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Management of Urolithiasis by Naturopathy approaches

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Abstract
Background: Urolithiasis, is an escalating global problem commonly known as stone formation. In India 50% of the population suffers from kidney stones. The lifetime risk of lithiasis is estimated at around 15%, with high prevalence in males. They can be classified as calcium oxalate, calcium phosphate, struvite, uric acid, and drug-induced kidney stones based on their chemical makeup. Its common symptoms are severe abdominal and back pain, urinary obstructions, sudden urge to urine, blood in urine (hematuria), nausea, fever and recurrent infections. The different factors, like dietary, genetic, metabolic, and environmental, contribute via different modes. Conventional treatments like ureteroscopy, lithotripsy, pharmacotherapy, etc can be too costly for all to afford, and they also create side effects.
Methods: This review evaluates the role of naturopathic approaches in management of urolithiasis, by analysing the past literature searches from databases like Google Scholar, PubMed and Science Direct on herbal, nutraceuticals and microbial therapies by identifying plant-based compounds, traditional formulations, gut microbiota modulation approaches, that inhibits stone formation pathways.
Results: Findings indicate that herbal formulations have been traditionally utilized by indigenous communities for many years as the natural plants and their formulations are the richest source of phytochemicals, which have the potential to prevent, inhibit, and cure kidney stone formation. Some nutraceuticals like chyawanprash and green tea contain many antioxidants, which can help in kidney stone dissolution. Nowadays, microbial formulations like oxalate-degrading bacteria particularly *Oxalobacter formigenes*, can naturally dissolve the oxalate kidney stones by focusing on modifying the gut microbiota to degrade oxalate before reaching kidney.
Conclusion: These naturopathic therapies are found to be more useful for treating kidney stones, as they help in suppressing the multiple mechanisms of stone formation, offer a safer, non-toxic, long-term effects as compared to pharmacological treatments therefore, there is growing interest in alternative therapeutic approaches, so many people moved towards these.

Keywords: Urolithiaisis, herbal formulations, nutraceuticals, engineered microorganisms, traditional medicinal systems

Introduction

Lithiasis is the establishment of calculi (stones), medically termed nephrolithiasis or renal calculi. Urolithiasis is a disorder typically identified by the emergence of stones in any part of the urinary tract, such as the kidneys, ureter, bladder, and urethra. Stone creation involves a number of physiochemical events, including supersaturation of urine, crystal nucleation, expansion, grouping, and storage on the renal epithelium surface; hence, urolithiasis is a complex process (Gupta S & Shamsher, 2018) [11]. Stone formation is regulated by an imbalance between stone inhibitors (citrate, magnesium, and urine prothrombin fragment) and urinary stone promoters (albumin, oxalate, and uric acid). Kidney stones originate when urine carries excessive amounts of calcium, oxalate, phosphate, and uric acid. Approximately 75% of individuals have calcium oxalate stones, which makes it one of the most prevalent types, while magnesium ammonium phosphate is around 10-20% (struvite or triple phosphate), urate 5%, and cystine 1-2% (Gupta S & Shamsher, 2018) [11]. Kidney stones vary in size from micrometres (less than 5 mm-7 mm) to several centimetres in diameter (Gupta S & Shamsher, 2018) [11].

Globally, the incidence of urolithiasis is increasing due to changes in dietary habits, lifestyles, metabolic disorders, and dehydration. Epidemiological studies suggest a lifetime risk of kidney stone development ranging from 10% to 15%, with a higher prevalence in males than in females. In addition, its recurrence is common, with approximately 50% of patients experiencing a second development within 5-10 years (Ashvini *et al*., 2025) [4]. In China, urolithiasis is quite prevalent due to dietary habits, geographical conditions, and lifestyle choices (Arathi S Nair, 2025) [2]. In the USA and Europe, kidney stones are believed to impact 0.1–0.4% of overall population annually; 2–5% of people in Asia; 8–15% of people in Europe and North America, and in Saudi Arabia 20% of people, affected annually by kidney stone (PRADNYA NILESH JAGTAP*, 2020) [23].

Globally, approximately 80% of individuals seek their main medical care from traditional medicine (Vibhute *et al*., 2024) [34]. Plant-based natural products have been utilized for multiple motives for over 5000 years, with herbal medicine serving as the primary form of healthcare. Herbal medicines, rooted in traditional medicine practices, are composed of naturally occurring substances obtained from plants are employed in treatment and prevention of renal stones (Vibhute *et al*., 2024) [34].

An estimated 2 million Indians suffer from urolithiasis each year, and some regions of the country have been designated as "stone belts", because of the high prevalence to kidney stones, states like Gujarat, Punjab, and Delhi are included. Some factors, including lifestyle, genetic and environmental factors, and diet (high animal protein, processed foods) also contribute significantly (Sequira *et al*., 2023) [27]. Renal calculi affect about 50% of people in India, that can contribute to renal injury or a reduction in kidney function. (Parvani *et al*., 2025) [22].

Material and methods

This review provides the data from previous literature review searches from the relevant studies of herbal based

therapies, microbial, nutraceuticals for the treatment and prevention of urolithoasis. The data is collected thoroughly from the databases like Google Scholar, PubMed, and ScienceDirect from articles published between 2010 and 2025 by using keywords "urolithiasis", "kidney stones", "Medicinal Plants", "Nutraceuticals", "Engineered Microorganisms" and "Alternative therapies". Included inclusion criteria such as Relevant data from published papers, studies related to alternative management of kidney stones, clinical, *in vivo* and *in vitro* studies, and articles in English language are preferred. For exclusion criteria, the duplicate studies, non-scientific sources, and lacking full text.

Types of kidney stones

Kidney stones can be categorized as calcium oxalate, calcium phosphate, uric acid, struvite, and cystine based on their chemical composition.

Table 1: Types of kidney stones

S. No.	Stone type	Percentage of stones	Common causes	References
1.	Calcium	80%(PRADNYA NILESH JAGTAP*, 2020)	High sodium intake, insufficient fluid intake, low citrate, and magnesium levels in urine.	(Varshney *et al*., 2024)
2.	Uric acid stones	5-10% (PRADNYA NILESH JAGTAP*, 2020)	High intake of animal proteins	(Varshney *et al*., 2024)
3.	Struvite stones	10-15% (PRADNYA NILESH JAGTAP*, 2020)	By urinary tract infection, especially with urease-producing bacteria.	(Varshney *et al*., 2024)
4.	Cystine stones	2% (PRADNYA NILESH JAGTAP*, 2020)	Due to a rare genetic disorder, cystinuria.	(Varshney *et al*., 2024)
5.	Drug-induced stones	1%	Sulfa drugs used for treating HIV infection.	(PRADNYA NILESH JAGTAP*, 2020)

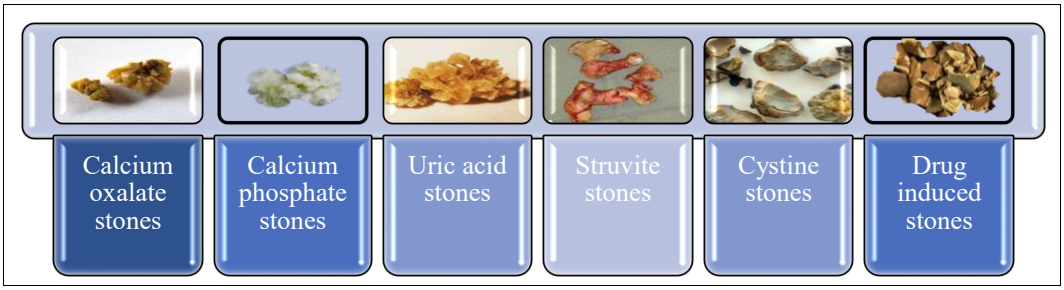


Fig 1: Showing different types of kidney stones.

Calcium stones: These include oxalate (CaOx) and phosphate stones of calcium, among the most prevalent are oxalate stones. The two main forms of calcium oxalate are calcium oxalate monohydrate (COM) and calcium oxalate dihydrate (COD). Normally, excess calcium that is not used by our bones and muscles is excreted by the kidneys in urine; however, when this process does not occur, calcium stones are formed. Formation of calcium oxalate crystals are another toxic effect of ethylene glycol poisoning (Arya, 2017) [3]. Food products naturally contain oxalate. High oxalate content is found in some fruits, vegetables, nuts, and chocolates. The amount of calcium or oxalate in urine can rise due to nutritional variables, increased vitamin D intake, and a number of metabolic disorders. (Arya, 2017) [3]. Calcium oxalate and phosphate calculis are whitish, black, or grey, approximately 1 cm in diameter, and appear small, dense, and sharp on radiographs (Gupta S & Shamsher, 2018) [11]. Typically, these stones are ovoid, hard, granular, and tiny (less than a centimeter). (Arya, 2017) [3].

Uric acid stones: These stones created when urine contains excessive acid or has an acidic pH (below 5) and low urinary volume. Other factors include abnormalities such as gout syndrome, consumption of a high amount of protein, such as a lot of fish and red meat, and not drinking enough fluids (Gupta S & Shamsher, 2018) [11]. These stones are smooth and yellow-orange in color. Usually they are diamond, square, or rod-shaped, and are pleomorphic crystals that can be polarized. (Arya, 2017) [3].

Struvite stones: These may form after urinary tract infections brought on by urease-producing bacteria and grows rapidly. These organisms convert urea to ammonia and carbon dioxide by using the urease enzyme. (Arya, 2017) [3]. By alkalinizing the urine, they creates an environment that contributes to the formation of struvite stones. (Arya, 2017) [3]. Struvite stones are frequently referred as infection stones or triple phosphate stones. Individuals having recurrent UTIs are at a greater risk of acquiring struvite stones, and women are more likely to have struvite stones than men. They grow fast. They are yellowish-white and tend to be friable with irregular shapes.

Cystine stones: These are rare and are due to the hereditary disorder called cystinuria (the kidney fails to reabsorb the amino acid cystine and excretes excessive amounts of certain amino acids in the urine (Arya, 2017) [3]. These are small, moderately radio-opaque, rounded, and smooth, with greenish-yellow marked with shiny crystallites (Gupta S & Shamsher, 2018) [11]. When the stones are small, they can be passed out with urine, but when they are large, they restrict urine flow (urine obstruction).

Drug-induced kidney stones: Of all stone types, these stones contribute roughly 1%. These stones are produced by pharmaceuticals like guaifenesin, nelfinavir, oxypurinol, triamterene, atazanavir, and sulfa drugs.

Individuals undergoing HIV infection treatment medication indinavir sulfate, that is a protease inhibitor, are more susceptible to kidney stones. (PRADNYA NILESH JAGTAP*, 2020) [23].

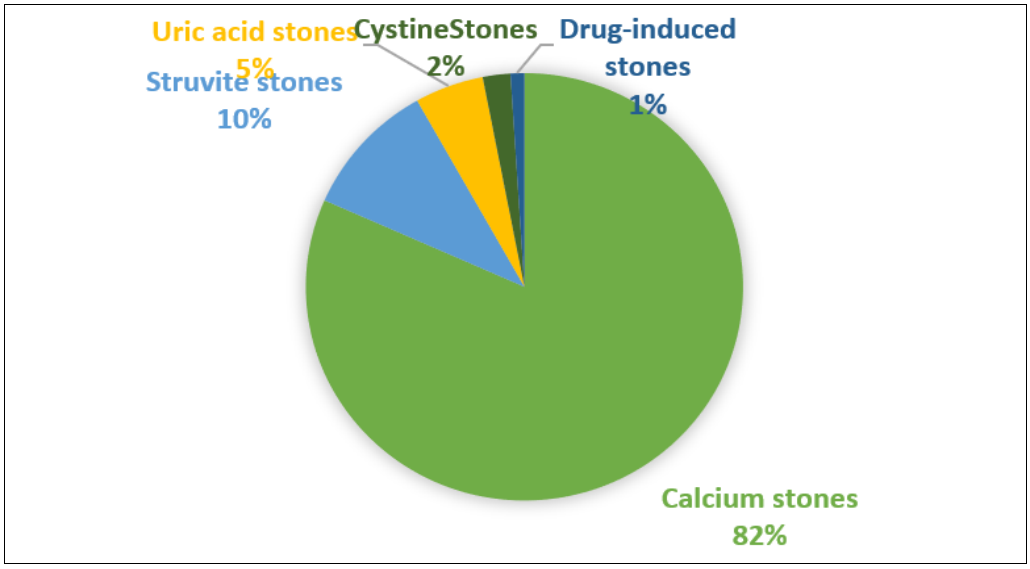
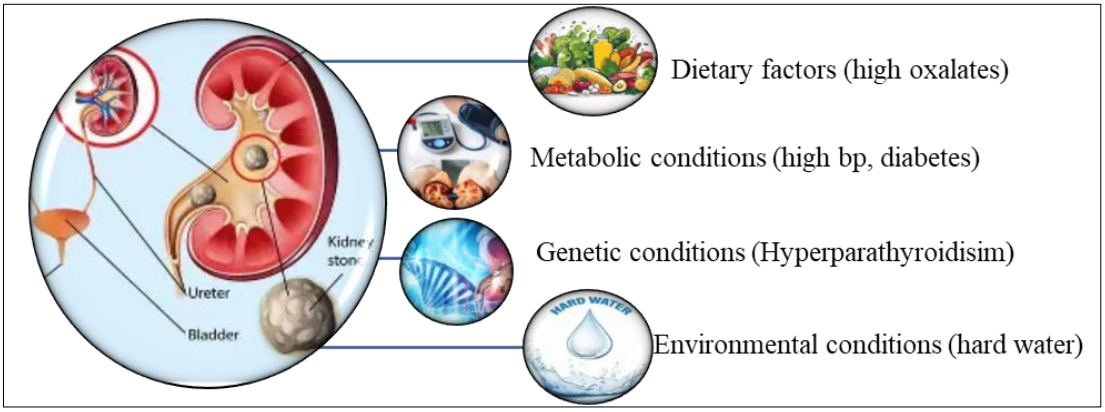


Fig 2: Distribution of different types of stones.

Cause of formation



Diet and kidney stone: Dietary factors enhance the possibility of kidney stones, such as higher sodium intake, which enhances the calcium level in urine, and insufficient fluid intake, which increases the risk of calcium-based stones. Examples include processed foods, pickles, and fast food. Excessive intake of oxalate-rich foods (spinach, nuts) forms calcium oxalate stones. Fruit juices such as grape, apple, and cranberry juice. Foods high in animal protein includes meat, eggs, and fish, certain reports have proved that vegetarians face a reduced risk of stones compared to those who eat a non-vegetarian diet (Vibhute *et al*., 2024) [34]. Food and supplements rich in vitamins C and D. Due to the high salt content and purines, in alcohol, beer, and wine should only be used in limit as they can form stones.

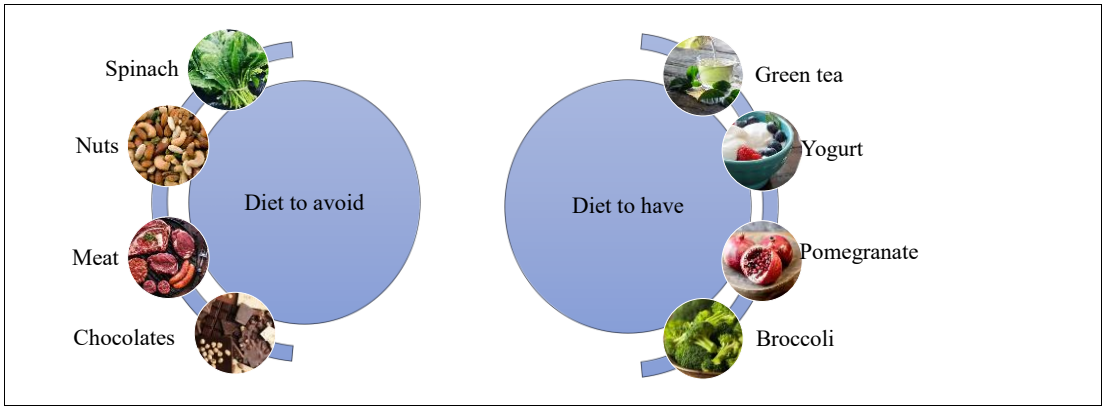


Fig 4: Showing diets to avoid and to have for preventing kidney stones.

Metabolic conditions such as hypercalciuria (excessive calcium in urine), hyperoxaluria (high oxalate levels), and metabolic syndromes includes high blood pressure (hypertension) and diabetes increase the risk of kidney stones (Chang *et al*., 2021) [7]. Genetic conditions such as familial hyperparathyroidism (parathyroid glands produce more hormones, leading to high calcium levels) and cystinuria (excretion of excessive cystine), insulin

resistance, and a history of hypertension triple the risk and cause kidney stones to develop. (Vibhute *et al*., 2024) [34].
Environmental aspects such as hot climates increase sweating and loss of body fluid, which concentrates the urine, and the higher the hardness (calcium and magnesium) in the drinking water because everyone doesn't have proper source of drinking water and not using water purifiers so they rely on other water sources that may contain high content of calcium and magnesium.
A high-potassium diet reduces the chance of development of kidney stones, because potassium promotes elimination of citrate by urine, which inhibits the stone formation in urine. Also, high magnesium diets reduce the risk of stones, as magnesium citrate functions as preventive measure against the production of urinary crystal. (Vibhute *et al*., 2024) [34].

Table 2: Showing stone promoters and inhibitors. (Arya, 2017)

Stone promoters ↑	Low volume and pH of urine, calcium, sodium oxalate, and urate
Stone inhibitors ↓	Citrate, magnesium, organic and inorganic inhibitors, prothrombin fragments.

Symptoms

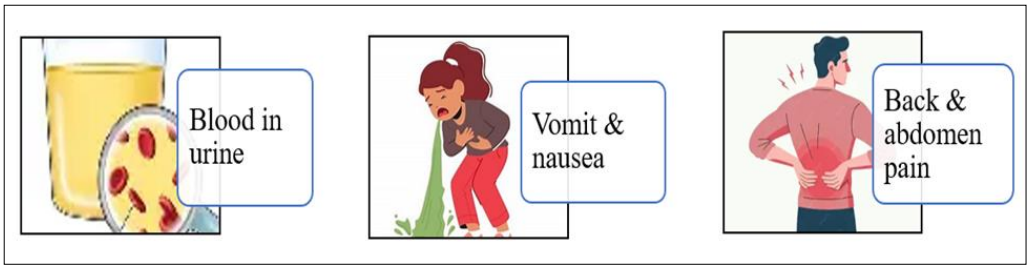


Fig 5: Showing symptoms of kidney stone.

Hematuria is characterized by severe pain and blood in urine. From minor damage to the kidney or ureter to severe damage, pus in the urine is also called pyuria (Vibhute *et al*., 2024) [34]. While a burning sensation at the time of urination is known as dysuria. Oliguria is a condition characterized by low urine volume. Embryological connection with the colon stimulates the vomiting centre, which results in vomiting and nausea showing in fig.4. (Vibhute *et al*., 2024) [34]
The lower abdomen in both sexes and the vaginal area in females are most affected by abrupt, severe, and sharp pain in the back and all its sides. The symptoms are further characterized by an unexpected urge to urinate, burning when urinating, discoloration of urine (due to RBCs are present in urine, it can either red or black), nausea and vomiting, or, in male patients, pain may be at the tip of the penis. (Vibhute *et al*., 2024) [34]

Process of Stone formation: The kidney stones take place when the concentration of crystal-forming substances, like uric acid, calcium, phosphates, and oxalate, exceeds in the urine. It results when the proper equilibrium between the solubility and precipitation of salts within kidney and urinary tract is out of balance (Vibhute *et al*., 2024) [34].
Kidney stones form when urine becomes concentrated (less water and more waste), and crystals stick together and grow into stones.

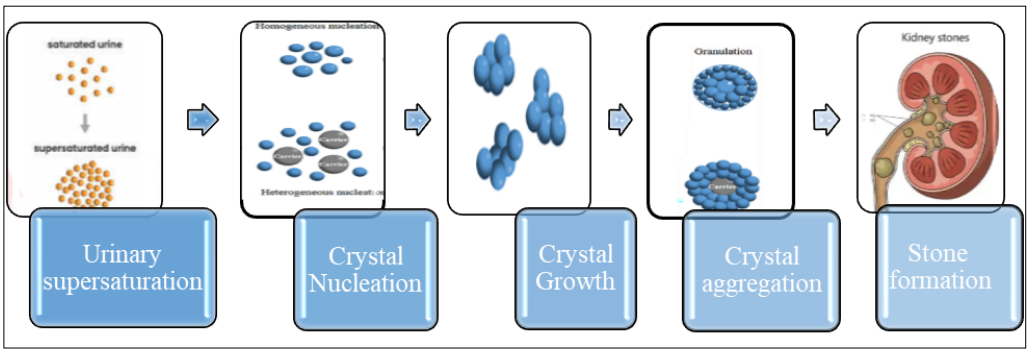


Fig 6: Diagram showing kidney stone formation.

Supersaturation of Urine: Urine is an extremely saturated urea solution Typical situations do not cause urine to precipitate because of the existence of stone-forming inhibitors present in it (Arya, 2017) [3]. Urine contains dissolved minerals like calcium, oxalate, phosphate, uric acid, and cystine. Bur as their concentration rises, the urine becomes supersaturated (with more solutes in the urine solvent) and contains one or more calculogenic (crystal-forming) compounds (Arya, 2017) [3]. Supersaturation of urine is the first accelerator for crystal formation, and nucleation may occur in the formation of a seed crystal.

Crystal nucleation (nidus formation): Nucleation is the process by which changes the liquid phase of a supersaturated solution into a solid phase (Arya, 2017) [3]. Salts of sone in solution combine to create loose clusters,

referred to as nuclei. The first non-dissolving crystal is formed by nuclei, which have a distinctive lattice pattern. (Arya, 2017) [3].

Homogeneous nucleation: Crystal formation is a continuous process without any break (requires very high supersaturation).

Heterogeneous nucleation: Crystal forms on the surface, such as epithelial cells and cell debris (calcium and phosphate deposits in renal papillae), and this is commonly found in humans.

Crystal growth: After nucleation, additional ions from the urine attach to the nucleus, resulting in crystal enlargement. A crystal nucleus achieves a certain size, and by adding new crystal component nuclei, the process is called crystal growth. When the degree of supersaturation is high, it accelerates growth.

Crystal aggregation: The process by which tiny free-form components in a solution are aggregated to form larger multicomponent particles is known as aggregation (Ratkalkar & Kleinman, 2011) [24]. Here, individual crystals may collide in the solution and stick together to form large particles. Crystal aggregates and an organic matrix structure acting as a binding agent form stones. (Ratkalkar & Kleinman, 2011) [24]. Among other substances, the organic matrices consists of proteins, lipids, and polysaccharides. (Ratkalkar & Kleinman, 2011) [24]. This process is enhanced by viscous binding, which suggests the presence of crystal-foreign substances with numerous binding sites (Arya, 2017) [3]. This process is enhanced when urinary inhibitors are deficient in the body.

Crystal retention and stone formation: For stone formation, crystals must be retained in the kidney instead of being flushed out with urine. In this process, calcium oxalate crystals grow over pre-existing calcium phosphate plaques in the renal papillae. Slow urine flow allows crystals to remain in the urinary tract for a longer duration. The aggregated crystals continue to grow and form larger stones. Over time, retained crystals undergo layering with salts and an organic matrix, developing into detectable stones. A mixture of promoters and a deficiency of inhibitors determine the final stone type.

Diagnosis: A blood test is the initial step in diagnosis and is used to detect excess calcium or uric acid in the bloodstream. During this process, calcium and creatinine levels are carefully examined and helps doctors to examine the overall condition of kidney (Vibhute *et al*., 2024) [34]. The 2nd diagnosis method which is usually used is urine testing. In this test urine from two consecutive days is collected and is analysed for insufficient stone forming minerals. The metabolites which are carefully analysed are citrate, oxalate, uric acid, calcium, and phosphate. Abnormal levels of these compounds can help in diagnosis of kidney stone (Vibhute *et al*., 2024) [34]. Blood and urine test both are preliminary tests, and ultimate confirmation of kidney stones are by imaging which involves basic X-rays, CT scans and ultrasonography.

Organ-specific stones: Stones can form in various organs where salt crystallization occurs.

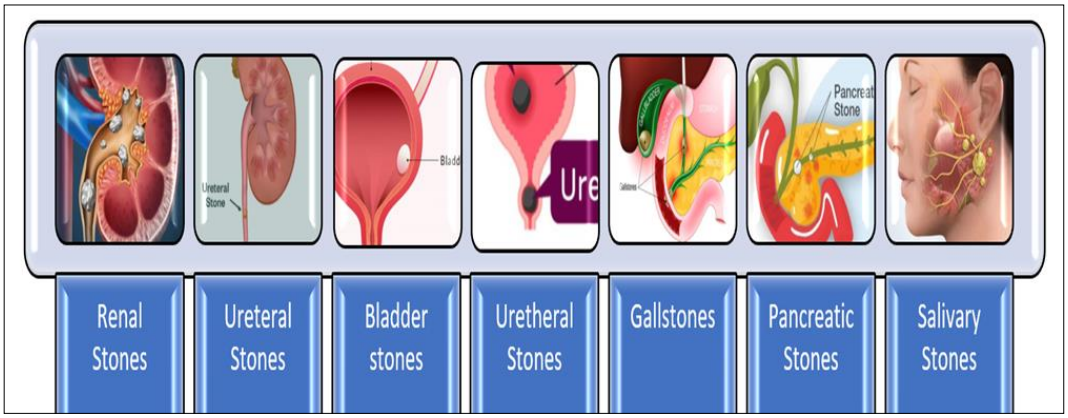


Fig 7: Showing stones in different organs.

Renal stones: Alternative names for these are kidney stones, renal calculi, nephrolithiasis, or urolithiasis. Under this state, hard deposits of minerals and salts, mostly calcium oxalates and phosphates, are formed in the kidneys.

Ureteral stones: When kidney stones travel and are stuck inside the ureters (the tubes that connect the kidneys and bladder), usually calcium-based stones migrate from the kidney. This condition is known as ureterolithiasis.

Bladder stones: These are formed in the urinary bladder due to infections or an enlarged prostate in men. They are mostly uric acid and calcium oxalate stones. It is also known as vesical calculi.

Urethral stones: These stones can form in the urethra or migrate from the bladder. It causes urethral narrowing, chronic infection, and difficulty in urination.

Gallstones: Gallstones are hardened, concentrated bile fragments that develop in the gallbladder or bile ducts. Bile can normally dissolve cholesterol, but if there is a lot of it, it will crystallize and eventually turn into stones.(Singh *et al*., 2020) [32]. The term "cholelithiasis" is used for gallstones. The most common symptoms are upper abdomen pain and nausea. A complicated chain of processes including bile supersaturation, nucleation and initiation, and stone growth by accretion results in these stone's formation.(Singh *et al*., 2020) [32].

Pancreatic stones: These are formed in pancreatic ducts by calcium carbonate and protein-based deposits. It is caused by chronic pancreatitis, alcohol consumption, and other metabolic disorders.

Salivary stones: These are formed in the salivary glands by calcium phosphate or carbonate salts. It reduces salivary flow and causes dehydration and infections. The condition in which stones are formed in salivary glands such as parotid, submandibular, and sublingual glands is known as sialolithiasis.

Results

Alternative therapies used for prevention and cure of kidney stones: Conventional treatments such as surgery, pharmacotherapy are successful but frequently have numerous adverse effects and with high recurrence rate. As a result, increasing interest of people in alternative therapies, especially those derived from medicinal plants, dietary modifications, traditional system of medicine.

Herbal and plant based nutraceuticals in the treatment of Urolithiasis

Nutraceuticals are "specially formulated preparations" which focus on particular nutritional needs and offer health advantages that prevent disease. (Puri *et al*., 2022). These include individual or combined pro- and prebiotic foods, such as spices and herbs, which can improve quality of life and lower the risk of several diseases (Puri *et al*., 2022). Nutraceuticals like calcium, omega-3 polyunsaturated lipids, vitamin D, folic acid, zinc, inositol, and probiotic dietary supplements have been identified as promising new options (Puri *et al*., 2022). The market is still robust and expanding in the field of nutraceuticals, which include antioxidants, omega-3 fatty acids, plants like wheatgrass, *Aloe vera*, tea and herbs like ginseng and Echinacea. (Puri *et al*., 2022).

Chyawanprash: It is a formulation of rich Ayurvedic minerals and herbs explore the urolithiatic, and diuretic potential, which comes under nutraceuticals (Bhosle *et al*., 2021) [6]. It is among the typically utilized Ayurvedic formulations mentioned in text Charaka Samhita and widely taken as a nutritional supplement as well as illness prevention, immunity promotion, and overall wellness. Its formulation is made by traditional plants which are reported anti-nephrolithiatic, nephroprotective and diuretic to treat kidney stone (Bhosle *et al*., 2021) [6]. These have analgesics, lithotryptic, anti-inflammatory, nephron-protective, diuretic, and property to reduce chronic heavy metal exposure. The normal dosage of Chyawanprash (12–28 g) should be consumed on an empty stomach in the morning, either with or without milk (100–250 ml) (Bhosle *et al*., 2021) [6].

Green tea: Green tea is made from non- fermented leaves and buds of *Camellia sinensis.* The primary component in fresh leaves of tea is polyphenolic compounds, particularly flavonoids known best for the health benefits. The flavonoid compounds with high antioxidant activity are found in catechins including epigallocatechin, epigallocatechin gallate, epicatechin and epicatechin gallate (Sari *et al*., 2023) [26]. Stone formation was inhibited by antioxidants such as epigallocatechin gallate (Palaniyandi *et al*., 2025a) [20]. In recent studies we observed that when compared to a common medication like cystone, green tea with lemon juice had a significantly greater impact. (Chegu *et al*., 2018) [8]. Lemon juice and green tea has citrate, vitamin C and E, and flavonoids such limonoids, hesperetin, and eriocitrin and shows high antioxidant capacity (Chegu *et al*., 2018) [8].

Case studies: Carried out *in vitro*, anti-urolithiatic efficacy by analyzing lemon and green tea extracts using standard. According to the data, a mixture of green tea and lemon juice dissolves 78.5% of calcium oxalate stones, while green tea extract aids in 19.03% calcium oxalate disintegration (Chegu *et al*., 2018) [8].

Kidney stone treatment using engineered microorganisms

In synthetic biology, genetically engineered and altered cells or living things have biological functions that satisfy human requirements. By generating healthy metabolites like short-chain fatty acids, breaking down toxic metabolites like oxalates, and treating inflammatory conditions, certain probiotics contribute to overall health maintenance (Wan *et al*., 2024). The products of genetically modified microbes may be used to cure a number of illnesses.

Microorganisms engineered in intestine

Intestinal oxalate-degrading bacteria

Certain bacteria of the human intestinal microbiome, such as *Oxalobacter formigenes*, possess the capability to degrade oxalate within the gut. This bacterium can break down oxalate present in food, thereby reducing oxalate excretion in the urine and intestinal absorption. Additionally, it secretes a bioactive compound that, although deactivated by heat or pepsin, stimulates the secretion of intestinal oxalate by interacting with the intestinal epithelium, ultimately decreasing the chance of developing calcium oxalate stones (Wan *et al*., 2024). *Oxalobacter formigenes* requires a strictly anaerobic environment for survival and is highly sensitive to antibiotics. Antibiotic use may cause oxalate-degrading bacteria to cease expanding, which is ineffective in reducing oxalate levels for long term. Successful colonization of these bacteria necessitates a high-oxalate diet (Wan *et al*., 2024). Other naturally existing intestinal oxalate-degrading bacteria, which includes Lactobacillus and Bifidobacterium, shown *in vitro* oxalate-degrading properties. *Oxalobacter formigenes* specifically degrades oxalate into formic acid and carbon dioxide.

An oxalate-degrading bacteria such as oxalate decarboxylase from Bacillus subtilis used in order to treat calcium oxalate stones. Oxalate decarboxylase converts oxalate to carbon dioxide and formate. (Shamsher & Gupta S, 2018) [11]

In this case study, a single dose of *Oxalate formigenes* was effectively administered to 22 healthy individuals without a history of kidney stones. Ion chromatography was used to measure the amounts of oxalate in their urine and stool after a 24-hour period. (Fargue *et al*., 2025) [10]. Oxalate excretion in the urine and feces was shown to have dropped by 14% and 54%, respectively, following colonization. These studies demonstrate that an effective *Oxalate formigenes* colonialism lessens urine oxalate excretion in renal stones caused by calcium oxalate. (Fargue *et al*., 2025) [10].

Plant phytochemicals with anti-urolithiatic activity

Medicinal plants contain diverse secondary metabolites that interfere with kidney stone formation at different stages, such as nucleation, development, compilation, and retention of crystals in the kidney tissues. Several bioactive molecules found in plants (phytochemicals), such as polyphenol, alkaloids, terpenoids, glycosides, polysaccharides, and fatty acids, can prevent kidney stones from forming. (Shetty & Hegde, 2024) [29]. Phytochemicals interfere in a stone formation in a different manner and at different stages. The different mode of action includes the crystal formation inhibition, biochemical modulation, and physiological effects.

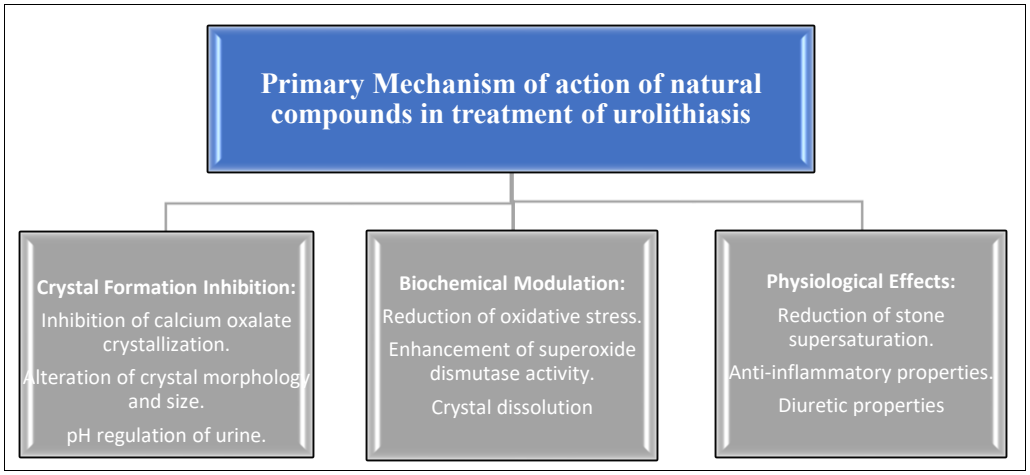


Fig 8: Primary Mechanism of action of natural compounds in treatment of urolithiasis.

Flavonoids: They contribute in the inhibition phases of calcium oxalate crystal nucleation and aggregation. Flavonoids possess antioxidant property. They enhance urinary citrate excretion, which naturally inhibits stone formation. Examples include Rutin from *Tamarindus indica*. kaempferol from *Mangifera indica*, is regarded as largest group of secondary plant metabolites and has antimicrobial, antioxidant, antitumor and anti-inflammatory activities. It can inhibit calcium oxalate crystal deposition and shows therapeutic potential against Calcium oxalate nephrolithiasis (Dudhe *et al*., 2025) [9].*Camellia sinensis* contains quercetin, a possible dietary antioxidant that reduces kidney conditions like nephrotoxicity, inflammation, fibrosis, and apoptosis. It prevents calcium oxalate crystals from sticking together and minimizes oxidative stress in renal tubular cells. (Dudhe *et al*., 2025) [9].

Saponins: Saponins increase urinary volume, act as natural diuretics, and reduce crystal supersaturation. They coat the crystals and make them less adhesive to renal cells. They exhibit surfactant activity that breaks down mucoproteins, which act as a binding matrix for stones.

Examples include Diosgenin from *Tribulus Terrestris* and beta-sitosterol glycosides.

Alkaloids: These compounds prevent the renal tubular transport of calcium and oxalate. It has anti-inflammatory effects by reducing tubular injury caused by crystals. Some alkaloids increase urinary pH, which prevents the formation of uric acid stones. Examples: Berine from *Berberis vulgaris*, Piperine from *Piper nigrum*, Quinoline (*Ruta graveolens*).

Terpenoids: These compounds support the enzymatic balance in oxalate metabolism by reducing glyoxylate oxidase activity and increasing glycolate oxidase activity. They exhibit anti-inflammatory activity, which protects the renal tissue from crystal-induced damage. They reduce calcium and oxalate retention in the kidneys. Examples: Limonene from *Citrus* species, Ursula acid from *Ocimum sanctum.* Lupeol is a pentacyclic triterpenoid with anti-urolithiasis and renal toxicity protection, derived from *Kataeva nerval*. It has cytoprotective effects against damage caused by free radicals, and lowers the amount of cadmium and calcium oxalate in the kidney (Dudhe *et al*., 2025) [9].

Tannins: They decrease the calcium ions' availability for stone formation by chelating them. Reduce urinary oxalate and uric acid levels. Examples: Gallic acid (*Punica granatum*).Ellagic acid derivatives are a naturally occurring bioactive substance that occurs as a secondary metabolite in *Emblica officinalis*. (Dudhe *et al*., 2025) [9]. It acts as antioxidant, antimutagenic, and anticarcinogenic. It detoxifies the kidneys and offers nephroprotection.

Phenolic compounds: They modulate the effect of enzymes involved in glycolate metabolism and reduce oxalate synthesis in the liver. Increase the antioxidant defense system.

Examples: Caffeic acid (*Coffea arabica*), Chlorogenic acid (*Cynodon dactylon*), Ferulic acid (*Curcuma longa*). Green tea contains a natural polyphenol called epigallocatechin (EGCG), which is used to cure and prevent kidney stones. It has anti-inflammatory and anti-oxidant properties that can lower renal inflammation and oxidative stress. It lowers the creation of harmful free radicals, prevents the building of calcium oxalate crystals, and decreases the ability to bind crystals. (Dudhe *et al*., 2025) [9].

Glycosides: They dilute the urinary stones by acting as diuretics. Protects the renal epithelial cells from crystal adhesion. Reduce inflammation and oxidative stress in the kidneys. Examples: Aucuba (*Plantago major*), Iridoid glycosides (*Gardenia aminoxides).*

Essential oils: They reduce the ureteral contractions and ease stone passage. Prevents adhesion of crystals to the epithelial lining. Provides antimicrobial activity and helps prevent infection-induced stones.

Examples: Eugenol (*Ocimum sanctum*), Menthol (*Mentha* species), Cineole (*Eucalyptus*).

Traditional Medicinal System for kidney stone treatment

Many plants are used in traditional medicine for dissolving, preventing, or expelling stones. Traditional medicinal plants are used to cure urolithiasis has been deeply rooted in traditional medicinal system including Ayurveda, Unani, Siddha, Traditional Chinese Medicine (TCM), and

ethnomedicine adopted by indigenous communities (Ashvini *et al*., 2025) [4]

One of the most effective ways to prevent and cure urolithiasis is through herbal medicine, which controls the crystallization process. Herbal medicine is non-invasive, affordable, and may include qualities that break or dissolve the stones, so it is a feasible medical care option for acute nephrolithiasis.

Renal stones were mentioned by renowned Indian physicians Charaka and Sushruta in their writings. Sushruta Samhita and Charaka Samhita (Arathi S Nair, 2025) [2].

Ayurveda: In Ayurveda, the panchmahabhutas hypothesis, holds that all living things and objects are made up of five elements-earth, water, fire, air, and sky. The bedrock of Ayurvedic therapies believes that the body of every individual is composed of three humors: Vata, Pitta, and Kapha. When these doshas or humors are out of balance, it results in illness. In Ayurveda, among the wight most troublesome condition is urolithiasis. It describes four types of urinary calculi: sukraashmari (calcium-oxalate stone), Sleshmaashmari (phosphatic stone), pittaashmari (urate stone), vataashmari (oxalate stone). Herbal formulations, alkaline treatments, and surgical methods are used in Ayurveda for treating kidney stones. Stone disorders are treated in Ayurveda with herbal products and their formulations. Usually, oral intake of herbal products like teekshnaushna (penetrative) and ashmaribhedana (lithotriptic). (Anand Nimavat *et al*., 2022) [1].

Traditional Chinese Medicinal System: It is among the earliest medicinal system, has about more than 2500 years of existence. The five phases-metal, wood, water, fire, and earth as well as the yin-yang theory serves as its foundation. Yin signifies for the earth, cold, and femininity, and yang for the sky, heat, and masculinity(Kasote *et al*., 2017) [13]. Its primary focus is on maintaining health and treating illness through regulating yin and yang levels. Herbal remedies, massage, exercise, dietary treatment, acupuncture and changes in lifestyles are its six main subfields (Kasote *et al*., 2017) [13]. Its primary therapeutic schemes basically consists of heat elimination, reducing moisture, free and disinhibited the urine, and stone expulsion, all of which are typically accomplished by taking polyherbal remedies. *Pyrrosiae petiolosa, Laportea bulbifera* and some other plants or polyherbal compositions are utilized in Traditional Chinese Medicinal System. (Kasote *et al*., 2017) [13]

Siddha: It is commonly practiced in Tamil Nadu, and is one of India's oldest traditional medicinal systems. Vath in childhood, pitta in adulthood and kapha in old age are the fundamental ideas of Siddha (Kasote *et al*., 2017) [13]. Based on the three humors in the body, siddha has described four different kinds of stones. *Aerva lanata*, *Asparagus racemosus*, *Carica papaya*, *Cynodon dactylon*, and some other plants are used in Siddha for treating stones (Kasote *et al*., 2017) [13].

Unani: It is the traditional medicinal system adopted in Middle Eastern and Southern Asian countries, including India. It was developed by Persian physicians. In this, the four humors that make up the human body are blood, phlegm, yellow bile, and black bile. Some plants used in this system are *Adiantum capillus veneris*, *Vigna unguiculata*, etc(Kasote *et al*., 2017) [13].

Herbal Formulations used for kidney stone treatment:

Herbal formulation is a therapeutic preparation made from one or more medicinal plants that possess anti-urolithiatic, diuretic, antioxidant, and lithotriptic (stone-dissolving) properties. These formulations can be single herb extracts, polyherbal combinations, or classical Ayurvedic preparations for the prevention of stone formation, dissolving existing stones, and reducing recurrence. Various Ayurveda based classical or commercial formulations are used for treating kidney stones particularly polyherbal products with their natural ingredients known for their prevention, efficacy and safety.

Polyherbal tablets: These formulations are made from multiple herbs which are known for their therapeutic effects and minimizing the side effects. These formulations are more used because they can effective against wide range of diseases, having fewer side effects than pharmacological drugs, cost-effectiveness, and easy availability, and are eco-friendly (Kamble *et al*., 2024) [12]. The formulation includes powder of *Bryophyllum pinnatum* (pattharchatta), *Moringa oleifera* (drumsticks) leaves and ginger (adrak), and are combined into tablets by using wet granulation method (Kamble *et al*., 2024) [12].

Cystone forte: Cystone is a polyherbal formulation has been clinically evaluated for its effectiveness in expelling and safety in managing kidney stones. In addition to powders of purified Shilajeet (26gm) and Hajrul yahood Bhasma (32 mg), each Cystone forte tablet contains extracts of *Didymocarpus pedicellate* (130 mg), *Saxifraga ligulate* (98 mg), *Rubia cordifolia* (32gm), *Cyperus scariosus* (32 mg), *Achyranthes aspera* (32 mg), *Onosma bracteatum* (32 mg), and *Vernonia cinerea* (32 mg) (Azarfar *et al*., 2020) [5]. *Didymocarpus pedicellata* has been reported to have diuretic properties, *Saxifraga ligulata* has tannins which possess astringent and anti-microbial activity, the roots of Rubia cordifolia contains ruberythic acid known to dissolve oxalate stones, oil from roots of *Cyperus scariosus* has anti-inflammatory and anti-oxidant properties, *Achyranthes aspera* is potential for anti-inflammatory and diuretic properties, Onosma bracteatum has diuretic properties also regulates urine output and reduces bladder irritation (Palaniyamma & Jeyaraman, 2017a) [18]. Harjul yahood Bhasma known for diuretic activity and reduces retention of urine, shilajeet has tonic activity and used for urinary disorders (Palaniyamma & Jeyaraman, 2017a) [18].

Case study: In the case study, there were 65 kidney stone patients, of these, 36 were men and 29 were women in the 18–50 age range (Palaniyamma & Jeyaraman, 2017b) [18]. The individuals with renal stones > 5 mm and < 12 mm. All patients received Cystone forte was given to all patients for three months at a dosage of 2 tablets daily (Palaniyamma & Jeyaraman, 2017b) [18]. Out of 65, 35 having stone size > 5 mm to <6.9 mm and 20 patients following treatment expel out calculi. And remaining 30 who have calculi size > 7 to 12 mm, after cystone forte treatment 16 patients expel out calculi (Palaniyamma & Jeyaraman, 2017b) [18].

Action produced by herbal drugs include

Diuretic action increases the urine production, which facilitates the easier elimination of tiny calculi by urine. By keeping the equilibrium between stone-forming promoters

and inhibitors, crystallization inhibition action benefits in avoiding stone formation at various phases. Lithotriptic action (avoid binding calculi's mucin to stop crystals from aggregating to form big stones). Their antioxidant activity (prevents tissue damage) and antimicrobial action (prevents infection. (Shukla *et al*., 2017) [31]

Mechanism of herbal extract in treating kidney stone

The phytoconstituents in these plants, which have several therapeutic effects on urolithiasis, are processed by herbal extracts helps to treat the kidney stones. These include: Improving the quantity and pH of urine. Making it easier for stones to move.

Keeping the balance between stone promoters and inhibitors.

Improving renal function.

Regulating oxalate metabolism

Elevating antioxidant levels, and exhibiting antimicrobial activity. (Vibhute *et al*., 2024) [34]

Many herbal extracts contain phytochemicals like flavonoids, saponins, and alkaloids that can aid in reducing the levels of ions that cause stones in urine, including calcium, oxalate, uric acid, and phosphate, and herbs prevent the urine from becoming supersaturated, which is the initial step of stone nucleation. Active compounds in herbs like tannins and phenolic acids can bind to free calcium and oxalate and reducing their tendency to combine and form crystals. This helps in the interruption of the nucleation process and also slows down the aggregation and enlargement of crystals into stones. Saponins and glycosides present in many plant extracts have a surfactant-like activity, which disrupts the sticking of small crystals with each other and with renal epithelium cells and reducing the chance of stone formation.

Some medicinal plants for urolithiaisis

Table 3: Some plants for lithiasis

Botanical name	Common Name	Family name	Part used/ whole plant	References
Aerva lanata	Pashanabheda, Pattura	Amaranthaceae	Whole plant	(Vibhute *et al*., 2024)
Asparagus racemosus	Shatavari	Asparagaceae	root	(Palaniyandi *et al*., 2025b)
Tribulus terrestris	Gokshur	Zygophyllaceae	Roots, fruit	(Shukla *et al*., 2017)
Carica papaya	Papaya	Caricaceae	root	(Vibhute *et al*., 2024)
Camellia sinensis	Green tea	Theaceae	Leaf	(Palaniyandi *et al*., 2025)
Raphanus sativus L.	Radish	Brassicaceae	Leaf	(Palaniyandi *et al*., 2025)
Zea mays	Maize	Poaceae	Flower or corn silk	(Parvani *et al*., 2025)
Oscimum sanctum	Tulsi	Lamiaceae	Leaves	(Shukla *et al*., 2017)
Syzigium cumini	Jamun	Myrtaceae	Fruit	(Parvani *et al*., 2025)
Mangifera indica	Mango	Anacardiaceae	Fruit	(Vibhute *et al*., 2024)
Crataeva nurvala	Varuna	Capparaceae	Bark	(Shukla *et al*., 2017)
Terminalia arjuna	Arjun	Combrataceae	Bark	(Shamim, 2024)
Kalanchoe pinnata	Miracle plant or life plant or patharchatta	Crassulaceae	Leaves	(Nagpal G, 2020)
Punicagranatum	Pomegranate	Lythraceae	Flower	(Palaniyandi *et al*., 2025)
Tamarindus indica	Imli	Fabaceae	Fruit pulp	(Shukla *et al*., 2017)

Bryophyllum pinnatum **(Fig.9 (i)):** It is one of the medicinal plants used traditionally for pashanbheda (ayurvedic term known for breaking up and degrading renal and kidney stones) and is also a main ingredient of commercial polyherbal formulations with ginger and drumsticks. Common names for it include *Bryophyllum pinnatum*, air plant, life plant, miracle plant, and patharchatta (Nagpal G, 2020) [17]. It is an evergreen succulent herb making it versatile in medicine, as it possesses diuretic, anti-inflammatory, antibacterial, and ulcer-treating characteristics (Khoddami *et al*., 2013a) [14]. It contains flavonoids and phenolic acids, and glycosides. Glycosides inhibit calcium oxalate stones formation, flavonoids shield the kidneys from renal damage, and phenols are efficient at dissolving calcium oxalate and phosphate. (Khoddami *et al*., 2013b) [14]. Fresh leaves or the aqueous extract of *Bryophyllum pinnatum* are used for the curing or inhibiting urinary disorders and kidney stone (Samantha *et al*., 2023) [25].

Tribulus terrestris **(Gokshura) (Fig.9 (ii))**

It contains steroidal saponins (discoing), flavonoids, which prevent the supersaturation of the urolithiasis substances. Widely utilized to treat urinary tract infections and stones. It functions as natural diuretic by increasing the urine volume, diluting the stone-forming substances, and helping in the expulsion of crystals. *Bergenia ligulata* and *Tribulus terrestris* have been used in herbomineral combination to treat renal and ureteric calculi(Nagal & Singla, 2013) [16]. With this combination, 29% of patients with renal calculi and 75% with ureteric calculi passed their calculi completely, and in other patients, the calculi were expelled along with alternations in the shape and size(Nagal & Singla, 2013) [16].

Crataeva nurvala **(Varuna) (Fig.9 (iii))**

It contains flavonoids, saponins, and lupeol, which help in dissolving and expelling the calculi, reduce urinary retention, and strengthen bladder muscles. The impact of *Crataeva nurvala* bark decoction on calcium oxalate urolithiasis caused by 3% glycolic acid studied in rats (Nagal & Singla, 2013) [16]. By suppressing the action of liver enzyme glycolate oxidase, the decoction significantly reduces the amount of calcium phosphate that accumulates in the kidney (Nagal & Singla, 2013) [16]. The phosphate type of stones dissolved by C. *nurvala*, while oxalate, uric acid, and cystine stones were not. With its bark treatment, it helps in lowering the levels of intestinal sodium and potassium salts and potassium ATPases(Nagal & Singla, 2013) [16]. Its use for urinary stones is mentioned in the traditional medicinal system in the Charaka Samhita.

***Asparagus racemosus* (Shatavari) (Fig.9 (iv))**
It contains saponins and flavonoids, which have diuretic properties and phytoconstituents like flavonoids and polyphenols contributed to antioxidant effects (Shetty & Hegde, 2024) [29]. *A. racemosus* prevents the supersaturation of crystalizing salts by either increasing or decreasing the amounts of salts in the urines. Since bacterial infections have been linked to the promotion of urolithiasis, the active component of *A. racemosus*, 9,10-dehydrophenantherene, has antibacterial properties that may possibly be a contributing factor to its anti-urolithiatic qualities (Shetty & Hegde, 2024) [29].

***Ocimum sanctum* (Tulsi) (Fig.9 (v))**
It contains eugenol, unsolic acids, and flavonoids, which show antioxidant properties, diuretic activity, and breakdown of calcium oxalate crystals. In Ayurveda, Tulsi juice is used for kidney stones.

***Tamarindus indicus* (Fig.9 (vi))**
Consumption of 3-10 g of tamarind pulp in stone former and regular studies. A dose of 10 g of Tamarind pulp is beneficial for avoiding spontaneous crystallization in both healthy individuals and stone formers(Shraddha & Shraddha, 2021) [30].

***Terminalia arjuna* (Fig.9 (vii))**
Calcium oxalate stones are unable to establish as Terminalia arjuna suppresses their nucleation, growth, and aggregation. (Shamim, 2024) [28]. It has multi-targeted bioactivity towards kidney stones. Encouraging results have been obtained regarding its anti-inflammatory, antioxidant, crystal-nucleation inhibition, and renal tissue-protecting properties. Essential phytochemicals in plant are arjungenin, arjunic acid (titerpenoid saponins), flavonoids, saponins and tannins derived through bark (Shamim, 2024) [28]. Arjunic acid has antioxidant and anti-inflammatory properties which help in inhibition of formation of kidney stone by reducing oxidative stress, arjungenin helps in regeneration of renal tissue, flavonoids reduce inflammation and oxidative damage, tannins has inhibitory properties which bind to calcium oxalate crystals and prevent the aggregation and promote their dissolution, saponins has diuretic effect which enhance urine flow and flush out small stones (Shamim, 2024) [28].

***Syzygium cumini* (Fig.9 (viii))**
Syzygium cumini commonly referred to as the Java plum or jamun, is a member of Myrtaceae family and primarily known for its saponin and flavonoid phytochemicals (Parvani *et al*., 2025) [22]The phytochemical constituents of flavonoids, tannins, and essential oils exhibit diuretic activities and have a significant impact on renal physiology. These chemical substances helps in increasing the renal blood flow which enhance the urine output. Jamun mediates the excretion of water and sodium, contributing in maintaining the electrolyte balance. Additionally, the antioxidants in these safeguard the renal tissues from oxidative damage. (Parvani *et al*., 2025) [22].

***Zea mays* (Fig.9 (ix))**
Maize silk is the portion of Zea mays utilized for urolithiasis; it refers to the long, thread-like structures that emerge from maize ears and are primarily rich in flavonoid phytochemicals. (Parvani *et al*., 2025) [22]. The functioning of starch tissues and uricosuric effects of corn silk are through renal functioning and solute excretion. Urinary excretion of water, sodium, potassium, and uric acid has been enhanced by the aqueous extract of corn silk. (Parvani *et al*., 2025) [22].

***Mangifera indica* (Fig.9 (x))**
It is commonly referred as mango, is a member of Anacardiaceae family and its primary phytochemicals are tannins, alkaloids, and flavonoids. It produces mangiferin, which is a natural C-glucosyl xanthonoid polyphenol, mangiferin works by triggering antioxidant responses in order to prevent renal inflammation and oxidative stress(Parvani *et al*., 2025) [22]. Apoptosis, one of the primary contributors of kidney damage, is inhibited by mangiferin. For kidney problems, it is regarded as a potent natural medicinal agent.(Parvani *et al*., 2025) [22].

Fig 9: Showing some medicinal plants used for kidney stones.

Discussion

Urolithiasis remains a significant global health burden with its high recurrence rates with limitations of conventional treatment. Current findings of study explored the naturopathic approaches, including dietary, herbal, microbial, nutraceuticals, and lifestyle modifications as best alternatives for kidney stone management. This study also provide the therapeutic potential of medicinal plants such as *Phyllanthus niruri, Bryophyllum pinnatum* and many more are by providing antiurolithiatic activites. These findings contribute to growing interest in these approaches but despite this, they need clinical validations, to ensure safety, dosage, and efficacy.

Conclusions

In future the kidney stone management can't be achieved with just one method but we will have to adopt multifaceted alternative approaches that offers promising, cost-effective, and safer options compared to conventional therapies. It includes the preventive ability of herbal remedies, dietary modifications (nutraceuticals), precision of engineered microorganisms, and the proven efficacy of certain traditional herbs and their commercial formulations for offering a safe and effective treatment against the kidney stone. The use of Herbal and microbial formulations along with nutraceuticals provides holistic approach for prevention and management of kidney stones. These natural alternatives offer multiple therapeutics benefits, including diuretics, inhibition of crystal formation and aggregation, antioxidant effects, and reduce inflammation in urinary tract. Herbal formulations derived from medicinal plants are more useful because they are inexpensive, and now having supported clinical validity, so more people moving towards the herbal drugs for prevention and cure of kidney stone. Microbial formulations contributing by promoting good gut microbiome, and help in reducing the absorption of oxalate, thereby minimizing the possibility of stones in the kidneys. Nutraceuticals, includes vitamins, minerals, helps in maintaining the metabolic imbalance, reduce risk of prevalence by improving renal health. We should adopt these approaches because as compared to conventional treatments, these are safer, cost-effective, and having fewer side effects. Despite of their potential of reducing risk of stones, these approaches need more clinical validations, standardization of dosages, more quality checks, for ensuring their efficacy and safety for future.

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References

1. Nimavat A, Trivedi A, Yadav A, Patel P. A review on kidney stone and its herbal treatment. Journal of Pharmacy and Pharmacology,2022:10(6). doi: 10.17265/2328-2150/2022.06.003.
2. Nair AS, AA, SK, JN, SK. A review on herbal drugs in the management of urolithiasis. Journal of Pharmacognosy and Phytochemistry,2025:14(1):283-9. doi: 10.22271/phyto.2025.v14.i1d.15248.
3. Arya P. Kidney stones formation and use of medicinal plants as antiurolithiatic agents. Universal Journal of Pharmaceutical Research,2017:2(4):42-8. doi: 10.22270/ujpr.v2i4.RW1.
4. Ashvini M, Kakad A, Ingle RA, Biyani K. Investigation of traditional medicinal plants and formulation in the treatment of urolithiasis,2025. Available from: www.ijnrd.org.
5. Azarfar A, Rafiee Z, Ravanshad Y, Moghadam NS, Bakhtiari E. Effect of herbal formulation "Cystone®" on urolithiasis. Jundishapur Journal of Natural Pharmaceutical Products,2020:15(3). doi: 10.5812/jjnpp.69246.
6. Bhosle P, Gorle K, Deokar A. Chyawanprash: a nutraceutical in the treatment of calcium oxalate kidney stones: let food be your medicine. International Journal of Health Sciences and Research,2021:11(7):303-8. doi: 10.52403/ijhsr.20210741.
7. Chang CW, Ke HL, Lee JI, Lee YC, Jhan JH, Wang HS, *et al*. Metabolic syndrome increases the risk of kidney stone disease: a cross-sectional and longitudinal cohort study. Journal of Personalized Medicine,2021:11(11):1154. doi: 10.3390/jpm11111154.
8. Chegu K, Mounika K, Rajeswari M, Vanibala N, Sujatha P, Sridurga P, *et al*. A study on *in vitro* anti-urolithiatic activity of aqueous extracts of green tea & lemon. World Journal of Pharmaceutical Research,2018:7. doi: 10.20959/wjpr20185-11390.
9. Dudhe R, Dudhe AR, Kamdi D, Pise AG. Herbs used for urolithiasis activity: a critical review. Journal of Advanced Scientific Research,2025:16(4):25-9. doi: 10.55218/jasr.2025160404.
10. Fargue S, Suryavanshi M, Wood KD, Crivelli JJ, Oster RA, Assimos DG, *et al*. Inducing *Oxalobacter formigenes* colonization reduces urinary oxalate in healthy adults. Kidney International Reports,2025:10(5):1518-28. doi: 10.1016/j.ekir.2025.02.004.
11. Gupta S, Shamsher. Kidney stones: mechanism of formation, pathogenesis and possible treatments,2018.
12. Kamble PR, Kamble JR. Formulation and evaluation of polyherbal tablet for kidney stone. International Journal of Research Publication and Reviews,2024:5(7). Available from: www.ijrpr.com.
13. Kasote DM, Jagtap SD, Thapa D, Khyade MS, Russell WR. Herbal remedies for urinary stones used in India and China: a review. Journal of Ethnopharmacology,2017:203:55-68. doi: 10.1016/j.jep.2017.03.038.
14. Khoddami A, Wilkes MA, Roberts TH. Techniques for analysis of plant phenolic compounds. Molecules,2013:18(2):2328-75. doi: 10.3390/molecules18022328.
15. Khoddami A, Wilkes MA, Roberts TH. Techniques for analysis of plant phenolic compounds. Molecules,2013:18(2):2328-75. doi: 10.3390/molecules18022328.
16. Nagal A, Singla RK. Herbal resources with antiurolithiatic effects: a review. Indo Global Journal of Pharmaceutical Sciences,2013:3(1).
17. Nagpal G, SM. Kalanchoe pinnata and its remedial properties to treat kidney stone – a lesser known plant. International Journal of Biology, Pharmacy and Allied Sciences,2020:9(11). doi: 10.31032/ijbpas/2020/9.11.5259.
18. Palaniyamma D, Jeyaraman R. Evaluation of efficacy and safety of a herbal formulation Cystone Forte in the management of urolithiasis. J Urol Res,2017:4(4).
19. Palaniyamma D, Jeyaraman R. Evaluation of efficacy and safety of a herbal formulation Cystone Forte in the management of urolithiasis. J Urol Res,2017:4(4).
20. Palaniyandi N, Raman K, Velayutham S, Natarajan D, Natesan S. Researching medicinal plants for

antiurolithiatic activity: a systematic review,2025. Available from: http://ymerdigital.com.
21. Palaniyandi N, Raman K, Velayutham S, Natarajan D, Natesan S. Researching medicinal plants for antiurolithiatic activity: a systematic review,2025. Available from: http://ymerdigital.com.
22. Parvani K, Katariya HV, Thalkar A, Darvadiya R. Review: evaluating the efficacy of phytochemicals in treating urolithiasis by inhibiting the mechanism of action in the pathophysiology of stone formation,2025. Available from: www.ijfmr.com.
23. Jagtap PN, PP, MS, SC, RY. Comprehensive review on kidney stone,2020. Available from: www.ijppr.humanjournals.com.
24. Ratkalkar VN, Kleinman JG. Mechanisms of stone formation. Clinical Reviews in Bone and Mineral Metabolism,2011:9(3-4):187-97. doi: 10.1007/s12018-011-9104-8.
25. Samantha R, Shanika W, Fatema T, Keisha BW. Inhibition and dissolution of calcium oxalate crystals and kidney stones by the extract of *Kalanchoe pinnata*. Journal of Medicinal Plants Research,2023:17(6):201-17. doi: 10.5897/jmpr2023.7296.
26. Sari NWS, Tallei TE, Kolondam BJ. Benefits of green tea polyphenols for kidney health: a literature review. Grimsa Journal of Science Engineering and Technology,2023:1(2):60-70. doi: 10.61975/gjset.v1i2.13.
27. Sequira L, Hebbar S, Ravishanker N. Prevalence and associated risk factors of urolithiasis in India, a systematic review. Biomedicine (India),2023:43(2):572-6. doi: 10.51248/.v43i02.2198.
28. Shamim M. Terminalia arjuna as a natural remedy for kidney stone prevention and treatment. International Journal of Pharmaceutical Science and Medicine,2024:2(4):159-64. doi: 10.70199/ijpsm.2.4.159-164.
29. Shetty AN, Hegde K. Revolutionizing urolithiasis management: a paradigm shift through nutraceutical interventions, fluid therapy and pH maintenance - a comprehensive review. International Journal of Research and Review,2024:11(5):579-93. doi: 10.52403/ijrr.20240565.
30. Shraddha G, Shraddha S. A review on antiurolithiatic activity of some herbal drugs. World Journal of Pharmaceutical Research,2021:10(2). doi: 10.17605/OSF.IO/ZC4X6.
31. Shukla AK, Shukla S, Garg A, Garg S, Ajay M. A review on anti-urolithiatic activity of herbal folk plants. Asian Journal of Biomaterial Research,2017:3(2). Available from: www.ajbr.in.
32. Singh VK, Jaswal BS, Sharma J, Rai PK. Analysis of stones formed in the human gall bladder and kidney using advanced spectroscopic techniques. Biophysical Reviews,2020:12(3):647-68. doi: 10.1007/s12551-020-00697-2.
33. Varshney H, Kumar Gupta A, Upadhyay E. Kidney stones: a multifaceted approach to diagnosis, treatment, and prevention in modern urology. International Journal of Science and Research (IJSR),2024:13(12):1656-61. doi: 10.21275/sr241225181624.
34. Vibhute AR, Patil VV, Gadekar AA, Nalawade SN, Bandgar IS, Nitalikar MM. Herbal remedies for kidney stone: natures solution. International Journal of Research and Analytical Reviews,2024. Available from: www.ijrar.org.