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Review Article

Herbs used for Urolithiasis Activity: A Critical Review

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ABSTRACT

Renal stone formation is one of the oldest known diseases and is referred to as nephrolithiasis. When a stone moves out of the pelvis and progresses toward the rest of the urinary system, such as the ureter, bladder, and urethra, it gives rise to a condition called urolithiasis. Various medicinal herbs are used to manage stones and are potentially effective in lowering the risk of renal failure. This review article aims to highlight medicinal plants and their mechanistic approaches to urolithiasis. The current review explains the mechanism of action of promising active phytoconstituents, such as quercetin, lupeol, epigallocatechin, ellagic acid, and kaempferol.

Keywords: Urolithiasis, Nephrolithiasis, Renal stones, Calcium oxalate, Oxalate crystal inhibition

INTRODUCTION

Urinary stone formation in the renal tract is known as urolithiasis or nephrolithiasis. Kidney stones are usually caused by a poor lifestyle, low water intake, and inappropriate dietary habits.[1] Urinary stones (calculi) are solid crystalline masses that can form anywhere in the renal tract. Urolithiasis is a condition in which a stone forms or appears anywhere in the urinary tract. The composition of urinary calculi depends on the specific nucleation process triggered by calculogenic seed crystals in the supersaturated urine. Stone nucleation is often pH-dependent and may occur in the presence of metabolic abnormalities such as hypercalciuria, hyperoxaluria, and hyperuricosuria. Calcium-containing stones, such as calcium oxalate monohydrate/dihydrate and calcium phosphate (brushite, apatite) calculi, are the most common, occurring in approximately 80% of the cases.[2] An estimated 80,000 people with chronic renal failure and 19 million individuals with chronic kidney disease is diagnosed with these conditions in India each year.[3]

Over 13,000 plants have been examined for various diseases and disorders worldwide over the last few years. Kidney stones are common ailments that affect people worldwide. Calcium oxalate crystals constitute 75% of the kidney stones. In addition, the overuse of synthetic medications, which leads to a higher incidence of adverse drug reactions, has prompted humans to seek safe cures in nature. *In-vitro* and preclinical *in-vivo* models have been used to evaluate the efficacy of several herbal extracts and treatments as chemolytics or medicines that inhibit the development of new stones.[2,4]

Several clinical trials have also been conducted to explore the efficiency of various herbal treatments in the primary/secondary care of urolithiasis. Phytochemicals are compounds found in plants that are not required for the normal functioning of the body but have a beneficial effect on health or play an active role in the amelioration of diseases. From different regions, varied plant species having potent nephroprotective activity area units are portrayed at intervals the subsequent section.[2,3]

Nephroprotective medicinal plants

Bryophyllum pinnatum

B. pinnatum is a succulent plant in the Crassulaceae family that goes by several names, including the air plant, cathedral bells, life plant, and miracle leaf.[5] They widely grow in hot and humid areas, around dwellings, along roadsides, and in abandoned farms and fields. They are widely used in the folk medicine of its indigenous region (Madagascar, Tropical Africa, India, China, Australia, Hawaii, and Tropical America).[6] The plant contains alkaloids, flavonoids, phenolic compounds, tannins, macro elements (magnesium, calcium, potassium, phosphorus, sodium), microelements (iron, zinc), vitamins (ascorbic acid, riboflavin, thiamine, niacin), Syringic acids, caffeic acid, 4-hydroxy-3- methoxycinnamic acid, 4-hydroxybenzoic acid, hydroxycinnamic acid, p-coumaric acid, ferulic acid, protocatechuic acid and phosphoenol pyruvate isolated from aerial parts of plants.[7] The leaves of *B. pinnatum* are health-giving and chiefly used in holistic medicines for curing urinary bladder& kidney stones.[8,9]

Phyllanthus niruri

P. niruri (Family -Phyllanthaceae), also known as Chanca Piedra, is a gale of the wind, stonebreaker, or seed-under-leaf. It is taken for

Table 1: Phytoconstituents present in *B. pinnatum*

Phytoconstituents	*Properties*
Quercetin	Effective for preventing stone forming diseases and decrease CaOx crystal deposition in renal tubules.
Phenolics	More effective in dissolving calcium phosphate stones than oxalate stones.
Kaempferol	Inhibits crystallization, nucleation, and aggregation of crystals.
Glycoside	Prevent damage in the kidneys and decrease urinary disorders.
Steroids	Reduce the time of stone passage from the urine.[9]

diuretics, hypoglycemia, and hypertensive situations in addition to treating kidney stones.[10] *P. niruri* contains several bioactive molecules such as lignans, phyllanthin, hyophyllantin, flavonoids, glycosides, tannins, alkaloids, ellagitannins, phenyl propanoids, and steroids. *P. niruri* extract is also administered in hypercalciuric patients; it can decrease urinary calcium levels and also reduce the excess uric acid in hypouricemic people by the lignans with uricosuric action in the extract.[11-15] It inhibits the growth of calcium oxalate in calculi (Fig. 1), and *in-vitro* experiments suggest that the aqueous extract of *P. niruri* inhibits calcium oxalate crystal growth and aggregation in human urine. An aqueous infusion of the whole plant, which is a typical preparation, was used as a diuretic.[11-13]

Aerva lanata

A. lanata (Family Amaranthaceae), commonly called *`Gorakhganja',* is distributed throughout India's plains in wastelands. *A. lanata* contains a diverse range of phytoconstituents. Phytochemical screening revealed the presence of numerous classes of phytochemicals, such as alkaloids, steroids, flavonoids, tannins, amino acids and proteins, carbohydrates, cardiac glycosides, saponins, and terpenoids. Flowers are used to remove kidney stones. The methanol extract of *A. lanata* roots showed an effect only on urinary volume.[16-18] Administration of an aqueous suspension (2 g/kg body weight per day for 28 days) to CaO_2 urolithic rats reduced oxalate-synthesizing enzymes and decreased markers of crystal deposition in the kidneys.[19]

Camella sinesis

The tea plant (*C. sinensis*) (Family – Theaceae) has traditionally been consumed worldwide as "tea" for its many health benefits, with the potential for the prevention and therapy of various conditions. It is cultivated in mainland China and South and Southeast Asia but is cultivated worldwide in tropical and subtropical regions. It acts as a diuretic and promotes urine excretion.[20-22] Among the 400 chemicals identified, most tea ingredients are polyphenolic constituents that have anti-inflammatory, antioxidant, and anti-apoptotic properties and, consequently, are potentially beneficial against kidney diseases. Polyphenols, such as EGCG, have beneficial effects on pathological states related to oxidative stress in the kidney. It reduces the oxidative stress of renal epithelial cells, resulting in COM crystal reduction (Fig. 2). This reduces the crystal cell adhesion (Fig. 2). EGCG is a promising therapeutic and protective agent for various kidney diseases.[23-25]

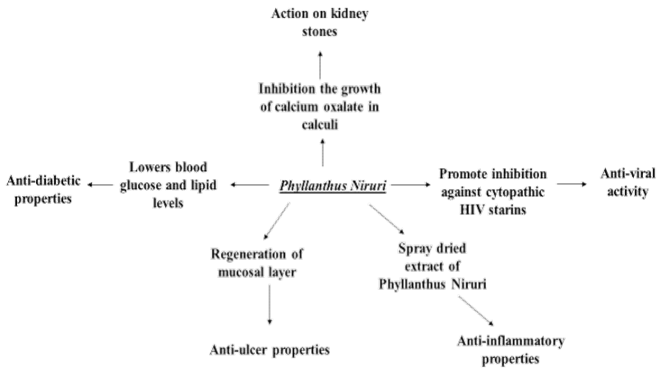

Fig. 1: Pharmacological mechanisms of *Phyllanthus niruri*

Macrotyloma uniflorum

M. uniflorum is a member of the Papilionaceae family. They are primarily found in Africa and Asia. Most of these species are pantropical; however, they are widely grown in the tropics. Historically, seeds have been used to treat urolithiasis and nephrolithiasis.[26] The main bioactive components of *M. uniflorum* are acids, such as phenolic acid, phytic acid, and proteinase enzymatic inhibitors, which have important physiological and metabolic effects.[27] A substantial diuretic effect and several parameters were demonstrated by the ethanolic extract at 400 mg/kg.[28] *M. uniflorum* seeds were tested for calcium oxalate urolithiasis in male albino Wistar rats.[29]

Molecular Mechanisms of Phytoconstituents

Quercetin

Quercetin is a potent dietary antioxidant. It minimizes nephrotoxicity, inflammation, fibrosis, and apoptosis in a variety of kidney conditions and has demonstrated high potential as an antioxidant, diuretic, anti-inflammatory, and hypouricemic drug. It reduces oxidative stress in renal tubular cells, prevents calcium oxalate (CaOx) crystals from aggregating, and reduces oxalate-induced lipid peroxidation in cell cultures. It is effective in kidney stones and deposits CaOx crystals in renal tubules (Table 1). Quercetin inhibits calcium

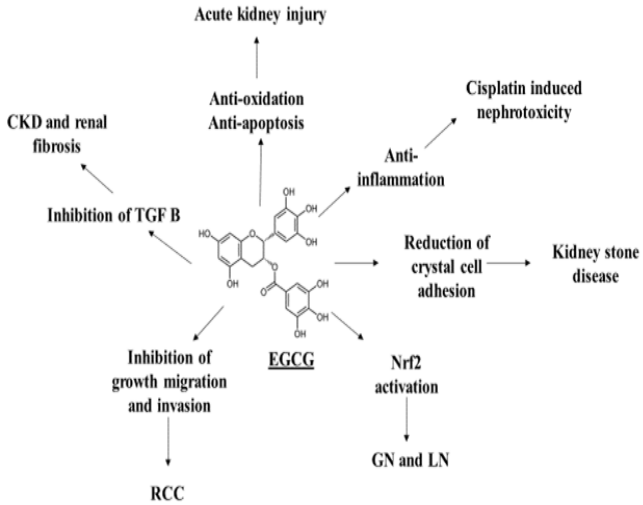

Fig. 2: Renoprotective effects of EGCG against a broad spectrum of kidney diseases

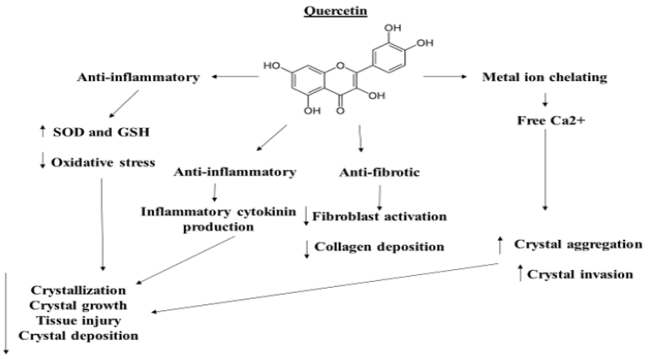

Fig. 3: Schematic summary of quercetin for reducing the risk of stone formation

oxalate crystal deposition, thereby reducing oxidative damage, lipid peroxidation, cell viability, and the production of urinary crystal deposits. Quercetin has been used to reduce oxalate stone formation in hyperoxaluria, particularly in individuals who frequently develop stones (Fig. 3).[34, 35]

Lupeol

Lupeol is a pentacyclic triterpenoid that exhibits various pharmacological activities, such as urolithiasis. Lupeol has been tested for its protective efficacy against renal toxicity and its anti-urolithiasis activity. Lupeol decreases the levels of calcium oxalate, has cytoprotective action against free radical-induced damage, and decreases the level of cadmium in the kidney (Fig. 4). Lupeol is a prominent therapy against renal cell carcinoma, influences the RCC cell line SKRC-45, and is able to prevent RCC in terms of mitochondrial dynamics.[31,36,37]

Ellagic acid

Ellagic acid (EA) is a bioactive polyphenolic compound naturally occurring as a secondary metabolite in many plant taxa.[38] It is an antioxidant, antimutagenic, and anticarcinogenic substance found naturally in phenol structures in plants. Ellagic acid (EA) has demonstrated protective effects against superoxide anions, hydroxyl anions, and reactive oxygen species (ROS). It decreases TNF-α, COX-2, VEGF, and NF-κB protein expressions and thus reduces kidney tissue damage (Fig. 5).[39] Ellagic acid has a promising nephroprotective effect through detoxification and ameliorates nephrotoxicity.[40]

Epigallocatechin (EGCG)

Epigallocatechin (EGCG) is a type of natural polyphenol that is found in green tea. It has beneficial effects and can be used to prevent and treat kidney stones (Fig. 6). EGCG has also been shown to have antioxidant and anti-inflammatory properties, which may help reduce oxidative stress and inflammation in the kidneys. It inhibits the formation of calcium oxalate crystals by modulating the activity of various enzymes involved in crystal formation, including oxalate oxidase, alkaline phosphatase, and calcium ATPase, and reduces the production of reactive oxygen species (ROS) in the kidney. EGCG reduces free-radical production, crystal binding capability, and urinary oxalate excretion and changes the expression of urinary gamma-glutamyltranspeptidase, N-acetyl-glycosaminidase and α-enolase expression.[34, 35]

Table 2: Phytoconstituents from medicinal plants for nephroprotective activity

Name	*Family*	*Major constituents*	*Responsible phytoconstituents*
Bryophyllum pinnatum	Crassulaceae	Flavonoid	Quercetin [30]
Aerva lanata	Amaranthaceae	Triterpenoids	Lupeol [31]
Phyllanthus niruri	Phyllanthaceae	Polyphenol	Ellagic acid [32]
Camella sinesis	Theaceae	Polyphenol	Epigallocatechin [25]
Macrotyloma uniflorum	Papilionaceae	Flavonoid	Kaempferol [33]

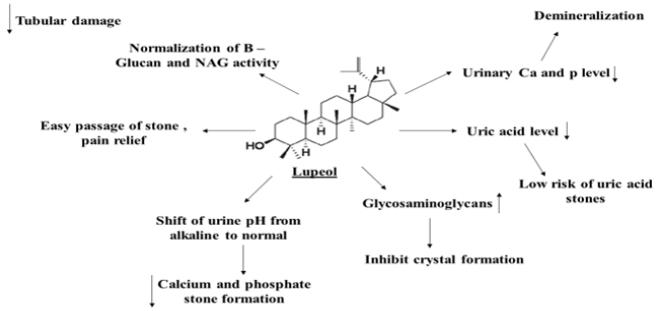

Fig. 4: Schematic mechanism of lupeol on calcium stone formation

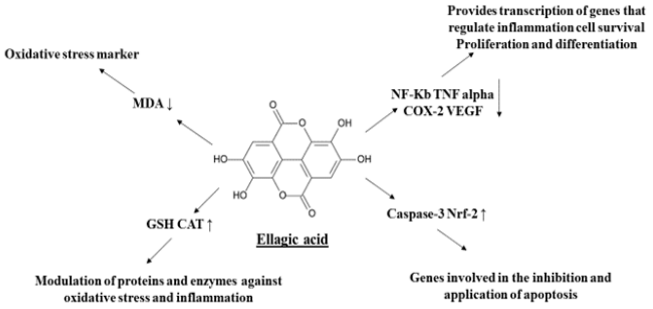

Fig. 5: The transcriptional mechanisms of NF-κB, TNF-α, Nrf-2, COX-2, VEGF, Casepase-3 proteins in ellagic acid

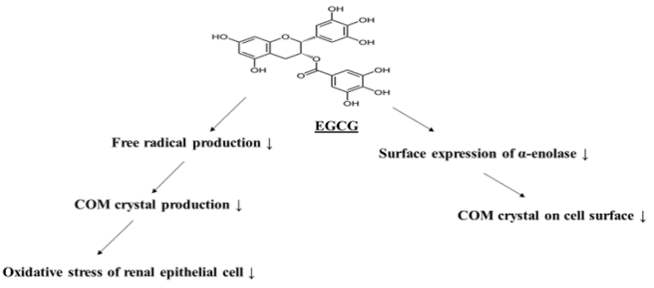

Fig. 6: Schematic representation of EGCG on kidney stones

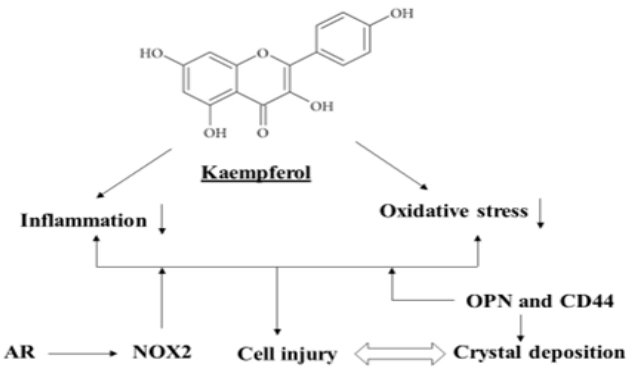

Fig. 7: Kaempferol alleviates calcium oxalate crystals

Kaempferol

Kaempferol is a flavonoid regarded as the largest group of secondary plant metabolites. It is found in many plants and displays promising biological activities, such as antimicrobial, antioxidant, antitumor, cardioprotective, neuroprotective, antidiabetic, and anti-inflammatory activities.[41, 42] Kaempferol has a promising role in the treatment of acute nephritic injury caused by nephrotoxins such as cisplatin and antibiotics. It has a suppressive effect on renal AR expression, which can attenuate CaOx crystal deposition and crystal-induced kidney injury by repressing oxidative stress and inflammation in the kidney by modulating the AR/NOX2 signaling pathway and inhibiting the effects of nucleation, crystallization, and aggregation (Table 2). Kaempferol shows therapeutic potential against CaOx nephrolithiasis (Fig. 7). [4, ,43]

CONCLUSION

In recent years, it has been observed that herbal therapy has emerged as an alternative and better approach for the treatment of kidney stones and urolithiasis, as most of the conventional therapies available to date are not 100% effective. Serval phytomolecules have promising mechanisms in the management of stones, such as quercetin, lupeol, epigallocatechin, and ellagic acid. By studying their mechanistic approach at the molecular level, it was concluded that it could be a safe and effective treatment to mitigate various kidney diseases such as urolithiasis.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Suryawanshi H, Suryawanshi M, Patil G. Pharmaceutical sciences: A review on herbal treatment for kidney stones. *IAJPS*. 2020;12:100-106.
2. Monti E, Trinchieri A, Magri V, Cleves A, Perletti G. Herbal medicines for urinary stone treatment: A systematic review. *Arch Ital Urol Androl*. 2016;88(1):38-46.
3. Sundararajan R, Bharampuram A, *et al*.. Review of phytoconstituents for nephroprotective activity. *Pharmacophore*. 2014;5(1):160.
4. Nimavat A, Trivedi A, Yadav A *et al*..A review of kidney stones and their herbal treatment.*J Pharm Pharmacol*. 2022;10(6).
5. Dhumane S, Naik T, Shelke M, Dukare K, Dhongade K. Exploring the therapeutic potential: Phytochemistry and pharmacology of Bryophyllumpinnatum. *J Drug DelivTher*. 2024;14(2):171-177.
6. Kumar S, Kumar Vaidya S, Prasad AK, Kumar S, Iyer S, Sudani RJ, Vaidya SK. Pharmacognostical, phytochemical, and pharmacological review of Bryophyllumpinnata. *Int J Pharm Biol Arch*. 2012; 3(3).
7. Kawade RM, Ghiware NB, Ghante MH, Malwatkar SM, Vadvalkar SM, Dhadwe AK, Choudhary RV. Phytochemical and pharmacological potential of Kalanchoepinnata (Crassulaceae). *Am J PharmTech Res*. 2014;4(1).
8. Batra E, Prasad N, Maheshwari P. Kalanchoepinnatum-"RAKTASTAMBHAK": A review. *Int J Res Formal Appl Sci*. 2015;15-441.
9. Kalanchoepinnata and its remedial properties to treat kidney stones–a less-known plant. *Int J Biol Pharm Allied Sci*. 2020;9(11).
10. Damasak A. Phytochemical components and in vitro antioxidant activity of methanol leaves extract of Phyllanthusniruri Linn. (Chancapiedra). Arid-Zone *J Basic Appl Res*. 2023:105-111.
11. Nimmi I, AraJahan I, HemayetHossain M, BurhanUddin M, SohelRana M, MahbubulHaq M. Comparative study of the antioxidant properties of two Phyllanthus species growing in Bangladesh. *Journal of Pharmaceutical Sciences* 11 (2):191-97.
12. Twahirwa A, Ndagijimana A, Mukazayire MJ, Nyombaire G, Kabera JN. Phyllanthusniruri: ethnobotany, chemistry, and pharmacological properties of drug formulations. *Int J Curr Res Life Sci*. 2018;7(09).
13. Lee NYS, Khoo WKS, Adnan MA, Mahalingam TP, Fernandez AR, Jeevaratnam K. Pharmacological potential of Phyllanthusniruri. *J Pharm Pharmacol*. 2016:953-969..
14. KP V. Various health benefits and phytochemical constituents of Phyllanthusniruri. *Pharma Innov J*. 2022;11(6):1886-1895.
15. Satya AK, Narendra K, Swathi J, Sowjanya KM. Phyllanthusniruri: A review on its ethnobotanical, phytochemical and pharmacological profile. *J Pharm Res*. 2012;5(9):4681-4691.
16. Sharma A, Sharma SC, Vaghela JS. Phytopharmacological investigation of Aervalanata flowers with special emphasis on diuretic activity. *Pharmacognosy Journal*, 2010,2,17, 59-62.
17. Sridhar N, Surya Kiran BVVS, Rudrapal M. Diuretic potential of Aervalanata and Ecboliumligustrinum root extracts. *Asian J Pharm Res Health Care*. 2014;6(2):12-14.
18. Bitasta M, Madan S. Aervalanata: A blessing of Mother Nature. *J Pharmacogn Phytochem* 2016;5(1):92-101.
19. Goyal M, Pareek A, Nagori BP, Sasmal D. Aervalanata: A review on phytochemistry and pharmacological aspects. *Pharmacogn Rev*. 2011;5(10):195-198.
20. Chopade VV, Phatak AA, Upaganlawar AB, Tankar AA. Green tea (Camellia sinensis): Chemistry, traditional, medicinal uses and its pharmacological activities: A review. *Pharmacogn Rev*. 2008;2(3):157.
21. Mukesh R, Namita P, Vijay KJ. Camellia sinensis (Green Tea): A review. *Glob J Pharmacol*. 2012;6(2):52-59.
22. Brimson JM, Prasanth MI, Kumaree KK, Thitilertdecha P, Malar DS, Tencomnao T, Prasansuklab A. Tea plant (Camellia sinensis): A current update on use in diabetes, obesity, and cardiovascular disease. *Nutrients*. 2023;15(1).
23. Ayusso LL, Girol AP, Burdmann EA. Protective effect of green tea (Camellia sinensis) against kidney diseases. Urology and Nephrology, 2022,15,1-10.
24. Yokozawa T, Noh JS, Park CH. Green tea polyphenols for the protection against renal damage caused by oxidative stress. Evid Based Complement Alternat Med. 2012;2012:845917.
25. Kanlaya R, Thongboonkerd V. Protective effects of epigallocatechin-3-gallate from green tea in various kidney diseases. *Adv Nutr*. 2019;10(1):112-121.

26. Ahmed S, Hasan M, Ashraf J, GhousiaBaig S, MohtasheemulHasan M. Analgesic, anti-inflammatory and diuretic activities of Macrotylomauniflorum (Lam.) *Verdc*. 2018;31(5). https://www.researchgate.net/publication/327097251.
27. Kashid RR, Talekar SM, Sonajirao K. Horse gram (Macrotylomauniflorum): Nutraceutical pulse crop: A review. *World J Pharm Res*. 2021;10(6):1683.
28. Kaundal S, Sharma A, Kumar R, Kumar V. Exploration of medicinal importance of an underutilized legume crop, Macrotylomauniflorum (Lam.) Verdc. (Horse Gram): A review. *Int J Pharm Sci Res*. 2019;10(7):3178-3186.
29. Pal Sharma N, Kumar A, Sharma N, Singh Bisht S, Gupta S, Chandra Melkani D. Macrotylomauniflorum: A legume having anti-lithiatic potential of Uttarakhand. *European Journal Pharmaceutical and Medical Research,*2019,6(3):201-204
30. Chaiyarit S, Phuangkham S, Thongboonkerd V. Quercetin inhibits calcium oxalate crystallization and growth but promotes crystal aggregation and invasion. *Curr Res Food Sci*. 2024;8.
31. Sharma N, Palia P, Chaudhary A, Shalini, Verma K, Kumar I. A review on pharmacological activities of lupeol and its triterpene derivatives. *J Drug Deliv. Ther.* 2020;10(5):325-332..
32. Chinnappan S, Ying PZ, Ying TH, Wen LC, Yun NR, Xin SJ, Mani RR, Panneerselvam J, Ranganathan V. Review on phytochemicals for the treatment of kidney stones. *Curr Trends Biotechnol Pharm.*2021;15(1):120-133.
33. Sawasdee N, TraidejCharoenkiatkul S, SurasiBangphoomi C, KittisakSripanidkulchai S. Antioxidant activity and total phenolic content of indigenous herbal plants from southern Thailand. Malays. *J Nutr.* 2009;15(1):71-80..
34. Sharma N, Pal Sharma N, Sharma RK. Horse gram (Macrotylomauniflorum): An underutilized food legume: Nutritional, phytochemical and pharmacological review. *Journal of Food Biochemistry*. 2022;46(1):e13993.
35. Kaundal S, Sharma A, Kumar R, Kumar V. Exploration of medicinal importance of an underutilized legume crop, Macrotylomauniflorum (Lam.) Verdc. (Horse Gram): A review. Int J Pharm Sci Res. 2019;10(7):3178-3186.
36. Wal A, Wal P, Kumar Rai A. Lupeol as a magical drug. Pharm BiolEval.2015. *Pharmaceutical and Biological Evaluations*. 2015;2(5):142–151.
37. Roychoudhury S, Chakraborty S, Sinha A, Kosgi R, Mandal SC. Herbal antilithiatic biomolecules. In: Herbal Biomolecules in Healthcare Applications. 2022:573-590.
38. Sharifi-Rad J, Quispe C, Castillo CMS, *et al*. Ellagic acid: A review on its natural sources, chemical stability, and therapeutic potential. *Oxid Med Cell Longev*. 2022;2022:3848084.
39. Aslan A, Gok O, Beyaz S, *et al*. Ellagic acid prevents kidney injury and oxidative damage via regulation of Nrf-2/NF-κBsignaling in carbon tetrachloride induced rats. *Mol Biol Rep*. 2020;47(10):7959-7970.
40. Chinnappan S, Ying PZ, Ying TH, *et al*. Review on phytochemicals for the treatment of kidney stones. *Curr Trends Biotechnol Pharm*. 2023;17(4A):151-161.
41. Cechinel-Zanchett CC, Bolda Mariano LN, Boeing T, *et al*. Diuretic and renal protective effect of kaempferol 3-O-α-l-rhamnoside (afzelin) in normotensive and hypertensive rats. *J Nat Prod*. 2020;83(6):1980-1989.
42. Periferakis A, Periferakis K, Badarau IA, *et al*.Kaempferol: Antimicrobial properties, sources, clinical, and traditional applications. *Int J Mol Sci*. 2022;23(23):15054..
43. Yuan P, Sun X, Liu X, *et al*. Kaempferol alleviates calcium oxalate crystal-induced renal injury and crystal deposition via regulation of the AR/NOX2 signaling pathway. *Phytomedicine*.2021;86:153555.

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