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Exploring globally used antiurolithiatic plants of A to L families: Asteraceae, Fabaceae and Lamiaceae revisited

Salman Ahmed, Imran Ahsan Mallick and Muhammad Mohtasheemul Hasan

Abstract
Urolithiasis is a common worldwide problem with high recurrence. This review covers forty four (44) families starting from alphabet A to L and includes Bignoniaceae (05); Araceae, Burseraceae, Combretaceae (04); Annonaceae, Berberidaceae, Betulaceae, Gentianaceae, Gesneriaceae (03); Aizoaceae, Adiantaceae, Alismataceae, Aristolochiaceae, Asclepiadaceae, Bombacaceae, Cannabaceae, Cyperaceae, Geraniaceae and Iridaceae (02); Acoraceae, Adoxaceae, Armatellaceae, Aquifoliaceae, Araliaceae, Averrhoeaceae, Basellaceae, Begoniaceae, Bromeliaceae, Cactaceae, Calophyllaceae, Campanulaceae, Caprifoliaceae, Caricaceae, Celastraceae, Clusiaceae, Dracaenaceae, Dryopteridaceae, Elaeagnaceae, Grossulariaceae, Hyacinthaceae, Hydrangeaceae, Hypoxidaceae, llecebraceae and Juglandaceae (01) plant used globally in different countries. The plants of three families Asteraceae, Fabaceae and Lamiaceae are revisited to provide updated information. This review will not only be useful for the general public but also attract the scientific world for antiurolithiatic drug discovery.

Keywords: Urolithiasis, antiurolithiatic, natural products, drug development.

Introduction
Urolithiasis is a common worldwide problem with high recurrence. Medicinal plants have been used in different countries and cultures for not only prophylactic management but also for treatment. Present paper is one of the parts of our study entitled "Searching globally used antiurolithiatic plants belonging to different families". The plants of the ninety three (93) families including Acanthaceae, Amaranthaceae, Amaryllidaceae, Anacardiaceae, Apiaceae, Apocynaceae, Arecaceae, Asparagaceae, Aspleniaceae, Asteraceae, Boraginaceae, Brassicaceae, Caesalpiniaceae, Capparidaceae, Caryophyllaceae, Chenopodiaceae, Convolvulaceae, Costaceae, Cucurbitaceae, Cupressaceae, Ebenaceae, Equisetaceae, Ericaceae, Euphorbiaceae, Fabaceae, Fagaceae, Hypericaceae, Lamiaceae, Lauraceae, Liliaceae, Lythraceae, Magnoliaceae, Malpighiaceae, Malvaceae, Meliaceae, Menispermaceae, Molluginaceae, Moraceae, Moringaceae, Musaceae, Myoporaceae, Myrtaceae, Nyctaginaceae, Oleaceae, Onagraceae, Orchidaceae, Oxalidaceae, Paeoniaceae, Papaveraceae, Parmeliaceae, Parnassiaceae, Pedaliaceae, Periplocaceae, Phyllanthaceae, Pinaceae, Piperaceae, Plantaginaceae, Platanaceae, Poaceae, Polygalaceae, Polygonaceae, Polypodiaceae, Portulacaceae, Primulaceae, Punicaceae, Ranunculaceae, Rhamnaceae, Rosaceae, Rubiaceae, Rutaceae, Salicaceae, Salvadoraceae, Santalaceae, Sapotaceae, Saxifragaceae, Scrophulariaceae, Simaroubaceae, Smilacaceae, Solanaceae, Tamaricaceae, Theaceae, Tiliaceae, Tropaeolaceae, Typhaceae, Ulmaceae, Urticaceae, Valerianaceae, Verbenaceae, Violaceae, Vitaceae, Xanthorrhoeaceae, Zingiberaceae and Zygophyllaceae [1-10] have already been discussed. The present review article covers forty four families starting from alphabet A to L. The medicinal plants of these families used against urolithiasis in different countries including Albania, Algeria, America, Bangladesh, Bosnia, Herzegovina, Brazil, Canada, Chile, China, Cyprus, Eastern Albania, India, Iran, Italy, Kyrgyzstan, Mexico, Pakistan, Palestine, Peru, Romania, Saudi Arabia, Thailand, Trinidad, Tunisia, Turkey, Uzbekistan and Vietnam. The plants of three families Asteraceae [3], Fabaceae [5] and Lamiaceae [7] against urolithiasis have already been discussed and now are revisited to provide updated information (Table-2). Their historical antiurolithiatc background have also been shared in well known books of Dioscorides (De Materia Medica), Pliny the Elder (Naturalis Historis), Ibn Sina (Al Qanoon Fit Tibb), Al Razi / Rhazes (Al-Hawi fi al-Tibb) and Al-Baitar (Kitāb al-Jāmiʿ li-Mufradāt Al Advia Wal Aghdia). The summarized information is presented in Table-1 and 2.

Abbreviations Used

h. = hour.
OD = once daily.
QID = four times a day.
tbsp. = table spoon.
TID = three times a day.
tsp. = tea spoon.
Days = days required to dissolve / expel kidney stones.
Before breakfast = every morning in empty stomach.
Brushite = Calcium hydrogen phosphate dihydrate.
Whewellite: Calcium oxalate monohydrate.
MSUM: Mono sodium urate monohydrate.

Table 1: Antiurolithiatic plants of different families (A-L).

Plants	Explanation
Acoraceae (01)	
Acorus calamus L.	Ibn Sina (Al Qanoon Fit Tibb): Roots are diuretic [11].
	Roots decoction--- Iran [12].
	Pharmacological activities: Roots possess antioxidant and litholytic properties [13, 14].
Adiantaceae (02)	
Adiantum capillus-veneris L.	Dioscorides (De Materia Medica): Whole plant is litholytic and used against dysuria; Ibn Sina (Al Qanoon Fit Tibb): Whole plant is litholytic and expels stones [11].
	Leaves infusion --- India [14], Iran, Turkey [12].
	Pharmacological activities: Leaves possess analgesic, anti-inflammatory, antioxidant [14], demulcent, diuretic, lithotriptic [15] and litholytic [16] properties.
	Antiurolithiatic spectrum (reported): Leaves against whewellite [17].
Adiantum venustum D. Don.	Leaves and rhizome decoction --- India [18].
	India: Leaves powder with luck water BD till stone expulsion [18].
Adoxaceae (01)	
Viburnum opulus L.	Fruits --- Turkey [19].
	Pharmacological activities: Fruits possess antioxidant, diuretic and lithotriptic [19].
	Antiurolithiatic spectrum (reported): Fruits against whewellite [19].
Aizoaceae (02)	
Trianthema portulacastrum L.	Leaves juice--- India, Pakistan [12].
	India: 250 ml of fresh leaf juice BD for 7 days [20].
	Pharmacological activities: Leaves possess analgesic, anti-inflammatory and diuretic properties [14, 21].
Zaleya pentandra (L.) C. Jeffrey.	Root decoction --- Pakistan [12].
Alismataceae (02)	
Alisma orientale (Sam.) Juz.	Root decoction --- Canada [20].
	Canada: 2 tsp. dried root, 10 oz. water, decoct 20 mins, steep 30 mins. 4 oz. TID till stone expulsion [20].
Alisma plantago-aquatica L.	Ibn Sina (Al Qanoon Fit Tibb): Whole plant decoction is useful in kidney stones [11].
	Plant decoction--- Iran [12].
	Pharmacological activities: Whole plant possesses diuretic properties [14].
Annonaceae (03)	
Annona squamosa L.	Antiurolithiatic spectrum (reported): Fruits against whewellite [22].
Malmea depressa (Baill) R.E. Fries.	Bark infusion --- Mexico [12].
Meiogyne minuta (G. Forst.) Less.	Whole plant infusion --- India [12].
Aristolochiaceae (02)	
Asarum europaeum L.	Dioscorides (De Materia Medica): Fruits are diuretic [11].
	Leaves --- India [23].
	Pharmacological activities: Antioxidant, anti-inflammatory, diuretic, lithotriptic [23].
	Antiurolithiatic spectrum (reported): Leaves against whewellite [23].
Aristolochia clementis Alain.	Al Razi / Rhazes (Al-Hawi fi al-Tibb): Whole plant expels stones [11].
Armatellaceae (01)	
Macaranga peltata (Roxb.) Müll. Arg.	Bark --- India [24].
Aquifoliaceae (01)	
Ilex aquifolium L.	Leaves decoction --- Eastern Albania [12].
	Pharmacological activities: Anti-inflammatory, antioxidant [14].
Araceae (04)	
Arum rupicola var. *detruncatum* Tzvelev.	Leaves infusion --- Turkey [12].
Colocasia esculenta (L.) Schott.	Rhizome juice --- India [20].
	India: 100 ml of rhizome juice OD for 5 days [20].
Dracunculus vulgaris Schott.	Dioscorides (De Materia Medica): Diuretic [11].
Typhonium giganteum Engl.	Whole plant --- Bangladesh [25].
	Pharmacological activities: Lithotriptic [25].
Araliaceae (01)	
Hedera helix L.	Aerial parts decoction --- Bosnia, Herzegovina [12] Italy, Tunisia [26].
Polyscias guilfoylei (W.Bull) L.H.Bailey	Leaves decoction---Indonesia [27].
Asclepiadaceae (02)	
Asclepias syriaca L.	Roots decoction --- America, Canada [12].
Leptadenia pyrotechnica (Forsk.) Dec.	Aerial parts infusion --- Algeria [28].
Averrhoeaceae (01)	

Averrhoa carambola L.	Fruit juice --- India [12].
	India: Mix 2.8 g silver element in 300 ml fruit juice. 125 ml OD for 5 days [20].
	Pharmacological activities: Lithotriptic [29].
	Antiurolithiatic spectrum (reported): Fruits against brushite and whewellite [22].
Basellaceae (01)	
Basella alba L.	Leaf extract --- India [20].
	India: 25 ml of leaf extract in early morning on empty stomach till stone expulsion [20].
	Antiurolithiatic spectrum (reported): Leaves against whewellite [30].
Berberidaceae (03)	
Berberis aristata DC.	Roots infusion before breakfast --- India [18].
Berberis brandisiana Ahrendt.	Roots and stem bark --- Pakistan [31].
Berberis integerrima Bunge.	Leaves decoction --- Uzbekistan, Kyrgyzstan [12]; fruits --- Iran [32].
	Pharmacological activities: Anti-inflammatory, antioxidant [14].
Berberis vulgaris L.	Root decoction --- Canada, India [20, 33].
	Canada: 1 tsp. dried root bark to 10 oz. water, decoct 10-15 mins, steep 30 mins. 4 oz. BD till stone expulsion [20].
	Pharmacological activities: Anti-inflammatory, antioxidant, litholytic [14] lithotriptic [29].
Begoniaceae (01)	
Begonia picta Smith.	Leaves and tuber --- India [18].
	India: Leaves decoction BD; powder of tuber BD before meal [18].
Betulaceae (03)	
Betula lenta L.	Leaves decoction --- America [12].
Betula pendula Roth.	Leaves / bark infusion --- Bosnia, Herzegovina [12].
	Pharmacological activities: Antioxidant [14].
Betula utilis D. Don.	Leaves infusion --- India [12].
	India: 50 ml leaves infusion TID till stone expulsion [20].
	Pharmacological activities: Anti-inflammatory, antioxidant [14].
Bignoniaceae (05)	
Arrabidaea brachypoda Bureau.	Roots--- Brazil [34]
Dolichandra unguis-cati (L.) L. G. Lohmann.	Aerial parts infusion or decoction --- Trinidad [35].
	Pharmacological activities: Diuretic [14].
Kigelia africana (Lam.) Benth.	Fruits --- India [36].
	Pharmacological activities: Lithotriptic [36].
	Antiurolithiatic spectrum (reported): Fruits against whewellite [22].
Kigelia pinnata (Jacq.) DC.	Fruit pickled in vinegar--- India [37].
	Antiurolithiatic spectrum (reported): Fruits against whewellite [37].
Stereospermum chelonoides (L.f.) DC.	Root powder with water or roots decoction --- India [38].
	India: 25 – 50 ml of root decoction OD [38].
Bombacaceae (02)	
Bombax ceiba L.	Bark or fruit powder --- India [12].
	India: Dried fruit powder OD in empty stomach till stone expulsion [20].
	Pharmacological activities: Analgesic, anti-inflammatory, antioxidant, litholytic [14].
	Antiurolithiatic spectrum (reported): Fruits against whewellite [39].
Ceiba pentandra (L.) Gaertn.	Antiurolithiatic spectrum (reported): Bark against MSUM [22].
Bromeliaceae (01)	
Ananas cosmosus (Linn.) Merr.	Fruit juice --- India [12].
	India: 25-30 ml fruit juice BD till stone expulsion [20].
	Pharmacological activities: Antioxidant, diuretic [14].
	Antiurolithiatic spectrum (reported): Fruits against brushite [22].
Burseraceae (04)	
Boswellia serrata Roxb. ex Colebr.	Antiurolithiatic spectrum (reported): Gum resin against MSUM [22].
Commiphora gileadensis (L.) C.Chr.	Dioscorides (De Materia Medica): Whole plant is diuretic and used against dysuria [11].
Commiphora mukul Engl.	Ibn Sina (Al Qanoon Fit Tibb): Gum is litholytic and expels stones [11].
	Gum --- Iran [12].
Commiphora wightii (Arn.) Bhandari.	Antiurolithiatic spectrum (reported): Fruit against struvite [22].
Cactaceae (01)	
Opuntia ficus-indica (L.) Mill.	Dry flower infusion --- Mexico [14].
	Pharmacological activities: Diuretic, litholytic [14].
Calophyllaceae (01)	
Mesua ferrea L.	Flowers --- India [29]
	Pharmacological activities: Lithotriptic [29].
Campanulaceae (01)	
Pratia nummularia (Lam.) A. Braun & Asch.	Whole plant --- India [12].
Cannabaceae (02)	
Cannabis sativa L.	Ibn Sina (Al Qanoon Fit Tibb): Fruits are litholytic and expel stones [11].
	Fruit --- Iran [12].
	Pharmacological activities: Analgesic, anti-inflammatory [14].
Celtis timorensis Span.	Leaves decoction --- India [12].

	India: Boil 10 g of leaves in 2 L of water. 250 ml BD for 10 days [20].
	Pharmacological activities: Lithotriptic [14].
Caprifoliaceae (01)	
Lonicera etrusca Santi.	Dioscorides (De Materia Medica): Flower / leaves are diuretic [11].
Caricaceae (01)	
Carica papaya L.	Roots decoction --- Bangladesh[25], India, Trinidad [12, 35] ; seeds powder taken orally --- Palestine [40].
	India: Boil 2–6 g of dried root in one L of water. 125 ml OD till stone expulsion [38]; Palestine: 10 g of seeds powder with water orally BD [40].
	Pharmacological activities: Lithotriptic [29].
	Antiurolithiatic spectrum (reported): Fruits against whewellite [41].
Celastraceae (01)	
Celastrus paniculatus Willd.	Leaves infusion --- India [12].
	India: Crush fresh leaves and mix with curd gives before breakfast and no intake except water up to 3pm. OD till stone expulsion [20].
	Pharmacological activities: Analgesic, anti-inflammatory, antioxidant, antispasmodic [14].
Clusiaceae (01)	
Garcinia pedunculata Roxb. ex Buch.-Ham.	Fruit juice --- India [38].
	India: 5–10 ml of fruit juice BD till stone expulsion [38].
Combretaceae (04)	
Anogeissus latifolia (Roxb. ex DC.) Wall. ex Guillem. & Perr.	Stem bark decoction --- India [38].
	India: 30 – 50 ml stem bark decoction BD [38].
Terminalia arjuna (Roxb.) Wt. & Arn.	Bark infusion --- India [12].
	Pharmacological activities: Analgesic, anti-inflammatory, antioxidant [14] lithotriptic [29].
	Antiurolithiatic spectrum (reported): Bark plant against brushite and whewellite [42].
Terminalia bellirica (Gaertn.) Roxb.	Fruits ---India [43].
	Pharmacological activities: Lithotriptic [43].
	Antiurolithiatic spectrum (reported): Fruits against whewellite [43].
Terminalia catappa L.	Roots --- India [38].
Terminalia chebula Retz.	Bark infusion / fruits extract --- India [38].
	Pharmacological activities: Lithotriptic [44].
	Antiurolithiatic spectrum (reported): Fruits against whewellite [22].
Cyperaceae (02)	
Cyperus longus L.	Aerial parts decoction --- Turkey [12].
	Turkey: A pinch of herb is decocted and 250 ml is taken on an empty stomach [45].
	Pharmacological activities: antioxidant, diuretic [14].
Cyperus rotundus L.	Dioscorides (De Materia Medica): Roots / rhizome are diuretic and litholytic [11]; Ibn Sina (Al Qanoon Fit Tibb): Fruits / roots are litholytic and expel stones [11].
	Rhizome decoction --- Iran [12]; tuber decoction --- India [46]
	Pharmacological activities: analgesic, anti-inflammatory, antioxidant, antispasmodic, diuretic, litholytic [14].
Dracaenaceae (01)	
Dracaena angustifolia (Medik.) Roxb.	Tuber --- Vietnam [47].
Dryopteridaceae (01)	
Dryopteris cochleata (D. Don) C. Chr.	Aerial parts --- India [18].
Elaeagnaceae(01)	
Elaeagnus angustifolia L.	Barks decoction --- Turkey [48]; fruits decoction--- Turkey [49, 50].
	Turkey: 125 ml of bark decoction BD for 20 days [48]; 125 ml of fruits decoction BD for 15 days [50].
Gentianaceae (03)	
Centaurium erythraea Rafn.	Aerial parts --- Albania [51].
Enicostema axillare (Lam.) A. Raynal.	Leaves infusion --- India [12].
	Pharmacological activities: Antioxidant [14].
Swertia chirata Buch.-Ham. ex Wall.	Stems --- India [29].
	Pharmacological activities: Lithotriptic [29].
	Antiurolithiatic spectrum (reported): Stems against whewellite [52].
Geraniaceae (02)	
Geranium robertianum L.	Aerial parts infusion--- Romania [53].
	Pharmacological activities: Diuretic [14].
Pelargonium graveolens L'Hér.	Stem or petiole/a 3-5 cm part that dipped in olive oil or suppository --- Turkey [54].
Gesneriaceae (03)	
Corallodiscus lanuginosus (Wall. ex DC.) B.L. Burtt.	Leaves infusion --- India [12].
Didymocarpus pedicellata R.Br.	Pharmacological activities: Antioxidant, diuretic, lithotriptic [14], lithotriptic [29].
	Antiurolithiatic spectrum (reported): Whole plant against whewellite [55].
Didymocarpus tomentosa Wight.	Plant decoction --- India [12].
	Pharmacological activities: Anti-inflammatory, antioxidant [14].
Grossulariaceae (01)	
Ribes triste Pall.	Root decoction --- China [56].

	Pharmacological activities: Lithotriptic [14].
Hyacinthaceae (01)	
Scilla indica Roxb.	Bulb --- Iran [12].
Hydrangeaceae (01)	
Hydrangea arborescens L.	Bark infusion --- Canada[20] ; roots decoction --- America [12].
	Canada: 1/2 - 1 tsp. dried bark in 8 oz. water, cover and keep for 1 h. 4 oz. TID till stone expulsion [20].
	Pharmacological activities: diuretic, lithotriptic [14].
Hypoxidaceae (01)	
Curculigo orchioides Gaertn.	Rhizome decoction --- India [12].
	India: 2tsp. of fresh rhizome decoction with 1tsp. of honey. OD for 30 days in empty stomach [20].
	Pharmacological activities: Antioxidant**,** diuretic [14], lithotriptic [29].
Iridaceae (02)	
Crocus sativus L	Dioscorides (De Materia Medica): Stigma is diuretic [11]; Pliny the Elder (Naturalis Historis): Stigma is diuretic [11].
	Pharmacological activities: Antioxidant [57], lithotriptic [58].
	Antiurolithiatic spectrum (reported): Stigma against whewellite [58].
Iris pseudacorus L.	Dioscorides (De Materia Medica): Rhizome is diuretic and used against strangury [11].
Illecebraceae (01)	
Paronychia argentea Lam.	Aerial parts decoction --- Jordan [12], Palestine [59].
	Jordan: Boil 150 g plant in one L of water. 150 ml TID till stone expulsion [20].
Juglandaceae (01)	
Juglans regia L.	Seed decoction --- China [56]; leaves decoction --- Spain [60].
	Pharmacological activities: Diuretic**,** litholytic [14].

Table 2: Antiurolithiatic plants of revisited families Asteraceae, Fabaceae and Lamiaceae.

Plants	Explanation
Asteraceae (87)	
Eighty (80) antiurolithiatic plants have already been discussed [3]. The same family was revisited and following seven (07) plants were found.	
Calendula arvensis M. Bieb.	Aerial parts decoction --- Italy, Tunisia [26].
Carduus acanthoides subsp. *acanthoides*	Aerial parts decoction --- Turkey [48].
	Turkey: 125 ml BD for 10 days [48].
Carduus nutans subsp. leiophyllus (Petrovič) Stoj. & Stef.	Aerial parts decoction --- Turkey [48]
	Turkey: 125 ml BD for 10 days [48].
Carthamus tinctorius L.	Fruit / leaves powder 2 – 4 g orally taken --- India [38].
	Antiurolithiatic spectrum (reported): Leaves against whewellite [61].
Centaurea hyalolepis Boiss.	Flowers infusion --- Cyprus [62].
Helianthus tuberosus L.	Flower or rhizome decoction 250 ml TID--- Turkey [63]
Onopordum sibthorpianum Boiss. & Heldr.	Capitulum infusion --- Turkey [64]
Taraxacum hybernum Steven.	Flowers / leaves raw eaten--- Chile [65].
	Pharmacological activities: Litholytic [14].
Tessaria integrifolia Ruiz & Pav.	Leaves decoction --- Peru [66].
Fabaceae (71)	
Sixty four (64) antiurolithiatic plants have already been discussed [5]. The same family was revisited and following seven (07) plants were found.	
Crotalaria albida Heyne ex Roth.	Roots decoction --- Thailand [12].
Crotalaria pallida Ait.	
Crotalaria sessiliflora L.	
Copaifera langsdorffii Desf.	Leaves ---Brazil [67].
	Antiurolithiatic spectrum (reported): Leaves against whewellite [67].
Derris trifoliata Lour.	Aerial parts --- India [12].
	Pharmacological activities: Diuretic [14].
Desmodium microphyllum (Thunb.) DC.	Whole plant decoction --- India [12].
	Pharmacological activities: Lithotriptic [29].
Spartium junceum L.	Leaves decoction--- Turkey [50]
	Turkey: 125 ml of leaves decoction with 1 tsp. honey TID before meals for 15 days [50]
Lamiaceae (58)	
Forty seven (47) antiurolithiatic plants have already been discussed [7]. The same family was revisited and following eleven (11) plants were found.	
Lavandula dentata L.	Flower infusion --- Saudi Arabia [68]
Lavandula stoechas L.	Leaves decoction --- Palestine [69]
Origanum majorana L.	Al-Baitar (Kitāb al-Jāmiʿ li-Mufradāt Al Advia Wal Aghdia): Flowered aerial parts are diuretic [70].
	Aerial parts --- Palestine [69]
Origanum vulgare subsp. *hirtum* (Link) Ietsw.	Al-Baitar (Kitāb al-Jāmiʿ li-Mufradāt Al Advia Wal Aghdia): Flowered aerial parts are diuretic [70].
	Aerial parts decoction--- Turkey [48]
	Turkey: 125 ml of aerial parts decoction BD for 7 – 8 days [48].

Rosmarinus officinalis L.	Al-Baitar (Kitāb al-Jāmiʿ li-Mufradāt Al Advia Wal Aghdia): Flowered aerial parts are diuretic [70].
Salvia officinalis L.	Al-Baitar (Kitāb al-Jāmiʿ li-Mufradāt Al Advia Wal Aghdia): Flowered aerial parts and leaves are diuretic [70].
Sideritis scardica Griseb.	Aerial parts decoction--- Turkey [48].
	Turkey: 125 ml of aerial parts decoction BD for 7 – 10 days [48].
Teucrium chamaedrys L.	Leaves decoction --- Turkey [48].
	Turkey: 125 ml of aerial parts decoction BD for 10 - 15 days [48].
Teucrium polium L.	Al-Baitar (Kitāb al-Jāmiʿ li-Mufradāt Al Advia Wal Aghdia): Flowered aerial parts are diuretic [70].
	Aerial parts infusion TID--- Jordan [71, 72].
Thymbra spicata L.	Aerial parts infusion --- Turkey [64].
Thymus longicaulis var. *subisophyllus* (Borbás) Jalas.	Aerial parts decoction --- Turkey [48].
	Turkey: 125 ml of aerial parts decoction BD for 7 - 14 days [48].
Vitex polygama Cham.	Leaves---Brazil [34].

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