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A REVIEW ON RENAL STONES AND THEIR MANAGEMENT THROUGH HERBAL TREATMENTS

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Abstract

Urolithiasis is a globally prevalent condition characterized by the formation of urinary calculi, significantly influenced by dietary habits, industrialization, and lifestyle changes. Current therapeutic approaches often exhibit limitations, including recurrence and adverse effects, highlighting the need for safer and more effective alternatives. Medicinal plants have been utilized for thousands of years as valuable sources of bioactive phytoconstituents capable of preventing and treating diverse diseases, including kidney stones.

This review provides a comprehensive evaluation of commonly used herbal medicines documented in Ayurvedic pharmacopeia and scientific literature with relevance to urolithiasis management. Key phytochemicals such as flavonoids, phenolics, saponins, alkaloids, and terpenoids demonstrate potential roles in inhibiting crystal nucleation and aggregation, enhancing diuresis, reducing oxidative stress, and preventing stone recurrence. Additionally, emerging mechanistic insights and future research challenges are discussed to strengthen the scientific basis for herbal therapeutics in urinary stone disease. Overall, herbal interventions represent a promising complementary approach for the long-term management of kidney stones, warranting further clinical validation and standardization to ensure safety, efficacy, and global applicability.

Keywords: -Herbal plants, kidney stones, urinary stone, calcium oxalate crystals, treatment.

1 Introduction: -

The management of chronic diseases in the modern healthcare system involves a wide range of therapeutic modalities, including pharmacological and non-pharmacological interventions. However, many of these conventional medicines are often associated with significant limitations, such as adverse side effects, high cost, and limited accessibility, particularly in resource-constrained settings (Castellano-Tejedor, 2022; Patel et al., 2025). Consequently, a large proportion of the global population—estimated at over 80%, predominantly residing in low- and middle-income countries—relies on herbal medicines and traditional therapeutic practices to meet their primary healthcare needs. These herbal remedies are generally preferred due to their better patient compliance, affordability, cultural acceptance, and lower incidence of adverse effects compared to synthetic drugs (Aware et al., 2022; M. A. A. Khan et al., 2025).

Certain ailments such as urinary stones, haemorrhoids, and irritable bowel syndrome (IBS) exhibit complex and multifactorial pathogenesis, often involving genetic predisposition and environmental influences. Due to their heterogeneous etiology, these disorders frequently require multimodal therapeutic approaches rather than a single specific treatment. In many cases, traditional systems of medicine are preferred over conventional pharmacotherapy, as they offer holistic management with fewer side effects and better patient tolerance (Salm et al., 2023; WHO, 2023).

Urolithiasis, the formation of urinary calculi, is a significant global health issue affecting millions worldwide. In 2021, an estimated 106 million new cases were reported, with men comprising about 67%. Despite slight declines in age-standardized rates, the global incidence, mortality, and DALYs from urolithiasis have markedly increased over the past two decades (Yao et al., 2025). The condition predominantly affects adults, with men three times more likely to be affected than women. Its prevalence varies geographically, ranging from 1–5% in Asia to 7–15% in North America, and reaching 20% in Saudi Arabia.

In the United States, about 1 in 11 adults develop kidney stones, particularly those with hypertension or diabetes. Notably, recurrence is common, with nearly half of patients experiencing stone formation within ten years (Liu et al., 2018).

Urinary stones can be classified based on their size, location, radiographic properties, composition, etiology, and recurrence risk; however, classification by anatomical site and chemical composition is most common. Stones formed in the kidney, ureter, and urinary bladder are termed nephrolithiasis, ureterolithiasis, and cystolithiasis (vesical calculi), respectively (Ivanuta et al., 2024). Structurally, urinary stones consist of protein-coated organic and inorganic crystalline components. The predominant constituents include calcium, uric acid, struvite, and ammonium acid urate. Among these, calcium stones account for approximately 75–85% of cases, primarily composed of calcium oxalate (monohydrate or dihydrate) or calcium phosphate. Other notable types include uric acid stones (8–10%), struvite stones (7–8%), and the less common cystine stones (1–2%) (Kumar et al., 2024; Tamborino et al., 2024).

Table 1: Different Types of Renal stones with composition

S. No.	Type of Stone	Composition	Frequency (%)	Causative Factors
1	Struvite (Triple phosphate)	Magnesium ammonium phosphate	7–8%	Urinary tract infection
2	Uric acid	Uric acid anhydrous / dihydrate	8–10%	Hyperuricosuria, acidic pH or both
3	Cystine	Cystine	1–2%	Cystinuria

Calcium oxalate stones constitute the majority of calcium-based nephroliths, occurring more frequently than calcium phosphate stones. represents a principal risk factor in the pathogenesis of calcium nephrolithiasis. Struvite stones, composed of magnesium, ammonium, and phosphate, are the second most prevalent type and are often termed infection stones due to their association with urinary tract infections. Uric acid stones rank third in prevalence and typically arise from hyper uricosuria, persistently acidic urinary pH, or a combination of both. Cystine stones, which are rare, consist of cystine and result from inherited defects in renal tubular amino acid transport(Shastri et al., 2023a). Additionally, melamine-associated nephrolithiasis has recently been reported, particularly among children, until it progresses significantly. Small calculi, typically a few millimetres in diameter, may pass spontaneously through the urinary tract. Urinary stones are generated when urine becomes saturated with salts or when urine lacks the normal(Rashedinia et al., 2025).

Urinary stone formation occurs when urine becomes supersaturated with lithogenic salts or when normal inhibitors of crystallization are deficient. The development of urolithiasis is influenced by multiple environmental and dietary factors, including low urine volume, high protein intake, and metabolic abnormalities such as hypercalciuria. A deficiency of stone-inhibiting substances—such as citrate, magnesium, and glycosaminoglycans (GAGs)—further contributes to stone formation. In the absence of recurrent episodes, early detection and prevention of urolithiasis are challenging, as the condition often remains asymptomatic (Tamborino et al., 2024). Calcium oxalate stones constitute the predominant subtype of calcium-based nephroliths and occur more frequently than calcium phosphate stones. Hypercalciuria serves as a major pathogenic factor in calcium nephrolithiasis. Struvite stones, composed of magnesium, ammonium, and phosphate, represent the second most common urinary calculi and are often referred to as infection stones due to their strong association with urinary tract infections. Uric acid stones are the third most prevalent type, commonly resulting from hyperuricosuria, persistently acidic urine pH, or both. Cystine stones are rare and arise from inherited defects in renal tubular transport of cystine and other dibasic amino acids. Moreover, melamine-associated nephrolithiasis has recently been reported, particularly in pediatric populations (Coe et al., 2016; Rashedinia et al., 2025).

Descriptions of urinary stone disease can be traced back to ancient medical texts from Ayurvedic, Chinese, and Greek traditions, which documented its clinical manifestations and therapeutic approaches. Common symptoms of urolithiasis include flank or lower abdominal pain, hematuria, and dysuria. These symptoms are frequently accompanied by nausea and vomiting. The pain associated with urinary calculi often presents as intermittent waves originating in the abdomen and radiating toward the groin, testis, or vulva, with episodes typically lasting 20–60 minutes. This characteristic pattern of severe, colicky pain is medically referred to as renal colic(Câmara & Soto-Blanco, 2025).

Dietary modification and stone-expulsive therapies are often ineffective in many cases of urolithiasis, particularly when calculi are large or become lodged within the urinary tract. In such situations, contemporary interventional approaches are required. However, these procedures can be technically demanding and are often unsuitable for patients with a high risk of recurrence. Conversely, traditional herbal therapies have demonstrated notable efficacy and remain accessible and cost-effective alternatives. Despite extensive historical documentation supporting their therapeutic potential, the widespread integration of these remedies into modern medical practice remains limited, primarily due to insufficient scientific validation and standardized clinical evidence(Leslie & Murphy, 2019).

The reliance on synthetic pharmaceuticals and the associated risk of adverse drug reactions have renewed increasing interest in natural and plant-derived alternatives. The modern resurgence of traditional medicine can be traced back to the WHO Conference in Canberra in 1976, which emphasized the importance of integrating traditional medicinal systems into healthcare strategies for developing nation. These stones can vary widely in size and can be found in any part of the urinary tract, including the kidney, ureters, and bladder. The founder of the College of Physicians, Linacre, passed away in London in 1518 from a urinary stone that he was able to detect but not treat (Maria I. Dalamagka, 2024).

1.1 Pathophysiology: -

Renal calculi (kidney stones) are crystal aggregates formed within the kidneys, which may be expelled through urine without symptoms; however, stones ≥2–3 mm can obstruct the ureter, leading to clinical complications. Their formation is influenced by multiple intrinsic and extrinsic factors, including age, sex, occupation, diet, climate, genetic predisposition, urinary tract infections, metabolic abnormalities, and structural abnormalities of the urinary system. Abnormal crystallization processes—characterized by crystal nucleation, aggregation, and growth—underlie the pathogenesis of urinary stone disease (Leslie & Murphy, 2019).

1.1.1 Lithiasis: -

When crystals separate from urine, a hard mass known as a kidney stone form in the urinary tract. Typically, urine contains chemicals that inhibit or stop crystals from forming in the urinary system. These crystals are tiny enough to go undetected through the urinary tract and out of the body in the urine. A less common type of stone is caused by an infection in the urinary system. Struvite or infection stone are terms used to describe this kind of stone. While cystine stones are rare, uric acid stones are less common. Kidney stones are created when organic and inorganic crystals interact with proteins(Wesson, 2025).

1.2 Urinary stones: -

Hard mineral masses caught in the urinary system at any time are called urine calculi. The organs in the urinary tract that filter blood to remove liquid waste (urine) ejected from the body are the kidneys, ureter, bladder, and urethra. Bladder, ureteric, and kidney stones are examples of stones that develop in the kidney and move through the urine canal before being trapped in smaller tubes(Breeggemann et al., 2024).

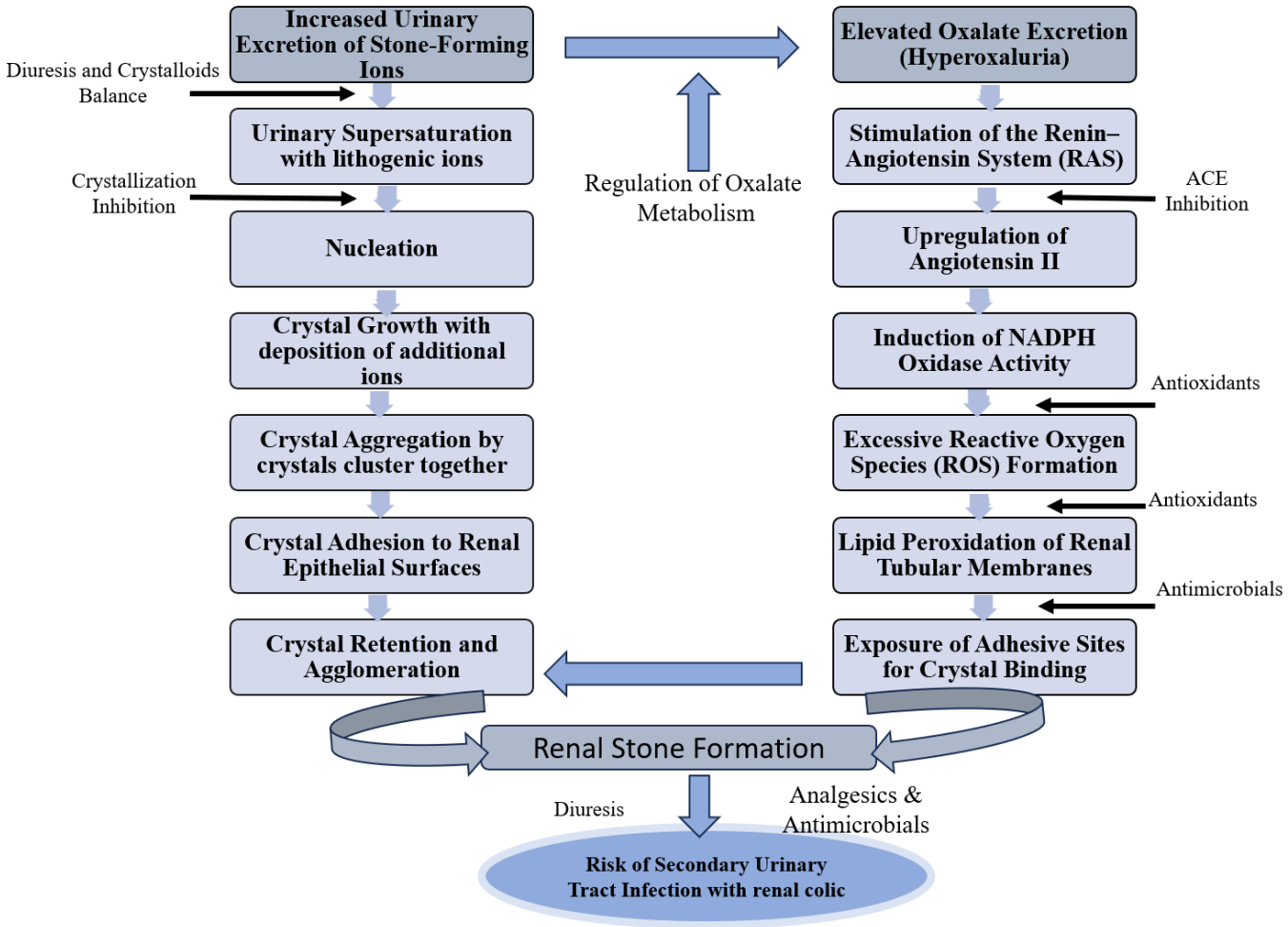

Figure 2: Mechanism of action of Herbal therapeutic agents

It's possible that the illness is quite painful. Numerous physicochemical phenomena can occur concurrently or sequentially in urolithiasis, making it a complex disorder. It is unclear how calcium oxalate crystals are kept in the kidney and develop into renal stones. Urinary tract infections (UTIs) are a major risk factor for infants and young children. Splitting urease, the most often isolated microorganisms include Proteus, Klebsellia, Pseudomonas, Staphylococcus, and anaerobes. By breaking down urea, these microbes increase the pH and concentration of magnesium ammonium phosphate ions in the urine, which promotes the development of stones (Câmara & Soto-Blanco, 2025).

1.3 Etiology -

Kidney stones can be caused by common metabolic conditions such renal tubular acidosis, modularly spongy kidney, Dent's disease, and hyperparathyroidism.

1.4 Types of kidney stones: -

The four main types of kidney stones are calcium (75 to 85%), struvite (2 to 15%), uric acid (6 to 10%), and cystine stones (1 to 2%). The geographic location of the living organism and the population being studied determines the distribution and frequency of these stones Kidney stones, which make up about 1% of cases, are rarely caused by long-term drug use (F. Khan et al., 2019).

- **Calcium stones:** They are Calcium oxalate, calcium urate, and calcium phosphate stones are associated with hyper calciuria, which is caused by hyperparathyroidism. People with the condition experience hyper uricosuria, hyper xaluria, hypo citraturia, hypo magnesuria, and stenalcalcium or phosphate leak due to increased calcium absorption from the stomach (Favus, 2009).
- **Struvite stones**: They are composed of magnesium ammonium phosphate stones that expand to fill the collecting system (partial or total staghorn calculi). This stage is brought on by persistent urinary tract infections brought on by Gram-negative urea-splitting rods such Proteus, Pseudomonas, and Klebsiella species(Shastri et al., 2023a).
- **Uric acid stones**: They are generally caused by high purine intake medications or high cell turnover (such as cancer), both of which are prevalent in gout sufferers. Urine that is somewhat (pH 5.5) is most likely to develop uric acid stones. They are observable in nature and typically radiolucent on X-ray film(Shastri et al., 2023a).
- **Cystine stones**: They are caused by an ancestral intrinsic metabolic disorder called cystinuria, which prevents cystine from recovering in the renal tubule. Because of the significant amount of sulfur, X-ray detection of these stones may be difficult. Renal stones may form as a result of certain medication(Tamborino et al., 2024).

Cystinuria, a genetic intrinsic metabolic condition that impedes cystine reabsorption in the renal tubule, is the cause of cystine stones. X-ray detection of these stones may be challenging due to the considerable amount of sulfur. In drug-induced stones, a number of medications may contribute to the development of renal stones. High purine intake drugs or high cell turnover (such as cancer) are the main causes of uric acid stones, and the two are common in gout patients. Uric acid stones are most common in urine with a pH of 5.5. They are usually radiolucent on X-ray film and can be noticed in the natural world (Leslie & Murphy, 2019).

1.5 Signs and symptoms: -

It could be detected. The ureters carried the material to the bladder after it had gone through the kidney. Without knowing if he had kidney stones, the individual did not report any symptoms. Hydronephrosis is the result of some stones staying in the ureters at the same time, obstructing the kidneys' ability to expel urine and enlarging both. This caused a great deal of agony for the kidneys. A strong, wavy pain in the back and its full side, which may radiate to the lower abdomen or the vaginal area, is a common sign of kidney stones. According to some female patients, the pain is more severe than the contractions experienced during labor. It produces a condition of sporadic discomfort and pain(Shastri et al., 2023b). The signs and symptoms are as follows: -

1]A sudden urge to urinate

2]Urination causes burning sensation.

1.5.1 Symptoms: -

It is said that colicky discomfort is the worst ache a person has ever experienced. Hematuria is the presence of blood in the urine due to minor injury to the ureter, urethra, or kidney's interior. Pus in the urine is called pyuria. A burning feeling while urinating is known as dysuria. A condition known as oliguria causes the volume of urine to decrease. An embryological connection with the colon prompts the vomiting center, which in turn causes nausea and vomiting. The hydronephrosis Following renal azotemia, a kidney stone clogs the ureter(Shastri et al., 2023b).

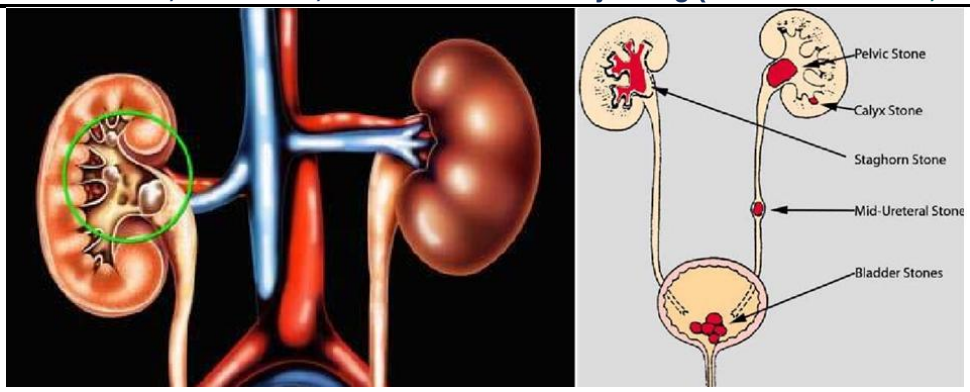

Figure 1: Different locations of Urinary Stones

1.6 Risk factors: -

Kidney stone production can be either encouraged or inhibited by dietary factors. The surroundings, body weight, DNA, and fluid intake are additional elements that may contribute to the formation of a stone. Some of the things that can increase your risk of kidney stones include the following.

Dehydration in the body can cause kidney stones to be passed down through the generations. A genetic disorder called cystinuria increases the risk of cystine stones. Increasing your intake of proteins, fats, sugar, and sodium can increase your risk of kidney stones. Struvite stones are more common in people with kidney infections (especially in women) and urinary tract infections (UTIs) than in those with other conditions. Kidney stones arise as a result of metabolic syndrome. Obesity has been linked to an increased risk of kidney stones Kidney stones arise as a result of metabolic syndrome. Obesity has been linked to an increased risk of kidney stones(Shastri et al., 2023b).

1.6.1 Composition of kidney stones: -

A collection of crystals that have come together to produce a hard mass in one or both kidneys known as a kidney stone. They can range in length from a few millimeters to many centimeters. Most stones will pass through the body in the urine on their own, but some will need to be removed with medical help.

Urinary stones have been made from phosphate, uric acid, magnesium ammonium phosphate, apatite, and struvite crystals. About 75% of all urinary calculi are composed of five calcium-containing stones, which can be pure calcium oxalate (50%) or calcium phosphate (5%) crystals, or a combination of both (45%). Food can have an impact on the concentration of some compounds in the urine as well as its acidity. A 24-hour urine collection suggests that any of the following characteristics may have an increased risk of forming a stone(Shastri et al., 2023b).

High calcium levels (hypercalciuria), high oxalate levels (hyperoxaluria), and elevated uric acid levels (hyperuricemia), along with reduced citrate levels (hypocitraturia), are major metabolic risk factors for urolithiasis. Key urinary constituents such as uric acid, citrate, oxalate, and calcium play critical roles in stone formation. Urinary pH determines the solubility of these components, where a pH <7 indicates acidity and >7 indicates alkalinity. Normal urinary pH generally fluctuates between 5 and 8 depending on dietary intake. Calcium oxalate stones can develop across a wide pH range, whereas alkaline urine favours calcium phosphate stone formation, and acidic urine promotes the formation of uric acid stones.

1.6.2 Chemistry of urinary stones:-

The chemical makeup of kidney stones is similar to that of adult kidney stones (Figure 2). About half of it is calcium oxalate, 15–25% is calcium phosphate, and 10–15% is a combination of the two. 15–30% are made up of struvite (magnesium ammonium, phosphate), 6–10% are made up of cystine, and 2–10% are made up of uric acid. Because of their relatively high densities (based on their calcium content), the majority of these stones can be seen on plain radiographs, albeit some are better than others.

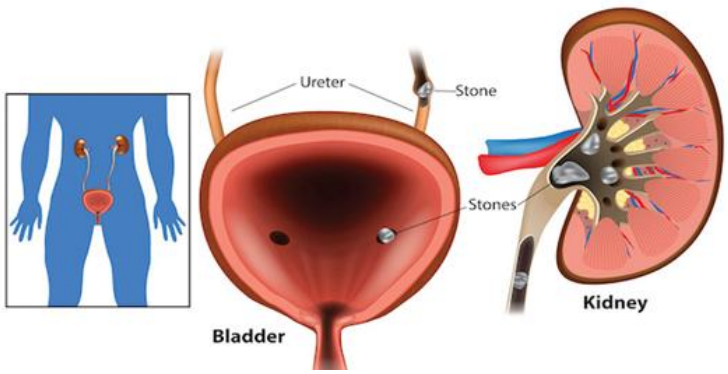

Figure 3: Urinary stones-

2 Diagnosis: -

- **Blood tests:** Look for high levels of uric acid or calcium in the blood. The results of a blood test can assist physicians in keeping an eye on kidney function and may encourage them to look for additional medical problems.
- **Urine testing:** A 24-hour urine collection test can determine whether your kidneys are excreting too many minerals that cause stones or not enough compounds that prevent stones. The physician may advise taking at least two urine samples over the course of two days for this test.
- **Imaging tests:** They can show whether kidney stones are present in the urinary system. High-speed or dual-energy computed tomography (CT), which may identify even minute stones, has replaced simple abdomen X-rays, which can miss microscopic kidney stones.

A further imaging option is ultrasonography, a non-invasive procedure that involves injecting dye into an arm vein and obtaining CT images (CT urogram) or X-rays (intravenous pyelogram) while the dye travels through the kidneys and bladder.

3 Treatment: -

In the past few decades, several types of treatment solutions for urinary stone diseases have been discovered. However, because most of these therapies involve surgery, they are expensive and typically not easily accessible. Because of this, a lot of people only have access to or choose to use traditional herbal remedies, like Ayurveda, to treat urinary stones (Table 2).

The most popular herbal medicines are prescribed orally, including diuretics, linthnotriptic, and penetrative. Urinary stone illness is frequently treated in Ayurveda with herbal remedies and their formulations.

Table 2: Some Indian herbal drug their mechanisms

S.No	Scientific name (family)	Part of plant used	Method of extraction/ solvent	Experimental description and outcomes	References
1.	*Stigma maydis* -corn silk (poaceae)	corn silk (CS)-stigma	75% of ethylene glycol (EG) and 1% of ammonium chloride (AC)	Corn silk extract demonstrated protective and antiurolithiatic effects in a rat model, reducing biochemical markers of kidney damage and calcium oxalate deposition while improving urinary pH, volume, and citrate. These findings support its potential as a natural aid in kidney stone prevention.	(Gumaih et al., 2023)
2.	*Petroselinum crispum (Umbelliferae)*	Parsley seeds	EG (0.75% v/v) and AC (1% w/v)	Parsley showed strong antiurolithiatic effects in rats, markedly reducing calcium oxalate crystal formation and improving kidney histology. It also increased urine volume and pH, suggesting diuretic and nephroprotective actions that support its potential as a natural remedy for urolithiasis.	(Gumaih et al., 2023)
3.	*Bergenia ligulata* (pashanbhed)	Dried rhizome	Maceration, decoction	*Bergenia ligulata*, especially its DCM fraction, strongly inhibits calcium oxalate stone formation in experimental models, reducing biochemical markers and kidney deposits. Findings support its traditional use against urolithiasis.	(Sharma et al., 2017)
4.	*Phaseolus vulgaris* (fabaceae)	Pods and seeds	Nano-aqueous extract of Phaseolus vulgaris (NAPV) suspension	Allopathic options for urolithiasis are limited and recurrence is frequent, prompting interest in phytochemical therapies. This study investigates bean aqueous extract, traditionally used for kidney stone relief.	(Jayaprakash et al., 2025)
5.	*Apple cider vinegar* (rosaceae)	apple juice	GC-MS analysis	Urolithiasis is increasingly common and recurrent, prompting interest in natural therapies. Apple cider vinegar showed notable antioxidant and in vitro antiurolithic activity, indicating potential as a supportive treatment for bladder stones.	(Singh et al., 2023)
6.	*Salvia miltiorrhiza* (lamiaceae)	Root	60 μg/ml of Danshen extract 2% K-citrate and Danshen (30 and 60 μg/ml)	Danshen, a traditional Chinese medicinal herb, inhibited calcium oxalate crystal formation in a Drosophila model, showing both preventive and therapeutic effects. Its higher doses were comparable to potassium citrate, indicating potential antiurolithic activity.	(Chen et al., 2019)

7.	*Aspidopterys obcordata vine* (malpighiaceae)	herb	size exclusion column chromatography	Aspidopterys obcordata fructan (AOFOS) inhibited calcium oxalate crystal formation and growth in Drosophila, showing potential as an anti-urolithiasis agent.	(Chen et al., 2019)
8.	Duranta erecta (verbenaceae)	leaves	methanolic extract of Durantaerecta leaves by in vitro and in vivo analysis	Urolithiasis, affecting 10–15% of people, is a common urinary disorder. Recent research increasingly focuses on natural sources for new antiurolithic therapies.	(Sun et al., 2022)
9.	*Argemone mexicana L* (papaveraceae)	leaves	petroleum ether, chloroform, methanol, and water	This study evaluated *Argemone mexicana* leaf extracts as a natural anti-urolithic remedy to reduce side effects associated with synthetic drugs.	(Kiran Chilivery et al., 2016)
10.	*Gracilaria fisheri* (Gracilariaceae)	sulfated galactans (N-SGs)	Nucleation, Aggregation, crystal morphology and size	Sulfated galactans from *Gracilaria fisheri* show strong antioxidant and antiurolithiatic activity and protect renal cells, suggesting promising functional food and pharmaceutical potential.	(Sakaew et al., 2022)
11.	*Aerva lanata L.* (Amaranthaceae)	undershrub	ethyl acetate and methanol extracts	*Aerva lanata* is a traditional Indian herb rich in alkaloids and flavonoids, widely used for urinary and other ailments. It exhibits strong diuretic, anti-inflammatory, antimicrobial, and antiurolithiatic activities, supporting its pharmacological potential.	(Goyal et al., 2011)
12.	*Pleurolobus gangeticus* (L.) (Fabaceae)	P. gangeticus roots	HPTLC, FT-IR, and GC-MS techniques	The stigmasterol-rich chloroform fraction of *Pleurolobus gangeticus* roots shows notable antiurolithiatic, antioxidant, and antibacterial activity. These results indicate its promise for future kidney stone and UTI-related therapeutics.	(Mohan et al., 2022)
13.	*Beriberi vulgaris* (Berberidiaceae)	root bark,	B. vulgaris root bark (200c, 20 µl/100 g body weight/day, p.o, for 28 days)' 0.75% ethylene glycol (EG), drinking water	This study examines the anti-urolithiatic potential of ultra-diluted homeopathic preparations of *Berberis vulgaris* root bark. *B. vulgaris* is traditionally used in homeopathy for managing renal calculi.	(Jyothilakshmi et al., 2013)/
14.	*Malva neglecta Wallr* (Malvaceae)	Whole plant	aqueous extracts of Malva neglecta Wallr	This study investigated the anti-urolithiatic effects of *Malva neglecta* aqueous extract in rats with induced kidney stones. The extract showed protective activity against stone formation.	(Saremi et al., 2015)
15.	*Pedalium murex* (L.) (Pedaliaceae)	herb	ethyl acetate extract of *P. murex* L. (EAEP)	*Pedalium murex* ethyl acetate extract inhibits struvite crystal formation and reduces renal damage in vivo. These results highlight its potential for managing struvite kidney stones.	(Kaleeswaran et al., 2019)
16.	*ficus racemosa L* (mulberry)	bark	Bark extraction with ethylene glycol	*Ficus racemosa* bark extract dissolved calcium crystals in vitro and significantly reduced EG-induced urolithiasis and oxidative stress in rats. These findings indicate its promise for preventing kidney stone recurrence.	(Yelne & Shinde, 2025)
17.	*Quercus gilva Bume,* (Fagaceae)	evergreen oak	QGB material (7.0 kg) was extract	Phenolic compounds from *Quercus gilva* exhibit strong antioxidant and anti-inflammatory effects, including inhibition of cytokine expression. These activities support their potential anti-urolithiatic role in kidney stone management.	(Youn et al., 2017)/
18.	*Glechomae Herba* (lamiaceae)	Whole plant	UHPLC-QTOF-MS/MS	UHPLC-QTOF-MS/MS profiling of Glechomae Herba identified 91 metabolites, primarily excreted through urine and bile.	(Luo et al., 2019)

				These findings help clarify its active components and support its traditional use in urolithiasis and cholelithiasis.	
19.	*Aspidopterys obcordata* (Malpighiaceae)	Stems and branch	hot water, HCl solution, NaOH solution, and 0.1 M NaCl	Polysaccharides from *Aspidopterys obcordata* extracted with NaOH showed the highest yield, strongest antioxidant activity, and greatest inhibition of calcium oxalate crystallization. These findings support their potential as anti-urolithiatic agents.	(Luo et al., 2019)
20.	*Hygrophila schulli* (acanthaceae)	whole plant or its parts	*H.schulli* extract	*Hygrophila schulli* possesses diverse bioactive compounds with notable nephroprotective, diuretic, and antiurolithiatic properties. This review compiles its key phytochemicals and pharmacological activities to support future research.	(Nissanka et al., 2023)
21.	*Ensetesuperbum* (Musaceae)	Seeds, pseudo stem	*E. superbum* extract	*Ensete superbum* ("Wild Banana") is widely used as an ethnomedicine and nutritional resource across India, Ethiopia, Thailand, Myanmar, and Vietnam. It holds traditional significance for various therapeutic applications.	(Sethiya et al., 2019)

4 Herbal Drugs

Natural plants are used to heal human ailments due to their biological activity and therapeutic qualities. Approximately 3,500 large species are being studied for potential medical benefits in the fight against human illness. Herbs and herbal remedies can be used to treat kidney stones. These drugs' scientifically proven advantages—such as immunomodulation, adaptogenicity, and antimutagenicity—have sparked interest. Additionally, people are turning back to natural medicines due to the abuse of synthetic drugs, which increases the likelihood of adverse drug reactions (Misganaw et al., 2025a).

4.1 Banana pseudostem

Figure 4: *Musa paradisiaca* Plant and its pseudostem

Musa paradisiaca is valued for its nutritional and therapeutic properties, with its often-discarded pseudostem showing notable pharmacological potential. Emerging evidence supports its nutraceutical role in managing urolithiasis, diabetes, and nephropathy.

- Research has shown that the pseudostem has anti-inflammatory, diuretic, anti-urolithiatic, and nephroprotective qualities. It can also prevent kidney stone deposition by lowering stone-forming indicators like lactate dehydrogenase and glycollic acid oxidase.
- As a potential plant-based treatment for diabetic nephropathy, the pseudostem has anti-hyperglycemic actions in diabetes management by enhancing kidney function and modifying advanced glycation end-products
- Rich in fiber, protein, carbohydrates, and essential minerals, *Musa paradisiaca* offers valuable nutraceutical potential. Its pseudostem transforms an underused byproduct into functional food and supplement applications benefiting both agriculture and healthcare.
- The potential of pseudostems in Ayurvedic medicine, supporting their incorporation into medicinal formulations and dietary plans to successfully treat chronic illnesses.
- The banana pseudostem is a nutrient-rich stalk containing fiber, potassium, and vitamin B6, traditionally used to heal ulcers and support haemoglobin and insulin production. Its juice also shows potential as a natural muscle-boosting sports drink.
- The inner part of the fibrous stalk is known as the edible part of the banana stem. Banana pseudostem is used in Ayurvedic medicine to help people lose weight and is also said to be good for general health because it acts as a diuretic and prevents kidney stones (V.S, 2024).

4.2 Ashwagandha

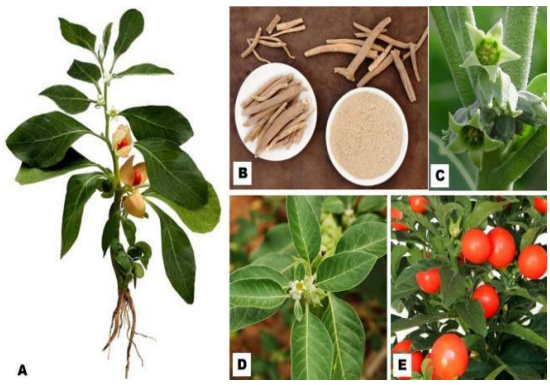

Figure 5 *:Withania somnifera plant* aereal parts

Withania somnifera (L.) Dunal (Solanaceae), popularly known as Ashwagandha in Sanskrit, has been extensively utilised as a herbal remedy since its creation around 6000 B.C. W. somnifera, an evergreen woody shrub belonging to the Solanaceae family, has been given multiple names with different meanings, including "Indian winter cherry" or "Indian ginseng" in English. Because of its beneficial anti-stress characteristics, the species has been given the names "somnifera," which means "sleep-inducer" in Latin; "ashwagandha," which means "horse," and "gandha," which means "smell," because the roots have a distinctive "wet horse" smell; and Indian ginseng because of its familiarity with pharmacologic effects and traditional uses of Korean ginseng tea. WS is a small xerophytic evergreen shrub with tomentose, silver-gray branches and green, nearly hairless leaves above and hairy beneath. It bears small green bell-shaped flowers and urn-shaped ribbed fruits emerging from leaf nodes(Mukherjee et al., 2021).

The flower is light yellow to yellow-green, narrowly campanulate, five lobed, and 5–8 mm long. There is strong evidence that *Withania somnifera* has anti-urolithiatic properties based on preclinical research in animal models. These investigations used a variety of animal models of urolithiasis, caused via techniques such *Withania somnifera* extracts were used to treat calcium oxalate crystal formation. A. Significant decreases in stone formation have been observed, both about the quantity and size of stones. In specific cases, Additionally, *Withania somnifera* has shown that it can help dissolve stones that have already formed, Since W. somnifera is widely accessible and therefore inexpensive, the goal of the current study was to examine its nephroprotective and nephrocurative properties(Mirjalili et al., 2009).

4.3 Role of oxidative stress and inflammation

The Function of Inflammation and Oxidative Stress one important element in the onset and development of urolithiasis is oxidative stress. Reactive oxygen species (ROS), in particular, are produced during a number of metabolic activities and increase oxidative stress in the renal tissues, which leads to kidney damage.

4.4 Diuretic activity

The high nitrate and basic oil content of *Tribulus terrestris*'s green veggies is what gives it its diuretic properties. The diuretic impact may possibly be attributed to the high concentration of potassium salts. A rodent diuretic model was used to measure *T.terrestris* fluid contents, and the leaf meal and isolated guinea pig ileum underwent contractility testing. The watery concentrate of *T.terrestris* at a normal dose of 5g/kg, which was marginally higher than that of furosemide, caused a positive diuresis. The urine included higher levels of salt and chloride. The passage of stones along the urine stream was facilitated by *T.terrestris* 's diuretic activity and the enhanced smooth muscle composition it produced(Saeed et al., 2024).

Tested fluid, methanolic, Kwatha high strength, Kwathalow strength, and Ghanapowder concentrations of v organic compounds for diuretic movement in mice. Kwatha high strength exhibited a potassium-saving effect that was particularly beneficial and a diuretic effect similar to that of the reference standard furosemide. For hypertensive specialists, *T.terrestris* is an effective antidote due to its diuretic characteristics(Al-Snafi et al., 2023).

5 Additional Herbal Therapeutic Agents

- ***Celosia argental****:* The Indian medical system is regarded as unique when it comes to treating urinary stones. Stones are dissolved and expelled with this plant's aqueous decoction.
- ***Didymocarpus pedicellata***, sometimes referred to as Patharphodi or Shilapushp, can be used to cure kidney and bladder stones.
- ***Trigonella foenum***-graecum, or fenugreek seed, is widely used to treat and prevent kidney stones in northern Africa. In an animal study, fenugreek seed was shown to significantly lower kidney calcification and prevent kidney stones.

- ***Asparagus racehorses* root** This important Ayurvedic Ramayana (rejuvenate treatment) was found to reduce the development of calcium oxalate stones in test animals.
- **Phyllanthus niruri** : also called Stonebreaker, or Chancapiedra: A tropical herb known as the Chanca stone buster has long been used to both prevent and treat kidney stones. Numerous in vitro and animal studies have demonstrated that this plant helps prevent kidney stones.
- ***Origanum vulgare*:** This herb, which contains lithotripter, diuretic, and antispasmodic qualities, is frequently used as a spice and medication. The number of crystals produced in calcium oxalate liquid solutions as well as the nucleation and aggregation of calcium oxalate crystals in vitro were both decreased by the crude aqueous metabolic extract of the aerial part of O. vulgare**.**
- ***Berberis vulgaris*:** By preventing calcium oxalate crystallization, barberry root bark (*Berberis vulgaris*) has been shown to reduce kidney damage brought on by oxidative stress. The water extract preparation was the most effective. In animal experiments, the use of black cumin seed (Nigella sativa) considerably reduced the production of calcium oxalate stones in test animals**.**
- ***Boerhaavia diffusa*** (Punarnava herb)**:** This common Indian plant is used as a kidney restorative and to aid in the removal of kidney stones. In an in vitro study, it prevented the development of strong vitamins; it is unclear if this is possible in vivo.
- ***Cratae vanurvala*** (Varuna bark): an Ayurvedic herb, decreased kidney stone formation and the excretion of calcium in the urine. When mixed with banana stem (*Muse paradisiacal*), this Ayurvedic herb is used to both prevent and treat kidney stones. The authors of a recent human trial reported that this formula helped dissolve renal calculi, facilitated their clearance, and decreased pain.
- ***Oenothera biennis*** (Evening primrose): seed oil Regular dose of EPO (1,000 mg/day) decreased urinary oxalate, calcium, and the Tiseliusrisk index, a risk indicator for kidney stone development, while increasing citraturia (urine citrate levels) in a human study. In animal trials, the rupturewort plant (Herniariahirsuta) stopped CAOx crystals from building up in test animals' kidneys.
- ***Visnaga daucoides* (**Ammi visnaga): In Egypt and around the world, patients suffering from kidney stones have long used several kinds of tea prepared from the fruits of Ammi visnaga. The aqueous extract from this fruit helped the kidneys break down cystine stones. It has been demonstrated that the fruit and its two primary components, khellin and visnagin, can help alleviate kidney stones brought on by hyperoxaluria.
- ***Hibiscus sabdariffa:*** Thai traditional medicine uses hibiscus sabdariffa to prevent and treat urinary stones. After consuming a cup of tea made from 1.5 g of dry H. sabdariffa twice a day for 15 days, a clinical study on 18 participants revealed a uricosuric impact and a notable increase in uric acid excretion and clearance from the kidneys by urine.

6 Synthetic Drug Used in Treatment of Stone Diseases (Miyah et al., 2025)

Type of Stone	Main Drugs Used	Target
Uric acid	Allopurinol, Alkali therapy	↓ Uric acid & ↑ urine pH
Calcium oxalate	Thiazides, Potassium citrate, Magnesium, B6	↓ Ca / Ox excretion & ↑ Inhibitors
Struvite	Antibiotics, AHA	Eliminate infection
Cystine	Alkali therapy, Tiopronin	↑ Solubility / ↓ cystine concentration

7 Challenges and Future Aspects of Medicinal Plants

The use of medicinal plants in the creation of new drugs is growing in importance. Herbal remedies are well-liked due to their effectiveness, safety, and absence of adverse effects. With varying degrees of success, plants and plant compounds have been used to prevent and treat diseases. In many countries throughout the world, natural plant-derived products are currently in high demand (Misganaw et al., 2025b).

As the outline above shows, nature is the best combinatorial chemistry and has likely answers to all issues faced by humans. The usage of therapeutic herbs is required for stone ailments. The use of herbs has already gained popularity due to the adverse effects associated with modern medicine. Building trust and confidence in the safer indigenous system by proving that it's efficient in treating a variety of ailments is essential to increasing public acceptance and awareness. We need to integrate herbal medicine systems into our healthcare systems because they have become becoming increasingly expensive. Let's hope that natural products will eventually be able to compete with modern medications by offering further advantages like lower costs and improved safety (Rizvi et al., 2022).

The majority of people on the planet today lack access to contemporary medical facilities for the treatment of urinary stones due to socioeconomic conditions. Because of this, many still use readily available herbal remedies to address urinary stone issues. Many of these plants and herbal formulations cannot be established as therapeutic remedies for the treatment and maintenance of urinary stones, despite the fact that some of these traditional antiurolithiatic claims have been confirmed in recent studies. Therefore, additional clinical research is required to validate traditional antiurolithiatic claims made by these plants and herbal combinations, in addition to chemical characterisation of antiurolithiatic herbs(Miyah et al., 2025).

8 Conclusion

Urolithiasis remains a widespread and recurrent urological disorder, influenced by dietary habits, industrialization, and lifestyle changes. Conventional pharmacotherapies are often associated with adverse effects and high recurrence rates, emphasizing the need for safer and more effective alternatives. Herbal medicines, enriched with bioactive phytoconstituents such as flavonoids, saponins, phenolics, alkaloids, and terpenoids, exhibit multifaceted therapeutic actions including diuretic, antioxidant, anti-inflammatory, and crystal growth inhibitory properties.

This review highlights the most frequently used medicinal plants documented in Ayurvedic pharmacopeia and scientific literature, along with their plant parts, pharmacological mechanisms, and therapeutic potential in preventing or managing urinary calculi. Despite promising preclinical evidence, further systematic research is required to clarify mechanisms, optimize dosage regimens, and validate clinical efficacy. Strengthening standardization, safety profiling, and translational studies will support the integration of herbal interventions as complementary or alternative strategies for long-term management of kidney stone disease.

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