A REVIEW ON MEDICINAL PLANTS USED AS DIURETICS FROM KARNATAKA STATE

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ABSTRACT
Medicinal herbs are the significant source for treatment of number of diseases, one such is Diuretics. Mono and poly-herbal preparations have been used as diuretics. According to estimate, more than 650 mono and poly-herbal preparations in the form of decoction, tincture, tablets and capsules are from more than 75 plants that are in clinical use. There exist a large number of studies which supports the diuretic effects of traditional herbal medicines. Herbal medicine have been the most commonly prescribed medications for diuretics. They inhibit electrolyte reabsorption from the lumen of the nephron, increasing osmolarity, enhancing water and electrolyte excretion. It is important to note that there is a delicate balance between dietary sodium intake and sodium loss. If the balance is compromised and there is a greater intake of sodium into the body, but not enough sodium removal, complications of fluid overload occur, such as oedema, pulmonary oedema or high blood pressure. When there is greater removal of sodium, but not enough sodium intake, complications of fluid depletion take place, such as renal failure or reduced output of blood from the heart. The ability to induce a negative fluid balance has made diuretics useful in the treatment of a variety of conditions, particularly in hypertension and oedematous states. This review gives information about few herbal plants which are used traditionally in Karnataka as diuretics. There are a large number of studies which supports the diuretic effects of traditional herbal medicines which is presented along with chemical constituents and other pharmacological action of the plants.

KEYWORDS: Medicinal plants, Diuretics, Karnataka, review.
1. INTRODUCTION
The Worldwide trend towards the utilization of natural plant remedies has created an enormous need for information about the properties and uses of the medicinal plant. The Indian Traditional Medicine like Ayurvedic, Siddha and Unani are predominantly based on the use of plant materials. Herbal drugs have gain importance and popularity in recent years because of their safety, efficacy and cost effectiveness.[1] A diuretic is any substance that promotes increased production of urine called diuresis which includes forced diuresis. Several categories of diuretics increase the excretion of water from bodies. Alternatively, anti-diuretic such as vasopressin, or anti-diuretic hormone reduces the excretion of water in urine.[2] Diuretics are the main drugs which increase the urine flow rate, sodium excretion and are used to adjust the volume and composition of body fluids in a variety of clinical situations. Drug induced diuresis is beneficial in many life-threatening disease conditions such as congestive heart failure, nephritic syndrome, cirrhosis, renal failure, hypertension, and pregnancy toxaemia. Most of the drugs have the adverse effects such as hyperkalemia, metabolic acidosis, fatigue, and weakness etc. Naturally occurring diuretics include caffeine in coffee, tea and cola, which inhibit Na+ reabsorption and alcohol in beer, wine inhibit secretion of ADH, although most of the diuretics proved to be very effective in promoting sodium excretion, all cause potassium loss and prompted the search for potassium sparing diuretic. Hence search for a new diuretic agent that retains therapeutic efficacy and yet devoid of potassium loss is justified. Many indigenous drugs have been claimed to have diuretic effect in Ayurvedic system.[3] Medicinal herbs are the significant source for the treatment of Diuretics. Mono and poly-herbal preparations have been used as diuretics. According to estimate, more than 650 mono and poly-herbal preparations in the form of decoction, tincture, tablets and capsules are from more than 75 plants that are in clinical use. This review gives information about few herbal plants which are used traditionally in Karnataka as diuretics. There are a large number of studies which supports the diuretic effects of traditional herbal medicines which is presented along with chemical constituents and other pharmacological action of the plants.

2. HERBAL PLANTS EXERTING DIURETIC ACTIVITIES FROM KARNATAKA

2.1 ABRUS PRECATORIUS
Abrus precatorius is one of the important herb commonly known as Indian liquorice belonging to family Fabaceae. It is distributed in various parts of Karnataka [Fig 1],
particularly in Bangalore, Belgaum, Bellary, Bijapur, Chickmangalore, Coorg, Hassan, Kolar, Mysore, Raichur, Shimoga and Tumkur.\[4\]

![Photo of Abrus precatorius](image)

**Fig1: Photo of Abrus precatorius**

### 2.1.1. CHEMICAL CONSTITUENTS of *A. precatorius*

The phytoconstituents which are isolated from different parts is given below:

- Abrol, abrasine, precol and precasine were isolated from the roots. Seeds are rich in several essential amino acids like serine, alanine, valine, choline and methyl ester.\[5\] Seeds contain Abrine, Abraline, Abrasine, Abricin, Abrin, Abrusgenic-acid, Abrusgenic-acid-methyl-ester, Abruslactone, Abrussic-acid, Anthocyanins, Calcium, Campesterol, Choline, Cycloartenol, Delphinidin, Gallic-acid, Glycyrrhizin, Hypaphorine, N, N-dimethyl-tryptophan, N,N-dimethyltryptophan-metho-cation-methyl-ester, P-coumaroylgalloyl glucodelphinidin, Pectin, Pentosans, Phosphorus, Picatorine, Polygalacturonic-acids, Precasine, Precatorine and Trigonelline.\[6,7\] Isoflavonoids and quinones viz., Abruquinones A, B, C, O, E, F and G are present in the root and abrusalactone A, abrusgenic acid and methyl abrusgenate in the aerial parts. Triterpenoids and saponins -Glycyrrhizin and oleanolic acid are found in the root and abrusosides A, B, C, O and E in the aerial parts. Abrus-saponins I and II, abrisapogenol, β-amyrin, squalene, abricin, abridin, cycloartenol, campesterol, cholesterol and β-Sitosterol have isolated from the seeds. Proteins-Abrins I, II and III, *A. precatorius* agglutinin (APA) I and (APA) II, Precatorine, trigonelline, choline and abrine are present in the seeds.\[6,7\]

### 2.1.2 DIURETIC ACTIVITY

The study was carried out in Sprague Dawley Wistar rats induced renal damage when orally administered alcohol (1.6 g/kg). The crude extract (200 mg/kg) in addition to alcohol for six weeks with normal feeds and water showed decrease significant elevation of potassium, sodium, creatinine and malondialdehyde in serum levels. Histological studies confirmed with...
structural alterations in renal tubules, glomerular infiltration when compared with chronic inflammatory cells induced renal damage by alcohol. Concurrent administration of same doses of alcohol and seed extract of *A. precatorius* resulted in a suppression of alcohol induced renal injury. Measurement of malondialdehyde level indicated that this effect is related to the attenuation of alcohol induced lipid peroxidation by the seed extract (p<0.05). It was concluded that seed extract of *A. precatorius* could protect the kidney against alcohol-induced parenchymal injury.\[8\]

2.2 CISSAMPELOS PAREIRA

*Cissampelos pareira* Linn. belongs to the family Menispermaceae is a sub-erect or climbing herb, known as ambastha or laghupatha in Indian traditional medicine. It is basically seen in certain regions of Karnataka [Fig 2] (Bangalore, Coorg, Chickmangalore, North Kanara, Shimoga and Tumkur).\[4\]

![Fig 2: Photo of Cissampelos pareira](image)

2.2.1. CHEMICAL CONSTITUENTS of *C.pareira*

The phytoconstituents which are isolated from different parts is given below:

Two novel tropoloisoquinoline alkaloids, Pareirubrines A and B, had been isolated as antileukemic substances from *C. pareira*, together with the same skeleton alkaloids, grandirubrine and isoimerubrine.\[9,10\] Pelosine, Deyamittin, Cissamine and cycleanine have been reported from the roots. Root was also reported to contain l-curine, menismine, pareirine and hayatinine. Chemical investigation on the roots from Kashmir, reported 0.33% of alkaloids, mainly hayatine and berberines, 0.2% essential oils, 3.4% fixed oils and a sterol. Tetrandrine has been reported from the roots. Dicentrine, dihydrodicentrine, cycleanine, insularine and isochoondrodendrine have been reported from roots of the plant growing in Ghana. It contains a number of alkaloids, especially bisbenzylisoquinoline alkaloids. The
rhizomes contain hayatine, hayatidine, d-4’’o-methylberberine, L-berberine, isochondrodendrine, dicentrine, dehydrodicentrine and insularine. The rhizomes and leaves contain cycloamine while cissampareine has been isolated from the whole plant.\textsuperscript{[11,12, 13]} A Chalcone dimer named Cissampleoflavone was proved to be 2-(4-hydroxy-3-methoxyphenyl)-7-(4-methoxyphenyl)-6- (2-hydroxy-4, 6-dimethoxybenzoyl)-furano [3, 2 g] benzopyran-4-one.\textsuperscript{[14]} Aerial parts of the plant contains polyphenolic compounds flavonoids and tannins.\textsuperscript{[15]}

2.2.2. DIURETIC ACTIVITY

The diuretic activity was studied in male rats after oral administration of 100 mg/kg and 200mg/kg BW of methanolic extract of \textit{C. pareira} and standard used was 20 mg/kg BW of furosemide\textsuperscript{[16]} which demonstrated significant activity.

2.3. CURCUMIS MELO

\textit{Curcumis melo} which is commonly known as musk melon belongs to family cucurbitaceae and is known as kharbuzah in Unani medicine. It is an annual climbing or creeping herb and mostly found in all the districts of Karnataka [Fig 3].\textsuperscript{[4]}

![Fig 3: Photo of Curcumis melo](image)

2.3.1 CHEMICAL CONSTITUENTS

The phytoconstituents which are isolated from different parts is given below:

Meloside A, meloside L and their caffeoyl ester have been isolated from leaves. $\alpha$-carotene, $\beta$-carotene, $\gamma$-carotene and three more carotenes were also isolated.\textsuperscript{[17,18]} Sulphur compounds (mostly thioesters) are responsible for the characteristic aroma of the fruits. Fruits contain ferulic, caffeic and chlorogenic acids. Fruit stalk contains cucurbitacin B and E.\textsuperscript{[17]} Fruit has urease, peptidase, protease and Vitamin A, B, C.\textsuperscript{[19]} Methyl-2-methylbutaoate-(2)-3 hexanal, 2hexanal and ethyl-2 methyl propane were identified as the primary odorants of musk melon.
The green notes of musk melon are because of 2- and 3-hexenal, 1, 8-cineol and-1, 5-octadien-3-one. Methanolic extract of *C. melo* fruit contains a saponin \((C_{40}H_{64}O_{16}, \text{mp, 158-59}^\circ \text{C})\) which is identified as stigmasta-7-16-25(26) triene-3-0-\(\beta\)-D-glucopyranosyl (15)-0-\(\beta\)-Dxylofuranoside. Presence of curcumin and leptodermin is also reported in the fruits. Myristic acid, phosphates, galactane, lysine, citrulline, histidine, tryptophane, cystine\(^{[19]}\) were isolated from seed oil. The seeds of melon contain multiflorenol, isomultiflorenol, 24-methylenecycloartenol, \(\alpha\) and \(\beta\) amyrin, teraxerol, lupeol, euphol, 24-methyl-25(27)-dehydrocycloartenol, 24-methylene-24dihydrolanosterol, 24-methylene-24-dihydroparkeol, tirucallol and cycloartenol.\(^{[18]}\) From seeds, Codisterol, 25(27)-dehydrooporiferasterol, avenasterol, clerosterol, isofucosterol, stigmasterol, campesterol, sitosterol, 25(27)-dehydrochondrillasterol, 24 \(\beta\) ethyl-25-(27)-dehydrolathosterol, 24 \(\beta\)-methylathosterol, spinasterol and 22dihydrosinasterol were isolated.\(^{[18]}\) Cucurbit seeds are promising substitutes for various nuts in milk beverages which is evidenced by the high enzyme activities of urease, lipase, lipoxygenase, trypsin inhibitors and low activity of \(\beta\)-amylase in musk melon. The seeds contain triterpenoid glucoside.\(^{[20]}\)

2.3.2. DIURETIC ACTIVITY

The diuretic effects of *C. melo* L. were demonstrated in albino rats. The ethanol extract extensively increased the urinary volume and chloride substance. Further extract of *C.melo* [400 mg/Kg] showed more diuretic effect than the standard furosemide.\(^{[27]}\)

2.4. ERYTHRINA VARIEGATA

*Erythrina variegata* [Fig 4] is a shrub with prickly stems, it is a wild growing forest plant in certain areas of Chickmangalore, Coorg, North Kanara and Shimoga) belonging to family Papilionaceae.\(^{[4]}\)

![Fig 4: Photo of Erythrina variegata](image)
2.4.1. CHEMICAL CONSTITUENTS

The phytoconstituents which are isolated from different parts is given below:

The bark and root of the plant showed the presence of carbohydrates, glycosides, proteins, volatile oils and tannins. The plant is a rich source of alkaloids (2.5%). Isoflavonoids are reported to be major phytocostituents in stem and bark. Seeds yield an alkaloid, fatty oil, and a glucoside. The alkaloid has properties identical to hypaphorine.\(^\text{[22]}\) Leaves and bark yielded a poisonous alkaloid, erythrine. Bark, leaves and seeds yield saponin. Hydrocyanic acid is found in the leaves, stems, roots and fruit. Phytochemical screening yielded eight spiromaine alkaloids and 3 carboxylated indole-3-alkylamines. Dried bark yielded erythraline, hypaphorine, amino acids, organic acids, erythrinin and saponins.\(^\text{[23,24]}\)

2.4.2. DIURETIC ACTIVITY

The chloroform and ethanol extract of *E. variegata* was evaluated for diuretic activity. According to their body weight, the total volume of urine and the urine concentration of Na+ and K+ were measured by flame photometry\(^\text{[25]}\) and found to possess significant activity.

2.5. LEPIDIUM SATIVUM

*Lepidium sativum* is called as Garden Cress [Fig 5], belonging to family Brassicaceae. It is a fast growing erect glabrous annual herb mostly found in Bangalore and Kolar district of Karnataka.\(^\text{[4]}\)

![Fig 5: Photo of Lepidium sativum](image)
2.5.1. CHEMICAL CONSTITUENTS
The phytoconstituents which are isolated from different parts is given below:
Seeds contain volatile aromatic oil and good source of iron.\textsuperscript{[26]} It also contain alkaloid (0.19%), glucotropaeolin, sinapine (choline ester of sinapic acid), sinapic acid, mucilaginous matter (5%) and uric acid (0.108 g/kg). Mucilage is the mixture of cellulose (18.3%) and uronic acid containing polysaccharides; acid hydrolysis yield L-arabinose, D-galactose, L-rhamnose, D-galacturonic acid and D-glucose. The plant contains pantothenic acid, pyridoxine, rutin and glucoside glucoprotein.\textsuperscript{[27]} Five new dimeric imidazole alkaloids isolated from seeds known as lepidine B, C, D, E and F in addition to the known imidazole alkaloid lepidine and two new monomeric imidazole alkaloids semilepidinoside A and B.\textsuperscript{[28]} A new steryl ester isolated from the aerial parts of \textit{Lepidium sativum} garden grass has been identified as stigmast-5-en-3, β27-diol 27-benzoate.\textsuperscript{[29]} Endosperm contains fat, dietary fibre, amino acid and protein.\textsuperscript{[30]}

2.5.2. DIURETIC ACTIVITY
Diuretic activity of aqueous and methanolic extract of \textit{L. sativum} garden grass was evaluated in rats. Hydrochlorothiazide was used as positive control. On administration, there was increase in urine volume, sodium content by both aqueous and methanolic extract but potassium excretion was increased only by aqueous extract. The diuretic effect was comparable to Hydrochlorothiazide and methanol extract has an advantage of potassium conserving effect.\textsuperscript{[31]}

2.6. PHYLA NODIFLORA
\textit{Phyla nodiflora} belongs to the family Verbenaceae. Phyla are a fast-growing, mat-forming and prostrate perennial plant. It grows in most of the districts of Karnataka [Fig 6].\textsuperscript{[4]}

Fig 6: Photo of \textit{Phyla nodiflora}
2.6.1. CHEMICAL CONSTITUENTS

The phytoconstituents which are isolated from different parts is given below:

The plant contains a variety of constituents such as triterpenoids, flavonoids, phenols, steroids and many others. Among these flavonoids were the most commonly found, Nodifloretin, β-sitosterol glycoside and stigmasterol glycoside were isolated from the leaves of *L. nodiflora*.\[^{32}\] Nodifloridin A and Nodifloridin B along with lactose, maltose, glucose, fructose and xylose were isolated from the plant.\[^{33}\] Two new flavone glycosides lippiflorin A and lippiflorin B, along with the known compound nepetin and batatifolin were isolated from the ethanol extract of *L. nodiflora*.\[^{34}\] From the flowers of *L. nodiflora*, two flavones glycosides, 6- hydroxyluteolin-7-O-apioside and luteolin-7-O-glucoside and three flavones 6-hydroxyluteolin, nepetin and batatifolin were isolated.\[^{35}\] From the alcoholic extracts of *L. nodiflora*, two phenylpropanoid compounds acteoside and 2'-O-acetylenchinacoside and a flavone demethoxycentaureidin were isolated.\[^{36}\] Twelve flavones sulfates Hispidulin 7-sulfate, Hispidulin 7,4'-disulfate, Jaceosidin 7,4'-disulfate, Nepetin 3',4'-disulfate, Nodifloretin 6,7-disulfate, 6- Hydroxyluteolin 6,7-disulfate, Nodifloretin 7-sulfate, 6-Hydroxyluteolin 6-sulfate, 6-Hydroxyluteolin 7- sulfate, Jaceosidin 7-sulfate, Nepetin 7-sulfate and Hispidulin 4'-sulfate along with the known compounds Nepetin, Hispidulin, and Jaceosidin were isolated.\[^{37}\] Halleridone and Hallerone as their acetyl derivatives from the leaves of *L. nodiflora* were isolated.\[^{38}\] From the methanolic extract of the aerial parts of *L. nodiflora*, a new triterpenoid lippiacin, a new steroid 4', 5'- dimethoxybenzoloxy stigmasterol along with the known stigmasterol and β-sitosterol were isolated.\[^{39}\]

2.6.2. DIURETIC ACTIVITY

The diuretic activity of methanol and aqueous extract at a dose of 250 and 500 mg/ kg i.p. and frusemide was carried out. The parameters taken for each individual rat were body weight before and after test period, urine volume (concentrated for water intake during the test period), concentration of Na + and K + in urine. The content of Na + and K + in the urine was estimated by ICP-OES (Inductive Coupled Plasma-Optical Emission Spectroscopy).\[^{40}\] and found to possess significant activity.

2.7. *SPILANThUS ACMELLA MURR*

*Spilanthus acmella Murr* is a flowering herb belonging to the family Asteraceae. It is basically seen in certain regions of Karnataka [Fig 7] (Bangalore, Belgaum, Chickmangalore, Coorg, Hassan, Kolar, Mysore, North Kanara and Shimoga).\[^{4}\]
2.7.1. CHEMICAL CONSTITUENTS

The phytoconstituents which are isolated from different parts is given below:

Major isolates were lipophilic alkylamides or alkamides bearing different number of unsaturated hydrocarbons (alkenes and alkynes), such as spilanthol or affinin (2E, 6Z, 8E)-N-isobutyl- 2, 6, 8-decatrienamide[41] and amide derivatives. The synthesis of spilanthol was reported in multistep and afforded low overall yields. However, an efficient synthetic method had been developed[42] and product is available in the market.

2.7.2. DIURETIC ACTIVITY

The diuretic potential of *S. acmella* extracted with cold water at a dose of 500, 1000 and 1500 mg/Kg was evaluated. The onset of diuretic action was extremely prompt within 1 hour and lasted throughout the study period of 5 hours. It caused marked increase in urinary Na$^+$ and K$^+$ level and decrease in osmolarity of urine suggesting that it acts as loop diuretics.[43]

2.8. XANTHIUM STRUMARIUM

*Xanthium strumarium* L. (Family: Composite) is a common weed found in India. This plant is basically seen in most of the districts of Karnataka [Fig 8].[44]
2.8.1. CHEMICAL CONSTITUENTS

The phytoconstituents which are isolated from different parts is given below:

The aerial parts of the plant contain a mixture of unidentified alkaloids, which are said to be toxic. Besides alkaloids, the aerial parts of the plant contain sesquiterpene lactones, viz. xanthisnin; its stereoisomer, xanthumin, xanthatin (deacetyl xanthisnin); a toxic principle, a sulphated glycoside: xanthostrumarin, atractyloside, carboxy atractyloside; phytosterols, xanthanol, isoxanthanol, xanthinosin, 4-oxo-bedfordia acid, hydroquinone; xanthanolides[44-47], caffeoylquinic acids; α and γ-tocopherol[48]; thiazinedione[49]; 4-oxo-1(5),2,11,(13)-xanthatriene-12,8-olide, known as “deacetyl xanthumin” an antifungal compound. The main toxic compound isolated from the plant has been identified as carboxy atractyloside, a kaurene glycoside previously called xanthostrumarum.[50] In addition to carboxy atractyloside, potentially toxic ingredients include several sesquiterpene lactones (e.g. guaianolides, germacranolides and elemanolides).[51] Aerial parts contain three xanthanolide and xanthenetype sesquiterpenoids, 11α, 13-dihydroxanthatin, 4β, 5βepoxyxanthatin-1α, 4α-endoperoxide, 1β, 4β, 4α, 5α-diep oxy xanthat-11(13)-en-12-oic acid[52], a dimeric xanthanolide, sesquiterpene lactones[53], 8-epixanthatin, 2-epixanthumin and 8-epi-xanthatin-5β-epoxide. The phenols isolated are caffeic acid, potassium3-O-caffeeoylquinate, 1-O-caffeeoyl quinic acid, chlorogenic acid, 4-O-caffeeoylquinic acid, 1,4-di-O-caffeeoylquinic acid, 1,5-di-O-caffeeoylquinic acid, 3,5-di-O-caffeeoylquinicacid, 4,5-di-O-caffeeoylquinic acid, 1,3,5-tri-O-caffeeoylquinic acid, 3,4,5-tri-O-caffeeoylquinic acid and cyanarin.[54,55] The toxic principles of the seeds are hydroquinone, choline and a third more toxic unidentified compound. Besides these, the seeds also contain considerable amount of iodine.[56,57] The fruits are rich in vitamin C. Thiazinediones isolated from the fruits are 7-hydroxy methyl-8,8-dimethyl4,8-dihydrobenzol[1,4]thiazine-3,5-dione-11-O-β-d-glucopyranoside[58], 2-hydroxy-7-hydroxyl methyl -8,8dimethyl-4,8-dihydrobenzol[1,4]thiazine-3,5-dione-11-Oβ-d-glucopyranoside, 7-hydroxymethyl-8,8-dimethyl-4,8dihydrobenzo[1,4]thiazine-3,5-dione, 7-hydroxymethyl-8,8 dimethyl-4,8-dihydrobenzol[1,4]thiazine-3,5-dione-(2-Ocaffeoyl)-β-d-glucopyranoside, ferulic acid, formononetin and ononin.[58] The young fruit contains glucose, fructose, sucrose, organic acids, phosphatides, potassium nitrate, β-sitosterol, γ-sitosterol, β-d-glucoside of β-sitosterol called strumaroside.[59,60] The total free amino acid content is 1.65%. It includes amino-n-butyric acid, arginine, aspartic acid, cystine, glutamic acid, methionine, proline, tryptophan in micromoles per milligram dry weight.[61,62] The stem oil is characterised by large amounts of monoterpenes (49.4%) and sesquiterpenes (29.1%); the leaf oil is also characterised by higher amounts of monoterpenes (55.8%) than sesquiterpenes.
(26.4%). Oil contains d-limonene (35.0%), d-carveol (25.0%), α-ionone (10.5%), terpinolene (7.0%), β-caryophyllene (6.0%) and p-cymene (5.0%). Twenty two compounds representing 86.4% of the stem oil were identified, among which bornyl acetate (19.5%); limonene (15.0%) and β-selinene (10.1%) were the major ones. The leaf oil of the plant is characterised by higher amount of limonene (24.7%) and borneol (10.6%) among the 28 components comprising 85.2% of the total oil detected. Steam distillation of the essential oil of X. strumarium under pressure gave in decreasing amounts: limonene, carveol, terpineolene, β-caryophyllene, p-cymene, sabinene, bornyl acetate, β-cubebene and a trace of α-pinene. Sesquiterpenes (germacrene D) constituted the major part of the volatiles in Iran. Fatty acid composition of oil includes unsaturated fatty acids like oleic, linoleic, palmitic, stearic, behenic acid and saturated fatty acids include capric, lauric, myristic and palmitic acid.

Lipid fraction of the plant is composed of C27–C33 n-alkanes and C28–C32 n-alkanols, and the unsaponifiable fraction consists of C23–C35 n-alkanes and C22–C30 n-alkanols besides a mixture of β-sitosterol, stigmasterol, campesterol, isohexacosane, chlorobutanol, stearyl alcohol, stromasterol, oleic acid, 3,4-dihydroxycinnamic acid, heptacosanol, oxalic acid, KCl, KNO₃, K₂SO₄ in roots and stems. B-selinene, phytol, xanthanodiene, isoalantolactone, 2-hydroxytomentosin, tomentosin, isoguaiaene is also present.

2.8.2. DIURETIC ACTIVITY
The diuretic activity was assessed using PEXS, at doses of 250 and 500 mg/kg, (p.o) respectively and Frusemide as positive control. After oral administration of PEXS, the urinary output of each group was recorded at different time intervals from the graduated urine chamber at metabolic cage. Urine samples were analyzed for Na+ and K + concentration by flame photometric method which showed very good activity.

3. Other Pharmacological activity of these eight plants
The pharmacological activity of 8 plants is summarized as below [Table 1].
<table>
<thead>
<tr>
<th>Sl. No</th>
<th>BOTANICAL NAME</th>
<th>FAMILY</th>
<th>VERNACULAR NAMES</th>
<th>OTHER PHARMACOLOGICAL ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Abrus precatorius L.</td>
<td>Fabaceae</td>
<td>Indian liquorice(E), Gulagangii(Kan), Gunja (San), Kundrimani (Tam)</td>
<td>Anti-diabetic activity(^{[73]}), Anti-oxidant activity(^{[74]}), Antibacterial Activity(^{[75,76]}), Anticancer activity(^{[77]}), Anti-inflammatory activity(^{[78,79]}), Anti-depressant activity(^{[80]}), Neuromuscular blocking activity(^{[81]}), Antiepileptic activity(^{[82]}), Antiviral activity(^{[83]}), Anti-yeast activity(^{[84]}), Anti-malarial activity(^{[85]}), Anti-inflammatory activity(^{[78,79]}), Anti-depressant activity(^{[80]}), Neuromuscular blocking activity(^{[81]}), Antiepileptic activity(^{[82]}), Antiviral activity(^{[83]}), Anti-yeast activity(^{[84]}), Anti-malarial activity(^{[85]})</td>
</tr>
<tr>
<td>2.</td>
<td>Cissampelos pareria L.</td>
<td>Menispermaceae</td>
<td>Kandagunduchi/Padavali(Kan), Tittar(Tam), Ambasta(San)</td>
<td>Anti-diarrhoeal activity(^{[86]}), Gastroprotective activity(^{[87]}), Chemo-preventive effects(^{[88]}), Anti-hyperglycemic activity(^{[89]}), Antioxidant and immunomodulatory activity(^{[90]}), Anti-inflammatory activity(^{[91,92]}), Anti-fertility activity(^{[93,94]}), Memory enhancing activity(^{[95]}), Anti-nociceptive and Antiarthritic activity(^{[96]}), Cardioprotective activity(^{[97]}), Anti-oxidant activity(^{[98]}), Anti-haemorrhagic effects(^{[99]}), Hepato-protective activity(^{[100]})</td>
</tr>
<tr>
<td>3.</td>
<td>Cucumis melo L.</td>
<td>Cucurbitaceae</td>
<td>Ervaruka/Trapusha (san), Mulvellari(Tam), Kallangadi(ken),</td>
<td>Antimicrobial activity(^{[101]}), Antioxidative and cytotoxic activity(^{[102-104]}), Anti-hyperlipidemic activity(^{[105]}), Thyroid stimulatory and antiperoxidative activity(^{[106]}), Anthelmintic property(^{[107]})</td>
</tr>
<tr>
<td>4.</td>
<td>Erythrina variegata L.</td>
<td>Papilionaceae</td>
<td>Parijathaka/MullAnti-hyperlipidemic activityym utla(kan), Paribhadrika/Rakta pushpa(San), Kalyanamurungai (Tam), Indian coral tree(Eng)</td>
<td>Anti microbial activity(^{[108]}), Anti angiogenetic activity(^{[109]}), Anti bacterial activity(^{[110]}), Anti convulsant activity(^{[111]})</td>
</tr>
<tr>
<td>5.</td>
<td>Lepidium sativum L.</td>
<td>Brassicaceae</td>
<td>Alavibeeja/alvi (Kan), Garden cress(Eng),Chandsur (Hin),Chandrasura (San), Kokila(Tam), Adiyalu(Tel)</td>
<td>Bone fracture healing effect(^{[112]}), Hepato-protective effect(^{[113]}), Antihypertensive effect(^{[112]}), Antimicrobial activity(^{[114]}), Anti-diabetic effect(^{[112]}), Chemoprotective effects(^{[112]}), Laxative effect(^{[115]})</td>
</tr>
<tr>
<td>6.</td>
<td>Phyla nodiflora L.</td>
<td>Verbenaceae</td>
<td>Jalapippali, Poduthalai</td>
<td>Antifungal activity(^{[116,117]}), Antiurolithiatic activity(^{[118]}), Antidiabetic and Hypolipidaemic(^{[119]}), Neuropharmacological activity(^{[120]}), Antitumor activity(^{[121]})</td>
</tr>
<tr>
<td>7.</td>
<td>Spilanthus acmella L.</td>
<td>Asteraceae</td>
<td>Local Anaesthetic Activity(^{[122]}), Antipyretic Effects(^{[123]}), Anti-Inflammatory/</td>
<td></td>
</tr>
</tbody>
</table>
8. **Xanthium strumarium L.** Asteraceae Maruloomattai, Kacchaka

| Analgesic Activity[^124], Antifungal Activity[^125], Immunomodulatory Activity[^126] | Antitussive Activity[^127,128], Antifungal Activity[^61,129], Hypoglycaemic Activity[^130], Antimitotic Activity[^131], Neuropharmacological Activity[^132], Antiallergic Activity[^133] |

### 4. CONCLUSION

The current review is intended to provide an overview of the current knowledge for the use of Herbal Medicines as Diuretics in Karnataka. Indeed, there are more than a 100 extracts purporting Diuretic effects.

Traditional systems of Medicine are popular in developing countries and up to 80% of population relies on traditional medicines or Folk Remedies for their primary health care needs. So far in Ayurvedic practice, many indigenous drugs have been claimed to have diuretic effect. However, several other diuretic plants from different families have been reported to contain triterpenoids, steroids, saponins, alkaloids, flavonoids, phenolics, glycosides and bis-benzylisoquinolines.[^134,135]

Most Diuretic drugs have the adverse effects on quality of life including impotency, fatigue and weakness. Herbal medicines are in great demand in the developed as well as developing countries for primary health care because of their wide biological and medicinal activities, higher safety margins and lesser costs.

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### 7. Ethical Issues

There is none to be applied.

### 8. Conflict of Interest

None to be declared.
9. REFERENCES
156.


