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Antiuro lithiatic plants: Multidimensional pharmacology

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Abstract

Urolithiasis is a common problem afflicted for many centuries with high recurrence. The aim of this review is to provide comprehensive information about traditionally used antiuro lithiatic plants and their scientifically proved pharmacological activities like analgesic, anti-inflammatory, antioxidant, astringent, demulcent, diuretic, litholytic, lithotriptic, antiuro lithiatic, antispasmodic, ACE inhibition and Phospholipase A₂ inhibition as a plausible mechanism of action. A total of 503 species, 365 genera and 119 families were cited for treating kidney stones. The most cited families are Asteraceae (41), Fabaceae (34), Lamiaceae (26), Apiaceae (21), Rosaceae (19) and Poaceae (16). The most common used plant parts are root and rhizome (25%), mode of preparation decoction (62%) and route of administration is oral in all cases. This review will provide the opportunities for the future research and development of new natural antiuro lithiatic compounds.

Keywords: urolithiasis, antiuro lithiatic, natural products, drug development.

Introduction

The belief and observations regarding traditionally used medicinal plants, increasing the interest of people to use natural medicine for their primary health care needs. A wide range of medicinal plants have been used in different countries and cultures as a prophylactic and curative agent for urolithiasis. Most of the remedies are very useful, but their mechanism of action remains unclear. Scientific studies reveal the mechanism of actions of these antiuro lithiatic plants and the results show very interesting and multidimensional action, responsible for their effectiveness at different stages of urolithiasis, such as, the diuretic action increases the quantity of fluid going pass through the kidneys as a result flush out the deposits. Therefore, the increase in urine volume decreases the saturation of the salts and prevents the precipitation of the crystals at physiological pH. Breaking, disintegration and dissolution of preformed stones (litholytic activity) and binding inhibition among particles to form stones (lithotriptic activity) play an important role in this pathological condition. Crystal inhibitors decrease crystal nucleation, aggregation and growth. Furthermore, they inhibit crystallization by their adsorption to the crystal surface which makes them unable for renal tubular attachment (crystallization inhibition activity). In urine different crystalloids like oxalate, uric acid, calcium and cystine are present with mucin and sulphuric acid colloids in dissolved form. The disturbance in crystalloid-colloid balance (increase in crystalloid and decrease in colloid) causes renal stone formation. Renal exposure to oxalate and calcium oxalate causes lipid peroxidation, produces Reactive Oxygen Species followed by renal cell injury and inflammation. This loss of membrane integrity, promotes fibrosis and collagen formation, facilitates calcium oxalate retention and subsequent stone formation [1, 2]. Renin-Angiotensin System activates the NADPH oxidase in renal cells, which produces Reactive Oxygen Species. Angiotensin converting enzyme inhibition significantly reduces calcium oxalate crystal deposition and renal inflammation. The Reactive Oxygen Species end up phospholipase A₂ activation through nuclear transcription factor NF-κB. Activation of cytosolic phospholipase A₂ generates arachidonic acid and lysophosphatidylcholine, which increase reactive oxygen species production that in turn increase in cell death and crystal formation [1, 3]. The obstructing stone causes renal colic and in this condition an antispasmodic activity of the smooth muscles along with analgesic and anti-inflammatory activities play an important role in symptomatic relief from renal colic and dysuria. Antispasmodics help in stone passage. The obstruction of urine outflow by stones decreases the glomerular filtration rate (GFR) resulting nitrogenous waste (urea, creatinine and uric acid) accumulation in blood [1].

The antiadherent layer of Glycosaminoglycans in renal tubule plays an important role in urolithiasis as a defender. Its damage potentiates bacterial attack, resulting stone nucleus (nidus) formation, leading to urinary stone formation. In urinary tract infection the urea splitting organisms (*Proteus mirabilis*), splits urea into ammonia and carbon dioxide. These byproducts damage the glycosaminoglycan leading to the bacterial adherence, followed by biofilm formation and mineral encrustation. They also make the urine alkaline which provides a favorable environment for precipitation of calcium and magnesium phosphate and calcium carbonate crystals which are already present in that medium in large amount^[4, 5]. *Proteus mirabilis* and *Escherichia coli* alter urokinase activity leading to matrix (non crystalline portion of kidney stone) formation. This matrix formation increases crystal adherence to renal epithelium to form stone^[1]. Astringent actions tightens and tones the weak, atonic, swollen or injured tissues and make it harder for bacteria to adhere them. Demulcents causing urinary tissues moistening or lubrication, soothe inflammation, irritation and injury thus facilitate stone expulsion^[6].

The present review is an attempt to share traditionally used antiurolithiatic plants with their possible multidimensional mechanism of action. A bibliographic investigation was performed from Google Scholar, Pubmed, SciFinder, Scirus, Web of Science, Yahoo and a library search by using plant name, parts used, analgesic, anti-inflammatory, antioxidant, antiurolithiatic, antispasmodic, astringent, demulcent, diuretic,

litholytic, lithotriptic, ACE inhibition and Phospholipase A₂ inhibition activities.

Conclusion

Urolithiasis is a major health problem with high recurrence rate, complex pathophysiology and multifactorial etiology. Urinary stone formation occurs due to urinary supersaturation, precipitation, crystal nucleation, aggregation of crystals, growth and finally retention in the epithelial cells of renal tubules. Besides a number of therapies are available for urolithiasis none of them is 100% effective and similarly the medicinal plants with less side effects and cost effective are used in different ways and theories for the production and course of urolithiasis.

Currently known herbal drugs exert their antiurolithiatic effect with multidimensional pharmacological actions as angiotensin converting enzyme inhibition, analgesic, antiinflammatory, antioxidant, antispasmodic, astringent, crystallization inhibition, diuretic, demulcent; litholytic, lithotriptic, Phospholipase A₂ inhibition and by changing the ions concentrations in urine such as increase magnesium and citrate excretion e.g., decreasing the calcium and oxalates. Although these herbal medicines are popular in folk culture but rationale behind their efficacy and safety are not well established. The understandings of the pathophysiology of stone formation and the mode of action of these plant based medicines are of great importance for the development of safe and effective antiurolithiatic medicines.

Table 1: Antiurolithiatic plants with reported pharmacological parameters.

Family	Species	Parts used (Mode of preparation)	Pharmacological parameters of used part(s)
Acanthaceae(08)	<i>Anisotes trisulcus</i> (Forssk.) Nees.	Le(Inf) ^[7]	AI, AO ^[8]
	<i>Barleria prionitis</i> L.	Ro(Dec) ^[7]	DI ^[9]
	<i>Dipteracanthus repens</i> Hassk.	Le(Pw) ^[7]	NDF
	<i>Ecbolium viride</i> (Forssk.) Alston	Le / Ro(Dec) ^[7]	AG, AO, DI ^[10]
	<i>Gymnocarpus decandrum</i> Forssk.*	Ap(NDF) ^[7]	NDF
	<i>Hygrophila auriculata</i> (Schumach.) Heine.	Ro(Dec) ^[7]	AG, AO ^[11] , DI ^[12]
Acoraceae (01)	<i>Thunbergia alata</i> Bojer ex Sims.	Le(Dec) ^[7]	NDF
	<i>Acorus calamus</i> L.	Ro(Dec) ^[7]	AO ^[13]
Aizoaceae (02)	<i>Trianthema portulacastrum</i> L.	Le/Ro(Dec) ^[7]	AG, AI ^[14]
	<i>Zaleya pentandra</i> (L.) C.Jeffrey.	Ro(Dec) ^[15]	NDF
Alismataceae (01)	<i>Alisma plantago-aquatica</i> L.	Wp(Dec) ^[7]	DI ^[16]
Amaranthaceae (12)	<i>Achyranthes aspera</i> L.	Le /St/Ro(Inf / Dec) ^[7, 17]	AG, AI, AO, DI ^[18] , LL ^[19]
	<i>Aerva javanica</i> (Burm.f.) Juss. ex Schult.	Le(Ju); Ro/Se (Dec) ^[20]	AO ^[21] , DM, DI ^[12]
	<i>Aerva lanata</i> (L.) Juss.	Le(Ju) ^[7]	AO, DI ^[22] , LL ^[12]
	<i>Alternanthera brasiliana</i> (L.) Kuntze.	Le(Ju) ^[12]	AO ^[23] , AI ^[24] , DI ^[23] , LL ^[12]
	<i>Amaranthus blitum</i> L.	Le(Inf) ^[7]	NDF
	<i>Amaranthus caudatus</i> L.		AO ^[25] , DI, LL ^[12]
	<i>Amaranthus viridis</i> L.	Wp(Dec) ^[7]	AO, LL ^[12]
	<i>Beta vulgaris</i> L.	Ro(Ju) ^[7]	AI, AO ^[26]
	<i>Celosia argentea</i> L.	Ro(Inf) ^[7]	AI, AO ^[27]
	<i>Chenopodium album</i> L.	Le(Inf) ^[17]	AG, AI, AO, AS ^[28] .
<i>Gomphrena celosoides</i> Mart.	Wp(Ju) ^[7]	AG, AI, AO ^[29]	
<i>Nothosaerva brachiata</i> (L.) Wight.	Ro(Dec) ^[30]	DI ^[9] , LL, LT ^[30]	
Amaryllidaceae (04)	<i>Allium cepa</i> L.	Bl(Inf) ^[7]	AI ^[31] , AS ^[32] , DI, LT ^[31]
	<i>Allium odorum</i> L.	Le(Dec) ^[7]	AO ^[33] , LT ^[34]
	<i>Allium sativum</i> L.	Bl(Inf) ^[7]	AG, AI, AO ^[35]
	<i>Ungernia victoris</i> Vved. ex Artjush.	Se(Inf) ^[7]	NDF
Anacardiaceae (03)	<i>Pistacia lentiscus</i> L.	Wp(Dec) ^[7]	AO ^[36]
	<i>Rhus succedanea</i> L.	Fr (Dec) ^[7]	
	<i>Spondias axillaris</i> Roxb.	Fr (Dec) ^[7]	NDF
Annonaceae (02)	<i>Malmea depressa</i> (Baill.) R.E.Fr.	Ba(Inf) ^[7]	
	<i>Meiogyne minuta</i> (G.Forst.)Less.*	Wp(Inf) ^[7]	
Apiaceae (20)	<i>Ammi visnaga</i> (L.) Lam.	Ba / Le / Fr (Dec) ^[37]	AO ^[38] , AS ^[1] , DI, LL ^[37] , LT ^[1]

	<i>Ammi majus</i> L.	Wp(Inf) ^[7]	AI, DI, LT ^[39]
	<i>Apium graveolens</i> L.	Ro / Se (Dec) ^[7]	AI ^[40] , AO ^[41] , AS ^[42] , DI, LL ^[41]
	<i>Bunium persicum</i> (Boiss.)B.Fedtsch.	Fr(Dec) ^[7]	AG, AI ^[43] , AO ^[44]
	<i>Carum carvi</i> L.	Fr(Dec) ^[7]	AG, AI, AO, DI ^[45]
	<i>Carum copticum</i> (L.) Benth. & Hook. f.	Fr(Dec) ^[7]	AG, AI ^[46] , LL ^[47]
	<i>Centella asiatica</i> (L.) Urb.	Wp(Dec) ^[7]	AI, AO ^[48]
	<i>Coriandrum sativum</i> L.	Le / Se (Dec) ^[7]	AO, DI ^[49]
	<i>Daucus carota</i> L.	Ro(Dec) ^[7]	NDF
	<i>Eryngium campestre</i> L.	Fl / St (Dec) ^[7]	AI ^[50]
	<i>Eryngium creticum</i> Lam.	Ro / Se (Inf) ^[7]	AO ^[51]
	<i>Ferula persica</i> Willd.	oleo gum resin ^[7]	NDF
	<i>Foeniculum vulgare</i> Mill.	Fr (Dec) ^[7]	AG, AI, AO, DI ^[52]
	<i>Levisticum officinale</i> W.D.J.Koch.	Fr / Ro(Dec) ^[7]	DI ^[53]
	<i>Peucedanum grande</i> C.B.Clarke.	Fr (Dec) ^[7]	NDF
	<i>Pimpinella anisum</i> L.	Fr (Dec) ^[12]	AG, AI, AO ^[54] , AS, DI, LL ^[12]
	<i>Petroselinum crispum</i> (Mill.) Fuss.	Le/ Ro(Inf) ^[55, 56]	AO, DI, LL ^[55, 56] , LT ^[57]
	<i>Petroselinum sativum</i> Hoffm.	Le /Ro/Se(Dec) ^[58]	DI, LL ^[55, 59] ,LT ^[60]
Apocynaceae (08)	<i>Asclepias syriaca</i> L.	Ro (Dec) ^[7]	NDF
	<i>Carissa opaca</i> Stapf ex Haines.	Le(Dec) ^[7]	
	<i>Ceropegia bulbosa</i> Roxb.	Tu(Dec) ^[12]	AO ^[61] , LL ^[12]
	<i>Holarrhena antidysenterica</i> (Roth) Wall. ex A.DC.	Ro / St / Se(Dec) ^[7]	ACE-I, AG, AI ^[62] ,AS ^[63] , LL ^[62]
	<i>Hemidesmus indicus</i> (L.) R. Br. ex Schult.	Le /Ro(Dec) ^[7]	AI ^[64]
	<i>Ichnocarpus frutescens</i> (L.) W.T.Aiton.	Ro(Dec) ^[65]	LL ^[66]
Aquifoliaceae (01)	<i>Ilex aquifolium</i> L.	Le(Dec) ^[7]	AI, AO ^[67]
Araceae (01)	<i>Arum rupicola</i> Boiss.	Le(Inf) ^[7]	NDF
Araliaceae (01)	<i>Hedera helix</i> L.	Le(Dec) ^[7]	AI ^[68]
Arecaceae (03)	<i>Borassus flabellifer</i> L.	Bd(Inf) ^[7]	DI ^[69]
	<i>Cocos nucifera</i> L.	Fruit water ^[7]	AG, AI, AO ^[70]
	<i>Serenoa repens</i> (W.Bartram) Small.	Fr(RE) ^[71]	AI, AO, AS, Di, PLA ₂ -I ^[71]
Asparagaceae (06)	<i>Asparagus racemosus</i> Willd.	Ro(Dec) ^[7]	AI ^[72] , AO ^[73] , AS ^[72] , DI ^[74] , LL ^[19]
	<i>Asparagus officinalis</i> L.	Ro(Dec) ^[75]	AO ^[76] , DI ^[75]
	<i>Asparagus racemosus</i> Willd.	Ro(Dec) ^[77]	AO, DI ^[77]
	<i>Drimia indica</i> (Roxb.) Jessop.	Bl(Inf) ^[7]	DI ^[78]
	<i>Ruscus aculeatus</i> L.	Le / St (Dec) ^[58]	AO ^[79] , LL ^[58]
	<i>Ruscus hypoglossum</i> L.	Fr(RE) ^[7]	NDF
Aspleniaceae (04)	<i>Asplenium hemionitis</i> L.	Le(Inf) ^[80]	DI, LL ^[80]
	<i>Asplenium scolopendrium</i> L.	Le (Dec) ^[7]	AO ^[81]
	<i>Asplenium ceterach</i> L.	Le(Dec) ^[7]	AO ^[82]
	<i>Ceterach aureum</i> Buch.	Wp(Inf) /Ro(Dec) ^[80]	DI, LL ^[80]
Asteraceae(41)	<i>Aaronsohnia pubescens</i> (Desf.) K.Bremer & Humphries.	Le(Inf) ^[7]	NDF
	<i>Achillea falcata</i> L.	Ap(Inf) ^[37]	AS, LL ^[37]
	<i>Achillea millefolium</i> L.	Wp(Dec) ^[7]	AI ^[83] , AO ^[84] , AS ^[83] , DI ^[85]
	<i>Acmella oleracea</i> (L.) R.K.Jansen.	Wp(Dec) ^[7]	AG, AI, AO, DI ^[86]
	<i>Ageratum conyzoides</i> (L.) L.	Ro(Dec) ^[7]	AG, AI, AO, AS ^[87] , LL ^[19]
	<i>Anthemis nobilis</i> L.	Fl(Dec / Inf) ^[7]	AI, AS ^[85]
	<i>Arctium lappa</i> L.	Ro(Dec) ^[7]	AI, AO ^[88]
	<i>Arnica montana</i> L.	Ap(Dec) ^[7]	AO ^[89] , AT, DI ^[90]
	<i>Artemisia abrotanum</i> L.	Fr(Inf) ^[7]	NDF
	<i>Artemisia absinthium</i> L.	Wp(Inf) ^[7]	AG, AI ^[91] , AS ^[92]
	<i>Artemisia scoparia</i> Waldst. & Kitam.	Wp(Inf) ^[7]	AG, AI, DI ^[93]
	<i>Artemisia vulgaris</i> L.	Wp(Inf) ^[7]	AG, AI, AS, DI ^[94]
	<i>Aster tripolium</i> L.	Fr(Dec) ^[7]	---
	<i>Blumea balsamifera</i> (L.) DC.	Le(Dec) ^[95]	AO,DI ^[95] , LL ^[12]
	<i>Calendula officinalis</i> L.	Le / Fl(NDF) ^[90, 96]	AO, AT, DM, DI ^[90, 96]
	<i>Cichorium intybus</i> L.	Le(RE) ^[7]	NDF
	<i>Cynara scolymus</i> L.	Ro(Dec) ^[7]	DI, LT ^[31]
	<i>Echinops echinatus</i> Roxb.	Wp(Ex) ^[17]	NDF
	<i>Echinops spinosus</i> L.	Fl / Ro (Dec) ^[7]	DI ^[97]
	<i>Enhydra fluctuans</i> Lour.*	Wp(Dec) ^[7]	AO ^[98]
	<i>Erigeron karvinskianus</i> DC. *	Wp(NDF) ^[99]	LT ^[99]
	<i>Eupatorium birmanicum</i> DC.	Le(Dec) ^[7]	AG, DI ^[100]
	<i>Eupatorium purpureum</i> L.	Ro / Ri tincture ^[7]	DI, LT ^[101]
	<i>Erigeron canadensis</i> L.	Essential oil	AT, DI ^[75]
	<i>Helichrysum arenarium</i> (L.) Moench	Wp(Inf) / Fl(Dec) ^[7]	AO ^[102]
	<i>Helichrysum maracandicum</i> Popov.	Fl(Dec) ^[7]	AI, AO, DI ^[103]
<i>Helichrysum pallasii</i> (Spreng.) Ledeb.	Wp(Inf) ^[7]	AO ^[104]	

	<i>Helichrysum plicatum</i> DC.	Ap(Dec / Inf) ^[7]	AI, AS, DI ^[105]	
	<i>Inula oculus-christi</i> L.	Fl(Dec) ^[7]	AO ^[106]	
	<i>Kalimeris indica</i> (L.) Sch. Bip.	Wp(Dec) ^[7]	NDF	
	<i>Matricaria chamomilla</i> L.	Fl(NDF) ^[7]	AG, AI, AO, AS ^[107]	
	<i>Onopordum acanthium</i> L.	Se ^[7]	AO ^[108]	
	<i>Silybum marianum</i> (L.) Gaertn.	St(Dec) ^[7]	AI, DI ^[109]	
	<i>Sonchus oleraceus</i> (L.) L.	Ba(Inf) ^[7]	AG, AI, AO, DI ^[110]	
	<i>Sphaeranthus indicus</i> L.	Ro(Dec) ^[7]	AG, AI, AO, DI ^[111]	
	<i>Tanacetum chiliophyllum</i> (Fisch. & E.Mey. ex DC.) Sch.Bip.	Fl(Dec) ^[7]	NDF	
	<i>Tanacetum parthenium</i> (L.) Sch.Bip.	Fl(Dec) ^[7]	AI ^[112]	
	<i>Trapogon buphtalmoides</i> (DC.) Boiss.*	Le(RE) ^[7]	AO ^[113]	
	<i>Tridax procumbens</i> (L.) L.	Le(Ju) ^[12]	LL ^[12]	
	<i>Xanthium strumarium</i> L.	Ro(Dec / Inf) ^[7]	AG, AO, DI ^[114]	
Berberidaceae (02)	<i>Berberis integerrima</i> Bunge.	Le(Inf) ^[7]	AI, AO ^[115]	
	<i>Berberis vulgaris</i> L.	Ro(Dec) ^[19]	AI ^[40] , AO ^[116] , LL ^[19]	
Betulaceae (03)	<i>Betula lenta</i> L.	Le(Dec) ^[7]	NDF	
	<i>Betula pendula</i> Roth.	Ba / Le(Inf) ^[7]	AO ^[117]	
	<i>Betula utilis</i> D.Don	Le(Inf) ^[7]	AI, AO ^[118]	
Bignoniaceae (01)	<i>Kigelia pinnata</i> (Jacq.) DC.	Fr(PcVn) ^[119]	DI ^[9]	
Bombacaceae (01)	<i>Bombax ceiba</i> L.	Ba(Dec) ^[7]	AG, AI, AO ^[120] , LL ^[66]	
Boraginaceae (10)	<i>Arnebia euchroma</i> (Royle) I.M.Johnst.	Ro(NDF) ^[7]	NDF	
	<i>Cordia ecalyculata</i> Vell.	Fr(roasted & brewed) ^[7]		
	<i>Cordia grandis</i> Roxb.	Fr(NDF) ^[7]		
	<i>Heliotropium crispum</i> Desf.	Wp(Dec) ^[15]		
	<i>Heliotropium indicum</i> L.	Le(Dec) ^[7]		AI ^[121]
	<i>Lithospermum officinale</i> L.	Fr / Le(Dec) ^[7] , ^[122]		DI, LT ^[122]
	<i>Pulmonaria officinalis</i> L.	Le(NDF) ^[90]		AO ^[123] , DI, LT ^[90]
	<i>Rotula aquatica</i> Lour.	Ro / St (Dec) ^[7]		DI ^[124]
	<i>Tournefortia acuminata</i> A.DC.	Le(NDF) ^[7]	NDF	
Brassicaceae (09)	<i>Armoracia lapathifolia</i> Gilib.	Se(NDF) ^[12]	AO ^[125] , DI, LL ^[12]	
	<i>Barbarea vulgaris</i> R.Br.	Le / Ro ^[12]	LL ^[12]	
	<i>Brassica napus</i> L.	Le(Ju) ^[58]	AO ^[126] , LL ^[58]	
	<i>Brassica oleracea</i> L.	Fr(Dec) ^[7]	AG, AI ^[127] , AO ^[128]	
	<i>Capsella bursa-pastoris</i> (L.) Medik.	Wp(Dec / Inf) ^[7]	AI ^[129] , DI ^[130]	
	<i>Lepidium latifolium</i> L.	Le(Inf) ^[80]	DI, LL ^[80]	
	<i>Lepidium sativum</i> L.	Se(NDF) ^[80]		
		<i>Raphanus sativus</i> L.	Ba / Le(Ju) / Ro(Inf)/Se(Pw) ^[7]	AO ^[131] , DI, LL ^{[1, 132], [133]}
		<i>Zilla spinosa</i> (L.) Prantl.	Ap(Dec) ^[7]	NDF
Bromeliaceae (01)	<i>Ananas comosus</i> (L.) Merr.	Fr(Ju) ^[7]	AO ^[134] , DI ^[135]	
Burseraceae (01)	<i>Commiphora mukul</i> (Hook. ex Stocks) Engl.	gum ^[7]	NDF	
Cactaceae (01)	<i>Opuntia ficus-indica</i> (L.) Mill.	dry Fl(Inf) ^[80]	DI, LL ^[80]	
Caesalpiniaceae (03)	<i>Cassia auriculata</i> L.	Le(Ju) ^[7]	AO ^[136]	
	<i>Cassia fistula</i> L.	Fr(Ju) ^[7]	AO ^[137] , LL ^[12]	
	<i>Hardwickia binata</i> Roxb.	Balsam ^[75]	DI ^[75]	
Campanulaceae(01)	<i>Pratia nummularia</i> (Lam.) A.Braun & Asch.	Wp(Dec) ^[7]	NDF	
Cannabaceae (02)	<i>Cannabis sativa</i> L.	Fr(NDF) ^[7]	AG, AI ^[138]	
	<i>Celtis timorensis</i> Span.	Le(Dec) ^[7]	LT ^[139]	
Capparaceae (03)	<i>Crateva adansonii</i> DC.	Ba(Dec) ^[7]	AG, AO ^[140]	
	<i>Crataeva magna</i> (Lour.) D.C.*		AG, AI, AO, DM, DI, LT ^[141]	
	<i>Crataeva nurvala</i> Buch.-Ham.*			
Caryophyllaceae (05)	<i>Gypsophila struthium</i> Loeffl.	Ro(NDF) ^[7]	NDF	
	<i>Herniaria glabra</i> L.	Ap(NDF) ^[90]	LT ^[90]	
	<i>Paronychia argentea</i> Lam.	Le / Fl (Dec) ^[58]	AO ^[142] , LL ^[37]	
	<i>Saponaria mesogitana</i> Boiss.	Le / Ro (Dec) ^[7]	LL ^[143]	
	<i>Spergularia rubra</i> (L.) J.Presl & C.Presl.	Le(Inf) ^[144]	DI, LT ^[75]	
Celastraceae (01)	<i>Celastrus paniculatus</i> Willd.	Le(Inf) ^[7]	AG, AI, AO, AS ^[145, 146]	
Chenopodiaceae (02)	<i>Haloxylon stocksii</i> (Boiss.) Benth. & Hook. f.	Wp(NDF) ^[7]	NDF	
	<i>Suaeda fruticosa</i> Forssk. ex J.F.Gmel.	Le(Inf) ^[7]		
Combretaceae (01)	<i>Terminalia arjuna</i> (Roxb. ex DC.) Wight & Arn.	Ba(Inf) ^[7]	AG, AI, AO ^[147]	
Compositae (06)	<i>Taraxacum androssovii</i> Schischk.	Le(Inf) ^[7]	NDF	
	<i>Taraxacum fedtschenkoi</i> Hand.-Mazz.	Le(Inf) ^[148]	AI, LL ^[148]	
	<i>Taraxacum hybernium</i> Steven	Fl / Le(RE) ^[148]	LL ^[148]	
	<i>Taraxacum officinale</i> (L.) Weber ex F.H.Wigg.	Le / Ro(Inf) ^[148]	AI, DI, LL ^[148]	
	<i>Taraxacum pseudobrachygloussum</i> Soest.	Ro(Dec) ^[148]	LL ^[148]	
Convolvulaceae (01)	<i>Argyrea nervosa</i> (Burm. f.) Bojer.	Le(Inf) ^[7]	AG, AI, AO ^[149]	

	<i>Xenostegia tridentata</i> (L.) D.F. Austin & Staples.	Ro(Dec) ^[7]	AI, DI ^[150]
Costaceae (04)	<i>Costus arabicus</i> L.	Ro(NDF) ^[151]	LL, LT ^[151]
	<i>Costus igneus</i> N. E. Br.	Ro(NDF) ^[66]	AO, DI ^[152] , LL ^[66]
	<i>Costus speciosus</i> (J.Koenig) Sm.	Tu(Dec) ^[7]	AS, DI ^[153] , LL ^[12]
	<i>Costus spicatus</i> (Jacq.) Sw.	Wp(Inf) ^[7]	AG, AI ^[154]
Crassulaceae (04)	<i>Aeonium canariense</i> (L.) Webb & Berthel.	Wp(Ju) ^[80]	DI, LL ^[80]
	<i>Bryophyllum calycinum</i> Salisb.	Le(Ju) ^[7]	AG, AI, AO, DI, LL ^[155]
	<i>Bryophyllum pinnatum</i> (Lam.) Oken.	Le(Inf / Ju) ^[7]	AG, AI ^[156] , LL ^[19]
	<i>Kalanchoe pinnata</i> (Lam.) Pers.	Le(Ju) ^[7]	AG, AI, DI, LL ^[157]
Cruciferae (01)	<i>Cardamine uliginosa</i> M.Bieb.	Ap(Dec / Inf) ^[7]	NDF
Cucurbitaceae (14)	<i>Benincasa hispida</i> (Thunb.) Cogn.	Fr(Ju) ^[7]	AG, AI, AO ^[158] , AT ^[159] , DI ^[158]
	<i>Bryonia alba</i> L.	St(Inf) ^[7]	NDF
	<i>Citrullus colocynthis</i> (L.) Schrad.	Wp(NDF) ^[7]	AI, AO ^[160]
	<i>Citrullus lanatus</i> (Thunb.) Matsum. & Nakai.	Se(Inf) ^[7]	AG ^[161] , AI, AO ^[162]
	<i>Citrullus vulgaris</i> Schrad.	Fr / Se (Inf) ^[7]	AG, AI, AO ^[163] , DI ^[17]
	<i>Coccinia grandis</i> (L.) Voigt.	Ro(Dec) ^[7]	AG, AI, AO ^[164]
	<i>Coccinia indica</i> Wight & Arn.	Wp(NDF) ^[7]	LL ^[66]
	<i>Cucumis melo</i> L.	Se / Fr(Ju) ^[7]	AG, AI, AO, DI ^[165]
	<i>Cucumis sativus</i> L.	Se/ Fr/Le/Ro(Dec) ^[7]	LL ^[66]
	<i>Cucurbita maxima</i> Duchesne	Se(NDF) ^[166]	AO, DI, LT ^[166]
	<i>Lagenaria abyssinica</i> (Hook.f.) C.Jeffrey.	Se(Pw) ^[167]	AG, AI, AO ^[168] , DI ^[132]
	<i>Lagenaria siceraria</i> (Molina) Standl.	Fr ^[169]	DI, LL ^[169]
	<i>Momordica cochinchinensis</i> (Lour.) Spreng.	Fr/Se(Inf) ^[7]	AO ^[170]
	<i>Momordica dioica</i> Roxb. ex Willd.	Se(NDF) ^[7]	AG, AI, AO ^[171]
<i>Mukia maderaspatana</i> (L.) M.Roem.	Wp(Inf) ^[7]	AI ^[172] , AO ^[173] , DI ^[174]	
Cupressaceae (07)	<i>Juniperus chinensis</i> L.	Fr(Inf) ^[7]	AO ^[175]
	<i>Juniperus communis</i> L.	Ba / Fl(NDF) ^[176]	AG, AI, AO ^[177] , DI ^[176]
	<i>Juniperus excelsa</i> M.Bieb.	Fr(Inf) ^[7]	AO, DI ^[178]
	<i>Juniperus oxycedrus</i> L.	Cn(NDF) ^[7]	AI, AO ^[175]
	<i>Juniperus sabina</i> L.		NDF
	<i>Juniperus polycarpus</i> K.Koch.	Ro(Dec) ^[7]	AI, DI ^[179]
Cyperaceae (02)	<i>Juniperus pseudosabina</i> Fisch. & C.A.Mey.	Fr(NDF) ^[7]	NDF
	<i>Cyperus longus</i> L.	Ap(Dec) ^[7]	AO, DI ^[180]
Ebenaceae (01)	<i>Cyperus rotundus</i> L.	Ri(Dec) ^[7]	AG, AI, AO, AS, DI, LL ^[181]
	<i>Diospyros ebenum</i> J.Koenig ex Retz.	Wd(NDF) ^[7]	AO ^[182]
Equisetaceae (05)	<i>Equisetum arvense</i> L.	St(Ju) ^[7]	AG, AI, AO ^[183] , DI ^[184] , LL ^[183]
	<i>Equisetum bogotense</i> Kunth.	Wp(Inf) ^[7]	DI ^[132]
	<i>Equisetum debile</i> Roxb. ex Vaucher.	Wp(Ju) ^[7]	AO ^[185]
	<i>Equisetum ramosissimum</i> Desf.	Ap(Dec/Inf) ^[7]	DI ^[80]
	<i>Equisetum telmateia</i> Ehrh.	Ap(Inf) ^[7]	NDF
Ericaceae (05)	<i>Arctostaphylos pungens</i> Kunth.	Le(Dec) ^[7]	AO ^[186]
	<i>Arctostaphylos uva ursi</i> (L.) Spreng.	Le(Dec) ^[187]	AI ^[187] , AO ^[188] , AT, DI ^[75] , LL ^[187]
	<i>Chimaphila maculata</i> (L.) Pursh.	Le(Dec) ^[7]	DI ^[189]
	<i>Chimaphila umbellata</i> (L.) Nutt.	Ap(Dec) ^[7]	AO, DI ^[190]
	<i>Vaccinium vitis-idaea</i> L.	Ap(Dec) ^[7]	AO ^[191]
Euphorbiaceae (11)	<i>Acalypha indica</i> L.	Le(Ju);Fl(NDF) ^[7]	AG, AI, AO ^[192] , DI ^[193]
	<i>Euphorbia hirta</i> L.	Wp(Dec) ^[7]	AG, AI, AO, DI ^[194]
	<i>Euphorbia nerifolia</i> L.	Wp(Dec) ^[7]	AG, AI, AO ^[195]
	<i>Euphorbia prostrata</i> Aiton	Wp(Dec) ^[7]	AI, AO ^[196]
	<i>Euphorbia retusa</i> Forssk.	La(NDF) ^[7]	NDF
	<i>Euphorbia serpens</i> Kunth.	Wp(Dec) ^[7]	NDF
	<i>Homonoia riparia</i> Lour.	Ro(Dec) ^[7]	DI ^[197] , LT ^[159]
	<i>Macaranga peltata</i> (Roxb.) Müll.Arg.	Ba(Dec) ^[7]	NDF
	<i>Mallotus philippensis</i> (Lam.) Müll.Arg.	Ba(Dec) ^[7]	NDF
	<i>Ricinus communis</i> L.	Ro(Dec) ^[7]	AG, AI, AO ^[198]
Fabaceae (34)	<i>Sapium sebiferum</i> (L.) Roxb.	Le(Inf) ^[7]	DI ^[199]
	<i>Abrus precatorius</i> L.	Le / Se(Ju) ^[7]	AG, AI, AO ^[200] , AS ^[201] , DI ^[200] , LT ^[167]
	<i>Acacia jacquemontii</i> Benth.	Le(Inf) ^[7]	NDF
	<i>Acacia tortilis</i> (Forssk.) Hayne	Fr(Dec) ^[7]	NDF
	<i>Alhagi mannifera</i> Jaub. & Spach	Ro(Dec) ^[12]	LL ^[12]
	<i>Alhagi maurorum</i> Medik.	Ro(Dec) ^[58]	AG, AI, AO ^[202] , LL ^[58]
	<i>Astragalus hamosus</i> L.	Fr(Dec) ^[7]	AG, AI, AO ^[203]
	<i>Bauhinia forficata</i> Link	Le(Dec) ^[7]	AO ^[204]
	<i>Bauhinia purpurea</i> L.	Ba(Inf) ^[7]	AG, AI ^[205]
	<i>Butea monosperma</i> (Lam.) Taub.	St Ba /Le(Dec); Se(Pw) ^[7]	AI, AO ^[206]

	<i>Caesalpinia nuga</i> (L.) Aiton.	Ro(Dec) ^[12]	DI, LL ^[12]
	<i>Cassia italica</i> (Mill.) Spreng.	Wp(NDF) ^[7]	AG, AI ^[207]
	<i>Cassia occidentalis</i> L.	Fl(NDF) ^[7]	AG, AI, AO ^[208]
	<i>Cicer arietinum</i> L.	Se(Inf) ^[7]	AG, AI, AO, DI, LL ^[209]
	<i>Clitoria ternatea</i> L.	Ro Ba (Dec) ^[7]	AG, AI, AO ^[210] , LL ^[66]
	<i>Crotalaria albida</i> Roth.		NDF
	<i>Crotalaria pallida</i> Aiton.	Ro(Dec) ^[7]	AI, AO ^[211]
	<i>Crotalaria sessiliflora</i> L.		AI, AO ^[212]
	<i>Desmodium microphyllum</i> (Thunb.) DC.	Wp(Dec) ^[7]	NDF
	<i>Glycyrrhiza glabra</i> L.	Ro(Dec) ^[7]	AG, AI, AO ^[213]
	<i>Indigofera tinctoria</i> L.	Ro(Dec) ^[7]	AI, AO ^[214]
	<i>Lupinus albus</i> L.	Se(Inf) ^[7]	NDF
	<i>Lupinus varius</i> "L., p.p."	Se(Inf) ^[58]	LL ^[143]
	<i>Macrotyloma uniflorum</i> (Lam.) Verdc.	Se(Inf) ^[7]	AT, DI, LL ^[12]
	<i>Medicago sativa</i> L.	Ro(Dec) ^[7]	AO ^[215]
	<i>Melilotus officinalis</i> (L.) Pall.	Ap(Dec) ^[7]	AO ^[216] , DI ^[217]
	<i>Mimosa pudica</i> L.	Le(Ju); Ro(Dec) ^[7]	Ag, AI, AO, DI ^[218] , LL ^[12]
	<i>Ononis spinosa</i> L.	Ro(Dec/Inf) ^[219]	AG, AI, AO ^[220] , DI, LT ^[219]
	<i>Phaseolus vulgaris</i> L.	Se(Dec / Inf) ^[7]	DI ^[221]
	<i>Prosopis farcta</i> (Banks & Sol.) J.F.Macbr.	Le(Dec) ^[58]	AI ^[222] , LL ^[143]
	<i>Saraca asoca</i> (Roxb.) Willd.	Ba / Se (Dec) ^[7]	AG, AI ^[223]
	<i>Tamarindus indica</i> L.	Fr / Le(Dec) ^[7]	AG, AO ^[224] , AS ^[225] , LL ^[12]
	<i>Teline microphylla</i> (DC.) P.E.Gibbs & Dingwall.	Fl(Inf) ^[80]	DI, LL ^[80]
	<i>Tephrosia purpurea</i> (L.) Pers.	Le(Dec); / Ro(Ju) ^[7]	NDF
	<i>Trigonella foenum-graecum</i> L.	Fr / Se (Inf) ^[7]	AG, AI, AO ^[226] , DI ^[227]
Fagaceae (04)	<i>Quercus cerris</i> L.		
	<i>Quercus petraea</i> (Matt.) Liebl.	Ap(Inf) ^[7]	NDF
	<i>Quercus pubescens</i> Willd.		
	<i>Quercus robur</i> L.		
Gentianaceae (01)	<i>Enicostema axillare</i> (Poir. ex Lam.) A. Raynal.	Le(Ju) ^[7]	AO ^[228]
Geraniaceae (01)	<i>Geranium robertianum</i> L.	Ap(Inf) ^[90]	DI ^[90]
Gesneriaceae (03)	<i>Coraliodiscus lanuginosus</i> (Wall. ex DC.) B.L.Burt.	Le(Inf) ^[7]	NDF
	<i>Didymocarpus pedicellatus</i> R.Br.	Le(Inf) ^[229]	AO ^[229] , DI ^[12] , LL ^[229]
	<i>Didymocarpus tomentosus</i> Wight.	Wp(Dec) ^[7]	AI, AO ^[230]
Grossulariaceae(01)	<i>Ribes triste</i> Pall.	Ro(Dec) ^[169]	LT ^[169]
Hydrangeaceae (01)	<i>Hydrangea arborescens</i> L.	Ro(Dec) ^[7]	DI, LT ^[231]
Hypericaceae (05)	<i>Hypericum hypericoides</i> (L.) Crantz.	Le(Dec) ^[144]	LT ^[144]
	<i>Hypericum montbretii</i> Spach.	Wp(Dec) ^[7]	NDF
	<i>Hypericum montanum</i> L.	Ap(Inf) ^[7]	AO ^[232]
	<i>Hypericum perforatum</i> L.		AO ^[233]
	<i>Hypericum tetrapterum</i> Fr.		AO ^[234]
Hypoxidaceae (01)	<i>Curculigo orchiooides</i> Gaertn.	Ri(Dec) ^[7]	AO, DI ^[235]
Juglandaceae	<i>Juglans regia</i> L.	Se(Dec) ^[169]	DI, LL ^[169]
Lamiaceae (26)	<i>Ajuga chamaepitys</i> (L.) Schreb.	Wp(Dec) ^[7]	DI ^[236]
	<i>Coleus amboinicus</i> Lour.	Le(Ju) ^[7]	AI, AO ^[237]
	<i>Glechoma hederacea</i> L.	Le(Dec) ^[7]	AO, DI ^[238]
	<i>Gmelina arborea</i> Roxb.	Fr(Inf) ^[7]	AO, DI ^[239]
	<i>Lamium album</i> L.	Wp(Dec) ^[75]	AI, AO ^[240] , DI ^[75]
	<i>Lavandula stoechas</i> L.	Le(Dec) ^[7]	NDF
	<i>Mentha arvensis</i> L.	Le(Dec) ^[7]	AG, AI, AO, DI ^[241]
	<i>Mentha pulegium</i> L.	Wp(Dec) ^[7]	AS ^[242]
	<i>Mentha spicata</i> L.	Le(Dec) ^[7]	AO ^[243]
	<i>Micromeria biflora</i> (Buch.-Ham. ex D.Don) Benth.	Wp(Dec) ^[7]	NDF
	<i>Ocimum basilicum</i> L.	Wp(Dec) ^[7]	AO ^[244]
	<i>Ocimum sanctum</i> L.	Le / Ro(Dec) ^[7]	AG, AI, AO, DI ^[245]
	<i>Orthosiphon aristatus</i> (Blume) Miq.	Ap(Dec) ^[7]	AO, AI ^[246]
	<i>Orthosiphon grandiflorus</i> Bold.	Wp(Dec) ^[7]	NDF
	<i>Orthosiphon stamineus</i> Benth.	Wp(Dec) ^[7]	AO, DI, LL ^[247]
	<i>Origanum majorana</i> L.	Wp(Dec) ^[7]	AI, AS, AO, DI ^[248]
	<i>Plectranthus amboinicus</i> (Lour.) Spreng.	Le(Inf) ^[7]	AG, AI, AO ^[249]
	<i>Rosmarinus officinalis</i> L.	Le(Dec) ^[7]	AI ^[250] , DI ^[12]
	<i>Salvia canariensis</i> L.	Ap(Inf) ^[80]	AS, DI ^[80]
	<i>Tectona grandis</i> L.f.	Ro/ Se(Dec) ^[7]	AG, AI, AO, DI ^[251]
	<i>Teucrium chamaedrys</i> L.	Wp(Dec) ^[7]	NDF
	<i>Teucrium polium</i> L.	Le(Dec) ^[143]	LL ^[143]
	<i>Teucrium scordium</i> L.	Wp(Dec) ^[7]	
	<i>Thymus kotschyanus</i> Boiss. & Hohen.	Le(Inf) ^[7]	NDF
	<i>Thymbra spicata</i> L.	Le(Dec) ^[7]	

	<i>Thymus migricus</i> Klokov & Des.-Shost.	Le(Dec) ^[7]	
Lauraceae (08)	<i>Actinodaphne angustifolia</i> Nees.	Wp(Dec) ^[7]	
	<i>Cinnamomum aromaticum</i> Nees.	Ba(Inf) ^[7]	
	<i>Cinnamomum bejolghota</i> (Buch.-Ham.) Sweet.	Ba(Inf) ^[7]	AO ^[252]
	<i>Cinnamomum tamala</i> (Buch.-Ham.) T.Nees & Eberm.	Le(Inf) ^[7]	AO ^[253]
	<i>Cinnamomum verum</i> J.Presl.	Le(Dec) ^[7]	AI, AO ^[254]
	<i>Laurus nobilis</i> L.	Ba(Inf) ^[7]	AG, AI, AO ^[255]
	<i>Persea americana</i> Mill.	Le(Dec) ^[66]	LL ^[66]
	<i>Persea gratissima</i> C.F.Gaertn.	Le(Dec) ^[7]	DI ^[256]
Lemnaceae (01)	<i>Lemanea fluviatilis</i> L.	Wp(Dec) ^[7]	AO ^[257]
Liliaceae (01)	<i>Scilla indica</i> Roxb.	Bl(NDF) ^[7]	DI ^[258]
Linderniaceae (01)	<i>Lindernia ruellioides</i> (Colsm.) Pennell.	Wp(Dec) ^[7]	NDF
Loganiaceae (01)	<i>Strychnos potatorum</i> L.f.	Se(Dec) ^[7]	AI ^[259] , AO ^[260] , DI ^[132]
Loranthaceae (01)	<i>Dendrophthoe falcata</i> (L.f.) Ettingsh.	Wp(Dec) ^[7]	AO, DI ^[261]
Lythraceae (03)	<i>Lawsonia inermis</i> L.	Ba / Ro(Dec) ^[7]	AG, AI, AO ^[262]
	<i>Punica granatum</i> L.	FrRn/ Se(Dec) ^[7]	AI, AO ^[263]
	<i>Rotala rotundifolia</i> (Buch.-Ham. ex Roxb.) Koehne.	Ap(Ju) ^[7]	NDF
Malvaceae (13)	<i>Abelmoschus moschatus</i> Medik.	Le(Dec) ^[264]	AO ^[265] , DI ^[9] , LL ^[66]
	<i>Abutilon indicum</i> (L.) Sweet.	Le(Ju) ^[7]	AG, AI, AO, DI ^[266]
	<i>Abutilon muticum</i> (Delile ex DC.) Sweet.	Le / Ro(Dec) ^[15]	
	<i>Alcea pterocarpa</i> (Fenzl) Boiss. *	Ro /Sh(Dec) ^[7]	
	<i>Alcea calvertii</i> (Boiss.) Boiss.	Wp(Dec) ^[7]	NDF
	<i>Alcea fasciculiflora</i> Zohary.	Ro(Dec) ^[7]	
	<i>Alcea flavovirens</i> (Boiss. & Buhse) Iljin.	Wp(Dec) ^[7]	
	<i>Alcea pallida</i> (Willd.) Waldst. & Kit.	Fl/ Se(Dec) ^[7]	
	<i>Althaea officinalis</i> L.	Le/ Ro(Inf) ^[7]	DM, DI, LT ^[267]
	<i>Hibiscus sabdariffa</i> L.	Le(Dec) ^[7]	AO ^[268]
	<i>Lavatera arborea</i> L.	Le(Inf) ^[269]	DI ^[269]
	<i>Malvella sherardiana</i> (L.) Jaub. & Spach.	Wp(Dec) ^[7]	
	<i>Sida rhombifolia</i> L.	Ro(Dec) ^[7]	NDF
Meliaceae (01)	<i>Melia azadirachta</i> L.	Le(Ju) ^[169]	DI, LT ^[169]
Menispermaceae (07)	<i>Chondrodendron tomentosum</i> Ruiz & Pav.	Ro(Dec) ^[7]	NDF
	<i>Cissampelos pareira</i> L.	Ro(Inf) ^[7]	AO, DI ^[270]
	<i>Cocculus hirsutus</i> (L.) W.Theob.	Ap(NDF) ^[7]	AO ^[271] , AS ^[272] , DI ^[132] , LT ^[272]
	<i>Cyclea peltata</i> (Lam.) Hook.f. & Thomson	Le(Ju) ^[7]	DI ^[273]
	<i>Tinospora cordifolia</i> (Willd.) Miers.	Le / St(Ju) ^[7]	AI, AO ^[274] , AI, AS ^[275] , LL ^[12]
Moraceae (02)	<i>Ficus carica</i> L.	Fr / La/ Le(Dec) ^[58]	AI, AO, AS ^[276] , LL ^[12]
	<i>Ficus palmata</i> Forssk.	Fr(NDF) ^[7]	AO ^[277]
Moringaceae (01)	<i>Moringa oleifera</i> Lam.	Fl /Le/Ro/Se (Dec) ^[278]	AG, AI, AO, AS ^[278] , DI ^[279] , LL ^[19]
Musaceae (03)	<i>Ensete superbum</i> (Roxb.) Cheesman.	Ro(Ju); Se(Pw) ^[7]	NDF
	<i>Musa balbisiana</i> Colla.	Ro(Dec) ^[7]	AI ^[280]
	<i>Musa × paradisiaca</i> L.	Fl /Le/Ro/ St(Dec) ^[7]	DI ^[9]
Myrtaceae (04)	<i>Leptospermum amboinense</i> Reinw. ex Blume.	Ap(NDF) ^[7]	
	<i>Leptospermum scoparium</i> J.R.Forst. & G.Forst.	Ap(NDF) ^[7]	NDF
	<i>Myrtus communis</i> L.	Se(Dec) ^[7]	AG, AI, AO, DI ^[281]
	<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry.	Fl Bd(Pw) ^[7]	AG, AI, AO ^[282]
Nyctaginaceae (01)	<i>Boerhavia diffusa</i> L.	Ro(Dec) ^[283]	ACE-I ^[284] , AI, AS ^[283] , AO ^[285] , DI ^[283] , LL ^[12]
Oleaceae (03)	<i>Fraxinus excelsior</i> L.	Le(NDF) ^[90]	DI, LL ^[90]
	<i>Olea europaea</i> L.	Ba / Le (Dec) ^[7]	ACE-I, AG, AI, AO ^[286] , AS ^[71] , LT ^[75]
	<i>Phillyrea latifolia</i> L.	Fr(NDF) ^[7]	AI, DI ^[287]
Onagraceae (01)	<i>Ludwigia perennis</i> L.	Wp(Dec) ^[7]	AG ^[288]
Orchidaceae (01)	<i>Dactylorhiza umbrosa</i> (Kar. & Kir.) Nevski.	Tu(Dec) ^[7]	NDF
Oxalidaceae(04)	<i>Averrhoa carambola</i> L.	Fr(NDF) ^[7]	AG, AI, AO, DI ^[289] , LT ^[34]
	<i>Biophytum reinwardtii</i> (Zucc.) Klotzsch.	Ro(Dec) ^[7]	AG, AI, AO ^[290]
	<i>Biophytum sensitivum</i> (L.) DC.	Ro(Dec) ^[7]	AI, AO ^[291] , LL ^[292]
	<i>Oxalis corniculata</i> L.	Le(Dec) ^[7]	AG, AI, AO, DI ^[293]
Paeoniaceae (01)	<i>Paeonia officinalis</i> L.	Fr(NDF) ^[7]	NDF
Papaveraceae (01)	<i>Fumaria officinalis</i> L.	Wp(Inf) ^[80]	DI, LL ^[80]
Papilionoideae (01)	<i>Derris trifoliata</i> Lour.	Ap(NDF) ^[7]	DI ^[9]
Parmeliaceae (01)	<i>Parmelia perlata</i> (Huds.) Ach.*	Wp(Pw) ^[294]	AT, AI, DI, LT ^[159]
Pedaliaceae(01)	<i>Pedaliium murex</i> L.	Fr(NDF) ^[267]	AO ^[295] , LT ^[267]
Phyllanthaceae(06)	<i>Phyllanthus emblica</i> L.	Fr(Ju) ^[7]	AG, AI, AO, AS ^[296]
	<i>Phyllanthus fraternus</i> G.L.Webster.	Wp(Dec/ Inf) ^[7]	DI ^[9]
	<i>Phyllanthus lanceolatus</i> Poir.	Le / St(Dec) ^[7]	NDF

	<i>Phyllanthus niruri</i> L.	Le / Wp(Dec) ^[7]	ACE-I ^[284] , AG, AI, AS, DI ^[297] , LL ^[66] , LT ^[298-300]
	<i>Phyllanthus urinaria</i> L.	Wp(Dec) ^[7]	AO, DI ^[301]
	<i>Physalis alkekengi</i> L.	Fr(Dec) ^[7]	AO ^[302] , DI ^[303]
Pinaceae (05)	<i>Cedrus deodara</i> (Roxb. ex D.Don) G. Don.	Wd / La(NDF) ^[7]	AG, AI, AO, DI, LT ^[304]
	<i>Picea mariana</i> (Mill.) Britton, Sterns & Poggenb.	Ba(Dec) ^[7]	AI, AO ^[305]
	<i>Picea smithiana</i> (Wall.) Boiss.	Le(Dec) ^[7]	AO ^[306]
	<i>Pinus brutia</i> Ten.	Fr(NDF) ^[66]	LL ^[66]
	<i>Pinus eldarica</i> Medw.	Fr(NDF) ^[7]	LL ^[307]
Piperaceae(05)	<i>Peperomia pellucida</i> (L.) Kunth	Le(Dec/ Inf) ^[7]	AG, AI, DI ^[308] , AO ^[309]
	<i>Piper aduncum</i> L.	Le(Dec / Inf) ^[7]	NDF
	<i>Piper cubeba</i> L.f.	Fr(NDF) ^[7]	AO ^[310]
	<i>Piper longum</i> L.	Fr/ Le (Dec) ^[7]	AG, AI, AO ^[311] , DI ^[267]
	<i>Piper nigrum</i> L.	Fr(Dec) ^[7]	AG, AI, AS ^[312]
Plantaginaceae(03)	<i>Plantago coronopus</i> L.	Wp(Inf) ^[80]	DI, LL ^[80]
	<i>Plantago lanceolata</i> L.	Le(Inf) ^[7]	AI ^[313]
	<i>Plantago major</i> L.	Ro(Dec) ^[7]	AG, AI, AO, DM, LL ^[314]
Platanaceae(01)	<i>Platanus orientalis</i> L.	Fr(Inf) ^[7]	AG, AI ^[315]
Poaceae(16)	<i>Agropyron repens</i> (L.) P.Beauv.	Ri(Dec) ^[267]	DM, DI ^[267] , LT ^[31]
	<i>Bambusa nutans</i> Wall. ex Munro	Sh(Dec) ^[7]	AG, AI, AO, AS, DI ^[316]
	<i>Coix lacryma-jobi</i> L.	Ro(Dec) ^[7]	NDF
	<i>Cymbopogon citratus</i> (DC.) Stapf.	Wg(Dec) ^[7]	AG, AI, AO ^[317]
	<i>Cymbopogon schoenanthus</i> (L.) Spreng.	Fl(NDF) ^[7]	DI, LL ^[318]
	<i>Cynodon dactylon</i> (L.) Pers.	Ri(Dec) ^[319]	AG, AI, AO, DI, LL ^[319]
	<i>Hordeum vulgare</i> L.	Se(Dec/Inf) ^[7]	AI, DI ^[320] , AO ^[321] , DM ^[321]
	<i>Hyparrhenia hirta</i> (L.) Stapf.	Ap(Inf) ^[80]	DI, LL ^[80]
	<i>Lolium perenne</i> L.	Ap(NDF) ^[7]	NDF
	<i>Maydis stigma</i> L.(corn silk)*	Zmh(Dec/ Inf) ^[58, 80]	AI, AO, DM, DI ^[322] , LL ^[1]
	<i>Panicum miliaceum</i> L.	Fl(Dec) ^[7]	NDF
	<i>Phragmites australis</i> (Cav.) Trin. ex Steud.	Ro(Dec) ^[169]	DI, LT ^[169]
	<i>Saccharum officinarum</i> L.	Ro(Dec) ^[7]	DI ^[323]
	<i>Saccharum spontaneum</i> L.	Ro(Dec) ^[7]	DI, DM, LT ^[324]
	<i>Triticum aestivum</i> L.	wheat bran ^[66]	LL ^[66]
		<i>Vetiveria zizanioides</i> (L.) Nash.	Ro(Dec) ^[7]
Polygonaceae(07)	<i>Emex spinosa</i> (L.) Campd.	Le(Dec) ^[7]	AS,DI ^[325]
	<i>Polygonum aviculare</i> L.	Wp(Dec) ^[80]	AI, AO ^[326] , DI, LL ^[80]
	<i>Polygonum cognatum</i> Meisn.	Le(Dec) ^[7]	AO, DI ^[327]
	<i>Rheum emodi</i> Wall.	Ro(Dec) ^[7]	AO, DI ^[328]
	<i>Rumex acetosa</i> L.	Ro(Dec) ^[7]	AO, DI ^[85]
	<i>Rumex acetosella</i> L.	Ro(Dec) ^[7]	NDF
	<i>Rumex hastatus</i> D. Don	Ro(Dec)	NDF
Portulacaceae (01)	<i>Portulaca oleracea</i> L.	Le(Dec) ^[58]	AI, AO ^[329] , DI ^[132] , LL ^[58]
Primulaceae (01)	<i>Primula veris</i> L.	Wp(Dec) ^[7]	AO ^[330]
Pteridaceae (01)	<i>Adiantum capillus-veneris</i> L.	Le(Inf/ Ju) ^[7]	AG, AI, LT, AO ^[331]
Ranunculaceae (02)	<i>Aquilegia fragrans</i> Benth.	Ro(NDF) ^[7]	AI ^[332]
	<i>Nigella sativa</i> L.	Fr/ Se(Inf) ^[7]	AG, AI, AO, DI ^[333]
Rhamnaceae (03)	<i>Paliurus spina-christi</i> Mill.	Fr(Dec) ^[7]	NDF
	<i>Sageretia brandrethiana</i> Aitch.	Ro(Dec) ^[7]	NDF
	<i>Ziziphus lotus</i> (L.) Lam.	Ba / Ro(Inf) ^[7]	Ag, AI ^[334] , AS ^[335]
Rosaceae (19)	<i>Agrimonia eupatoria</i> L.	Se(NDF) ^[336, 337]	AO, AT, DI ^[336, 337]
	<i>Prunus amygdalus</i> var. <i>amara</i> (DC.) Focke.	oil ^[7]	AO ^[338]
	<i>Cerasus avium</i> (L.) Moench.	Wp(Dec) ^[7]	DI ^[339]
	<i>Cerasus mahaleb</i> (L.) Mill.	Se(Inf) ^[7]	NDF
	<i>Crataegus aronia</i> (L.) Bosc ex DC.	Le(Dec) ^[37]	AO ^[340] , DI, LL ^[37]
	<i>Crataegus azarolus</i> L.	oleo gum resin ^[7]	AO ^[341]
	<i>Crataegus monogyna</i> Jacq.	Ap(Inf) ^[7]	AI ^[342]
	<i>Crataegus pentagyna</i> Waldst. & Kit. ex Willd.	Ap(Inf) ^[7]	AO ^[343]
	<i>Duchesnea indica</i> (Jacks.) Focke.	Wp(Dec) ^[7]	AI, AO ^[344]
	<i>Eriobotrya japonica</i> (Thunb.) Lindl.	Le(Dec) ^[58]	AG, AI ^[345] , LL ^[58]
	<i>Filipendula vulgaris</i> Moench.	Ro(Dec) ^[144]	LT ^[144]
	<i>Fragaria nilgerrensis</i> Schltdl. ex J.Gay	Wp(Dec) ^[7]	NDF
	<i>Prunus avium</i> (L.) L.	Fr(NDF) ^[75]	AO ^[346] , DI ^[75]
	<i>Prunus cerasus</i> L.	Ch(NDF) ^[75]	AO ^[347] , DI, LT ^[75]
	<i>Rosa canina</i> L.	Fr / Le(Dec / Inf) ^[7]	AG, AI, AO, DI ^[348]
	<i>Rosa indica</i> L.	Fl / Bd ^[7]	AG ^[349]
	<i>Rubus caesius</i> L.	Le / Ro(Dec/Inf) ^[7]	NDF
	<i>Rubus ellipticus</i> Sm.	Fr(NDF) ^[7]	AG, AO ^[350]
	<i>Rubus fruticosus</i> Lour.	Fr / Fl / Ro(NDF) ^[7]	NDF

	<i>Rubus sanctus</i> Schreb.	Ro(Dec) ^[7]	AG, AO, AI, LL ^[351]	
Rubiaceae (13)	<i>Coffea arabica</i> L.	SeHuBv ^[7]	AG, AO, DI ^[352]	
	<i>Galium aparine</i> L.	Wp(Dec) ^[7]	NDF	
	<i>Galium verum</i> L.	Wp(Dec) ^[7]		
	<i>Hamelia patens</i> Jacq.	Ro(Dec) ^[7]	AI, AO ^[353] , DI ^[354]	
	<i>Morinda citrifolia</i> L.	Fr(Ju) ^[355]	DI ^[9]	
	<i>Neolamarckia cadamba</i> (Roxb.) Bosser.	Ba /Fr(Dec) ^[7]	AG, AI ^[356] , DI ^[357] , LL ^[66]	
	<i>Oldenlandia herbacea</i> (L.) Roxb.	Wp(Dec) ^[7]	AO ^[358]	
	<i>Paederia foetida</i> L.	Le(NDF) ^[7]	AG ^[359]	
	<i>Rubia cordifolia</i> L.	Ro(Dec) ^[7]	AI, AO, DI ^[360]	
	<i>Rubia manjith</i> Roxb. ex Fleming.		NDF	
	<i>Rubia tinctorum</i> L.			
		<i>Spermaceoce hispida</i> L.	Le(NDF) ^[75]	AG, AI, AO ^[361] , LT ^[75]
	Rutaceae (06)	<i>Aegle marmelos</i> (L.) Corrêa.	Le/Fr (NDF) ^[12]	AO, DI ^[362] , LL ^[12]
<i>Citrus aurantiifolia</i> (Christm.) Swingle.		Fr(NDF) ^[7]	AO, DI ^[363]	
<i>Citrus latipes</i> (Swingle) Yu.Tanaka.		Fr(Inf) ^[7]	NDF	
<i>Citrus limon</i> (L.) Osbeck.		Fr(Ju) ^[7]	AG ^[364] , AO ^[365] , DM, DI ^[364]	
<i>Citrus sinensis</i> (L.) Osbeck.		Fr(NDF) ^[7]	AI, AO ^[366]	
<i>Ruta graveolens</i> L.		Le(NDF) ^[7]	DI ^[9]	
Salicaceae (01)	<i>Populus alba</i> L.	Ba/ Le (Inf) ^[367]	AI, DI ^[368, 369]	
Santalaceae (01)	<i>Santalum album</i> L.	sandalwood ^[75]	AI, AO ^[370] , DI ^[75]	
Sapotaceae (03)	<i>Manilkara zapota</i> (L.) P.Royen.	Fr(RE);Se(Dec) ^[7]	AG, AI, AO ^[371]	
	<i>Mimusops elengi</i> L.	Ba(Dec) ^[7]	DI ^[9] , LL ^[66]	
	<i>Pouteria sapota</i> (Jacq.) H.E.Moore & Stearn.	Se(NDF) ^[7]	NDF	
Saxifragaceae (04)	<i>Bergenia ciliata</i> (Haw.) Sternb.	Ro(Dec) ^[7]	AI, AO ^[372]	
	<i>Bergenia ligulata</i> Engl.	Ri(Dec) ^[7]	AO ^[373] , AT, DI ^[12] , LT ^[373]	
	<i>Bergenia stracheyi</i> (Hook.f. & Thomson) Engl.		NDF	
Scrophulariaceae (06)	<i>Bonnaya brachiata</i> Link & Otto.	Wp(Dec) ^[7]	AG, AI, AO ^[374]	
	<i>Bonnaya reptans</i> (Roxb.) Spreng.		LT ^[139]	
	<i>Buddleja polystachya</i> Fresen.		AI ^[375] , AS ^[376]	
	<i>Scoparia dulcis</i> L.	Ro(Inf) ^[58]	LL ^[58]	
	<i>Verbascum thapsus</i> L.	Ap(Dec) ^[7]	AO ^[377]	
	<i>Veronica orientalis</i> Mill.	Wp(Inf) ^[7]	AO ^[378]	
Simaroubaceae (01)	<i>Quassia amara</i> L.	Wd(Inf) ^[7]	NDF	
Smilacaceae (02)	<i>Smilax aspera</i> L.	Le/ Ro (Inf) ^[7]	DI ^[80]	
	<i>Smilax lanceifolia</i> Roxb.	Ri(Dec) ^[7]	AG ^[379]	
Solanaceae (09)	<i>Physalis alkekengi</i> L.	Fr ^[169]	DI, LT ^[169]	
	<i>Solanum anguivi</i> Lam.	Ro(Dec) ^[7]	LL ^[66]	
	<i>Solanum incanum</i> L.	Ro(Dec) ^[7]	AG ^[380]	
	<i>Solanum nigrum</i> L.	Se/ Wp(Dec) ^[7]	AI, DI ^[381]	
	<i>Solanum surattense</i> Burm. f.	Ro(Dec) ^[7]	DI ^[9]	
	<i>Solanum torvum</i> Sw.	Fr / Se(Dec) ^[7]	AG, AI, AO ^[382]	
	<i>Solidago virgaurea</i> L.	Fl / Le(NDF) ^[7]	DI, LT ^[383]	
	<i>Solanum virginianum</i> L.	Ro(Dec) ^[7]	NDF	
	<i>Withania somnifera</i> (L.) Dunal.	Wp(Dec) ^[7]	AG, AI, AO, DI ^[384]	
Tamaricaceae (01)	<i>Tamarix aphylla</i> (L.) H. Karst.	Le(NDF) ^[7]	NDF	
Theaceae (01)	<i>Anneslea fragrans</i> Wall.	Le(Dec) ^[7]		
Tropaeolaceae (01)	<i>Tropaeolum tuberosum</i> Ruiz & Pav.	Ro(Dec) ^[7]		
Typhaceae (01)	<i>Typha latifolia</i> L.	Le(NDF) ^[7]		
Ulmaceae(02)	<i>Ulmus parvifolia</i> Jacq.	Le(NDF) ^[169]	LT ^[169]	
	<i>Ulmus pumila</i> L.			
Urticaceae (05)	<i>Forsskaolea angustifolia</i> Retz.	Wp(Inf) ^[80]	DI, LL ^[80]	
	<i>Forsskaolea tenacissima</i> L.	Le(Dec) ^[7]	AO ^[385]	
	<i>Urtica dioica</i> L.	Le /Se (Dec) ^[59]	AG, AO ^[386] , DI ^[59]	
	<i>Urtica morifolia</i> Poir.	Le(Dec) ^[80]	DI, LL ^[80]	
	<i>Urtica pilulifera</i> L.	Le(RE) ^[7]	AI, AT, DI ^[387]	
Valerianaceae (02)	<i>Valeriana officinalis</i> L.	Ro(Dec) ^[7]	AO ^[85]	
	<i>Valeriana wallichii</i> DC.	Ro(Dec) ^[7]	AO, AS ^[388]	
Verbenaceae (06)	<i>Clerodendrum serratum</i> (L.) Moon.	Ro(Dec) ^[7]	AG, AI, AO ^[389]	
	<i>Phyla nodiflora</i> (L.) Greene.	Wp(Dec) ^[66]	LL ^[66]	
	<i>Stachytarpheta indica</i> (L.) Vahl.	Le(Ju) ^[7]	NDF	
	<i>Verbena officinalis</i> L.	Ap(Dec) ^[7]	AO ^[377]	
	<i>Vitex agnus-castus</i> L.	Se(Dec) ^[7]	AO ^[390]	
	<i>Vitex negundo</i> L.	Ro(Dec) ^[7]	AG, AI, AO ^[391]	
Vitaceae (03)	<i>Cissus adnata</i> Roxb.	Le(Dec) ^[7]	AO, DI, LL ^[392]	
	<i>Cissus gongylodes</i> (Baker) Burch. ex Baker.	Le(NDF) ^[7]	NDF	
	<i>Vitis vinifera</i> L.	Fr(Ju) ^[7]	AI, AO ^[393]	
Xanthorrhoeaceae (01)	<i>Asphodelus tenuifolius</i> Cav.	Le(Dec) ^[7]	AO ^[394] , LL ^[19]	

Zingiberaceae (04)	<i>Elettaria cardamomum</i> (L.) Maton.	Fr(Inf) ^[7]	AO ^[97] , DI ^[395]
	<i>Hedychium aurantiacum</i> Roscoe.	St(NDF) ^[7]	NDF
	<i>Hedychium coronarium</i> J.Koenig.	Ri(Inf) ^[7]	AG, AI, AO, LL ^[396]
	<i>Zingiber officinale</i> Roscoe.	Ri(Dec) ^[7]	AG, AI, AO ^[71] , AO ^[397] , AS ^[71] , LL ^[398]
Zygophyllaceae (03)	<i>Larrea tridentata</i> (Sessé & Moc. ex DC.) Coville.	Le(Dec) ^[7]	NDF
	<i>Peganum harmala</i> L.	Fr(Inf) ^[7]	AO ^[399]
	<i>Tribulus terrestris</i> L.	Fr/ Le / Se / Ro(Dec / Inf) ^[7]	AG, AI, AO, DI, LL ^[400]

Keys: AG= analgesic; AI= antiinflammatory; AO= antioxidant; Ap= Aerial part; AS= antispasmodic; AT= astringent; Ba= Bark; Bd= buds; BI= Bulb; Br= berries; Ch= Cherry; Cn= cone; Dec= decoction; DI= diuretic; DM= demulcent; Ex= extract; Fe= Fresh; Fl= Flower; Fr= Fruit; Inf= infusion; Ju= Juice; La= Latex; Le= Leaf; LL= litholytic; LT= lithotriptic; NDF= No data found; PLA₂-I= Phospholipase A₂ inhibition; PcVn= pickled in vinegar; Pw= powder mix with water; RE= raw eaten; Rn= rind; Ri= rhizome; Ro= root; Se= seed; SeHuBv= seed husk beverage; Sh=shoots; St= stem; Tu= tuber; Wd= wood; Wg=whole grass; Wp= whole plant; Zmh= *Zea mays* hairs; *= plants not found in the electronic database The Plant List - a working list of all plant species created by Royal Botanical Gardens, Kew and Missouri Botanical Garden

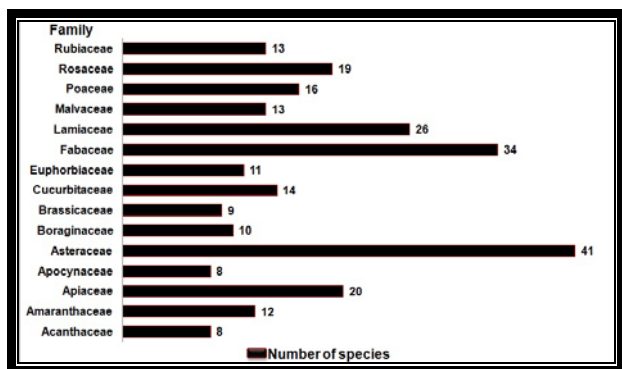


Fig 1: The fifteen families with highest number of cited species.

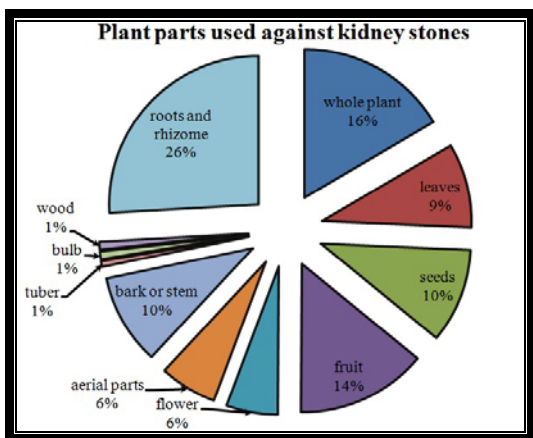


Fig 2: Percentage contribution of plant parts used against urolithiasis.

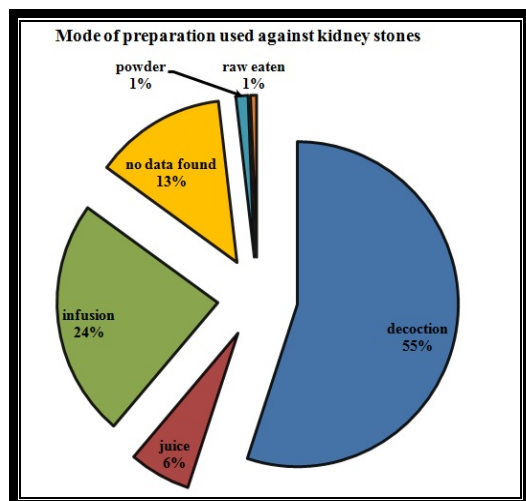


Fig 3: Percentage contribution of mode of preparations used against urolithiasis

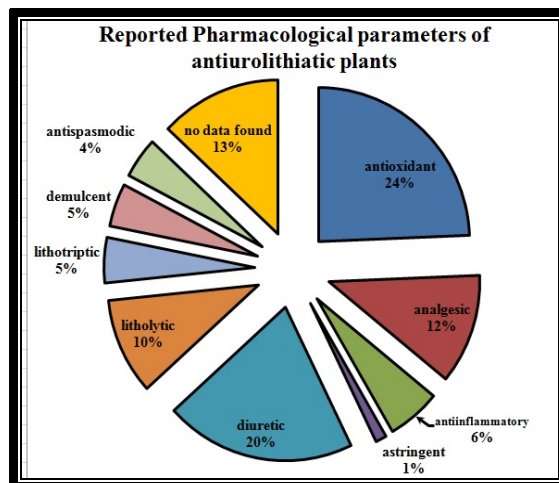


Fig 4: Percent reported pharmacological parameters of antiurolithiatic plants.

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