstrated to lessen kidney stone incidence and clearance.Because the medicinal plants included in this review research are native to Iran and have anti-kidney stone qualities in traditional medicine, they may be employed in clinical and experimental settings, and if successful, they can be used to make natural medications.

It is vital for medical professionals to comprehend pharmacokinetics, which is evidence-based knowledge about efficacy, pharmacological mechanisms, and side effects. Traditional remedies derived from natural plants are also used when conventional medicine is unable to treat diseases, such as advanced cancer, or when new diseases arise.

Acknowledgment: It's our privilege to express the profound sense of gratitude and cordial thanks to our respected Chairman Mr. Anil Chopra, Vice Chairperson Ms. Sangeeta Chopra and Managing Director Prof. Manhar Arora, St. Soldier Educational Society, Jalandhar for providing the necessary facilities to complete this review/research work.

Conflicts Of Interests: There are no conflicts of interest.

Funding: Nil

Authors Contributions

All the authors have contributed equally.

Source of Support: Nil

Informed Consent Statement: Not applicable.

Data Availability Statement: The data supporting in this paper are available in the cited references.

Ethics approval and consent to participate: Not applicable.

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