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A review of plant based medicine in treatment of Urolithiatic disorder

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Abstract
Medicinal plants have been known for ancient time and are well admired in globe as a potential source of curative compounds for the prevention of different diseases. Urolithiasis is precipitation of insoluble and less soluble salt such as Oxalate and Phosphate in urinary tract causing obstruction in urethra resulting renal colic and hematuria. The information on flora was collected from various Journals, websites and books which were additionally revised to ascertain use parts, studied model, ethno medicinal use and different mechanism of action. By analysing 36 articles of 27 journals this review accumulates information of list of 94 plants of 55 families covering 21 mechanism of action which can suppress urolithiasis with three studied model. Also, Conventionally, 20 parts of these plants are used by different modes like boiling, decoction, extract, paste, juice, powder and ash. In this article, an effort has been made to highlight on effective native flora which is used in cure of urolithiasis.

Keywords: Oxalate, Phosphate, Review and Urolithiasis

1. Introduction
Urolithiasis is the precipitation of insoluble and less soluble salt such as oxalate and phosphate in urinary tract, which causes obstruction of urethra resulting renal colic, hematuria, pyuria, dysuria, oliguria and hematuria. It is third most common disorder of urinary system after urinary tract infection and prostrate disease, affecting nearly 2% of world population [1, 2, 3]. In past years, incidence of kidney stone is increased in both male and female of industrialized country possibly due to high dietary intake of mineral and protein. The reoccurrence rate of this disease differs about 70-80% in males and 47-60% in females [4]. As it affects all age group of people, fifty to sixty is peak age for the incidence of calcium oxalate stones with a female to male to ratio of 1:2 which is due to larger muscle mass of male. Also, high presence of testosterone; a hormone with enhancing effect to stone formation, in male favours in stone formation whereas estrogen; which have high presence in women, helps in prevention of formation of kidney stone by keeping alkaline urine and increasing citrate level in urine [5, 6, 7, 8]. Calcium salts are major type of covering about 75% of all calculi. It is observed as calcium oxalate (50%), calcium phosphate (5%) and mixture of both (45%) [5]. Calcium oxalate exists in two different molecular states monohydrate and dihydrate form. Being thermodynamically stable and having greater affinity for renal tubular cell monohydrate form is observed repeatedly in stone than dehydrate [9]. The mechanism of kidney stone is guided by events of crystal nucleation, aggregation and growth of insoluble particle. Crystals are formed in urine due to super saturation of crystal forming compounds, presence of stimulatory and absence of inhibitory component. Prevention of urolithias is carried out by intervening symptomatically, physiologically and change in lifestyle. Increasing fluid intake, painkiller for alleviation of colic pain and administration of salt monitoring drug helps in management of stones [10]. These medicines are not effective in all cases and are not used due to high cost, adverse reaction and high probability of reoccurrence. Hence, medicinal plants are used conventionally for urolithiaisis due to their cost effectiveness, fewer side effects and they contains numerous phytochemicals that shows beneficial effects in urolithiasis [11].

2. Methods and result
The information on flora having antiurolithiasis activity was collected from various journal, websites and books which were additionally revised to ascertain use parts, studied model, ethno medicinal use and different mechanism which can inhibit urolithiasis. Based upon the theory that traditionally used plants can show affirmative result in screening in various *in vivo-vitro* models, the investigation has been done on 36 articles of 27 journals consisting of 94

plants belonging in 55 families.

After collection of statistics the process has been choose from generalization to specification. Table 1 contains list of plants having antiurolithiasis activity.

S. N.	Scientific name	Family	Part used	Mechanism of action	Studied model/ Mode of use
1.	*Abel moschus*	Malvaceae	Seeds	Diuretic, antioxidant	Animals *in vivo* [12].
2.	*Abrus precatorius*	Malvaceae	Leaves	Diuretic	Aqueous extract is taken [4].
3.	*Achyranthus aspera*	Amaranthaceae	Leaves	Diuretic, prevents renal epithelial damage	Leaves extract is taken. *In vitro*, cell culture, animals *in vivo* [11, 2].
4.	*Acorus calamus*	Araceae	Rhizome	Diuretic, nephroprotective actions	Animals *in vivo* [13].
5.	*Actinodaphne angustifolia*	Lauraceae	Leaves	Diuretic	Decoction of leaves is taken. [4].
6.	*Aerva javanica*	Amaranthaceae	Whole Plant	Diuretic, dissolves kidney stone	Whole plant paste is taken [3, 14].
7.	*Aeschynomene indica*	Papilionaceae	Leaves	Diuretic	Decotion of leaves is taken [4]
8.	*Alcea rosea*	Malvaceae	Roots	Diuretic, anti-inflammatory	Animal *in vivo* [15, 16].
9.	*Allium odorosum*	Alliaceae	Leaves	Diuretic	Decotion of leaves is taken [4]
10.	*Ananas comosus*	Bromeliaceae	Ripe Fruits	Diuretic	Extract of ripe fruit is taken [4].
11.	*Anneslea fragrans*	Theaceae	Leaves	Diuretic	Boiled in water and taken [4].
12.	*Asparagus racemosus*	Liliaceae	Roots	Dissolve kidney stone, diuretics	Decoction of root is taken [3, 4].
13.	*Averrhoa carambola*	Averrhoaceae	Fruits	Diuretic	Fruit juice is taken [4].
14.	*Bambusa nutans*	Poaceae	Shoots	Diuretic	Boiled shoot extract is taken. [4].
15.	*Bauhinia acuminata*	Caesalpiniaceae	Barks,Leaves	Diuretic	Decoction of bark and leaves is taken [4].
16.	*Benincasa hispida*	Cucurbitaceae	Fruits	Diuretic	Decoction of fruit is taken. Fruit extract mixed with jaggery is taken [4, 14].
17.	*Bergenia ligulata*	Saxifragaceae	Rhizomes	Decreases calcium oxalate crystal	*In vitro* turbidity assay, *In vivo* animals [11, 17].
18.	*Biophytum sensitivum*	Oxalidaceae	Whole Plant	Diuretic, antioxidant, anti-inflammatory	Animals *in vivo* [18].
19.	*Blumea balsamifera*	Asteraceae	Leaves	Diuretic	Crushed leaves in water are taken [4].
20.	*Bonnaya reptans*	Scrophalariaceae	Whole Plant	Diuretic	Decoction is taken [4].
21.	*Celosia argentea*	Amaranthaceae	Roots	Diuretic	Boiled extract of root is taken [4].
22.	*Celtis australis*	Urticaceae	Leaves	Diuretic	Boiled extract of leaves is taken [4].
23.	*Celtis timorensis*	Ulmaceae	Shoots	Diuretic	Boiled juice is taken [4].
24.	*Centella asiatica*	Apiaceae	Whole Plant	Diuretic	Plant juice is taken [4].
25.	*Cinnamomum bejolghota*	Lauraceae	Barks	Diuretic	Bark is taken [4].
26.	*CinnamomumGlaucescens*	Lauraceae	Barks	Diuretic	Powder of bark is taken [4].
27.	*Cinnamomum tamala*	Lauraceae	Leaves	Diuretic	Boiled leaves extract is taken [4].
28.	*Cissampelos pareira*	Menispermaceae	Roots	Antioxidant, diuretic, hypocalciuric	*In vivo* animal model [1].
29.	*Cissus adnata*	Vitaceae	Leaves And Roots	Diuretic, antibacterial, prevents crystal formation	Decoction of leaves and root is taken [4].
30.	*Cissus javana*	Vitaceae	Leaves	Diuretic	Boiled extract of leaves is taken [4].
31.	*Citrus latipes*	Rutaceae	Fruits	Diuretic	The fruit extract is taken [4].
32.	*Citrus limon*	Rutaceae	Fruits	Antioxidant, inhibition of crystal growth, diuretic	*In vitro*, *in vivo* animal assay [17, 19].
33.	*Citrus medica*	Rutaceae	Whole Plant	Diuretic, hypocalciuric, hypooxalouric effect	*In vivo* animal assay [3].
34.	*Copaifera langsdorffii*	Fabaceae	Leaves	Inhibit crystal formation, prevent crystal growth	*In vitro*, *in vivo* animal assay [20].
35.	*Cordia grandis*	Borageineae	Fruits	Diuretic	Fruits juice are taken [4].
36.	*Crateva magna*	Capparidaceae	Roots, Stem and Barks	Diuretics, reduced serum creatinine and calcium, hypooxalourea	Animal *in vivo* [3, 21].
37.	*Crataeva nurvala*	Capparaceae	Barks	Antibacterial, inhibit growth of stone, inhibit glycolic acid oxidase, lower intestinal Na K-ATPases.	Bark decoction is used, *In vivo* animal [3, 4, 11].
38.	*Cucumis trigonus*	Cucurbitaceae	Fruits	Antioxidants, inhibit lipid peroxidation in liver and kidney	Animals *in vivo* [22].
39.	*Cuminum cyminum*	Umbelliferaeceae	Fruits	Prevent nucleation, diuretic, antibacterial, make urine alkaline	Decoction of fruits is taken [4].
40.	*Curcuma longa*	Zingiberaceae	Rhizomes	Dissolve kidney stone, diuretic	Turmeric powder mixed with jaggery is taken [3, 14].
41.	*Cymbopogon citratus*	Poaceae	Whole Plant	Diuretic	Decoction is taken [4].
42.	*Cynodon dactylon*	Poaceae	Roots	Increase calcium oxalate dihydrate compared to monohydrate form.	Root decoction is taken. *In vivo* animal [11, 23].

43.	*Dendrophthoe elastic desr*	Loranthaceae	Whole Plant	Diuretic, hypocalciuric, hypooxalouric	*In vivo* animal assay [25].
44.	*Desmodium microphyllum*	Papilionaceae	Whole Plants	Diuretic	Decoction of the plant is taken [4].
45.	*Didymocarpus pedicellata*	Gesneriaceae	Whole Plant	Diuretic, hypocalciuric, hypooxalouric effect, dissolve kidney stone	*In vivo* animal assay [3, 25].
46.	*Dolichos biflorus*	Leguminoceae	Seeds	Dissolve kidney stone, diuretic and prevent stone deposition	*In vitro*, *in vivo* animal assay [3, 11, 17].
47.	*Duchesnea indica*	Rosaceae	Whole Plant	Diuretic	Decoction of plant is taken [4].
48.	*Emblica officinalis*	Euphorbiaceae	Fruits	Diuretic	Juice extract is taken [4].
49.	*Enhydra fluctuans*	Asteraceae	Shoot	Diuretic	Boiled with sugar and taken. [4].
50.	*Eupatorium birmanicum*	Asteraceae	Leaves	Diuretic, antibacterial activity, prevent crystal formation, make urine alkaline	Decoction of the leaves is taken [4].
51.	*Euphorbia hirta*	Euphorbiaceae	Whole Plant	Diuretic	Boiled with *Cuminumcyminum*, extract mixed with goat milk is taken [4, 14].
52.	*Fragaria indica*	Rosaceae	Vegetative Parts	Diuretic	Boiled with sugar and taken [4].
53.	*Fragaria nilgerensis*	Rosaceae	Vegetative Parts	Diuretic	Boiled along with sugar candy taken [4].
54.	*Fructus aurantii*	Cucurbitaceae	Whole Plant	Inhibit nucleation, dissolve formed stone, antioxidant, antimicrobial.	Animals *in vivo*, *In vitro* [24].
55.	*Hedychium aurantiacum*	Zingiberaceae	Rhizomes	Diuretic	Boiled with water and drink [4].
56.	*Hibiscus sabdariffa*	Malvaceae	Leaves	Diuretic, antibacterial activity, prevent crystal formation, dissolve stone	Decoction of leaves is taken. *In vivo* animal assay [4, 26].
57.	*Holarrhena antidysenterica*	Apocynaceae	Seeds	Antioxidant, renal epithelial protective effect, Inhibit crystal aggregation	*In vitro*, animals *in vivo* [27].
58.	*Hordeum vulgare*	Poaceae	Seeds	Diuretic, antioxidant, nephroprotective, and lower the concentration of urinary stone-former	Animals *in vivo* [28].
59.	*Ichnocarpus frutescens*	Apocyaneceae	Roots	Hypocalciuric, hypooxalouric, restore phosphate level and regulate endogenous oxalate synthesis	*In vivo* animal assay [2, 3, 15].
60.	*Ipomoea eriocarpa*	Convolvulaceae	Leaves	Diuretic, lower urinary concentrations of stoneformer	Animals *in vivo* [29].
61.	*Jasminum auriculatum*	Oleaceae	Flowers	Regulatory action on endogenous oxalate synthesis	Animal *in vivo* [15].
62.	*Lindernia ruellioides*	Linderniaceae	Whole Plant	Diuretic	Boiled along with sugar candy and drink [4].
63.	*Mallotus philippensis*	Euphorbiaceae	Barks	Diuretic	Decoction of the bark is taken [4].
64.	*Mentha arvensis*	Lamiaceae	Leaves	Diuretic	Crushed in water and drink [4].
65.	*Mimosa pudica*	Mimosaceae	Roots	Diuretic	Root decoction is taken [4, 15].
66.	*Moringa oleifera*	Moringaceae	Roots, Bark and Flower	Reduce stone formation in urine and their kidney retention, Diuretic, improve renal function	Decoction is taken. *In vivo* animal [3, 11, 14, 21, 15].
67.	*Myriogyne minuta*	Asteraceae	Aerial Parts	Diuretic	Extract of the plants is taken [4].
68.	*Nasturtium officinale*	Lileaceae	Aerial Parts	Preventive effect on renal stone formation and crystal deposition	Animals *in vivo* [30].
69.	*Nigella sativa*	Ranunculaceae	Seeds	Antioxidant, anti-inflammatory, prevents crystal formation	Animals *in vivo* [31].
70.	*Origanum vulgare*	Lamiaceae	Aerial Part	Inhibit crystallization, diuretic, antioxidant, antispasmodic, epithelial cell protection	Cell culture, Animals *in vivo* [32].
71.	*Oxalis corniculata*	Oxalidaceae	Leaves	Diuretic, antibacterial activity, prevent crystal formation	Decoction of the leaves is taken [4].
72.	*Pedalium murex*	Pedaliaceae	Fruits	Regulatory action on endogenous oxalate synthesis, prevent renal epithelial cell damage	Fruit powder is given with sheep milk. *In vivo* animals [14, 33].
73.	*Phyllanthus niruri*	Phyllanthaceae	Leaves	Antispasmodic, inhibit crystal growth	*In vitro*, *in vivo* animals [11, 17].
74.	*Piper longum*	Piperaceae	Leaves	Diuretic, antibacterial activity, prevent crystal formation, dissolve stone	Decoction of the leaf is taken [4].
75.	*Piper nigrum*	Piperaceae	Seeds	Diuretic	Seeds Boiled with water and

					taken [4].
76.	*Potentilla anserina*	Rosaceae	Whole Plant	Diuretic	Decoction of the plant is taken [4].
77.	*Pratia nummularia*	Companulaceae	Whole Plant	Diuretic	Boiled extract of whole plant is taken [4].
78.	*Raphanus sativus*	Brassicaceae	Tubers	Diuretic	Ash mixed with water is given. *In vivo* animal [3, 11, 14].
79.	*Rhus succedanea*	Anacardiaceae	Fruits	Diuretic	Powders of the fruits mixed with egg and taken [4].
80.	*Rotula aquatica*	Boraginaceae	Leaves, Stem and Roots	Diuretic, reduce oxalate, calcium and phosphate in urine.	*In vitro*, *in vivo* animal assay [17, 15].
81.	*Sargassum graminifolium*	Algae	Whole	Inhibit calcium oxalate crystallization, antioxidant	*In vitro* assay [34].
82.	*Solanum xanthocarpum*	Solaneceae	Fruits	Inhibit nucleation, diuretic, antioxidant, maintain balance between promoter and inhibitor	*In vivo* animal assay [3, 6].
83.	*Syzygium aromaticum*	Myrtaceae	Flower Buds	Diuretic	Boiled with water and taken. [4].
84.	*Tamarindus indica*	Caesalpinaceae	Leaves	Diuretic, antibacterial activity, prevent crystal formation, dissolve stone	Decoction of the leaves along with sugar and taken [4].
85.	*Tamarindus indicus*	Fabaceae	Pulps	Inhibit crystallization	*In vivo* animal assay [11].
86.	*Teraxacum officinale*	Asteraceae	Whole Plant	Diuretic, hypocalciuric, hypooxalouric effect	*In vivo* animal assay [25].
87.	*Terminalia arjuna*	Combretaceae	Barks	Inhibit nucleation, antioxidant	*In vitro* assay [9, 35].
88.	*Thunbergia alata*	Acanthaceae	Leaves	Diuretic	Boiled extract of the leaves is taken [4].
89.	*Trachyspermum ammi*	Apiaceae	Leaves	Maintain renal function and decrease crystal excretion in urine and retention in renal tissue	*In vivo* animal assay [11, 23].
90.	*Tribulus terrestris*	Zygophyllaceae	Roots, Whole Plant, Fruits and Leaves	Decrease oxalate	Root decoction is given. *In vivo* animal assay [11, 23, 14, 21].
91.	*Viburnum opulus*	Caprifoliaceae	Fruits	Balance pH, diuretic and antioxidant	Juice of fruits is taken. *In vivo* animal assay [36].
92.	*Wedelia chinensis*	Asteraceae	Whole Plant	Diuretic	Decoction of plant is taken [4].
93.	*Xanthium strumarium*	Asteraceae	Roots	Diuretic	Root decoction is taken [4].
94.	*Zea mays*	Poaceae	Tassel, Corn Silk,	Diuretic	Corn silk extract is taken [3, 14].

3. Conclusions

Medicinal plants which were used in traditional practices as remedies for the urolithiasis have been well established *in vivo-vitro* test, clinical trial and effective use but are lacking well documented record. By analysing 36 articles of 27 journals this review accumulates information of list of 94 plants of 55 families covering 21 mechanism of action which can suppress urolithiasis with three studied model. Also, conventionally, 20 parts of these plants are used by different modes like boiling, decoction, extract, paste, juice, powder and ash. Hence, plant based medicine are effective herbal alternative as well as mean of discovery of novel drug molecule for curing urolithiatic disorder and researchers should be focused to discover their value for human use.

Conflicts of Interest

Authors declare no conflict of interests regarding the publication of this paper.

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