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UROLITHIASIS MANAGEMENT- TRADITIONAL AND HERBAL PRACTICES

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Abstract : This comprehensive review explores kidney stone management through traditional and herbal practices. Kidney stones/ calculi affect 12% of global population, with a high recurrence rate. The study delves into medicinal plants' potential, emphasizing their significance for those facing affordability and availability challenges in accessing conventional treatments. The prevalence of renal calculi, their composition, and mechanisms of formation, particularly focusing on calcium oxalate stones, are discussed. The review analyzes herbal extracts' role in treating kidney stones, highlighting their diverse mechanisms, such as urine pH regulation and antioxidant enhancement. Detailed examinations of specific medicinal plants—Aerva lanata, Boerhaavia diffusa, Carica papaya, and Rosmarinus officinalis—underscore their antiurolithiatic efficacy through in vivo studies. The article also addresses preventive measures, including lifestyle habbits and dietary management. Overall, this review come up with valuable insights into herbal alternatives, offering a rich resource for current research and developments in antiurolithiatic interventions.

Index Terms **- Kidney Stone, Renal Calculi, Management, Antiuroliathiatic, Prevention.**

I. INTRODUCTION

Kidney stones affects around 12% of people worldwide, having a recurrence incidence of 70 to 81% in men and 47 to 60% in women. In 10 years, almost half of individuals with past urinary calculi will have a recurrence. Males are 2-3 times as likely than females to have stone disease. The majority of renal calculi occur in persons aged 20 to 49 years (Ankur et al., n.d.).

Many treatment alternatives are available in the current health care system to treat both infectious and non-infectious disorders. Unfortunately, due to affordability and availability concerns, a number of these medications have their own disadvantages and are not available to the vast majority of people on the planet. Because of this, more than 75% of people, primarily from lower-income countries, continue to rely on herbal remedies to take care of their basic medical requirements (Anand Nimavat et al., 2022). Between 3000 and 2000 BC, early Sanskrit texts in India mention the production of kidney stones (Kvsrg, n.d.).

Protein-coated inorganic as well as organic crystals make up urinary stones. The most common urinary stone components are calcium, uric acid, struvite, and ammonium acid. Approximately 60-85% of human stones consist of calcium oxalate or calcium phosphate, sometimes both. Uric acid stones account for 10-20% of total urinary stones, while the remaining composition includes struvite, carbonate apatite, and cystine (Anand Nimavat et al., 2022).

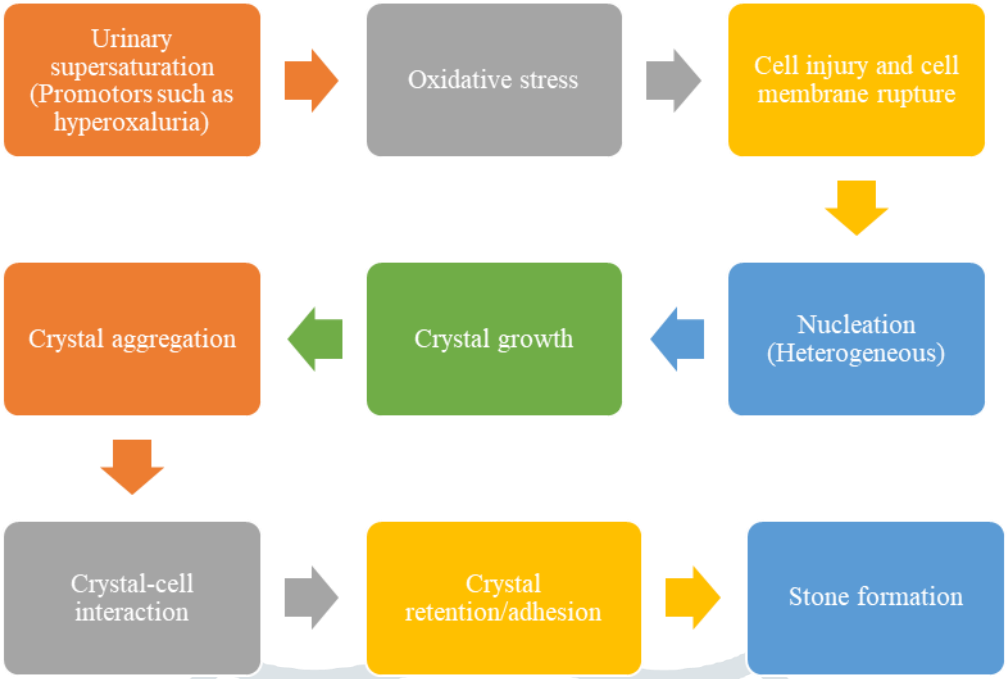
This study aims to offer a thorough examination of kidney stones and the role of traditional remedies in treating urolithiasis. Plant usage is critical in order to lessen the side effect associated with allopathic therapies. This current review may be useful as a source of information on current developments in research on plants with antiurolithiatic action (Patel, 2019).

II. KIDNEYSTONE FORMATION

Lithiasis is production of stones in kidney, which causes abdominal and groin discomfort, urethral bleeding, pus in urine, and secondary infection. It happens to be one of the most frequent human diseases. Around 75% of population commonly experiences the calculi, making it a prevalent type (Chanchal et al., 2016).

Urine that is oversaturated with CaOx causes oxidative stress, which harms renal tubular epithelial cells and encourages crystal adhesion, the initial stage of renal calculi formation. This leads to form Randall plaque which is additionally stimulated by immune system's inflammatory reaction that follows an injury (Chen et al., 2023).

Randall plaques are areas of subepithelial mineralized tissue that encircle the calcium phosphate containing Bellini duct apertures at papillary tip. Randall plaques consists of calcium phosphate crystals combined with lipids like collagen fibres, proteins, membrane-bound vesicles or exosomes and other components found outside of cell (Wang et al., 2021).



Depict of The Different Processes During Renal Stone Formation (Alelign & Petros, 2018)

Mechanisms of Herbal Extract in Treating Kidney Stone (Patel, 2019)

There are several ways in which the phytoconstituents found in plants work in treating urolithiasis:	•Assisting in increasing pH and volume of urine for easy crystal passage.
	•Regulation of oxalate metabolism.
	•Controlling crystal imbalance.
	•enhancing renal function to reduce the likelihood of a stone recurrence.
	•Enhancing the levels of antioxidants.
	•Inhibit stone-forming enzymes.
	•Having an antimicrobial effect.

III. Medical Plants That Inhibit and Reduce Kidney Stones from Pre-Clinical Data

1. Aerva lanata

Aerva lanata (L) (Pashanabheda) has been historically utilized for medicinal purposes, diuretic and antiurolithiatic properties. Phytochemical compounds like flavonoids (kaempferol, quercetin, persinol, persinosides A and B), methyl grevillate, lupeol, lupeol acetate, benzoic acid, b-sitosteryl acetate, tannic acid, and alkaloids (ervine, methylervine, ervoside, aervine, methylaervine, aervoside, ervolanine, and aervolanine) (Dinnimath et al., 2017). The phytochemical content of the HAEAL (hydroalcholic extract of Aerva lanata) was examined, and confirmatory tests revealed that the alkaloid, carbohydrate, tannin, flavonoids, terpenoid, phenol, and glycosides were its active ingredients (Singh & Srmist Gowri, 2021).

The assessment of the antiurolithiatic potential was conducted on Albino male rat induced with urolithiasis with ethylene glycol-0.75% v/v. Oral administration involved the reference medication and isolated components (betulin and quercetin) through a stainless-steel feeding tube.

Diseased animals displayed CaOx microcrystal deposition in cortical area of kidney; conversely, treatment groups exhibited significantly low crystal deposition. Microscopic urine examination indicated tiny crystals in treated rats compared with those in the disease group. Analysis of urine showed rised of calcium and oxalate concentration in diseased animal, while quercetin and betulin-treated rat exhibited significantly decreased levels. Diseased group of animals showed high creatinine and blood urea nitrogen concentration than normal group, which significantly decreased with treatment (Dinnimath et al., 2017).

The results showed that the induction group's excretion of phosphorus, calcium, and oxalate was lower than that of the treated group, highlighting anti-urolithiasis effect of magnesium in plant extract. Unlike induced groups with elevated urine creatinine, the treated and standard groups demonstrated restored creatinine clearance levels (Singh & Srmist Gowri, 2021).

2. Boerhaavia diffusa

Boerhaavia diffusa known as Erva tostão in Brazil and Punarnava in India, has a rich history of medicinal use in both countries. Traditionally employed for treating kidney stones, urinary tract ailments, liver diseases like hepatitis and jaundice, and gallbladder stones, Punarnava roots hold significance in herbal therapy. Designated as diuretic agent in the Indian Pharmacopoeia- 2006, the plant's roots are a fundamental component of Cystone, a polyherbal remedy widely utilized by Himalaya Health Care Pvt. Ltd. for renal stone disease.

This research sought to validate the preventive efficacy of Boerhaavia diffusa (BDE) root extracts in urolithiasis, utilizing ethylene glycol model.

A significant drop in mean body weight was seen in the diseased animals, whereas the BDE-treated animals displayed no discernible changes in weight. Microscopic examination of the urine from rats showed presence crystals, while control rats showed none. Elevated blood creatinine and BUN levels in untreated rats post-lithogenic therapy indicated decreased renal function, with dose-dependent prevention observed in BDE-treated rats.

Upon histopathology of kidney of untreated group, crystalline deposits were conspicuous, in stark contrast to the scarce, smaller deposition in the BDE-treated groups. The study illustrated BDE's ability to effectively hinder the nucleation and aggregation of CaOx crystals in a concentration-dependent manner. Treated animals displayed heightened output of urine, inhibit stone at normal pH levels along with reduced saturation of oxalate attributed to diuretic, and CaOx crystal inhibitory activities and preventing renal cell damage (Pareta et al., 2011).

3. Carica papaya

Papaya (Carica papaya) is traditionally recognized for its laxative, stomachic, diuretic, carminative and therapeutic applications in treating urinary issues and bleeding piles. Phytochemical analysis of papaya roots indicated the presence of glycosides, steroids, saponins, alkaloids, flavonoids, tannins, and carbohydrates.

Compared to the normal group animals, ethylene glycol-induced urolithiasis group exhibited a rise in blood nitrogen urea, uric acid and creatinine. while comparing the MECP (methanolic extract of Carica papaya) 200 mg/kg and 400 mg/kg with the induced group, a notable reduction in all serum parameters was observed, except calcium. The experiment concluded that the MECP inhibited development of calcium oxalate calculi in kidneys. Animals treated by MECP had lower uric acid with less formation of stones.

The antiurolithiatic property of MECP was evident in the treatment groups through a reduction in BUN, uric acid and creatinine. Changes in oxalate concentration may contribute to protective effect of papaya's extract against CaOx production, possibly by regulating and diminishing oxalate synthesis. Overall, administrating ethylene glycol-induced rat with 200 mg/kg and 400 mg/kg of MECP decreased and avoided the development of urinary stones (Velmurugan, n.d.).

4. Rosmarinus officinalis

Rosemary, indigenous to South Europe and South Asia, thrives in Mediterranean basin and in India. Employing an experimental paradigm involving the induction of hyperoxaluria through ethylene glycol administration in albino rats during the temporal span from day 15 to day 35, an evaluation of the anti-urolithiatic efficacy was assessed.

Throughout this time, 100 mg and 200 mg of Rosmarinus officinalis extract were fed to the treatment group. Interestingly, after the oral administration of ethylene glycol until day 14, significant increases in serum creatinine, uric acid, urea, urine calcium, and serum protein were seen in all experimental groups (not the normative control cohort). By restoring uric acid levels to baseline following treatment with Rosmarinus officinalis extract, the risk of stone formation was reduced. In addition, there was a significant decrease in calcium, uric acid and creatine levels.

According to the results, Rosmarinus officinalis ethanolic extract- 200 mg/kg showed a greater effect than 100 mg/kg extract. The extract's synergistic or potentiated effect might be the cause of this noteworthy impact, which contains diverse active principles capable of targeting multiple mechanisms implicated in the pathophysiology of kidney stones (Sahu & Sharma, 2023).

IV. Prevention of Kidney Stones Disease

a. Increased fluid intake and diuresis

Renal stones are caused by dehydration, it is critical to continue consuming excess fluids to avoid them. Large urine volume, which can be attained by ingesting more fluids, has been linked to a diminished risk of recurrent nephrolithiasis, according to research. This impact is exacerbated by recognized diuretics like as tea, coffee and alcohol.

Additionally, incidence of KSD gets negatively correlated with green tea, which has the advantageous ingredient epigallocatechin gallate (EGCG). Even though tea contains oxalate, a study reveals that a tea supplement lowers oxalate excretion and calcium oxalate deposition via boosting antioxidant activity. Thus, consuming more fluids and including certain beverages into one's diet might influence crucial stages of stone formation and diminish the possibility of developing kidney stones.

b. Lifestyle and habit modifications

The European Association of Urology and the Urological Association of Asia have recommended maintaining a healthy BMI as preventive measure against KSD. Although past research indicated a connection between smoking and KSD, more current investigations have not consistently confirmed this link. However, nonsmokers exposed to secondhand smoke showed a higher frequency of KSD than nonexposed individuals, according to a recent Taiwanese study. To lower the risk of KSD, it is advised to abstain from smoking and secondhand smoke exposure, even if further research is required.

c. Dietary management

Kidney stone formation is known to be associated with a number of metabolic disorders, including hypercalciuria, hyperuricosuria, hyperoxaluria, hypocitraturia and hypomagnesuria. Dietary changes may thereby rectify these metabolic disorders, lessen the hazad of KSD and stop stones from occurring again.

Sodium Chloride intake

The heightened consumption of salt correlates with an augmented excretion of Ca and the genesis of CaOx crystals within the kidney. In-vivo investigations on genetically predisposed rats prone to stone formation substantiate that a regimen characterized by diminished sodium chloride intake proficiently diminishes both the prevalence of CaOx crystals and the excretion of calcium in urine.

Oxalate intake

One potential approach in preventing renal calculi is, restrict oxalate-rich foods that are consumed. Such dietary restrictions include spinach, soy products, almonds, other nuts, potatoes (especially the peel), navy beans, raspberries, dates and beets.

Vitamin C intake

Eatable provide the body with the majority of ascorbic acid, or vitamin C. After undergoing metabolic activities, it is transformed into oxalate and subsequently eliminated by the urine system. Prominent studies demonstrate that an excessive vitamin C consumption is positively correlated with an increased risk of kidney stones (Peerapen & Thongboonkerd, 2023).

Animal protein

High concentration of amino acid cause escalated acid load. Hence, it's advised to limit the consumption of meat and poultry products. A high-protein diet raises urinary citrate levels and causes the pH to become acidic. As such, in the event that an individual's urine exhibits a significant level of acidity, it is necessary to limit consumption of meat, fish, and poultry as well as to abstain from vitamin D-rich meals (Alelign & Petros, 2018).

V. CONCLUSION

In conclusion, this review delves into prevalence of kidney stones, emphasizing their recurrent nature and the flaws of traditional therapies treatments. The study underscores the significance of herbal and traditional practices, focusing on plants like Aerva lanata, Boerhaavia diffusa, Carica papaya and Rosmarinus officinalis. These botanicals exhibit promising antiurolithiatic activity through various mechanisms, offering potential alternatives to conventional medications. The article also highlights preventive measures, emphasizing lifestyle modifications and dietary management. Overall, the review provides valuable insights into the diverse therapeutic avenues for managing kidney stones, clearing the path for more study and advancement in this vital area of urology.

ABBREVIATION

CaOx- Calcium oxylate, BUN- blood urea nitrogen, Ca- calcium, KSD- kidney stone disease and BMI-body mass index

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