Chapter 4

4.a. *Bergenia ligulata* (Wall.) Engl. (Saxifragaceae)

Synonyms: ***Bergenia ciliata*** **(Haw.) Sternb.**

Sanskrit: Ashmaghna, Bhimayojini, Pashanabhedana, Shilabheda, Shveta.

Vernacular Names:

Assamese : Patharkuchi.

Bengali : Patharkuchi, Himasagara, Patrankur.

Gujrati : Pashanbheda, Pakhanbheda.

Hindi : Pakhanabheda, Silphara, Patharcua, Pakhanabhed, Silpbheda.

Kannada : Alepgaya, Pahanbhedi, Hittaga, Pasanaberu, Hittulaka.

Kashmiri : Pashanbhed.

Malayalam : Kallurvanchi, Kallurvanni, Kallorvanchi.

Marathi : Pashanbheda.

Oriya : Pasanbhedi, Pashanabheda.

Punjabi : Kachalu, Pashanbhed.

Tamil : Sirupilai.

Telugu : Kondapindi.

Distribution and habitat

A small perennial herb found throughout temperate Himalayas from Bhutan to Kashmir at an altitude between 2000-3000 m and in Khasia hills upto 1200 m altitude.

Morphological features.

Leaves variable coarsely hairy, sparsely hairy to glabrous, leaf apex obtusely pointed, alternate and exstipulate or with stipules adnate to the base of the petiole, or opposite and exstipulate. Flowers are usually hermaphrodite; sepals, petals and stamens symmetrically regular pinkish white. Calyx usually 5-numerous, more or less adnate to the ovary; lobes imbricate or valvate. Petals 5 or 4 (rarely 0), usually perigynous, often small imbricate or valvate. Stamens inserted with the petals, equaling or double their number, rarely indefinite. Ovary of 2 or 3-5 united carpel's, usually 2 or 3-5 celled with axile placentas, occasionally 1-celled with parietal placentas, ovules numerous, anatropous, erect or pendulous; styles as many as the carpels, free or more or less connate, stigma capitate, or lateral and subcapitate. Fruit capsular or baccate. Seeds usually numerous, usually albuminous.

Medicinal uses

The plant is used for wound healing and ulcers, in vertigo, headache, dizziness as antilithitic, in boils and blisters, in urinary calculi and other urinary diseases, as an antidiabetic, in heart diseases, haemorrhoids, stomach disorders and ophthalmia. The leaves are used as anti-inflammatory and for wound healing , leaves and shoot are used for wound healing and as haemostatic, for dissolving kidney stones. The rhizome is used as tonic, antipyretic, antidiarrhoeal, in ophthalmia, kidney stones, as analgesic, antilithitic, antipyretic, in myalgia and urinary complaints. The root is used in abdominal disorders, post partum haemorrhage, urinary calculi and other urinary disorders, haemorrhoids, heart diseases, as antidiabetic ,antipyretic, antidiarrhoeal, tonic, in ophthalmic diseases, skin diseases. pulmonary affections, as galactagogue, in toothache, dropsy, urinary troubles, as an anti-inflammatory, abortifacient, antipyretic, for wound healing, in menorrhagea, dysuria, urogenital disorders, as antilithitic and diuretic (Anon.2004). Acetone extract of root showed maximum decrease in the elevated blood glucose level and significant effect on the lipid profile (Singh *et al.*, 2011).

Previous Phytochemical reports

The rhizome contained gallic acid, tannic acid and glucose (Anon.1989), β -Sitosterol, bergenin and galloylated leucoanthocyanidin-4- (2-0-galloyl) glucoside. Flavonols-quercetin and kaempferol alongwith their 3-rhamnosides quercitrin and afzelin ; β-sitosterol and arbutin derivatives have reported in the leaves (Anon.1990).

Previous pharmacognostic reports

Only the T.S of the rhizome has been done (Anon.1989 & Anon.2004) but study of T.L.S and R.L.S is remaining to be done. So a detailed study is conducted on rhizome of the plant.

Materials and methods

The plant material has been collected from hilly areas of Dehradun, Uttarakhand. Phytochemical analysis of rhizome of the plant for their secondary metabolites such as alkaloids, flavonoids, phenolics, steroids, quinones, mucilages and other compounds were done by standard methods of chromatography and spectrophotometry described in Chapter 2. Pharmacognostic, HPTLC finger printing

and physico-chemical studies were done by using standard methods described in Chapter 2.

Results

Phytochemistry

Rhizome

Along with reported gallic acids the rhizome also showed the presence of phenolic acids such as vanillic acid, syringic acid along with high concentration of *p*-Hydroxy benzoic acids. Mucilage amounted to 4.2 % consisting of rhamnose and glucose. The rhizome also showed the presence of unidentified alkaloids and steroids.

Pharmacognosy

Macroscopic characters (Fig.51)

The rhizome was cylindrical and woody. The outer surface yellowish brown in colour and showed longitudinal wrinkles and furrows and ridges. Fracture short to fibrous , Odour faint aromatic.

Fig.51. *Bergenia ligulata*, rhizome.

Microscopic characters

Rhizome : T.S (Fig.52)

The T.S of the rhizome was circular in outline with well developed cork and cortex. The outermost region of cork consisted of 3 to 5 rows of thick walled, tangentially elongated cells containing starch grains and rosette crystals, of which the outer one or two rows of cells were ruptured and light brown in colour. The phellogen was a single row of narrow thin walled tangentially elongated cells followed by phelloderm consisted of 4 to 6 layers of thin walled tangentially elongated cells where in the 2 to 3 rows of cells towards cortex were polygonal in shape and filled with starch grains and rosette crystals. The wide secondary cortex consisted of circular to oval, thin walled parenchymatous cells with inter cellular spaces ,many of them were filled with rosette crystals (5-9µm) and starch grains. Starch grains were simple and of varying in shape, spherical and oval with blunt beak. some of the cortical cells were showed the deposition of light brown contents. Endoderm and pericycle were absent. Vascular bundles were 'V' shaped, open collateral, endarch and arranged in a ring. Both secondary xylem and phloem were not continuous but formed discrete bundles separated by broad medullary rays. The ray cells were thin walled and contained starch grains and rosette crystals while some of the cells showed the deposition of light brown contents. Phloem was 3-5 layered made up of usual elements. The xylem made up of fibres, tracheids, vessels and xylem parenchyma. The vessels were scattered and were simple and bordered pitted, some were spiral thickened. Central pith cells were similar to that of cortical parenchymatous cells and some of the cells showed the deposition of light brown contents.

Rhizome : T.L.S (Fig.53)

The cork cells were thick walled contained starch grains and rosette crystals. Parenchyma cells in the cortical region were large polygonal and contained starch grains and rosette crystals. Phloem cells appeared straight and upright. Tracheids were simple pitted. Vessels showed the presence of simple pits and few with spiral thickening also. .

Rhizome : R.L.S (Fig.54)

The thick walled cork cells followed by the large polygonal parenchyma showed the deposition of light brown contents. The pith parenchyma were square to rectangular in shape and the cell was filled with starch grains and rosette crystals.

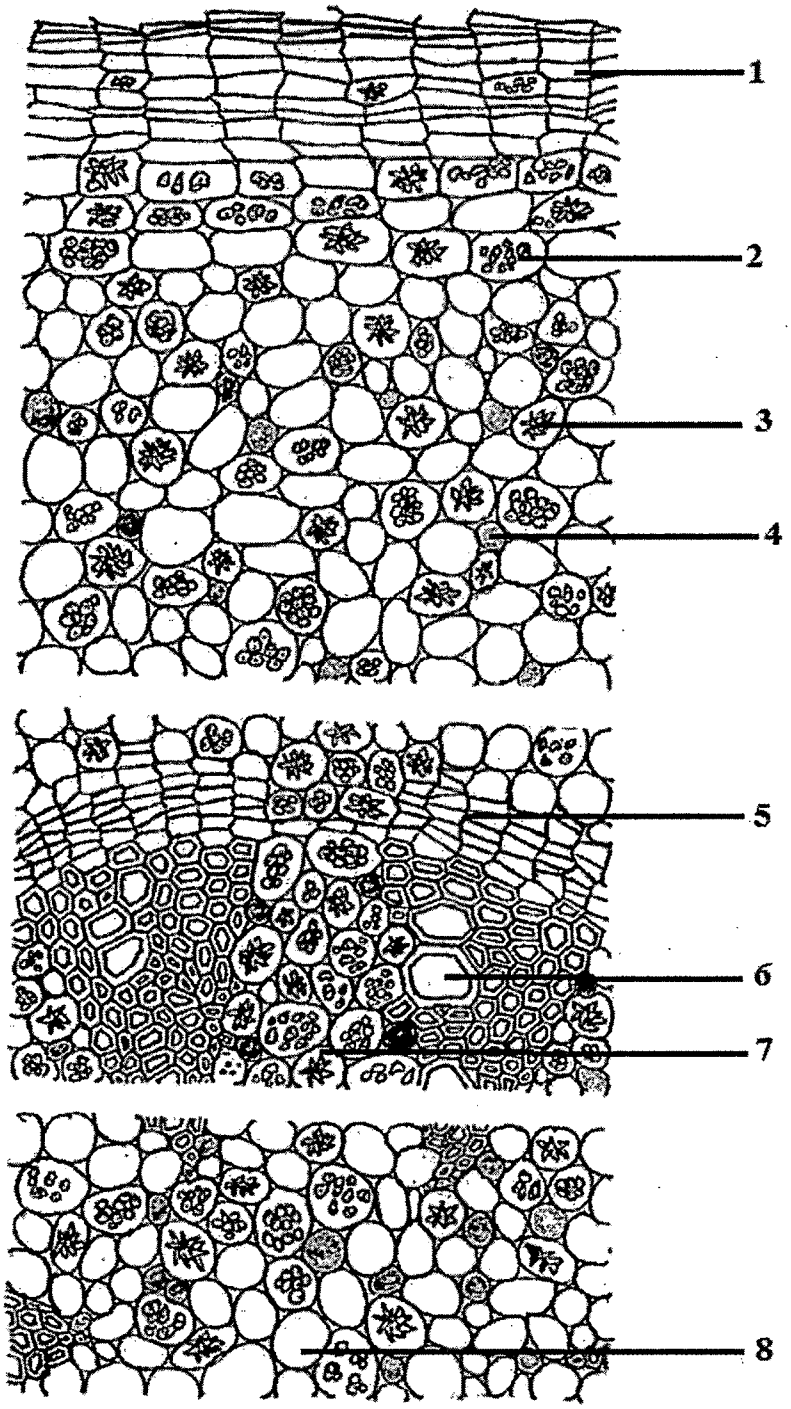


Fig.52. *Bergenia ligulata* rhizome, T.S: 1. Cork, 2. Parenchyma with starch grains, 3. Rosette crystal, 4. Parenchyma with light brown contents, 5. Phloem, 6. Vessels 7. Broad medullary rays, 8.Pith parenchyma.

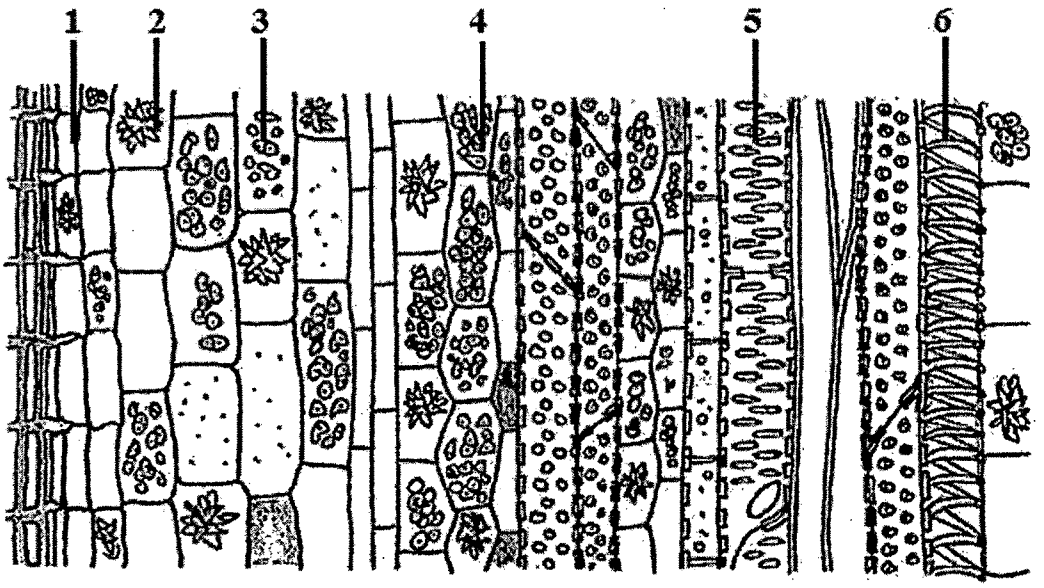


Fig.53. ***Bergenia ligulata*** **rhizome, T.L.S:**1. Cork, 2. Rosette crystal, 3. Starch grains, 4. Phloem rays, 5. Vessels with simple pits, 6. Spiral vessel.

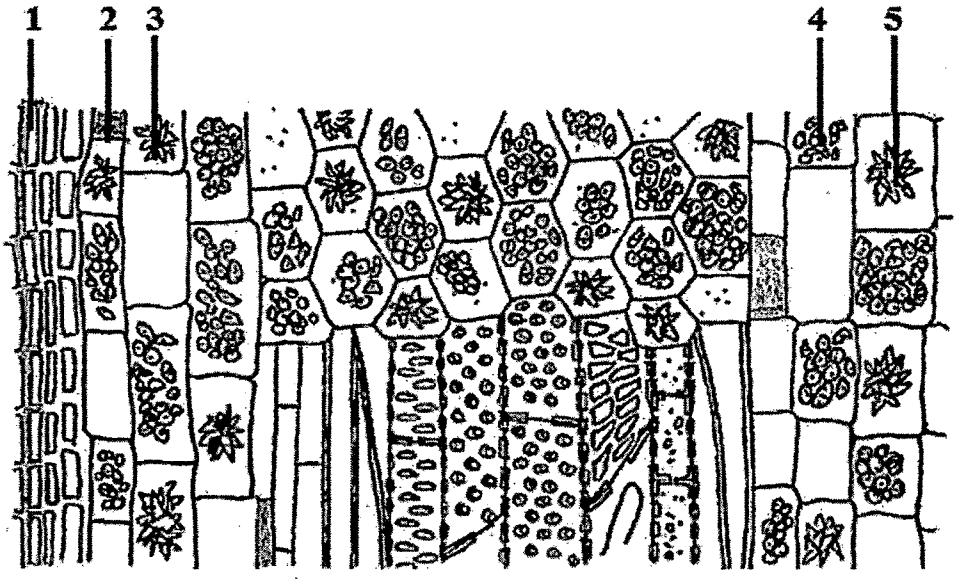


Fig.54. ***Bergenia ligulata*** **rhizome, R.L.S:**1. Cork cells, 2. Parenchyma with light brown deposites, 3. Rosette crystal,4. Pith parenchyma with starch grains, 5. Pith parenchyma with with rosette crystals.

Rhizome : Powder study (Fig. 55)

The powder was characterized by the presence of groups of light brown thick walled cork cells, cortical cells showing deposition of light brown contents, groups of starch grains, rosette crystals, simple pitted vessels and spiral vessel.

Distinguishing features

Phytochemical markers

1. *P*-Hydroxy benzoic acid.
2. Vanillic acid.
3. Syringic acid.

Pharmacognostic markers

1. Light brown thick walled cork cells.
2. Parenchyma showing deposition of light brown contents.
3. Starch grains.
4. Rosette crystals.
5. Spiral and simple pitted vessels.

Physico-chemical analysis:

Table 8 : Values obtained for the proximate analysis.

Sr.No.	Parameter	Mean ± SD (%)*			Average (%)
		Summer	Monsoon	Winter	
1.	Total Ash Content	12.03±0.31	12.14±0.11	12.09±0.12	12.09
2.	Acid Insoluble Ash content	1.18±0.31	1.21±0.30	1.18±0.26	1.19
3.	Alcohol soluble extractive	11.29±0.19	11.61±0.11	11.43±0.22	11.44
4.	Water soluble extractive	15.44±0.16	15.89±0.23	15.49±0.18	15.61

*Each value is a mean of 3 readings

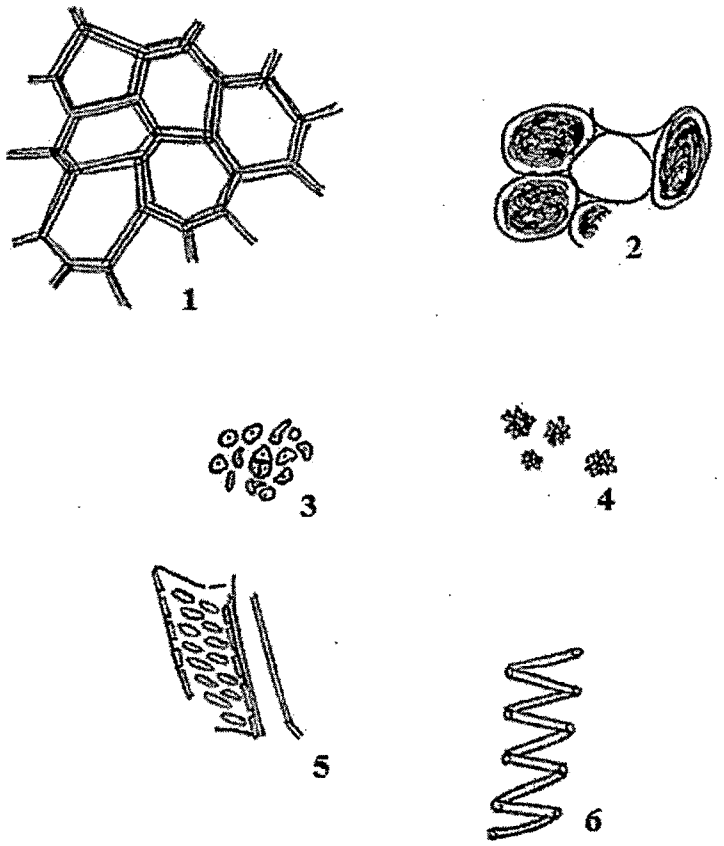


Fig.55. *Bergenia ligulata* rhizome, powder study:1. Cork, 2. Cortical cells with light brown deposition, 3. Starch grains,4. Rosette crystals, 5. Vessels with simple pits, 6. Spiral vessel.

4.b.*Aerua lanata* (Linn.) Juss.

Sanskrit: Astmabayda, Bhadra, Goraksaganja, Pasanabheda, Pashanabheda.

Vernacular names:

Bengali : Chaya.

English : Sunny Khur.

Gujarati : Gorakh-ganjo.

Hindi : Gorakh-ganja.

Kannada : Bilihindisoppu.

Malayalam : Cherula , Cherupula.

Marathi : Kapur-Madhura.

Oriya : Paunsia , Sanna sondo.

Punjab : Buikallan.

Tamil : Sirupoolai , Cerupulai.

Telugu : Pindiconda .

Distribution and habitat

The plant is a common weed found in all plains districts and upto 900 metres elevation. It is widespread in the drier parts of the tropics and subtropics of the Old World, Africa and Asia.

Morphological features.

The plant is an erect or prostrate herb with a long tap root, branched from near the base; branches many, terete, pubescent or woolly tomentose, striate. Leaves alternate, 2-2.5 by 1-1.5cm. on the main stem, 6-10 by 5-6 mm. on the branches, elliptic or obovate or sub-orbicular, obtuse or acute, entire, pubescent above, more or less white with cottony hair beneath; petioles 3-6 mm. long, often obscure. Flowers greenish-white, very small, sessile, often bisexual, in small dense subsessile axillary heads or spikes 6-13 mm. long, often closely crowded and forming globose clusters; bracteoles 1.25 mm. long, membranous, broadly ovate, concave, apiculate. Perianth 1.25-1.5 mm. long, sepals oblong, obtuse, sometimes apiculate, silky hair on the back; stigmas two in number. Utricle broadly ovoid, acute. Seed 0.85 mm. diameter, smooth and polished, black in colour

Medicinal uses:

The plant is anthelmintic and demulcent. It is used to treat malaria, skin diseases, indigestion and wounds (Daniel,2006). It is also used to treat diarrhea (Warrier *et al.*, 1994) .Extracts of the whole plant showed antibacterial, antifungal and cytotoxic activities (Chowdhury *et al.*,2002). The partially purified fraction of the petroleum ether extract of the plant reduced the development of solid tumour in mice significantly (Nevin and Vijayammal 2003). Leaf extracts increased urinary volume (Udupihille and Jiffry.1986) and showed antilithic property(Selvam *et al.*,2001). Various extracts of leaves were reported to inhibit angiotensin converting enzyme (Somanadhan *et al.*,1999). Alcoholic extract of shoots showed antidiabetic (Vetrichelvan and Jagadeeshan 2002), anti-inflammatory and diuretic activities in rats (Vetrichelvan *et al.*,2000) and produced a fall in blood pressure as well as negative chronotropic effect(Tripathi *et al.*,1985). Leaf paste is mixed with gingelly oil and given to treat piles. Leaf and root paste is applied to treat pimples and skin infections. Leaf decoction is given as anthelmintic and demulcent. Root and flower decoction is given to treat headache. Root decoction is used as an antidote for snakebite. Root powder is used as tooth paste to treat toothache (Retnam and Martin).

Previous Phytochemical reports

The plant is found to contain β-sitosterol (Aiyer *et al.*,1973, Aboutabl,1996, Chandra and Sastry 1990), α-amyrin (Aiyer *et al.*,1973,Chandra and Sastry 1990), hentriacontane (Chandra and Sastry 1990), campesterol (Aboutabl,1996,Chandra and Sastry 1990),stigmasterol (Aiyer *et al.*,1973, Aboutabl,1996, Chandra and Sastry 1990), stigmasterol acetate (Aboutabl,1996), daucosterol(Wassel and Amnar 1987), β-sitosterol palmitate (Aiyer *et al.*,1973), ergosterol, lupeol (Aboutabl,1996), β-amyrin (Chandra and Sastry 1990), olean-12-en-28-oic acid-3,16-dioxymethyl ester (Aboutabl,1996), kaempferol, kaempferol-3-galactoside, kaempferol-rhamnogalactoside (Afaq *et al.*, 1991), starch (Afaq *et al.* 1991), free sugars (fructose, galactose, rhamnose and sucrose) (Afaq *et al.* 1991), alkaloids like canthin-6-one, β-carboline-1-propionic acid, 10-methoxy-canthin-6-one, 10-hydroxy-canthin-6-one, 10-O-β-glucopyranosyloxy canthin-6-one, 6-methoxy-β-carboline 1-propionic acid (Zapesochnaya *et al.*, 1992), aervoside (Zapesochnaya *et al.*, 1991,Zapesochnaya *et al.*, 1992), aervolanine (Zapesochnaya *et al.*, 1992),

flavonols like aervitrin (Zadorozhnii *et al.,* 1986), narcissi (Pervykh *et al.,* 1992) and a flavone chrysin (Zapesochnaya *et al.*, 1992). The plant also shows the presence of saponins and phenolic acids such as vanillic and syringic acids (Mangalan 1988).

Previous pharmacognostic reports

Very little data available on the pharmacognosy of the root of this plant (Gupta *et al.*,2008)

Materials and methods

The plant material has been collected from Pavagadh, Vadodara,Gujarat. Phytochemical analysis of roots of the plant for their secondary metabolites such as alkaloids, flavonoids, phenolics, steroids, quinones, mucilages and other compounds were done by standard methods of chromatography and spectrophotometry described in Chapter 2. Pharmacognostic, HPTLC finger printing and physico-chemical studies were done by using standard methods described in Chapter 2.

Results

Phytochemistry

Root

There was no flavonoid in the root.The phenolic acids located were vanillic, syringic, ferulic (*cis* and *trans* isomers), melilotic, *p*- coumaric and *o*-coumaric acids. Mucilage amounted to 4.8% consisting of rhamnose and galactose . Steroids ,coumarins and saponins were also found to be present.

Pharmacognosy

Macroscopic characters (Fig.56)

The root was cylindrical and woody. The outer surface was yellowish brown in colour and showed longitudinal wrinkles and furrows and ridges. Fracture Short to fibrous , Odour faint aromatic.

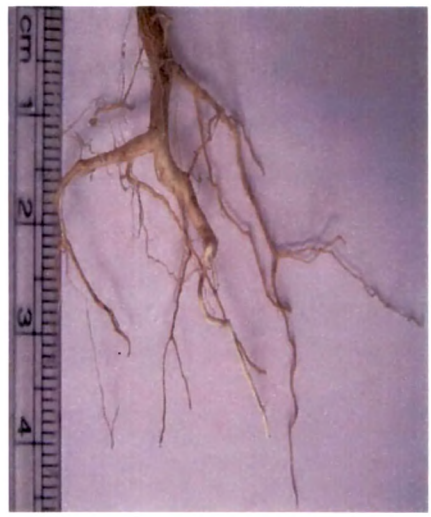


Fig. 56. *Aerua lanata* root.

Microscopic characters

Root : T.S (Fig.57)

The T.S of the root was circular in outline. The cork consisted of 3 to 6 rows of thin walled, tangentially elongated cells of which the outermost one or two rows of cells were slightly ruptured. Inner to the cork was the phellogen consisting of a single row of narrow thin walled tangentially elongated cells followed by one to three layers of phelloderm. The secondary cortex also was very narrow consisting of three to five rows of comparatively large polygonal or slightly tangentially elongated thin walled parenchyma cells, which were compactly arranged. Most of the cells were filled with rosette crystals and occasionally with rhomboidal crystals. The wood showed the secondary anomalous growth, consisting of a large number of vascular bundles arranged in successive rings separated by thin walled parenchyma filled with rosette and rhomboidal crystals. These vascular bundles were separated from the central phloem by thick walled parenchyma containing rosette and rhomboidal crystals. In the centre wood was a triarch. The phloem consisted of usual phloem

elements. Phloem rays were uni- to bi-seriate and the cells were thin walled and contained starch grains. Wood consisted of vessels, tracheids, fibres, wood parenchyma and rays. Xylem rays were thin walled containing starch grains in traces. Starch grains were small, spherical or ovoid in shape. Vessels were simple and bordered pitted. Spiral thickened vessels were also common.

Root : T.L.S (Fig.58)

Cork cells appeared rectangular with wavy walls. The cells of the cortex were thin walled, polygonal in shape and each cell contained rosette crystals and rhomboidal crystals. The fibres were thick walled and narrow lumened. Rays were spindle shaped biseriate and contained starch grains. The cells of the rays were thin walled, polygonal in shape and each cell contained 10-15 starch grains each. The bordered pits in vessels and tracheids were arranged loosely in 3-5 rows. The primary xylem vessel showed spiral thickening.

Root : R.L.S (Fig.59)

The phloem ray cells were thin walled and appeared hexagonal in shape. The xylem ray cells also were hexagonal in shape and filled with 5-10 starch grains each cell. The pits on the wall were of simple type.

Root : Powder study (Fig.60)

The components present in the powder were cork, rosette crystals, rhomboidal crystals, parenchyma, narrow lumened fibres, spiral vessles.

Distinguishing features

Phytochemical markers

1. Ferulic acid (*cis*- and *trans*-isomers).
2. *p*- Coumaric acid.
3. *o*-Coumaric acid.
4. Melilotic acid.
5. *p*-Hydroxy benzoic acid.

Pharmacognostic markers

1. Rosette crystals.
2. Rhomboidal crystals.
3. Spiral vessels.

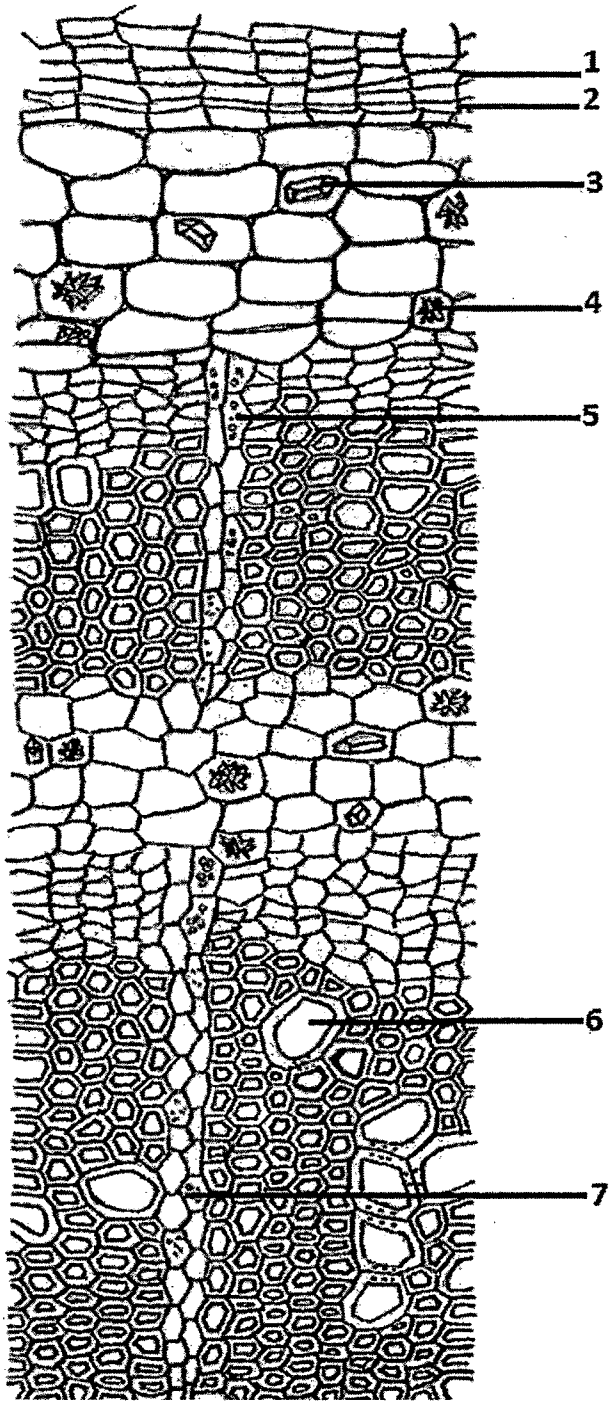


Fig.57. ***Aerua lanata*** **root, T.S:** 1. Cork, 2. Phellogen, 3. Parenchyma with rhomboidal crystal, 4. Rosette crystal, 5. Phloem ray with starch grains, 6. Vessels, 7. Xylem rays.

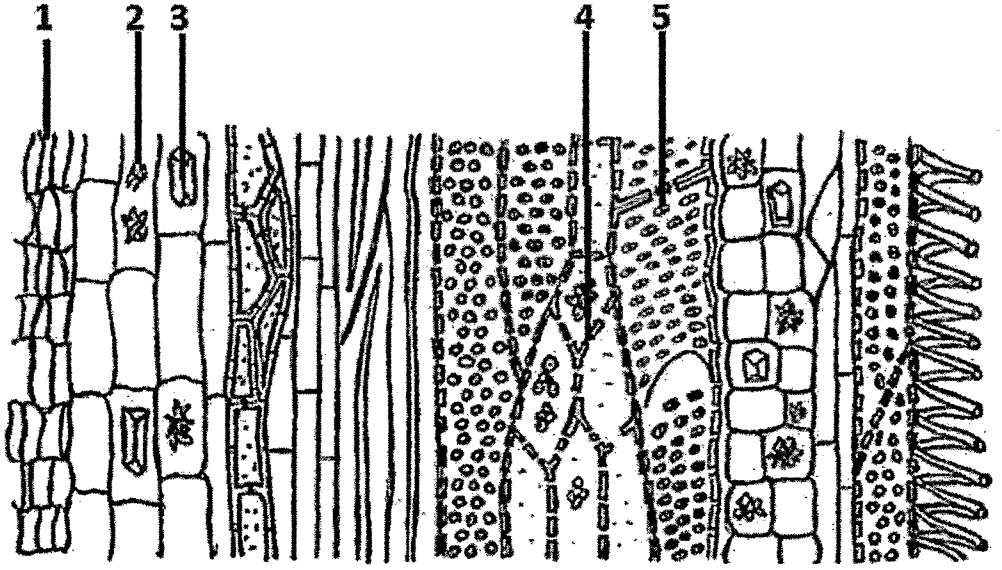


Fig.58. ***Aerua lanata*** **root, T.L.S**:1.Cork cells with wavy walls, 2.Rosette crystal, 3.Rhomboidal crystal, 4. Fibers with narrow lumen, 5. Spindle shaped medullary rays with starch grains, 6.Vessels with alternate bordered pits.

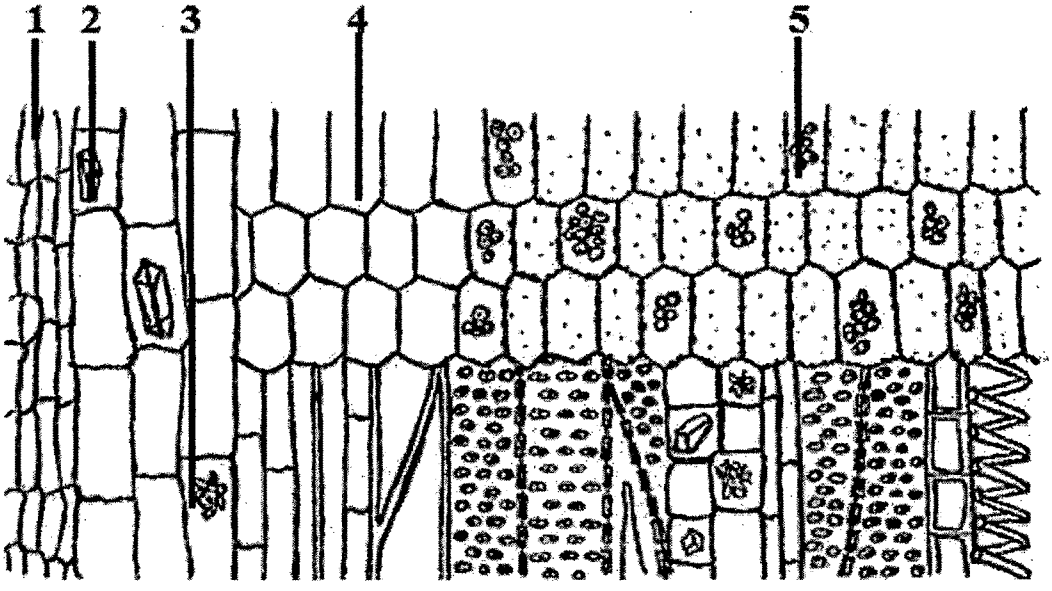


Fig.59. ***Aerua lanata*** **root, R.L.S**:1. Cork, 2. Rhomboidal crystal, 3. Rosette crystal, 4.Thin walled phloem rays, 5. Xylem rays with starch grains.

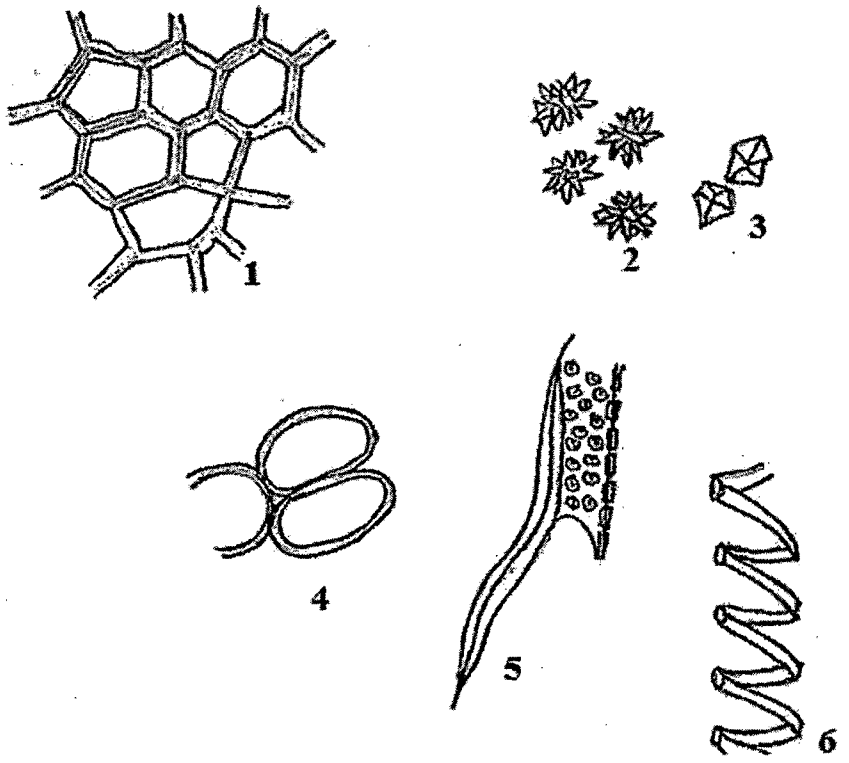


Fig.60. ***Aerua lanata*** **root Powder study:**1. Cork, 2. Rosette crystal, 3.Rhomboidal crystal, 4.Fragments of cortical parenchyma, 5. Fiber (adjoining vessel), 6. Spiral vessel.

Physico-chemical analysis:

Table :9 Values obtained for the proximate analysis.

Sr.No.	Parameter	Mean ± SD (%)*			Average (%)
		Summer	Monsoon	Winter	
1.	Total ash content	15.13±0.26	15.11±0.16	15.10±0.19	15.11
2.	Acid insoluble ash content	01.68±0.31	01.66±0.41	01.58±0.39	1.64
3.	Alcohol soluble extractive	4.16±0.16	4.13±0.19	4.17±0.22	4.15
4.	Water soluble extractive	10.13±0.36	10.32±0.29	10.28±0.37	10.24

*Each value is a mean of 3 readings

4.c.*Ammannia baccifera* Linn. (Lythraceae)

Synonyms: ***Ammannia salicifolia*** **sensu Clarke**

Sanskrit: Agnigarba, Brahmasoma, Davagni, Kurandika, Mahasyama, Pasanabheda.

Vernacular names:

Bengali : Dadmari, Banmarach.

English : Blistering Ammania.

Hindi : Dadamari, Mehudi, Jal Bhangro, Lal Babusi, Do-Patti-Ki-Kanduri, Lalbabusi.

Kannada : Agnivendrapaaku, Kaadugida, Kallurive.

Malayalam : Kallarvanchi, Kallur Vanchi, Kalluruvi, Nirummelneruppu.

Marathi : Bharajambhula, Aginbuti, Agyo, Dadmari.

Tamil : Kallarivi, Nirumelneruppu, Kalluruvipoondu,Tipputu.

Telugu : Agnivendapaku, Agnivendra-Paku, Agni Vendrapaku, Aginendramu.

Distribution and habitat

This species is globally distributed in the Paleotropics. Within India, it is found as a weed in rice-fields and marshy regions throughout.

Morphological features.

A glabrous, annual, branched herb reaching upto 60 cms. high with erect tetragonous stem. Leaves opposite, upto 6.6 cm, sessile, linear-oblong or oblong-lanceolate, subacute, much narrowed at the base. Flowers in dense axillary clusters short cymes, forming whorls in the axils; bracts filiform, shorter than the pedicels. Calyx tube hemispheric; teeth 4 (rarely 5), broadly triangular, acute; accessory teeth inconspicuous. Petals 0. Stamens 4, inserted in the middle of the calyx-tube; filaments filiform. Ovary superior, 1 celled; ovules numerous; style filiform, exserted; stigma capitate. Capsule globose, red, irregularly circumcise above the middle. Seeds subhemispheric.

Medicinal uses

The plant is used as an anthelmintic (guinea worm disease), antipyretic (Joshi, 1991; Pareek, 1994); in rheumatism (Singh and Pandey, 1980; Husain and Siddiqui, 1987; Siddiqui and Husain, 1992) and for skin eruptions (Chetty *et al.*,1998). The leaves are used in rheumatic pains and skin diseases (Bhatnagar *et al.*,1973; Kapoor and Kapoor, 1980; Shah *et al.*,1981; Saxena and Vyas,1983; Das,1995); in blisters (Siddiqui and Husain, 1992); ringworm (Singh *et al.*, 1989) and intermittent fever

(Chetty *et al.*,1998), These are also used as analgesic and antipyretic (Bhatnagar *et al.*,1973).

Previous Phytochemical reports

The aerial parts were found to contain lawsone (Saoji *et al.*,1972). The tannin content in the 50 per cent ethanolic extract of the plant was 11.63 per cent (Atal *et al.*, 1978).The fruits were reported to contain hentriacontane, dotriacontanol, triacontanediol and β-sitosterol glucoside while the leaves contained ellagic acid and quercetin in addition to hentriacontane,dotriacontanol and β-sitosterol. Betulinic acid and lupeol were reported from the root (Thakkar *et al.*,1986).

Previous pharmacognostic reports

No pharmacognostic work have been done on root of this plant.

Materials and methods

The plant material has been collected from Vadodara,Gujarat. Phytochemical analysis of roots of the plant for their secondary metabolites such as alkaloids, flavonoids, phenolics, steroids, quinones, mucilages and other compounds were done by standard methods of chromatography and spectrophotometry described in Chapter 2. Pharmacognostic, HPTLC finger printing and physico-chemical studies were done by using standard methods described in Chapter 2.

Results

Phytochemistry

There was no flavonoid in the root. The phenolic acids located were vanillic, syringic, melilotic and gallic acids. Mucilage amounted to 7.5 % consisting of xylose. The root also showed the presence of alkaloid ephedrine and steroids while coumarins and saponins were found in good concentrations.

Pharmacognosy

Macroscopic characters (Fig.61)

The tap roots were vertical, slightly tortuous, smooth with many lateral wiry rootlets and gray in colour. Fracture short.

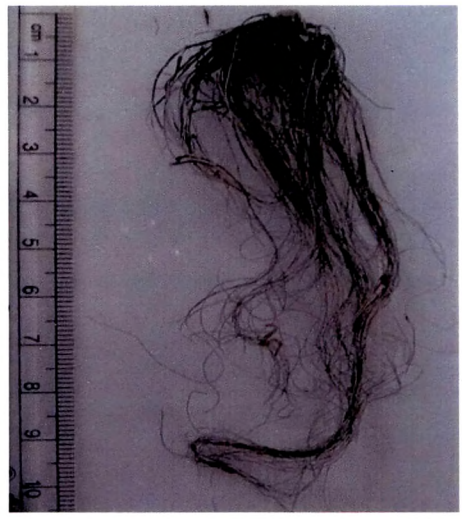


Fig.61. *Ammannia baccifera* root.

Microscopic characters

Root : T.S. (Fig.62)

The T.S of the root was circular in outline with well developed cork. The outermost region of cork consisted of 2 to 3 rows of thick walled, square and tangentially elongated cells, of which the outermost one or two rows of cells were ruptured and light brown in colour while inner 2 to 3 rows of cells were compressed and tangentially elongated. The Secondary cortex consisted of circular to oval, thin walled parenchymatous cells showing inter cellular spaces many of them were filled with rosette crystals (5-9μm). The root showed the anomalous secondary growth forming continuous ring of stele by secondary cambium which arises from the outer layers of collenchyma near the original epidermis. The cells of collenchyma were slightly oblong, compactly packed and contained rosette crystals. The central core of the root was occupied by a primary xylem. The phloem was few layered and contained parenchyma and sieve elements. Xylem consisted of fibres, tracheids, parenchyma and vessels. The vessels were simple, bordered pitted and scalariform thickened. The fibres were of both thin and thick walled. Medullary rays were narrow, mostly biseriate, thin walled and simple pitted. The central xylem portion was dominated by the vessels.

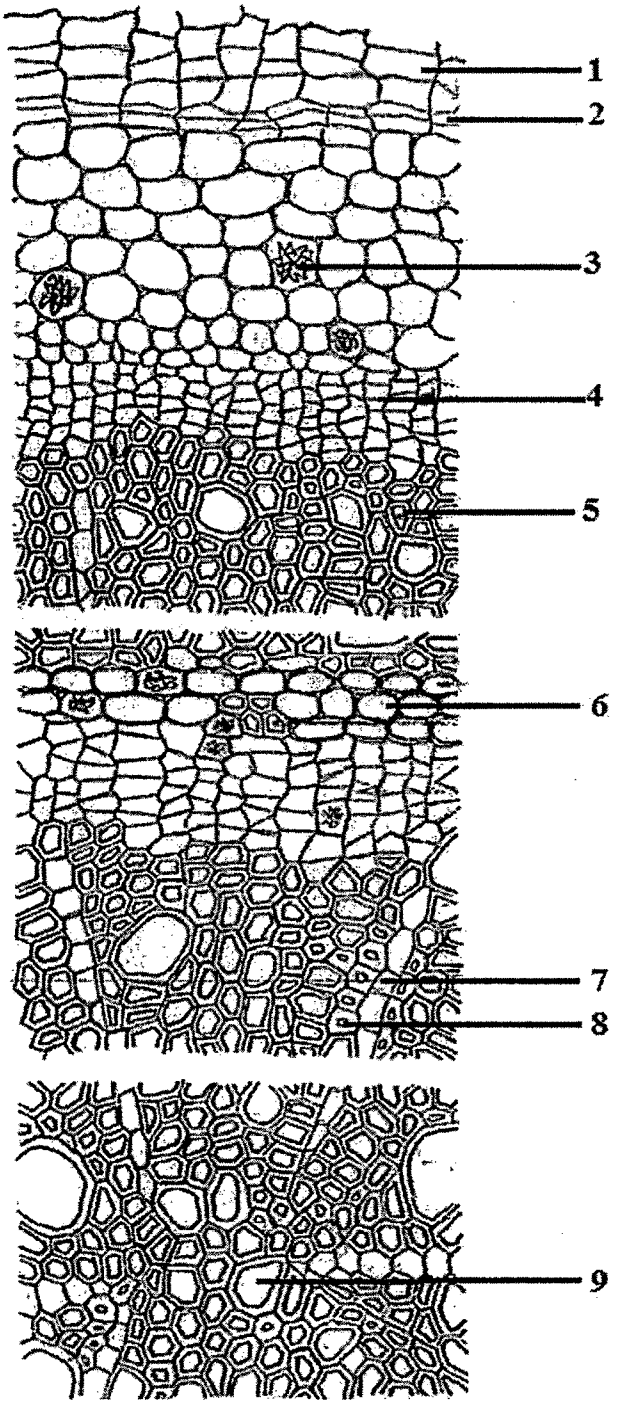


Fig.62. ***Ammannia baccifera*** **root, T.S:** 1. Cork, 2. Phellogen, 3. Parenchyma with rosette crystals, 4. Phloem, 5. Xylem, 6. Collenchyma, 7. Xylem rays, 8. Wood fibres, 9.Vessel.

Root : T.L.S (Fig.63)

Cork cells were thick walled rectangular followed by layers of polygonal cortical cells containing rosette crystals. The vessels were simple pitted, with 3-5 rows of simple pits. Xylem rays were biseriate and the cells were polygonal, thin walled. Scalariform vessel was with straight end walls.

Root : R.L.S (Fig.64)

Cork cells were thick walled rectangular laid one above the other. The cortical cells were polygonal, thin walled and contained rosette crystals. The collenchyma cells were polygonal in shape and were thick walled. The xylem rays were thin walled and had simple pits on its walls.

Root : Powder study (Fig.65)

The components present in the powder were light brown coloured thick walled cork cells, rosette crystals, collenchyma with rosette crystals, thin walled cortical parenchyma, thick walled fibres with pointed ends and simple pitted vessels.

Distinguishing features

Phytochemical markers

1. Gallic acid.
2. Melilotic acids.
3. Xylose.
4. Ephedrine.
5. Absence of flavonoid.

Pharmacognostic markers

1. Light brown coloured thick walled cork cells.
2. Rosette crystals.
3. Collenchyma.
4. Thick walled fibres with pointed ends.

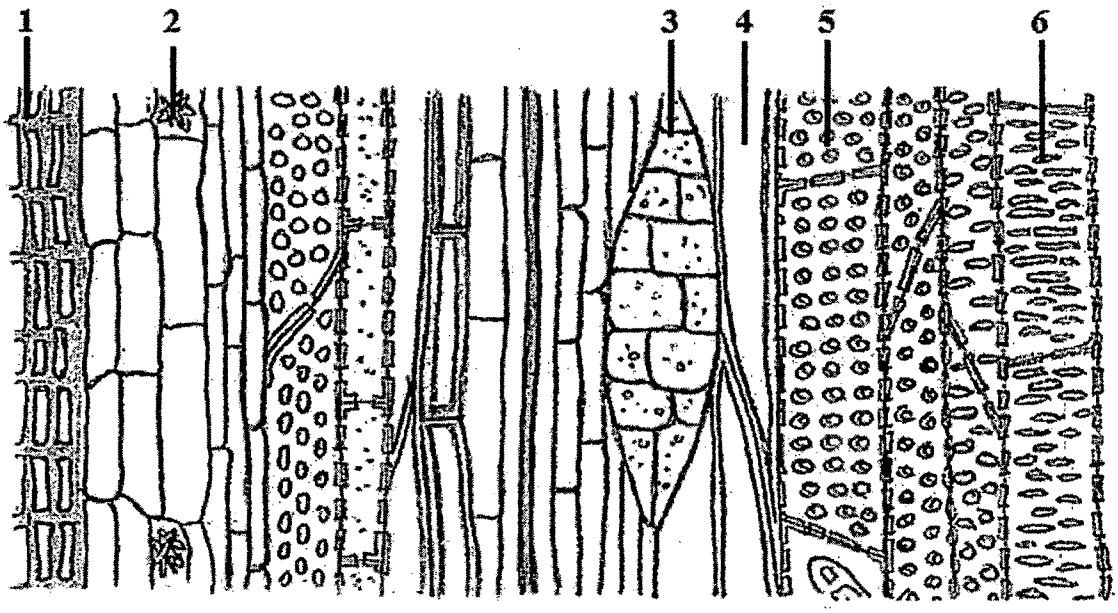


Fig.63. ***Ammannia baccifera*** **root, T.L.S:**1.Tthick walled cork cells with light brown walls, 2. Cortical parenchyma with rosette crystal, 3.Spindle shaped medullary rays, 4. Fibers, 5.Vessels with bordered pits, 6. Scalariform vessel with straight end walls.

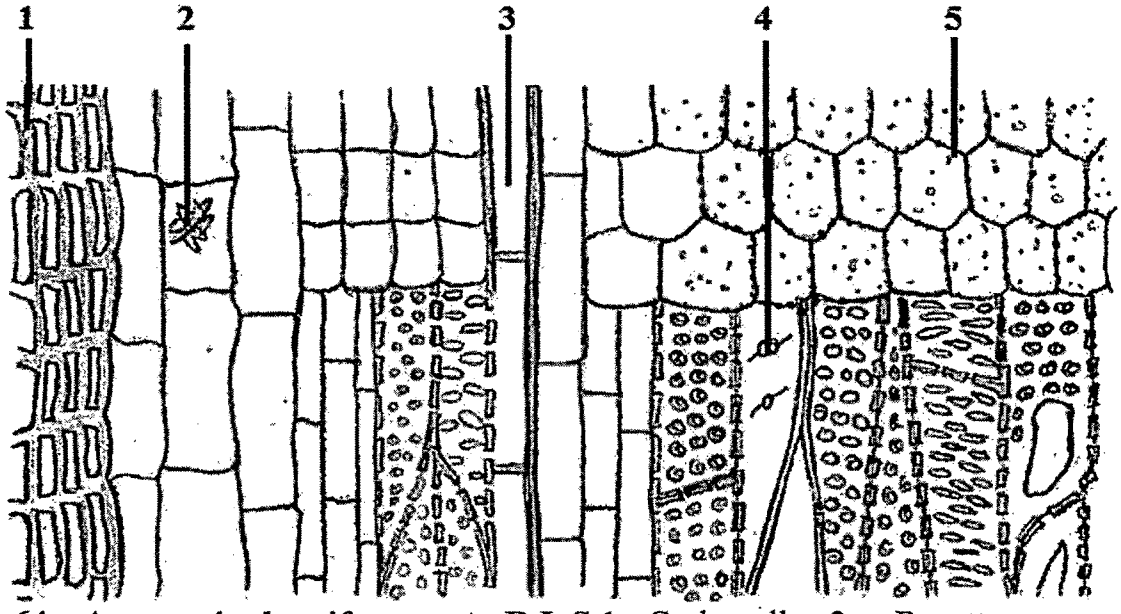


Fig.64. ***Ammannia baccifera*** **root, R.L.S**:1. Cork cells, 2. Rosette crystal, 3.Collenchyma, 4. Fibers with scanty pits, 5. Xylem rays.

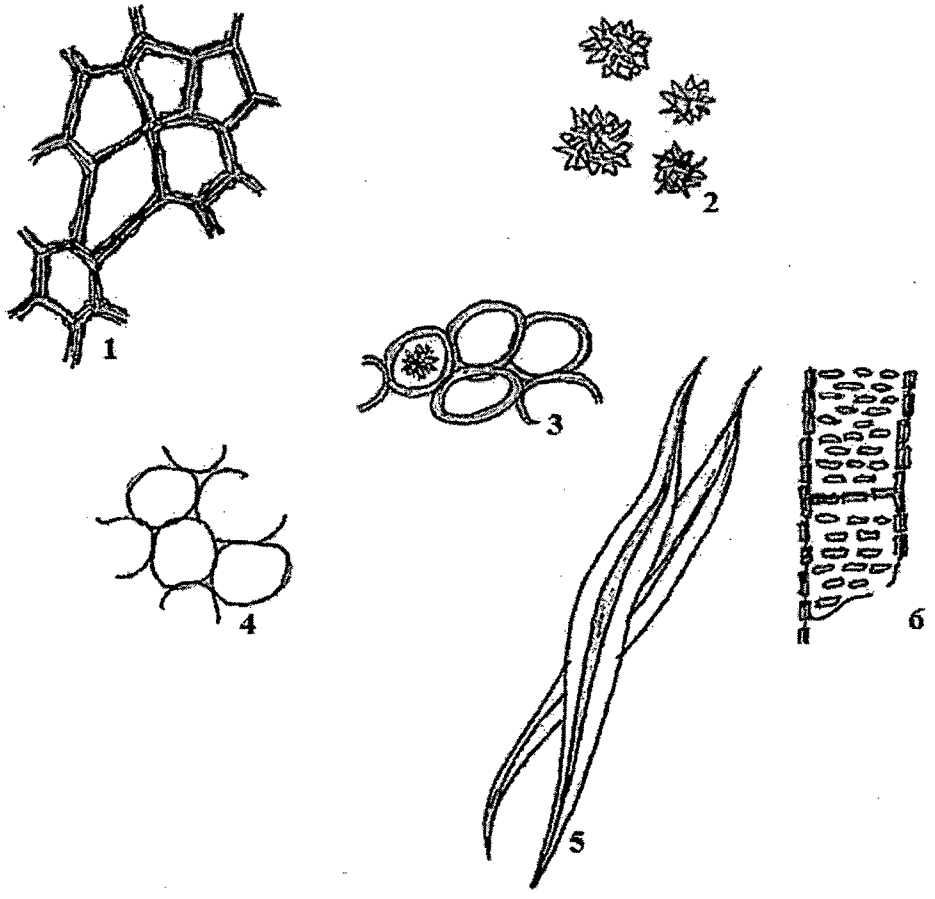


Fig.65. ***Ammannia baccifera*** **root, powder study:** 1.Light brown coloured thick walled cork cells, 2.Rosette crystals, 3. Collenchyma with rosette crystals, 4. Thin walled cortical parenchyma, 5. Thick walled fibres with pointed ends , 6.Simple pitted vessels.

Physico-chemical analysis:

Table 10:. Values obtained for the proximate analysis.

Sr.No.	Parameter	Mean ± SD (%)*			Average (%)
		Summer	Monsoon	Winter	
1.	Total ash content	05.29±0.13	05.21±0.19	05.14±0.18	5.21
2.	Acid insoluble ash content	0.77±0.25	0.69±0.26	0.68±0.19	0.71
3.	Alcohol soluble extractive	5.93±0.13	06.11±0.11	05.82±0.17	5.95
4.	Water soluble extractive	13.17±0.33	13.56±0.22	13.28±0.46	13.34

*Each value is a mean of 3 readings

4.d.*Celosia argentea* Linn.(Amaranthaceae)

Sanskrit: Sitivara, Vitunnaka, Sunishannaka, Indivara.

Vernacular names:

Assam : Boga kukurjoa.

Bengal : Swetmurga; Safed-morugphul,Swetmurgha.

English : Quail Grass, Silver-spiked,Cockscomb.

Gujarati : Lambadi, Lapadi.

Hind : Survali, Safed murga, Sufaid-murgha.

Kannada : Annesoppu,kanne hoo, karadoo.

Oriya : Gangachulia.

Punjab : Sarpankha, Sarwali.

Tamil : Pannakeerai, Pannai.

Telugu : Gurugu, Panchechettu, Gulugkura.

Distribution and habitat

An erect glabrous annual herb, 30 to 90 cm high, with conical to oblong feathery flowering spikes found commonly growing as a weed in cultivated fields throughout India upto an altitude of 1500 m.

Morphological features.

Annual herb, erect, 0.4-2 m, simple or with many ascending branches. Stem and branches strongly ridged and often sulcate, quite glabrous. Leaves lanceolate-oblong to narrowly linear, acute to obtuse, shortly mucronate with the excurrent midrib, glabrous; lamina of the leaves from the centre of the main stem 2-15 x 0.1-3.2 cm, tapering below into an indistinctly demarcated, slender petiole; upper and branch leaves smaller, markedly reducing; leaf axils often with small-leaved sterile shoots. Inflorescence a dense (rarely laxer below), many-flowered spike, 2.5-20 x 1.5-2.2 cm, silvery to pink, conical at first but becoming cylindrical in full flower, terminal on the stem and branches, on a long, sulcate peduncle up to c. 20 cm long, which often lengthens during flowering. Bracts and bracteoles lanceolate or the lower deltoid, 3-5 mm, hyaline, more or less aristate with the excurrent midrib, persistent after the fall of the flower. Perianth segments 6-10 mm, narrowly elliptic-oblong, acute to rather blunt, shortly mucronate with the excurrent midrib, with 2-4 lateral nerves ascending more than halfway up each segment, margins widely hyaline. Filaments very delicate, free part subequalling or exceeding the staminal

sheath, sinuses rounded with no or very minute intermediate teeth; anthers and filaments creamy to magenta. Stigmas 2-3, very short, the filiform style 5-7 mm long; ovary 4-8-ovulate. Capsule 3-4 mm, ovoid to almost globular. Seeds 1.25-1.5 mm, lenticular, black, shining, testa very finely reticulate.

Medicinal uses:

The leaves are used in poultices in China on infected sores, wounds and skin eruptions and in India mixed with honey on inflamed areas and painful afflictions such as buboes, abscesses etc. The whole plant is used as an antidote for snake bite and the root as a specific for colic, gonorrhoea and eczema. The water in which the leaves, flowers and stems have been boiled is used as a body wash for convalescents(Burkill, 1985).

Previous Phytochemical reports

Two rare isoflavones, 5-methoxy-6,7-methylenedioxy-2'-hydroxyisoflavone and 2',5-dimethoxy-6,7-methylenedioxyisoflavone, were isolated from the aerial parts of the plant(Jong and Hwang,1995). Alcoholic extract of seeds showed the presence of Celosian (Hase *et al.*, 1996).

Previous pharmacognostic reports

Very little data available on the pharmacognosy of the root of this plant (Anon.2007).

Materials and methods

The plant material has been collected from Pavagadh, Vadodara,Gujarat. Phytochemical analysis of roots of the plant for their secondary metabolites such as alkaloids, flavonoids, phenolics, steroids, quinones, mucilages and other compounds were done by standard methods of chromatography and spectrophotometry described in Chapter 2. Pharmacognostic, HPTLC finger printing and physico-chemical studies were done by using standard methods described in Chapter 2.

Results

Phytochemistry

There was no flavonoid in the root. The phenolic acids located were vanillic, syringic and melilotic and *p*-cournaric acids. Mucilage amounted to 4.9 % consisting of xylose. The root also showed the presence of steroids while coumarins and saponins were found in good concentrations.

Pharmacognosy

Macroscopic characters (Fig.66)

The roots occurred in long, cylindrical somewhat tortuous and was branched with few lateral rootlets. The surface was grayish yellow to yellowish brown coloured and showed longitudinal fissures and transversely elongated wrinkles. The fracture was short.

Fig.66. *Celosia argentea* root

Microscopic characters

Root : T.S (Fig.67)

The T.S. of root was circular, showed the peripheral cork, wide central wood encircled by rings of xylem and phloem. The cork zone was well developed showed the outer 4-6 rows of compressed tangentially elongated cells. The walls of these cells were comparatively thick and light brown in colour. The cells of phelloderm were thin walled big polygonal and contained microspheroidal crystals. The secondary cortex was of 4-10 layers of somewhat broadly rectangular, thin walled parenchymatous cells, many of them contained microspheroidal crystals. The secondary growth was abnormal the primary cambium ceases the activity after some time to produce a central disc shaped xylem surrounded by phloem. Further secondary growth was on outer ring of cambium developed from the cortex. The behavior of this ring also was abnormal in that instead of producing a continuous ring of xylem or phloem it produces discrete secondary vascular bundles separated by 2 layered thick medullary

rays of rectangular cells. The pericycle showed isolated or small groups of fibers at intervals. The cortical cells between the central cylinder and outer ring of bundles also contained characteristic polygonal parenchyma cells containing microspheroidal crystals. Phloem was made up of usual elements. and also was contained yellow amorphous substances. The central primary xylem consisted of vessels, tracheids and fibers where the major portion was occupied by the broad vessels and distributed equally. The vessels were angular boarded pitted while the primary vessels showed annular and spiral thickenings. The scalariform vessels were also common. Xylem rays were indistinct.

Root : T.L.S (Fig. 68)

The cork cells were thick walled and light brown in colour followed by large polygonal cortical cells contained microspheroidal crystals. Pericyclic fibres were thick walled and narrow lumened. Phloem rays were thin walled. Xylem vessels had angular boarded pits. Primary xylem showed annular thickened vessel.

Root : R.L.S. (Fig. 69)

The cork cells were thick walled and light brown in colour followed by large polygonal cortical cells contained microspheroidal crystals. The ray cells present between two secondary vascular bundles were hexagonal in shape and contained microspheroidal crystals. The vessels were scalariform. Primary xylem showed spiral thickened vessel.

Root : Powder study (Fig.70)

The components present in the powder were thick walled brown colour cork cells, large polygonal shaped parenchyma contained microspheroidal crystals, angular boarded pitted,scalariform and annular thickened vessels.

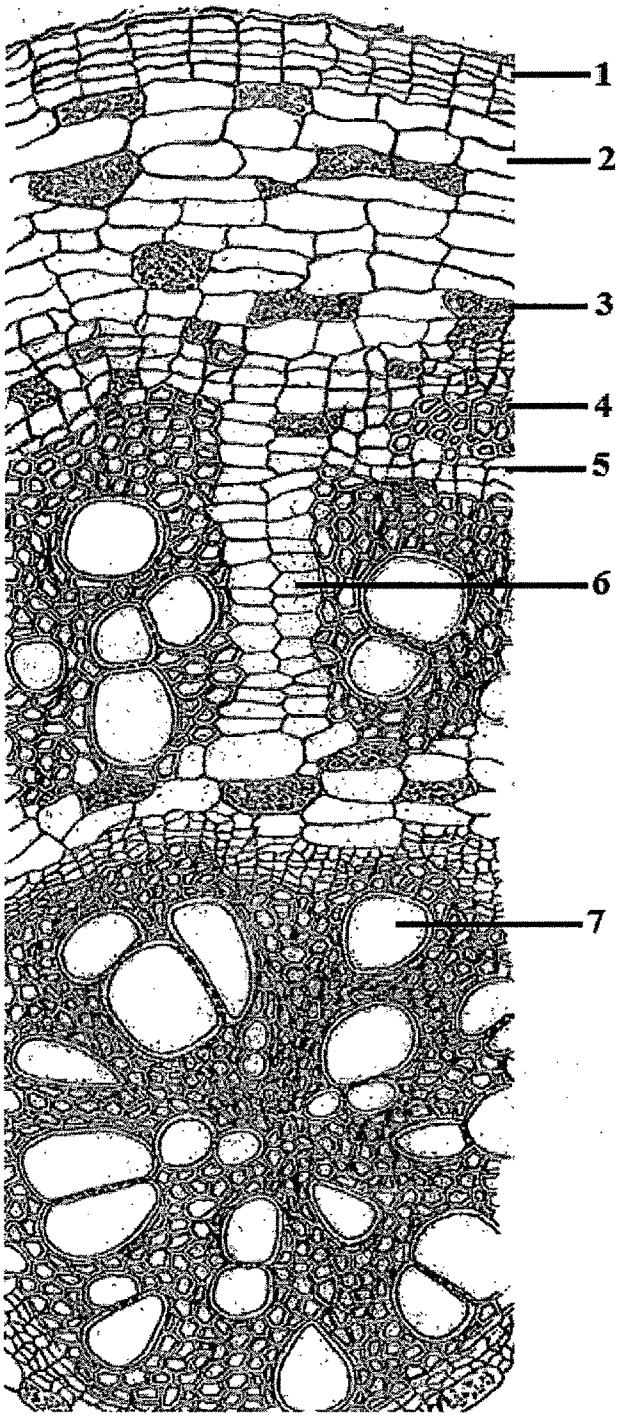


Fig.67.*Celosia argentea* root, T.S: 1. Cork, 2. large polygonal Parenchyma, 3.Microspheroidal crystals, 4. Pericyclic fibers, 5. Phloem, 6. Rays, 7.Vessels.

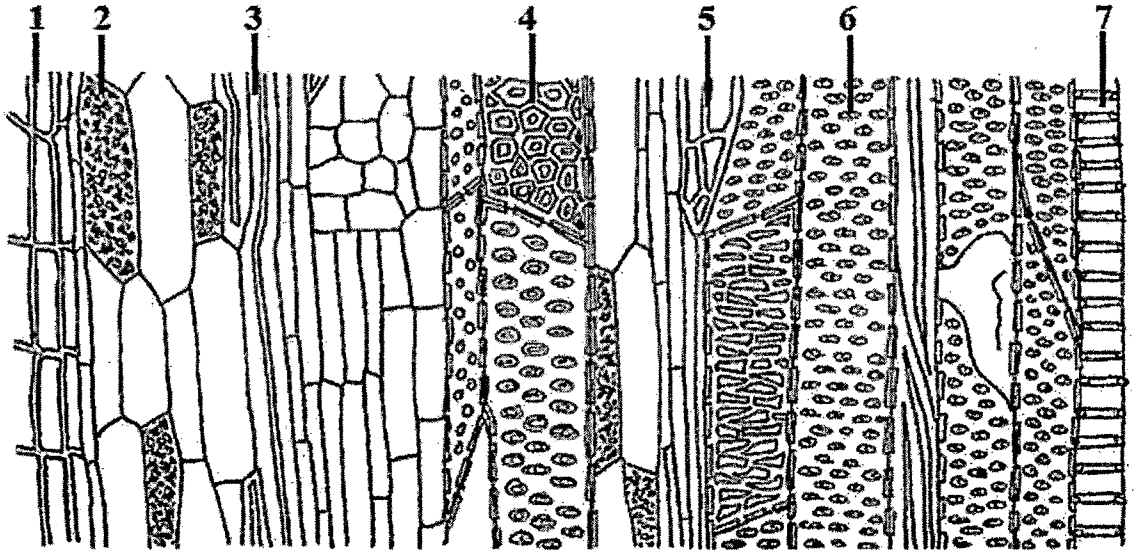


Fig. 68. ***Celosia argentea*** **root, T.L.S :** 1. Thick walled cork cells, 2.Parenchyma with microspheroidal crystals, 3. Pericyclic fibres,4. Vessel with angular boarded pits, 5. Narrow xylem rays, 6. Vessels with alternate bordered pits, 7. Annular thickened vessel.

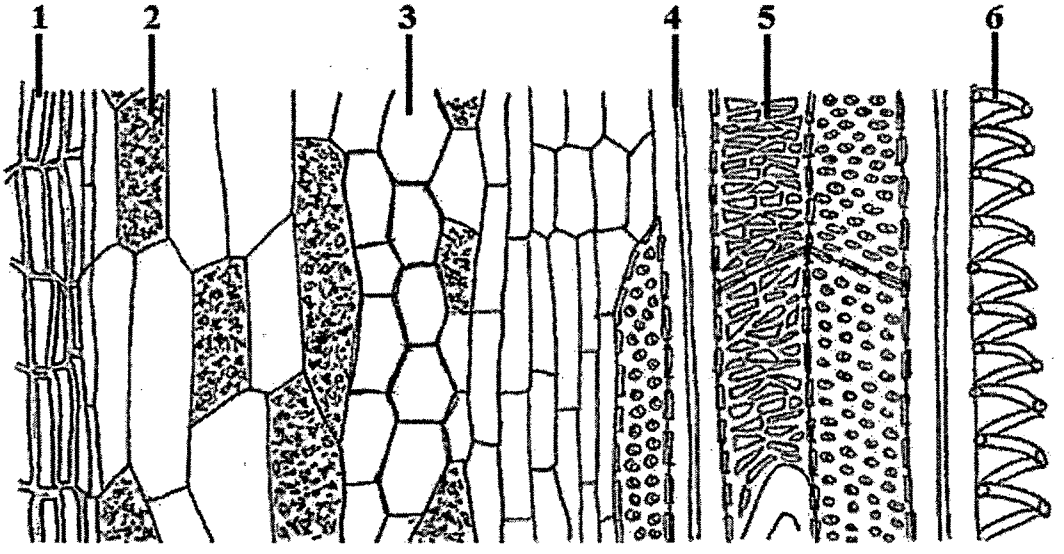


Fig.69. ***Celosia argentea*****root, R.L.S:**1. Cork cells, 2.Microspheroidal crystals, 3. Medullary rays, 4. Thick walled fiber, 5. Scalariform vessels, 6. Spiral vessel.

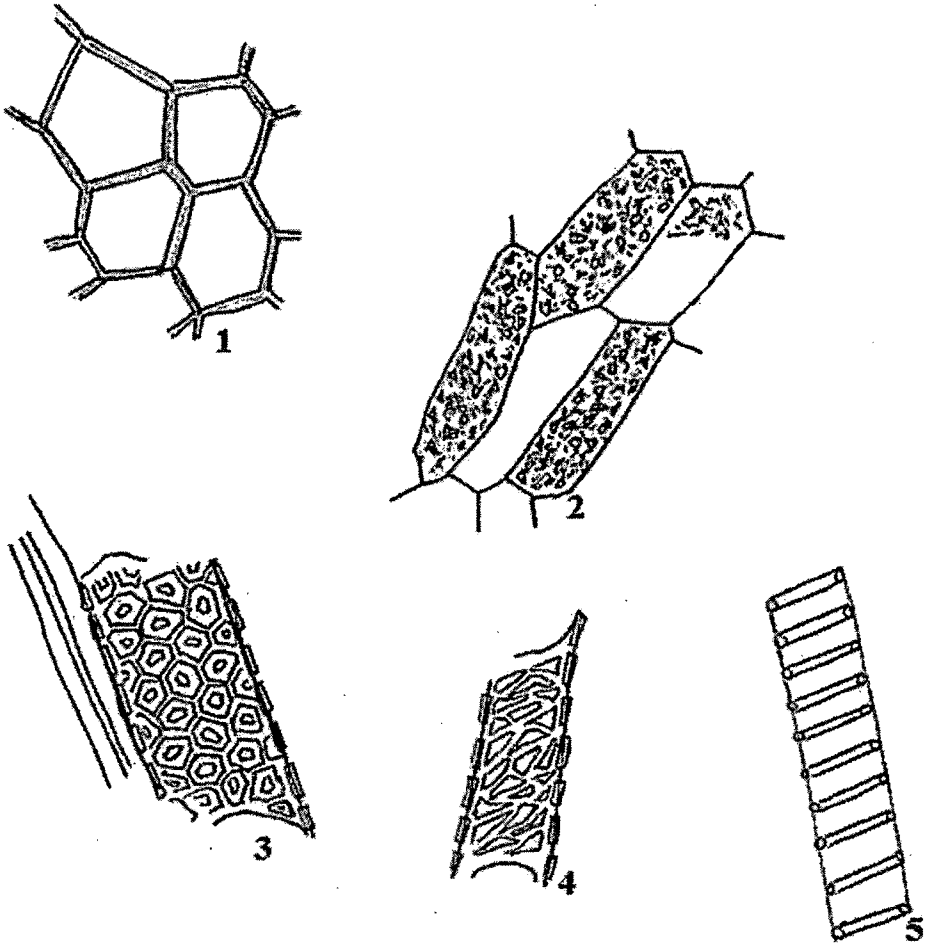


Fig.70. ***Celosia argentea*** **root, powder study:** 1. Cork cells, 2. Parenchyma with microspheroidal crystals, 3.Angular boarded pitted vessel, 4. Scalariform vessels 5. Annular thickened vessels.

Distinguishing features

Phytochemical markers

1. Melilotic acid.
2. *p*-Cournaric acid.
3. Xylose.
4. Absence of flavonoids

Pharmacognostic markers

1. Thick walled brown colour cork cells.
2. Microspheroidal crystals.
3. Angular boarded pitted vessels.
4. Scalariform vessels.
5. Annular thickened vessel

Physico-chemical analysis:

Table :11. Values obtained for the proximate analysis.

Sr.No.	Parameter	Mean ± SD (%)*			Average (%)
		Summer	Monsoon	Winter	
1.	Total ash content	4.33±0.42	4.46±0.51	4.32±0.49	4.37
2.	Acid insoluble ash content	0.93±0.11	0.94±0.09	0.93±0.09	0.93
3.	Alcohol soluble extractives	07.22±0.12	19.47±0.26	19.30±0.19	15.33
4.	Water soluble extractives	29.00±0.32	29.81±0.41	29.13±0.19	29.31

*Each value is a mean of 3 readings.

4.e.*Coleus amboinicus* lour. (Lamiaceae)

Synonyms: ***Coleus aromaticus*** **Benth**

Sanskrit: Karpuravalli, Modayanti, Parnayavani,Pashanabheda, Pashanabhedi, Silabhedha.

Vernacular Names:

Bengali : Patherchur, Pathar Chur, Pashan Bhed.

English : Indian borage, Country borage.

Gujarati : Garmur ni bhaaji, Laanpadi, Lonpadi.

Hindi : Pathorchur, Amroda, Patharchur.

Kannada : Doddipatre.

Malayalam : Iribeli, Kannikkurka, Panikkurkaa.

Marathi : Karmelo.

Punjabi : Suravaali.

Tamil : Karpuravalli, Camparavalli, Omavalli, Muttainari, Ukkirikam.

Distribution and habitat

The plant is an aromatic,succulent perennial herb commonly cultivated in gardens throughout india and found wiled in Rajesthan.

Morphological features.

An erect annual, 3-10 dm high. Stem simple or branched, glabrous, strongly ribbed. Leaves 4-13 by 0.5- 5 cm, oblong-lanceolate or linear-lanceolate or rhombic or ovate, alternate, acute or acuminate at apex, petioles 1-3 cm long; leaf axils often with fulcate small leaves. Spikes usually solitary, pedunculate, cylindric with a conical, straw-coloured apex, sometimes tinged reddish, very dense, upto 10 cm long, 1-2 cm broad. Flowers perfect, the uppermost occasionally sterile, sessile; bracts and bracteoles 2.7 mm long, subequal, ovate, oblong, mucronate, pellucid, 1-nerved, perisistent. Perianth 6-10 mm long; lobes subequal, ovate, concave, mucronate, white or white with pink tip. Stamens 5, 3-5 mm long, united to form a 1.5-2 mm high cup, the free portion longer. Pseudo-staminodes minute, triangular or absent; anthers oblong. Ovary ellipsoid; style 1, 3-6 mm long, usually exceeding the perianth; stigma 2, minute. Fruit an utricle shorter than the perianth, 3-4 mm long, obovoid with rounded apex. Seeds dark reddish-brown, polished, shining.

Medicinal uses:

The plant used to treat malarial fever, hepatopathy, renal and vesical calculi, cough, chronic asthma, hiccough, bronchitis, helminthiasis, colic, convulsions, and epilepsy (Chopra *et al.*,1956, Kirtikar and Basu 1975, Nadkarni,1996).

Previous Phytochemical reports

The phytochemical study reveals the presence of various flavonoids like quercetin, apigenin, luteolin, salvigenin, genkwanin and volatile oil in the leaves (Rastogi and Mehrotra,1979). The main constituents are phenol, 2-methyl-5-(1-methylethyl), β-caryophyllene, γ-terpinene , α-bergamotene, m-cymene, α-caryophyllene, caryophyllene oxide and their isomers (Wang and Chen, 2005).

Previous pharmacognostic reports

Very little work has been done on roots of the plant (Hullatti and Bhattacharjee, 2011). In the present work it has been subjected for the detailed study. The root has been studied both for their phytochemical and pharmacognostic characteristics.

Materials and methods

The plant material has been collected from Pavagadh, Vadodara,Gujarat. Phytochemical analysis of roots of the plant for their secondary metabolites such as alkaloids, flavonoids, phenolics, steroids, quinones, mucilages and other compounds were done by standard methods of chromatography and spectrophotometry described in Chapter 2. Pharmacognostic, HPTLC finger printing and physico-chemical studies were done by using standard methods described in Chapter 2.

Results

Phytochemistry

The roots showed the presence of phenolic acids such as vanillic acid, syringic acid (in high concentration) along with melilotic and gallic acid . Mucilage amounted to 4.8 % consisting of xylose. The roots also showed the presence of unidentified alkaloids and steroids.

Pharmacognosy

Macroscopic characters (Fig.71)

Roots were cylindrical, vertical, slightly tortuous, with many lateral rootlets and gray in colour. Fracture short.

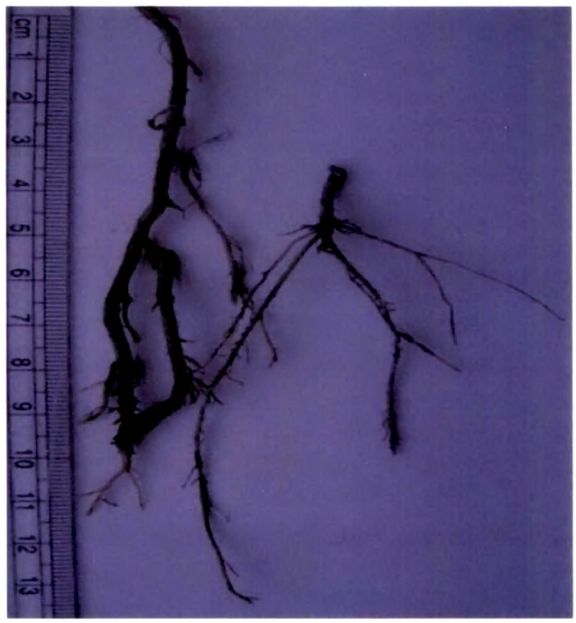


Fig. *Coleus amboinicus* root.

Root : T.S (Fig. 72)

The T.S. of root was circular, showed well developed peripheral cork and wide central wood encircled by few layered secondary cortex . The cork zone consisted of 6 to 13 rows of tangentially elongated thin walled cells, where the phellogen separates outer 6 to 8 layers of phellem from the inner 4 to 6 layers of phelloderm. The outer layers of the cork were broken at places and were thick walled. The phellogen was single layerd . The secondary cortex was a thin zone consisting of 5 to 6 rows of circular to oval shaped, thin walled cells, some of which showed the deposition of reddish brown contents. The cells were loosely arranged with inter-cellular spaces. The phloem was 8 to 10 layered thick made up of usual phloem elements. The phloem were capped by the sclerenchymatous fibers adjoining which

were stone cells. The sclerenchymatous fibers showed both broad and narrow lumen. The stone cells were thick walled and central lumen were unequal . The phloem rays were two celled wide, thick walled, usually tangentially elongated. The wood composed of many vessels, xylem parenchyma, fibres, tracheids and the medullary rays. The vessels were scalariform and bordered pitted. The fibres were thick walled, narrow lumened. Xylem rays were mostly biseriate and the cells were radialy elongated, thick walled with simple pits and few with starch grains. Scalariform vessel showed oblique end walls. The primary xylem showed mostly spirally thickened vessels.

Root : T.L.S (Fig. 73)

The cork cells were thick walled and rectangular in shape. Cortical parenchyma were polygonal in shape. The stone cells were thick walled with unequal lumen and were polygonal in shape. Xylem rays were mostly broad biseriate, spindle shaped wherein the cell walls were thick, pitted and few filled with starch grains.Vessels were scalariform.

Root : R.L.S (Fig.74)

The cortical parenchyma were polygonal in shape and showed the deposition of reddish brown contents. Sclereids were thick and thin walled. Phloem rays appeared rectangular and was elongated. The primary xylem region showed mostly spiral thickenings.

Root : Powder study (Fig. 75)

The components present in the powder were cork cells, fragments of cortical parenchyma with deposits of reddish brown contents, stone cells, ray parenchyma, scalariform vessel with oblique end walls and bordered pitted tracheids.

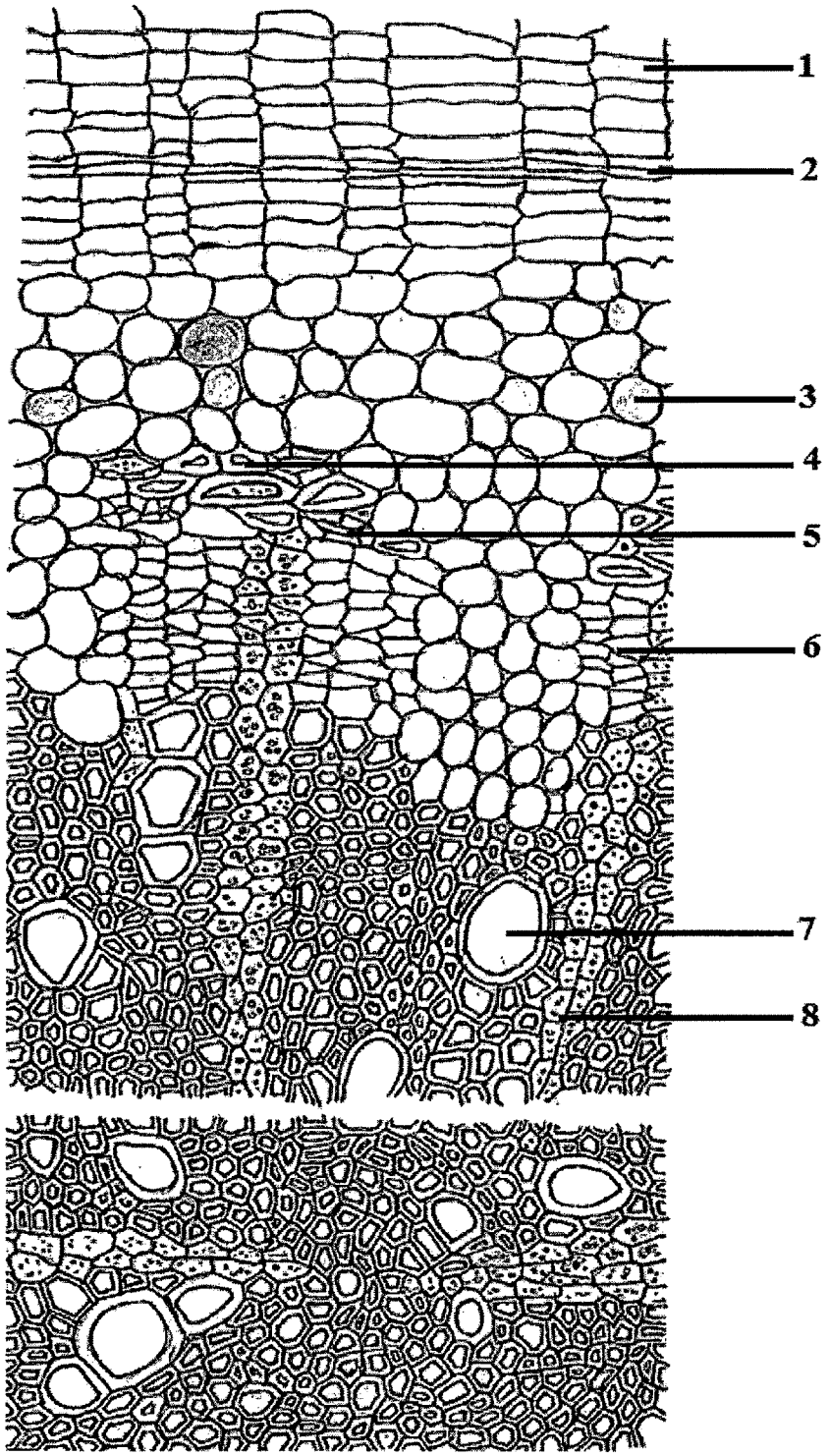


Fig.72.*Coleus amboinicus* root, T.S: 1. Cork, 2. Phellogen, 3. Parenchyma with deposits of reddish brown contents, 4. Sclereid, 5. Stone cell, 6. Phloem, 7.Vessel 8. Xylem rays.

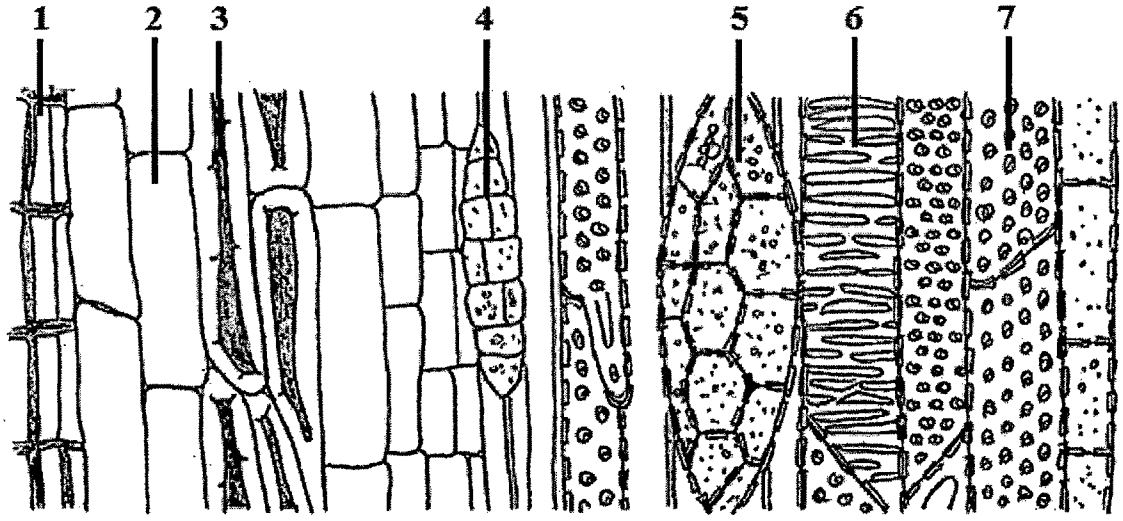


Fig.73.*Coleus amboinicus* root, T.L.S:1. Cork cells, 2. Cortical parenchyma, 3.Stone cell,4. Phloem ray with scanty pits, 5. Xylem rays, 6. Scalariform vessel,7.Bordered pitted vessel.

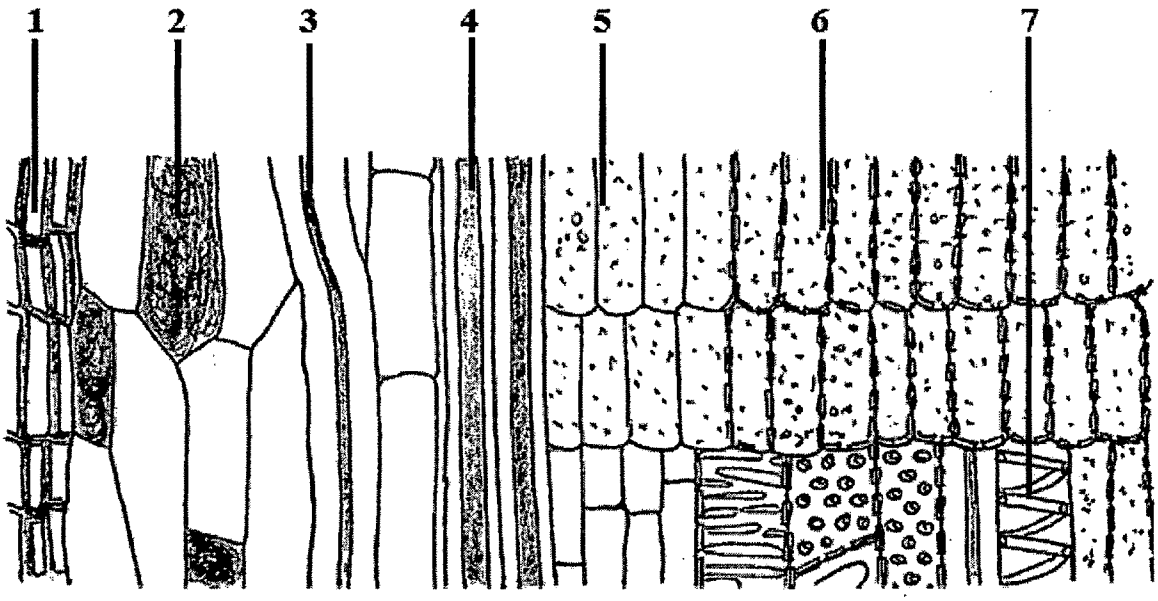


Fig.74.*Coleus amboinicus* root, R.L.S:1. Cork cells, 2. Cortical parenchyma with deposits of reddish brown contents, 3.Thick walled sclereid,4. Thin walled sclereid, 5. Phloem rays,6. Xylem rays, 7.Spiral vessel.

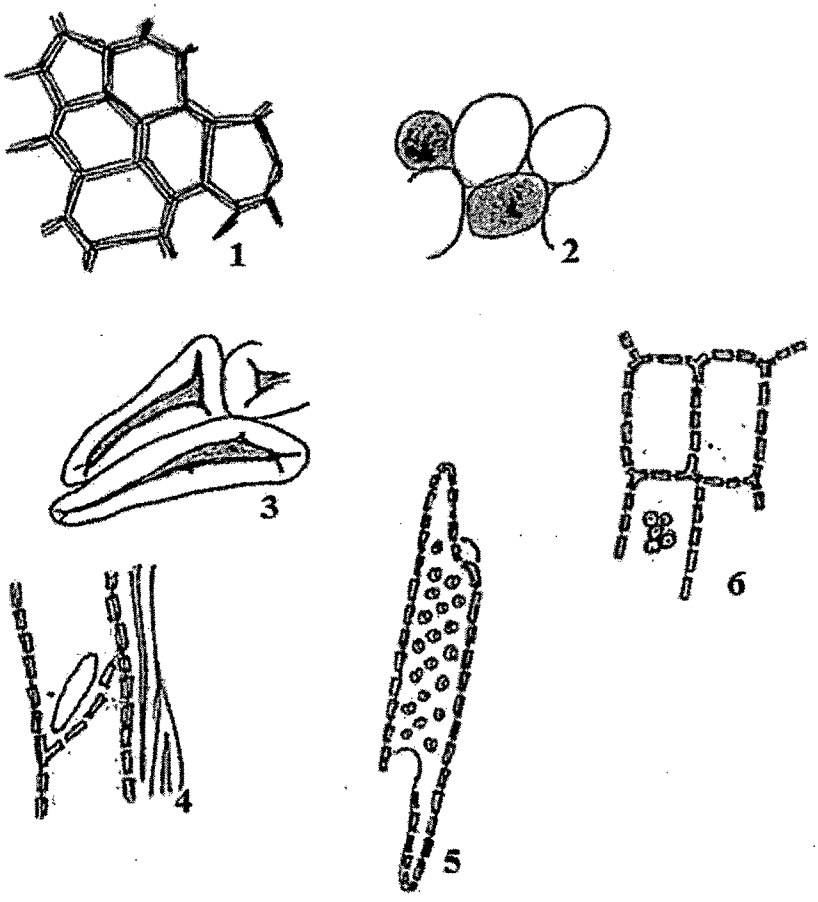


Fig.75. ***Coleus amboinicus*** **root, powder study**: 1. Cork, 2. Cortical parenchyma with deposits of reddish brown contents, 3. Stone cells, 4. Scalariform vessel with oblique end wall, 5.Bordered pitted tracheids, 6. Ray parenchyma.

Distinguishing features:

Pharmacognostic markers

1. Cortical parenchyma with the deposition of reddish brown contents.
2. Stone cells.
3. Thin and thick walled sclereids.
4. Scalariform vessel having oblique end walls.

Phytochemical markers

1. Gallic acid.
2. Vanillic acid.
3. Syringic acid.
4. Melilotic acid.
5. Xylose .

Physico-chemical analysis:

Table :12. Values obtained for the proximate analysis.

Sr.No.	Parameter	Mean ± SD (%)*			Average (%)
		Summer	Monsoon	Winter	
1.	Total ash content	08.93±0.21	08.99±0.12	08.96±0.18	8.96
2.	Acid insoluble ash content	0.97±0.09	0.99±0.10	0.98±0.08	0.98
3.	Alcohol soluble extractive	5.14±0.16	5.23±0.15	4.82±0.11	5.06
4.	Water soluble extractive	12.41±0.33	13..02±0.16	12.58±0.13	12.67

*Each value is a mean of 3 readings

4.f.*Glossocardia linearifolia* Cass.(Asteraceae)

Sanskrit: Charak, Renu, Pithari.

Vernacular names:

English : Rock anethum.

Gujarati : Davanapada.

Hindi :Phattar-Suva, Seri.

Kannada : Parpataka.

Marathi : Phattar-Suva, Seri.

Tamil : Parapalanam.

Telugu : Parapalanamu.

Distribution and habitat

Found in Central India and Deccan Occuring in sandy and rocky tracts.

Morphological features.

The plant is small, prostrate or diffuse, tufted annual. Leaves bipinnatisect; segment narrowly linear. Heads small, yellow, heterogamous, about 8×8 mm. Achenes densely bearded,especially along the edge.

Medicinal uses:

The whole plant is used medicinally in the form of a confection, as an emmenagogue, in cases of suppressed menses, in doses of 1 to 4 drachms. It is useful also in fevers caused by *pitta* and vitiated *vayu* (Nadkarni,1954).

Previous Phytochemical reports

Root of the plant contains an essential oil; leaves, stems and flowers contain a bitter alkaloid (Nadkarni,1954).

Previous pharmacognostic reports

No work has been done on root of this plant. So the root of plant has been subjected for a detailed study.

Materials and methods

The plant material has been collected from Pavagadh, Vadodara,Gujarat. Phytochemical analysis of roots of the plant for their secondary metabolites such as alkaloids, flavonoids, phenolics, steroids, quinones, mucilages and other compounds were done by standard methods of chromatography and spectrophotometry described in Chapter 2. Pharmacognostic, HPTLC finger printing and physico-chemical studies were done by using standard methods described in Chapter 2.

Results

Phytochemistry

The root of this plant showed the presence of flavone acacetin. The phenolic acids located were vanillic, syringic and ferulic (*cis* and *trans* isomers) acids. Mucilage amounted to 4.4 % consisted of xylose. The root also showed the presence of alkaloid and steroids.

Pharmacognosy

Macroscopic characters (Fig.76)

The roots were short, vertical, cylindrical somewhat tortuous and were with few lateral rootlets. The surface were grayish-yellow in colour. Fracture short.

Fig.76 *Glossocardia linearifolia* root

Microscopic characters (Fig.77)

Root : T.S (Fig.78)

The T.S of the root was circular in outline with a large central woody region and narrow cortex and outer bark. The cork consisted of 2 to 5 rows of cells wherein outer one or two rows were thick walled and inner, thin walled, light yellow coloured and tangentially elongated. The phellogen was indistinct. The secondary cortex was made up of polygonal or tangentially elongated thin walled parenchymatous cells. Some of them showed the deposition of reddish-brown contents. The central vascular bundles were surrounded by discontinuous ring of pericycle. The pericyclic fibers were 3 to 4 cell wide and found associated with stone cells at periphery. Both

pericyclic fibers and stone cells were thin and thick walled. The stone cells were mostly cubical to rectangular (180µm X35µm)with broad lumen, distinct prominent pits on their walls and without striations. Few stone cells with different shapes also present. The phloem composed of sieve elements and parenchyma , traversed by phloem rays; phloem rays 1-2 cells wide and were thin walled, isodiametric to slightly radially elongated. Wood consisted of fibres, tracheids, vessels and xylem parenchyma, traversed by xylem rays. Vessels were short (12-18µm) and mostly occurred singly with multiseriate simple and boarded pits. The tracheids were narrow (35 µm).The fibres were linear with blunt ends and broad lumen. Xylem rays uni to biseriate, thick-walled, cells radially elongated and pitted. The primary xylem showed the spiral vessels.

Root : T.L.S (Fig.79)

Cork cells appeared rectangular and walls were thick and wavy. The cells of the cortex were also appeared rectangular as of cork, but were larger in size. The stone cells showed distinct prominent pits on their walls. The phloem rays were thin walled. Xylem rays were fairly thick walled, oval and simple pitted. Tracheids contained 2 to 3 rows of bordered pits. The vessels had bordered pits and arranged alternately followed by broad lumen fibers.

Root : R.L.S (Fig.80)

Cork cells appeared rectangular with light yellow coloured, thick, wavy walls. The cortical parenchyma showed deposition of reddish-brown contents. The pericyclic fibers were narrow lumened. Xylem rays were thick walled, rectangular and simple pitted. The tracheids were narrow.

Root : Powder study (Fig.81)

The components present in the powder were cork with thick light yellow coloured wavy walls, cortical parenchyma with reddish-brown deposition, thin and thick walled stone cells, thick walled ray parenchyma with pits, blunt ends and broad lumen fibre, boarded pitted vessel adjoining tracheids.

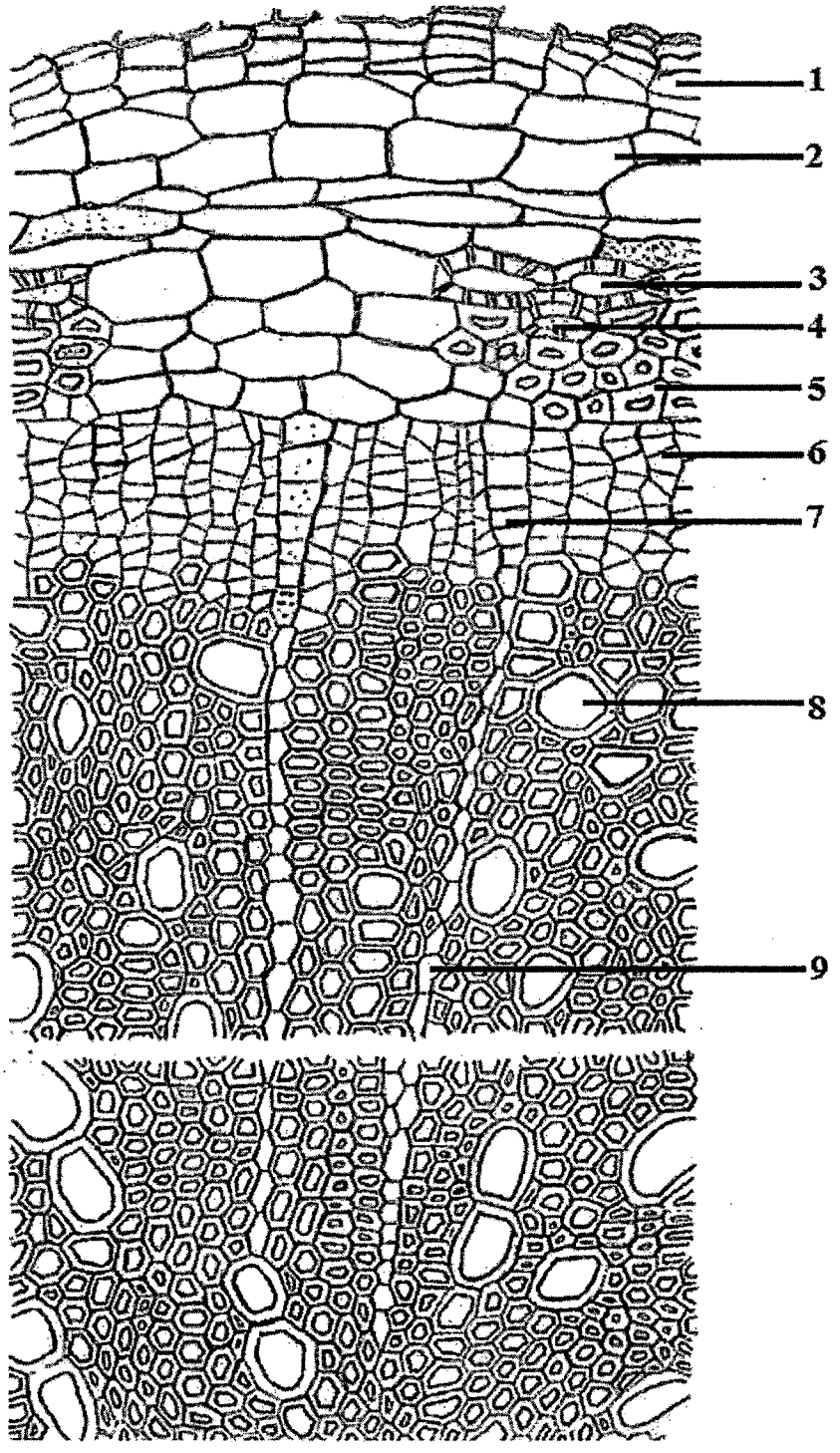


Fig.78.*Glossocardia linearifolia* root, T.S: 1. Cork, 2. Cortical parenchyma, 3.Stone cell, 4. Stone cell with narrow lumen, 5. Pericyclic fiber, 6. Phloem, 7. Phloem ray, 8. Vessel, 9. Xylem ra.

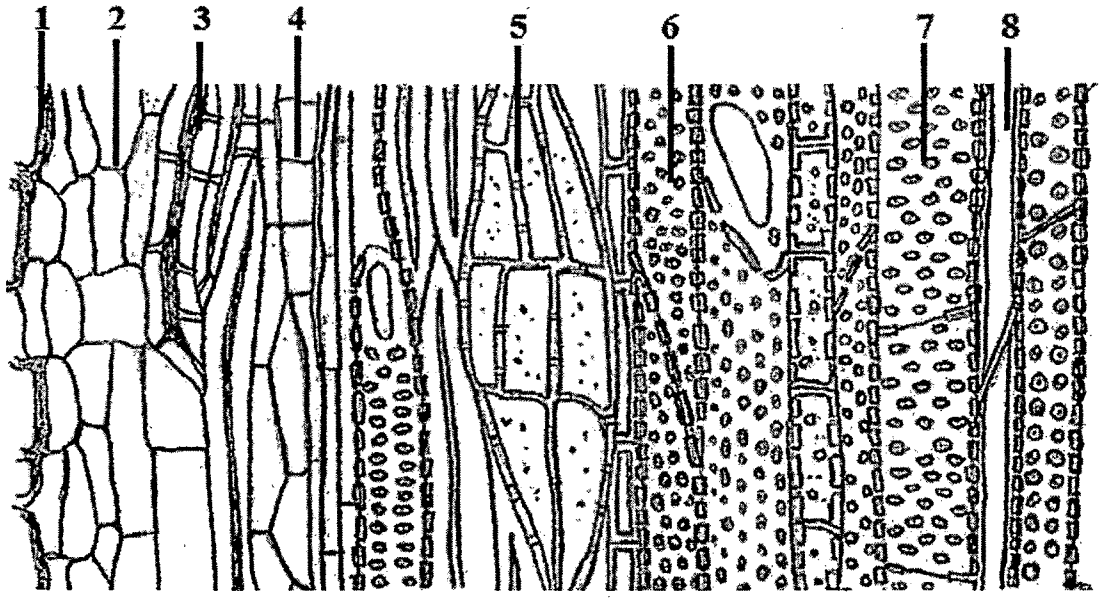


Fig.79. *Glossocardia linearifolia* root, T.L.S: 1. Cork, 2. Cortical parenchyma, 3. Stone cell with broad lumen, 4. Phloem ray, 5. Xylem rays, 6.Tracheid, 7. Bordered pitted vessels, 8.Broad lumen fiber.

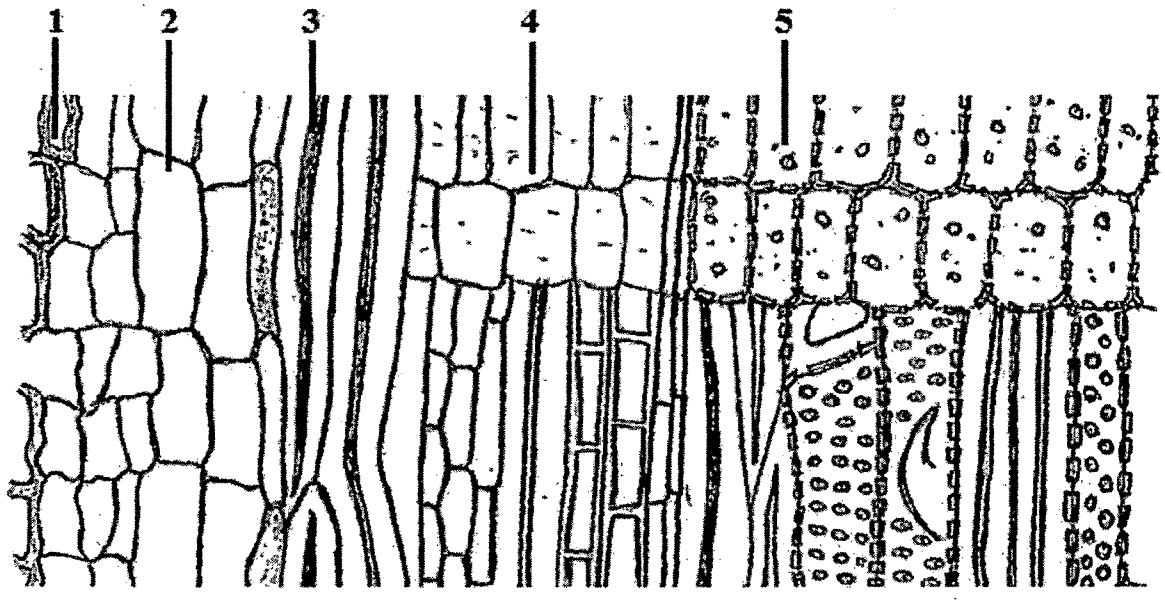


Fig.80. *Glossocardia linearifolia* root, R.L.S: 1. Cork, 2. Cortical parenchyma, 3. Pericyclic fiber, 4. Phloem ray, 5. Xylem ray.

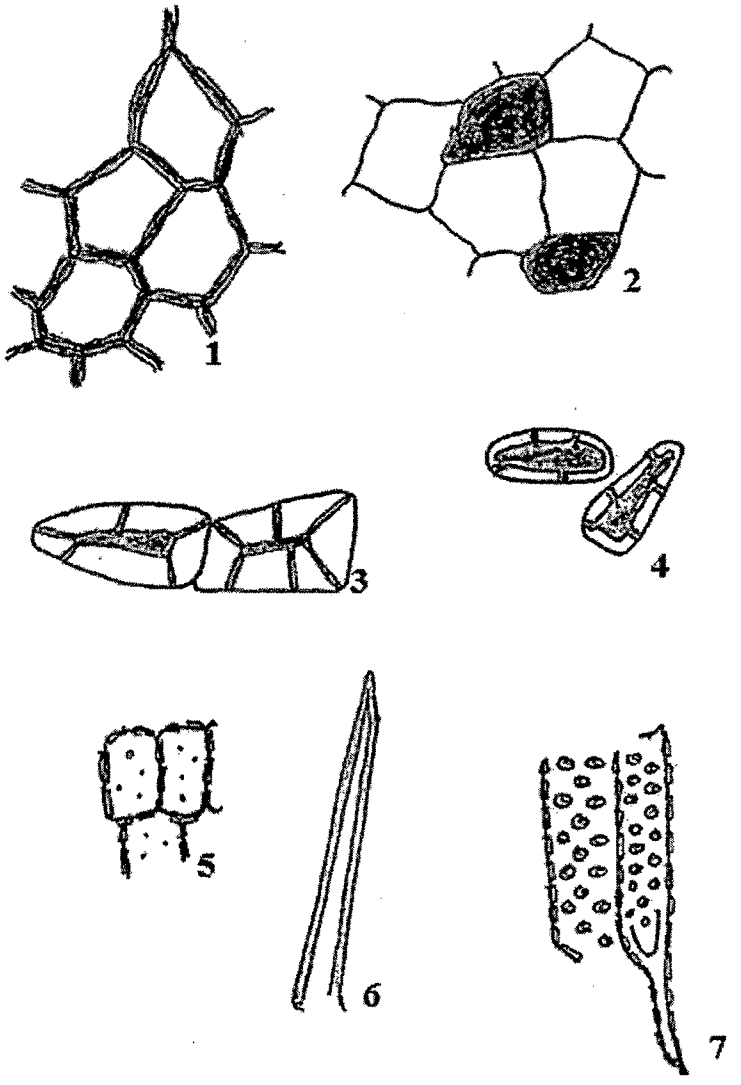


Fig.81.*Glossocardia linearifolia* root, powder study: 1.Cork with thick, light yellow coloured wavy walls, 2.Cortical parenchyma with reddish-brown deposition, 3. Thick walled stone cells, 4. Thin walled stone cells, 5. Thick walled ray parenchyma with pits, 6.Blunt ends and broad lumen fibre, 7.Boarded pitted vessel adjoining tracheids.

Distinguishing features

Phytochemical markers

1. Flavone acacetin.
2. Vanillic acid.
3. Syringic acid.
4. Ferulic (*cis* and *trans* isomers) acid.

Pharmacognostic markers

1. Cork with thick light yellow coloured wavy walled cork cells.
2. Cortical parenchyma with reddish-brown deposition.
3. Stone cells.
4. Thick walled ray parenchyma with pits.
5. Blunt ends and broad lumen fibres.

Physico-chemical analysis:

Table :13 Values obtained for the proximate analysis.

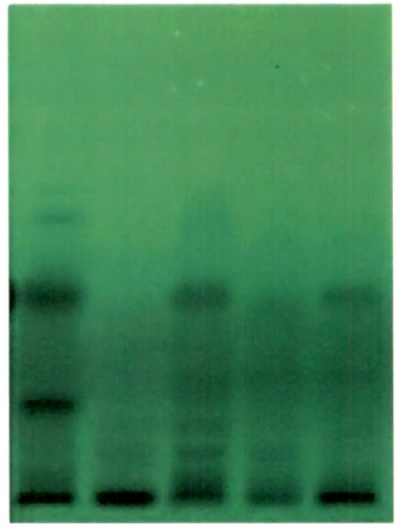
Sr.No.	Parameter	Mean ± SD (%)*			Average (%)
		Summer	Monsoon	Winter	
1.	Total ash content	06.33±0.18	06.48±0.11	06.16±0.28	6.32
2.	Acid insoluble ash content	0.57±0.10	0.59±0.13	0.57±0.09	0.58
3.	Alcohol soluble extractive	9.24±0.14	9.69±0.19	9.22±0.17	9.38
4.	Water soluble extractive	16.99±0.18	16.89±0.21	17.11±0.09	17.00

*Each value is a mean of 3 readings

4.g. HPTLC fingerprinting and Physo-chemical analysis of *Bergenia ligulata* and its substitutes/adulterants

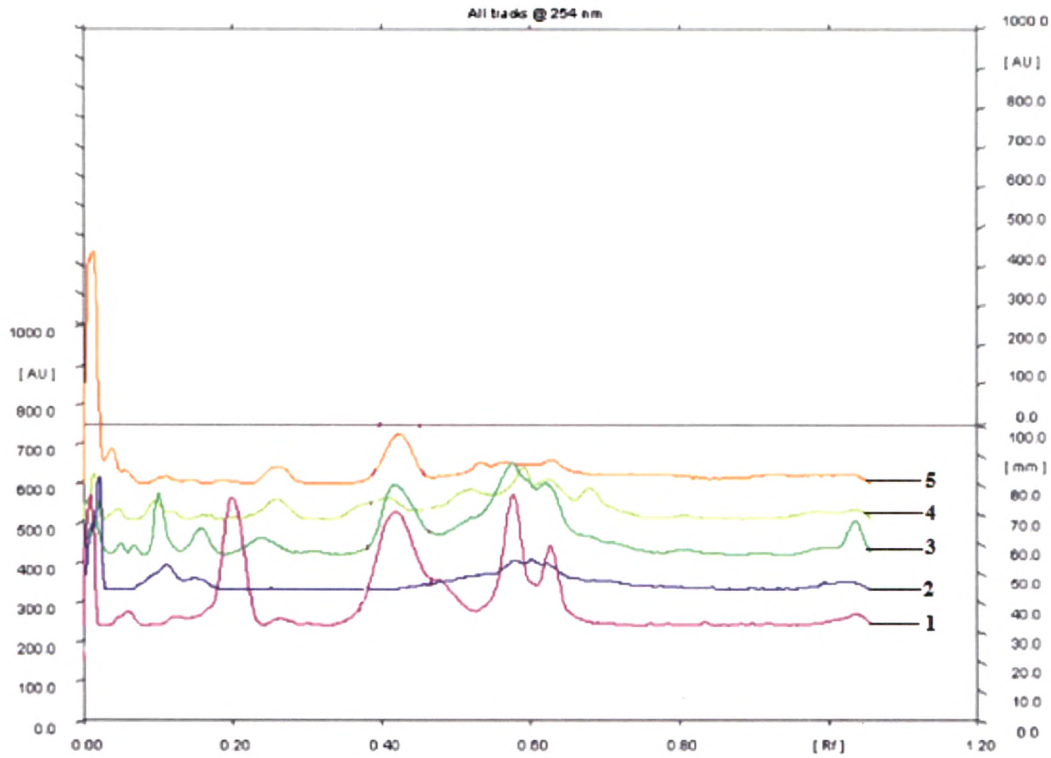
HPTLC fingerprinting

Figure 82.a : HPTLC chromatogram of *Bergenia ligulata* and its substitutes/adulterants (UV 254 nm).



(a).T1- *Bergenia ligulata,* T2- *Glossocardia linearifolia,* T3-*Coleus amboinicus,* T4-*Aerua lanata,* T5-*Ammannia baccifera.*

Figure 82.b : HPTLC chromatogram of *Bergenia ligulata* and its substitutes/adulterants (UV 254 nm).



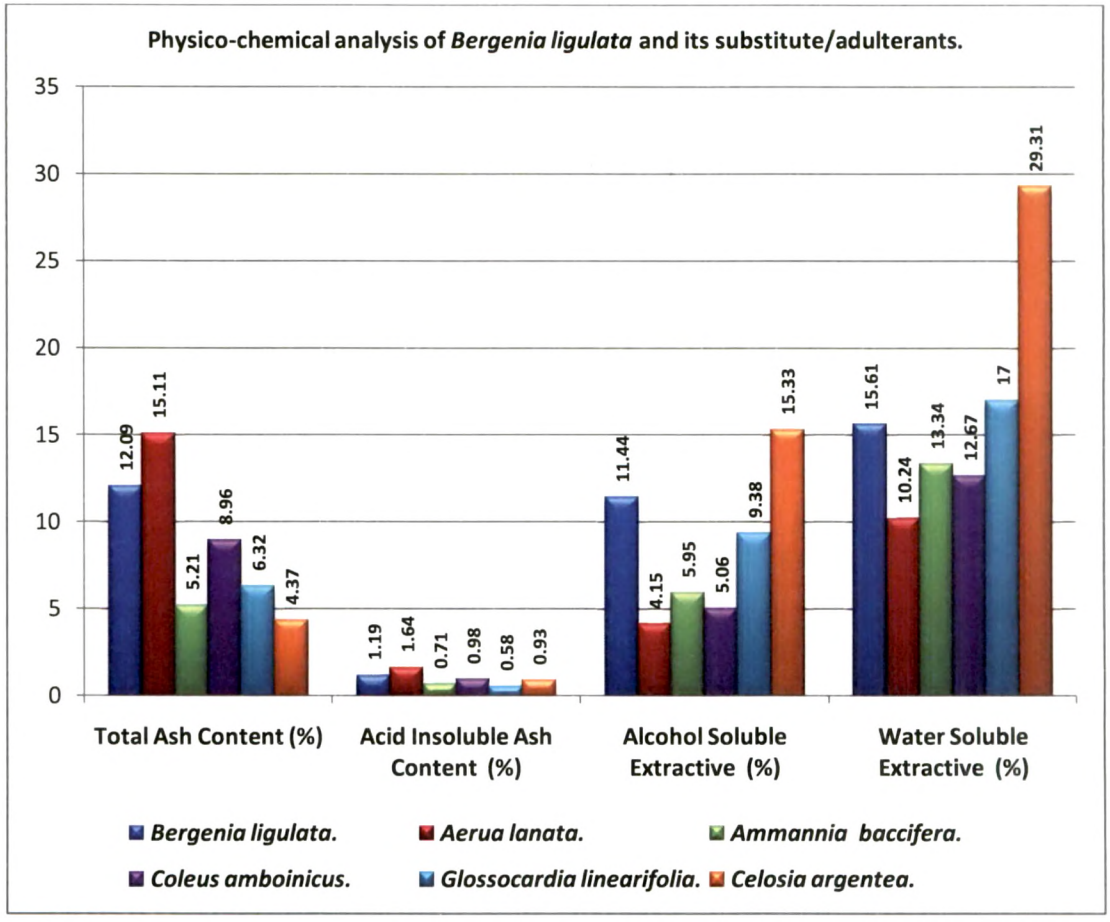
(b). 1- *Bergenia ligulata,* 2-*Glossocardia linearifolia,* 3-*Coleus amboinicus,* 4-*Aerua lanata,* 5-*Ammannia baccifera.*

HPTLC profile observed under UV 254 nm (figure82.b) the *Bergenia ligulata* showed the presence of 9 peaks and the major peaks were found at R_f 0.01, R_f 0.20, R_f 0.42, R_f 0.57 and R_f 0.63. The *Glossocardia linearifolia* also showed the presence of 9 peakes while *Coleus amboinicus, Aerua lanat* and *Ammannia baccifera* showed the 11,14 and 8 peaks respectively. *A. baccifera* was similar in 5 peaks and differed in 3 peaks *C. amboinicus* and *A. lanata* were found similar in 4 peaks but *C. amboinicus* differed in 7 peaks and *A. lanata* in 10 peaks while *G. linearifolia* was not show any peak similar to that of *B.ligulata* but differed in having 9 peaks.

HPTLC studies on *Celosia argentea* could not be conducted beacause of the great viscosity of the extract.

Physico-chemical analysis

Physico-chemical analysis of *Bergenia ligulata* and it substitutes/adulterants



Total ash content

Total Ash Content of *Bergenia ligulata* (12.09 %) along the material collected in different season does not show significant variation (Table-8) while the closest value to the substitute/adulterant in descending order is 15.11% (*Aerua lanata*), 8.96% (*Coleus amboinicus*), 6.32% (*Glossocardia linearifolia*), 5.21% (*Ammannia baccifera*) and 4.37% (*Celosia argentea*).

Acid insoluble ash content

Acid insoluble ash content of *Bergenia ligulata* (1.19 %) along the material collected in different season does not show significant variation (Table-8) while the closest value to the substitute/adulterant in descending order is 0.98%, 0.93%, 1.64%, 0.71% and 0.58% of *Coleus amboinicus* , *Celosia argentea*, *Aerua lanata*, *Ammannia baccifera*, and *Glossocardia linearifolia* respectively.

Amongst all substitutes/adulterants of *B. ligulata* , the *A. lanata* showed the closest value of total ash content which showed that the *A.lanata* was more close to *B. ligulata* as compared to other substitutes/adulterants of *B. ligulata.*

Alcohol soluble extractive

Alcohol soluble extractive value of *Bergenia ligulata* (11.44 %) along the material collected in different season does not show significant variation (Table-8) while the closest value to the substitute/adulterant was of *Glossocardia linearifolia* (9.38%), but the *Celosia argentea* showed the maximum extraction (15.33%) while values of *Ammannia baccifera, Coleus amboinicus* and *Aerua lanata* was found to be 5.95%,5.06% and 4.15% respectively.

Water soluble extractive

Water soluble extractive value of *Bergenia ligulata* (15.61 %) along the material collected in different season does not show significant variation (Table-8) while the closest value to the substitute/adulterant was of *Glossocardia linearifolia* (17.0%), but the *Celosia argentea* showed the maximum extraction (29.31%) while values of *Ammannia baccifera, Coleus amboinicus* and *Aerua lanata* was found to be 13.34%, 12.67% and 10.24 % respectively.

Amongst all substitutes/adulterants of *Bergenia ligulata* , the *C. argentea* showed the maximum extraction of phytoconstituents which reflect that the *C.argentea* could be chemically rich as compared to other substitutes/adulterants of *B. ligulata.*