Chapter 6

6.a.*Polygala senega* L. (Polygalaceae)

Synonyms: *Polygala rosea* Steud ; *Senega officinalis* Spach.

Vernacular names:

English : Senega Root, Snake Root.

Distribution and habitat

A small plant widely distributed over the United States and the southern parts of Canada (Wallis, 1960).

Morphological features

These are herbs or shrubs with upright, herbaceous to woody stems often branching profusely, the branches occasionally becoming geotropic or subterranean and bearing cleistogamous flowers. The leaves are simple, often lanceolate or linear, exstipulate, alternate. The inflorescence is a raceme or spike. Flowers are irregular, hermaphroditie with 5 distinct sepals, the 2 lateral ones being large and petaloid; 5 petals of which the two lateral are wanting or rudimentary and the anterior large and boat-shaped; 8 stamens; and a bicarpellate pistil. The fruit is a 2-celled capsule., rarely a drupe or samara. Pollen grains are barrel-shaped(Youngken,1951).

Medicinal uses:

Ethanolic extract of *Polygala senega* is used as an expectorant to treat cough, sore throat, bronchitis, and asthma (Lacaille *et al.*,2005, Kindscher,1992) and as an antihypoglycemic agent (Kako *et al.*,1996). The saponins of *P. senega* are used as vaccine adjuvants to increase specific immune responses (Katselis *et al.*,2007) and it is remedy for snake-bite(Wallis,1960).

Previous Phytochemical reports

Senegin,polygalic acids,methyl salicylate and fixed oil are the compounds reported(Wallis, 1960).

Previous pharmacognostic reports

Only the T.S of the root has been studied (Anon. 2004). So a detailed study with T.L.S and R.L.S is conducted on root of the plant.

Materials and methods

The plant material has been procured from authentic vender, Mumbai. 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 were found to contain saponin, steroids, vanillic and syringic acids while flavonoids were found to be absent. Mucilage amounted to 5.02 % consisting of arabinose, ribose, rahmnose and xylose.

Pharmacognosy

Macroscopic characters (Fig.109)

The roots were thick, tortuous, vertical mostly with a knotty crown at the top which gradually tapers at the end. Surface longitudinally wrinkled with few transverse scares and yellowish brown to light brown in colour; odour particular. fracture short and somewhat splintery in the centre.

Fig.109. *Polygala senega*, root

Microscopic characters

Root : T.S (Fig. 110)

The root possessed a few layered cork where the cells were thin and rectangular and were yellowish brown followed by a single layered phellogen. Phelloderm consisted of two to five layers of oblong parenchymatous cells of which some of them became collenchymatous and filled with oil globules while others were with light yellow contents. . Narrow zone of secondary cortex was made up of three to four rows of compactly arranged parenchymatous cells traversed by medullary rays. The medullary rays were V- shaped very broad towards the outer side and cells contained oil globules. The active phloem was 5-6 layers of thin walled cells. The xylem composed of mostly tracheids and vessels along with many thick walled wood parenchyma. The primary xylem was diarch. Vessels were many, scattered.

Root : T.L.S (Fig.111)

The cells of the cork were rectangular and contained yellowish- brown inclusions. Below cork were radial rows of rectangular thick walled collenchyma cells contained light yellow oil globules. The phloem rays were thin walled and polygonal containing light yellow coloured content and oil globules. The vessels were narrow, with 3-4 alternate rows of bordered pits. The xylem rays were spindle shaped and contained light yellow coloured content and oil globules.

Root : R.L.S (Fig.112)

The phloem ray cells were erect, polygonal and were filled with light yellow coloured content and oil globules. Between the cells of phloem and xylem rays there were the single upright column of the cambium was found. Xylem rays were heterogeneous square to hexagonal and contained oil deposits. Primary xylem had tracheids with spiral thickening.

Root : Powder study (Fig.113)

The components present in the powder were yellowish-brown cork cells, collenchyma with oil droplets, ray parenchyma with oil droplets, lignified parenchyma, bordered pitted vessel and tracheids.

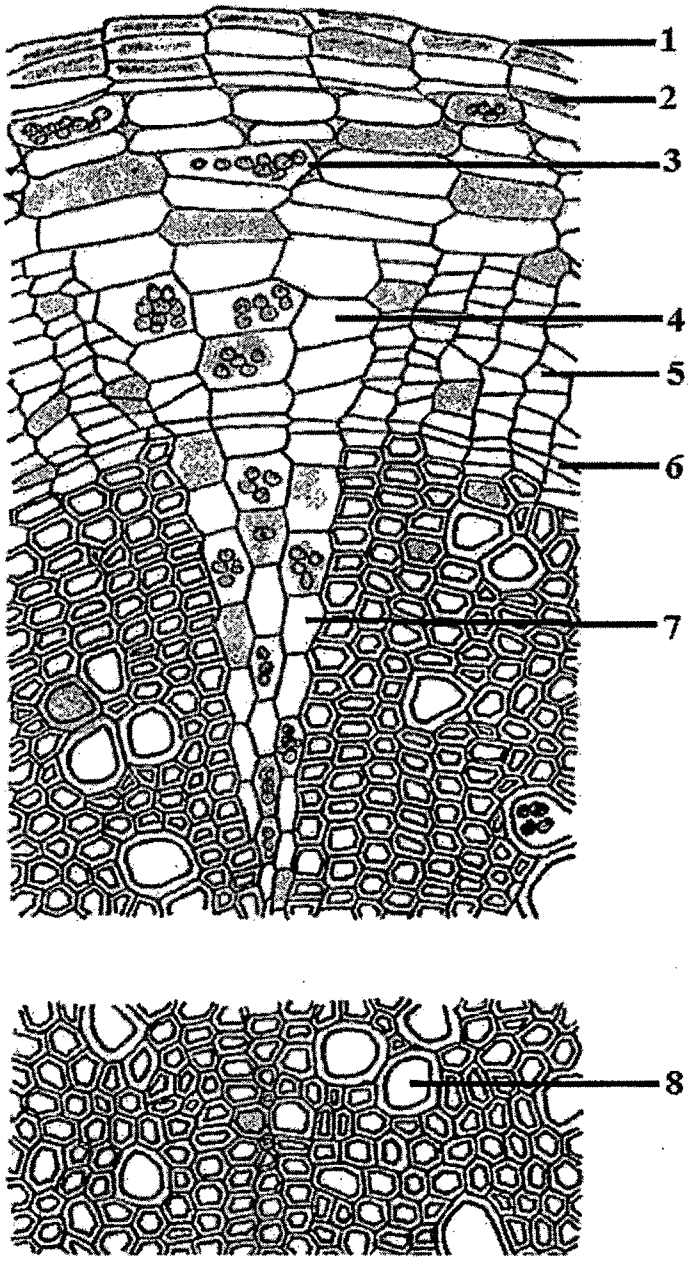


Fig.110. ***Polygala senega*** **root, T.S**: 1. Cork, 2. Phellogen, 3. Cortex,4. Oil droplets, 5. Broad V-shaped medullary ray, 6. Phloem 7. Cambium, 8.Xylem rays, 9. Vessels.

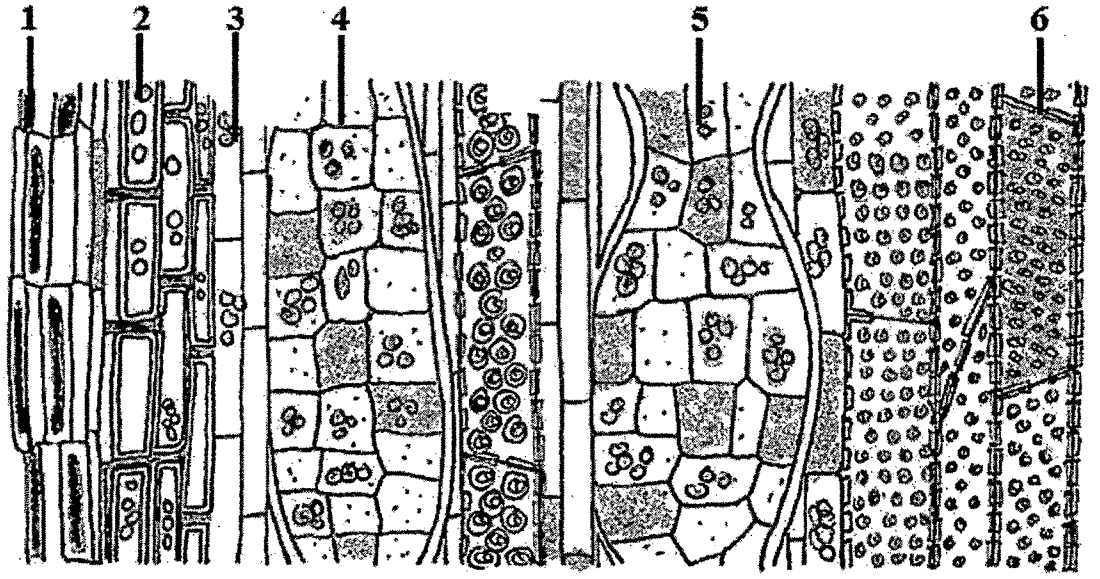


Fig.111. ***Polygala senega*** **root, T.L.S**:1. Cork, 2 Collenchyma with oil droplets, 3.Phloem parenchyma, 4. Phloem rays, 5. Xylem rays, 6. Vessels with alternate bordered pits.

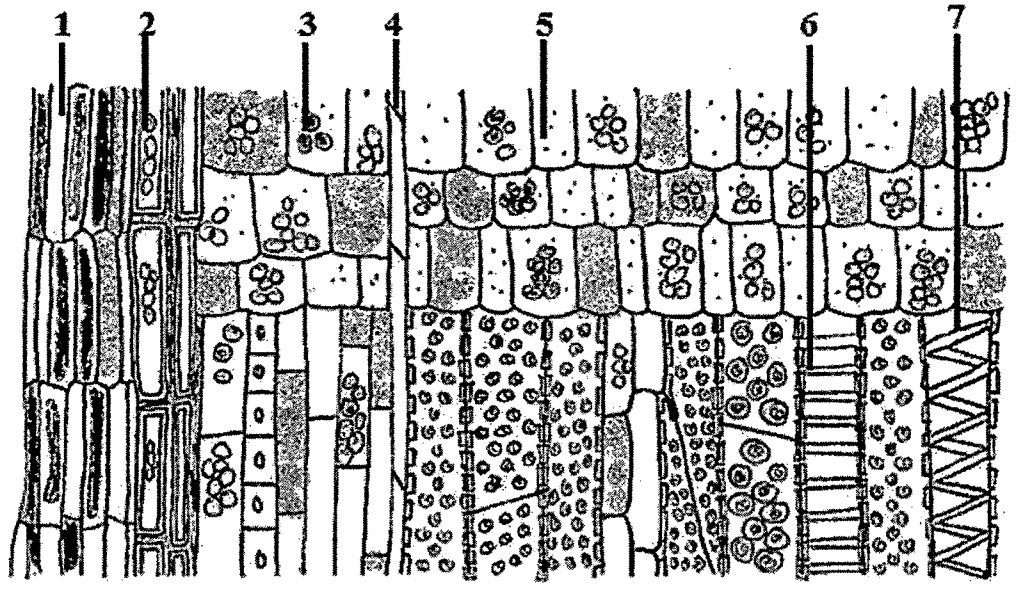


Fig.112. ***Polygala senega*** **root, R.L.S**:1. Cork, 2. Collenchyma with oil droplets, 3.Phloem rays, 4. Cambium, 5. Xylem rays, 6.Annular thickened vessel, 7.Vessels with spiral thickening.

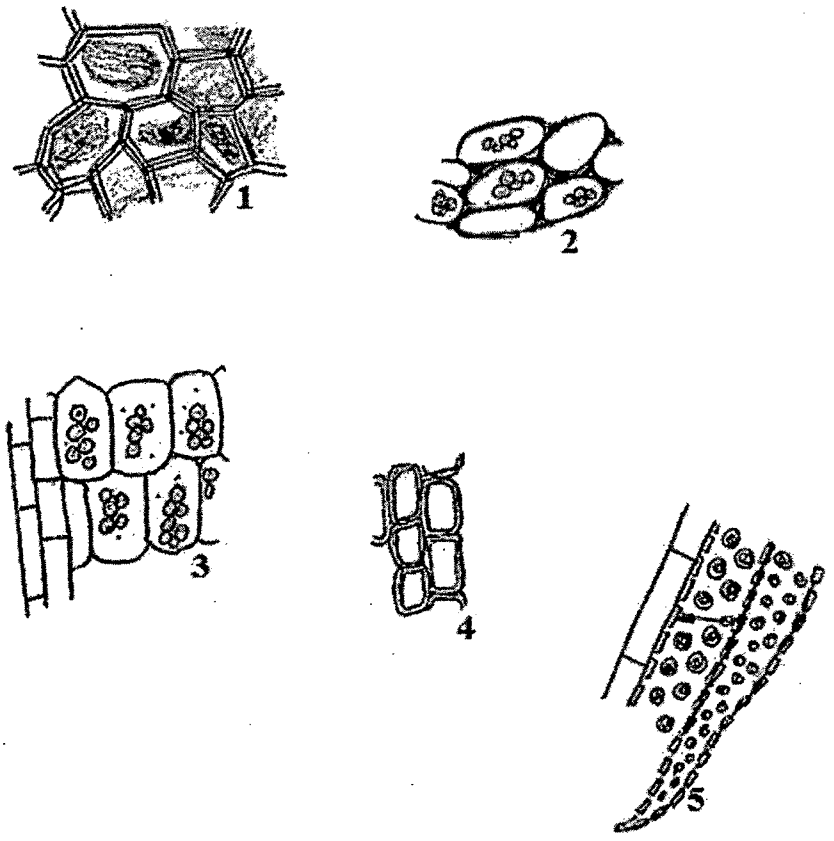


Fig.113. ***Polygala senega*** **root,Powder study:** 1.Yellowish-brown cork cells, 2.Collenchyma with oil droplets, 3. Ray parenchyma with oil droplets, 4. Thick walled wood parenchyma,5.Bordered pitted vessel and tracheids.

Distinguishing features

Phytochemical markers

1. Vanillic acid.
2. Syringic acid.
3. Rhamnose.
4. Xylose.
5. Arabinose .
6. Ribose.
7. Absence of flavonoids.

Pharmacognostic markers

1. Yellowish-brown cork cells.
2. Collenchyma with oil droplets.
3. Medullary rays were broad forming V- shape.
4. Ray parenchyma with oil droplets.
5. Thick walled wood parenchyma.
6. Bordered pitted vessel and tracheids.

Physico-chemical analysis:

Table 19 : Values obtained for the proximate analysis.

Sr.No.	Parameter	Mean ± SD (%)*			Average (%)
		Summer	Monsoon	Winter	
1.	Total Ash Content	5.39±0.31	5.36±0.34	5.33±0.33	4.37
2.	Acid Insoluble Ash content	1.11±0.07	1.09±0.08	1.10±0.03	0.933
3.	Alcohol soluble extractives	18.62±0.38	18.89±0.66	18.17±0.49	19.33
4.	Water soluble extractives	28.80±0.41	29.02±0.29	28.77±0.38	29.313

*Each value is a mean of 3 readings.

6.b. *Acalypha indica* Linn. (Euphorbiaceae)

Synonyms : ***Acalypha canescens*** Wall.

Sanskrit names: Arittamanjarie, Rudra, Muktavarchas.

Vernacular names:

Bengal : Muktajhuri,Sveta-baśanta, harita manjari.

English : Indian acalypha.

Gujarati : Vanchi Kanto.

Hind : Kuppu,Khokali, khokla, khokli, kuppi, kuppikhokli, kholi

Kannada : Kuppigida.

Konkani : Kunkmiphal.

Malayalam : Kuppamani.

Tamil : Kuppivaeni; Kuppaimeni.

Telugu : Kuppichettu, Harita-manjiri, Kuppinta,Muripindi.

Uriya : Indramaris.

Distribution and habitat

The plant is a common weed found in waste places, gardens and along the road sides throughout the hotter parts of India.

Morphological features:

An annual erect herb, 30-100 cm high, branches numerous, long, ascending, angular, finely pubescent. Leaves 2.5 - 7.5 cm long and 2-2.5 cm broad, ovate or rhomboid- ovate, acute or sub-obtuse, crenate- serrate, glabrous, thin, base cuneate, somewhat 3- nerved; petioles usually longer than the blade, slender; stipules minute. Flowers unisexual, in numerous lax, erect, elongate axillary spikes; the male flowers minute, terminal or axillary; the female flowers scattered, 3-7, surrounded by a short pendunculate, large, leafy, truncate, dentate, cuneiform, many-nerved bract, 6-8 mm in diameter. Ovary hispid. Capsules small, hispid, quite concealed by the bract, often only 1-seeded. Seeds ovoid, smooth, pale-brown.

Medicinal uses:

The plant is emetic, purgative, beneficial in cough, dyspnoea, fever, deranged kapha and vata. Fresh leaf extract with common salt is applied in eczema. It is used in gastrointestinal and respiratory affections (Raj and Singh 2000) and is a useful remedy for bronchitis, asthma and pneumonia. The plant extracts have significant antioxidant properties(Durga *et.al*, 2009). The methanolic extract showed analgesic and anti-inflammatory effect (Rahman *et.al*, 2010) .The water extract showed the

maximum zone of inhibition for *Staphylococcus aureus* and *Pseudomonas aeruginosa* (Raja *et al.*,2009). According to Siddha Materia Medica the leaf powder when given in the dose of 950 mg to 1300 mgs, cures respiratory diseases (Muthaliar 1988). The leaf juice when mixed with neem oil and applied to the inner part of children's tongue with the help of quill, induces vomiting and acts as expectorant. The root is employed as a cathartic. In small doses it is expectorant and nauseant and in large doses emetic(Datta and Mukharji 1950). Roots acts as a laxative and anthelmintic (With garlic) (Chopra *et al.*,1956;Watt,1972; Desai, 1975; Dymock *et al.*,1976;Bhandari,1977). The ethanol and aqueous extracts of root exhibited significant antioxidant activity (Balakrishnan *et al.*,2009; Durga *et al.*,2010).

Previous Phytochemical reports

The plant contained a cyanogenetic glucoside, acalyphine, two alkaloids, viz, acalyphine and triacetonamine, an essential oil n-octacosanol, quebrachitol, b-sitosterol acetate and tannin. Acalyphamide (as acetate), aurantia-mide and its acetate, succinimide calypho lacetate, 2-methyl anthraquinone, tri-O-methylellagic acid, b-sitosterol and its β -D-glucoside in leaves ; stigmasterol in root (Raj and Singh 2000) and four known kaempferol glycosides, mauritianin, clitorin, nicotiflorin and biorobin, have been isolated from the flowers and leaves (Nahrstedt *et al.*, 2006) and B-group vitamins were detected in the plant (Rao *et al.*,1982).

Previous pharmacognostic reports

Only the T.S of the root has been studied (Raj and Singh 2000; Datta and Mukharji 1950).

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

The acalyphine alkaloid which has been reported earlier, was located in the present investigation in roots in traces. The flavonoids were found to be absent. The

phenolic acids present were vanillic, syringic, and *cis* and *trans* ferulic acids. The mucilage amounted to 2.8% consisting of xylose and glucose.

Pharmacognosy

Macroscopic characters (Fig.114.)

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

Fig. 114. *Acalypha indica* Linn. root

Microscopic characters

Root : T. S (Fig. 115)

The T.S of the root was circular in outline. The cork consisted of 4 to 7 rows of thin walled, tangentially elongated cells of which the outermost one or two rows of cells were slightly ruptured. The secondary cortex was narrow zone consisting of 5 to 7 rows of isodiametric, thin walled parenchyma and arranged compactly. The cells of outer rows of cortex were narrow and tangentially elongated. Many of the cortical cells were filled with rosette crystals and simple spherical starch grains. Occasionally thick walled broad lumened sclerenchymatous fibres with distinct striations were also found in this region. The phloem consisted of usual phloem elements and many of them filled with rosette crystals and simple spherical starch grains. Phloem rays were uni- to bi-seriate and the cells were thin walled and contained starch grains. Wood consisted of vessels, tracheids, fibres and few wood parenchyma. Fibres were thick

walled and of various sizes and shapes with wavy margins. Xylem rays were thick walled containing starch grains. Starch grains were mostly simple and spherical or ovoid in shape. Vessels were simple and bordered pitted, mostly occurred singly but few were in groups of two and found associated with fibre tracheids. Spiral and scalariform thickened vessels were also common.

Root : T.L.S (Fig.116)

Cork cells appeared rectangular with thin walls.The sclerenchymatous fibres in the middle of the cortex were curved and spindle shaped. Some phloem parenchyma showed the presence of starch and rosette crystals. The cells of the rays were thin walled and contained starch grains. Xylem rays were comparatively thick walled, spindle shaped biseriate, simple pitted and contained starch grains. Tracheids contained multiseriate bordered pits. The bordered pits in vessels were arranged loosely in 4-6 rows.

Root : R.L.S (Fig.117)

The phloem ray cells appeared rectangular. They were thin walled and filled with starch grains in each cell. The pits on the wall were of simple type. The vessels showed 3-4 rows of bordered pits. The Primary xylem had spiral and annular type of thickenings.

Powder study (Fig. 118)

The components present in the powder were fragments of cork cells, rosette crystals of calcium oxalate, starch grains, thick walled broad lumened sclerenchymatous fibres with distinct striations, scalariform vessels, fibres with distinct lumen and wavy margins.

Distinguishing features

(I) Pharmacognostic markers

1. Rosette crystals.
2. Starch grains.
3. Thick walled broad lumened sclerenchymatous fibres with distinct striations.
4. Scalariform vessels.

(II) Phytochemical markers

1. *p*- Coumaric acid.
2. Ferulic (*cis*- and *trans*-isomers) acid.
3. Absence of flavonoids.

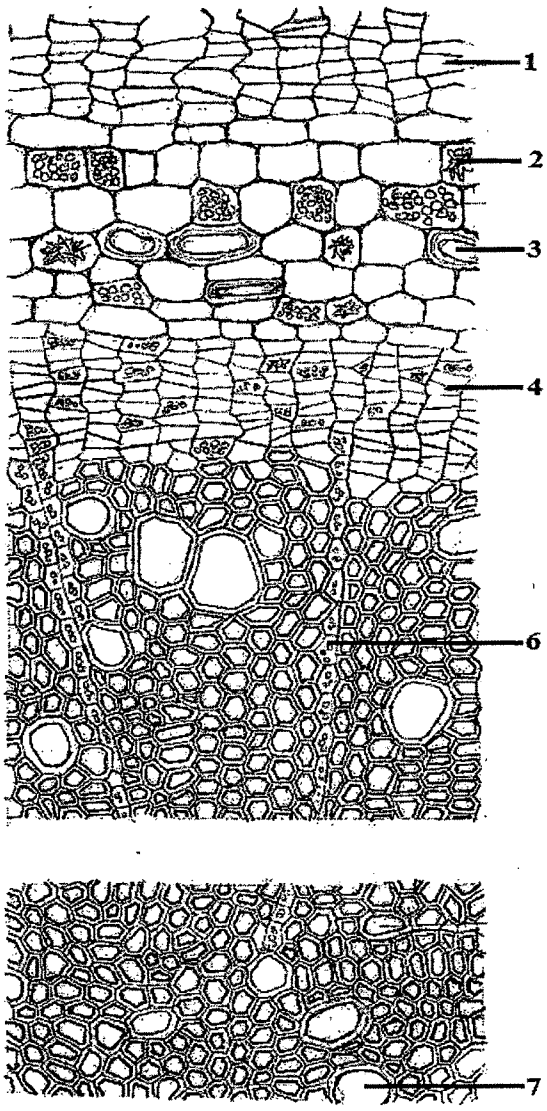


Fig.115. ***Acalypha indica*** **Linn. root, T.S**: 1.Cork, 2. Rosette crystal, 3.Parenchyma containing starch grains, 4. Sclerenchymatous fibre, 5. Phloem, 6. Xylem rays with starch grains, 7. Fibre tracheids, 8.Vessels.

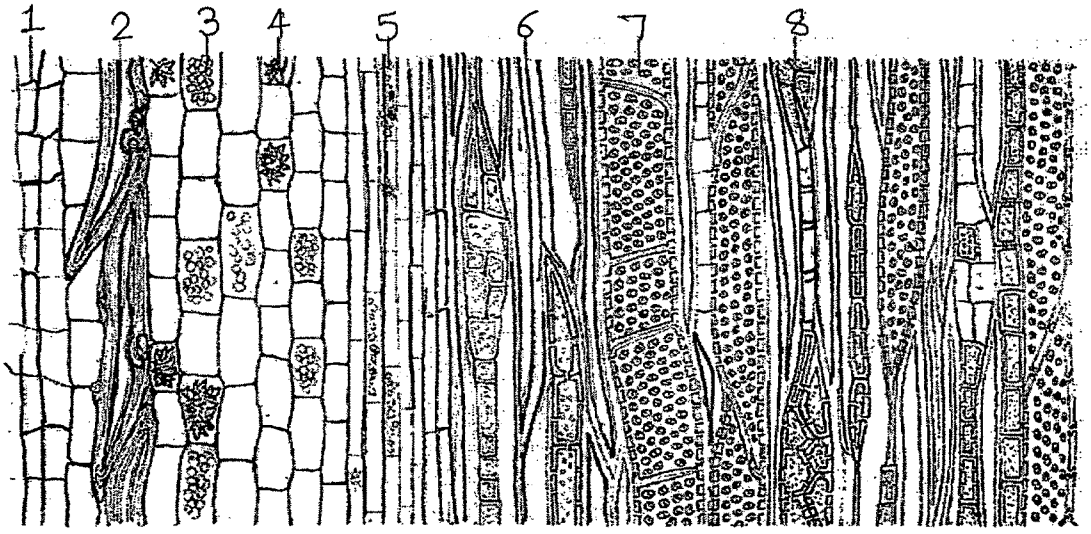


Fig.116. ***Acalypha indica*** **root, T.L.S**:1.Cork, 2.Sclerenchymatous fibre, 3.Starch grains, 4.Rosette crystal, 5. Phloem rays with starch grains, 6.Fibre tracheids, 7.Vessels, 8. Xylem rays.

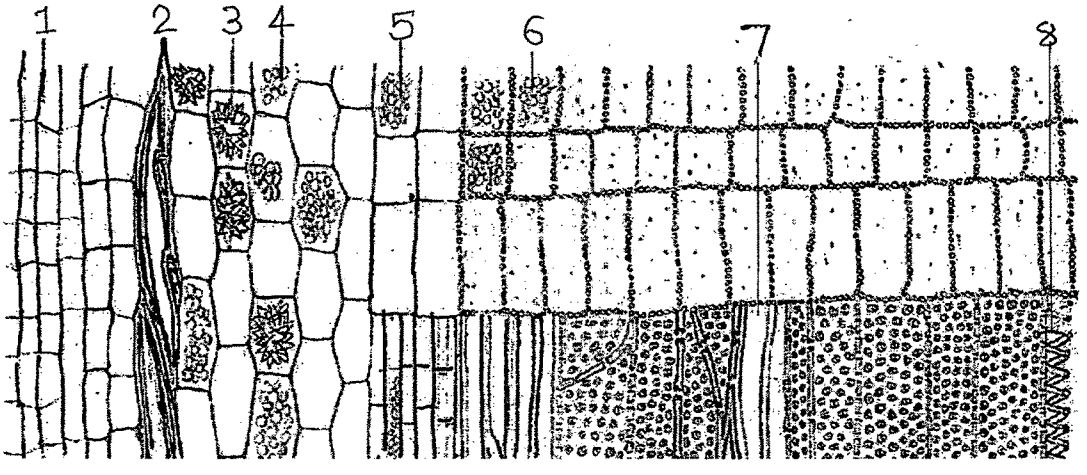


Fig.117.*Acalypha indica* **root, R.L.S**: 1.Cork, 2. Sclerenchymatous fiber, 3. Rosette crystal, 4. Starch grains, 5.Phloem rays with starch grains, 6. Xylem rays with starch grains, 7. Fibre tracheids, 8. Spiral vessel.

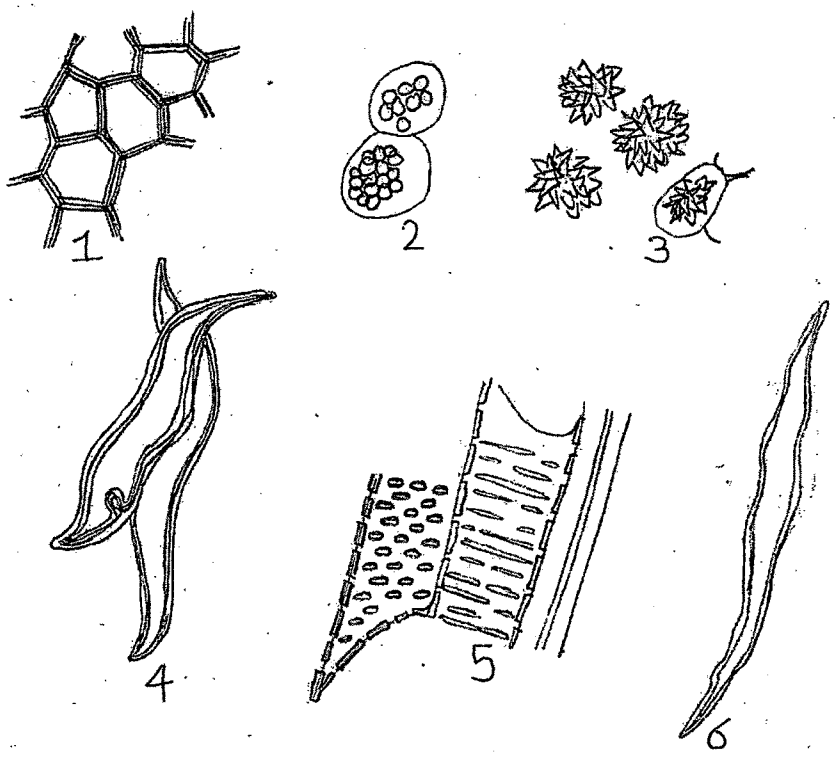


Fig.118. ***Acalypha indica*** **root, Powder study**: 1.Cork, 2. Parenchyma containing starch grains, 3. Rosette crystals, 4. Thick walled Sclerenchymatous fibres with distinct striations, 5. Scalariform vessels, 6. Fibre with wavy walls.

Physico-chemical analysis:

Table 20: Values obtained for the proximate analysis.

Sr.No.	Parameter	Mean ± SD (%)*			Average (%)
		Summer	Monsoon	Winter	
1.	Total Ash Content	02.68±0.29	02.93±0.31	02.35±0.36	2.653
2.	Acid Insoluble Ash content	0.97±0.35	0.97±0.84	0.97±0.	0.97
3.	Alcohol soluble extractive	01.51±0.11	01.31±0.17	01.52±0.15	1.446
4.	Water soluble extractive	03.43±0.31	02.91±0.24	02.98±0.39	3.106

*Each value is a mean of 3 readings

6.c.*Adhatoda vasica* L. Nees (Acanthaceae)

Synonyms: ***Adhatoda zeylanica*** Medic. A. (L.), ***Justicia adhatoda*** L.

Sanskrit : Atarusa, Simhasya, Vasaka.

Vernacular names:

Assamese : Bahak, Titabahak, Vachaka.

Bengali : Bakas, Basak.

English : Malabar nut.

Gujrati : Aradusi, Ardusi, Araduso.

Hindi : Adoosa, Aduss, Arusa.

Kannada : Adusoye.

Kashmiri : Vasa.

Malayalam : Adalodakam, Adarooshaka.

Manipuri :Nongmangkha Angouba.

Marathi : Adulsa, Vasa.

Oriya : Basanga, Vasanga.

Punjabi : Arusa, Bhekar, Vansa, Vishuti.

Tamil : Adadodi, Kattumurungai, Vachai, Atatotai, Akacattamarai.

Telugu : Addasaramu.

Urdu : Adoosa, Adusa , Arusa , Burg Bansa.

Distribution and habitat

The plant is an evergreen shrub distributed throughout India upto an altitude of 1300 m. and also cultivated.

Morphological features

A dense shrub 3 m high with many long opposite ascending branches; stem with yellowish bark, terete, glabrous. Leaves upto 20 cm long, elliptic-lanceolate, acuminate, and minutely puberulous when young, glabrous when mature, entire, dark-green above, paler beneath, base tapering; main nerves 10-12 pairs with reticulate venation between. Flowers in short dense axillary pedunculate spikes 8 cm long, towards the ends of the branches; peduncles shorter than the leaves; bracts elliptic, subacute, glabrous or nearly so, 5-7 nerved, closely reticulately veined; bracteoles oblong-lanceolate, acute, with ciliolate margins, 1-nerved, reticulately veined. Calyx rather less than 1 cm long, glabrous or slightly pubescent, divided to the base; segments imbricate, oblong-lanceolate, acute, 3-nerved, reticulately veined. Corolla

white, with a few irregular rose-colored bars in the throat, 3 cm long, pubescent outside; tube 1 cm long, the lower half cylindric, the upper half much laterally inflated; upper lip ovate-oblong, curved, obtuse, notched; lower lip as long as the upper, the lobes 1 cm deep, oblong, rounded, the middle lobe the broadest. Filaments hairy at the very base, long, stout, curved; lower anther-cells minutely apiculate at the base. Ovary pubescent; solid stalk flattened, 1 cm long. Seeds orbicular-oblong, tubercular-verrucose, glabrous.

Medicinal uses:

It is used as an herbal remedy for treating cold, cough, whooping cough and chronic bronchitis and asthma, as sedative expectorant, antispasmodic, anthelmintic and other pulmonary infections(Singh *et al.*,2011).It is also known for its antiarthritis, antiseptic, antimicrobial and antituberculosis properties (Dey, 1980). It is an important drug prescribed for malarial fever, fever caused by *pitta* and *kapha*, chronic fever, intrinsic hemorrhage, leprosy, skin diseases and piles (Soni, 2008).

Previous Phytochemical reports

The plant contains pyrroquinazoline alkaloids viz. vasicine, vasicol, vasicinone, peganine along with other minor constituents.Minor alkaloids include adhatonine vasicinol and vasicinolone. Flowers mainly yield of kaempferol and quercetin. A new moiety' 2 -4-dihydroxy chalcone-4-glucoside has been identified in the flowers. Four quinazoline alkaloids: vasicoline, adhatodine, vasicolinone and anisotine have been obtained from the leaves and vasicinone, vasicol have been isolated from the inflorescence. Sitosterol, ß -glucoside-galactose and deoxy vasicine have been isolated from the roots of the plant. Phytochemical investigations of leaves also yielded a quinazoline alkaloid identified as 1,2,3,9 tetrahydro-5-methoxypyrroloquinazoline-3-ol (Sayeed, 2009).

Previous pharmacognostic reports

Only the T.S of the root has been done (Anon.2004; 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 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 acid, syringic acid along with trace amounts of *p*-coumaric acid, *p*-hydroxy benzoic acid and ferulic acid (*cis*- and *trans*-isomers). Mucilage amounted to 2.46 % consisting of xylose and galactose. The root also showed the presence of alkaloids and steroids while coumarins and saponins were found in good concentrations.

Pharmacognosy

Macroscopic characters (Fig.119)

The tap root was cylindrical and woody. The outer surface was yellowish brown in colour and showed longitudinal wrinkles. Fracture hard , Odour not distinct.

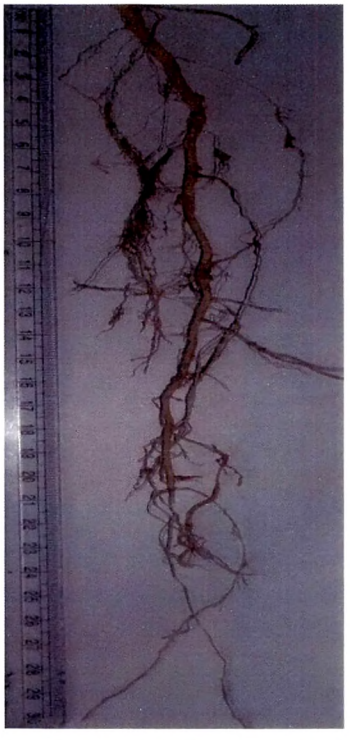


Fig.119. *Adhatoda vasica* root.

Microscopic characters

Root : T.S (Fig. 120)

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 4 to 8 rows of thin walled, rectangular to tangentially elongated cells. Inner to the cork was the phellogen consisting of a single row of narrow thin walled tangentially elongated cells. The secondary cortex was consisting of five to ten rows of comparatively large polygonal thin walled parenchyma cells where the cells towards periphery were comparatively bigger than that of inner ones. Isolated groups of 2 to 3 stone cells were embedded towards the centre in the cortex. The stone cells were mostly squarish to rectangular and of narrow lumened. The cells of cortex were also showed the presence of scanty groups of small simple starch grains and were spherical or ovoid in shape (2- 8 μm) , along with few compound starch grains having up to 4 components. phloem were well developed and showed the presence of isolated bast fibres along with usual phloem elements, where phloem parenchyma cells contained starch grains. Wood was wide consisted of vessels, tracheids, fibres and ray. The fibers were heterogenous. Here xylem in the centre were typically composed of thick walled fibre-tracheids (6-8 layers) surrounded by many Vessels equally distributed throughout or occurring singly or in a group of two distributed all over the xylem . Medullary rays were radially elongated and contained starch grains. Vessels were pitted and reticulate.

Root : T.L.S (Fig.121)

Cork cells appeared rectangular. The cells of the cortex also appeared rectangular as of cork , but were larger in size. There were large spindle shaped stone cells in the cortex. Phloem parenchyma were straight. Xylem rays were fairly thick walled, simple pitted and each cell contained 4-6 starch grains.. Tracheids contained 3 to 4 rows of bordered pits. The reticulate thickened vessels were also found.

Root : R.L.S (Fig.122)

The phloem ray cells appeared square to rectangular. They were thin walled and filled with starch grains. The xylem rays also were filled with starch grains. The vessels showed 3-4 rows of bordered pits.

Root : Powder study (Fig.123)

The components present in the powder were thin walled cork, stone cells, ray parenchyma with starch grains, fibre-tracheids, reticulate thickened vessels.

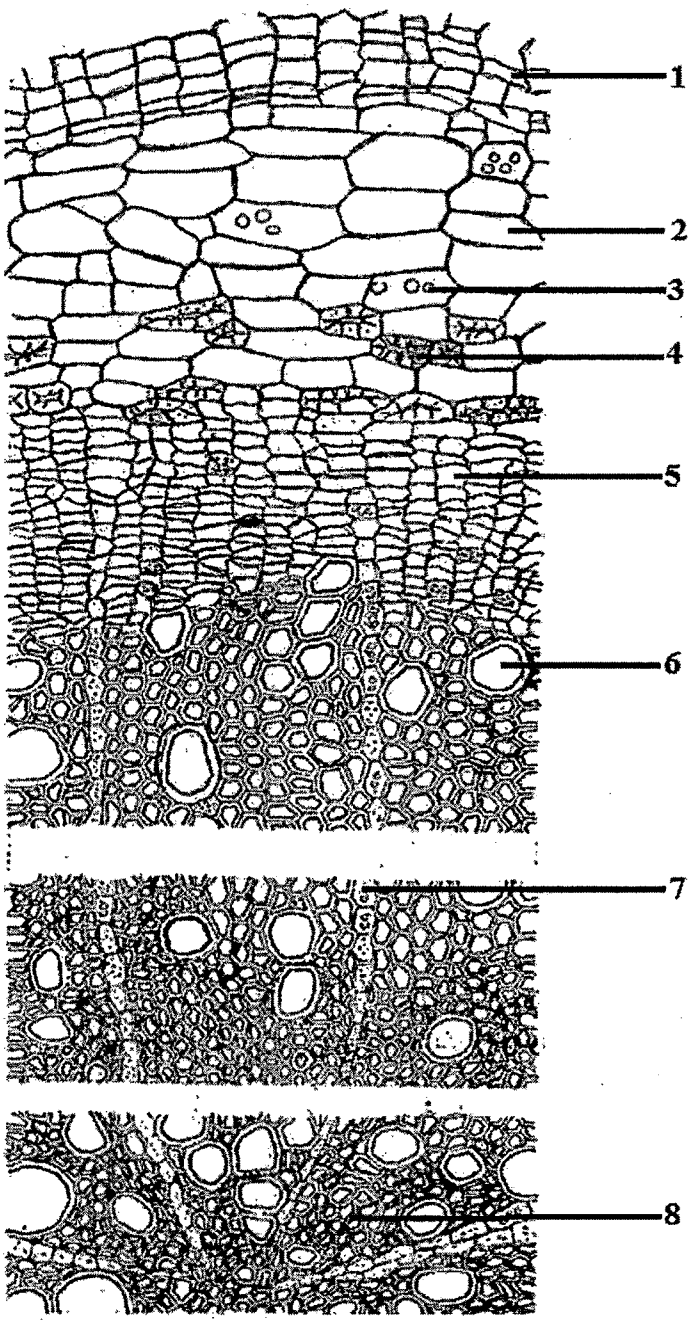


Fig.120. ***Adhatoda vasica*** **root, T.S:** 1. Cork, 2.Cortex, 3.Parenchyma with starch grains, 4.Stone cell, 5.Phloem, 6.Vessels, 7.Xylem rays, 8.Fibre tracheids.

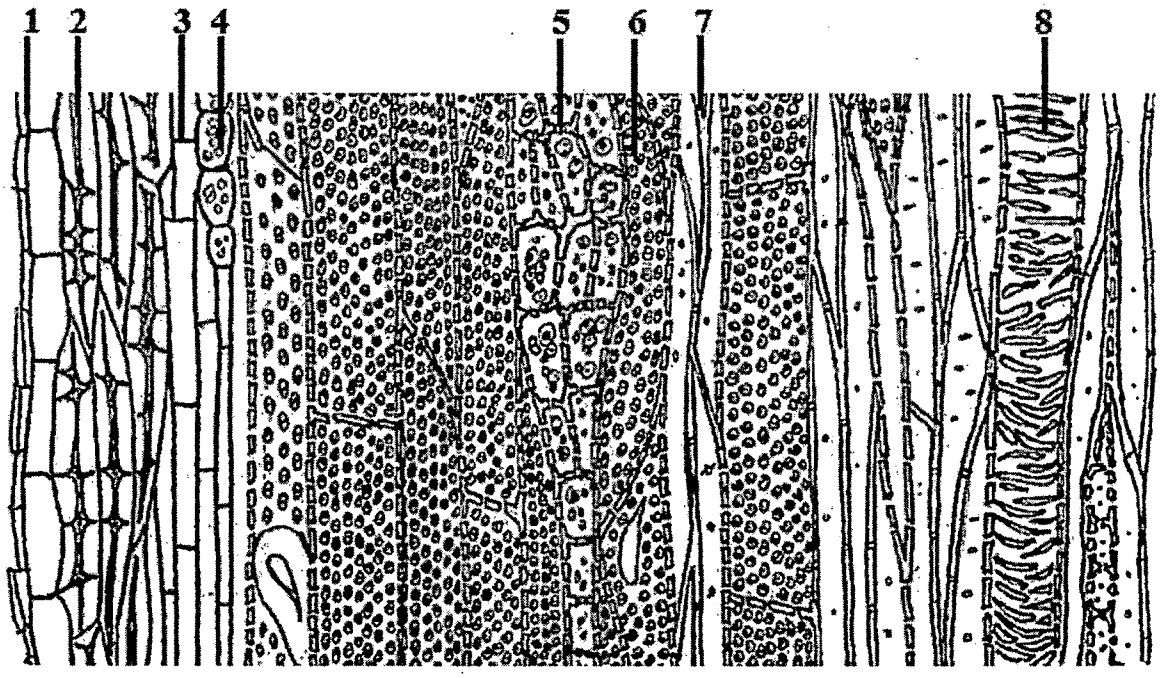


Fig. 121. ***Adhatoda vasica*** **root, T.L.S:** 1.Cork, 2.Stone Cell, 3.Phloem parenchyma, 4.Phloem rays, 5.Xylem rays with starch grains, 6.Bordered pitted tracheids, 7.Fibre tracheids, 8.Reticulate thickened vessels.

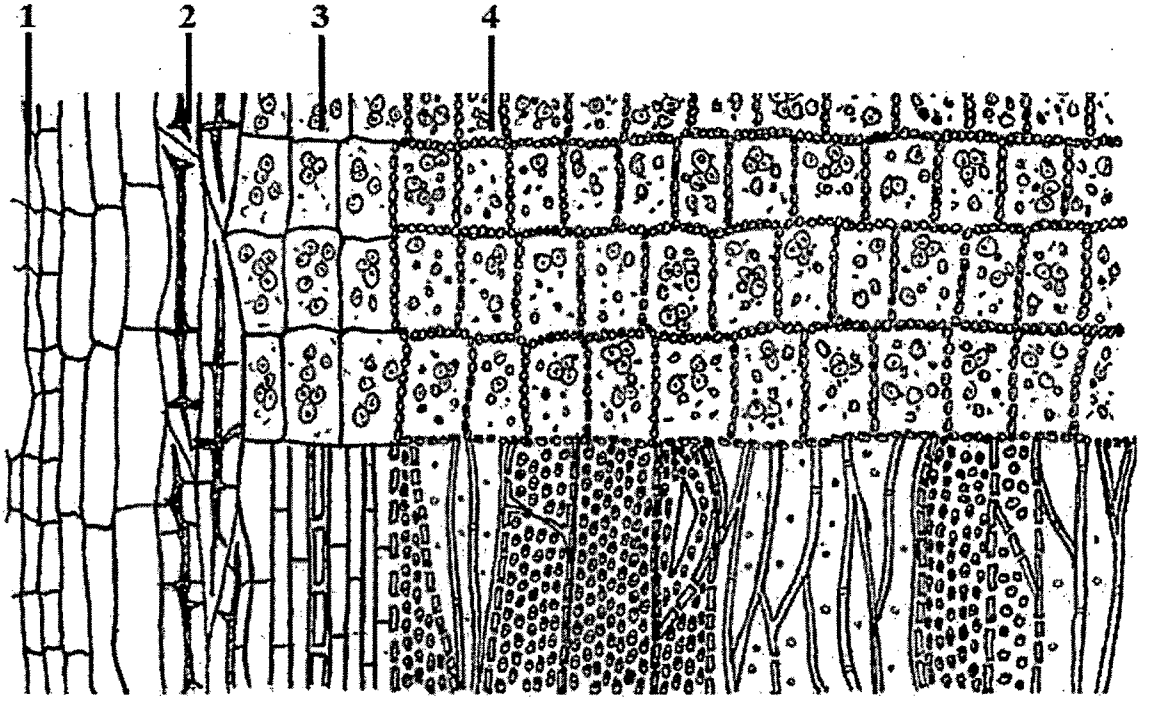


Fig.122. ***Adhatoda vasica*** **root, R.L.S:** 1.Cork, 2.Stone Cell, 3. Phloem rays, 4.Xylem rays with starch grains.

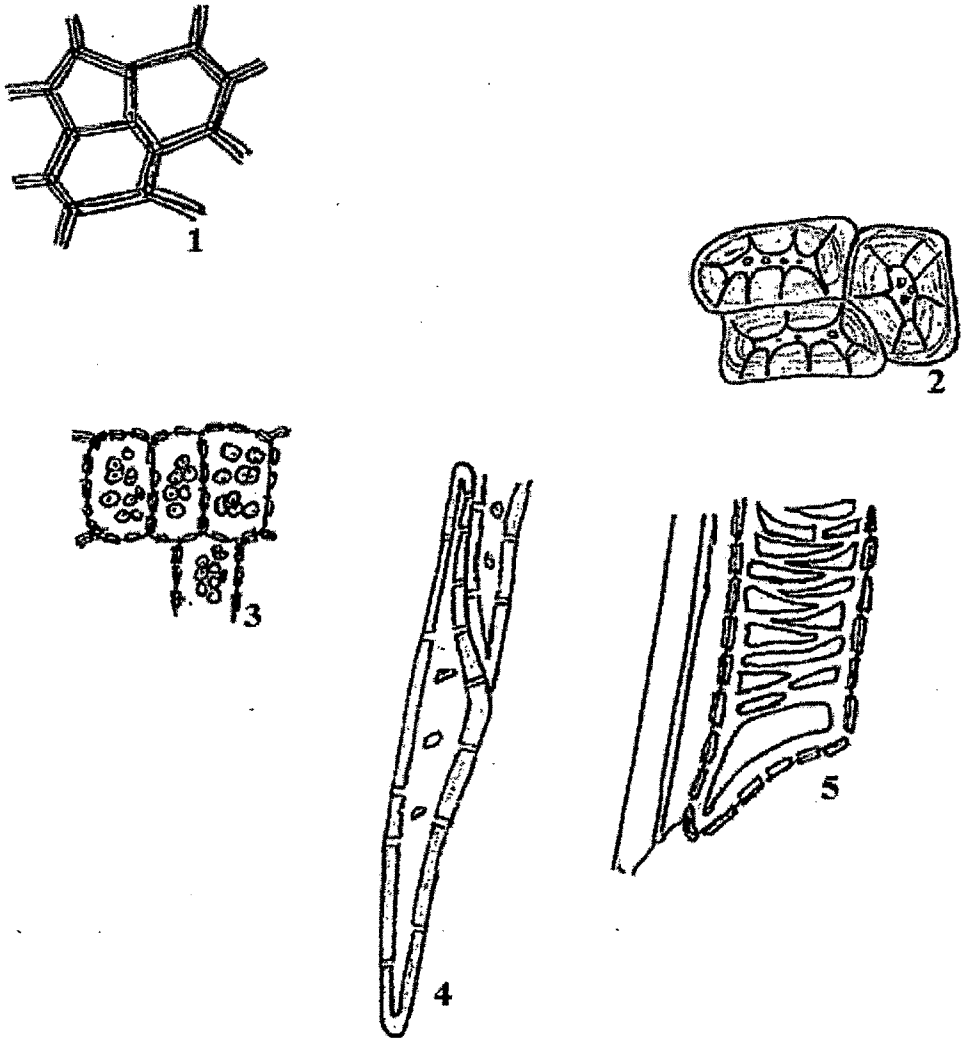


Fig.123. ***Adhatoda vasica*** **root,powder study:**1.Cork, 2.Stone cells, 3.Ray parenchyma with starch grains, 4.Fibre tracheids, 5.Reticulate thickened vessels.

Distinguishing features

Pharmacognostic markers

1. Thin walled cork
2. Starch grains.
3. Stone cells.
4. Xylem in the centre were composed of walled fibre-tracheids.
5. Ray parenchyma containing starch grains.
6. Reticulate thickened vessels.

Phytochemical markers

1. Vanillic acid.
2. Syringic acid.
3. Rhamnose.
4. Xylose.
5. Absence of flavonoids.

Physico-chemical analysis:

Table 21: Values obtained for the proximate analysis.

Sr.No.	Parameter	Mean ± SD (%)*			Average (%)
		Summer	Monsoon	Winter	
1.	Total Ash Content	04.63±0.31	04.69±0.41	04.66±0.39	4.66
2.	Acid Insoluble Ash content	0.88±0.41	0.89±0.46	0.90±0.39	0.89
3.	Alcohol soluble extractive	06.22±0.16	06.29±0.11	06.13±0.09	6.21
4.	Water soluble extractive	12.11±0.31	12.52±0.13	12.19±0.16	12.27

*Each value is a mean of 3 readings

6.d. *Polygala chinensis* Linn.(Polygalaceae)

Vernacular names:

English : Indian senega, Common Indian Milkwort.

Gujarat : Pilibhonyasana.

Hindi : Meradu, Miragu.

Marathi : Negli-; Nagpuri : Danaminjo, danaminju, Gurgur.

Distribution and habitat

Throughout India, upto 5,000 ft. (Anon.1956).

Morphological features

An erect branched annual reaching upto 25 cm high, pubescent. Leaves variable, upto 4 cm long, obovate, coriaceous, ciliate, mucronate; petioles hairy. Flowers yellow, in axillary or extra-axillary, short, almost capitate, few-flowered racemes; crest of a single tubular appendage multifid only at the apex; bracts small, membranous. Outer sepals broadly ovate acuminate, with membranous, ciliate margins. Wings herbaceous, oblique, ovate-oblong, acuminate, with narrow, membranous margins ciliate towards the base, longer than the capsule. Capsules orbicular-oblong, strongly ciliate, narrowly margined. Seeds hairy; strophiole glabrous or nearly so, rounded at the apex furnished with 3 membraneous basal appendages.

Medicinal uses:

The root is given in cases of fever and dizziness (Anon.1956).

Previous Phytochemical reports

The plant contained polygalic acid 4.5% and senegin, 2.1% (Hossain *et al.*,1943) and 1, 5–Anhydro-d-mannitol (Alagammal *et al.*,2011).

Previous pharmacognostic reports

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

Materials and methods

The plant material has been collected from Timbi village, 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 of the plant along with the known saponin and steroids were found to contain vanillic, and syringic acids while flavonoids were found to be absent. Mucilage amounted to 7.72 % consisting of rahmnose and xylose.

Pharmacognosy

Macroscopic characters (Fig.124)

The root cylindrical, woody. somewhat tortuous and yellow to yellowish brown colour. Fracture short.

Fig.124. *Polygala chinensis* root.

Microscopic characters

Root : T.S (Fig. 125)

The phellem or cork zone was well developed showed the 4-6 rows of tangentially elongated cells. The walls of these cells were comparatively thick and light brown in colour. Cortex was of 2-5 layers of somewhat broadly rectangular parenchymatous cells, many of them containing yellow amorphous substances. Phloem was made up of usual elements and also was contained yellow amorphous

substances. Phloem rays were found to contain yellowish-brown colouring matter. Secondary xylem was stratified with groups of fiber tracheids along with few isolated pitted parenchyma. Vessels were single and bordered pitted, usually occurred singly. Primary xylem consisted of tracheids having annular thickenings. Xylem rays were uniseriate with few biseriate and contained yellowish-brown colouring matter.

Root : T.L.S (Fig. 126)

The cork cells were many layered and the walls of these cells were comparatively thick and light brown in colour. Phloem rays were thin walled and appeared spindle shaped and some phloem rays contained yellow amorphous substances. Xylem vessels had bordered pits on their walls and few of them showed transversely elongated pits. Primary xylem consisted of tracheids having annular thickenings.

Root : R.L.S. (Fig. 127)

The Phloem and xylem rays consisted of hexagonal shaped pitted cells and contained yellow amorphous substances. Fiber tracheids were thick walled and had simple pits on their walls. Tracheids and vessels were bordered pitted.

Root : Powder study (Fig. 128)

The components present in the powder were cork with brown coloring matter, parenchyma containing yellow amorphous substances, phloem bearing yellow contents, pitted ray parenchyma, wood fibres with broad lumen and tapering ends, fiber tracheids and vessels with annular thickening.

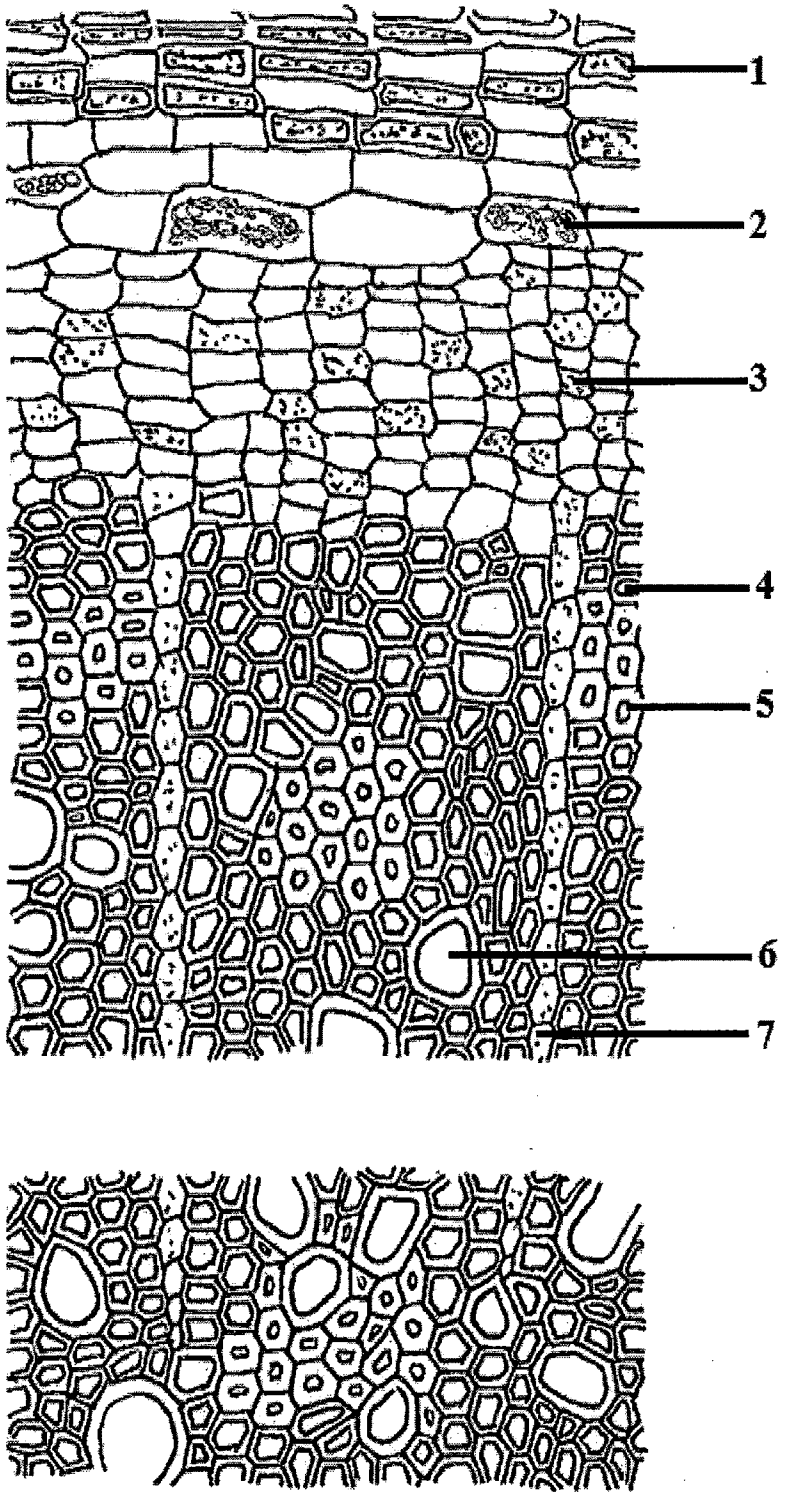


Fig.125.*Polygala chinensis* root, T.S: 1. Cork, 2. Parenchyma with yellow amorphous substances, 3. Phloem with yellow amorphous substances, 4. Xylem, 5.Groups of fibre tracheids, 6. Vessels 7. Xylem rays

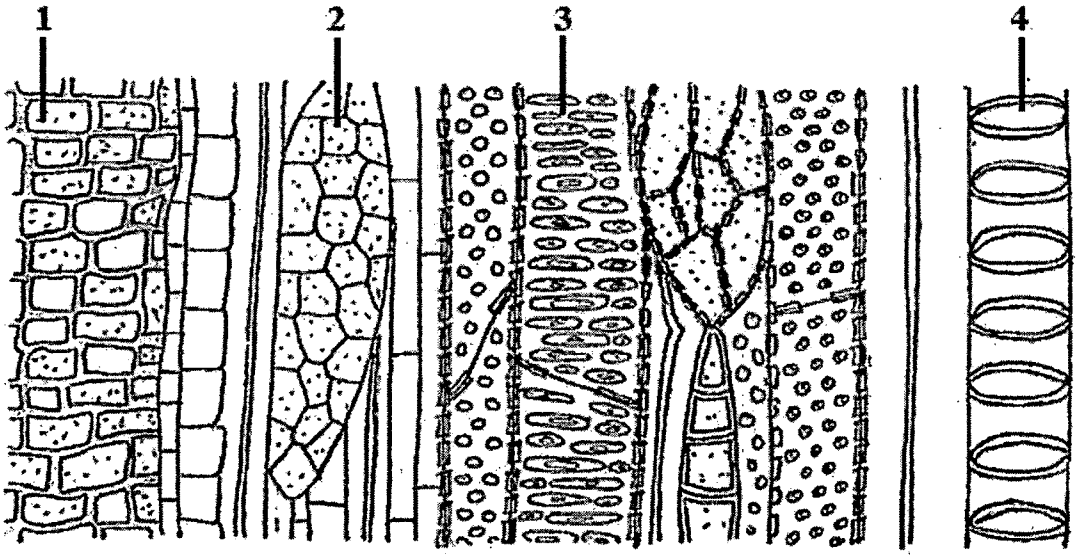


Fig.126. ***Polygala chinensis*** **root, T.L.S**: 1.Cork, 2. Phloem ray, 3.Vessels, 4.Primary xylem.

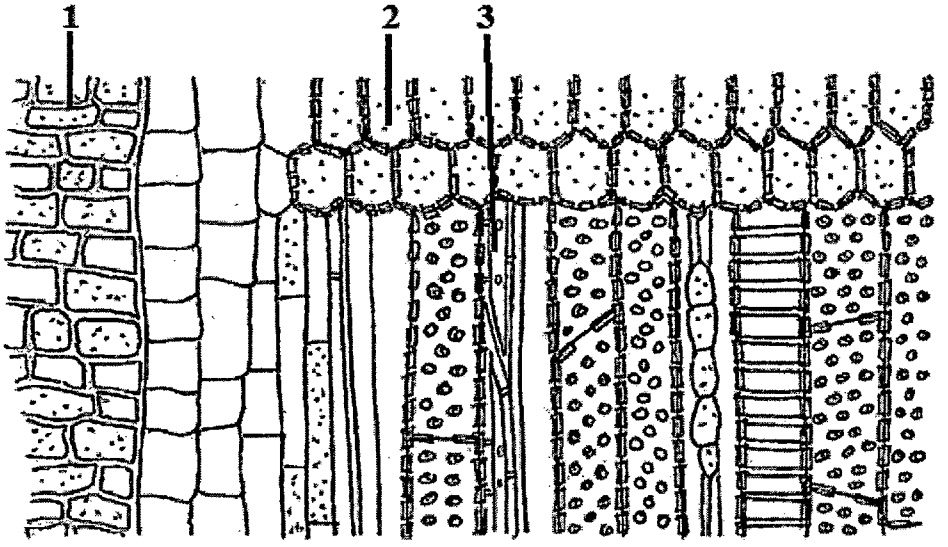


Fig. 127. ***Polygala chinensis*** **root, R.L.S**: 1.Cork, 2. Xylem ray, 3.Fibre tracheids.

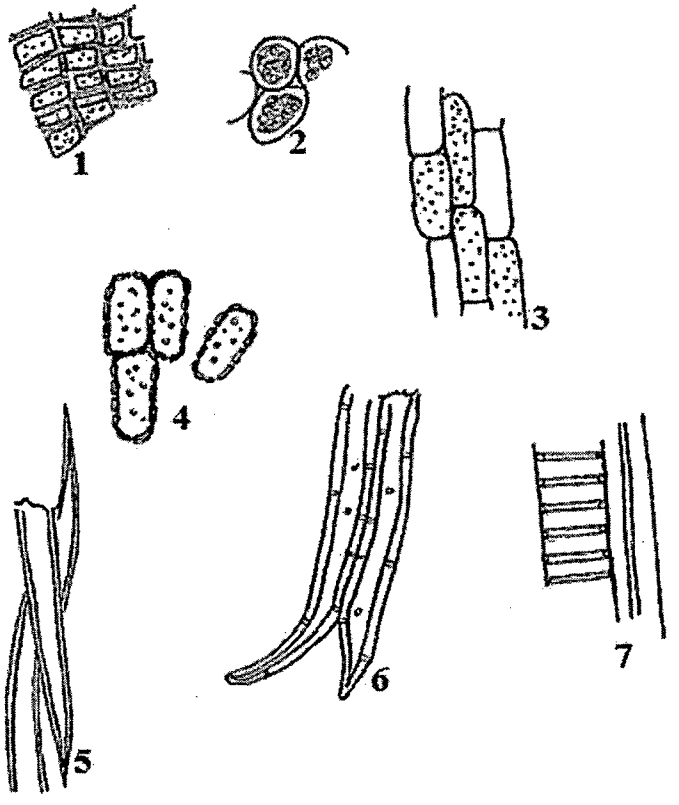


Fig.128.*Polygala chinensis* root,powder study:1.Cork, 2. Parenchyma with yellow amorphous substances, 3. Phloem with yellow amorphous substances,4. Ray parenchyma, 5.Broad lumened fibres, 6.fibre tracheids, 7.Vessels with annular thickening.

Distinguishing features

Phytochemical markers

1. Saponins.
2. Vanillic acid.
3. Syringic acid.
4. Rhamnose
5. Xylose.
6. Absence of flavonoids.

Pharmacognostic markers

1. Cork with brown coloring matter.
2. Parenchyma containing yellow amorphous substances.
3. Fibre tracheids.
4. Vessels with annular thickening.

Physico-chemical analysis:

Table 22 : 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	5.36
2.	Acid insoluble ash content	0.93±0.11	0.94±0.09	0.93±0.09	1.1
3.	Alcohol soluble extractives	19.22±0.12	19.47±0.26	19.30±0.19	18.56
4.	Water soluble extractives	29.00±0.32	29.81±0.41	29.13±0.19	28.86

*Each value is a mean of 3 readings.

6.e. *Xeromphis spinosa* (Thunb.) Keay (Rubiaceae)

Synonyms: *Catunaregam spinosa*(Thunb.)Tiruv.

Sanskrit : Madana, Pinditak, Dharaphal.

Vernacular names:

Assamese : Gurol, Behmona, Mona.

Bengali : Mainphal.

Hindi : Karhar.

Gujarati : Mindhal, Mindhola, Midhola.

Kanarese : Kare, Banegora, Mangari, Minkare.

Khasia : Diengmakasing-Khlaw.

Kashmir : Kirkla, Kokoa.

Malyalam : Kara.

Marathi : Ghela, Peralu, Mindhal, Wagatta, Gelphal.

Oriya : Palova.

Sanskrit : Madana, Pinditak, Dharaphal.

Tamil : Marukkalankay, Madkarai.

Telugu : Manga.

English : Emetic nut.

Distribution and habitat

Throughout India, common as and undergrowth in the Sal forest ok the Sub-Himalayan tract in many parts of the Indian peninsula.

Morphological features.

A deciduous, thorny shrub or small tree, up to 9m. in height and 90 cm. in girth, bark dark brown grey, tough . Leaves obovate. Flower first white, later turing yellow, fragrant. Berry yellow when ripe, 2.0-3.7 cm. long , globose or broadly ovoid, smooth or obscurely longitudinally ribbed ; seeds many, flat about 4 mm long, angular.

Medicinal uses:

The root is considered cooling, tonic, aphrodisiac, and is used in biliousness and boils of children (Datta and Mukerji,1950). The pulp of the fruit is a valuable

emetic. It is nauseant, expectorants, diaphoretic,anthelmintic and abortifacient. It is also useful as a nervine sedative and antispasmodic(Anon.1999).

Previous Phytochemical reports

Fruits yielded ursosaponin, triterpene (m.p. 225-27°), acid resin, yellow essential oil, scopoletin and d-mannitol; triterpene-dirandinin ; dumetoronin A,B,C,D,E,F .Fruit pulp contained sugars, citric and tartaric acids, tannins, pectin and mucilage ; 3-0-(β-D-xylopyranosyloxy) olean-12-en-28-oicacid. Two triterpenic acid sapogenins designated as randialic acid-A and randialic acid-B were reported from the bark while roots contain scopoletin and d-mannitol. Stem heartwood gave α-amyrin, β-sitosterol, oleanolic acid, ursolic acid and D-mannitol. Palmitic, stearic, oleic, linoleic, arachidic and lignoceric acids were present in the seed oil (Anon.1990).

Materials and methods

The plant material has been collected from Rajpipla,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 contained high concentration of a coumarin scopoletin along with phenolic acids vanillic and syringic acids while ferulic (*cis*- and *trans*-isomers), melilotic and *p*- coumaric acids were in traces. Mucilage amounted to 6.6% consisting of glucose , xylose and rhamnose . The root also showed the presence of unidentified alkaloids and steroids while saponins were found in good concentrations.

Pharmacognosy

Macroscopic characters (Fig.129)

The root were tap root, cylindrical, woody. The outer surface was light brown in colour and showed longitudinal wrinkles. Fracture fibrous , odour not distinct.

Fig.129. *Xeromphis spinosa* root.

Microscopic characters

Root : T.S (Fig. 130)

The root in T.S was circular in outline. The cork composed of 5-10 layers of thin-walled cells, cells of outer 2 to 4 layers were light brown and rectangular while the cells of inner 3 to 4 layers were more or less cubical in shape and some of them filled with brown content. The secondary cortex was well developed, several layered, consisting of large polygonal thin walled parenchymatous cells most of them filled with starch grains and few with reddish-brown content . There were 3 to 4 continuous layered of stone cells lied in the cortex with few scattered sclerenchymatous fibers and rhomboidal crystals. The starch grains were simple, rounded to oval.Secondary phloem composed of sieve elements and parenchyma , traversed by phloem rays; some phloem parenchyma found filled with yellowish-brown contents.; phloem rays 1-2 cells wide, isodiametric to slightly radially elongated in inner phloem region and radially elongated in outer phloem region.Wood occupied bulk of root dominated by fibre along with vessels, tracheids and few xylem parenchyma traversed by xylem rays, vessels occured singly or in groups of 2-3 with multiseriate

simple and boarded pits and mostly found associated with fibre tracheids, The fibres were linear with pointed ends, narrow lumen and uniseriate simple pitting found in abundance; xylem parenchyma have simple pits or spiral thickening; xylem rays uni to biseriate, thin-walled, cells redially elongated and pitted filled with starch grains. The starch grains were simple and rounded to oval in shape .

Root : T.L.S (Fig. 131)

The cork cells were compressed and elongated. The cells of the cortex contained starch grains. Narrow lumened stone cells were found associated with rhomboidal crystals.The phloem rays were spindle shaped and contained starch grains. They were mostly biseriate to triseriate. Wood fibres showed simple pits. The vessels showed 3-4 rows of bordered pits.

Root : R.L.S (Fig. 132)

The cork cells appeared flat, compressed and elongated. Cortical cells were polygonal and most of the cells here were filled with starch grains followed by wavy sclerenchymatous fibers. The cortical cells contained reddish-brown content. The phloem and xylem rays were with starch grains. The vessels showed angular pits The primary xylem elements showed spiral thickening.

Root : Powder study (Fig. 133)

The powder is characterized by the presence of brown cork cells, starch grains, groups of stone cells showed both broad and narrow lumen, ray cells with starch grains, wood fibre and vessels with spiral thickening.

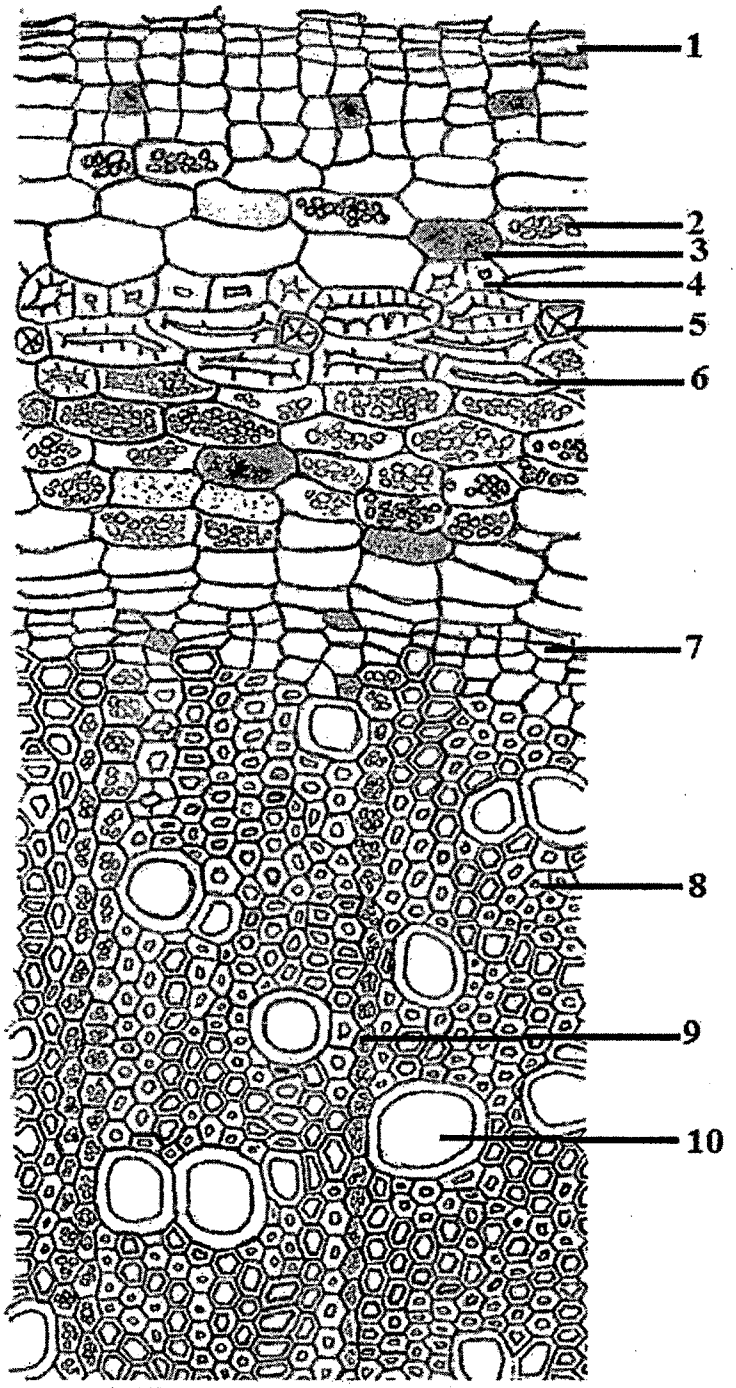


Fig.130. ***Xeromphis spinosa*** **root, T.S :** 1. Cork cell, 2. Starch grains, 3. Reddish-brown content cell, 4. Sclerenchymatous fiber, 5. Stone cell, 6. Rhomboidal crystal, 7.Phloem ray, 8. Wood fibre, 9. Xylem rays. 10.Vessel.

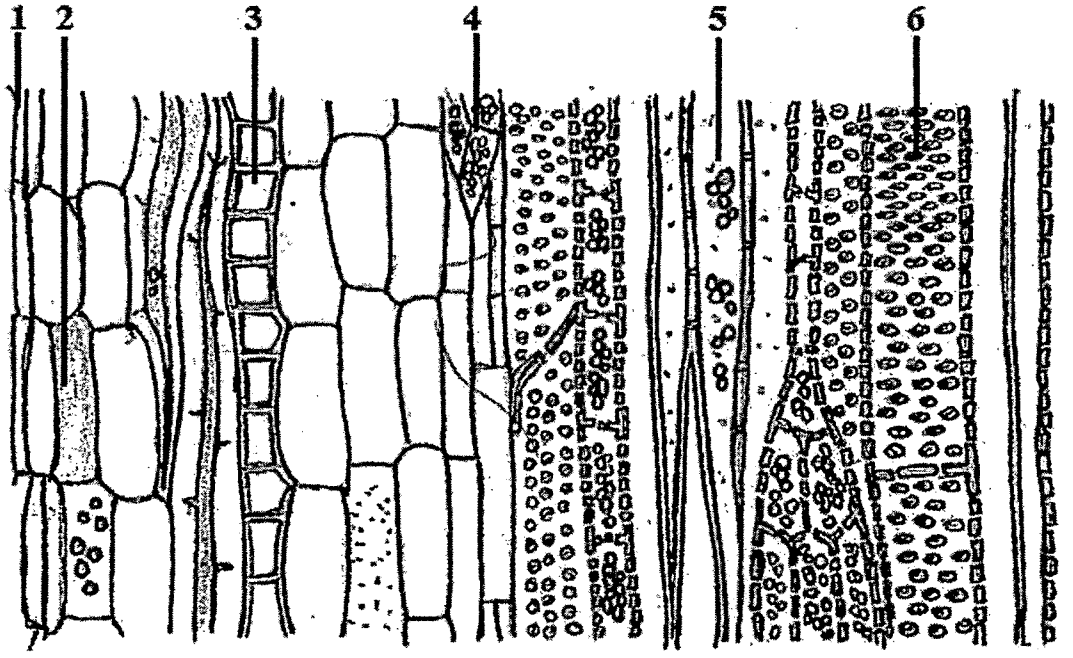


Fig. 131. ***Xeromphis spinosa*** **root, T.L.S:** 1. Cork cells, 2. large polygonal Parenchyma, 3. Redish-brown content cell, 4. Rhomboidal crystal, 5. Phloem ray, 6. Wood fibre, 7.Vessels.

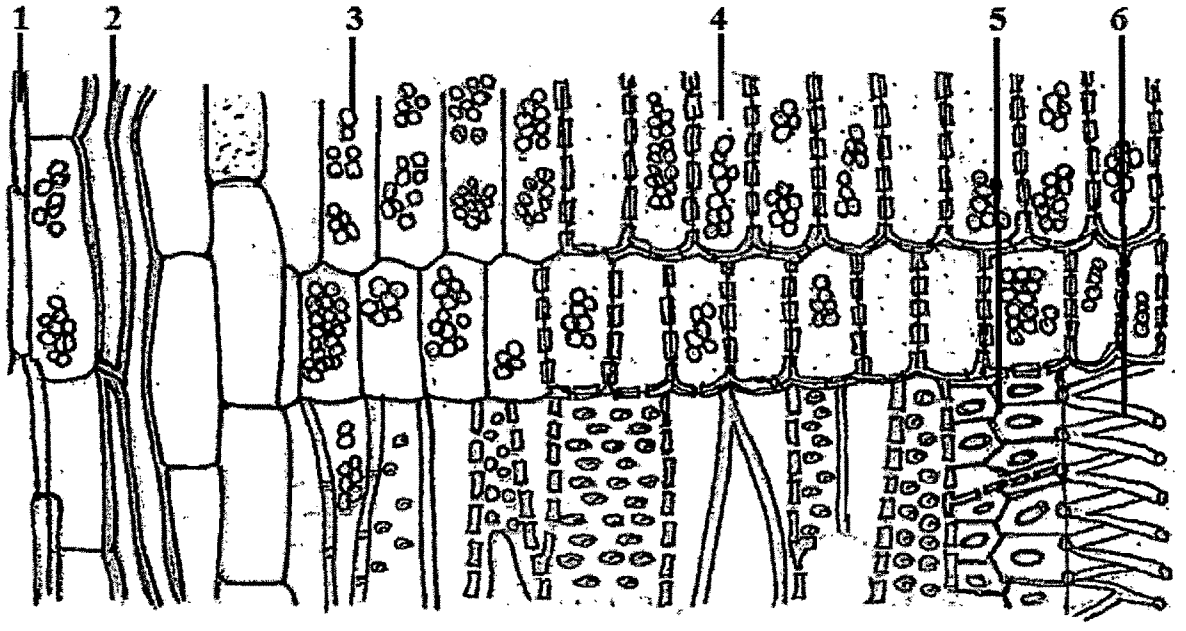


Fig.132.*Xeromphis spinosa*root,R.L.S:1.Cork cells, 2.Sclerenchymatous fiber, 3. Phloem rays with starch grains, 4. Xylem rays, 5.Angular pitted vessel, 6.Spiral vessels.

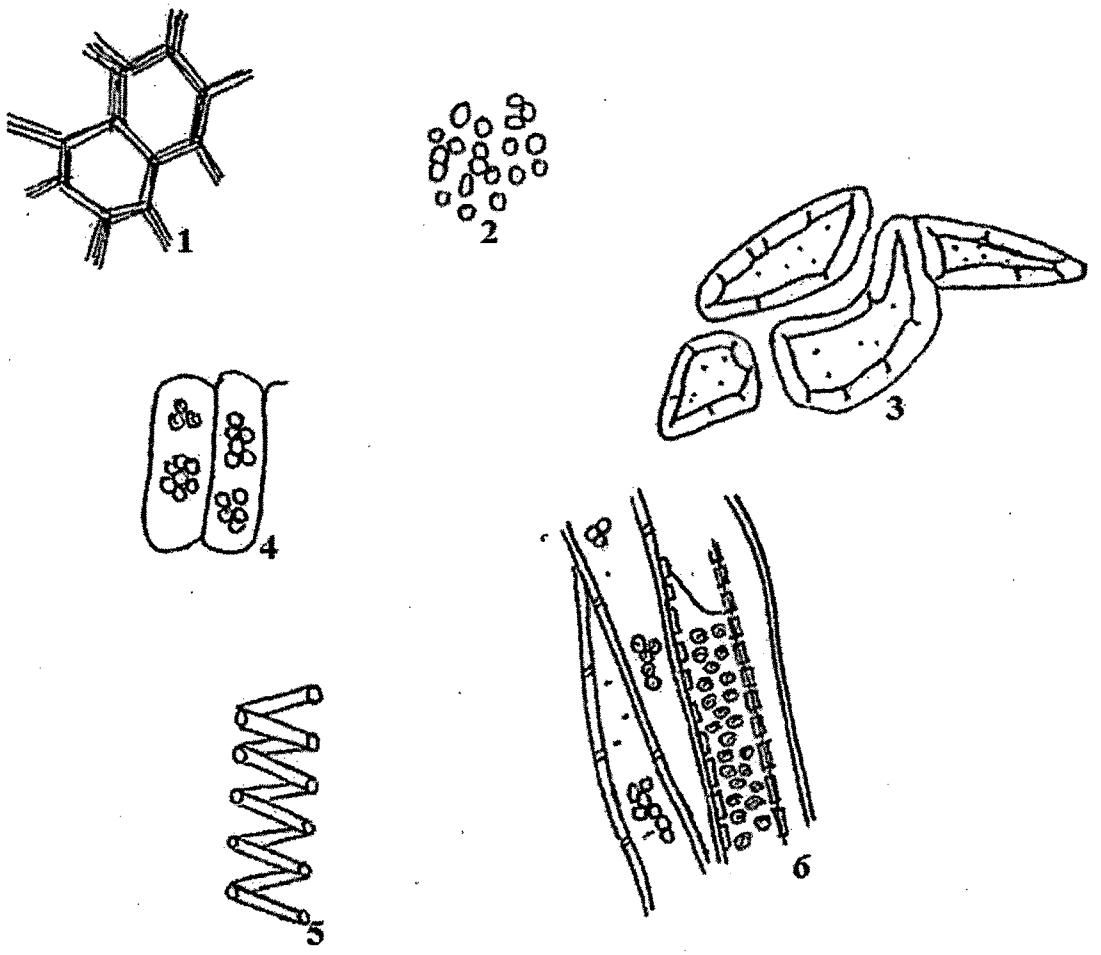


Fig.133. ***Xeromphis spinosa*** **root, Powder study:**1.Brown cork cells, 2.Starch grains, 3.Stone cells, 4.Ray cells with starch grains, 5. Spiral thickened vessel, 6.Wood fibres associated with vessels.

Distinguishing features

Pharmacognostic markers

1. Brown cork cells.
2. Parenchyma containing reddish-brown contents.
3. Starch grains.
4. Stone cells.
5. Sclerenchymatous fibers.
6. Reticulate thickened vessels.

Phytochemical markers

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

Physico-chemical analysis:

Table 23 : Values obtained for the proximate analysis.

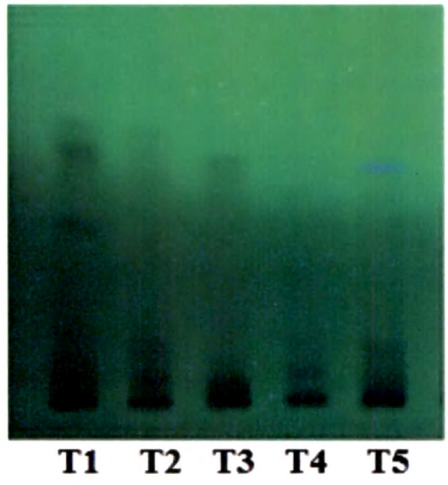
Sr.No.	Parameter	Mean ± SD (%)*			Average (%)
		Summer	Monsoon	Winter	
1.	Total Ash Content	03.13±0.21	03.24±0.32	03.16±0.22	3.176
2.	Acid Insoluble Ash content	0.68±0.41	0.71±0.33	0.68±0.46	0.69
3.	Alcohol soluble extractive	08.62±0.19	08.69±0.23	08.23±0.16	8.513
4.	Water soluble extractive	14.01±0.20	15.02±0.19	14.13±0.13	14.386

*Each value is a mean of 3 readings

6.f. HPTLC fingerprinting and Physo-chemical analysis of *Polygala senega* and its substitutes/adulterants

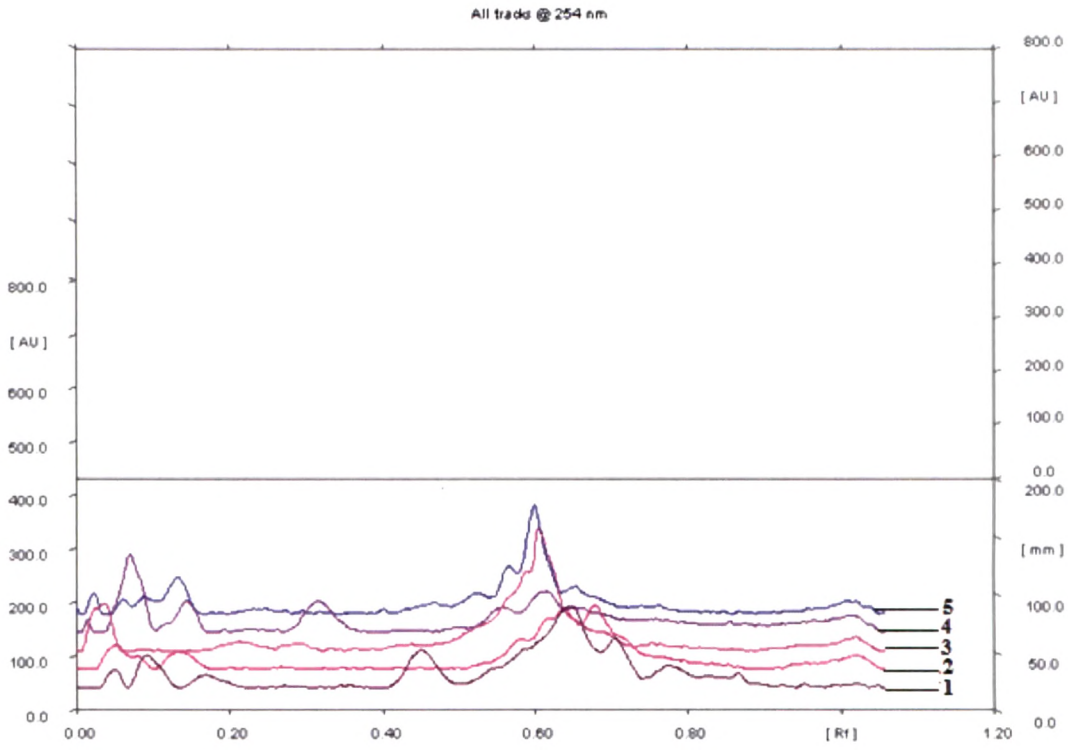
HPTLC fingerprinting

Figure 133.a : HPTLC chromatogram of *Polygala senega* and its substitutes/adulterants. (UV 254 nm).



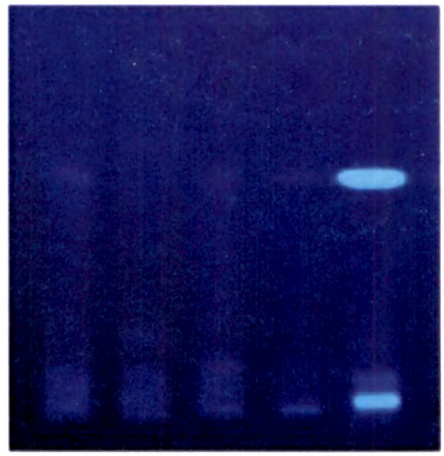
(a).T1-*Polygala senega,* T2-*Polygala chinensis,*T3-*Acalypha indica,*T4-*Adhatoda vasica,* T5-*Xeromphis spinosa.*

Figure 133.b : HPTLC chromatogram of *Polygala senega* and its substitutes/adulterants. (UV 254 nm).



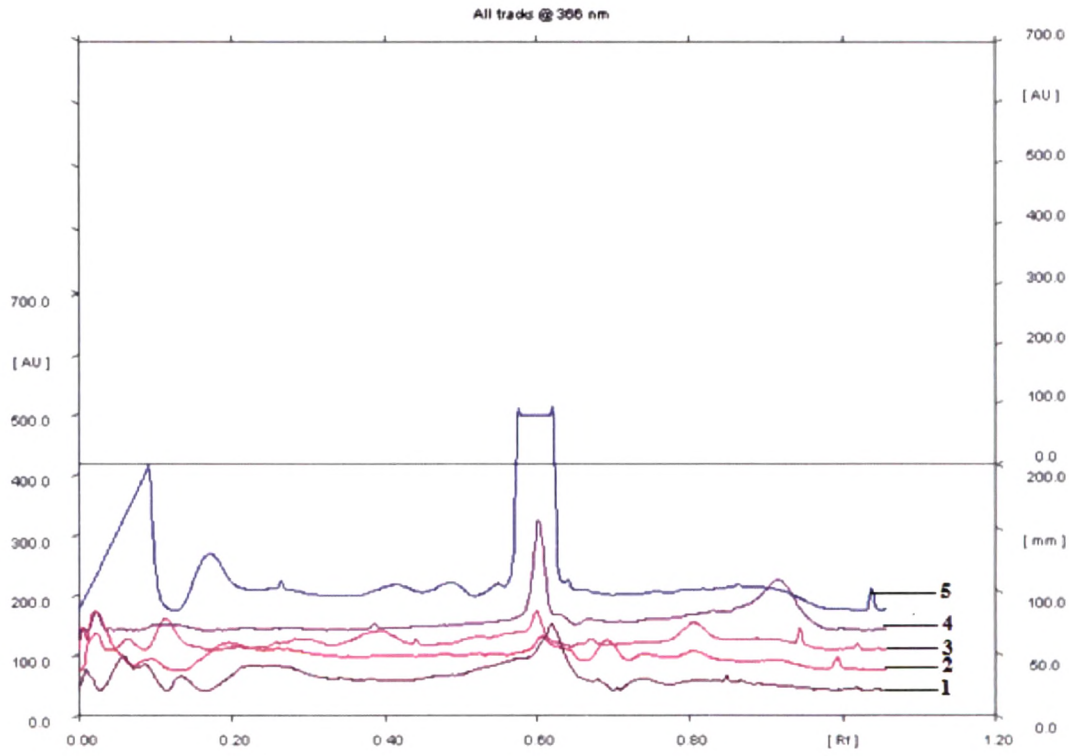
(b).1-*Polygala senega,* 2-*Polygala chinensis,*3-*Acalypha indica*,4-*Adhatoda vasica,* 5-*Xeromphis spinosa.*

Figure 133.c: HPTLC chromatogram of *Polygala senega* and its substitutes/adulterants (UV 366 nm).



(a).T1-*Polygala senega,* T2-*Polygala chinensis,*T3-*Acalypha indica*,T4-*Adhatoda vasica,* T5-*Xeromphis spinosa.*

Figure 133.d : HPTLC chromatogram of *Polygala senega* and its substitutes/adulterants (UV 366 nm).



(b).1-*Polygala senega,* 2-*Polygala chinensis,*3-*Acalypha indica*,4-*Adhatoda vasica,* 5-*Xeromphis spinosa.*

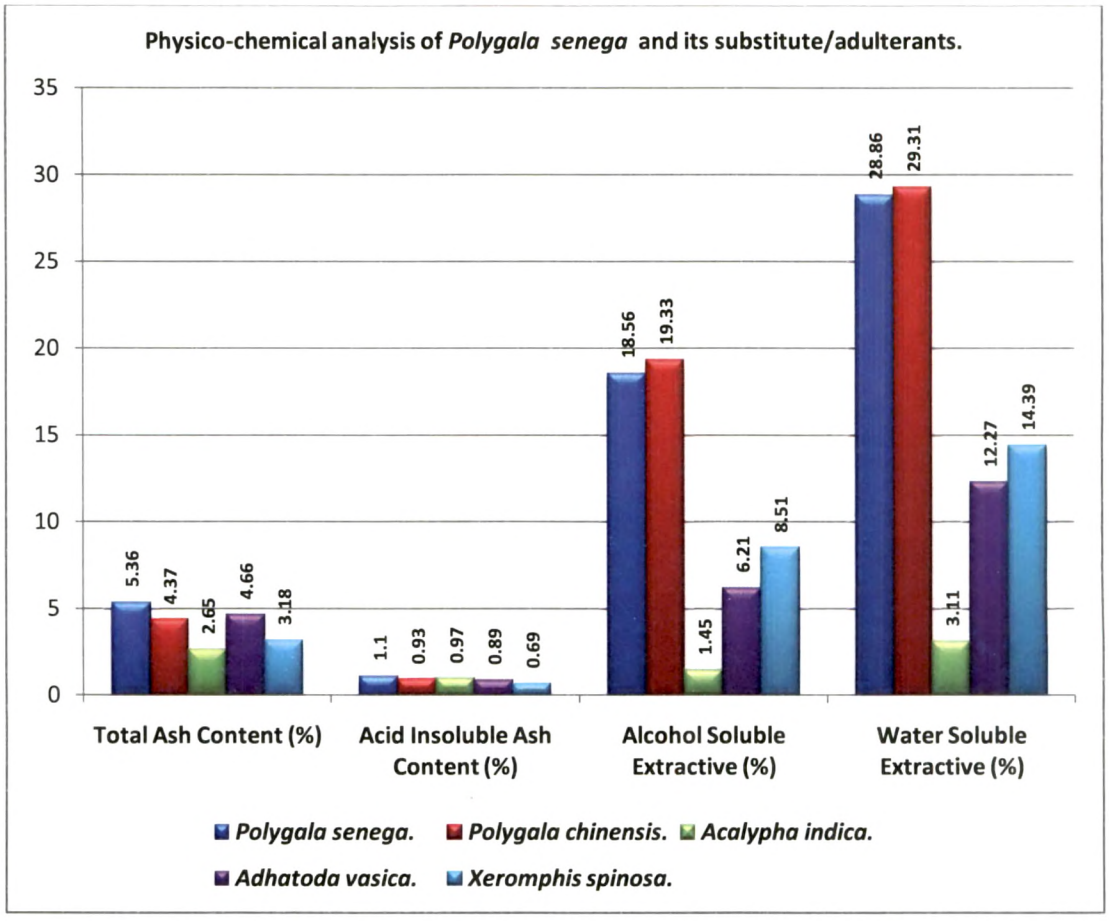
HPTLC profile of *Polygala senega* showed the presence of 8 peaks when observed under UV 254 nm (figure-133.b)and 10 peaks in 366 nm (figure-133.d). There were 3 major peaks found at R_f 0.45, R_f 0.65 and R_f 0.70 under UV 254 and 4 peaks at R_f 0.23, R_f 0.26 , R_f 0.57, and R_f 0.62 under 366 nm. The *Polygala chinensis* and *Adhatoda vasica* showed the presence of 8 peaks , *Acalypha indica* 6 peaks and *Xeromphis spinosa* 11 peaks when observed under UV 254 nm.Under UV366 nm, *Polygala chinensis* and *Xeromphis spinosa* both were showed the presence of 10 peaks while *Acalypha indica* showed the presence of 11 peaks and *Adhatoda vasica* 5 peaks.

HPTLC profile of *Polygala senega* and its substitutes/adulterants observed under UV 254 nm (figure-133.b) showed that *Xeromphis spinosa* was similar in 2 peaks but differed in 9 peaks. Both *Polygala chinensis* and *Adhatoda vasica* were similar in 1 peak but differed in 7 peaks, while *Acalypha indica* was not show any peak similar to that of *Polygala senega* but differed in having 6 peaks.

HPTLC profile of *Polygala senega* and its substitutes/adulterants observed under UV 366 nm (figure-133.d) showed that *Xeromphis spinosa* was similar in 4 peaks but differed in 6 peaks. *Polygala chinensis* was similar in 2 peaks and differed in 8 peaks. *Acalypha indica* was similar in 1 peak and differ in 10 peaks while *Adhatoda vasica* did not show any peak similar to that of *Polygala senega* but differed in 5 peaks.

Physico-chemical analysis

Physico-chemical analysis of *Polygala senega* and its substitutes/adulterants.



Total ash content

Total Ash Content of *Polygala senega*(5.39 %) along the material collected in different season does not show significant variation (Table-19) while the closest value to the substitute/adulterant in descending order is 4.66 % (*Adhatoda vasica*), 4.37% (*Polygala chinensis*), 3.18 % (*Xeromphis spinosa*), and 2.65 % (*Acalypha indica*).

Acid insoluble ash content

Acid insoluble ash content of *Polygala senega*(1.10 %) along the material collected in different season does not show significant variation (Table-19) while the closest value to the substitute/adulterant in descending order is *Acalypha indica* (0.97 %), *Polygala chinensis* (0.93 %), *Adhatoda vasica* (0.89 %) and *Xeromphis spinosa* (0.69%).

Amongst the substitutes/adulterants of *Polygala senega* the *Polygala chinensis* showed the closest value of total ash content which showed that the *P. chinensis* was more close to *P.senega* as compared to other substitutes/adulterants of *P. senega.*

Alcohol soluble extractive

Alcohol soluble extractive value of *Polygala senega* (18.56%) along the material collected in different season does not show significant variation (Table-19) while the closest while the closest value to the substitute/adulterant was of *Polygala chinensis* (19.33%) which also showed the maximum extraction. The values of *Xeromphis spinosa Adhatoda vasica* and *Acalypha indica* was found to be 8.51 %, 6.21% and 1.45 % respectively.

Water soluble extractive

Water soluble extractive value of *Polygala senega* (28.86 %) along the material collected in different season does not show significant variation (Table-19) while the closest value to the substitute/adulterant was of *Polygala chinensis* (29.31%) which also showed the maximum extraction. The values of *Xeromphis spinosa Adhatoda vasica* and *Acalypha indica* was found to be 14.39 %, 12.27% and 3.11 % respectively.

Amongst the substitutes/adulterants of *Polygala senega*, the *Polygala chinensis* showed the maximum extraction of phytoconstituents and the extractive values were also very close to *P. senega* while the extractive values of other substitutes/adulterants were less than the half values of *P. senega* which reflect that the *P. Chinensis* could be better substitute as compared to other substitutes/adulterants.