Chapter 5

5.a.*Glycyrrhiza glabra* Linn (Fabaceae)

Synonyms : *Liquiritae officinalis Moench.*

Sanskrit names: Yasti, Yastimadhuka, Madhuka, Madhuyasti, Yastika, Yastyahva.

Vernacular names:
Assamese : Jesthimadhu, Yeshtmadhu.

Bengali : Yashtimadhu.

English : Liquorice root.

Gujrati : Jethimadha, Jethimard, Jethimadh.

Hindi : Mulethi, Mulathi, Muleti, Jethimadhu, Jethimadh.

Kannada : Jestamadu, Madhuka, Jyeshtamadhu, Atimadhura.

Kashmiri : Multhi.

Malayalam : Irattimadhuram.

Marathi : Jesthamadh.

Oriya : Jatimadhu, Jastimadhu.

Punjabi : Jethimadh, Mulathi.

Telugu : Atimadhuramu.

Urdu : Mulethi, Asl-us-sus.

Distribution and habitat

It is distributed in the Sub-tropical and warm temperate regions of the world, chiefly in the Mediteranean countries, South Europe, Asia Minor, Egypt, Turkistan, Iran, Siberia, Persia, Arab countries and Afganistan. In India, it is reported to be cultivated in Baramulla, Srinagar, Jammu, Dehradun, Delhi and South India.

Morphological features

The plant is an erect perennial shrub. Its principal or primary root does not generally grow deep but gives off a number of long tuberous secondary roots which may reach a length of four feet or more. The shoot system consists of an erect stem with a limited number of strong herbaceous branches which bear alternate odd pinnate leaves with five to seven pairs of ovate-oblong entire pale greenish leaflets. It also produces a number of long slender somewhat succulent stoloniferous under-ground branches (rhizomes) which spread out in all directions. and reach four to six feet in length.The flowers are medium sized, sessile, purplish-blue, or pale violet and

typically papilionaceous and the fruits are straight compressed or flattened oblong to linear echinate glandular pods one half to one and a half inches long, containing several kidney shaped seeds.

Medicinal uses

The roots are sweet, refrigerant, emetic in large doses, tonic, diuretic, demulcent,mild laxative, aphrodisiac, trichogenous, expectorant, emmenagogue, alexipharmic, haemostatic, alterant and intellect promoting. They are useful in hyperdipsia, cough, bronchitis, ulceration of urinary tract, retention of urine, gastralgia, gastric ulcer, cephalagia, fever, skin diseases, ophthalmic diseases, pharyngitis, haemorrhoids, consumption, hoarseness of voice, epilepsy, hiccough, erysipelas, anaemia, meno-metrorrhagia, intrinsic haemorrhage, hemicrania, urticaria. Decoction of root is good wash for falling and greying of hair. It is externally applied for cuts and wounds (Anon. 2005).

Previous phytochemical reports

Glycyrrhizine, prenylated biaurone, licoagrone; 7- acetoxy- 2- methyl-isoflavone, 7- methoxy- 2- methylisoflavone and 7- hydroxy- 2 methyl isoflavone; 4-methyl coumarin, liqcoumarin; isoflavone, glyzaglabrin (7,2'- dihydroxy 3',4'-methylenedihydroxy isoflavone); quercetin, quercetin-3- glucoside, kaempferol, astragalin, liquiritigenin and isoliquiritigenin (root). Other constituents reported include a flavanone rhamnoglucoside, chalcone glucosides, trans-isoliquiritigenin-4'-β-D-glucopyrano (isoliquiritin) and trans-isoliquiritigenin-4-ß-D-glucopyranoside (neoisofiquiritin); 7-hydroxy-4'-methoxyisoflavone (formetin),licuraside, liquiritoside, rhamnoliquiritin, triterpenoid, liquoric acid, 11-deoxoglycyrrhetic acid, liquiritic acid, isoglabrolide, glabrolide, deoxoglabrolide, glycyrrhizic acid, glycyrrhetol, 21α- hydroxy- 11- deoxyglycyrrhetic, and 24- hydroxyglycyrrhetic acids, 18α-ahydroxy glycyrrhetic acid, olean-12-en-3ß-o1-30 oic, olean- 11, 13 (18)-dien3ß-o1-30 oic acid, glabranine (5,7-dioxy-8-3 (3', 3'- dimethylallyl- flavanone), pinocembrin, prunetin, 4- hydroxy chalcone, liquiritigenin, licoflavonol (6- γ-γ-dimethylallylkaempferol), kuniatakenin, glycerol, licoricone, glabridirt, glabrol, liqurazid, liquiritin, 3-hydroxyglabrol, 4'-0-methyl glabridin, 3'-methoxyglabridin, glycyrrhetinic- acid; methyl olean-11,13 (l8)-diene-3, 24- dio1-30-oate, glabranine, forniononetin, glabrene, saponaretin (isovitexin), 24- hydroxy-11-deoxyglycyrrhetic acid, methyl olean 11, 13 (18) diene-3, glycerrhetol, 21α-hydroxy

isoglabrolide, licoflavonol, gly7arin, glyzaglabrin, licoisoflavones A, B and licoisoflavon, glycyrin, sugars and aspargin (root and other plant parts)(Anon.2005)

Previous pharmacognostic reports

Though T.S of root was described earlier (Anon.1990 & Anon.1999), here a more detailed investigation was done with the help of T.L.S, R.L.S and powder microscopy

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

Along with reported glycyrrhizin the root also showed the presence of good no.of phenolic acids such as vanillic, syringic, ferulic (*cis*- and *trans*-isomers) and *p*-coumaric acids. Mucilage amounted to 8.6 % consisting of galactose. The root also showed the presence of unidentified alkaloids and steroids.

Pharmacognosy

Macroscopic characters

The root was cylindrical and woody. The outer surface was yellowish brown to dark brown in colour and showed longitudinal wrinkles. Fracture fibrous , odour distinc, taste slightly acrid and sweet.

Microscopic characters

Root : T.S (Fig.83)

Cork, the outermost tissue, composed of 3 to 6 rows of thin walled, rectangular tangentially elongated cells with reddish brown contents of which the outermost one or two rows of cells were slightly ruptured and light brown in colour.A phellogen composed of a single row of narrow, thin walled, tangentially elongated cells. The phelloderm was not differentiated clearly. Cortex was made of narrow zone of thin walled parenchymatous cells. The cells were round to oblong in shape with some of having single monoclinic prisms (prismatic crystals) of calcium oxalate in

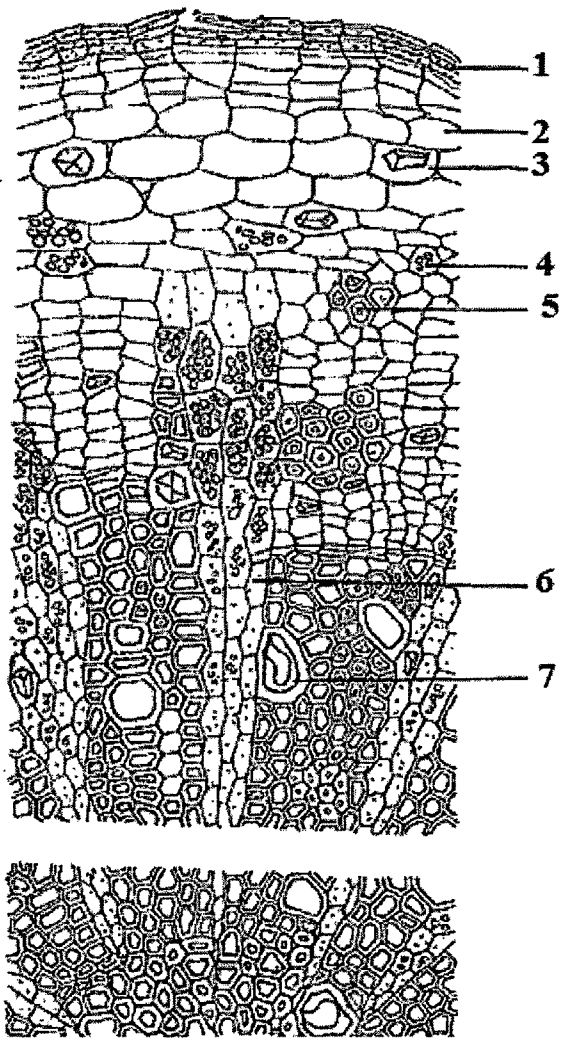


Fig.83.*Glycyrrhiza glabra* root, T.S: 1. Cork, 2. Cortex, 3. Parenchyma with prismatic crystals, 4. Starch grains, 5. Bast fibres, 6. Xylem rays,7. Vessels.

each cell. The bast was composed of an outer region wherein patches of bast fibres alternated with the regular phloem elements. Each patch of bast fibre contained up to abought 50 fibres. The bands of medullary rays present here is quite broad formed wedge shaped. The cambium was a distinct narrow band. The wide zone of wood composed mostly of secondary xylem. The wood consisted of vessels and patches of fibre tracheids alternating with patches of libriform fibres. Vessels showed presence of tyloses. The rays were filled with starch grains and prismatic crystal occasionally.

Root : T.L.S (Fig.84)

Cork cells appeared rectangular with brown contents. Large polygonal parenchyma contained prismatic crystal. The bast fibres were with a medium sized lumen. The rays were spindle shaped wherein the cell walls were pitted and filled with starch grains. The tracheids were with 2-3 rows of bordered pits. Vessels were many in number, having straight end walls showing bordered pits and reticulated thickened. In certain vessels, bordered pits were in compact rows and the pits were angular.

Root : R.L.S (Fig.85)

The phloem rays were upright and rectangular in shape and each cell was filled with starch grains. Here the bast fibres were found associated with prismatic crystals. Vessels showed the presence of tyloses.

Root : Powder study (Fig.86)

The components present in the powder were of cork of two types, parenchyma containing prismatic crystals and starch grains, crystals fibres, phloem fibres, vessels with angular bordered pits and reticulate thickened.

The rhizome of *G. glabra* which also used in medicine is similar to the root in almost all aspects,but differs in having a moderstely large pith in the centre.

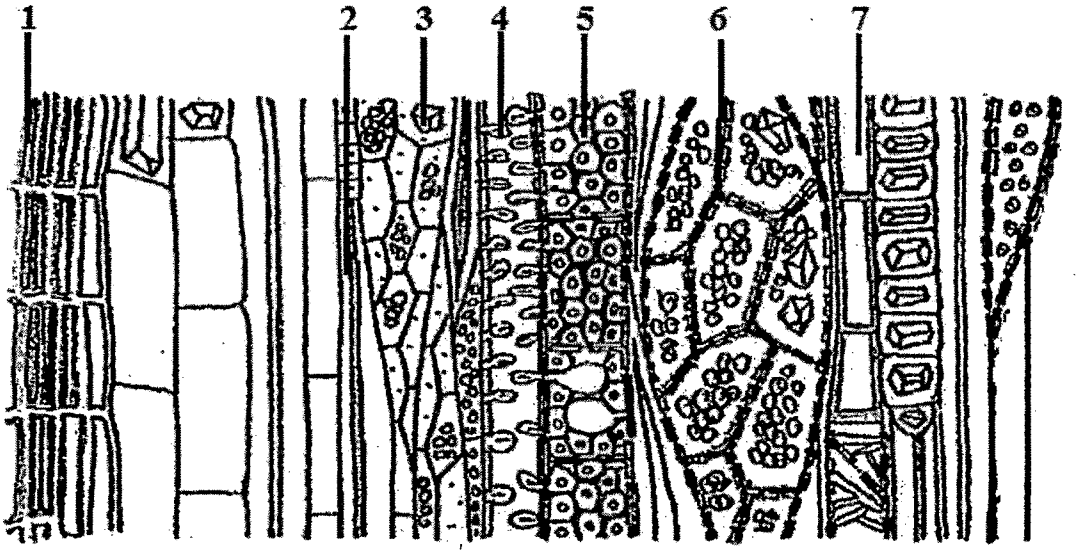


Fig.84.*Glycyrrhiza glabra* root, T.L.S:1.Cork, 2.Phloem fibres,3.Phloem rays,4. Trachieds, 5. Vessels with tyloses, 6. Xylem rays.7.Wood parenchyma.

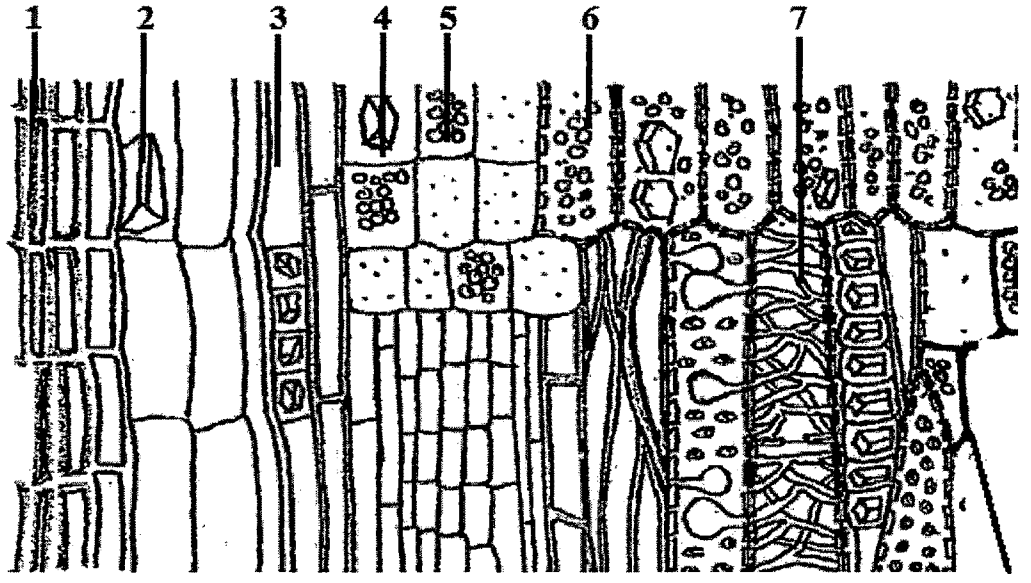


Fig.85.*Glycyrrhiza glabra* root, R.L.S:1.Cork, 2.Prismatic crystals, 3.Crystal fibres,4.Phloem rays with prismatic crystals, 5.Phloem rays with starch grains, 6.Xylem rays, 7. Reticulate thickened vessels.

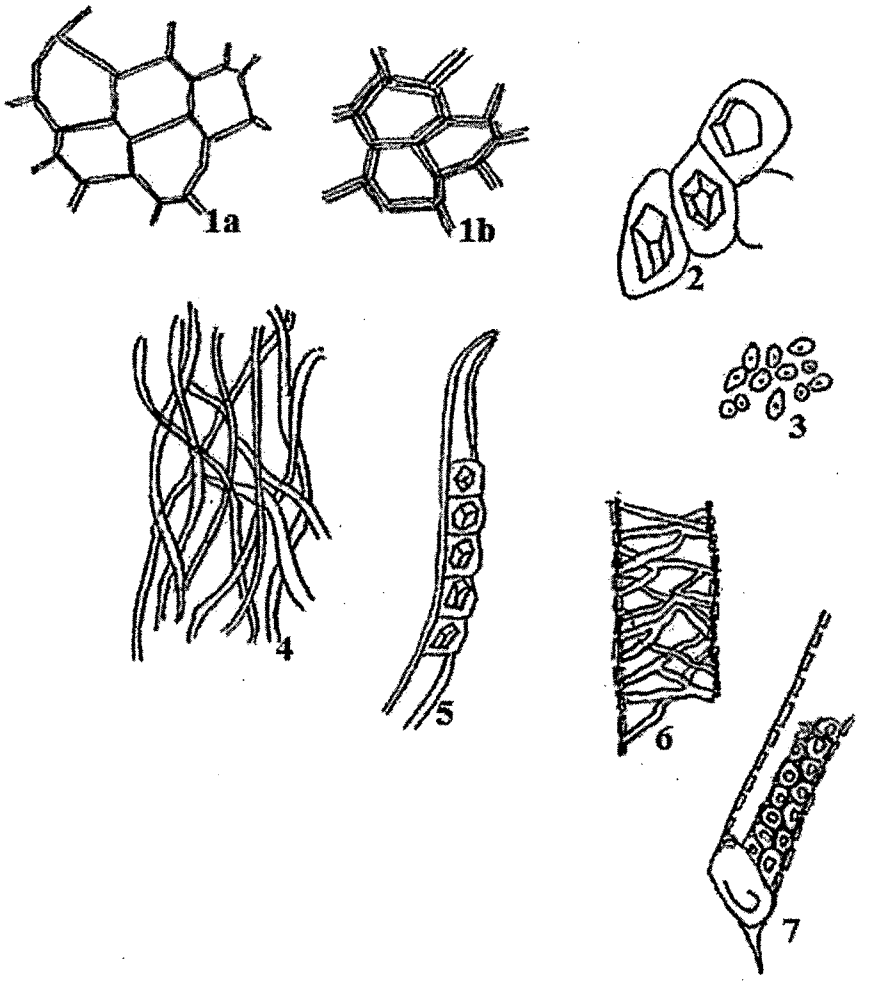


Fig.86.*Glycyrrhiza glabra* root, Powder study: 1.Cork a) Thin walled b) Thick walled, 2. Prismatic crystals, 3. Starch grains, 4. Phloem fibres, 5. Crystal fibres, 6. Reticulate thickened vessels. 7. Angular bordered pits in vessels.

Distinguishing features

Phytochemical markers

1. Ferulic (*cis*- and *trans*-isomers) acid.
2. *p*-Coumaric acid.

Pharmacognostic markers

1. Two types of cork cells i) thin walled and ii) thick walled.
2. Starch grains
3. Prismatic crystals.
4. Crystal fibres.
5. Vessels bordered pitted and reticulate thickened
6. Angular bordered pits in vessels
7. Presence of tyloses.

Physico-chemical analysis:

Table :14. Values obtained for the proximate analysis.

Sr.No.	Parameter	Mean ± SD (%)*			Average (%)
		Summer	Monsoon	Winter	
1.	Total ash content	06.31±0.19	06.26±0.20	06.29±0.16	6.29
2.	Acid insoluble ash content	01.69±0.21	1.73±0.33	01.69±0.26	1.70
3.	Alcohol soluble extractive	20.36±0.16	20.48±0.11	20.42±0.14	20.42
4.	Water soluble extractive	24.21±0.33	24.30±0.34	20.31±0.31	22.94

*Each value is a mean of 3 readings.

5.b.*Abrus precatorius.* Linn. (Fabaceae)

Sanskrit : Angaravalli, Aruna, Bhilabhushana, Gunja, Gunjika, Kaka, Kakachinchi.

Vernacular names:

Assamese : Latuwani , Aainuddik, Ratti Surkh.

Bengali : Kunch, Kawet.

English : Indian Liquorice,Coral Pea, Crab S Eye, Lucky Or Paternoster Bean.

Gujrati : Chanoti, Rati.

Hindi : Gunj, Chirmiti, Gaungchi, Gunja, Kunch, Rati, Tatti.

Kannada : Galaganji, Haga.

Malayalam: Atimadhuram,Cekkunni,Irattimadhuram,Kakani,Klitakam,Kunni.

Manipuri : Chaning.

Marathi : Gunj, Khaksi, Gunja.

Oriya : Runjo.

Persian : Chashmkhuros, Chashmekharush, Chashmkuros, Chashme-Khuros, Surkh.

Tamil : Gundumani, dimaduram, Adingam, Adisamiyai, Uyar, Uyarvukkoti.

Telugu : Atimadhuramu, Gurija, Gurivenda, Guruginja, Kukkutamu, Raktika, Mukkutamu.

Tibetan : Ma Ru Rtse, O La Mase Dmarpo.

Urdu : Ghunchi, Tukhm Kunch, Maghz Tukhm Kunch, Ghunchchi.

Distribution and habitat

This is a common plant occurring wild, found throughout tropical India and other warm countries from sea level up to 3000 feet under mesophytic conditions; seldom cultivated.

Morphological features.

A deciduous, wiry climber with tough branches: leaves abruptly pinnate with many pairs of leaflets, the rachis ending in a spine; the leaflets oblong, rounded at both ends, thinly membranous; flowers pink, clustered on tubercles arranged along the rachis of one-sided pedunculate raceme; fruits with a sharp deflexed beak; seeds usually scarlet with a black spot or sometimes pure white.

Medicinal uses:

The roots and leaves are astringent, sweet, emetic, diuretic and alexeteric. They are useful in cough, pharyngodynia, pectoralgia, inflammation, strangury and in vitiated conditions of vata.(Vaidyaratnam *et al.*, 1994).

Previous Phytochemical reports

The roots contain glycyrrhizin, the active principle of liquorice(Anon.1948), abrasine,abrol (Khaleqe *et al.*, 1966), choline, hypaphorine, precatorine(Ghosal *et al.*, 1971),abrine.(Ghosal *et al.*, 1971 & Karawaya *et al.*, 1980), abruquinones(Kuo *et al.*, 1995 & Kuo *et al.*, 1999), abrusgenic acid, methyl abrusgenate, abruslactone A(Chiang *et al.*, 1983), 7,5-dihydroxy-6,4-dimethoxy isoflavone and 7-*O*-*β*-D-galactopyranoside(Saxena *et al.*, 1999).

Previous pharmacognostic reports

Only the T.S of the root has been done (Anon.1999 & Gupta *et al.*,2008) but study of T.L.S and R.L.S is remaining to be done. So a detailed study is conducted on root of the plant.

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, ferulic (*cis*- and *trans*-isomers), melilotic, *p*- coumaric and *o*-coumaric acids. Mucilage amounted to 7.3% consisting of galactose. The root also showed the presence of unidentified alkaloids and steroids while coumarins and saponins were found in good concentrations.

Pharmacognosy

Macroscopic characters (Fig. 87)

The roots were vertical with few lateral roots, woody, cylindrical somewhat tortuous with minutely lenticellate warty surface and light brown in colour; odour not very particular. Taste faintly sweet. Fracture outer splintery, inner somewhat fibrous.

Fig.87. *Abrus precatorius* root.

Microscopic characters

Root : T.S (Fig. 88)

The outermost layer of the cork (28 to 48μ) consisted of 4 to 9 rows of rectangular to slightly tangentially elongated cells with yellowish-brown contents. The cells were tightly fitted together one above the other and without intercellular spaces. The outer layers of the cork were broken at places. The phellogen was indistinct. The cortex was a thin zone consisting of two to four rows of tangentially elongated large cells, some of which contained starch grains and a few prismatic crystals and was characterized by the presence of prominent, ring of sclereids, composed of oblong, ovoid or radially elongate stone cells with thick pitted walls. Some of them contained starch grains. Adhering to both the inner and outer margins of this ring and spaced at short intervals were parenchyma cells found containing prismatic crystals. The bast made up of usual elements and the cells of outer layers were comparatively large in size then that of inner layers. Here there were groups of bast fibres composed mostly of 2 to 4 or more tangential bands of thick walled

(double layered) gelatinous fibre groups, alternating with the regular phloem elements and being intercepted radially by the medullary rays. The wood was composed of many vessels, xylem parenchyma, fibre tracheids and the medullary rays. The wood fibres found in patches alternating with parenchyma, The vessels occurred mostly in pairs. Medullary rays were bi-seriate to multi-seriate (upto 12 rows) and most of the cells were packed with starch grains while a few other contained prismatic crystals of calcium oxalate. The ray cells were fairly thick walled and having simple pits on their walls and were usually tangentially elongated.

Root : T.L.S (Fig. 89)

The bark cells were seen squarish to rectangular in shape, some of which were filled with brown content. Cortical parenchyma were hexagonal in shape contained prismatic crystal and starch grains. The bast fibres had a very thin distinct lumen. The phloem rays were filled with starch grains. Xylem rays were mostly broad multiseriate, spindle shaped wherein the cell walls were thick, pitted and fully filled with starch grains and isolated prismatic crystal. Some of the cells in the center were found to be curved.

Root : R.L.S (Fig. 90)

The cork cells were few layered. Below cork in the cortex were radial rows of stone cells. The phloem cells contained starch grains and prismatic crystals. The bast fibres appeared straight in R.L.S. the xylem rays were pitted and contained starch grains inside the cells. The xylem tracheids were bordered pitted.

Root : Powder study (Fig. 91)

The components present in the powder were cork cells, fragments of cortical parenchyma, starch grains, prismatic crystals, stone cells, crystal fibres, ray parenchyma, fibre tracheids and bordered pitted vessels.

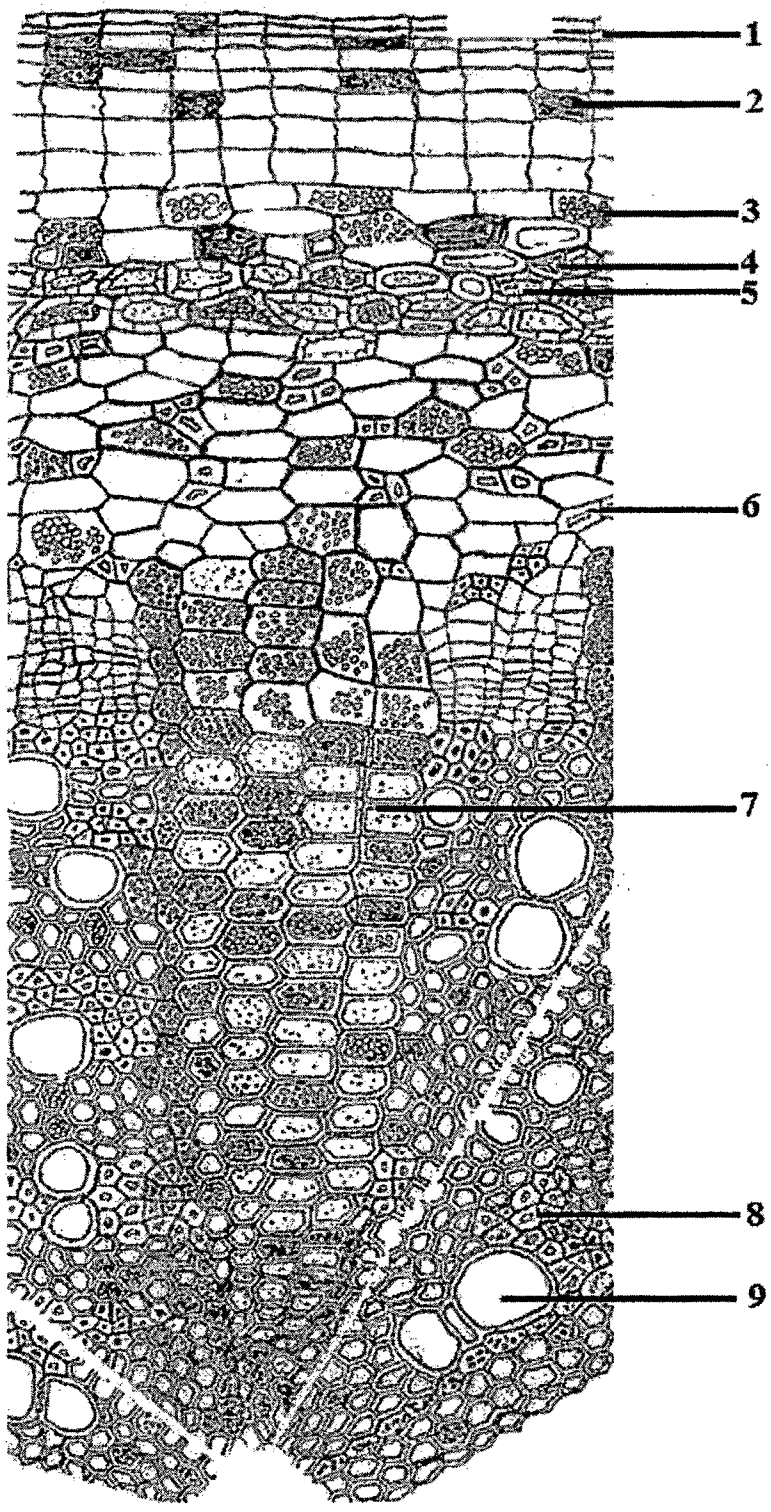


Fig.88.*Abrus precatorius* root, T.S: 1. Cork, 2. Cork with yellowish-brown contents 3. Parenchyma with starch grains,4. Prismatic crystals, 5. Stone cells, 6. Bast fiber,7.Xylem rays, 8.Libriform fibres, 9. Vessels.

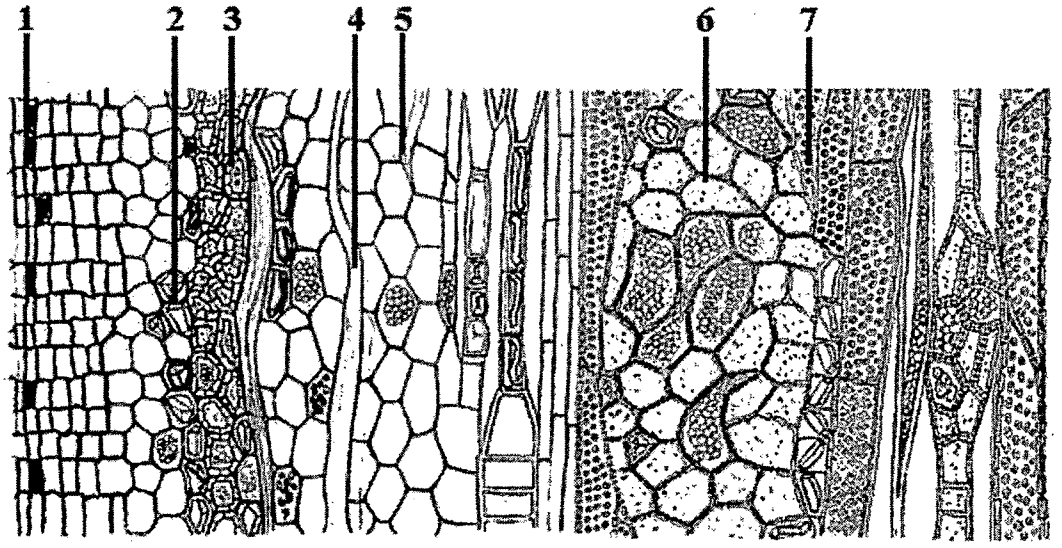


Fig.89. ***Abrus precatorius*** **root, T.L.S:** 1. Cork cells, 2. Prismatic crystals, 3. Stone cells,4. Bast fibres, 5. Phloem rays, 6. Xylem rays, 7.Fibre tracheids.

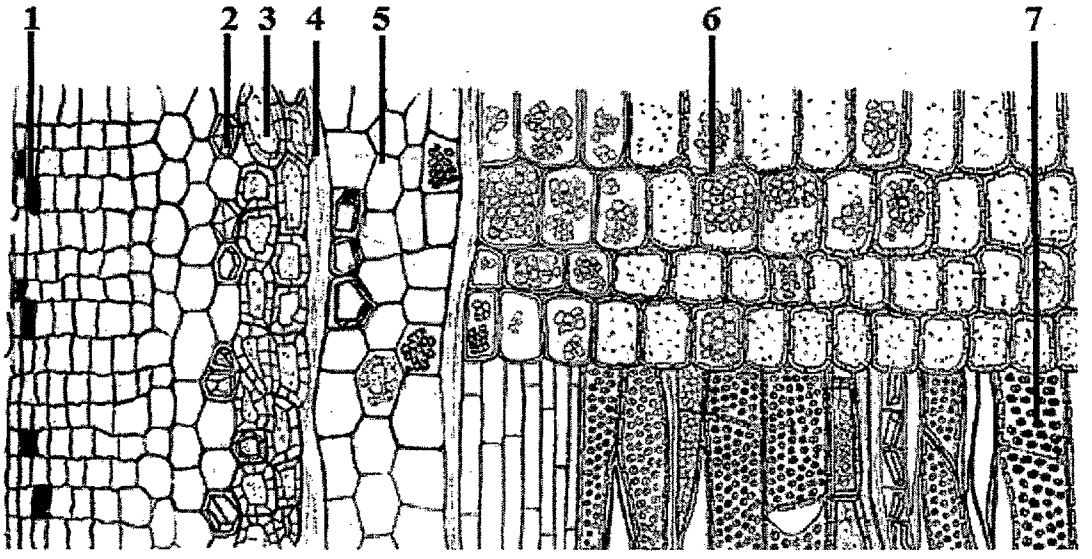


Fig.90. ***Abrus precatorius.*** **Linn root, R.L.S:** 1. Cork cells, 2. Sphaeraphides, 3. Stone cells,4. Bast fibres, 5. Phloem rays with starch grains and prismatic crystals, 6. Xylem rays, 7.Vessels.

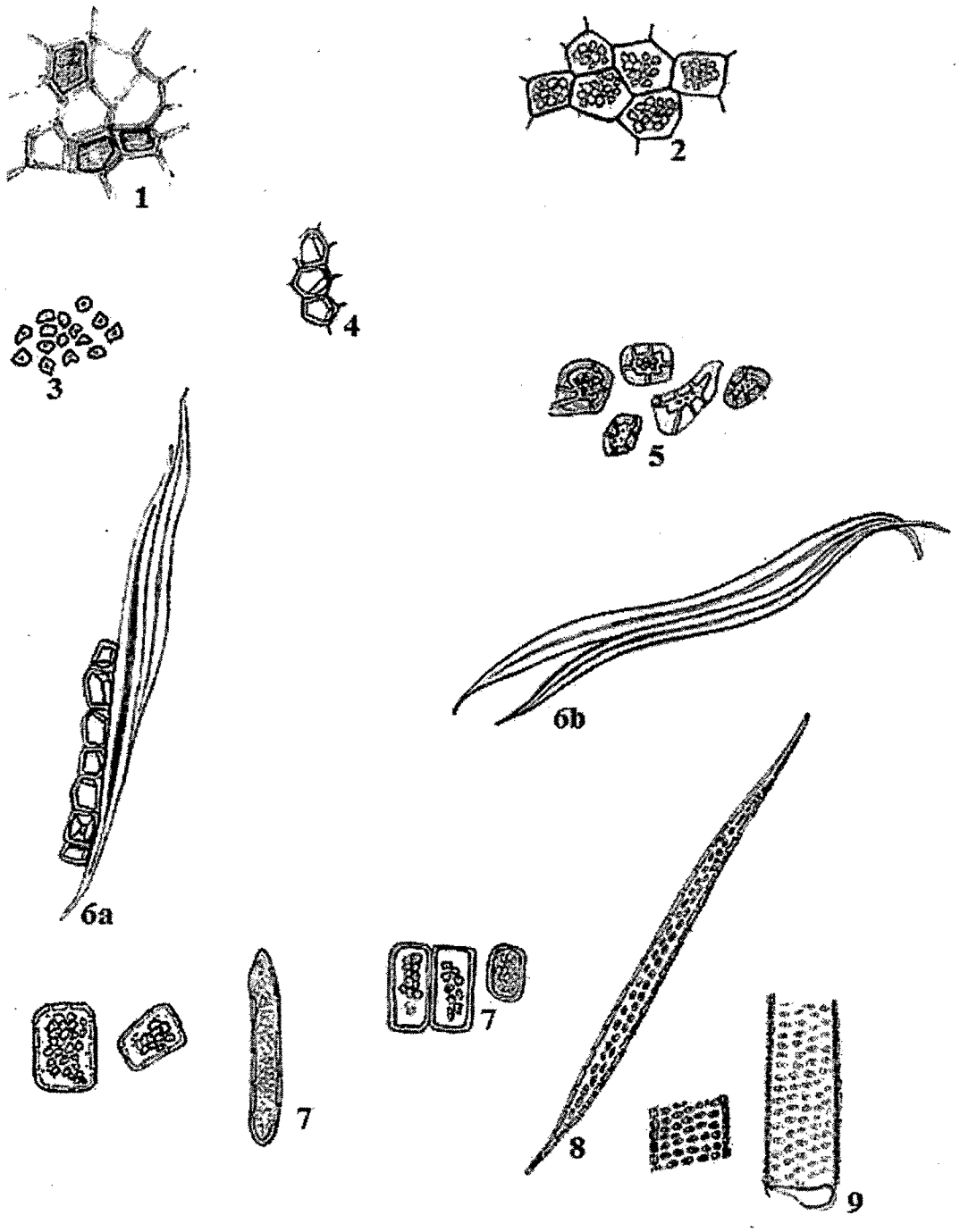


Fig.91. ***Abrus precatorius.*** **Linn root, Powder study:** 1. Cork cells, 2.Fragments of cortical parenchyma, 3.Starch grains, 4.Prismatic crystals, 5.Stone cells, 6.a)Crystal fibres, b)Wood fibres, 7.Ray parenchyma with starch grains, 8.Fibre tracheids, 9. Bordered pitted vessels.

Distinguishing features

Pharmacognostic markers

1. Starch grains.
2. Prismatic crystals.
3. Stone cells.
4. Crystal fibres.
5. Cells of ray parenchyma in the center were found to be curved in T.L.S.

Phytochemical markers

1. Ferulic (*cis*- and *trans*-isomers) acid.
2. Melilotic acid.

Physico-chemical analysis:

Table 15: Values obtained for the proximate analysis.

Sr.No.	Parameter	Mean ± SD (%)*			Average (%)
		Summer	Monsoon	Winter	
1.	Total ash content	04.73±0.16	04.81±0.21	04.49±0.26	4.68
2.	Acid insoluble ash content	01.07±0.25	0.99±0.54	01.08±0.29	1.05
3.	Alcohol soluble extractive	14.03±0.16	14.33±0.21	14.12±0.18	14.16
4.	Water soluble extractive	10.23±0.33	10.01±0.22	10.18±0.36	10.14

*Each value is a mean of 3 readings

5.c. *Alysicarpus longifolius* (Rottl. Ex Spreng.) Wight & Arn. (Fabaceae)

Vernacular names:

Gujrati : Ghoda samerwo, Ubhosamerwo, Dhodasamervo.

Hindi : Jangali gailia, Gubal.

Marathi : Shevra, Motha dampta.

Tamil. : Naamappoondu.

Telugu : Peddakandikaraku.

Distribution and habitat

It is distributed in Saurashtra, Madhya Pradesh, Bombay, Madras.

Morphological features

The plant is an erect herb 1.2-1.5 m tall. Leaves unifoliolate; stalks 3-10 mm long, leaflets 5-15 X 1-2 cm, oblong or lanceolate, base heart-shaped. Inflorescence is a dense raceme, 15-30 cm long. Bracts often longer than 1.3 cm, ovate, pointed. Flowers 1 cm, in pairs, blooming from the base of the spike upwards. "Standard" petal is yellow flushed with red. Wing and keel are dark pink. Pods 1 cm, 4-6 jointed.

Previous Phytochemical reports

The root is sweet and has been reported as a substitute for liquorice (Nadkarni, 1954; Chopra *et al.*,1956; Wealth of India. 1985).The ethanolic extract of the leaves and its various fractions were found to yield myricyl alcohol, β-sitosterol, β-sitosterol acetate, rutin and pinitol (Jain and Gupta.1981). The flavonoid glycosides isolated were 4' –α-D-glucopyranosyloxy-5-hydroxy-7-methoxyflavone (Jain and Gupta, 1984).quercetin-7-*O*-rhamnoside, chrysoeriol-7-*O*-xyloside and kaempferol-3-*O*-xyloside-7-*O*-rhamnoside(Jain and Gupta. 1986b) .The seed was found to be rich in amino acids. These were glutamic acid, aspartic acid, arginine, leucice, lysine, serice, phenylalanine, proline, valine, glycine, isoleucine, alanine, tyrosine, threonine, histidine, cystine and methionine. The seed oil showed the presence of saturated and unsaturated fatty acids (Jain and Gupta, 1985).

Previous pharmacognostic reports

No study has been done on the pharmacognostic characters of root of the plant.

Materials and methods

The plant material has been collected from Timbi, Baroda, 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 of the plant along with saponin, steroids were found to contain vanillic and syringic acids while melilotic acid and flavonoids were found to be present in traces. Mucilage amounted to 2.07 % consisting of rhamnose and xylose.

Pharmacognosy

Macroscopic characters (Fig.92)

The roots were vertical, woody, somewhat tortuous and of a pale buff colour; odour not very particular. Taste slightly bitter. Fracture short.

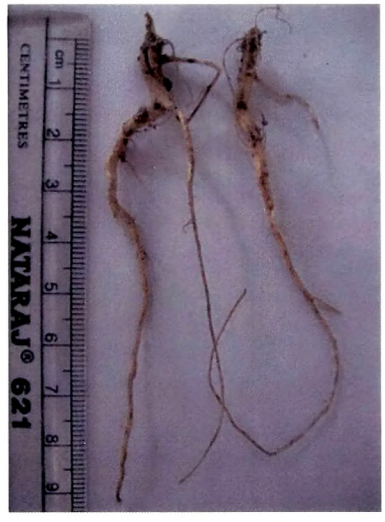


Fig.92. *Alysicarpus longifolius* root.

Microscopic characters

Root : T.S (Fig.93)

The T.S of the root was circular in outline with a large central woody region and a thin outer bark. The cork consisted of 2 to 4 rows of thin walled, tangentially

elongated cells. The phellogen was indistinct. The cortex was very narrow made up of three to six rows of comparatively large polygonal or tangentially elongated thin walled parenchyma cells. Some of them become thick walled collenchymatous. Isolated prismatic crystals and starch grains were found present in the cortex. Bast fibres were in a small patches, composed of two to ten or more thick walled (double layered) gelatinous fibres, alternating with thin walled phloem elements along with isolated narrow lumen fibers. The number of gelatinous fibres in patches were more towards cortex than that of patches present towards the wood. Phloem parenchyma cells at the outer region of phloem were bigger than that of inner ones some of them contained prismatic crystals. Cambium was indistinct. Wood consisted of vessels, tracheids, fibres and rays. They varied in size and shape. Medullary rays were radially elongated and contained starch grains and a single sphaeraphides in a cell. Here few isolated groups of gelatinous fibres were also found. Xylem in the centre were typically composed of thick walled fibre-tracheids. Vessels were many distributed throughout or occurring singly or many in a group of two. The association of pitted parenchyma with vessels were very common here. Starch grains were small, spherical or ovoid with a hilum in the centre.

.Root : T.L.S (Fig.94)

Cork cells appeared rectangular. The cells of the cortex were also appeared rectangular as of cork , but were larger in size. The phloem fibres were straight. Xylem rays were fairly thick walled, oval, simple pitted and each cell contained 10-15 starch grains and 1-3 prismatic crystals each. The vessels were found attached with radial rows of pitted parenchyma. Tracheids contained 2 to 3 rows of bordered pits. The bordered pits in vessels were arranged compactly in 5-6 rows. The primary xylem had both annular and spiral thickenings.

Root : R.L.S (Fig.95)

The phloem ray cells appeared rectangular. They were thin walled and filled with 10-15 starch grains and 1-2 prismatic crystals each cell. The xylem rays also were filled with starch grains and sphaeraphides. The pits on the wall were of simple type. The vessels showed 3-4 rows of bordered pits. The primary xylem showed spiral thickenings.

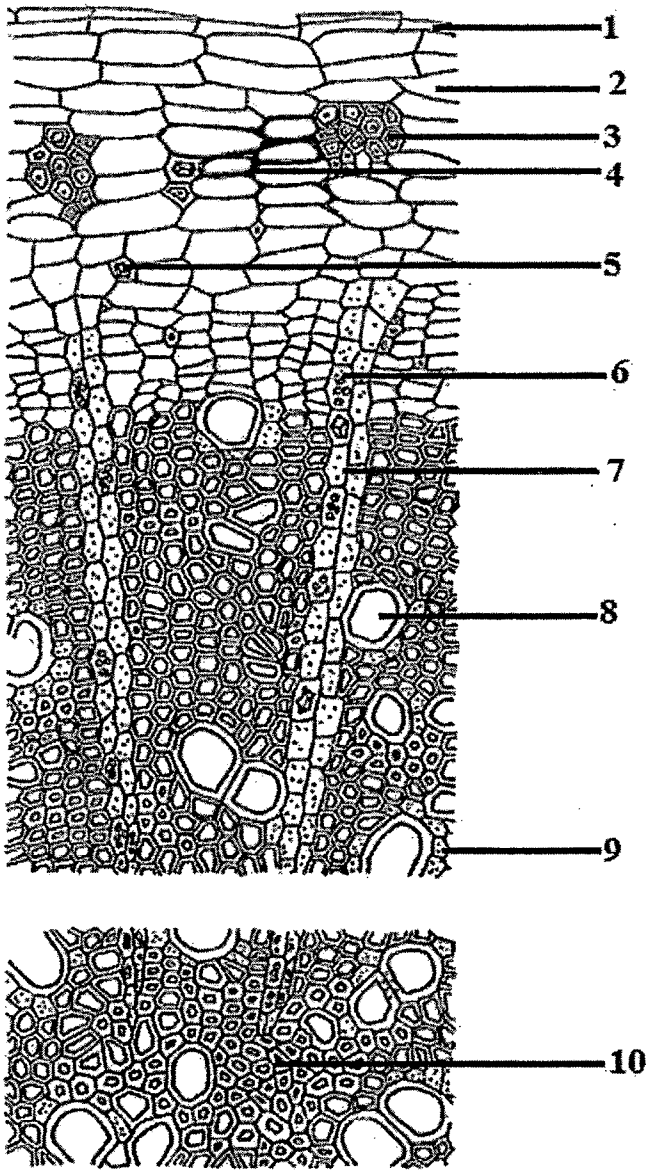


Fig.93.*Alysicarpus longifolius* root, T.S: 1. Cork, 2.Cortex, 3. Gelatinous fibres, 4. Collenchyma, 5.Prismatic crystals, 6.Starch grains, 7.Xylem rays, 8.Vessels, 9. Pitted parenchyma, 10. Fibre-tracheids.

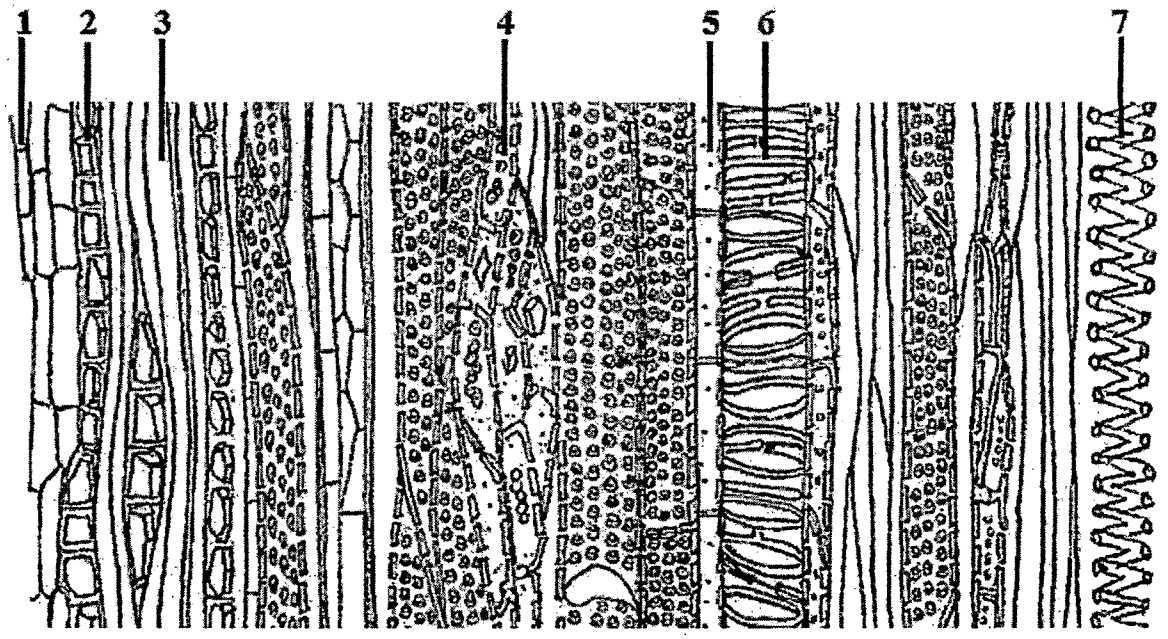


Fig.94. ***Alysicarpus longifolius*** **root, T.L.S:**1. Cork, 2.Prismatic crystal,3. Phloem fibres,4. Starch grains, 5. Pitted parenchyma, 6. Vessels with annular thickening,
7. Spiral thickened vessels.

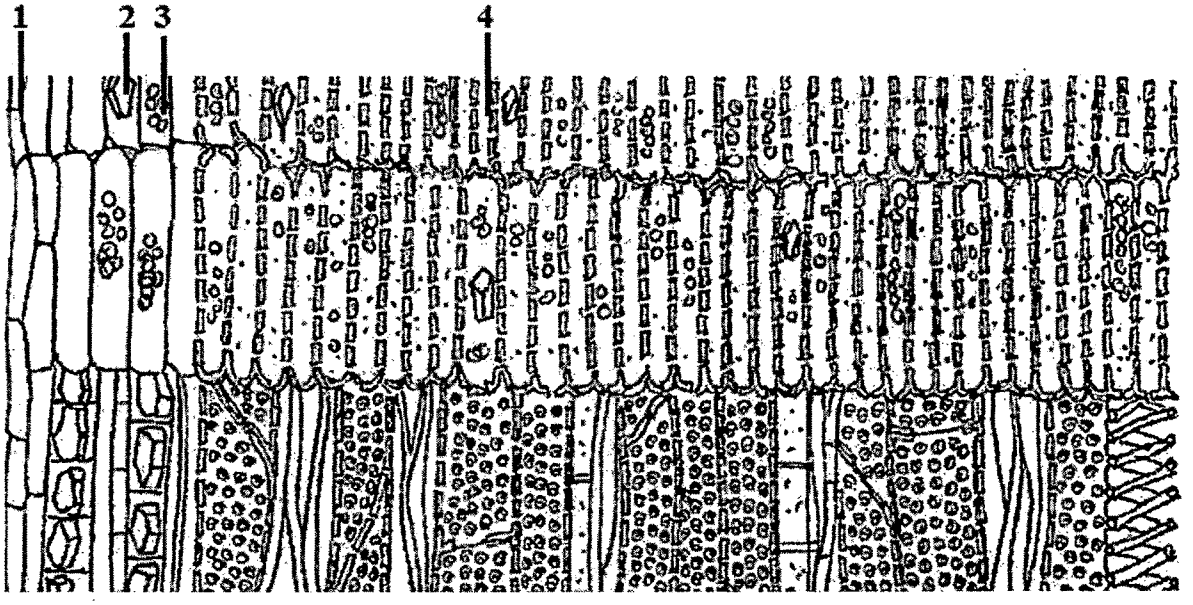


Fig.95. ***Alysicarpus longifolius*** **root, R.L.S:**1. Cork cells, 2.Prismatic crystal,3. Phloem rays with starch grains and prismatic crystals, 4. Xylem rays with starch grains and prismatic crystals.

Root : Powder study (Fig.96)

The components present in the powder were thin walled cork, prismatic crystal, starch grains, gelatinous fibres, crystals trapped between fibers, ray parenchyma with prismatic crystal , annular thickened tracheids.

Distinguishing features

Pharmacognostic markers

1. Thin walled cork.
2. Prismatic crystals.
3. Starch grains.
4. Gelatinous fibers.
5. Ray parenchyma containing prismatic crystal and starch grains.
6. Bordered pitted vessels.
7. Spiral and annular thickened tracheids.

Phytochemical markers

1. Vanillic acid.
2. Syringic acid.
3. Rhamnose.
4. Xylose.

Physico-chemical analysis:

Table 16 : Values obtained for the proximate analysis.

Sr.No.	Parameter	Mean ± SD (%)*			Average (%)
		Summer	Monsoon	Winter	
1.	Total Ash Content	02.42±0.22	02.63±0.32	02.43±0.38	2.49
2.	Acid Insoluble Ash content	0.98±0.31	1.07±0.66	1.01±0.39	1.02
3.	Alcohol soluble extractive	03.12±0.10	03.09±0.19	03.16±0.13	3.12
4.	Water soluble extractive	05.23±0.31	05.46±0.16	05.31±0.06	5.33

*Each value is a mean of 3 readings

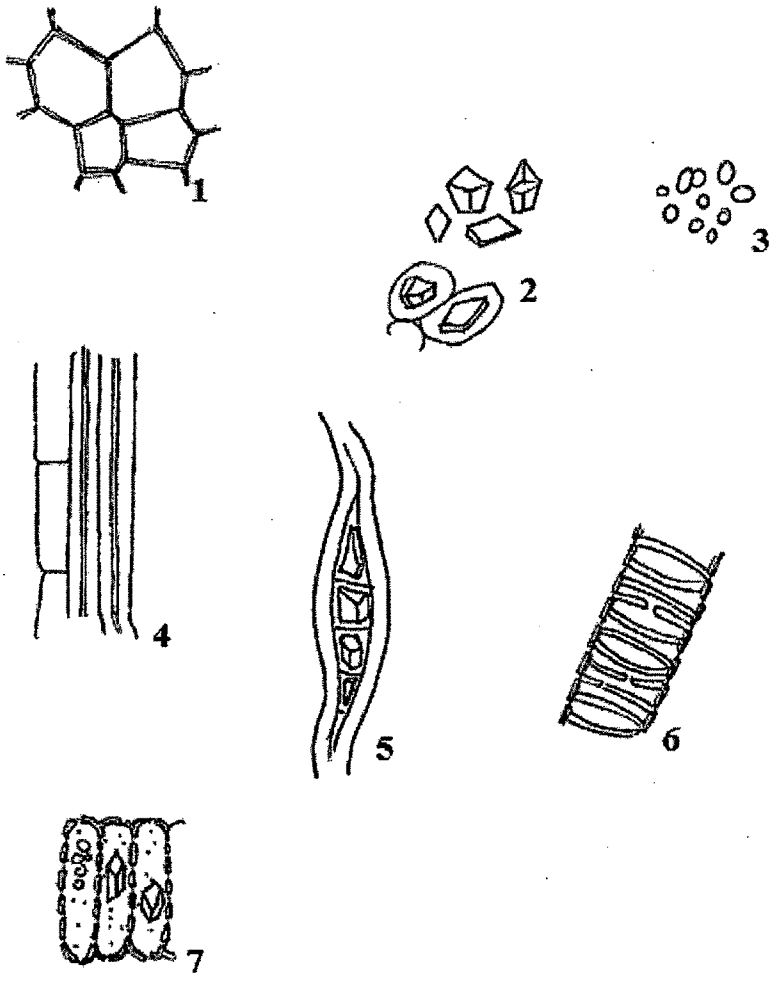


Fig.96. ***Alysicarpus longifolius*** **Powder study:** 1.Cork, 2.Prismatic crystal, 3.Starch grains, 4.Gelatinous fibres, 5.Crystals trapped between fibers, 6.Vessels with annular thickening,7.Xylem rays with starch grains and prismatic crystals.

5.d.*Maerua arenaria* Hook. f. &Thoms. (Capparidaceae)

Synonyms: ***Niebuhria arenaria*** **DC.Prodr.**

Vernacular names:

English : Earth Sugar-root.

Hindi : Vika.

Gujarati : Morinika, Dholokatkiyo, Dudhiyohemkand,Hemkand .

Tamil : Pumi Carkkarai Kilantu, Pumicarkkaraik.

Telugu : Bhumichakkarai Pattatiga, Bhucakramu.

Tibetan : Ro Ma Ha.

Distribution and habitat

The plant is a large woody climber, found in Southern and Central India, and Ceylon.

Morphological features.

The plant is climbing woody shrub with divaricate branches; bark smooth, pale. Leaves 2.5- 5 by 1-2.5 cm, elliptic-oblong, mucronate, glabrous. Flowers in corymbs, greenish-white, terminal or on lateral shoots. Bract one at the base of each pedicel, small, ovate. Calyx-lobes ovate, hooded at the apex, with a short horn behind the hood. Petals ovate-lanceolate, acute, with slightly undulate margins. Stamens many, inserted on the torus. Gynophore 2 cm long. Ovary cylindric, truncate; style 0; stigma large. Fruit pale brown, constricted between seeds. Seeds brown, globose, echinulate.

Medicinal uses:

The root is said to be used as an alternative, tonic, and stimulant.(Anon.1990) and for bleeding piles, as alterative in fevers; as a tonic in muscular debility.(The root resembles liquorice root in appearance and taste) (Khare,2007).

Previous Phytochemical reports

No detailed phytochemical studies have been done on root of this plant. The plant contained ordinary plant constituents and a certain quantity of sugar.(Nadkarni 1954).

Previous pharmacognostic reports

No study has been done on the pharmacognostic characters of root of the plant.

Materials and methods

The plant material has been collected from Rajpipala,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 was found to contained vanillic, syringic and melilotic acids. Mucilage amounted to 7.3% consisting of xylose. The root also showed the presence of unidentified alkaloids and steroids while coumarins and saponins were found in good concentrations. Saponins, Steroids and alkaloids were also present.

Pharmacognosy

Macroscopic characters (Fig.97)

The roots were vertical, somewhat tortuous and of a pale yellow in colour; odor not very particular, Taste slightly sweet. Fracture short.

Fig.97. *Maerua arenaria* root

Root : T.S (Fig.98)

The root possessed a few (4-9) layered cork where the cells were almost squarish .Outer 2-3 layers of phelloderm was of thick walled cells and the walls were

reddish-brown in colour. The cells of the phellogen was thin walled. Below the cork there was a single discontinues ring of a stone cells. The stone cells were small, circular to oblong, thick walled narrow lumened. Cortex made up of compactly arranged parenchymatous cell. The cells were polygonal in shape and showed the deposition of oil globules in it. The single or a group of stone cells were also embedded in the cortex. The stone cell were thick walled with distinct striations and narrow lumened filled with yellowish brown contents. There was single vascular bundles were also scattered in the cortex. Pericycle was made up of three to five layers of discontinuous rings of thick sclerenchyma. Phloem was 5-10 layered made up of usual elements with some of the cells showed the deposition of oil globules. The medullary rays were uni to biseriate and the cells were pitted some of contained oil globules. The xylem made up of tracheids with less no of wood parenchyma. The Vessels were many, scattered and were bordered pitted.

Root : T.L.S (Fig. 99)

Cork cells appeared rectangular with reddish-brown thick wall. The cells of the cortex were big polygonal and contained oil globules. The stone cells were rectangular and found filled with yellowish- brown content. Pericyclic sclerenchyma were straight. Phloem ray were thin walled and pitted. Fibre tracheids were pitted, and contained simple as well as bordered pits. Xylem rays were spindle shaped. The vessels were broad, with 3-4 alternate rows of bordered pits.

Root : R.L.S (Fig.100)

Cork cells were rectangular with reddish-brown thick wall. The phloem ray cells were erect, polygonal and were filled with oil globules. There were 3 to 4 companion cells found attached with each phloem parenchyma. Xylem rays were hexagonal, pitted and showed deposition of oil globules.

Root : Powder study (Fig.101)

The components present in the powder were thick walled cork cells, group of stone cells fragments of cortical parenchyma filled with oil globules, phloem ray cells with deposits, sieve tubes with deposits, bordered pitted vessels.

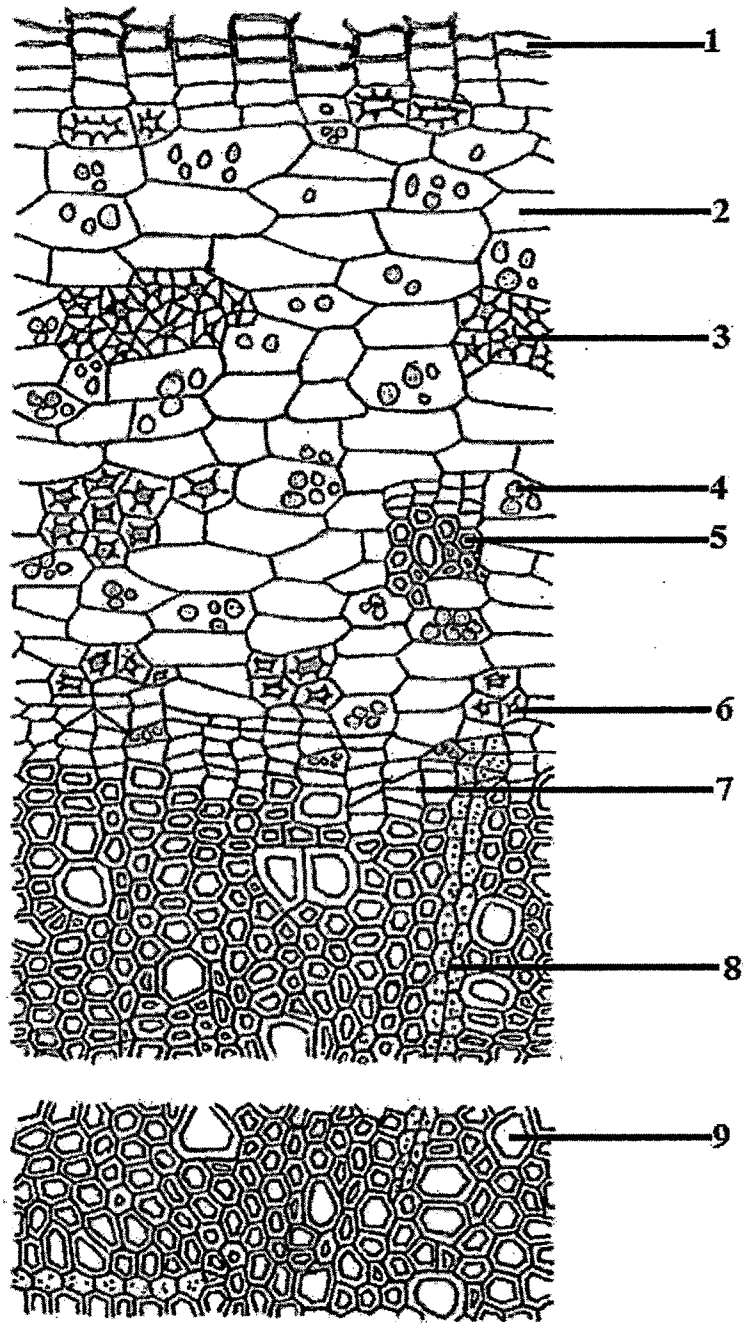


Fig.98 . ***Maerua arenaria*** **root, T.S:** 1. Cork, 2. Cortex , 3. Stone cell, 4. Oil globules ,5. Vascular bundle, 6. Pericycle,7. Phloem, 8. Xylem rays, 9. Vessels.

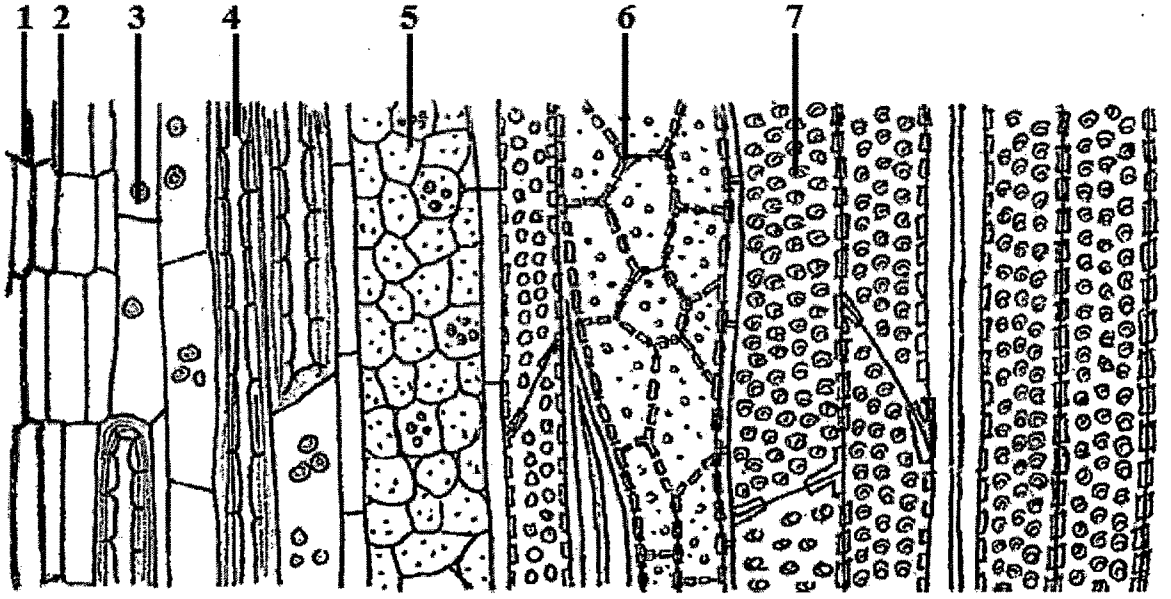


Fig.99. ***Maerua arenaria*** **root, T.L.S**:1.Cork cells with thick walls, 2.Cortex, 3.Oil globules,4. Stone cell, 5.Phloem ray, 6.Xylem rays, 7.Vessels with alternate bordered pits.

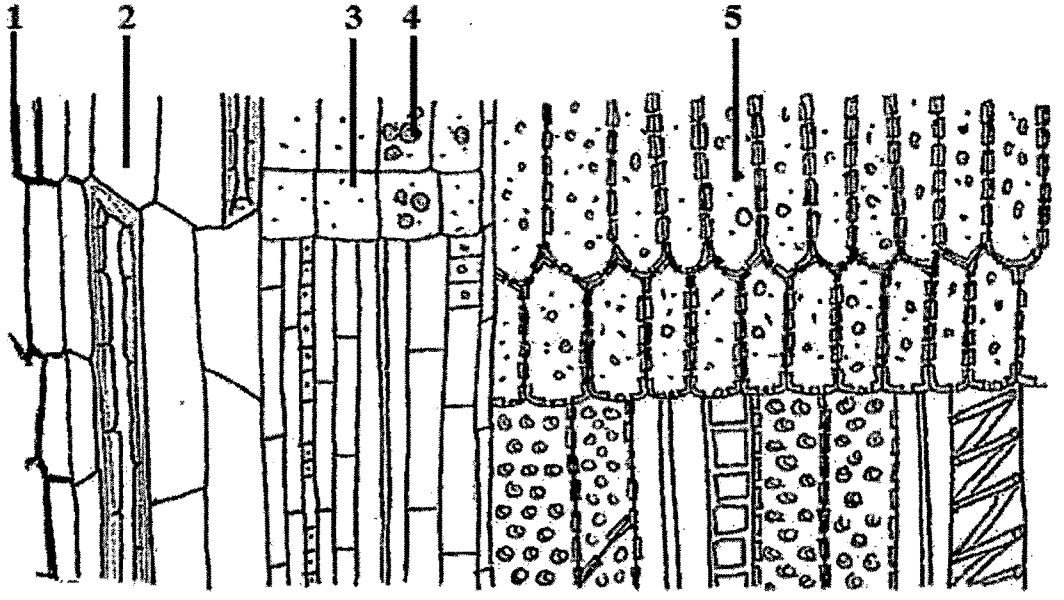


Fig.100. ***Maerua arenaria*** **root, R.L.S**:1.Cork cells, 2.Cortex, 3. Phloem rays, 4.Oil globules, 5. Xylem rays.

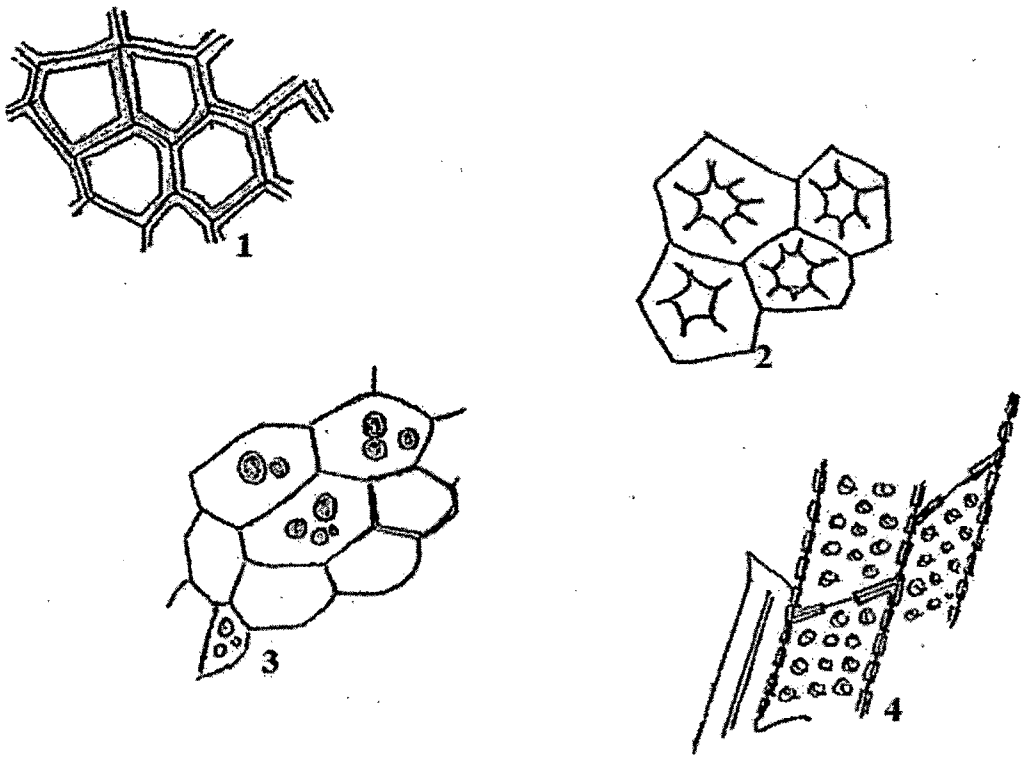


Fig.101 . *Maerua arenaria* root, Powder study: 1. Thick walled cork cells, 2.Stone cells, 3. Parenchyma filled with oil globules, 4. Bordered pitted vessel.

Distinguishing features

Pharmacognostic markers

1. Thick walled cork cells.
2. Parenchyma filled with oil globules.
3. Stone cells.
4. Bordered pitted vessel.

Phytochemical markers

1. Melilotic acid.

Physico-chemical analysis:

Table 17 : Values obtained for the proximate analysis.

Sr.No.	Parameter	Mean ± SD (%)*			Average (%)
		Summer	Monsoon	Winter	
1.	Total ash content	02.11±0.16	02.18±0.12	02.09±0.21	2.13
2.	Acid insoluble ash content	00.60±0.08	0.63±0.09	00.59±0.06	0.61
3.	Alcohol soluble extractive	10.01±0.21	10.13±0.23	10.02±0.13	10.05
4.	Water soluble extractive	08.19±0.42	08.16±0.02	08.24±0.29	8.2

*Each value is a mean of 3 readings.

5.e.*Taverniera cuneifolia* (Roth) Arn. (Family – Fabaceae)

Synonyms: ***Taverniera abyssinica*** A.Rich, ***T. nummularia*** Baker non-DC.

Vernacular names:

English : East Indian Moneywort.

Gujrati : Jangali Jethimadh.

Hindi : Jangali Jethimadh.

Marathi : Jethi-madh.

Distribution and habitat

Plains of Punjab, Gujarat and the Deccan in waste places. (Khare,2007)

Morphological features

The plant is shrub, 60-100 cm, branches pubescent. Leaf uni-trifoliolate, leaflets 0.6-2.5 cm long, obovate to oblanceolate, entire, mucronate, pubescent, becoming subglabrous; stipules connate, amplexicaul, c. 3 mm long. Inflorescence an axillary raceme, up to 10 cm long, Pedicel 1-2.5 mm long, bracts c. 2.5 mm. Calyx 4-5 mm long, silky, teeth deltoid, c. 2.5 mm long. Corolla purple, macrescent. Vexillum 10-13 mm long, vexillum and keel larger than the wing. Fruit with 1-3, 1-seeded joints, joints echinate and ovoid, pubescent.

Medicinal uses

Leaves of this plant used as a poultice for sloughing wounds. Roots used as a substitute for liquorice. (Khare,2007) and exhibited promising anti-inflammatory, anti-tumor, anti germ tube formation (in *Candida albicans*),protection from mutagen toxicity and cytotoxic activities (Zore 2008).

Previous Phytochemical reports

The roots contained 13.20% glycyrrhizin.(Zore 2008)

Previous pharmacognostic reports

No complete study has been done on the pharmacognostic characters of root of the plant.

Materials and methods

The plant material has been collected from Surendranagar road,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 phytochemical analysis of root of plant showed that it is rich in containing phenolic acids such as vanillic, syringic, ferulic, *o*-coumaric, melilotic , and *p*-hydroxy benzoic acids. It also showed the presence of coumarins,saponins,steroids and contained alkaloids and flavonoids in traces, while its mucilage contained sugar acid.

Pharmacognosy

Macroscopic characters (Fig.102):-

The roots occured in long, cylindrical slender pieces. The young root were light yellow, little shiny and comparatively smooth non-lenticellate surfaced with faint longitudinal fissures whereas the thicker mature pieces surface was grayish brown or light brown coloured and rough due to longitudinal fissures and transversely elongated wrinkles. The fracture was fibrous externally and hard in the centre. The roots were faintly sweet.

Fig.102. *Taverniera cuneifolia* root.

Microscopic characters

Root : T.S (Fig.103)

The root in transverse section was almost circular in outline with slightly undulating margin. The cork was composed of 3-6 rows of rectangular, tangentially

elongate cells. Those of the outer rows were usually much compressed and have thick light brown walls but the inner cells were arranged in regular rows and had comparatively thin light pinkish-brown walls and appeared small rectangular. The phellogen cells were found to be in collapsed condition. The phelloderm, consisted of usually 1 to 3 layers of thin walled parenchyma. The secondary cortex made up of 4 to 9 layers of thin walled tangentially elongated polygonal parenchymatous cells arranged compactly and lack in intercellular spaces, few of these cells were typical found in a pairs wherein the adjoining walls were straight and also showed the presence of small isolated groups of fibres of about 2 to 4, associated with cells containing isolated prismatic crystal of calcium oxalate. Most of the cells except a few rows towards the outside were filled with the starch grains. Cambium was indistinct. The secondary phloem was 9-12 layered. Besides having usual phloem elements it showed the presence of distinct groups of bast fibers arranged radially in groups of about 10 to 50 fibres, adhering to which are cells of crystal fibres containing prisms of calcium oxalate and gelatinous fibre. The phloem parenchyma present towards the cortex was comparatively larger than that of inner one present towards the wood. Phloem rays were thick walled pitted parenchymatous and the cells were tangentially elongated rectangular to polygonal in outline and slightly larger than the phloem parenchyma cells, loaded with starch grains. Xylem was dominated by fibers occurred in a groups similar to those of the bast. Xylem parenchyma were of two kinds, those associated with gelatinous fibres having thick pitted walls and the remaining with thin walls and lacking pits. The vessels were occurred mostly in a groups of 2-3 and have thick pitted walls and contained 3-5 rows of transversely oblique bordered pits. Vessels with annular thickening were also present. The cavities of some of the vessels present in the center are filled with reddish-brown contents. The medullary rays are almost uniform in size and 3 to 4 cell wide. Their cells are thick walled, pitted, radially elongate rectangular and fully loaded with starch grains of various sizes and prismatic crystals of calcium oxalate was quite characteristic and measured up to 36 μm in length. Starch grains which are mostly single, spherical, oval or elliptical or muller shaped , dimensions varying from 3 to 15 μm in length but sometimes attaining up to 21 μm. The starch grains with 2 components are few and 3 to 6 components are rare.

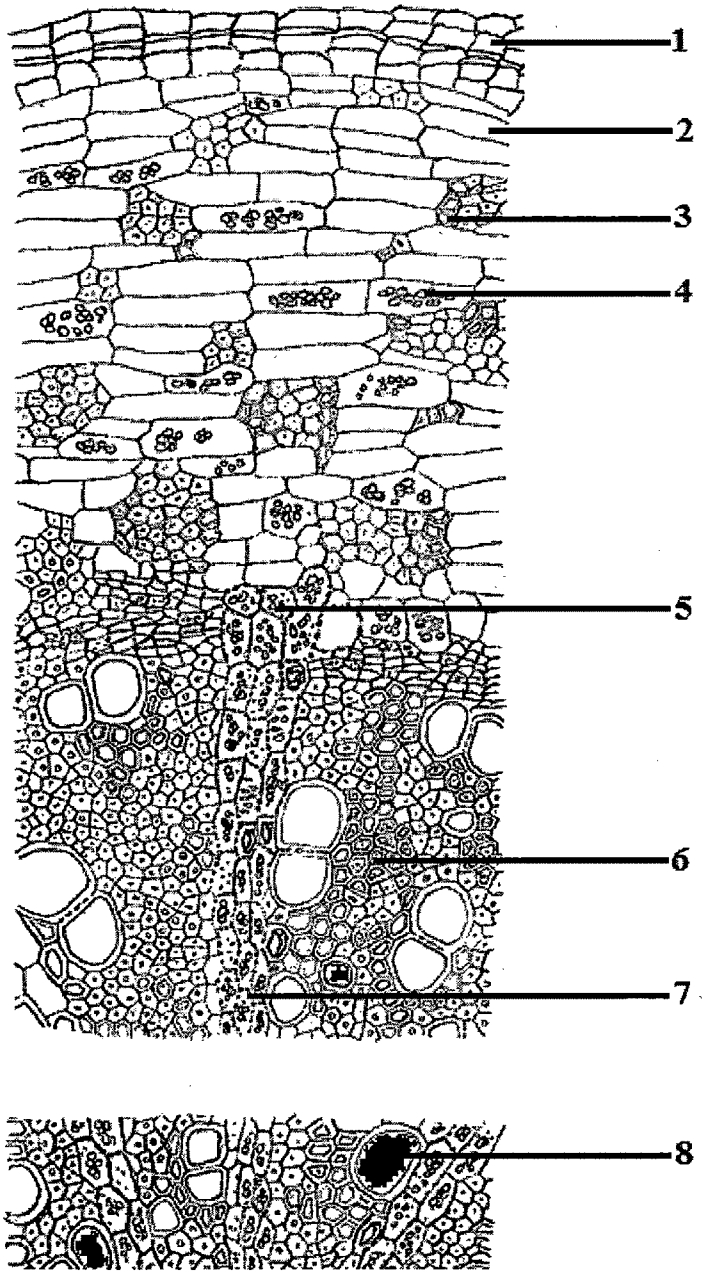


Fig.103.*Taverniera cuneifolia* root, T.S: 1.Cork, 2.Cortex, 3.Prismatic crystals, 4.Starch grains, 5.Phloem rays, 6.Gelatinous fibre 7.Xylem rays, 8.Vessels with reddish-brown contents.

Root : T.L.S (Fig.104)

The cork cells were many layered. Parenchyma cells in the cortical region were thin walled adhering to which were crystal fibres containing prismatic crystals. Thick walled bast fibers with narrow lumen appeared straight. Phloem rays, cells of which contained starch grains. The parenchymatous cells of the secondary phloem were thin walled. The xylem rays which were thick walled appeared multiseriate and contained starch grains. The vessels and tracheids contained bordered pits. Vessels were having straight end walls.

Root : R.L.S (Fig.105)

The gelatinous fibres were straight. The rays were upright and squar to rectangular in shape and each cell was filled with starch grains. Vessels showed the presence of boarded pits and few were annular thickened also .

Root : Powder study (Fig.106)

The powder was characterized by the presence of groups of light brown thick walled cork cells, cortical cells with starch , bast and wood fibers adhering to which were crystal fibers, containing prismatic crystals of calcium oxalate, thick walled fibers with narrow lumen and blunt tips, thick walled ray parenchyma cells with simple pits and having starch grains and boarded pitted vessels.

Distinguishing features

Phytochemical markers

1. Ferulic acid.
2. *o*-Coumaric acid.
3. Melilotic acid.
4. *p*-Hydroxy benzoic acid.

Pharmacognostic markers

1. Light brown thick walled cork cells.
2. Starch grains.
3. Prismatic crystals.
4. Crystal fibres.
5. Thick walled fibers with narrow lumen and blunt tips.
6. Thick walled pitted ray parenchyma.

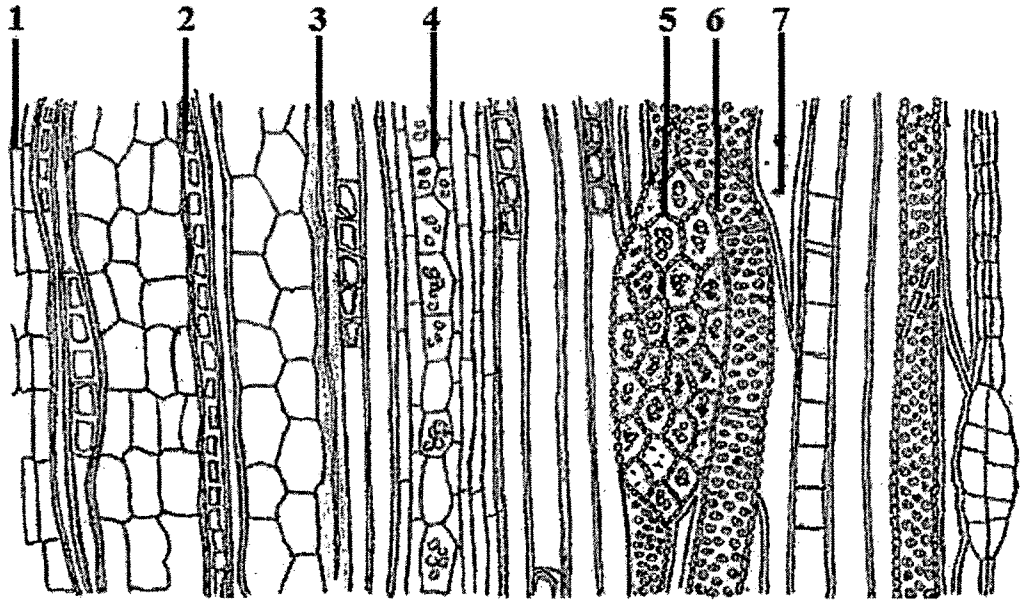


Fig.104.*Taverniera cuneifolia* root, T.L.S:1. Cork, 2. Crystal fibre, 3.Bast fibre, 4.Phloem rays,5. Xylem rays.6. Vessels with alternate bordered pits, 7. Fiber trachieds.

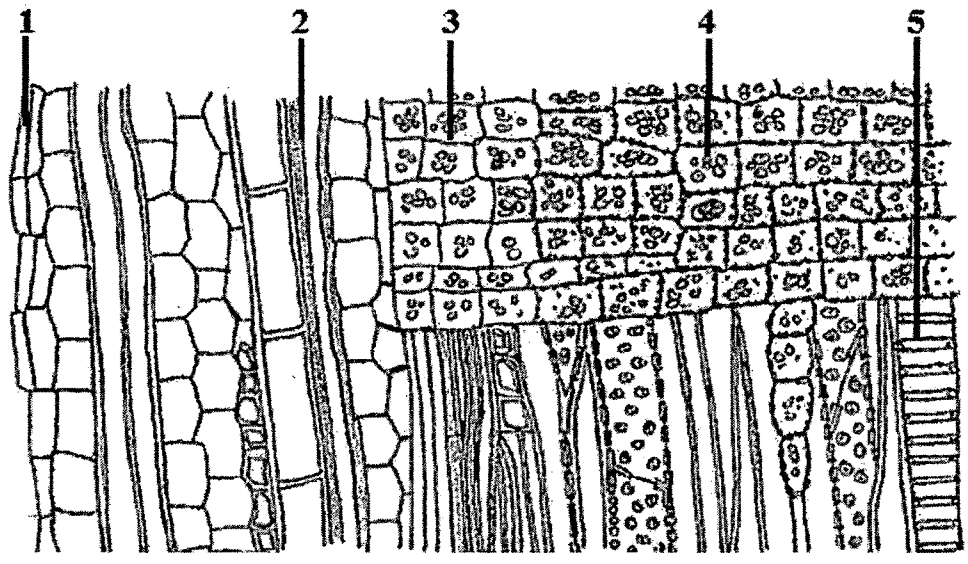


Fig.105. *Taverniera cuneifolia* root, R.L.S:1. Cork, 2. Gelatinous fibre, 3. Phloem rays with starch grains,4. Xylem rays, 5.Annular thickened vessels.

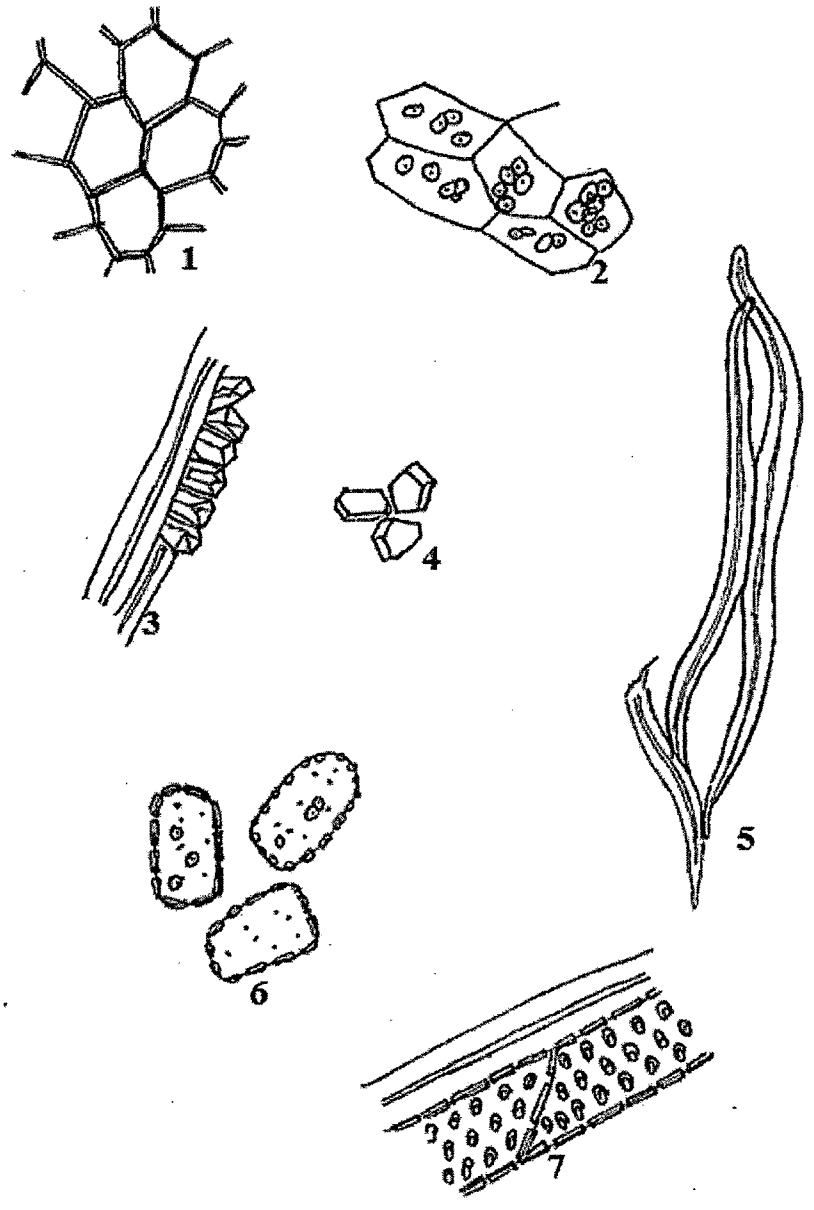


Fig.106.*Taverniera cuneifolia* root, Powder study: 1.Cork cells, 2.Parenchyma with starch grains, 3.Crystal fibre, 4.Prismatic crystals 5.Thick walled fibers with narrow lumen and blunt tips,6. Ray parenchyma, 7. Boarded pitted vessels.

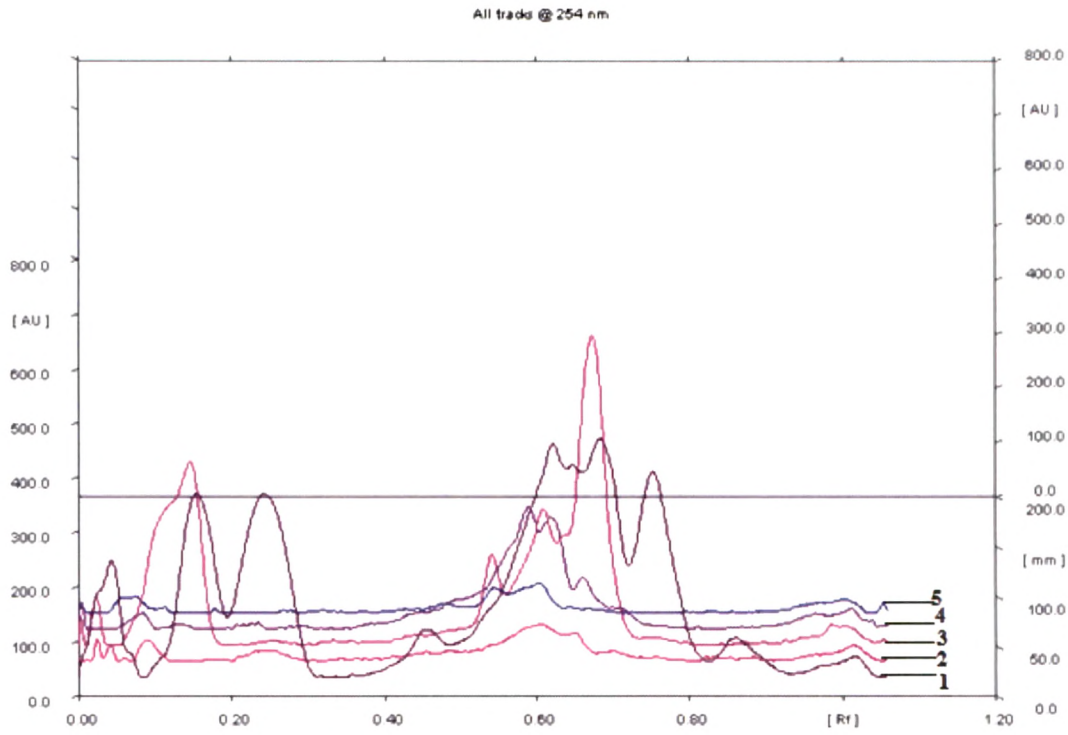
Physico-chemical analysis:

Table 18 : Values obtained for the proximate analysis.

Sr.No.	Parameter	Mean ± SD (%)*			Average (%)
		Summer	Monsoon	Winter	
1.	Total Ash Content	5.71±0.36	5.86±0.41	5.79±0.39	5.79
2.	Acid Insoluble Ash content	1.08±0.08	0.99±0.06	1.06±0.04	1.04
3.	Alcohol soluble extractives	16.01±0.63	16.87±0.53	16.03±0.61	16.30
4.	Water soluble extractives	18.80±0.46	19.02±0.29	18.73±0.42	18.85

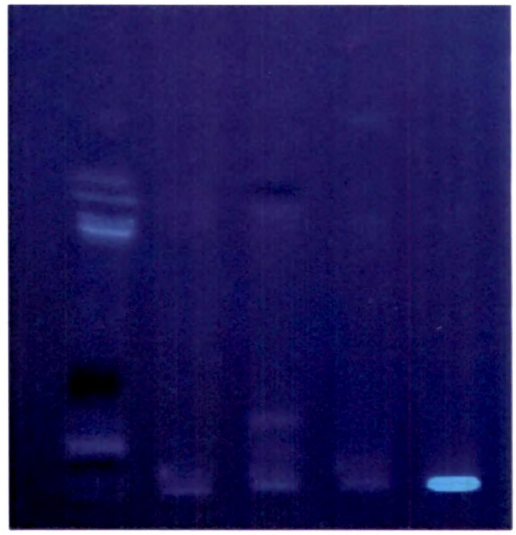
*Each value is a mean of 3 readings.

Figure 107.b: HPTLC chromatogram of *Glycyrrhiza glabra* and its substitutes/adulterants. (UV 254 nm).



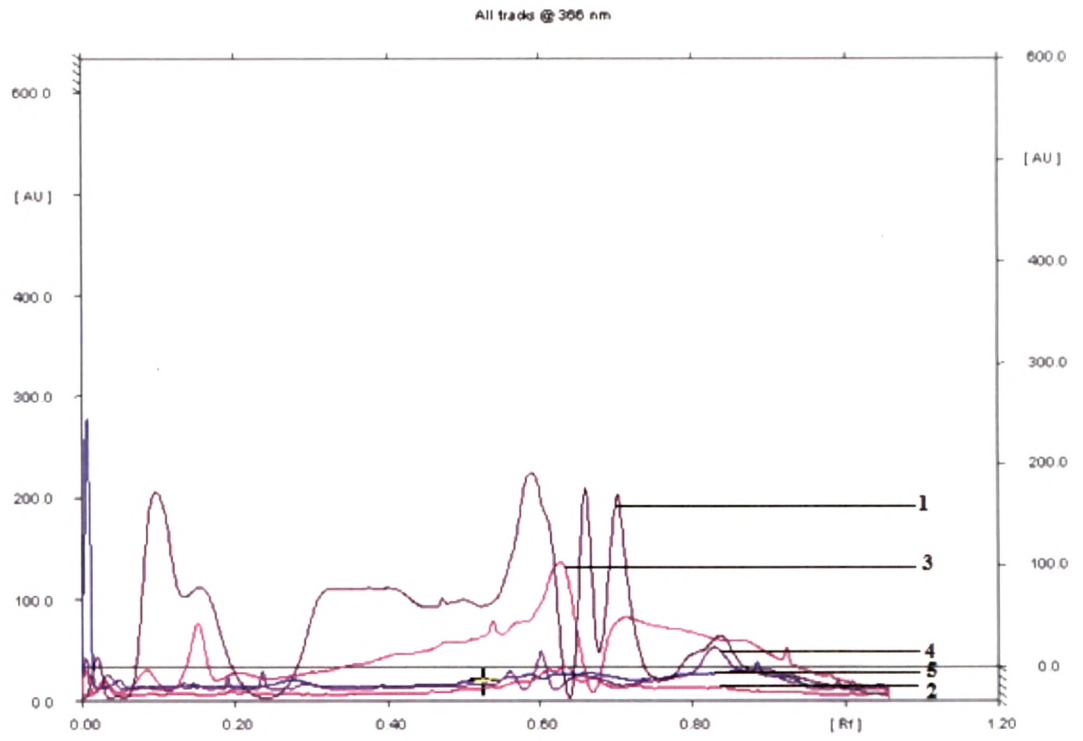
(b).1-*Glycyrrhiza glabra,* 2-*Taverniera cuneifolia,* 3-*Abrus precatorius*, 4-*Alyscicarpus longifolius*, 5-*Maerua arenaria* .

Figure 108.a : HPTLC chromatogram of *Glycyrrhiza glabra* and its substitutes/adulterants (UV 366 nm).



(a). T1-*Glycyrrhiza glabra,* T2-*Taverniera cuneifolia,* T3-*Abrus precatorius*, T4-*Alyscicarpus longifolius*, T5-*Maerua arenaria.*

Figure 108.b: HPTLC chromatogram of *Glycyrrhiza glabra* and its substitutes/adulterants (UV 366 nm).



(b). 1-*Glycyrrhiza glabra,* 2-*Taverniera cuneifolia,* 3-*Abrus precatorius*, 4-*Alyscicarpus longifolius*, 5-*Maerua arenaria* .

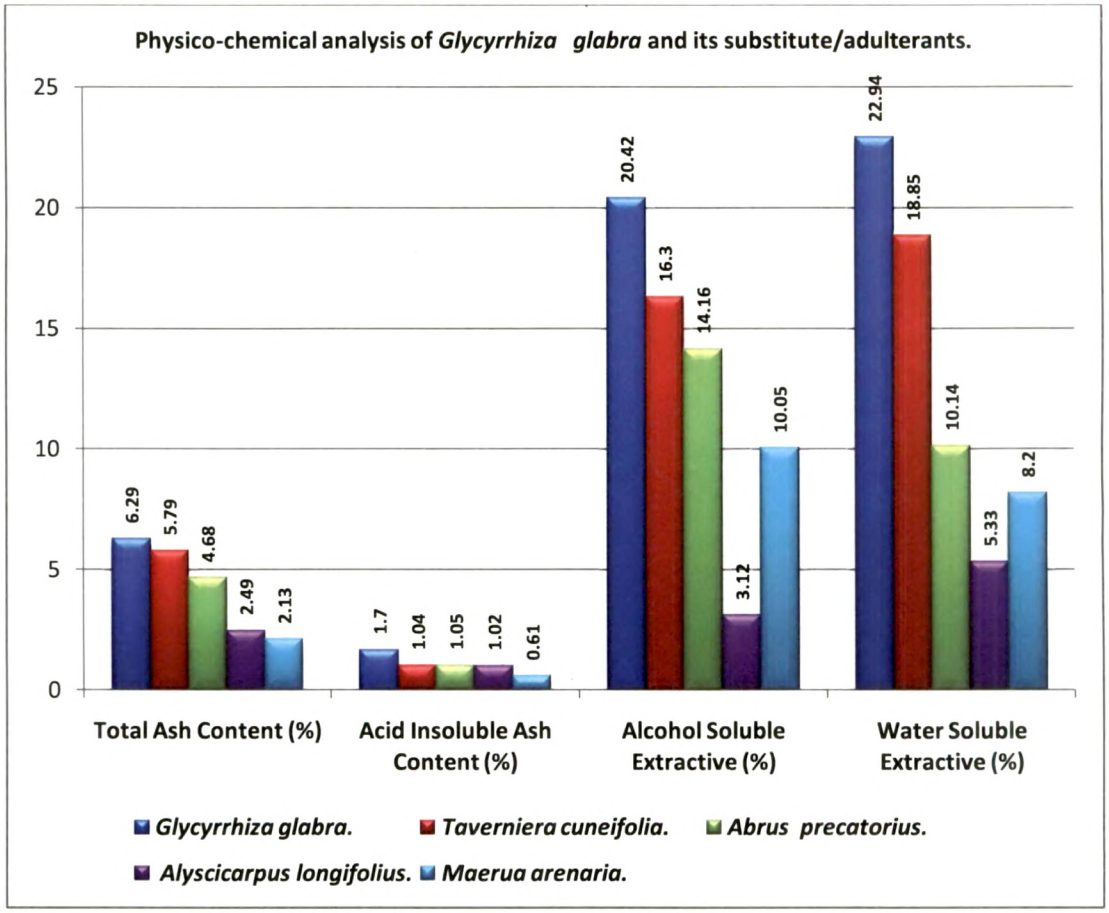
HPTLC profile of *Glycyrrhiza glabra* showed the presence of 10 peaks in both observed under UV 254 nm (figure 107.b)and 366 nm (figure 108.b). There were 5 major peaks at R_f 0.10, R_f 0.33 , R_f 0.40, R_f 0.59 and R_f 0.70 found under UV 254 and peaks at R_f 0.15, R_f 0.24 , R_f 0.62, R_f 0.68 and R_f 0.75 under 366 nm. The *Taverniera cuneifolia* showed the presence of 9 peaks, *Abrus precatorius* and *Alysicarpus longifolius* 8 peaks and *Maerua arenaria* 7 peaks when observed under UV 254 (figure-107.b)while under UV366 nm(figure 108.b); *Taverniera cuneifolia, Abrus precatorius, Alysicarpus longifolius* and *Maerua arenaria* showed the presence of 3,11,7 and 2 peaks respectively.

HPTLC profile of *G. glabra* and its substitutes/adulterants observed under UV 254 nm showed that *T. cuneifolia* was similar in 3 peaks but differed in 6 peaks. Both *Abrus precatorius* and *Alysicarpus longifolius* were similar in 1 peak but differed in 7 peaks, while *Maerua arenaria* was not show any peak similar to that of *G. glabra* but differed in having 7 peaks.

HPTLC profile of *G. glabra* and its substitutes/adulterants observed under UV 366 nm showed that both *Abrus precatorius* and *Alysicarpus longifolius* were similar in 1 peak but *Abrus precatorius* differed in 10 peaks and *A. longifolius* in 6 peaks while *T. cuneifolia* and *M.arenaria* did not showe any peak similar to that of *G.. glabra but T. cuneifolia* differed in 3 and *M. arenaria* in 2 peaks.

Physico-chemical analysis

Physico-chemical analysis of *Glycyrrhiza glabra* and its substitutes/adulterants



Total ash content

Total Ash Content of *Glycyrrhiza glabra* (6.29 %) along the material collected in different season does not show significant variation (Table-14) while the closest value to the substitute/adulterant in descending order is 5.79% (*Taverniera cuneifolia*), 4.68% (*Abrus precatorius*), 2.49%(*Alyscicarpus longifolius*) and 2.13% (*Maerua arenaria*).

Acid insoluble ash content

Acid insoluble ash content of *Glycyrrhiza glabra* (1.70 %) along the material collected in different season does not show significant variation (Table-14) while the closest value to the substitute/adulterant in descending order is 1.05% (*Abrus precatorius*),1.04% (*Taverniera cuneifolia*), 1.02% (*Alyscicarpus longifolius*) and 0.61% (*Maerua arenaria*).

Amongst the substitutes/adulterants of *Glycyrrhiza glabra*, the *Taverniera cuneifolia* showed the closest value of total ash content which showed that the *T.cuneifolia* was more close to *G. glabra*as compared to other substitutes/adulterants of *G. glabra.*

Alcohol soluble extractive

Alcohol soluble extractive value of *Glycyrrhiza glabra* (20.42%) along the material collected in different season does not show significant variation (Table-14) while the closest value to the substitute/adulterant was of *Taverniera cuneifolia* (16.3%).The values of *Abrus precatorius*, *Maerua arenaria* and *Alysicarpus longifolius* was found to be 14.16%,10.05% and 3.12% respectively.

Water soluble extractive

Water soluble extractive value of *Glycyrrhiza glabra* (22.94 %) along the material collected in different season does not show significant variation (Table-14) while the closest value to the substitute/adulterant in descending order is 18.85% (*Taverniera cuneifolia*),10.14% (*Abrus precatorius*), 8.14% (*Maerua arenaria*) and 5.33% (*Alyscicarpus longifolius*).

Amongst all substitutes/adulterants of *Glycyrrhiza glabra*, the *Taverniera cuneifolia* showed the extractive values close to the *G. glabra* while the extractive values of other substitutes/adulterants were almost half or less than half of *G. glabra* which reflect that the *T. cuneifolia* could better substitute as compared to other substitutes/adulterants.