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REVIEW ARTICLE **OPEN ACCESS**

Some medicinal plants with antiurolithiatic potential: An overview

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ABSTRACT
In the indigenous system of medicine in India, the medicinal plants is claimed to be useful for various ailments and one such use is for the treatment of renal calculi. It is said to be one of the eight most troublesome diseases. Urolithiasis is the third most disease of urinary tract. The overall probability of forming stones varies in different parts of the world. Surgical operation, lithotripsy and local calculus disruption are widely used to remove the calculi; however, these procedures are expensive and the recurrence is common. In spite of tremendous advances in the field of medicine there is no truly satisfactory drug for the treatment of renal calculi. Alternative systems of medicine are popular amongst the poorer sections of society in the developing world. In the present article an attempt has been made to review some medicinal plants used for the prevention and treatment of urolithiasis.
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INTRODUCTION

Stone formation in the kidney is one of the oldest and most wide spread diseases known to man. Urinary calculi have been found in the tombs of Egyptian mummies dating back to 4000 BC [1] and in the graves of North American Indians from 1500-1000 BC [2]

Reference to stone formation is made in the early Sanskrit documents in India between 3000 and 2000 BC [3]. The recurrent nature of stone disease is a well recognized clinical problem [4, 5]. Patients with more or less severe disease can have various episodes of recurrent stone formation [6, 7]. Stone formation tends to recur at very high rate; without preventive measures after a first stone. After 3 years this is about 40%, by 10 years up to 75% and by 25years virtually every patient has formed at least one more stone [8]. There are four types of kidney stones (9). These include calcium, cystine, struvite and uric acid. Calcium is the most common form of kidney stones, while cystine is the least common variety.

HISTORY OF KIDNEY STONE

The existence of kidney stones was first recorded thousands of years ago, and lithotomy for the removal of stones is one of the earliest known surgical procedures.[10] In 1901, a stone was discovered in the pelvis of an ancient Egyptian mummy, and was dated to 4,800 BC. Medical texts from ancient Mesopotamia, India, China, Persia, Greece and Rome all mentioned calculous disease. Part of the Hippocratic Oath suggests that there were practicing surgeons in Ancient Greece to whom physicians were to defer for lithotomies. The Roman medical treatise De Medicina by Aulus Cornelius Celsus contained a description of lithotomy [11] and this work served as the basis for this procedure up until the 18th century.[12]

Famous people who were kidney stone formers include Napoleon I, Napoleon III, Peter the Great, Louis XIV, George IV, Oliver Cromwell, Lyndon B. Johnson, Benjamin Franklin, Michel de Montaigne, Francis Bacon, Isaac Newton, Samuel Pepys, William Harvey, Herman Boerhaave, and Antonio Scarpa.[13]

SOME TRADITIONAL PLANTS WITH ANTIUROLITHIATIC POTENTIAL

1. *Adonis aestivalis* (Ranunculaceae)
   Adonis aestivalis is a ornamental plant which is used as folk medicine for its diuretic (edema) activity. Ethanolic extract 60 mg/kg of body weight using ethylene glycol induce model. The extract significantly inhibited lithiasis by potential resetting the ionic disturbance by ethylene glycol.[14]
2. *Aerva lanata* (Amaranthaceae)
   Aerva lanta (A. lanta) is an erect or prostrate herbaceous common weed with white axillary bunches of small woolly flowers. It is commonly found in the plains in the warmer parts of India. Aqueous suspension of *Aerva lanta* leaves 2g/kg body wt dissolved the CaOx stone and restored the renal structure in ethylene glycol induced model in rats.[15]
   Aqueous suspension of aerial parts of *A. lanata* was tested for its biopotency on membrane bound enzymes and marker enzymes within ethylene glycol induced urolithiasis in male albino rats. Therapeutic treatment with *A. lanata* aqueous suspension (2 g kg^{-1} b.wt. $dose^{-1}$ day^{-1} $oral^{-1}$) has significantly ameliorated to near normalcy in the curative group.[16] Antilithic effect *Aerva lanata* (3.0 mg kg^{-1} body weight) and Vediuppu chunnam (3.5 mg kg^{-1} body weight) using a ethylene glycol urolithic rat model. Increased urinary excretion of calcium, oxalate, uric acid, phosphorus and protein in hyperoxaluric rats was brought down significantly by the administration of *A. Lanata* or Vediuppu chunnam. Combination therapy was found to be more effective.[17]
3. *Asparagus racemosus* Asparagaceae
   Shatavari is a woody climber growing to 1-2 m in length. Shatavari means 'who possesses a hundred husbands'. It is considered both a common tonic and a female reproductive tonic. Shatavari is the major Ayurvedic rejuvenative tonic for the female, as is Withania for the male. The ethanolic extract of *Asparagus racemosus* Willd. was evaluated for its inhibitory potential on lithiasis (stone formation), induced by oral administration of ethylene glycolated water to adult male albino Wistar rats. The ethanolic extract, however, significantly reduced the high level of ions in urine. Findings also showed signs of improvement after treatment with the ethanolic extract.[18]
4. *Berberis vulgaris* (Berberidaceae)
   It is a deciduous shrub growing up to 4 m high native to central and southern Europe, northwest Africa and western Asia. Antiurolithic potential,the crude aqueous-methanol extract of Berberis vulgaris root bark (Bv.Cr) was tested in an animal model of urolithiasis, developed in male Wistar rats by adding 0.75% ethylene glycol in drinking water. Bv.Cr (50 mg/kg) inhibited CaOx crystal deposition in kidneys. Activity guided fractionation revealed the concentration of antiurolithic constituent(s) mainly in the aqueous fraction.[19]
5. *Bergenia ligulata* (Saxifragaceae)
   Bergenia ligulata is commonly used plant in South Asia, mainly India and Pakistan, as a traditional medicine for treatment of urolithiasis. The crude aqueous-methanolic extract of *Bergenia ligulata* rhizome (BLR) was studied using *in vitro* and *in vivo* methods. BLR caused diuresis in rats accompanied by a saluretic effect. In an animal model of urolithiasis, developed in male Wistar rats by adding 0.75% ethylene glycol (EG) in drinking water, BLR (5–10 mg/kg) prevented CaC_2O_4 crystal deposition in the renal tubules. the antiurolithic activity in *Bergenia ligulata* mediated possibly through CaC_2O_4 crystal inhibition, diuretic, hypermagneseuric and antioxidant effects.[20]
   The effect of calcium oxalate urolithiasis urinary risk factor of ethanolic extract of *Bergenia ligulata* rhizomes (500mg/kg), *Nigella sativa* seeds (200mg/kg) and their combination have been studied in albino rats using ethylene glycol model. In the present study of kidney stone, after the administration of ethanolic extract of *Bergenia ligulata* and ethanolic extract of *Nigella sativa* and their combination to the group of rats urine analysis shows that the occurrence of stone was decreased when compared to the kidney stone control group and combination (ethanolic extract of *Bergenia ligulata* and ethanolic extract of *Nigella sativa*) as effective as the standard group.[21]
6. *Boerhaavia diffusa* Nyctaginaceae
   Boerhaavia diffusa Linn., commonly known as Punarnava is a herbaceous plant. *Boerhaavia diffusa* Linn. is widely used plant in India, as a traditional medicine for the treatment of renal disorders including urolithiasis as mentioned in Ayurveda, Charaka Samhita, and Sushrita Samhita. *Boerhaavia diffusa* Linn. root aqueous extract (BDAE) was evaluated for antiurolithiatic activity in male wister albino rat with 0.75% v/v ethylene glycol (EG) and 1% ammonium chloride. BDAE (100 or 200 mg/kg) reduced the crystal depositions in a dose dependent manner in rat kidney after one week of urolithiasis induction. *Boerhaavia diffusa* Linn. causes diuresis and accelerate the process of dissolving the preformed crystals and help in mechanical expulsion of stone. [22]
7. *Carica papaya* (Caricaceae)

Carica papaya L. commonly known as Papaya (fruit). Its food and nutritional values are accepted throughout the world. The medicinal properties of papaya fruit and other parts of the plants are well known in traditional system of medicine. Antiurolithatic effects of the aqueous and alcoholic extracts (250 mg/kg body weight) of the fruit of *C. papaya* on ethylene glycol (EG) induced urolithiatic rats. Treatment with aqueous and alcoholic extracts of *C. papaya* fruit significantly reduced the elevated urinary oxalate, showing a regulatory action on endogenous oxalate synthesis. The stone formation was also significantly lowered by curative and preventive treatment using aqueous and alcoholic extracts of the fruits of C. papaya. [23]

8. *Cassia fistula* (Fabaceae)
   Cassia fistula, known as the golden shower tree, native to southern Asia. It is the state tree and state flower of Kerala in India and of immense importance amongst Malayali population. It is a popular ornamental plant and is an herbal medicine. Sodium oxalate induced urolithiasis in rats model was used to evaluated anti-urolithiatic activity of the wood bark methanolic (100 and 200mg/kg) and aqueous (100 and 200mg/kg) extracts of *Cassia fistula* in wistar rats. Methanolic and aqueous extract significantly increased urine output and elimination of sodium and chlorides as compared to normal group. [24]
9. *Ceiba pentandra* (Bombacaceae)
   Ceiba pentandra is a tropical tree, also known as the Java cotton, Java kapok, silk cotton or ceiba. It is a holy symbol in Maya mythology. The tree grows to 60-70 m tall and has a very substantial trunk up to 3 m in diameter. Ethno medically *Ceiba pentandra* bark decoction has been used as a diuretic, aphrodisiac. Aqueous (250mg/kg body weight) and alcohol (250mg/kg body weight) extracts of bark of *Ceiba pentandra* on calcium oxalate urolithiasis has been studied in male albino wistar rats by using ethylene glycol induced model. The increased deposition of stone forming constituents in the kidneys of calculogenic rats was significantly lowered by preventive treatment using aqueous and alcohol extracts. [25]
10. *Coryphanta mammillaria* Cactaceae
    Coryphanta mammillaria compact (Engelmann) Britton & Rose commonly known as "bisnaga, subcylindrical to cylindrical plant. This plant is also used in folk medicine as a remedy for the treatment of urolithiasis and a variety of urinary conditions in some areas of the states of San Luis Potosi, Durango, Queretaro, Morelos. Dose dependant study of the aqueous extract of the *Compact mammillaria* was tested for diuretic activity and antiurolithiatic. Urolithiasis was induced by implementation of zinc in the urinary bladder in disc of rats and tested for the extract was antiurolithiatic against activity in albino rats. The extract of *M. compact* is effective in reducing the development of ammonium phosphate stone magnesium dissolves as well as pre-formed stones. [26]
11. *Costus spiralis* (Zingiberaceae)
    Costus spiralis popularly known as 'cana-dobrejo' or 'cana-de-macaco' and used for ornamental purposes. Medicinal teas of the whole plant are used in the Brazilian folk medicine as diuretic and in diseases of the urinary tract, particularly for expelling urinary stones. The antiurolithiatic activity of the water extract of *Costus spiralis* (0.25 and 0.5 g/kg) was tested on formation of calculi on implants of calcium oxalate crystals or zinc disc in the urinary bladder of rats. The results indicate that the extract of *Costus spiralis* Roscoe is capable with antiurolithiatic activity confirming thus folk claim. [27]
12. *Crataeva adansonii* (Capparidaceae)
    Crataeva adansonii is a tropical tree that grows up to 5–10m height. These trees are widely distributed all over India, Burma, and Ceylon. The bark of *Crataeva adansonii* is reported for the treatment of urolithiasis in folklore literature. Calcium oxalate nephrolithiasis in rats was induced by sodium oxalate to assess the effect of petroleum ether extract (50 and 100 mg/kg, p.o.) of *Crataeva adansonii*. The prophylactic and therapeutic treatment with petroleum ether extract of bark of *Crataeva adansonii* showed an inhibitory effect on crystal growth, with improvement of kidney function. [28]
13. *Crataeva magna* (Capparidaceae)
    Crataeva magna commonly known as baruna has been investigated for its antiurolithiatic activity in two conventional models (*in vivo*) of urolithiasis in rats. The two methods selected were lactose (30%) + ethylene glycol (1%) and ammonium chloride (2%) + ethylene glycol (0.75%) induced urolithiasis, respectively. The ethanol extract (400 mg/kg bw) used in both models resulted in reduced serum creatinine and calcium, urine oxalate and kidney weight considerably with a marked increase in final body weight and urine volume output when compared to toxic group. [29]
14. *Crataeva nurvala* (Capparidaceae)

Crataeva nurvala Buch Ham is one of the medicinal plants in the Indian Ayurvedic system of medicine. The root and the bark are reported to have antilithic actions. It is also mentioned in the old Samhitas Charak (210 B.C. - 170 A.D.) and Sushrata (176 A.D.-340 A.D.) for the treatment of urinary calculi. The effect of oral administration of *Crataeva nurvalu* bark decoction (2 ml/rat/day) on calcium oxalate lithiasis was studied in rats. The increased deposition of stone-forming constituents in the kidneys of calculogenic rats was lowered with decoction administration. The increased urinary excretion of the crystalline constituents along with lowered magnesium excretion found in stone-forming rats was partially reversed by decoction treatment. [30]

15. **Cyclea peltata** (Menispermaceae)
    Cyclea peltata Lam. commonly known as paatha is a climbing shrub found throughout South and East India. The inhibitory effect of the root of *Cyclea peltata* Lam. on nephrolithiasis induced in rats by feeding with ethylene glycolated water (1%) for 35 days was studied. *Cyclea peltata* resulted in decreased urinary oxalate and calcium. Thus the plant inhibits the stone formation induced by ethylene glycol treatment.[31]
16. *Desmodium styracifolium* (Leguminosae)
    Desmodium styracifolium (Osb.) Merr., also known as Guangjinqiancao or Snowbellleaf Tickclover. There are about 350 species of plants in the Desmodium genus in the world which are distributed in the sub-tropical and tropical areas. In traditional Chinese medicine theory, Guangjinqiancao has the functions of removing evil heat and eliminating dampness, and relieving stranguria and expelling stones from the biliary duct or urinary tract, etc. inhibitory effects of *Desmodium styracifolium-triterpenoid* (Ds-t) (extracted from *Desmodium styracifohum (Osbeck) Merr,* a herbal medicine) on the formation of calcium oxalate renal stones induced experimentally by ethylene glycol (EG) and 1 α (OH)D_3 (1 α D_3) in rats. The results suggest that Ds-t (0.6 mg/kg/day) inhibits the formation of Ca oxalate stones in rat kidneys by increasing the output of urine, decreasing the excretion of calcium and increasing the urinary excretion of citrate.[32]
17. *Dichrostachys cinerea* (Mimosaceae)
    Dichrostachys cinerea is commonly known as Vidathalai. It is a medium sized thorny shrub occurs in tropical regions of India. Previous claims reported that the roots are lithontriptic and diuretic and are useful in vitiated conditions of Kapha and Vata. The effect of the ethanolic extract of the root of *Dichrostachys cinerea* (L.) was investigated for its anti-urolithiatic effect at 200mg/kg and 400mg/kg dose levels in male wistar albino rats. Ethanolic extract of the plant significantly reduced the elevated urinary oxalate, showing a regulatory action on endogenous oxalate synthesis.[33].
18. *Eleusine coracana* (Poaceae)
    Eleusine coracana usually known as mandva cultivated all over India in areas upto 1,500 m elevation. Indian Materia Medica describes the use of grains of *E. coracana* in the treatment of a numerous ailments, including diureticrenal and vesical calculi and general debility. The effect of aqueous and alcohol extracts of grains of *Eleusine coracana* Linn. on calcium oxalate nephrolithiasis has been studied in male albino rats. Aqueous and alcohol extracts of *E. coracana* grains (300 mg/kg b.w., p.o.) significantly reduced the elevated urinary oxalate, showing a regulatory action on endogenous oxalate synthesis. both the prophylactic and therapeutic treatment with aqueous and alcohol extracts of grains of *E. coracana* had an inhibitory effect on crystal growth. [34]
19. *Eysenhardtia polystachya* (Leguminosae)
    Eysenhardtia polystachya, commonly known as 'paloazul' belongs to the Leguminosae. It is a common herb that grows wild and plentifully in fields in Mexico. This plant is a popular folk remedy for the treatment of urolithiasis and a wide variety of urinary disorders in many areas of Puebla, Mexico and Hidalgo States. The aqueous extract (25, 50, 100 mg/kg p.o.) of the bark of *Eysenhardtia polystachya* was tested for its antilithiatic and diuretic activity. The urolithiasis was induced by implantation of a zinc disc in to the urinary bladder of rats. The aqueous extract of the bark of *E. Polystachya* significantly inhibited the formation of uroliths in a dose dependent manner. A significant decrease in the weight of stones was observed in animals that received aqueous extract compared with control groups.[35]
20. *Helianthus annuus* (Asteraceae)
    Helianthus annuus Linn. is commonly known as Sunflower . Found in Indian gardens, in marshy and malarious districts as its presence purifies the air. The leaves are used to cure diseases of the kidney in Unani system of medicne. The effect of aqueous (500 mg) and ethanolic (500 mg) extracts of Helianthus annuus Linn leaves on calcium oxalate nephrolithiasis was studied in male albino Wistar rats by ethylene glycol and ammonium chloride hyperoxaluria. Both the extracts of *Helianthus annuus* leaves had an inhibitory effect on crystal growth, with improvement of kidney function. [36]
21. *Herpestis monniera* (Scrophulariaceae)

Herpestis monniera commonly known as Bacopa, Thyme-leafed gratiola. It grows in marshy lands, and cultivated in the southern regions of India. The methanolic and aqueous extracts of *Herpestis monniera* were tested for its anti urolithiatic activity against calcium oxalate stones in male wistar albino rats. Calcium oxalate stones were induced by feeding 0.75% ethylene glycol along with normal feed for 30 days. The methanolic and aqueous extracts of *Herpestis monniera* (250 mg/kg/once orally for 30 days) were found to be effective in reducing deposition of calcium oxalate in kidney. It also decreased urinary excretion of calcium and oxalate. [37]

22. *Hibiscus sabdariffa* (Malvaceae)
    H. sabdariffa is an annual erect shrub, distributed throughout the tropical Africa and Asia. It is commonly known as Roselle and it is cultivated in hotter regions of India as a monsoon (April-November) crop. The ethanolic extract (50 mg/kg body weight) of leaves of *Hibiscus sabdariffa* Linn. (EEHS) was evaluated for its antilithiatic activity in rats. Lithiasis was induced by oral administration of ethylene glycolated water (0.75 %) in adult male albino Wistar rats. The EEHS, significantly reduced the elevated level of these ions (calcium, phosphate, uric acid and oxalate) in urine.[38]
23. *Homonia riparia* (Euphorbiaceae)
    The roots of *Homonia riparia* Lour. are reported to be useful in the treatment of urinary stones in the Indian indigenous system of medicine. Ethanol extract of the roots of *Homonia riparia* was tested for its antiurolithiatic activity against calcium oxalate and magnesium ammonium phosphate stones in male albino rats, by feeding 3% glycolic acid along with normal feed and magnesium ammonium phosphate stones were induced by implantation of zinc discs in the urinary bladder. The ethanol extract of *H. riparia* (2 g/kg/day, orally) was found to be effective in reducing deposition of calcium in the kidney of both prophylactic and curative group animals. The extract was found to be effective in reducing the formation and also in dissolving the pre-formed magnesium ammonium phosphate type of stones. [39]
24. *Hygrophila spinosa* (Acanthaceae)
    Hygrophila spinosa, known as Kokilaksha in Sanskrit is a distinguished medicinal plant found in paddy fields and muddy areas. The plant is commonly distributed throughout India, Sri Lanka, Burma, Malaysia and Nepal. The whole plant has medicinal properties and it is being used in Ayurveda for various ailments. Beneficial effect of ethanolic extract of *Hygrophila spinosa* in gentamicin-induced nephrotoxic model of kidney injury in male Sprague-Dawley rats was studied. Gentamicin at a dose of 80 mg/kg intraperitoneally (ip) was administered to induce nephrotoxicity in rats. *H. spinosa* extract showed free radical scavenging activities at doses of 50 and 250 mg/kg with a prime activity at 250 mg/kg. The ethanolic extract also caused a decrease in serum creatinine and urea levels, showed the therapeutic effect and inhibited gentamicin-induced proximal tubular necrosis. [40]
    The antilithiatic effect of aqueous extract of *Hygrophila spinosa* (200mg/kg) *was* determined on ethylene glycol induced lithiasis in male albino rats. The urinary ionic parameters were changed by ethylene glycol, which elevated the calcium, oxalate, inorganic phosphate, protein concentration in urine. The *Hygrophila spinosa* significantly reduced the elevated levels of these ions and protein in urine. The findings showed improvement after treatment with the extract. The plant *H.spinosa* has both prophylactic as well as curative property in urolithiasis of rats. [41]
25. *Ichnocarpus frutescens* (Apocynaceae)
    Ichnocarpus frutescens (Apocynaceae) is a large, evergreen, lactiferous, woody creeper with red appearance, found almost throughout India, ascending up to an altitude of 4000 ft. The root portion of this plant was much more used in traditional as well as in modern era. Antiurolithiatic activity of ethyl acetate root extract of *Ichnocarpus frutescens* (250, 500 and 1000mg/kg), was evaluated using ethylene glycol induced method in rats. Treatment of ethyl acetate root extract of *Ichnocarpus frutescens* restores phosphate level, thus reducing the risk of stone formation.[42]
26. *Jasminum auriculatum* (Oleaceae)
    Jasminum auriculatum commonly known as Juhi, needle flower jasmine, yutika, grows almost throughout South India, on the dry slopes of the Western Ghats. *J. auriculatum* has been claimed in traditional literature to be valuable against a wide variety of diseases. Indian Materia Medica describes the use of flowers of *J. auriculatum* in the treatment of a number of ailments, including burning diuretic, ulcers, urolithiasis, nephrolithiasis, strangury and dermatopathy. The effect of oral administration of aqueous and alcohol extracts (250 mg/kg body weight) of *Jasminum auriculatum* flowers on calcium oxalate nephrolithiasis were studied in male albino rats by ethylene glycol model. The increased deposition of stone forming constituents in the kidneys of calculogenic rats was significantly lowered by curative and preventive treatment using aqueous and alcohol extracts. [43]
27. *Kalanchoe pinnata* (Crassulaceae)

Kalanchoe pinnata commonly known as the Air Plant, Life Plant, Miracle Leaf. The diuretic and anti-urolithiatic activity of *Kalanchoe pinnata.* Hydroalcoholic extract of leaves of *Kalanchoe pinnata* was administered to male wistar rats by oral and intraperitonial route at 100, 300, 500 and 800 mg/kg body weight. Calcium oxalate was induced by ethylene glycol for 7 days and the effect of extract was studied by its concurrent administration. The *Kalanchoe pinnata* extract was found to be significant diuretic and anti-urolithiatic activity.[44]

28. *Lantana camara* Linn. (Verbenaceae)
Lantana camara is a plant which is commonly known as wild sage - a notorious weed and is a popular garden plant. Ethanolic extract of *Lantana camara* Linn. leaves were evaluated for antiurolithiatic activity against 0.75% v/v ethylene glycol and 2% w/v ammonium chloride induced calcium oxalate urolithiasis and for antioxidant activity against hyperoxaluria induced oxidative stress in male albino rats. On treatment with the extract, a significant reduction in the deposition of calcium, oxalate and also urinary excretion of calcium, oxalate and creatinine was observed, indicating its antiurolithiatic effect. The extract also lowered the extent of lipid peroxidation and consequently improved the levels of antioxidant enzymes in the kidneys of urolithic rats, reflecting its antioxidant efficacy against hyperoxaluria induced renal oxidative stress. [45]
29. *Macrotyloma uniflorum* (Fabaceae)
Macrotyloma uniflorum popularly known as horse gram "Kulthi, Kulatha" etc. It is widely used in dietary intake as well as in the traditional system of medicines. It is used as a vegetable in India and known as the poor man's pulse crop in southern India. The effect of oral administration of aqueous and alcohol extracts of *Macrotyloma uniflorum* seeds on calcium oxalate urolithiasis was studied in male albino wistar rats using ethylene glycol. Aqueous and alcohol extract of *Macrotyloma uniflorum* seeds significantly reduced the elevated urinary oxalate showing a regulatory action on endogenous oxalate synthesis. The increased deposition of stone forming constituents in the kidneys of calculogenic rats was significantly lowered by curative and preventive treatment using aqueous and alcohol extracts. The results indicate that the seeds of *M. uniflorum* are endowed with significant antiurolithiatic activity and it also indicates that the alcoholic extract of *M.uniflorum* shows better anti urolithiatic activity than aqueous extract. [46]
30. *Melia azedarach* (Meliaceae)
Melia azedarach commonly known as Persian Lilac, Pride of India. Cultivated and naturalized all over India. The effect of the aqueous extract of *Melia azedarach* Linn. (Meliaceae) against ethylene glycol–induced nephrolithiasis in male Wistar albino rats was studied in rats by administering 0.75% ethylene glycol in drinking water for 28 days and was manifested by high urinary calcium, phosphate, oxalate, and low urinary magnesium content. Concurrent administration of aqueous extract of *Melia azedarach* (AEMA; 250 mg=kg body weight) orally for 28 days along with ethylene glycol (0.75%) reduced urinary calcium, oxalate, phosphate, and elevated urinary magnesium level. It also increased the urine volume, thereby reducing the tendency for crystallization. The histopathological findings established the induction of lithiasis as microcrystal deposition was observed in sections of kidney from animals treated with ethylene glycol. This was reduced, however, after treatment with the extract. The observations concluded that AEMA is effective against ethylene glycol–induced nephrolithiasis.[47]
31. *Mimusops elengi* Linn. (Sapotaceae)
Mimusops elengi Linn.commonly known as Spanish-Cherry, West Indian Medlar. Cultivated in North India, Western Peninsula and South India. Petroleum ether, chloroform, and alcohol extracts (200 mg/kg b.w.) of *Mimusops elengi* bark were evaluated for antiurolithiatic and antioxidant activity in male albino Wistar rats by using ethylene glycol (0.75%) in drinking water was fed to all the groups except normal control for 28 days to induce urolithiasis. In hypercalculi animals, the oxalate, calcium, and phosphate excretion grossly increased. However, the increased deposition of stone forming constituents in the kidneys of calculogenic rats were significantly ($P < 0.001$) lowered by curative and preventive treatment with alcohol extract (AlE) of *M. elengi.* These results confirm that AlE of *M. elengi* possess potent antiurolithiatic activity. [48]
32. *Moringa oleifera* (Moringaceae)
Moringa oleifera Lam. commonly known as 'drumstick tree' or 'horse-radish tree', is mostly cultivated all over the plains of India, in the old world tropics and it is used medicinally in Guinea, La Reunion, Madagascar, Guiana and Burma. The effect of oral administration of aqueous and alcoholic extract (200 mg/kg body weight) of *Moringa oleifera* root-wood on calcium oxalate urolithiasis has been studied in male Wistar albino rats. Ethylene glycol feeding resulted in hyperoxaluria as well as increased renal excretion of calcium and phosphate. Aqueous and alcoholic extract of *Moringa oleifera* root-wood significantly reduced the elevated urinary oxalate, showing a regulatory action on

endogenous oxalate synthesis. The increased deposition of stone forming constituents in the kidneys of calculogenic rats was also significantly lowered by curative and preventive treatment using aqueous and alcoholic extracts.[49]

The efficacy of the root bark of *Moringa oleifera* as an antiurolithiatic agent using an experimentally induced urolithiatic rat model. Hyperoxaluria was induced in rats using 0.75% ethylene glycol inwater. Aqueous (AqE) (200 mg kg−1 body weight) and alcoholic extracts (AlcE) (200 mg kg−1 body weight) of the root bark of M. Oleifera were given orally in curative and preventive regimens over a period of 28 days. Both the extracts significantly ($P < 0.001$) lowered the urinary excretion and kidney retention levels of oxalate, calcium and phosphate. Moreover, elevated serum levels of urea nitrogen, creatinine and uric acid were significantly ($P < 0.001$) reduced by the extracts. The results were comparable with the standard drug, cystone (750 mg kg−1 bodyweight). [50]

33. *Musa paradisiaca* (Musaceae)

Musa paradisiaca is a herbaceous plant (up to 9 m long) commonly known as banana. The ethanolic extracts of dried roots of *Musa paradisica* Linn against ethylene glycol induced renal calculi in albino wistar rats were studied. A renal calculus was ingested in rats by 0.75% ethylene glycol in drinking water for 28 days and was manifested by high urinary calcium, oxalate, and low urinary magnesium contents. Simultaneous administration of 1ml (1 in 10) *Musa paradisica* Linn orally for 28 days along with ethylene glycol (0.75% v/v) reduced urinary calcium, oxalate and elevated urinary magnesium level. It also increased urinary volume thereby reducing the tendency for crystallization. The interpretation enable to conclude that Musa paradisica Linn is effective against ethylene glycol induced renal calculi. [51]

34. *Nigella sativa* (Ranunculaceae)

Nigella sativa is an annual flowering plant, native to south and southwest Asia. It is commonly known as fennel flower, nutmeg flower, black cumin. The effects of the ethanolic Extract (250 mg/kg) of *Nigella sativa* L (NS) seeds were studied on kidney calculi in rats for 30 days. The kidneys were removed and prepared for histological evaluation of calcium oxalate deposits. Urine calcium oxalate concentrations were determined by atomic absorption. The number of CaOx deposits was significantly greater in group B ($P = .001$). Calcium oxalate concentrations in the urine on days 14 and 30 increased significantly. Treatment of rats with ethanolic extract of NS reduced the number of calcium oxalate deposits in a group of rats that received ethanolic extract of NS. The NS could also lower the urine concentration of calcium oxalate[.52]

Thymoquinone (5and 10 mg/kg/d), a major component of *Nigella sativa* seeds was studied on ethylene glycol induced kidney calculi in rats for 28 days. Urine oxalate and citrate and serum electrolytes were calculated. Thymoquinone impressively diminished the number and size of calcium oxalate deposits in the renal tubules. The dose and span of treatment, however, does not have a straight connection with the outcomes.[53]

35. Orthosiphon grandiflorus, Hibiscus sabdariffa and Phyllanthus amarus

The antilithic effect of *Orthosiphon grandiflorus*, *Hibiscus sabdariffa* and *Phyllanthus amarus* extracts on known risk factors for calcium oxalate stones in rats at a dose of 3.5 mg daily was evaluated. The *Hibiscus sabdariffa* group showed significantly decreased serum oxalate and glycolate, and higher oxalate urinary excretion. The *Phyllanthus amarus* group showed significantly increased urinary citrate vs the untreated group. All parameters in the *Orthosiphon grandiflorus* treated group were comparable to those in the untreated group. *Hibiscus sabdariffa* and *Phyllanthus amarus* decreased calcium crystal deposition in the kidneys. In contrast, administering *Orthosiphon grandiflorus* had no antilithic activity. [54]

36. *Paronychia argentea* (Illecebraceae),

Paronychia argentea popularly known as Arabic tea. Medicinal uses of the aerial parts are indicated in Algerian popular medicine as diuretic and for the treatment of the renal diseases, especially as antiurolithiasis. This study was carried out to determine whether the aqueous extract (APA) or the butanolic extract (BPA) of aerial parts could avoid or decrease calculi aggregation in experimental calcium oxalate (Ox) nephrolithiasis in Wistar rats. The two extracts (APA and BPA) were administrated orally and daily, during 28 days to nephrolithiasic treated rats at the dose of 250, 500 mg/kg b.w. and 10, 20 mg/kg b.w. respectively. The effect of the extracts could be supportive in preventing urinary stone retention by reducing renal necrosis and thus inhibit crystal retention. The administration of the butanolic extracts of aerial parts to rats with NaOx induced lithiasis, and reduced and prevented the growth of urinary stones. [55]

37. *Pedalium murex* (Pedaliaceae)

Pedalium murex commonly known as Large Caltrops or Bara Gokhru is a glabrous annual succulent herb. The ethanolic fruit extract of *P.murex* (250 mg / kg body wt) by oral administration for 28 days

at a rate of 1.0 ml / rat / day against ethylene glycol induced model. The serum, urine and tissue homogenate was used to assay the marker enzymes in serum, urine and tissue constituents like ACP, ALP, AST, ALT and LDH. The levels of ACP, ALP, AST, ALT in serum and urine were considerably increased due to the damaged structural veracity of renal and hepatic cells. The levels of ACP and ALP, AST, ALT in renal and hepatic tissues of ethylene glycol induced rats might be due to leakage of the enzyme into the general circulation. LDH levels in serum, urine and tissues were increased on ethylene glycol intoxication is due to the oxalate induced renal and hepatic cellular damage. [56]

38. *Pergularia daemia* (Family: Asclepiadaceae),
Pergularia daemia known as "Uttaravaruni" in Sanskrit, is a perennial herb growing widely along the roadsides of India. The whole-plant, *Pergularia daemia* extract (50% alcohol) was investigated for its antiurolithiatic and diuretic activity using ethylene glycol (0.75% in water). Alcoholic extract (400 mg/kg) of *P. daemia* was given orally in curative and preventive regimens over a period of 28 days. The extract significantly lowered the urinary excretion and levels of oxalate, calcium and phosphate. High serum levels of urea nitrogen, creatinine and uric acid were significantly reduced by the extract. The reduction of stone-forming constituents in urine and their decreased kidney retention reduces the solubility product of crystallizing salts such as calcium oxalate and calcium phosphate, which could contribute to the antiurolithiatic property of the extract. The extract exhibited significant diuretic activity at dose of 400 mg/kg body weight as evidenced by increased total urine volume and the urine concentration of Na +, and K +. [57]
39. *Phyla nodiflora* (Verbenaceae),
Phyla nodiflora , a perennial herb, grows in maritime areas near rivers throughout the subcontinent, Africa and other tropical and subtropical regions. The ethanolic extract of whole plant of *Phyla nodiflora* (Linn.) Greene was studied for its antiurolithiatic activity against calcium oxalate type by administration of Gentamycin and calculi producing diet (5% ammonium oxalate in standard rat pellet feed). The extract was also evaluated for effect on in vivo antioxidant parameters like lipid peroxidation, reduced glutathione, catalase in hyperoxaluric kidney and in vitro scavenging of nitric oxide and 2-diphenyl-2-picryl hydrazyl free radicals. Ethanolic extract of P. nodiflora exhibited significant effect in preventing calcium oxalate stone formation and also in dissolving the pre-formed calcium oxalate stones in the kidney along with significant effect on both in vitro and in vivo antioxidant parameters. The study clearly confirmed the antiurolithiatic activity of *P. nodiflora* supporting the traditional claim. [58]
40. *Phyllanthus niruri* (Euphorbiaceae)
Phyllanthus niruri commonly known as Chanca Piedra is Native to America with a worldwide distribution; it is used in Brazilian folk medicine by patients with urolithiasis. The aqueous extract of *Phyllanthus niruri* (Pn) was evaluated to study the effect of chronic (42 days) administration of Pn (1.25 mg/mL/day, orally) was evaluated in a rat model of urolithiasis induced bythe introduction of a calcium oxalate (CaOx) seed into the bladder of adult male Wistar rats. The creatinine clearance or urinary and plasma concentrations of Na+, K+, Ca2+, oxalate, phosphate and uric acid were unaffected by Pn or the induction of lithiasis. Pn strongly inhibited the growth of the matrix calculus and reduced the number of stone. Pn has an inhibitory effect on crystal growth, which is independent of changes in the urinary excretion of citrate and Mg. [59]
41. *Pinus eldarica (*Pinaceae)
Pinus eldarica, is famous as a Tehran pine and is a tree with wide spacing between branches and stiff long dark green needles at maturity. The aqueous extract *Pinus eldarica* of fruit (500 and 1000 mg/kg/day) was studied for antiurolithiatic activity induced calcium oxalate nephrolithiasis in ethylene glycol induced model in rats for 30 days. Parameters determined were urine volume, urinary calcium excretion, and crystalluria. The aqueous extract prophylactic treatment (500 mg/kg/day) increased urinary calcium excretion. Qualitative analysis of crystalluria and histopathology examination showed that the administered dose of extract prevented stone formation in the kidneys significantly. [60]
42. *Plectranthus amboinicus* (Lamiaceae)
Plectranthus amboinicus is popularly known in English as Indian borage. Indians use it widely for various illnesses, including kidney stone. Fresh juice of the leaves of the *Plectranthus amboinicus* Lour (500 mg/kg) was evaluated on ethylene glycol-induced nephrolithiasis in rats for 35 days. Urine analysis showed a significant elevation of calcium, oxalates and total proteins level in the lithiotic control group (G2), when compared to normal control. The test group demonstrated a significant reduction in all the parameters almost comparable with normal control. The urine and histopathological results clearly revealed the antilithiotic activity of *P. amboinicus*, particularly of calcium oxalate origin. [61]

43. Polyherbal formulation
    Polyherbal formulation (PHF) consisting of aqueous extracts of *Terminalia chebula*, *Glycyrrhiza glabra*, *Nelumbo nucifera*, *Zingiber officinale*, *Hemidesmus indicus*, *Myristica fragrans* and *Citrus aurantofolia* at a dose of 1mg/kg and 2mg/kg body weight were used against ethylene glycol ingested model. Parameters assessed were urine volume, pH, body weight, urinary calcium, magnesium, phosphate, and citrate. In urolithiatic animals, calcium and oxalate excretion was grossly increased while in other groups showed weight gain, decreased calcium and oxalate excretion, increased levels of urinary volume, pH and stone inhibitors. [62]
44. *Quercus salicina* (Fagaceae)
    Quercus salicina also recognized as *Q. stenophylla*, a tall evergreen tree found in Japan. Aqueous extract ((250 and 500 mg/kg) of leaves of *Quercus salicina* was evaluated for calcium oxalate induced urolithiasis by oral administration of ethylene glycol and the vitamin D3 analog alfa-calcidol in Sprague–Dawley rats for 14 days. Increased urinary malondialdehyde and renal calcium levels were observed after treatment ethylene glycol and alfa-calcidol. This increase was considerably suppressed by the administration of QS extract, signifying that the inhibition of renal calcium accumulation by QS extract is due to its antioxidative activity. [63]
45. *Randia echinocarpa* (Rubiaceae)
    Randia echinocarpa commonly known as grangel, is a accepted folk remedy for the treatment of a extensive range of urinary disorders in many areas of Mexico such as Guerrero, Morelos, Michoacan and Sonora States. The aqueous extract (20, 40, and 60 mg/kg p.o) fruit of *Randia echinocarpa* were investigated for diuretic and urolithiatic activity rats by using Foreign body implant (zinc disc model). Parameters determined were pH, weight of stone, radiographical examination. A dose-dependent increase in the size of the stones was observed with 10, 20, 40 and 60 mg/kg doses. The study clearly showed that aqueous extract of *Randia echinocarpa* caused a significant increase in diuretic activity, and markedly provoked the formation of stones. [64]
46. *Raphanus sativus* (Cruciferae)
    Raphanus sativus plant of European origin commonly known as rabano negro. Plant is traditional used in treatment of urolithiasis and a wide variety of urinary disorders in many areas of the Oaxaca and Guerrero States. The aqueous extract (40, 70, 140 mg/kg, p.o) of the bark of *Raphanus sativus* was studied for its antiurolithiatic and diuretic activity. The urolithiasis was experimentally induced by implantation of zinc disc in the urinary bladder of rats. After treatment weight of stones was significantly decreased in animals which received aqueous extract in comparison with control groups. This extract showed an increase in the 24 h urine volume as compared to the control. The study showed that the plant extract clearly prevents the formation of urolith. [65]
47. *Rosa canina* (Rosaceae)
    Rosa canina commonly known as the dog rose is a variable scrambling rose species native to Europe, northwest Africa and western Asia. Hydroalcoholic extract (250, 500 mg/kg) *Rosa canina* (RC) fruit was evaluated as a preventive agent in experimentally induced calcium oxalate (CaOx) nephrolithiasis with ethylene glycol (1% EG) in rats for 30 days. Blood and urine were collected for biochemical analysis, and the liver and kidneys were prepared for total lipid peroxides, calcium content and histological assessment. The RC extract reduced the kidney and liver lipid peroxides to optimum levels in rats treated with EG-induced CaOx lithiasis. The extract also decreased renal and urinary calcium contents, decreased the size and number of CaOx calculi in the kidneys, and significantly increased citrate excretion without changing the volume, pH, or urinary concentrations of oxalate in comparison with the control group. [66]
48. Rotula aquatica (Borginaceae.)
    Rotula aquatica is a species of aromatic flowering shrub native to India. It is an important traditional medicine for kidney and bladder stones. The decoction of *Rotula aquatica* lour was investigated for antilithic activity in Wistar rats. Nephrolithiasis was induced in rats by 3% glycolic acid mixed feed for 45 days, which resulted in high urinary calcium, oxalate and high serum potassium. The results were summarized based on the ionic changes in both urine and serum. Simultaneous treatment with the decoction reduced calcium and oxalate ion concentration in urine, confirming the stone inhibitory effect. Histopathological studies of kidney tissue samples further substantiated the findings. The decoction was found to be nontoxic over the 45-day treatment period. [67]
    Effect of roots alcoholic extract (200 mg/kg body weight orally) of *Rotula aquatica* (Boraginaceae) against ethylene glycol induced urolithiasis in albino rats for 28 days. Urinary calcium, phosphate, oxalate, protein, uric acid, creatinine was reduced and urinary magnesium level was elevated. It also increased the urine volume, thereby reducing the tendency for crystallization. The histopathological studies confirmed the induction of lithiasis. This was reduced, though, after treatment with the

extract. These observations conclude that *Rotula aquatica* alcoholic extract is effective against ethylene-glycol induced urolithiasis in albino rats. [68]

49. *Rubia cordifolia* (Rubiaceae)
Rubia cordifolia, often known as Common Madder or Indian Madder. As per the native system of medicine, the roots of plant are useful in the treatment of urinary stones. The effect of the hydro-alcoholic extracts (286 and 667 mg/kg) of roots of *Rubia cordifolia* Linn. (HARC) against ethylene glycol induced urolithiasis was studied on male Wistar albino rats for 28 days. HARC considerably prevented change in urinary calcium, oxalate and phosphate excretion dose-dependently. The increased calcium and oxalate levels and number of calcium oxalate crystals deposits in the kidney tissue of calculogenic rats were significantly reverted by HARC treatment. HARC can defend against ethylene glycol induced urolithiasis as it reduced and prevented the intensification of urinary stones.[69]
50. *Rubus idaeus* (Rosaceae)
Rubus idaeus commonly known as Raspberry. It is a commercial fruit crop widely grown in all template regions of the world, used in folk medicine in Jordan, Syria and Palestine to treat renal stones. The aqueous extract (100 mg/kg/day and 200 mg/kg/day) of roots of *Rubus idaeus* was studied by using calcium oxalate (CaOx) nephrolithiasis in mice. Administration of glyoxylate and herbal treatments was done
simultaneously for 12 days, followed by histological and biochemical tests. Significant reductions were obtained in the urinary oxalate, calcium and phosphorus values in the herbal-treated groups relative to untreated animals while creatinine excretion increased. Serum oxalate, calcium and creatinine were significantly reduced, while phosphorus was not significantly changed. *Rubus idaeus* showed an impressive prophylactic effect on CaOx stones in nephrolithic mice. [70]
51. *Salix taxifolia* (Salicaceae)
Salix taxifolia, commonly known as "taray", it is a popular folk remedy for the treatment of urolithiasis and a wide range of urinary disorders in many areas of the Mexican states. The aqueous extract (20, 40 and 60 mg/kg p.o.) of the bark of *Salix taxifolia* was screened for antilithiatic and diuretic activities. Urolithiasis was experimentally induced by implantation of a zinc disc in the urinary bladder of rats. A significant reduction in the weight of the stones was seen after treatment in animals with the aqueous extract. This extract caused an increase in the 24 h urine volume. The aqueous extract of bark of *Salix taxifolia* significantly inhibited the formation of stone in rats in a dose-dependent manner. [71]
52. *Sesbania grandiflora* (Leguminosae)
Sesbania grandiflora also known as agate or humming bird tree. The antiurolithiatic activity leaf juice of *S. grandiflora* (1ml, 2ml) was evaluated by a calculi-producing diet model, using gentamicin (subcutaneously) and 5% ammonium oxalate in rat feed to induce calcium oxalate-type stones. The parameters screened were calcium and oxalate deposition in the kidney, kidney weights, urinary excretion of calcium and oxalate. The in vivo antioxidant parameters lipid peroxidation, glutathione reductase and catalase were monitored. The plant juice was also evaluated for scavenging of nitric oxide and 2-diphenyl-2-picryl hydrazyl free radicals. The leaf juice of *S. grandiflora* was safe orally and exhibited no gross behavioral changes except for an increase in urination. The leaf juice of *S. grandiflora* showed significant antiurolithiatic activity against calcium oxalate-type stones and also exhibited antioxidant properties. [72]
53. *Tribulus terrestris* (Zygophyllaceae)
It is an annual herb about 30-70 cm high and has pinnate leaves (of unequal length), yellow flowers and characteristic stellate shaped carpel fruits. It is widely distributed in Africa, Western Asia, China, Japan, Korea, Europe, Kuwait and India. *Tribulus terrestris* (fruit) has been used widely in the Ayurvedic system of medicine for the treatment of various urinary disorders including urolithiasis. [73]
The effect of an aqueous extract of *Tribulus terrestris* administered orally at a dose of 5 g/kg body weight was studied in six male adult rats in hyperoxaluria was iingested and maintained by hydroxyproline and sodium glycolate respectively. Twenty-four hour urinary oxalate excretion reversed to normal within 21 days of administration of *Tribulus terrestris* extract and remained so until 15 days after withdrawal of extract and sodium glycolate.[74]
The ethanolic extract of *Tribulus terrestris* (fruit) for activity against artificially induced urolithiasis in albino rats. The extract was administered at daily oral doses of 25, 50 and 100 mg/kg for 4 months. It exhibited dose-dependent antiurolithiatic activity and almost completely inhibited stone formation. Other biochemical parameters in urine and serum, and the histopathology of urinary bladder, which were altered during the process of stone formation, were also normalized by the plant extract in a

dose-dependent manner. These observations authenticate the traditional claim. *Tribulus terrestris* is the major component of the drug Nerunjil kudineer, advocated in Siddha medicine for the treatment of urolithiasis.[75]

Nerunjil kudineer was studied on experimentally induced calcium oxalate stones experimental urolithiasis for 28 days. Increase in serum urea was seen on day 14 and creatinine remained at the control value throughout the study. The drug-treated animals showed increased urinary output, decreased serum urea and crystalluria on day 14, and a tendency for alkalinization of urine compared with the ethylene glycol-treated animals, thus providing initial evidence for the clinical usefulness of this drug. [76]

Effect of sequential extracts (25mg/kgbody wt) of *Tribulus terrestris* with petroleum ether, chloroform, alcohol and water were compared with the spironolactone (synthetic steroidal drug) which was used on the lithiatic induced rats for 30 days. The levels of oxalate, calcium, inorganic phosphorous, sodium, potassium and magnesium were determined. Kidney ion and liver enzyme were also estimated. The alcohol and water extracts of *Tribulus terrestris*, was found to be effective then Spironolactone in reducing stone forming constituents both in urine and renal tissues and also reduced, the enzyme activity of GAO and LDH.out of this the alcohol extract of *Tribulus terrestris*, were found to be more effective and highly significant in the reduction of calculi, which can be used as anti urolithiatic agent.[77]

54. *Tridax procumbens* (Asteraceae)

    Tridax procumbens popularly known as 'Coat buttons' is a prostrate, procumbent, hirsute herb very common on waste lands throughout India. The ethanolic extract (0.5 and 1.0 g/kg, oral) of *T. procumbens* was evaluated against 0.75% v/v ethylene glycol and 2% w/v ammonium chloride induced calcium oxalate urolithiasis and hyperoxaluria induced oxidative stress in male albino rats. Parameters determined were kidney weight, renal deposition and urinary excretion of calcium and oxalate, urinary pH and creatinine in all the groups. Treatment with the extract was able to reduce caluculogenesis induced urinary excretion and renal deposition of calcium and oxalate and resultant lipid peroxidation, indicating its antiurolithiatic and antioxidant effects. [78]

55. *Trigonella foenum-graecum* (Leguminoceae)

    Trigonella foenum-graecum (Tfg) commonly known Fenugreek. Fenugreek is one of numerous plants whose seeds and leaves are used either as food or as an ingredient in conventional medicine. The inhibitory effect of the aqueous extract (100 mg/kg and 200 mg/kg) of Tfg seeds was evaluated on the formation of calcium oxalate renal stones induced by ethylene glycol (EG) with ammonium chloride. At the end of the experiment all kidneys were removed and examined microscopically for possible crystal/stone locations and the total calcium amount in the renal tissue was evaluated. The parameters evaluated were the levels of calcium, phosphorus, creatinine and urea. The amount of calcification in the kidneys and the total calcium amount of the renal tissue in rats treated with Tfg were significantly reduced compared with the untreated group. [79]

    The effect of *Trigonella foenum-graecum* seed and *Ammi majus* fruit (500 mg/kg per day orally) on experimentally-induced kidney stones. Oxalate urolithiasis in male rats was produced by the addition of 3% glycolic acid to their diet. After 4 weeks, highly significant deposition in the kidneys was noticed and changes in water intake and body weight recorded. Daily oral treatment with *T. foenum-graecum* significantly decreased the quantity of calcium oxalate deposited in the kidneys. The effects obtained by *A. majus* were, however, not significant. [80]

56. *Zea mays* (Poaceae)

    Zea mays usually known as maize, corn. Native to South America. Grown as a food crop mainly in India. The effects on the calcium oxalate urolithiasis urinary risk factors of *Zea mays*, in herb infusion form (2 g/L), combined with different diets (standard, high glucidic, high protein) have been studied using male Wistar rats. Drink volumes, urine volume, urine pH values, and the urine concentration (mg/L) of calcium, magnesium, phosphate, creatinine and citrate were determined. No influence on important urinary risk factors such as citraturia, calciuria or urinary pH values were detected. The diuretic effect of the herb infusion was evidently dependent on the diet and was maximum when the rats were fed with the standard one. [81]

REFERENCES

1. Riches E. (1968). The history of lithotomy and lithotrity. *Annals of The Royal College of Surgeons of England*, 43: 185.
2. Beck C.W., Mulvane W.P. (1996). Apathitic urinary calculi from early American Indians. *The Journal of the American Medical Association*; 195:168-169.
3. Butt A.J. (1954). Etiologic factors in renal lithiasis, Charles. C. Thomson Publishers, Springfield, Illinois, U.S.A

4. H Bek-Jensen and Tiselius, H.G. (1989). Stone formation and urine composition in calcium stone formers without medical treatment. *European Urology*; 16: 144-150.
5. Borghi, L., Schianchi, T., Meschi, T., Guerra,T., Allegri, F., Maggiore, U., Almerico N (2002). Comparison of two diets for the prevention of recurrent stones in idiopathic hypercalciuria. The New. England, *Journal of Medicine;* 346: 77-84
6. Tiselius, H.G. (1992). Recurrent stone formation in patients treated with extracorporeal shock wave lithotripsy. *Journal of Stone Disease*; 4:152-157.
7. Ahlstrand, C., and Tiselius, H.G. (1990). Recurrence during a 10-year follow-up period after first renal stone episode. *Urology Research*; 18: 397-399.
8. Pareta S.K, Patra C.K, Mazumder P.M and Sasmal D, (2011). Establishing the Principle of Herbal Therapy for Antiurolithiatic Activity: A Review. *Journal of Pharmacology and Toxicology*; 6: 321-332.
9. Fredric LC, Evan A, Worcester E. (2005). Kidney stone disease. *The Journal of Clinical Investigation*; 115(10): 2598-2608.
10. Eknoyan, G (2004). History of urolithiasis. *Clinical Reviews in Bone and Mineral Metabolism*; 2 (3): 177–85.
11. Celsus, Aulus Cornelius. 1831 Book VII, Chapter XXVI: Of the operation necessary in a suppression of urine, and lithotomy. Collier GF: A translation of the eight books of Aul. Corn. Celsus on medicine, (2nd ed) London: Simpkin and Marshall.
12. Shah. J, Whitfield, HN (2002). Urolithiasis through the ages, *British Journal of Urology International;* 89 (8): 801–10.
13. H Ellis, H (1979). A History of Bladder Stone, *Journal of the Royal Society of Medicine*, 72: 248.
14. Parameshwar P, Rao Y.N, Naik V.V and Reddy S.H, (2011). Evaluation of antilithiatic activity of *Adonis aestivalis* Linn. in male wister rats. *Der Pharmacia Lettre*; 3(2): 104-107.
15. Soundararajan P,Ramesh R, Ramesh T, Begum V.H, (2006). Effect of Aerva lanata on calcium oxalate urolithiasis in rats. Indian Journal of Experimental Biology; 44: 981-986.
16. Soundararajan P,Ramesh R, Ramesh T, Begum V.H, (2007). Biopotency of *Aerva lanata* on membrane bound ATPases and marker enzymes in urolithic rats. *International Journal of Biological Chemistry* ; (1) 4: 221-228.
17. Selvam R, Kalaiselvi P, Govindaraj A, Murugan V.B and. Sathish kumar A.S, (2001). Effect of *A. lanata* leaf extract and Vediuppu chunnam on the urinary risk factors of calcium oxalate urolithiasis during experimental hyperoxaluria. *Pharmacological Research*; 43(1): 89-93.
18. Christina A J M, Ashok K, Packialakshmi M, Tobin G.C, Preethi J, Murugesh N, (2005). Antilithiatic effect of *Asparagus racemosus* Willd on ethylene glycol-induced lithiasis in male albino wistar rats. *Methods and Findings in Experimental and Clinical Pharmacology*; 27: 633-638.
19. Bashir S, Gilani A.H, Siddiqui A.A, Pervez S, Khan S.R, Sarfaraz N,J and Shah A J, (2010). *Berberis vulgaris* root bark extract prevents hyperoxaluria induced urolithiasis in rats. *Phytotherapy Research*; 24: 1250–1255.
20. Bashira S and. Gilani A.H, (2009). Antiurolithic effect of *Bergenia ligulata* rhizome: An explanation of the underlying mechanisms. *Journal of Ethnopharmacology*; 122(1):106-116.
21. Harsoliya M S, Pathan J K , Khan N, Bhatt D , Patel V.M, (2011). Effect of ethanolic extracts of *Bergenia ligulata*, *Nigella sativa* and combination on calcium oxalate urolithiasis in rats. *International Journal of Drug Formulation & Research;* 2(2): 268-280.
22. Pareta S.K, Patra C.K, Mazumder P.M and Sasmal D, (2010). *Boerhaavia diffusa* Linn aqueous extract as curative agent in ethylene glycol induced urolithiasis. *Pharmacologyonline;* 3:112-120.
23. Nayeem K, Gupta D, Hashilkar N, Joshi R.K, (2010). Antiurolithiatic potential of the fruit extracts of *Carica papaya* on ethylene glycol induced urolithiatic rats. *Journal of Pharmacy Research*; 3(11): 2772-2775.
24. Ramesh C, Dharnendra Kumar B.K, Einstien J W, Saleem B S, Girish K, (2010). Anti-urolithiatic activity of wood bark extracts of *Cassia fistula* in rats. *Journal of Pharmaceutical And Biomedical Sciences*; 2(2):1-4.
25. Choubey A, Choubey A, Jain P, Iyer D, Patil U.K, (2010). Assessment of *Ceiba pentandra* on calcium oxalate urolithiasis in rats. *Der Pharma Chemica*; 2(6): 144-156.
26. Pérez G.R.M, Vargas S.R, (2006). Antiurolithiatic activity of the aqueous extract *Compact mammillaria* in rats. *Rev Salud Publica Nutr* 2006; 7 (4).
27. Araújo Viel T, Diogo Domingos C, da Silva Monteiro AP, Riggio Lima-Landman MT, Lapa AJ, Souccar C. (1999). Evaluation of the antiurolithiatic activity of the extract of *Costus spiralis* Roscoe in rats. *Journal of Ethnopharmacology*; 66(2):193-198.
28. Gupta P, Patel N, Bhatt L, Zambare G. N, Bodhankar S. L., Jain B. B, Nandakumar K, (2006). Anti-urolithiatic effect of petroleum ether extract stem bark of *Crataeva adansonii* in rats. *Pharmaceutical Biology;* 44(3):160-165.
29. Mekap S. K, Mishra S, Sahoo S and Panda P K, (2011). Antiurolithiatic activity of *Crataeva magna* Lour. bark. *Indian Journal of Natural Products and Resources*; 2(1): 28-33.
30. Varalakshmi P, Shamila Y. and Latha E, (1990). Effect of *Crataeva nurvala* in experimental urolithiasis. *Journal of Ethnopharmacology*; 28:313- 321.
31. Christina AJ, Packia Lakshmi M, Nagarajan M, Kurian S, (2002). Modulatory effect of *Cyclea peltata* Lam. on stone formation induced by ethylene glycol treatment in rats. *Methods and Findings in Experimental and Clinical Pharmacology*; 24(2):77-79.
32. Hirayama H, Wang Z, Nishi K, Ogawa A, Ishimatu T, Ueda S, Kubo T, Nohara T. (1993). Effect of *Desmodium styracifolium*-triterpenoid on calcium oxalate renal stones. *British Journal of Urology*; 71(2): 143-147.
33. Jayakumari S, Anbu J, and Ravichandran V, (2011). Antiurolithiatic activity of *Dichrostachys cinerea* (L.) Wight & Arn root extract. *Journal of Pharmacy Research*; 4(4):1206-1208.

34. Bahuguna Y.M, Rawat M.S.M., Juyal V and Gnanarajan G, (2009). Antilithiatic effect of grains of *Eleusine coracana*. *Saudi Pharmaceutical Journal*; 17(2): 182-187.
35. R. M. Perez G. R. Vargas S. S. Perez G. M. Zavala S. (1998). Antiurolithiatic activity of *Eysenhardtia polystachya* aqueous extract on rats. *Phytotherapy Research*; 12: 144–145.
36. Khan, N.I., Shinge, J.S., & Naikwade, N.S. (2010). Antilithiatic effect of *Helianthus annuus* Linn. Leaf extract in ethylene glycol and ammonium chloride induced nephrolithiasis. *International Journal of Pharmacy and Pharmaceutical Sciences*; 2(4): 180 -184.
37. Shri Vijay Kirubha T., Senthamarai R., Vasuki K. and Kavitha V, (2011). Antiurolithiatic activity of *Herpestis monniera* aerial parts in rats. *Advances In Pharmacology And Toxicology*; 12 (1): 25-29.
38. Kalyan S Betanabhatla, AJM Christina, B Syama Sundar, S Selvakumar and K Sundara Saravanan, (2009). Antilithiatic activity of *Hibiscus sabdariffa* Linn. on ethylene glycol-induced lithiasis in rats. *Natural Product Radiance*; 8(1) :43-47.
39. K.V.S.R.G. Prasad, R. Abraham, K. Bharathi and K.K. Srinivasan, (1997). Evaluation of Homonia riparia Lour. for antiurolithiatic activity in albino rats. *International Journal of Pharmacognosy*; 35(4): 278–283.
40. Bibu K.J, Joy A.D & Mercey K .A, (2010). Therapeutic effect of ethanolic extract of *Hygrophila spinosa* T. Anders on gentamicin-induced nephrotoxicity in rats. *Indian Journal of Experimental Biology*; 48: 911-917.
41. R.Sathish, K.Natarajan and Mukesh Madhavrao Nikhad (2010), Effect of H*ygrophila spinosa* T.Anders on ethylene glycol induced urolithiasis in rats. *Asian Journal of Pharmaceutical and Clinical Research*; 3(4): 61- 63.
42. Anbu J, Suman S, Swaroop Kumar SL, Satheeshkumar R, Nithya S, Kannadhasan R. (2011). Antiurolithiatic activity of ethyl acetate root extract of *Ichnocarpus frutescens* using ethylene glycol induced method in rats. *Journal of Pharmaceutical Science and Research*; 3: 1182–1189.
43. Bahuguna, Y., Rawat, M. S., Juyal, V., & Gupta, V., (2009) Antilithiatic effect of flowers of *Jasminum auriculatum* Vahl*, International Journal of Green Pharmacy*; 3 (2): 155-158.
44. Patil C, Bhargava S, Patel P, Singh P, Surana S, (2008) Diuretic and antiurolithiatic activity of hydroalcoholic extract of leaves of *Kalanchoe pinnata* Pers (Crassulaceae), *Journal of Pharmaceutical Research*; 7(2): 87-91.
45. Mayee R., Thosar A. (2011). Evaluation of *Lantana camara* Linn. (Verbenaceae) for antiurolithiatic and antioxidant activities in rats. *International Journal of Pharmaceutical and Clinical Research*; 3(1): 10-14.
46. D. Anantha Krishna Chaitanya, M. Santosh kumar, A. Manohar Reddy, N.S.V. Mukherjee, M.H. Sumanth, A. Ramesh, (2010). Anti urolithiatic activity of *Macrotyloma uniflorum* seed extract on ethylene glycol induced urolithiasis in albino rats. *Journal of Innovative trends in Pharmaceutical Sciences*; 1 (5): 216-226.
47. A.J.M. Christina, N.A. Haja Najumadeen, S. Vimal Kumar, N. Manikandan, G.C. Tobin, S. Venkataraman, and N. Murugesh, (2006). Antilithiatic Effect of *Melia azedarach* on ethylene glycol–induced nephrolithiasis in rats. *Pharmaceutical Biology,* 44(6): 480–485.
48. Purnima Ashok, Basavaraj C. Koti, A.H.M. Vishwanathswamy, (2010). Antiurolithiatic and antioxidant activity of *Mimusops elengi* on ethylene glycol-induced urolithiasis in rats. *Indian Journal of Pharmacology*; 42(6): 380-383.
49. Karadi R.V., Gadge N.B., Alagawadi K.R., Savadi R.V., (2006). Effect of *Moringa oleifera* Lam. root-wood on ethylene glycol induced urolithiasis in rats. *Journal of Ethnopharmacology;* 105(1-2): 306–311.
50. Karadi R.V., Palkar M.B., Gaviraj E.N, Gadge N.B, Mannur V.S, and. Alagawadi K.R, (2008). Antiurolithiatic property of *Moringa oleifera* root bark. *Pharmaceutical Biology*; 46(12): 861–865.
51. Jha U, Shelke T.T, Oswal R.J, Adkar P.P, Navgire V.N , (2011). Pharmacological screening of *Musa paradisica* Linn against ethylene glycol induced renal calculi. *International Journal of Research in Ayurveda & Pharmacy;* 2(3): 995-998.
52. Hadjzadeh, M. A., Khoei, A., Hadjzadeh, Z., & Parizady, M, (2007). Ethanolic extract of *Nigella sativa* L seeds on ethylene glycol-induced kidney calculi in rats. *Urology Journal*; 4 (2): 86-90.
53. Hadjzadeh, M. A., Mohammadian, N., Rahmani, Z., & Rassouli, F. B. (2008). Effect of Thymoquinone on ethylene glycol-induced kidney calculi in rats. *Urology Journal*; 5:149-55.
54. Woottisin, S., Hossain, R. Z., Yachantha, C., Sriboonlue, P., Ogawa, Y., & Saito, S (2011). Effects of *Orthosiphon grandiflorus*, *Hibiscus sabdariffa* and *Phyllanthus amarus* extracts on risk factors for urinary calcium oxalate stones in rats. *Journal of Urology*; 185:323-328.
55. Bouanani, S., Henchiri, C., Migianu-Griffoni, E., Aouf, N., & Lecouvey, M (2010). Pharmacological and toxicological effects of *Paronychia argentea* in experimental calcium oxalate nephrolithiasis in rats. *Journal of Ethnopharmacology;* 129: 38–45.
56. Teepa, K. S., Kokilavani, R., Balakrishnan, A., & Gurusamy, K (2010). Effect of ethanolic fruit extract of *Pedalium murex* Linn. in ethylene glycol induced urolithiasis in male wistar albino rats. *Ancient Science of Life*; 29(4): 29 - 34.
57. Vyas, B., Vyas, R., Joshi, S., & Santani, D (2011). Antiurolithiatic activity of whole-plant hydroalcoholic extract of *Pergularia daemia* in rats. *Journal Young Pharmacists*; 3:36-40
58. Dodoala, S., Diviti, R., Koganti, B. and Prasad, K. V. S. R. G., (2010). Effect of ethanolic extract of *Phyla nodiflora* (Linn.) Greene against calculi producing diet induced urolithiasis. *Indian Journal of Natural Products and Resources*; 1(3): 314-321
59. Freitas, A. M., Schor, N., & Boim, M. A., (2002). The effect of *Phyllanthus niruri* on urinary inhibitors of calcium oxalate crystallization and other factors associated with renal stone formation. *BJU International*; 89:829–834.
60. Hosseinzadeh, H., Khooei, A. R., Khashayarmanesh, Z., & Motamed-Shariaty, V, (2010). Antiurolithiatic activity of *Pinus eldarica* Medw. fruits aqueous extract in rats. *Urology Journal*; 7: 232-237.

61. Alvin Jose, M., Ibrahim and Janardhanan, S, (2005). Modulatory effect of *Plectranthus amboinicus* Lour. on ethylene glycol-induced nephrolithiasis in rats. *Indian Journal of Pharmacology*; 37 (1): 37-45.
62. Akila L., Ashok Kumar P and Nirmala P., (2011). Effect of a polyherbal formulation on ethylene glycol induced urolithiasis. *International Journal of Pharma and Bio Sciences*; 2(4): 7-24.
63. Moriyama M T, Suga K, Miyazawa K, Tanaka T, Higashioka M, Noda K, Oka M, Tanaka Mand Suzuki K, (2009) Inhibitions of urinary oxidative stress and renal calcium level by an extract of *Quercus salicina* Blume/*Quercus stenophylla* Makino in a rat calcium oxalate urolithiasis model. *International Journal of Urology*; 16: 397–401.
64. Vargas Solis, R., & Perez Gutierrez, R. M. (2002). Diuretic and urolithiatic activities of the aqueous extract of the fruit of *Randia echinocarpa* on rats. *Journal of Ethnopharmacology*;83(1-2): 145–147
65. Vargas, R., Perez, R. M., Perez, S., Zavala, M. A., & Perez, C. (1999). Antiurolithiatic activity of *Raphanus sativus* aqueous extract on rats. *Journal of Ethnopharmacology;* 68(1-3): 335–338.
66. Tayefi-Nasrabadi H, Sadigh-Eteghad S, Aghdam Z. (2012). The effects of the hydroalcohol extract of *Rosa canina* L fruit on experimentally nephrolithiasic wistar rats. *Phytotherapy Research*; 26(1): 78-85.
67. Christina AJ, Priya Mole M, Moorthy P, (2002). Studies on the antilithic effect of *Rotula aquatica* Lour in male wistar rats. *Methods and Findings in Experimental and Clinical Pharmacology*; 24(6): 357-359.
68. Gilhotra U.K, Christina A.J.M, (2011). Effect of *Rotula aquatica* Lour. on ethylene-glycol induced urolithiasis in rats. *International Journal of Drug Development and Research*; 3(1): 273-280.
69. Divakar. K, Pawar A.T, Chandrasekhar S.B, Dighe S.B, Divakar G, (2010). Protective effect of the hydro-alcoholic extract of *Rubia cordifolia* roots against ethylene glycol induced urolithiasis in rats. *Food and Chemical Toxicology;* 48: 1013–1018.
70. Ghalayini, I. F., AL-Ghazo, M. A. And Harfeil, M. N. A (2011). Prophylaxis and therapeutic effects of raspberry (*Rubus idaeus*) on renal stone formation in Balb/c mice. *International Brazilian Journal of Urology*; 37 (2): 259-266.
71. Vargas, R. and Pérez, R, (2002) Antiurolithiatic activity of *Salix taxifolia* aqueous extract. *Pharmaceutical Biology*; 40(8): 561–563.
72. Doddola S, Pasupulati H, Koganti B, Prasad K.V, (2008). Evaluation of *Sesbania grandiflora* for antiurolithiatic and antioxidant properties. *Journal of Natural Medicines*; 62: 300–307.
73. Sangeeta, D., Sidhu, H, Thind, S. K., Nath, R. and Vaidyanathan, S (1993). Therapeutic response of *Tribulus terrestris* (Gokhru) aqueous extract on hyperoxaluria in male adult rats. *Phytotherapy Research*; 7: 116-119.
74. Sangeeta, D., Sidhu, H., Thind, S. K., & Nath, R. (1994). Effect of *Tribulus terrestris* on oxalate metabolism in rats. *Journal of Ethnopharmacology;*, *44*(2): 61–66.
75. Anand, R., Patnaik, G. K., Srivastava, S., Kulshreshtha, D. K. and Dhawan, B. N. (1994). Evaluation of antiurolithiatic activity of *Tribulus terrestris*, *International Journal of Pharmacognosy*; 32(3): 217-224
76. Satish, S., Periasamy, P., & Namasivayam, A (1996). Effect of *Tribulus terrestris* on experimental urolithiasis induced by ethylene glycol in albino rats. *Pharmaceutical Sciences*; 2(1): 437-439.
77. Satish H, Raman D, Kshama D, Shivananda B G, Shridhar K A., (2009). Study the relative effect of spironolactone and different solvent extract of *Tribulus terrestris* on urolithiatic rats. *Pharmacognosy Magazine*; 5:83-89
78. Sailaja, B., Bharathi, K., & Prasad, K. V. S. R. G, (2011). Protective effect of *Tridax procumbens* L. on calcium oxalate urolithiasis and oxidative stress. *An International Journal of Advances In Pharmaceutical Sciences*; 2 (1):9-14
79. Laroubi, A., Touhami, M., Farouk, L., Zrara, I., Aboufatima, R., Benharref, A., & Chait, A (2007). Prophylaxis effect of *Trigonella foenum- graecum* L. seeds on renal stone formation in rats. *Phytotherapy Resarch*; 21(10): 921–925
80. Ahsan, S. K., Tariq, M., Ageel, A. M., al-Yahya, M. A., & Shah, A. H. (1989). Effect of *Trigonella foenum-graecum* and *Ammi majus* on calcium oxalate urolithiasis in rats. *Journal of Ethnopharmacology*; 26(3):249-254
81. Grases, F., March, J.G., Ramis, M. and Costa-Bauzá, A., (1993). The influence of *Zea mays* on urinary risk factors for kidney stones in rats. *Phytotherapy Research*; 7: 146-149

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