

## Chapter 3

### a. *Fumaria parviflora* Lam.( Fumariaceae )

**Synonyms:** *Fumaria indica* (Hausskn.) Pugsley.

**Sanskrit:** Parpata, Arako, Charaka, Pittari.

**Vernacular names:**

Arabic : Baglatulmulk, Bukslatulmulik, Shahatraja.

Bengali: Bansulpha ,Shotara pipapapra.

English : Common fumitory, Fine-leaved Fumitory.

Gujrati : Pittapapdo.

Hindi : Pitpapra, Pitpapada, khetpapra.

Kannad : Parpataka.

Marathi : Pittapapra.

Sindhi : Shahatra, Shatra.

Tamil : Turu, thusha.

Telgu : Chata-rashi, Chatarasi.

Urdu : Shahatra.

#### **Distribution and habitat**

The plant is a small, scandent, branched annual herb distributed throughout India, growing wild in plains and lower hills particularly on the banks of the Ganges and in the Himalayas up to an altitude of 2700 m. It is also found in Europe, Africa and many other Asian countries.

#### **Morphological features**

The plant is a pale green much branched up to 2 ft. height, an annual herb, suberect or diffuse. Leaves multifid more or less glaucous; leaflets 2-4 pinnatisect; segment long, linear or linear-oblong, flat, acute. Recemes with 10-12 flowers rather dense in flower, bract, lanceolate-subulate, slightly acuminate, pedicels 2-2.5, rarely 4.5 mm long, erect thickened at the apex. Sepals about 1.5 mm long, 0.5-1 mm broad, lanceolate or ovate, acuminate more or less inciso- dentate, rose colored often persistent in the young fruit. Corolla 5-6 mm long rose colored. Fruit about 2.5 mm, broad, subrotund, quadrate, subtruncate and sometimes obscurely retuse. Stem light green, smooth hollow about 3-4 mm thick, root brown color, branched about 2-3 mm thick, cylindrical.

### Medicinal uses

The whole plant is widely used in traditional and folkloric systems of medicine. The plant is regarded as a laxative, diuretic, diaphoretic and is beneficial in dyspepsia, liver complaints and scrofulus skin affections (Kirtikar and Basu, 1985) and used in fever, influenza (Anon. 1956), syphilis, scrofula, leprosy, constipation, ague and jaundice. The decoction of stem and leaves is given as a tonic, anthelmintic, aperients (Rastogi and Mehrotra, 1970-79) and claimed to possess various curative properties for ailments of the blood, skin, gastrointestinal system and central nervous system (Usmanghani, 1997).

### Previous Phytochemical reports

The plant is found to contain protopine, tetrahydro coptisine, tautomeric form of fumariline, a homogenous gum, a racemic mixture of bicuculine and its optical antipode, bicuculine, fumarilicine and narceimine (Pandey *et al.*, 1971). Later on protopine, quaternary salt of protopine, nonacosanol and sitosterol were isolated from the stem and leaves of *F. indica* (Satish and Bhakuni, 1972). fumariline, 8-methoxy dihydro sanguinarine and oxysanguinarine (Pandey, Gupta and Ray, 1979). A secopthalide isoquinoline alkaloid narceimine isolated from seeds (Pandey *et al.*, 1988). Isoquinoline base papracine along with six known base oxyhydrastinine, noroxyhydrastinine, fumaramine, stylophine, bisnorargemonine and fumariti (Rahman, Bhatti and Choudhary, 1992). Two new spirobeanzyl isoquinoline (tyramine base) alkaloids, papracinine and paprazine together with six other known alkaloids as fumaritine N-oxide, parfumine, lastourvilline, feruloyl tyramine, fumariflorine and N-methyl corydaldine identified from aerial parts of *F. indica* (Rahman *et al.*, 1992). A new seco-phalidi isoquinoline alkaloid narlumicine from stem of *F. indica* together with protopine nitrate, protopine, DL - tetrahydrocoptisine and narlumidine have been reported (Pandey and Tripathi 1992). Similarly three new seco-phthalide isoquinoline alkaloids peprafumine, peprarine and papraline along with three other known alkaloids cryptopine, raddeanine and oxocoptisine have been identified from the aerial part of *F. indica* (Rahman *et al.*, 1995). Recently, a new alkaloid, fuyuziphine together with (+/-)-alpha-hydrastine has been isolated from the whole plant of *F. indica* (Pandey *et al.*, 2008).

### **Previous pharmacognostic reports**

Very little data available on pharmacognosy of this plant. Only T.S of various parts of the plant has been studied (Anon.2004). In the present work roots, stem and leaves of this plant has been subjected to phytochemical and pharmacognostic studies.

### **Materials and methods**

The plant material has been collected from Tarikhet, Uttaranchal. Phytochemical analysis 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**

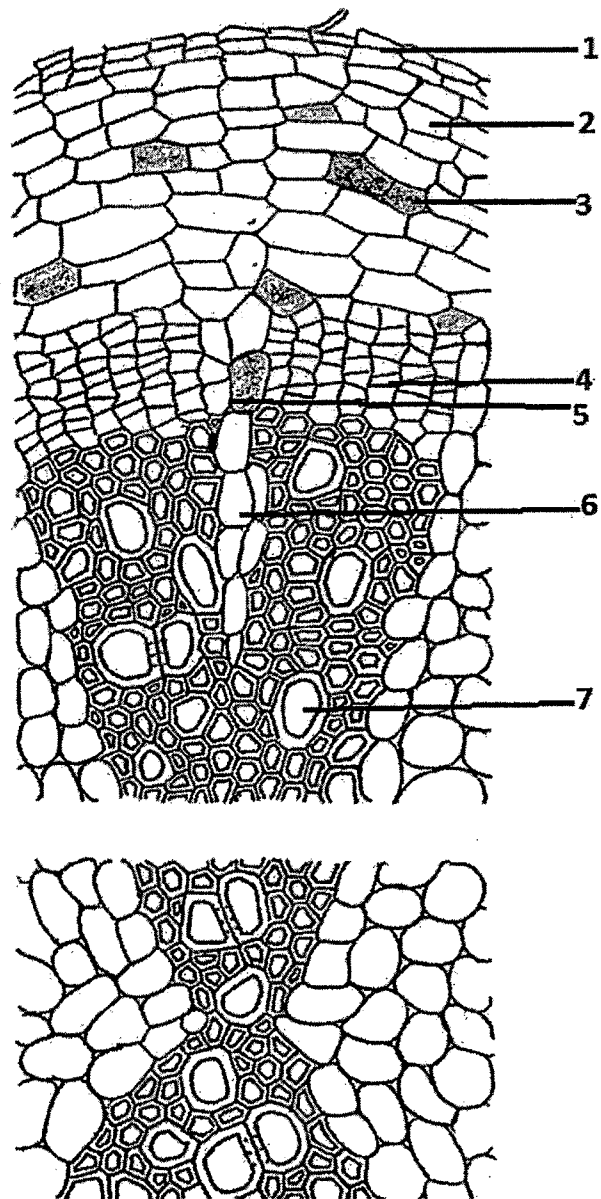
#### **Phytochemistry**

The plant is found to contain flavonol quercetin and 3'-OMe quercetin. The phenolic acids located were vanillic and ferulic (*cis*- and *trans*- isomers) acids while syringic acid was found absent. Mucilage amounted to 6.3 % consisting of ribose and xylose. The plant also showed the presence of unidentified alkaloids, steroids and tannins.

#### **Pharmacognosy**

##### **Root : T.S (Fig.1)**

The T.S. was circular in outline. Cork were poorly developed and cells were 2 to 3 layered. The cells were arranged one above the other. The cortex was 6-11 layered of compactly arranged thin walled cells. The cells of outer 2-4 layers were small and square while inner ones were large polygonal and bearing light brown contents.. The vascular bundle characteristically was fan shaped. The secondary phloem was 6-8 layered followed by wide zone of central wood. The rays were poorly developed and were uni- to biseriate. Some of them also were filled with light brown contents. The xylem vessels were many in number, mostly occurred singly but few were in groups of 2 were almost uniform in size. The xylem vessels were surrounded by fiber tracheids having large lumen. The primary xylem was not distinct.



**Fig.1.***Fumaria parviflora* root, T.S: 1. Cork, 2. Cortex, 3. Cortical parenchyma bearing light brown contents, 4. Phloem, 5. Phloem ray, 6. Xylem ray, 7. Vessel.

**Root : T.L.S (Fig. 2)**

The cells of the cortex were rectangular thin walled, some of bearing light brown contents. The fibers were curved around the spindle shaped medullary rays and each ray cell was thin walled and polygonal. Fiber tracheids were pitted, and contained simple pits in them. The vessels were broad, reticulate and bordered pitted. Scalariform thickened vessels were also observed.

**Root : R.L.S (Fig.3)**

The phloem parenchyma cells were erect, rectangular thin walled to which 3 to 4 companion cells were attached. Xylem parenchyma were homogenous upright, square and found with simple pits. Wood fibers were straight.

**Leaf micromorphology**

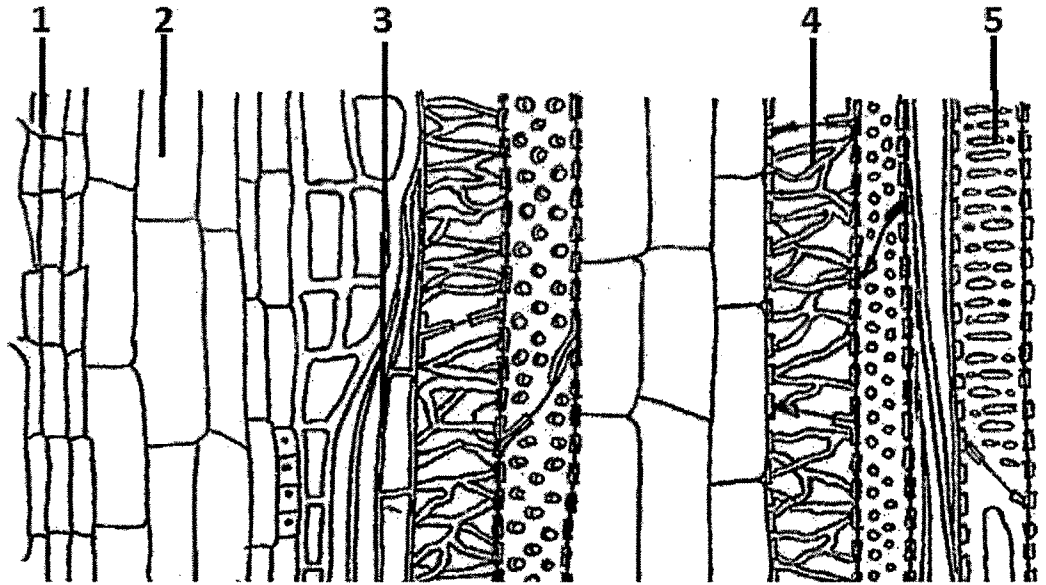
The stomata were of anomocytic type. The stomatal index was 15-18. Trichomes were found absent.

**Leaf : T.S (Fig.4 )**

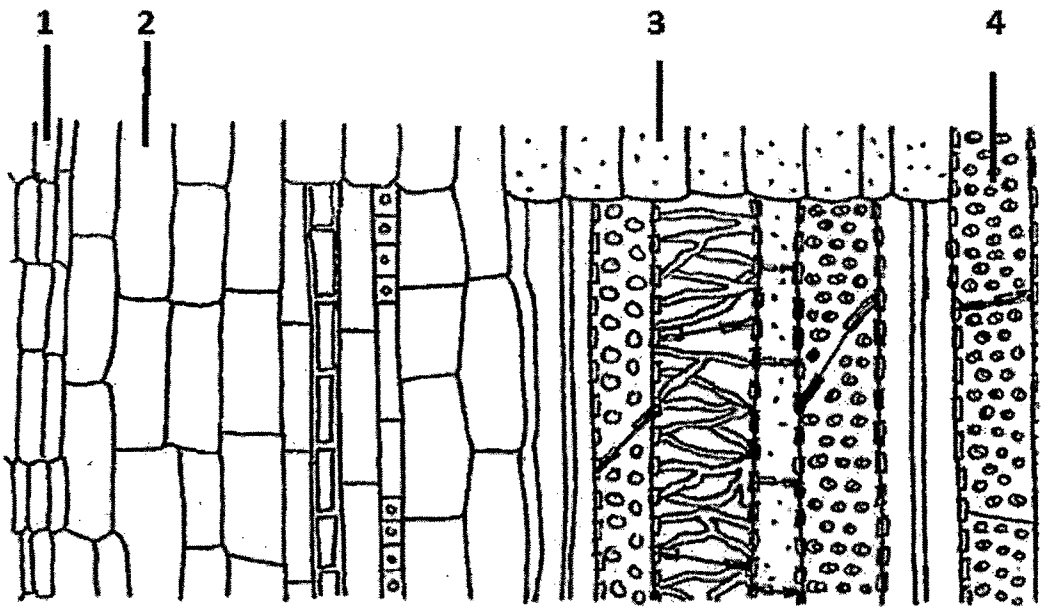
In the **lamina portion** there were stomata on the both the sides. The cells of epidermis were barrel shaped and covered by a thin cuticle. The mesophyll was not differentiated into palisade and spongy parenchyma and consisted of compactly arranged ( having very little intercellular spaces ) thin walled polygonal parenchyma filled with chlorophyll. vascular bundles were scattered throughout the mesophyll.

**Stem : T.S (Fig.5 )**

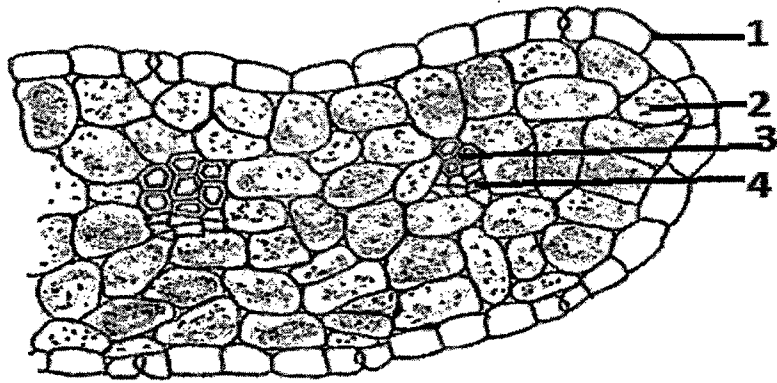
The T.S. was quadrangular to pentagonal in outline and showed a thick cuticle covered the barrel shaped cells of the single layered epidermis. Cortex was of 3-5 layers of thin walled parenchyma cells, most of the cells contained chlorophyll and became chlorenchymatous and collenchymatous at the portion below ridges. The cells of collenchyma were comparatively small in size. Endodermis was indistinct. The vascular bundles were in a ring present either single or in group of 2-3 and found present below the ridges. Phloem zone was covered with sheaths of sclerenchyma. The cells of sclerenchyma were of two types, small, rounded without striations and big, slightly oblong with striations. The phloem was 4-6 layered and consisted of usual elements. Xylem consists of usual elements. Vessels were mostly having simple and reticulate thickening were as spiral or annular thickening found occasional. wood fibers were 3-4 in a group. The pith was parenchymatous outer and hollow in the centre leaving a cavity. The cells were thin walled and were loosely arranged.



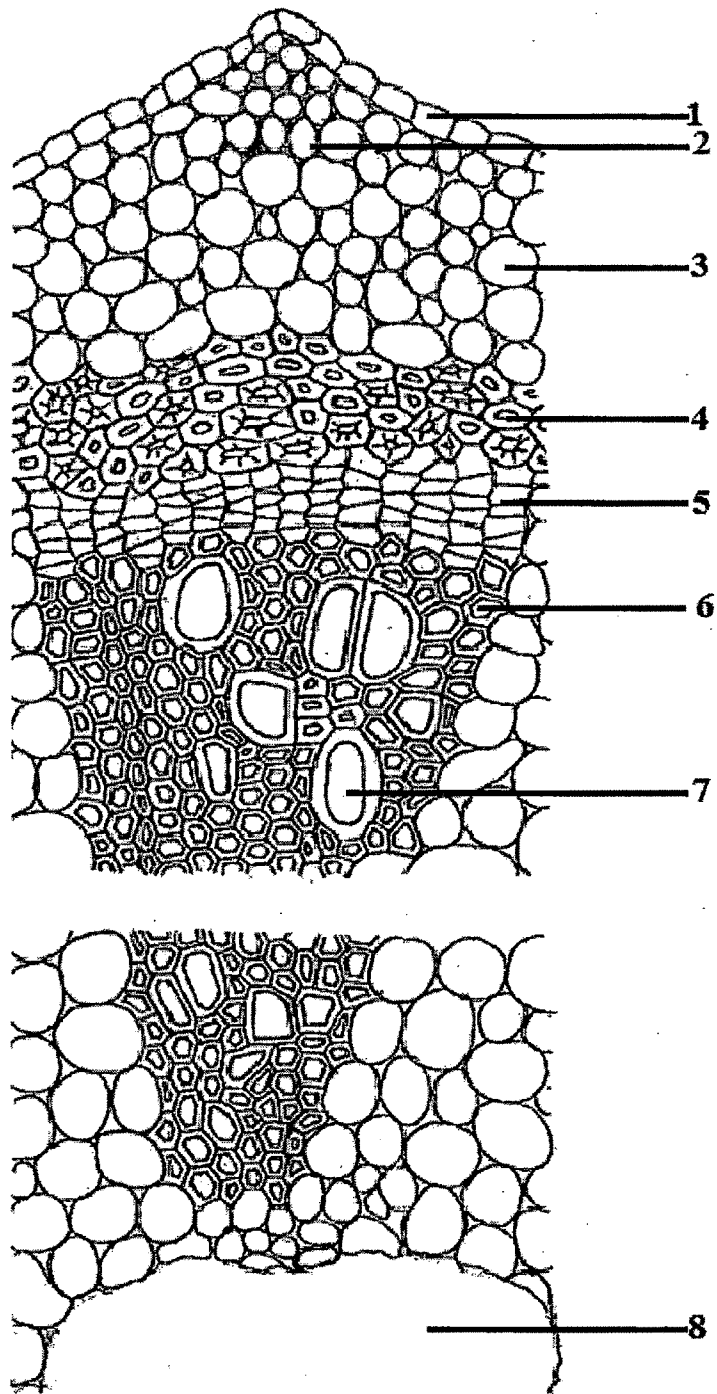
**Fig.2.***Fumaria parviflora* root, T.L.S: 1.Cork, 2.Cortex, 3.Wood fiber, 4. Reticulate vessel, 5. Scalariform vessels.



**Fig.3.***Fumaria parviflora* root, R.L.S:1. Cork cells, 2.Cortex, 3. Xylem rays, 4.Boarded pitted vessel.



**Fig.4.***Fumaria parviflora* leaf,T.S:1.Epidermis,2. Mesophyll, 3. Xylem, 4.Phloem.



**Fig.5.***Fumaria parviflora* stem, T.S : 1.Epidermis, 2.Collenchyma, 3.Cortex, 4.Sclerenchyma, 5. Phloem, 6. Xylem, 7. Vessel, 8. Centre hollow pith.



**Stem : T.L.S (Fig.6 )**

The cortical parenchyma cells were large rectangular contained chlorophyll followed by a group of sclerenchyma. Vessels showed simple and reticulate thickening. Xylem parenchyma were square and found with simple pits. The cells of pith were thin walled and large polygonal.

**Stem : R.L.S (Fig.7)**

Epidermal cells were barrel shaped followed by rectangular cells of collenchyma. Wood fiber were with simple pits. Vessels showed simple, reticulate and annular thickening. Pith showed large cavity.

**Powder study (Fig.8 )**

The components present in the powder were cork, fragments of collenchyma, parenchyma with light brown deposits, sclerenchyma, septet fibers, epidermal fragments with stomata and reticulate vessels.

**Distinguishing features****Pharmacognostic markers :****Root**

1. Cortical parenchyma cells bearing light brown contents.
2. Fan shaped vascular bundle.
3. Pitted fiber tracheids.

**Leaf**

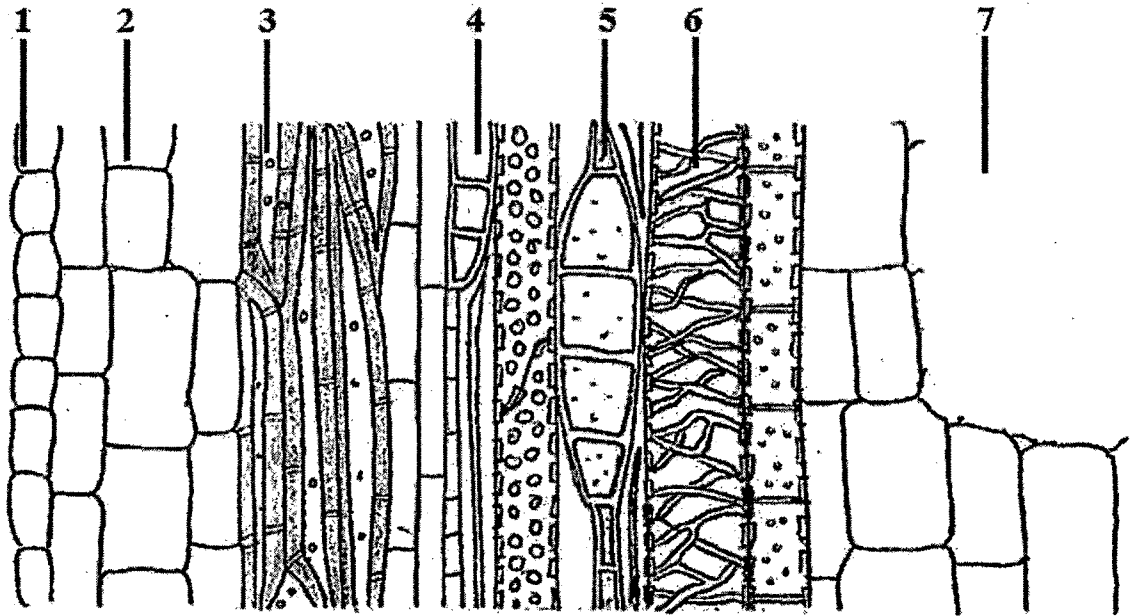
1. Deposition of cystoliths and globules in the epidermis.
2. Anomocytic type of stomata.
3. Mesophyll was not differentiated into palisade and spongy parenchyma
4. Absence of trichomes.

**Stem**

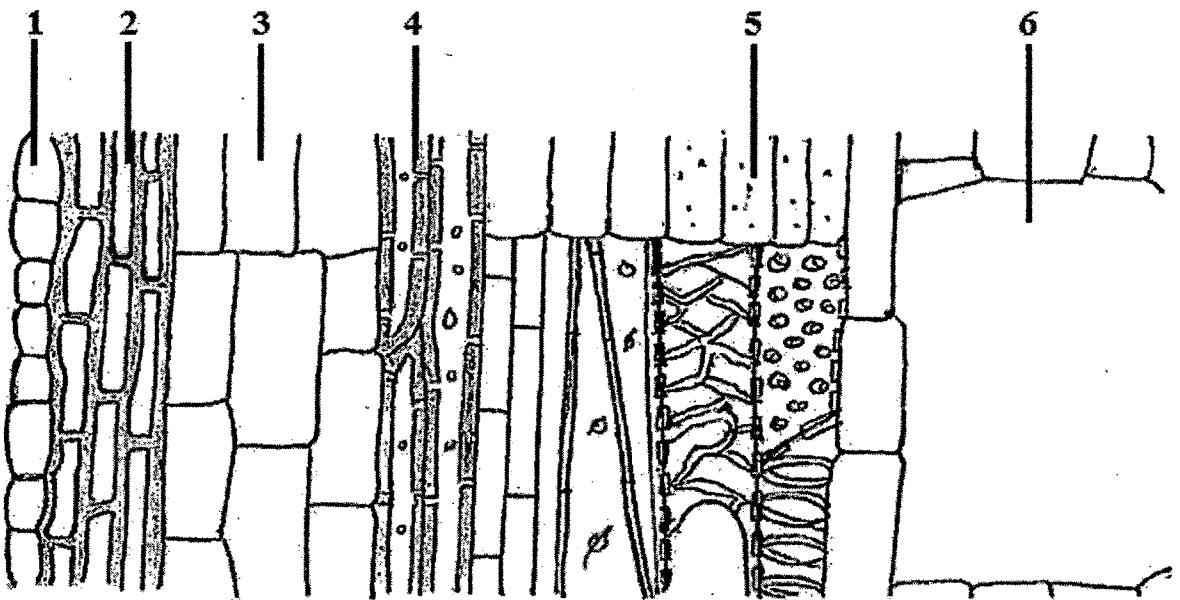
1. Pith showed large central cavity.
2. Vascular bundle was capped with sclerenchymatous sheath.
3. Vessels showed reticulate thickening.

**Phytochemical markers**

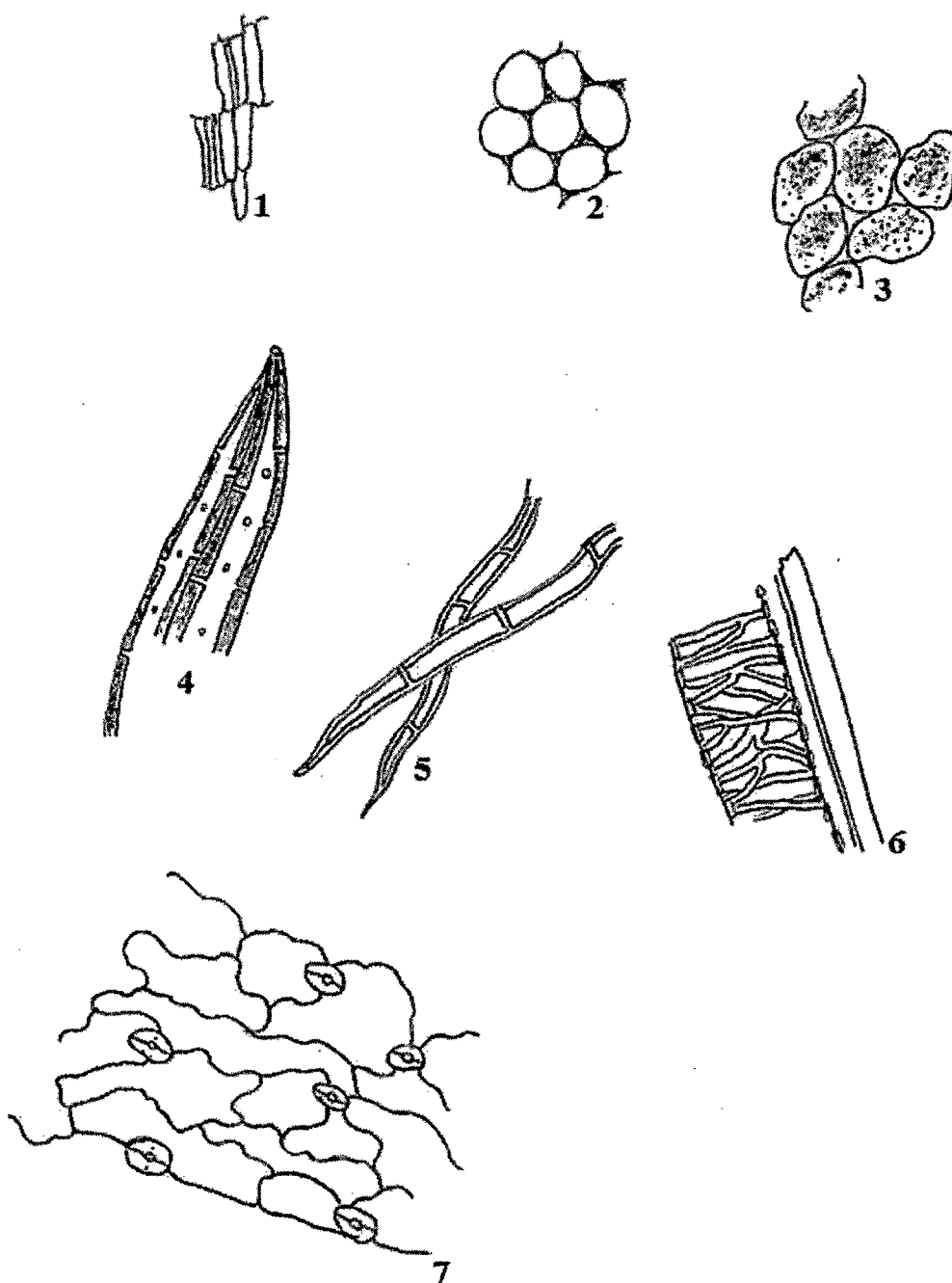
1. Quercetin.
2. 3'-OMe quercetin.
3. Vanillic acid.
4. Ferulic (*cis*- and *trans*- isomers) acid.



**Fig.6. *Fumaria parviflora* stem, T.L.S:** 1. Epidermis, 2. Cortex, 3. Sclerenchyma, 4. Phloem ray, 5. Xylem rey, 6. Reticulate vessel, 7. Centre hollow pith.



**Fig.7. *Fumaria parviflora* stem, R.L.S:** 1. Epidermis, 2. Collenchyma, 3. Cortex, 4. Sclerenchyma, 5. Xylem rey, 6. Centre hollow pith.



**Fig.8. *Fumaria parviflora* powder study:**1. Cork, 2. Collenchyma, 3. Parenchyma with light brown deposits, 4. Sclerenchyma, 5. Septet fibers, 6. Reticulate vessel, 7. Epidermal fragments with stomata.

**Physico-chemical analysis:**

**Table 2** : Values obtained for the proximate analysis.

| Sr.No. | Parameter                   | Mean $\pm$ SD (%)* |                  |                  | Average (%) |
|--------|-----------------------------|--------------------|------------------|------------------|-------------|
|        |                             | Summer             | Monsoon          | Winter           |             |
| 1.     | Total Ash Content           | 4.97 $\pm$ 0.12    | 5.16 $\pm$ 0.19  | 5.09 $\pm$ 0.22  | 5.07        |
| 2.     | Acid Insoluble Ash content  | 1.01 $\pm$ 0.09    | 1.12 $\pm$ 0.11  | 1.08 $\pm$ 0.09  | 1.07        |
| 3.     | Alcohol soluble extractives | 14.39 $\pm$ 0.16   | 14.32 $\pm$ 0.18 | 14.46 $\pm$ 0.11 | 14.39       |
| 4.     | Water soluble extractives   | 16.22 $\pm$ 0.42   | 16.32 $\pm$ 0.34 | 16.39 $\pm$ 0.23 | 16.31       |

\*Each value is a mean of 3 reading

### 3.b.*Justicia procumbens* Linn.( Acanthaceae )

**Synonyms :** *Rostellularia procumbens* L. Ness

**Sanskrit :** Kavacanamaka, Pansuparyaya, Parpata, Renu, Varatikta.

**Vernacular names:**

Hindi : Kagner, Makhania Ghas.

Kannada : Nela Bevu, Nucchu Nelabevu.

Malayalam : Tsjeru-Tardavel.

Marathi : Ghatipithpapra, Ghati-Pittapapada.

Tamil : Ottippul, Nerei-Poottie, Kotakacalai, Ampalakkotakam.

#### **Distribution and habitat**

The plant is erect or procumbent to ascending herb found throughout India mostly as a weed in moist places.

#### **Morphological features**

Stems 30-60 cm high, somewhat woody below, much-branched, subquadrangular. Leaves 2.5-4 by 1-2 cm, ovate-elliptic or elliptic-lanceolate, acute or acuminate, more or less lineolate, glabrous, base usually acute. Flowers in axillary and terminal narrow spikes 3-15 cm long; bracts shorter than the calyx, ovate, acuminate, with scarious margins, minutely scabrous at the tip, otherwise glabrous; bracteoles as long as and similar to the bracts but narrower. Calyx 4-partite nearly to the base; segments with scarious margins, lanceolate, acute, unequal, minutely scabrous at the tip. Corolla upto 0.5 cm long, pale- purple, slightly pubescent outside; upper lip 0.25 cm long, the lower portion ovate, the apical part subquadrate, subtruncate and slightly notched at the apex; lower lip very slightly 3-lobed at the rounded apex. Filaments glabrous except at their insertion. Ovary glabrous; lower part of style pubescent. Capsules long, shortly pointed, oblong, grooved on the back, glabrous. Seeds sub concentrically rugose.

#### **Medicinal uses**

The whole plant used in fever, pain due to pharyngolaryngeal swelling and cancer(Chen *et.al*, 1996).In India the decoction of leaf used in asthma ( Savithramma *et.al*, 2007)and root in fever due to typhoid (Joshi and Joshi, 2000).

#### **Previous Phytochemical reports**

Apigenin, quercetin 7 - O -  $\alpha$  - L - rhamnopyranoside , luteolin 7 - O -  $\beta$  - D - glucopyranoside, apigenin 7 - O -  $\beta$  - D - glucopyranoside, apigenin 7 - O -

neoperidoside , $\beta$  - sitosterol , $\beta$  - daucosterol , scopoletin , lupenyl acetate , cycloeucalenol , friedelin , epi- friedelinol , and asiatic acid , luteolin , and quercetin (Zhang, 2006).

#### **Previous pharmacognostic reports**

No pharmacognostic work has been done on any part of this plant.

#### **Materials and methods**

The plant material has been collected from Vadodara, Gujarat. Phytochemical analysis 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**

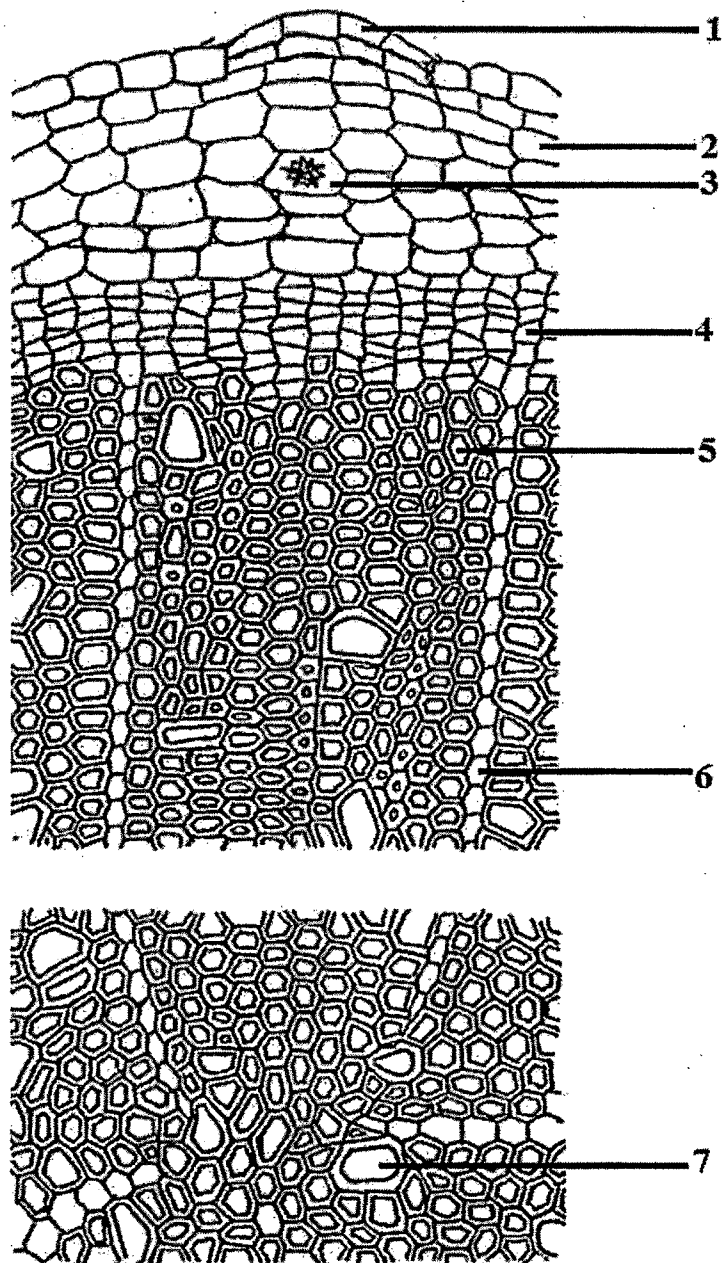
##### **Phytochemistry**

The plant is found to contain flavonoids such as 6-OH kaempferol and 7- OMe 6- OH kaempferol. The phenolic acids were vanillic, syringic and ferulic (*cis*- and *trans*- isomers) acids. Mucilage amounted to 6.8% consisting of rhamnose, glucose and xylose. The plant also showed the presence of unidentified alkaloids and steroids.

##### **Pharmacognosy**

##### **Root : T.S (Fig.8.a )**

The T.S of the root was circular in outline with a large central woody region. The cork was poorly developed and consisted of 2 to 4 rows of rectangular to slightly tangentially elongated cells and were thick walled. The secondary cortex was very narrow consisting of 5 to 8 rows of thin walled parenchymatous cells. The cells were large polygonal in shape and were compactly packed. Few of them were found filled with rosette crystals. Endodermis was indistinct. The narrow phloem zone consisted of 6 to 9 rows of cells made up of usual phloem elements. The phloem rays were thin walled and uni- to biseriate. Wood consisted of vessels, tracheids, fibers, parenchyma and rays. Medullary rays were radially elongated and uni- to biseriate with simple pits on their walls. Vessels were broad, simple and bordered pitted occurred singly or in groups. Some of the vessels showed the elongated pits laid parallel. The vessels were more in the centre.



**Fig.8.a. *Justicia procumbens* root, T.S:**1.Cork, 2.Cortex, 3.Parenchyma with rosette crystals, 4.Phloemrays, 5.Xylem, 6.Xylem rays, 7.Vessel.

**Root : T.L.S (Fig.9)**

Cork cells appeared rectangular. The phloem rays were compressed spindle shaped and thin walled and simple pitted. Fibers were thin walled and broad lumened. The xylem rays were spindle shaped with simple pits on their walls. The vessels had 3-4 rows of elongated parallel bordered pits.

**Root : R.L.S (Fig.10)**

The phloem rays were thin walled. Vessels were broad with bordered pits. The xylem ray cells were appeared rectangular and pitted. The vessels were with alternate bordered pits.

**Leaf micromorphology**

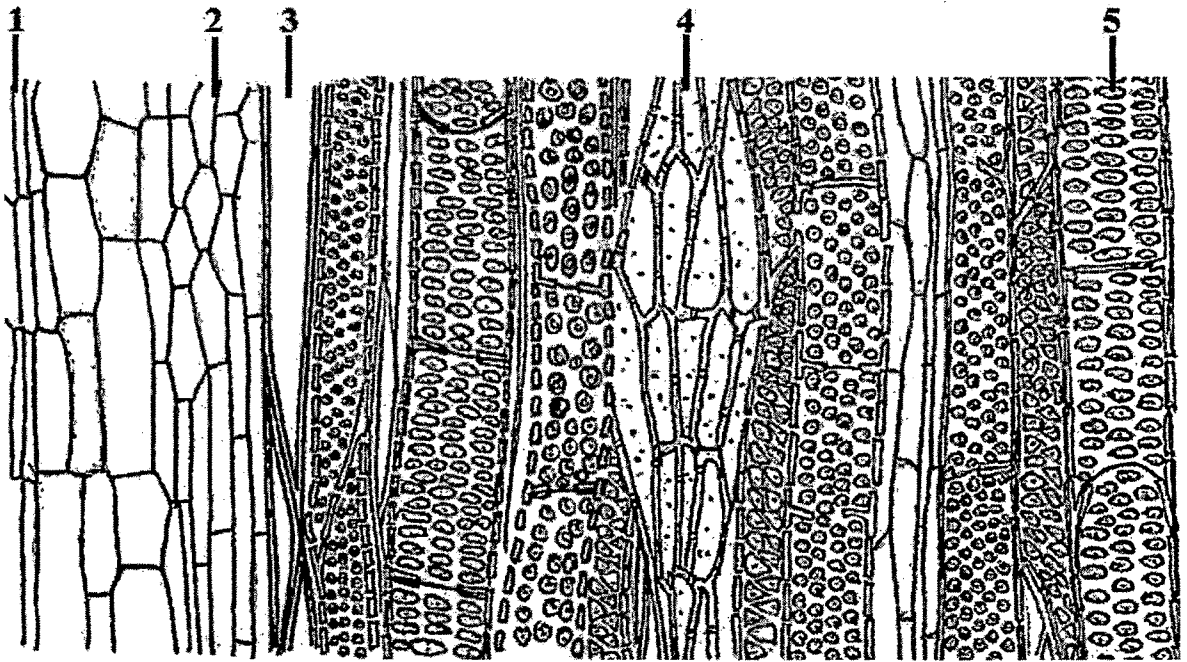
The stomata were of diacytic type. The stomatal index was 17-19. The trichome index was 9-12. The trichomes were of glandular and non glandular types. The non glandular trichomes were thick-walled unicellular as well as multicellular uniseriate showing broad basal cell, blunt tip and the warty walls. Unicellular trichomes was rare. The glandular trichomes were with a short stalk and circular head made up of two to four cells.

**Leaf : T.S (Fig. 11)**

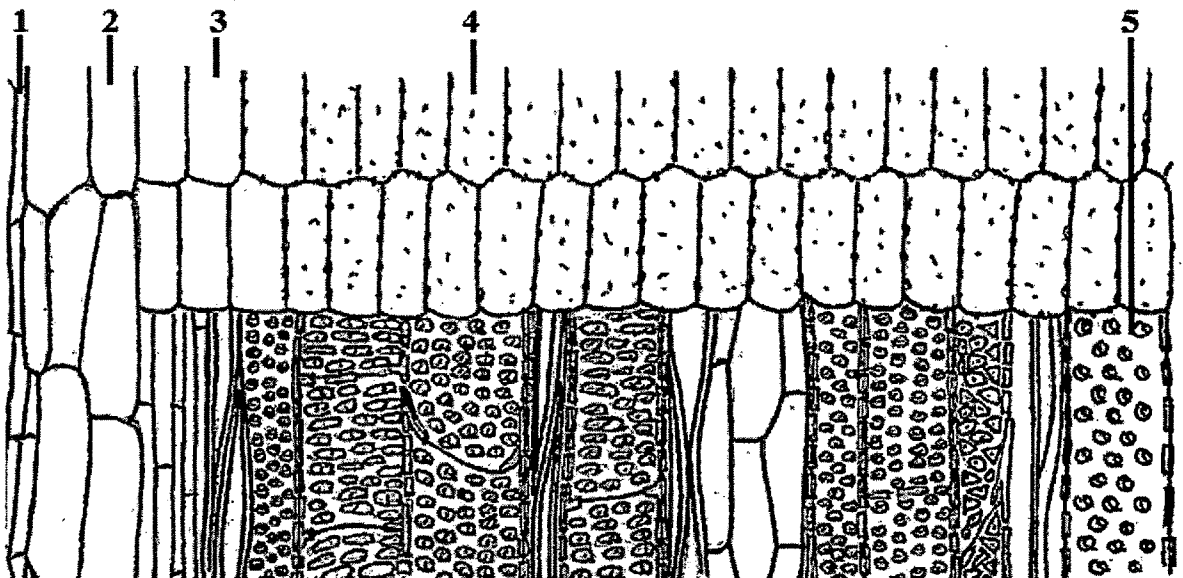
The **midrib portion** was characterized by a concave bulge on the upper side and hemispherical bulge on the lower side. The epidermal cells were polygonal in shape covered by thick cuticle. Here the lateral walls of the epidermal cells were characteristically thin and wavy while outer walls were thick and convexly arched outwards. Some of the epidermal cells were circular and showed the deposition of spherical cystoliths. The hypodermis on both upper and lower regions made up of angular collenchyma. The ground tissue was parenchymatous and the cells on the upper side were rounded and compactly arranged. The vascular bundle was crescent shaped. Below this were large parenchymatous cells. The trichomes were found present on both lower and upper epidermis.

In the **lamina portion (Fig. 12)** the epidermal cells were barrel shaped and the walls were similar to that of midrib. The mesophyll was isobilateral consisted of palisade and spongy tissues. The palisade was single layered and was finely packed with chloroplasts. The spongy tissues contained loosely arranged parenchyma with intercellular spaces.

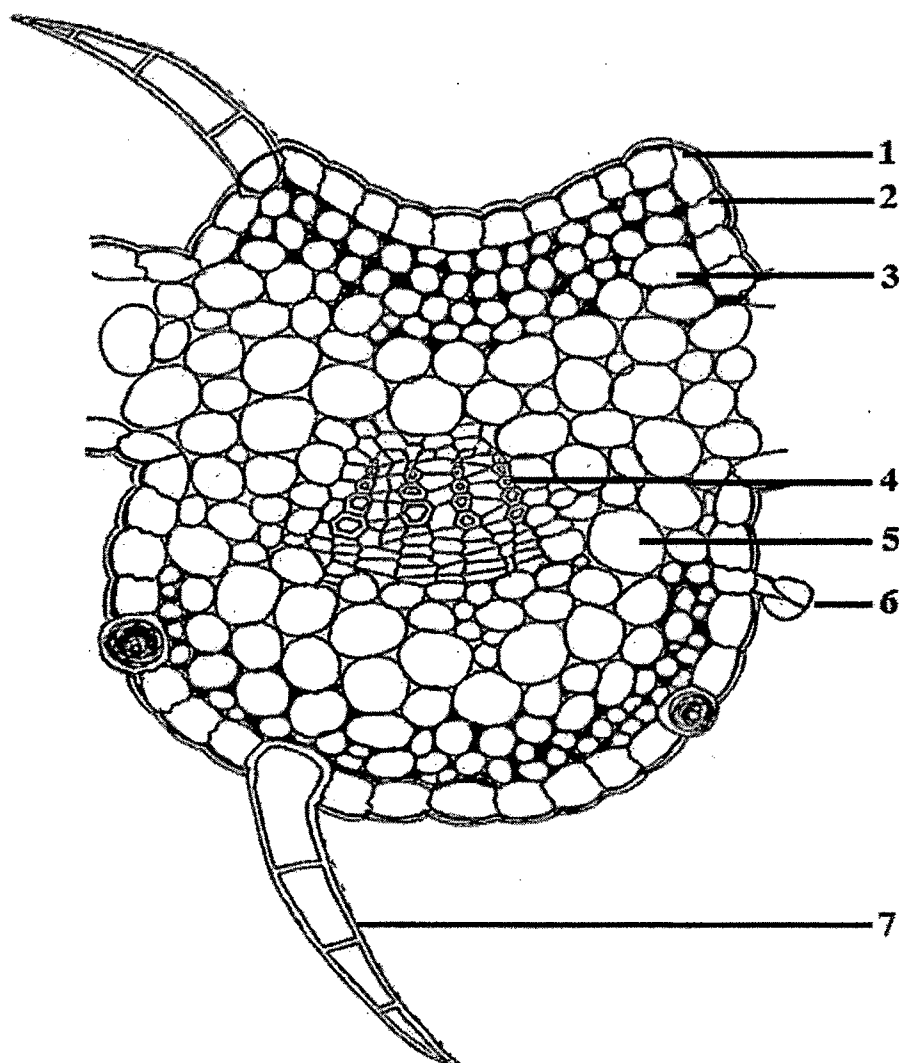




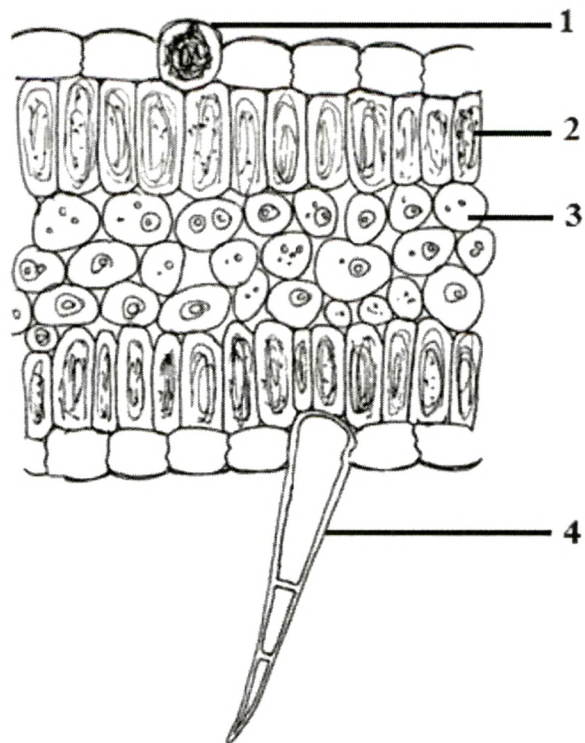
**Fig.9.** *Justicia procumbens* root, T.L.S:1. Cork cells, 2. Compressed spindle shaped phloem rays , 3. Fibers with broad lumened,4. Spindle shaped xylem rays, 5. Vessels with elongated parallel bordered pits.



**Fig.10.** *Justicia procumbens* root, R.L.S:1. Cork cells, 2. Cortex, 3. Phloem rays,4. Xylem rays, 5. Vessels with alternate boarded pits.



**Fig.11. *Justicia procumbens* leaf midrib,T.S:** 1. Epidermis with cuticle, Epidermal cells with wavy lateral walls, 3.Collenchyma, 4. Vascular bundles, 5.Parenchyma, 6. Glandular trichomes, 7. Multicellular trichome,



**Fig.12. *Justicia procumbens* leaf lamina, T.S:** 1. Epidermis with thick outer walls and spherical cystolith, 2. Palisade cells, 3. Spongy parenchyma, 4. Multicellular trichome.

**Stem : T.S (Fig.13)**

The T.S. of stem was quadrangular. The epidermis consisted of tabular cells covered with a thin cuticle and contained thick-walled unicellular as well as multicellular uniseriate trichomes with broad basal cells. The tip of the trichomes were blunt and the walls were warty. Some of the epidermal cells became large circular and contained cystoliths. The collenchymatous hypodermis was 3-4 layered developed at the angles of the quadrangular axis. The cortex consisted of 5-7 layers of large polygonal thin walled parenchyma. The endodermis was indistinct. The pericycle was composed of nearly continuous ring of sclereids. The wood composed of large xylem bundles at the angles connected by strands of interfascicular wood prosenchyma with a few rows of vessels embedded in them. The wood parenchyma was occurred in groups on the inner side of the angular xylem bundles. The phloem was a narrow zone consisting of usual elements of phloem. Xylem consisted of vessels, tracheids, fibres, parenchyma and xylem rays. Vessels were simple and boarded pitted. Few scalariform vessels were also found. The xylem rays were uniseriate. The central region of pith contained compactly arranged isodiametric thin walled parenchyma.

**Stem : T.L.S (Fig.14 )**

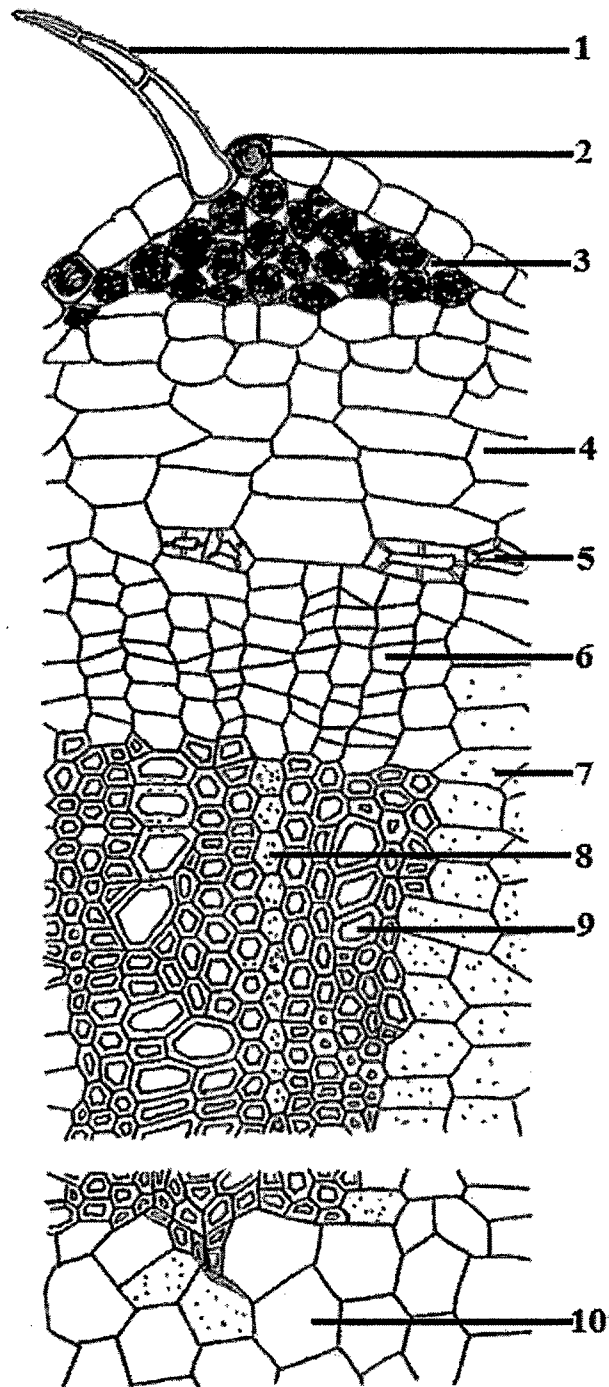
Epidermal cells were rectangular bearing trichomes followed by thick walled collenchyma. The cells of cortex were also polygonal shaped. Xylem rays were pitted and uniseriate. The fibre tracheids were with broad lumen. The pith cells appeared polygonal shaped and thin walled.

**Stem : R.L.S (Fig.15)**

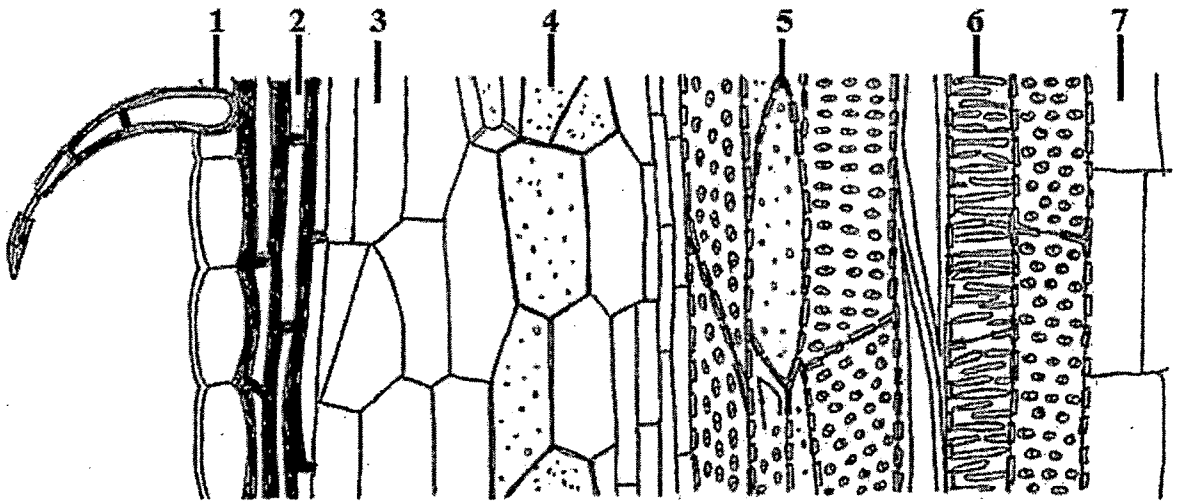
Epidermal cells were rectangular while the cells bearing cystolith were polygonal in shape. The prosenchyma were also polygonal in shape and thick walled. Xylem rays were rectangular and had pits on their walls.

**Powder study (Fig.16)**

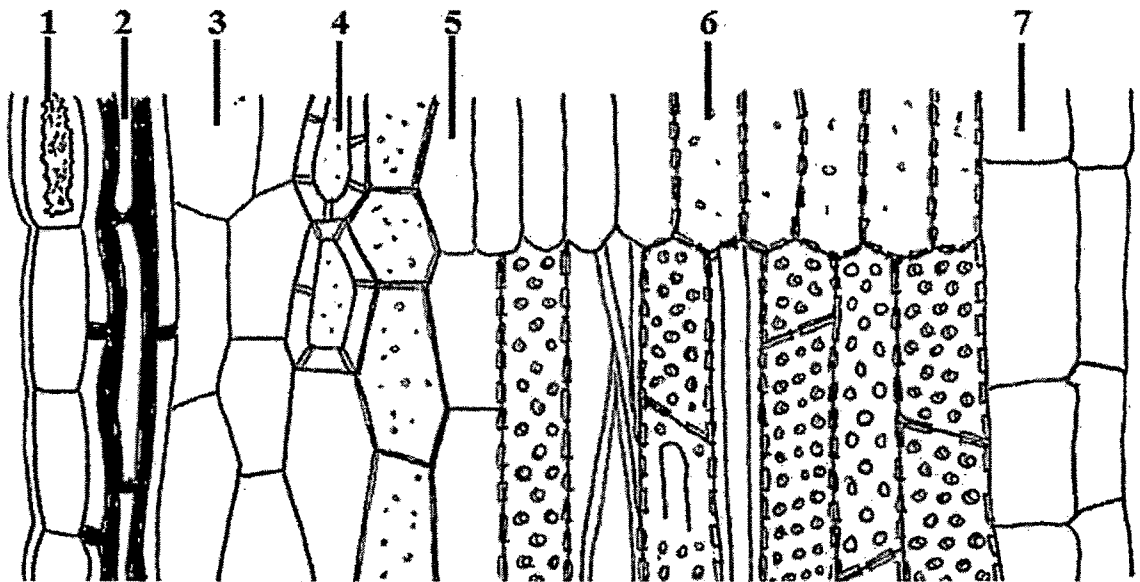
The components present in the powder were thick-walled unicellular as well as multicellular uniseriate trichomes having broad basal cell and warty walls with blunt tip, glandular hairs, fragments of collenchyma, thick walled prosenchyma, boarded pitted vessels and scalariform vessel.



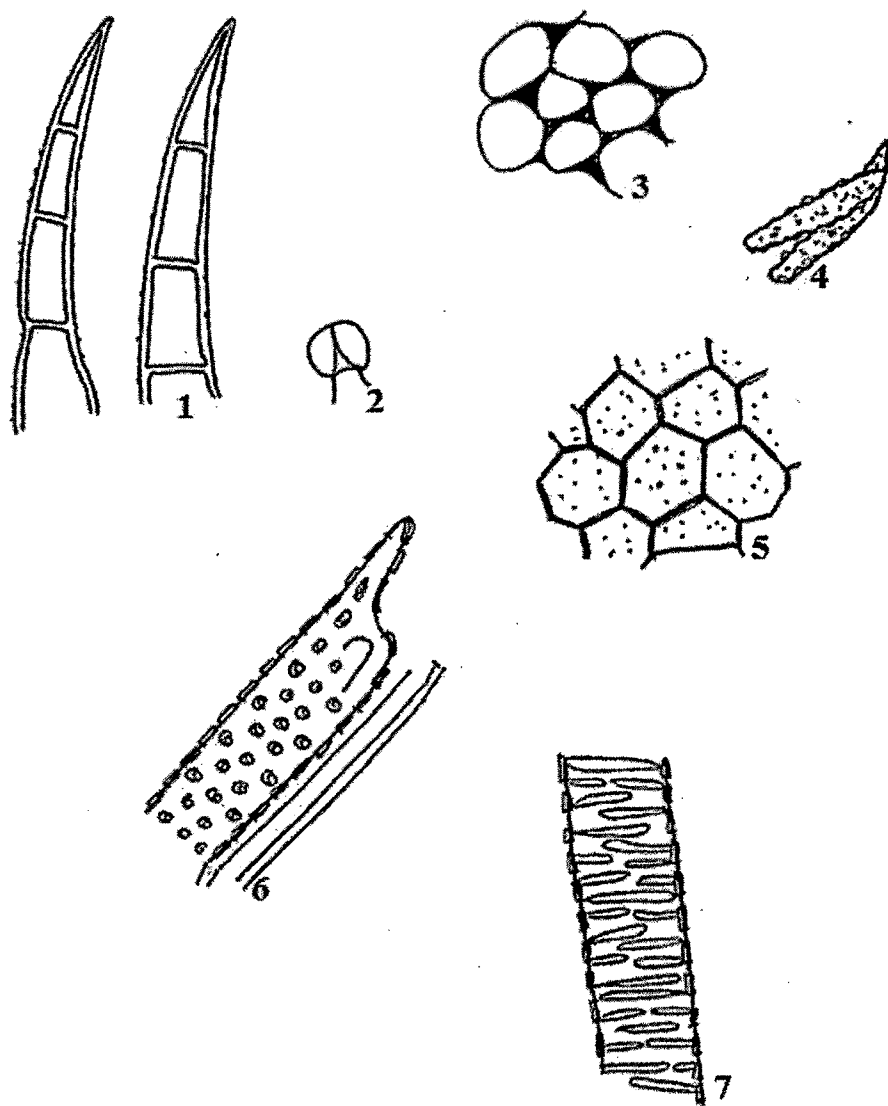
**Fig.13. *Justicia procumbens* stem, T.S:** 1. Multicellular uniseriate hair, 2. Epidermal cell with cystolith, 3. Collenchyma, 4.Cortical parenchyma, 4.Sclerenchyma, 6. Phloem, 7. Prosenchyma, 8. xylem rays, 9.Vessel, 10. Pith.



**Fig.14. *Justicia procumbens* stem, T.L.S:** 1. Epidermal cell with hair, 2.Collenchyma, 3. Cortex, 4.Prosenchyma, 5. Xylem rays, 6. Scleriform vessel, 7.Pith.



**Fig.15. *Justicia procumbens* stem, R.L.S:** 1. Epidermal cell with Cystolith, 2.collenchyma, 3. Parenchyma, 4. Sclerenchyma, 5. Phloem rays, 6. Xylem rays, 7.Pith.



**Fig.16. *Justicia procumbens* powder study:** 1. Broad basal celled trichomes with thick, warty walls, 2. Glandular hairs, 3. Fragments of collenchyma, 4. Cystoliths, 5. Fragments of prosenchyma, 6. Boarded pitted vessel, 7. Scalariform vessel.

**Distinguishing features****Phytochemical markers**

1. 6-OH Kaempferol.
2. 7- OMe 6- OH Kaempferol.
3. Ferulic (*cis*- and *trans*- isomers) acid.

**Pharmacognostic markers****Root**

1. Centre wood dominated by vessels.
2. Elongated parallel bordered pits.

**Leaf**

1. Thick-walled unicellular as well as multicellular uniseriate trichomes with broad basal cell, blunt tip and warty walls.
2. Thin and wavy lateral walls of epidermal cells.
3. Thick outer epidermis walls.
4. Diacytic type of stomata.
5. Isobilateral mesophyll.

**Stem**

1. Thick-walled unicellular as well as multicellular uniseriate trichomes with broad basal cell, blunt tip and warty walls.
2. Interfascicular wood prosenchyma.
3. Broad lumen fibre tracheids.

**Physico-chemical analysis:****Table:3.** Values obtained for the proximate analysis.

| Sr.No. | Parameter                   | Mean $\pm$ SD (%)* |                  |                  | Average (%) |
|--------|-----------------------------|--------------------|------------------|------------------|-------------|
|        |                             | Summer             | Monsoon          | Winter           |             |
| 1.     | Total Ash Content           | 11.02 $\pm$ 0.21   | 11.08 $\pm$ 0.17 | 11.16 $\pm$ 0.20 | 11.09       |
| 2.     | Acid Insoluble Ash content  | 0.98 $\pm$ 0.03    | 0.98 $\pm$ 0.06  | 0.99 $\pm$ 0.2   | 0.98        |
| 3.     | Alcohol soluble extractives | 13.33 $\pm$ 0.62   | 12.81 $\pm$ 0.66 | 12.39 $\pm$ 0.89 | 12.84       |
| 4.     | Water soluble extractives   | 17.39 $\pm$ 0.41   | 17.22 $\pm$ 0.23 | 17.31 $\pm$ 0.28 | 17.31       |

\*Each value is a mean of 3 reading



### 3.c. *Oldenlandia corymbosa* L. ( Rubiaceae )

**Synonyms:** *Hedyotis corymbosa* (L.) Lamk

**Sanskrit:** Ksetraparpatra, Kshetraparpata, Parapataparpata, Parpataka.

**Vernacular names:**

Bengal : Khetpapra.

Gujarati : Khetpapra , Parpat.

Hind : Daman-Paper, Damanpapar.

Kannada : Kallasabattrasige, Hutcchu Nelabevu, Kallu Sabseege.

Malayalam : Parpatakam , Paropatakapulla.

Marath : Parpat, Papti, Phapti, Parpato, Poripath.

Tamil : Parpadagam, Pappanpuntu, Parpatakam, Kattucayaver, Pappan.

Telugu : Verrinelavemu.

#### **Distribution and habitat**

A spreading, suffruticose annual, frequently found especially during monsoon in fields throughout India, Sri Lanka, tropical East Asia to Java and the Phillipines.

#### **Morphological features.**

The plant is an annual, height varying from 7.5-38 cm.; stems terete, numerous, slender, erect, ascending or spreading, glabrous or pubescent. Leaves subsessile, 2- 4.5cm. by 1.5-4 mm., linear or linear-lanceolate, acute, often with recurved and frequently scabrous margins; stipules short, membranous, truncate, with a few short bristles. Flowers on the filiform pedicels longer than the calyx, usually 2-3 (rarely 1 or very rarely 4) on the top of a very slender axillary solitary peduncle; bract beneath the pedicels 1, 25-1.5 mm. long, subulate. Calyx 2 mm. long, pubescent; teeth narrowly triangular, about equalling the calyx-tube when in flower. Corolla white, 2.5 mm. long; lobes acute, about 1.25mm. long. Capsules globose or sometimes slightly pyriform, somewhat didymous, the top rather flat and not protruded beyond the calyx, glabrous. Seeds pale brown and angular.

#### **Medicinal uses:**

The plant is known to clear heat and toxins, activate blood circulation, promote diuresis and relieve stranguria (urinary obstruction). It is also known to act against tumours of the digestive tract lymphosarcoma and carcinoma of the liver and larynx. It is also active against appendicitis, hepatitis, pneumonia, cholecystitis, urinary infection, cellulites and snake bite. Chinese folk medicine describes the plant to treat

skin sores, ulcers, sore throat, bronchitis, gynaecologic infections and pelvic inflammatory diseases (Chang 1986; Bensky 1990; Chang 1992; Ming 1990). It is usually administered in the form of a decoction in remittent fever with gastric irritability and nervous depression caused by deranged bile. It is also used to treat jaundice and diseases of liver. The juice of the plant is applied to palms and soles to relieve the burning sensation during fevers. The plant is used as an anthelmintic. In Philippines the plant is boiled in water and the brew is used as a mouthwash for relief during toothache (Anonymous). The methanolic extracts of the plant is found to be antioxidant, radical scavenging, anti-inflammatory, cytotoxic and antibacterial (Nordin and Ahmad 2006). Immunomodulatory studies (Sutarjadi *et al.*, 1991) and hepatoprotective studies (Sadashivan *et al.*, 2006) have been conducted using the plant extracts.

#### **Previous Phytochemical reports**

Iridoids such as geniposide, 6 $\alpha$ -hydroxygeniposide, scandoside methyl ester, asperulosidic acid, deacetylasperuloside, asperuloside, 10-*O*-benzoylscandoside methyl ester, 10-*O-p*-hydroxybenzoylscandoside methyl ester, (+)-lyoniresinol-3 $\alpha$ -*O*- $\beta$ -glucopyranoside (Tagaki *et al.*, 1981; Nishihama *et al.*, 1981) and rutin (Noiarsa *et al.*, 2008) have been identified. Acylated derivatives such as 10-*O*-benzoyl deacetyl asperulosidic acid methyl ester, and 10-*O*-benzoyl, 10-*O-p*-hydroxybenzoyl, and the 10-*O-p-trans*, *cis*-coumaroyl scandoside methyl esters have also been isolated and identified (Hideaki *et al.*, 1991). The plant is also known to contain oleanolic and ursolic acids (Nordin and Ahmad. 2006). The plant is also known to contain alkaloids biflorine and biflorone (Nordin and Ahmad. 2006).

#### **Previous pharmacognostic reports**

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

#### **Materials and methods**

The plant material has been collected from Vadodara, Gujarat. Phytochemical analysis 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 plant is found to contain flavonoids such as quercetin, 3'-methoxy quercetin and 3', 4'-dimethoxy quercetin. The plant contained the anthocyanin cyanidin and pelargonidin, while the phenolic acids located were vanillic, syringic, *p*-coumaric ( *cis* and *trans* isomers), *p*-hydroxybenzoic, gentisic and caffeic acids. Mucilage amounted to 7.6% consisting of glucose and xylose. The plant also showed the presence of unidentified alkaloids and steroids.

### **Pharmacognosy**

#### **Root : T.S. (Fig.17)**

The root was circular in outline. Cork was a narrow zone made up of 2-4 layers of thin walled cells. Cortex was of 5-9 layers of somewhat broadly rectangular parenchymatous cells, many of them contained bundles of raphides. Phloem was 10 to 12 layers thick and made up of usual elements. The wood composed of small vessels, fibre tracheids, parenchyma and rays with the patches of libriform fibres. The libriform fibres were thick walled, narrow lumened and having blunt ends. Xylem rays were uniseriate with few biseriate and having pits on their walls. The vessels were comparatively small.

#### **Root : T.L.S (Fig.18)**

The cork cells were many layered and rectangular. Cortical parenchyma contained bundles of raphides. Phloem rays were thin walled and appeared spindle shaped. Libriform fibre were found associated with tracheids. Xylem vessels had alternate simple pits.

#### **Root : R.L.S. (Fig.19)**

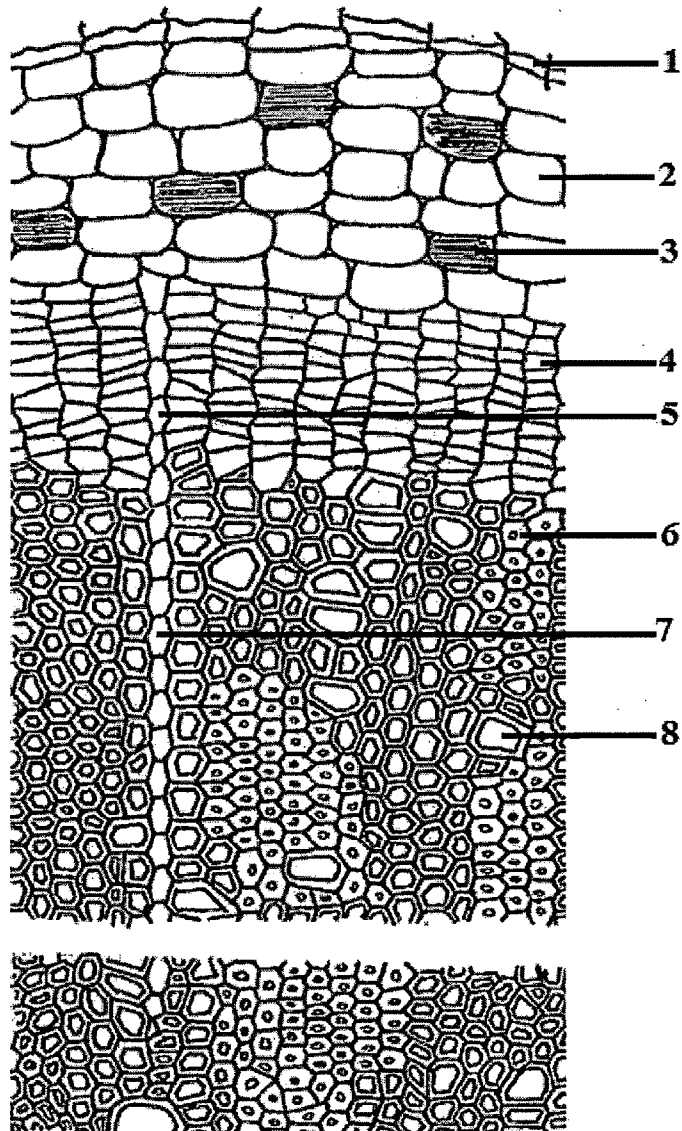
Cortical parenchyma were square to rectangular shaped and contained raphide bundles. The Phloem rays were thin walled. The xylem rays consisted of rectangular shaped pitted cells. Vessels were bordered pitted.

### **Leaf micromorphology**

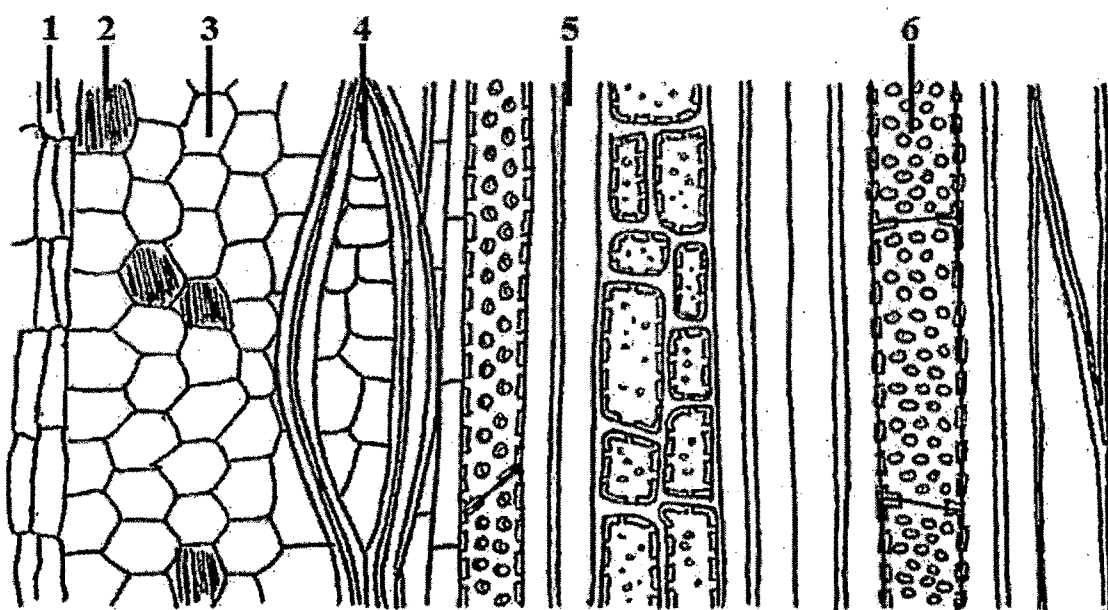
The stomata were of paracytic type. The stomatal index was 21-25. The leaf was free from trichomes or glands.

#### **Leaf : T.S (Fig.20)**

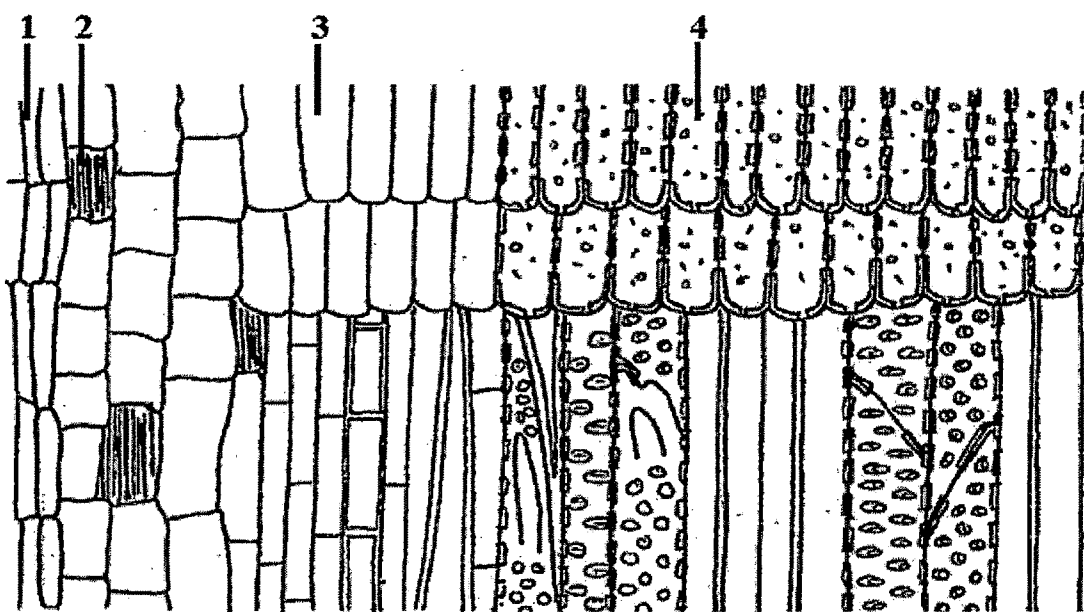
The **midrib portion** was characterized by a concave cavity on the upper side and a hemispherical bulge on the lower side. The epidermal cells were polygonal in shape covered by thin cuticle. The hypodermis on both upper and lower regions made



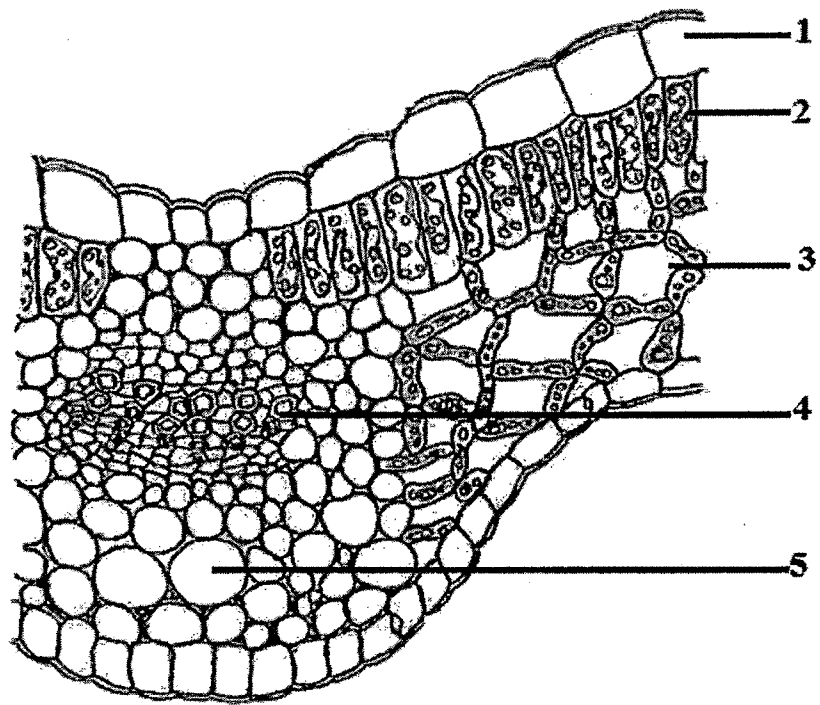
**Fig.17.***Oldenlandia corymbosa* root, T.S: 1. Cork, 2. Cortex, 3. Parenchyma with raphides bundles, 4. Phloem, 5. Phloem ray, 6. Libriform fibres, 7. Xylem rays, 8. Vessel.



**Fig.18.** *Oldenlandia corymbosa* root, T.L.S:1. Cork, 2. Raphides bundles, 3. Cortex, 4. Spindle shaped ray, 5. Libriform fibres, 6.Vessel.



**Fig.19.** *Oldenlandia corymbosa* root, R.L.S:1. Cork cells, 2. Raphides bundles, 3.Phloem rays, 4. Xylem rays.



**Fig.20.***Oldenlandia corymbosa* leaf, T.S: 1. Epidermis with cuticle, 2. Single layered palisade, 3. Mesophyll parenchyma, 4. Vascular bundle, 5. Ground tissue.

up of collenchyma. The ground tissue was parenchymatous. The cells of the ground tissues on the upper side of the vascular bundle were smaller and spherical while those on the lower side were composed of large isodiametric parenchyma cells. The vascular bundle was crescent shaped.

In the **lamina portion** the epidermal cells were barrel shaped. The cells of the upper epidermis were about double the size of the lower epidermis. The mesophyll cells were differentiated into a single layer of palisade and lower spongy tissue. The palisade cells were filled with large chloroplasts. The mesophyll region was almost double the size of the palisade, consisting of a network of lobed spongy cells containing chloroplasts. Air spaces within were very large. The leaf was free from trichomes or glands.

**Stem : T.S (Fig.21 )**

The T.S. of stem was almost square in outline. The epidermis consisted of barrel shaped cells. At some places there were cork formation in the outermost layers made up of 3 to 5 layers of thin walled rectangular cells. Cortex was 6 to 8 layers thick and composed of thin walled parenchymatous cells. The cells were circular in shape and compactly packed with very little intercellular spaces. Some of these cells contained raphide bundles and chlorophyll. Endodermis and pericycle were indistinct. Phloem was narrow zone consisting of 5 to 8 layers of cells. The wood was diffuse porous and composed of small vessels, fibres, tracheids, parenchyma and rays. In the xylem the libriform fibres found associated with tracheids. Xylem rays were uni- to biseriate, thick walled and did not contain any inclusions. The vessels were comparatively small and were simple and bordered pitted. The scalariform vessels were also common. The pith in the centre was large and was composed of thin walled large parenchymatous cells.

**Stem : T.L.S (Fig.22)**

Epidermal cells were thin and rectangular shaped followed by few layers of small square to pentagonal thin walled parenchymatous cells. Some large rectangular cortical parenchyma were found with raphide bundles. The phloem cells were thin rectangular. Xylem rays were pitted and biseriate. The scalariform vessels showed the straight end walls. The pith cells appeared rectangular and were thin walled.

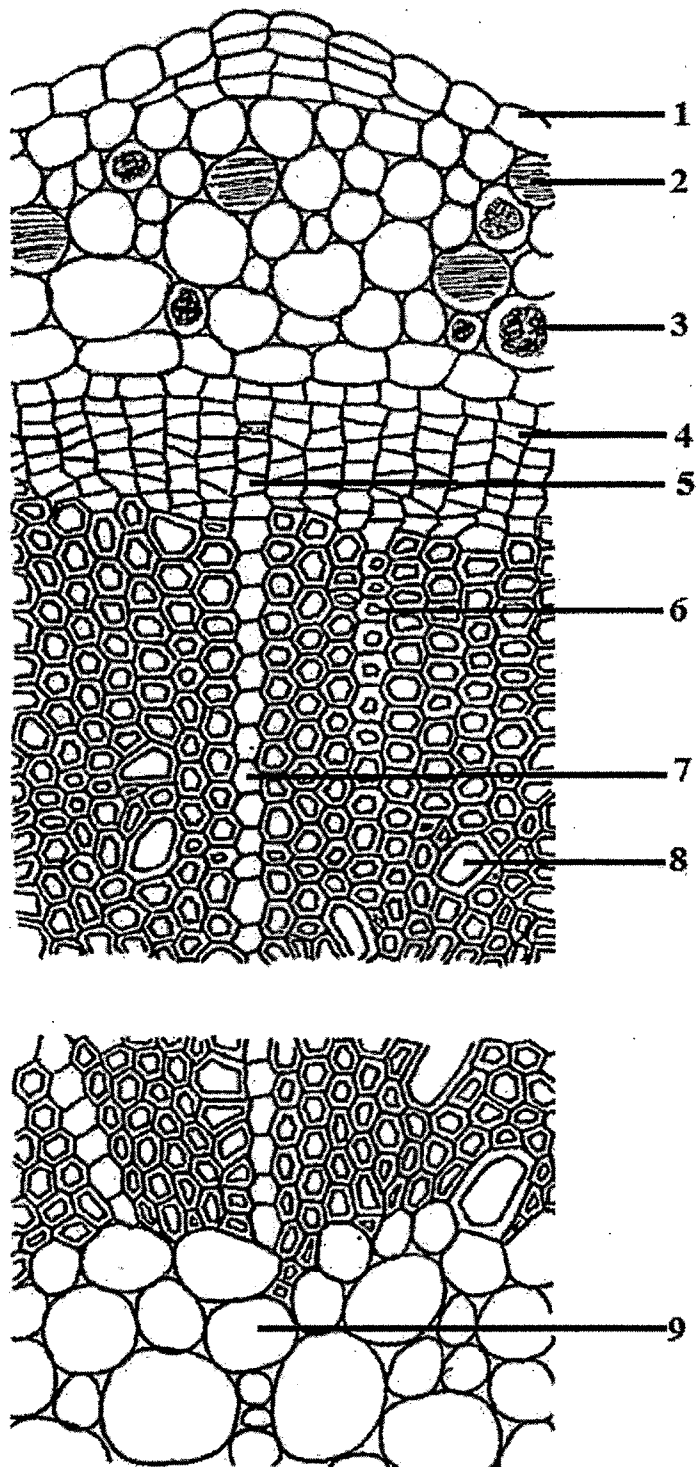
**Stem : R.L.S (Fig.23)**

Cork cells were thin walled and rectangular in shape. Cortical parenchyma were with raphide bundles. Phloem and Xylem rays were rectangular in shape. Xylem rays showed the pits on their walls.

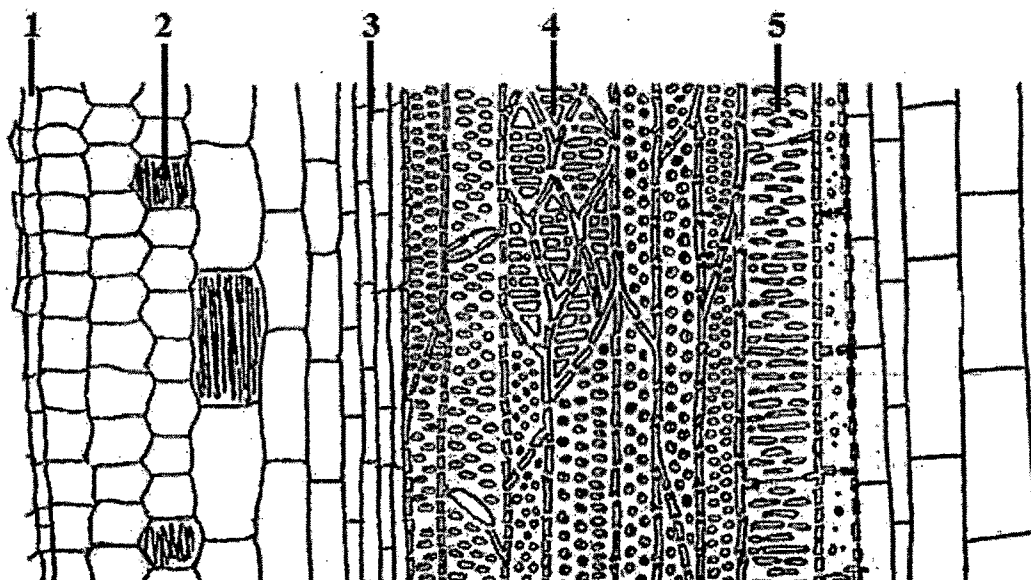
**Powder study (Fig.24 )**

The colour of the powder were light green and the components present in the powder were fragments of epidermis with stomata, thin walled cortical parenchyma containing raphide bundles, raphide bundles (made up of needle shaped crystals), mesophyll containg chlrenchyma, narrow lumened fiber.

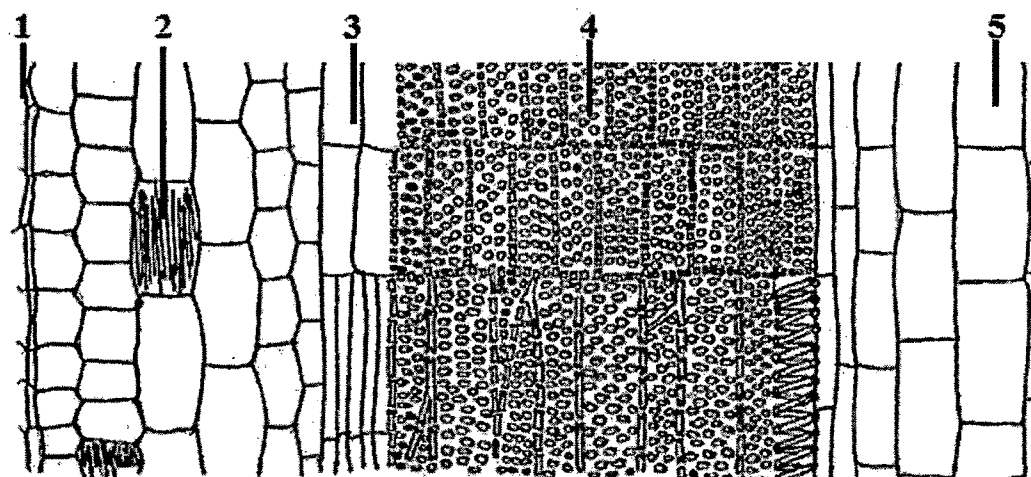




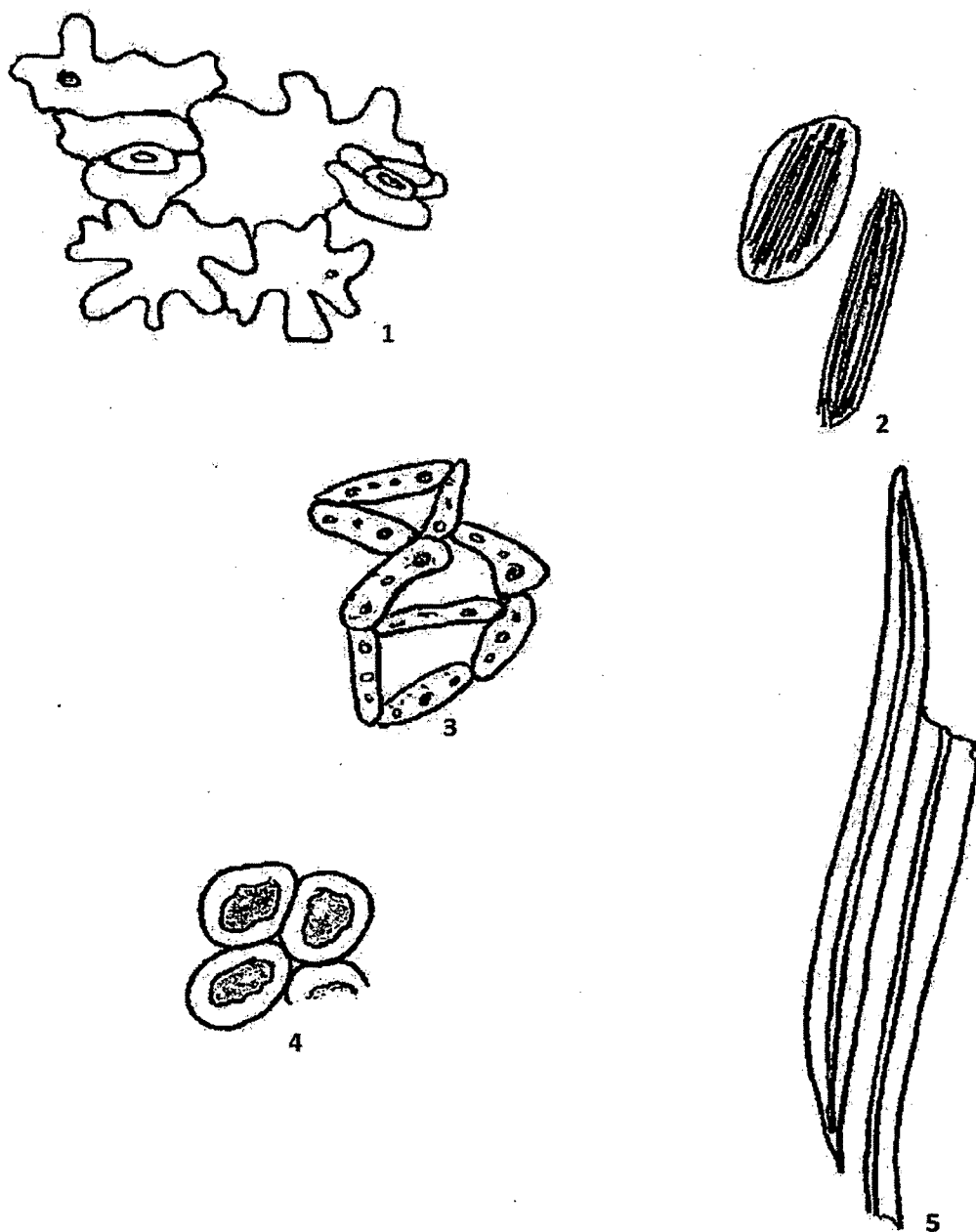
**Fig.21.***Oldenlandia corymbosa* stem, T.S: 1. Epidermis, 2. Parenchyma with raphides bundles, 3. Parenchyma with chlorophyll, 4. Phloem, 5. Phloem ray, 6. Libriform fibres, 7. Xylem rays, 8. Vessel, 9. Pith.



**Fig.22. *Oldenlandia corymbosa* stem, T.L.S:** 1. Epidermis, 2.Cortical parenchyma with raphides bundles 3. Phloem, 4. Xylem rays, 5. Scalariform vessel.



**Fig.23. *Oldenlandia corymbosa* stem, R.L.S:** 1. Cork, 2. Raphides bundles, 3.Phloem rays, 4. Pitted xylem rays, 5. Pith.



**Fig.24.***Oldenlandia corymbosa* Powder study:1. Fragments of epidermis with stomata, 2.Raphide bundles, 3.Mesophyll containing chloroplast, 4.Chlorenchyma , 5. Thick walled narrow lumened fibers.

### Distinguishing features

### Phytochemical markers

1. 3'-Methoxy quercetin.
2. 3', 4'-Dimethoxy quercetin.
3. *p*-Coumaric ( *cis* and *trans* isomers) acid.
4. *p*-Hydroxybenzoic acid.
5. Gentisic acid.
6. Caffeic acid.
7. Cyanidin.
8. Pelargonidin.

### Pharmacognostic markers

#### Root

1. Parenchyma cells bearing raphide bundles .
2. Narrow lumened libriform fibres.

#### Leaf

1. Cells of upper epidermis about double the size of the lower epidermis.
2. Paracytic type of stomata.
3. Network of lobed spongy cells.
4. Absence of trichomes.

#### Stem

1. Association of libriform fibres with tracheids.
2. Scalariform vessels with straight end walls.

### Physico-chemical analysis:

**Table: 4.** Values obtained for the proximate analysis.

| Sr.No. | Parameter                   | Mean $\pm$ SD (%)* |                  |                  | Average (%) |
|--------|-----------------------------|--------------------|------------------|------------------|-------------|
|        |                             | Summer             | Monsoon          | Winter           |             |
| 1.     | Total Ash Content           | 10.01 $\pm$ 0.18   | 10.11 $\pm$ 0.13 | 10.09 $\pm$ 0.14 | 10.07       |
| 2.     | Acid Insoluble Ash content  | 1.18 $\pm$ 0.14    | 1.14 $\pm$ 0.12  | 1.09 $\pm$ 0.21  | 1.14        |
| 3.     | Alcohol soluble extractives | 7.91 $\pm$ 0.54    | 7.26 $\pm$ 0.66  | 7.22 $\pm$ 0.46  | 7.46        |
| 4.     | Water soluble extractives   | 15.31 $\pm$ 0.27   | 15.11 $\pm$ 0.09 | 15.13 $\pm$ 0.11 | 15.18       |

\*Each value is a mean of 3 reading

### 3.d. *Peristrophe bicalyculata* Nees. (Acanthaceae)

**Synonyms:** *Peristrophe paniculata* (Forssk.) Brummitt

**Sanskrit:** Kakajangha, Nadikanta, Sulomasha.

**Vernacular names:**

Gujarati : Kaliadhedi, Kariadhedi, Lasiadhedi.

Hindi : Kali aghedi, Atrilal, Kakajangha.

Manipuri : Khuan langthrei.

Marathi : Ghatipittapapada, Ramkiayat, Pitpapra.

Tamil : Nagananda, Chebisa.

Malayalam : Katou-pulcholli.

Telugu : Chebura, Chebira.

Kannada : Cheebee gida, Cheebera Soppu.

Bengali : Nasabhaga.

**Distribution and habitat**

The plant is an erect hispid herb or under shrub 60-180 cm high, found throughout in India in forest as undergrowth, hedges and wasteland.

**Morphological features**

The plant is herbaceous, 1-1.5 m high; stems and branches usually 6-angled, more or less hairy, usually rough on the angles. Leaves 5-8 cm long, ovate, acuminate, densely linolate, more or less hairy above, somewhat densely so on the nerves and veins beneath, base usually rounded; main nerves 4-6 pairs; petioles upto 1 cm long. Flowers in trichotomous cymes in large lax divaricate pubescent panicles; bracts beneath the calyx 2, opposite, often 1 cm long, linear, acute, mucronate, with white membranous margins; bracteoles 4, similar to the bracts but shorter, subequal or sometimes unequal. Calyx divided to the base; segments lanceolate-subulate with ciliolate margins. Corolla rosy, nearly 1.5 cm long, pubescent outside; bilabiate upper lip elliptic-oblong, obtuse, entire; lower lip slightly longer, oblong, with 3 acute lobes. Filaments hairy; anther-cells one almost entirely about the other, muticous. Ovary pubescent at the tip; style nearly glabrous. Capsules 1 by 0.4 cm, narrowed into a long, pointed, pubescent cylindric stalk. Seeds orbicular, papillose and slightly rugose.

**Action and uses:**

In ethnomedicinal practices the traditional healers use the plant as an antidote to snake poison and in bone fractures and sprains (Anon.1966).The ethanolic extract of the plant has been reported to exhibit analgesic, anti-inflammatory and antibacterial properties (Chopra,1959 and Dwivedi, 2002) and was strongly effective against *Staphylococcus aureus*, *Klebsiella* spp., *E. coli*, and *Pseudomonas aeruginosa* ( Giwa *et al*,2010).The plant also showed the blood pressure lowering and hepatoprotective effects (Abdulazeez *et al*, 2010).

**Previous Phytochemical reports**

The chemical composition of the dried aerial parts showed 14-methyl-tritriacont-14-en-15-ol and 35-hydroxynonatriacontanal (Singh *et. al.*, 2000). The volatile oil contained beta-caryophyllene (33.9%), alpha-zingiberene (10.4%), germacrene D and globulol (5.0%) were the compounds occurring in abundance and phytol (56.3%), 1, 8-cineole (20.4%), with sizeable proportions of alpha-pinene (7.1%) and p-cymene (4.0%) ( Ogunwande *et. al.*, 2010).

**Previous pharmacognostic reports**

Very little data available on pharmacognosy of this plant. Only the T.S of various parts of the plant has been studied (Anon.2001 and Saraswathy *et.al.*, 2006).

**Materials and methods**

The plant material has been collected from Vadodara, Gujarat. Phytochemical analysis 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 plant contained alkaloids in traces and flavonoids were found absent. But it was rich in phenolic acids such as vanillic, syringic, ferulic, coumaric (*cis*- and *trans*-isomers), caffeic and p-hydroxy benzoic acids. Mucilage amounted to 5.8% consisting of xylose. The plant also showed the presence of coumarins.

## **Pharmacognosy**

### **Root : T.S (Fig.25 )**

The root was circular in outline in T.S. The cork cells were broad, thin walled and rectangular. The cortex made up of 4 to 8 layers of tangentially elongated polygonal parenchymatous cells. The cells were slightly thick walled and were compactly arranged and few of them were filled with the simple round starch grains (11-21 $\mu$ m). Endodermis was single layered and the cells were barrel shaped and slightly thick walled. Phloem was 6 to 9 layered and composed of phloem parenchyma, fibers and sieve elements. Phloem rays were indistinct. Xylem was dominated by trachieds and fibers. The vessels were scanty and mostly occurred singly in the periphery and in a groups of 2-3 in the center. Xylem rays were thin walled tangentially elongated, uni- to biseriate.

### **Root : T.L.S (Fig.26 )**

Cortical cells appeared rectangular and some of the cells here were filled with starch grains. The phloem rays were small spindle shaped. The fibres were straight with a narrow lumen. The vessels were very broad and contained 3-5 rows of transversely oblique bordered pits. Xylem rays were uniseriate to biseriate and contained simple pits.

### **Root : R.L.S (Fig.27)**

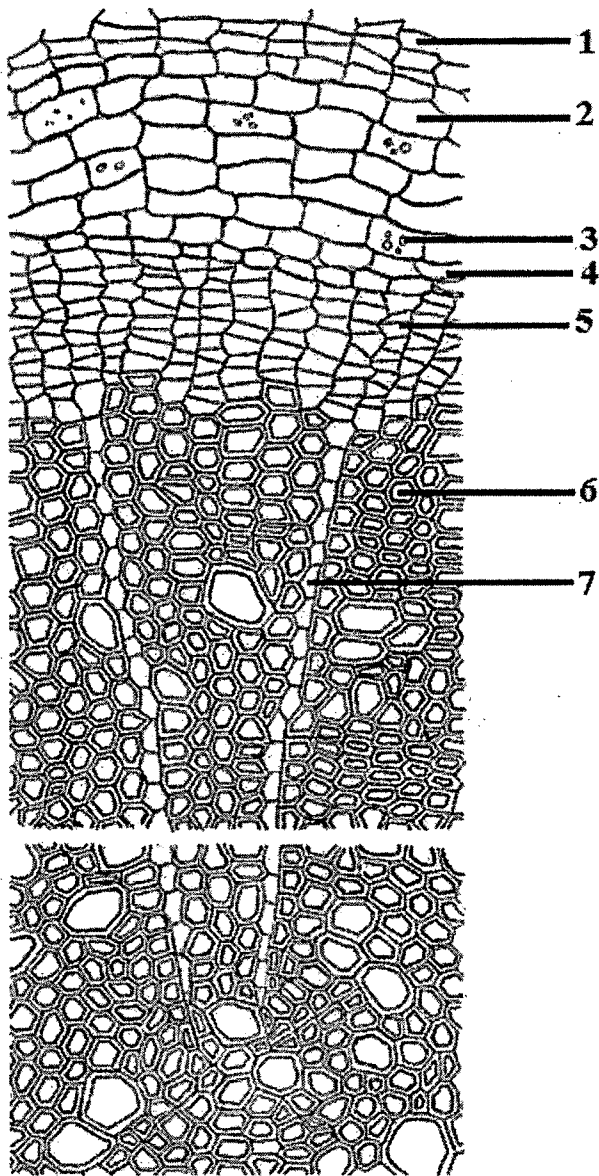
Cork cells appeared small rectangular. A single vertical row of thick walled endodermis was seen. Phloem rays were thin walled and without pits, while xylem rays were with simple pits. Vessels were reticulate and border pitted.

## **Leaf micromorphology**

Stomata was of diacytic type. Stomatal index was 16-23. Trichomes were multicellular uniseriate with a trichome index of 5-9 and glandular trichomes were very rare.

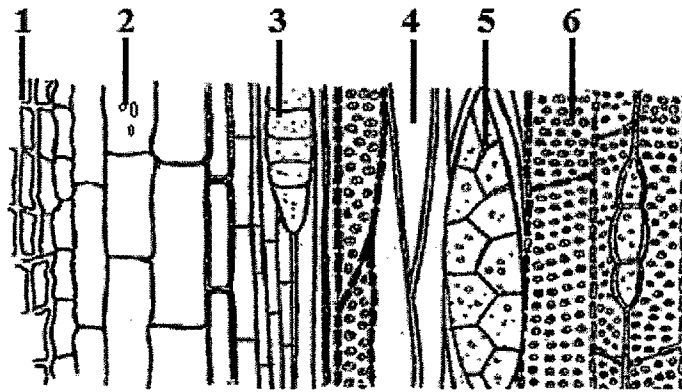
### **Leaf : T.S (Fig. 28 )**

In the **midrib portion** the epidermal cells were barrel shaped except the cells at uperridges which were polygonal in shape. Hypodermal lamellar collenchyma was discontinuously arranged and present only in the ridged portion of upper and lower midrib. Below this was a parenchymatous ground tissue. The cells of the ground tissue was loosely arranged. Some of them contained chlorophyll and few

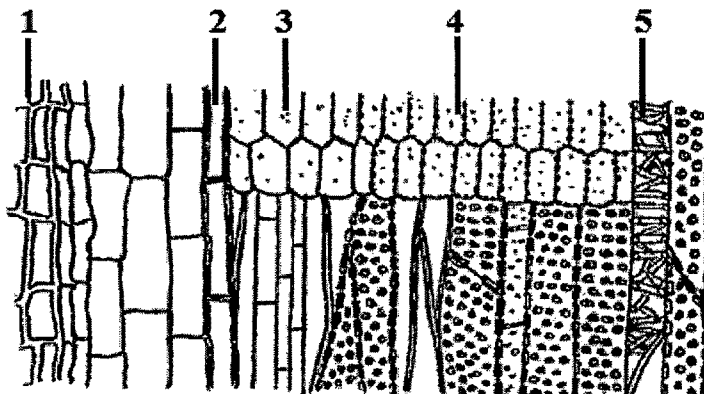


**Fig.25. *Peristrophe bicalyculata* root, T.S.:**1. Cork, 2. Cortex, 3.Starch grains, 4.Endodermis, 5.Phloem, 6. Xylem, 7.Xylem rays.





**Fig.26. *Peristrophe bicalyculata* root, T.L.S.:**1.Cork, 2. Cortical parenchyma with starch grains, 3. Phloem ray, 4.Fibres, 5. Xylem rays, 6. Vessel.



**Fig.27. *Peristrophe bicalyculata* root, R.L.S.:**1.Cork, 2. Endodermis, 3. Phloem rays, 4. Xylem rays, 5. Reticulate vessel.

showed the deposition of oil globules. The vascular bundle was crescent shaped. The tracheids were in about 4-6 rows, and there were 3-7 rows of secondary phloem cells. The upper and lower epidermis were covered by thin walled unicellular as well as multicellular uniseriate trichomes with pointed tip and also showed the presence of cystoliths. The 3 celled trichomes were most common. The cells of lower epidermis was smaller than the upper epidermis and also contained a few sessile or short stalked glandular trichomes.

In the **lamina portion** mesophyll was differentiated to an upper single layered palisade and lower 2-3 layered spongy tissue. The palisade cells contained a single row of chloroplasts forming a ring and the spongy cells were with 5-8 large chloroplasts. Trichomes were more on the lower epidermis whereas stomata and cystoliths were seen both on the upper and lower epidermis. Walls of lower epidermal cells were wavy.

#### **Stem : T.S (Fig.29)**

The stem in T.S was angular in outline. The single layered epidermis consisted of barrel shaped cells, which was covered by a thin cuticle. Some of the cells contained cystoliths of calcium carbonate. The hypodermis was of 2 to 3 layers of continuous ring consisted of lamellar collenchyma which were 5 to 8 layers thick below the angular protrusion. Cortex was differentiated into outer 1 to 2 layers of chlorenchyma followed by thin walled loosely arranged rounded or oval parenchyma. Some cells here contained brown deposits. Endodermis was single layered of closely fitted thin wall parenchymatous cells some of these cells were became thick walled. Phloem was narrow and composed of phloem parenchyma, phloem fibres and sieve elements. Xylem consisted of vessels, tracheids, xylem parenchyma and fibres. Vessels were scattered and a few of the vessels were in a 3 to 4 rows surrounded by the trachieds. Wide centre pith was parenchymatous. The cells were compactly arranged showing presence of isolated acicular crystals.

#### **Stem : T.L.S (Fig.30)**

Epidermal cells contained cystolith. The hypodermal collenchyma were ractangular in shape. Cortical cells were hexagonal in shape. Fibres had uniform lumen sizes. Xylem rays were fusiform 3- cell thick and 5-7 cells in height. In vessels the bordered pits were transversely elongated.

**Stem : R.L.S (Fig.31)**

In the R.L.S the cortical parenchyma were large polygonal. The phloem and xylem ray cells appeared erect and were of rectangular in shape. The protoxylem had both annular and spiral type of thickenings. Cells of the pith were thin walled, filled with acicular crystals.

**Powder study (Fig.32)**

The colour of the powder was yellowish green and the components present in the powder were unicellular as well as multicellular uniseriate trichomes having sharp pointed tips, glandular trichomes, epidermal cell containing cystoliths, acicular fibers, vessels, rod shaped crystals.

**Distinguishing features****Pharmacognostic markers****Root**

- 1) Cork cells were broad and thin walled.
- 2) Thick walled prominent endodermis.
- 3) Simple rounded starch grains.
- 4) Transversely oblique bordered pits.

**Leaf**

- 1) Epidermis were covered by thin walled unicellular as well as multicellular uniseriate trichomes with pointed tip.
- 2) Deposition of cystoliths in the epidermis.
- 3) The stomata were of diacytic type.
- 4) Presence of glandular trichome.
- 5) Lower epidermal cells were wavy.

**Stem**

- 1) cortical cells were showed brown deposits.
- 2) Pith was parenchymatous showed the presence of isolated acicular crystals.
- 3) Vessels were surrounded by the tracheids.

**Phytochemical markers**

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

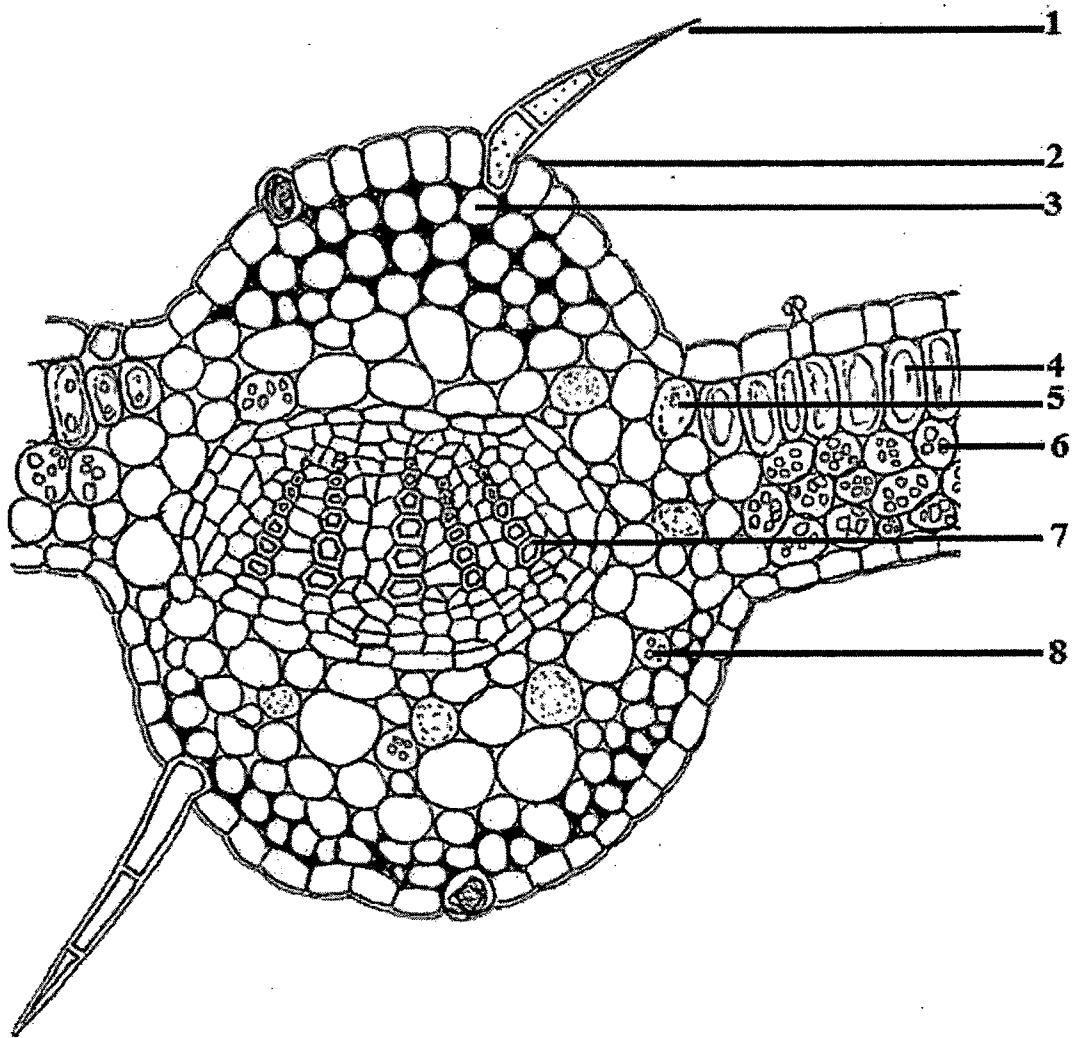
3. Caffeic acids.
4. *p*-Hydroxy benzoic acids.
5. Xylose.
6. Absence of flavonoids.

**Physico-chemical analysis:**

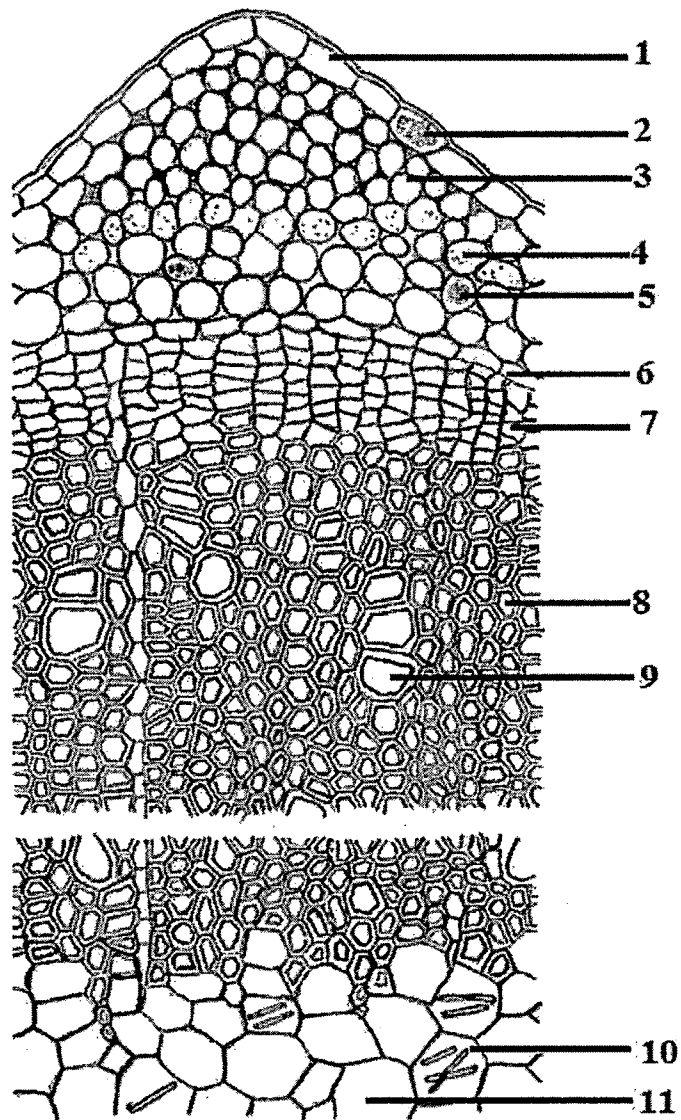
**Table:5.** Values obtained for the proximate analysis.

| Sr.No. | Parameter                  | Mean $\pm$ SD (%)* |                  |                  | Average (%) |
|--------|----------------------------|--------------------|------------------|------------------|-------------|
|        |                            | Summer             | Monsoon          | Winter           |             |
| 1.     | Total Ash Content          | 09.88 $\pm$ 0.23   | 10.09 $\pm$ 0.09 | 09.93 $\pm$ 0.21 | 9.97        |
| 2.     | Acid Insoluble Ash content | 0.53 $\pm$ 0.06    | 0.57 $\pm$ 0.03  | 0.54 $\pm$ 0.3   | 0.55        |
| 3.     | Alcohol soluble extractive | 08.87 $\pm$ 0.94   | 8.88 $\pm$ 0.89  | 8.82 $\pm$ 0.91  | 8.86        |
| 4.     | Water soluble extractive   | 11.12 $\pm$ 0.63   | 11.32 $\pm$ 0.38 | 11.22 $\pm$ 0.26 | 11.22       |

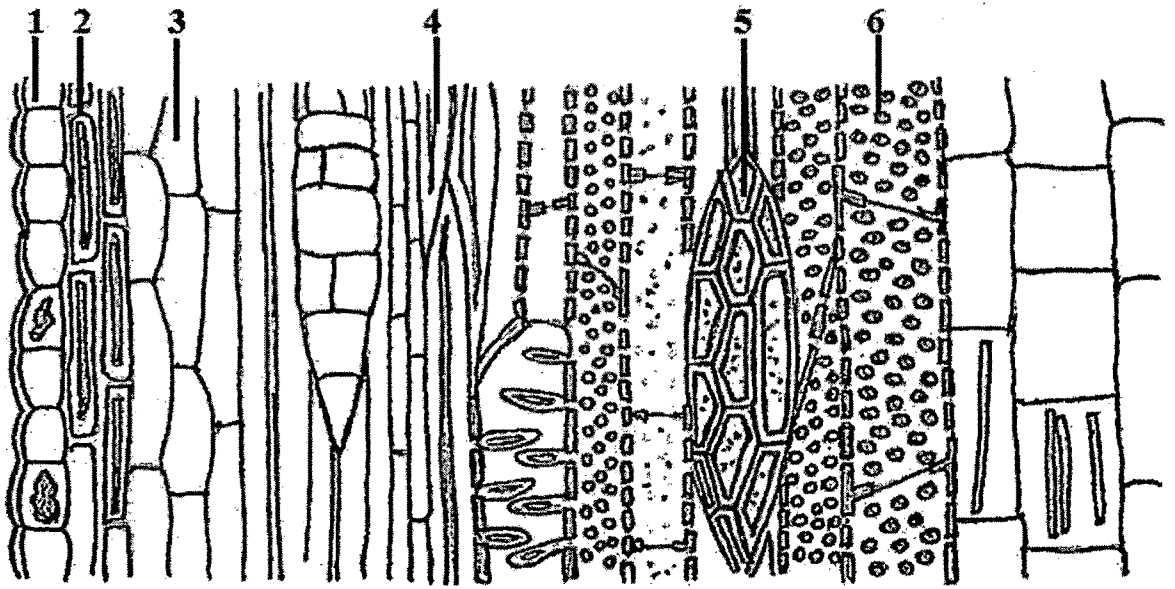
\*Each value is a mean of 3 reading



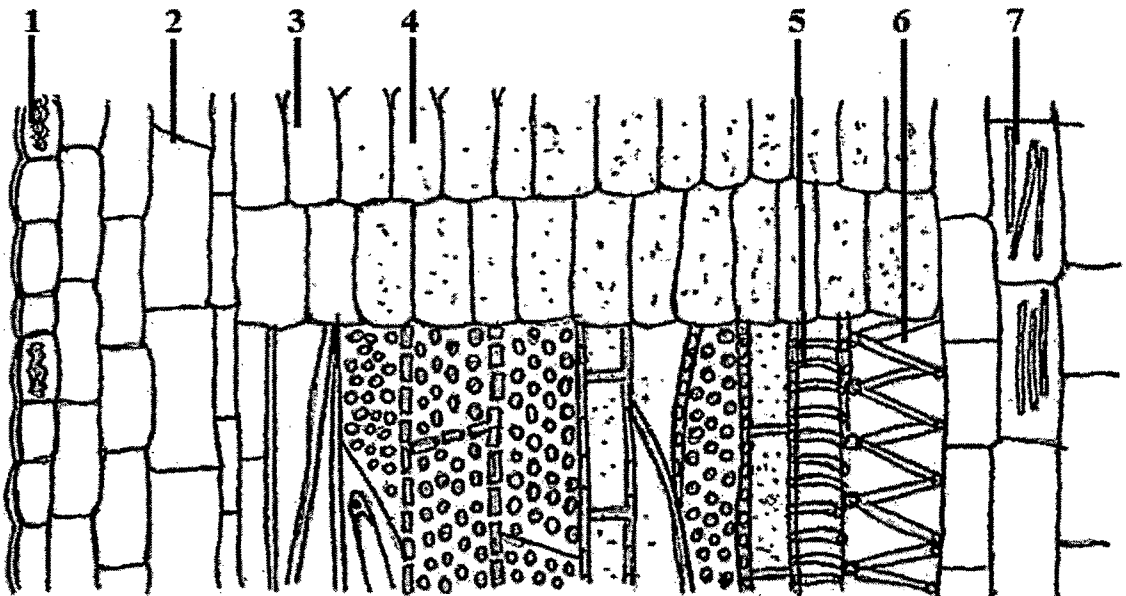
**Fig.28. *Peristrophe bicalyculata* leaf, T.S:** 1. Multicellular trichome, 2. Epidermis with cuticle, 3. collenchyma, 4. Palisade, 5. Chlorenchyma, 6. Spongy parenchyma, 7. Xylem, 8. Parenchyma with deposition of globules.



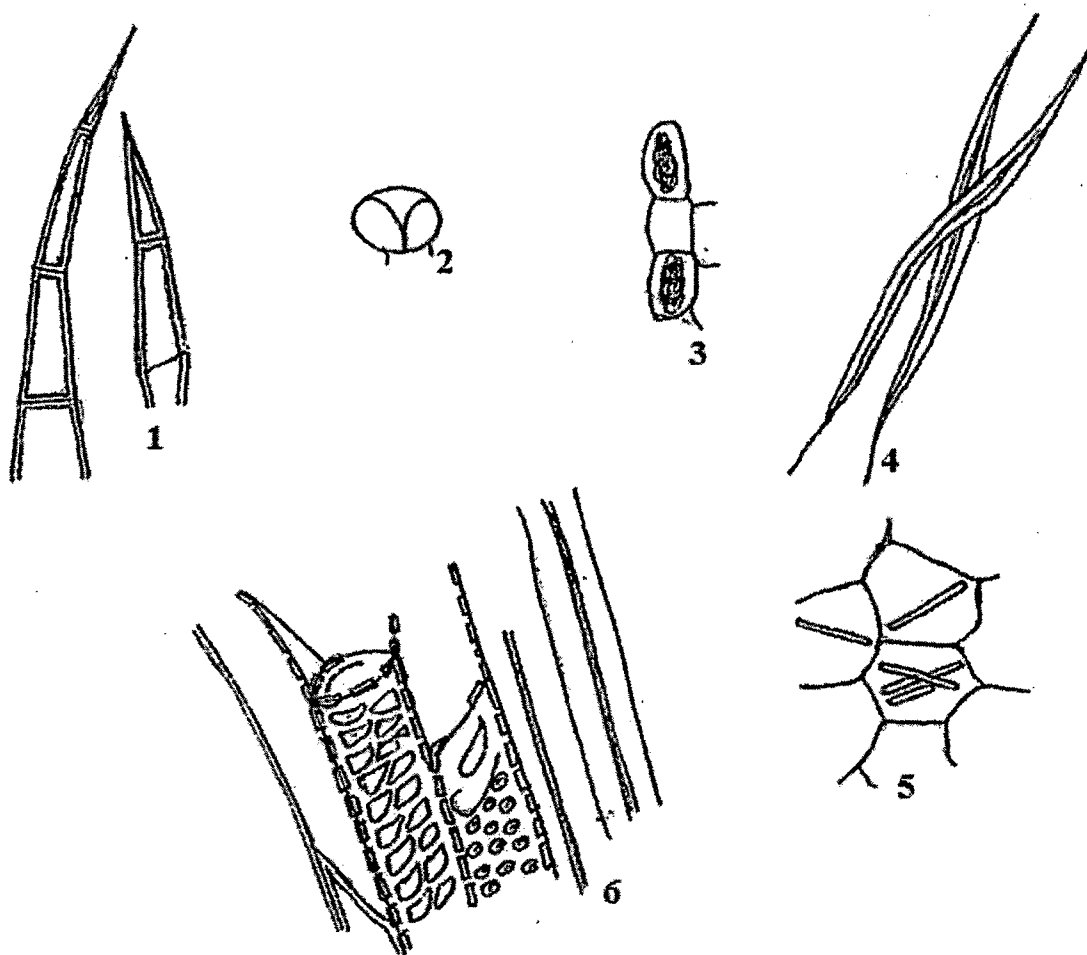
**Fig.29. *Peristrophe bicalyculata* stem, T.S:** 1. Epidermal cell with cuticle, 2.Cystolith, 3.Collenchyma, 4.Chlorenchyma, 5.Parenchyma with brown deposits, 6. Endodermis, 7. Phloem, 8. Xylem, 9. Vessel, 10. Acicular crystals, 11.Pith.



**Fig.30. *Peristrophe bicalyculata* stem, T.L.S:** 1. Epidermal cell cystolith, 2. Collenchyma, 3. Cortex, 4. Fibres, 5. . Xylem rays, 6. Vessel.



**Fig.31. *Peristrophe bicalyculata* stem, R.L.S:** 1. Epidermal cell with cystolith, 2. Cortex, 3. Phloem rays, 4. Xylem rays, 5. Annular vessel, 6. Spiral vessel, 7. Pith.



**Fig.32. *Peristrophe bicalyculata* powder:** 1. Multicellular uniseriate trichomes, 2. Glandular trichome, 3. Epidermal cells with cystolith, 4. Acicular fibers, 5. Vessels adjoining fibers, 6. Parenchyma with crystals.



### **3.e. *Polycarpea corymbosa* (L.) Lam. (Caryophyllaceae)**

**Synonyms:** *Achyranthes corymbosa* B. Heyne ex Wall.

**Sanskrit:** Bhisatta, Okharadi, Parpata, Tadagamritikodbhava.

**Vernacular Names:**

Hindi : Buggyale, Zutniokhad.

Kannada : Paade Mullu Gida, Poude Mullu, Poude Mullu Gida.

Malayalam : Katu-Mailosina.

Marathi : Koyap, Maitosin.

Tamil : Nilaisedachi, Cataicciver, Pallippuntu.

Telugu : Bommasari, Rajuma.

#### **Distribution and habitat**

An annual herb, generally erect and often very strict, often branched from the base but sometimes with simple main stems, 5–38 cm. tall, internodes covered with more or less curled white hairs when young, often glabrescent when older. Leaves opposite or apparently whorled, narrowly linear, acute and then terminating in a hair-like bristle 1 mm. long and caducous, 5–30 mm. long, 0.5–1 mm. broad, 1-nerved, glabrous or nearly so when mature. Inflorescences terminal to branches, of many-flowered cymes, differing greatly in density (see below). Flowers silvery white to pink or purplish red. Sepals lanceolate, acuminate, 2.5–3.75 mm. long, glabrous. Petals about 1.25 mm. long, slightly emarginate or erose. Stamens usually 5, 0.75 mm. long. Ovary with 5–13 ovules; style 0.25 mm. long or even less.

#### **Morphological features**

An annual herb, generally erect and often very strict, often branched from the base but sometimes with simple main stems, 5–38 cm. tall, internodes covered with more or less curled white hairs when young, often glabrescent when older. Leaves opposite or apparently whorled, narrowly linear, acute and then terminating in a hair-like bristle 1 mm. long and caducous, 5–30 mm. long, 0.5–1 mm. broad, 1-nerved, glabrous or nearly so when mature. Inflorescences terminal to branches, of many-flowered cymes, differing greatly in density (see below). Flowers silvery white to pink or purplish red. Sepals lanceolate, acuminate, 2.5–3.75 mm. long, glabrous. Petals about 1.25 mm. long, slightly emarginate or erose. Stamens usually 5, 0.75 mm. long. Ovary with 5–13 ovules; style 0.25 mm. long or even less.

### **Medicinal uses**

The plant used for the treatment of inflammation, jaundice, urinary disorders and other kidney problems. The plant also showed the antioxidant activity(Singh *et.al.*, 2009).

### **Previous Phytochemical reports**

The whole plant revealed the presence of alkaloid, catechin, coumarin, flavonoid, tannin, saponin, steroid,phenol, glycoside, terpenoid and xanthoprotein(Nishanthini and Mohan , 2013). Sterols like  $\alpha$ -1 barrigenol, camelliagenin A and stigmasterol have been isolated from this plant (Ghazanfar, 1994 ).

### **Previous pharmacognostic reports**

Very little data (only the T.S. of various parts) available of this plant (Jyothi *et.al.*, 2010) but there T.L.S and R.L.S has not been studied. So the plant has been subjected for a detailed study.

### **Materials and methods**

The plant material has been collected from Halol, Gujarat. Phytochemical analysis 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 plant is found to contain flavonoids such as apigenin, acacetin, 3'- OMe luteolin and 7,3-di OMe quercetin. The phenolic acids were vanillic, syringic, ferulic (*cis*- and *trans*-isomers). Mucilage amounted to 7.1% consisting of glucose and xylose. The plant also showed the presence of unidentified alkaloids and steroids.

#### **Pharmacognosy**

##### **Root : T.S (Fig.33)**

The T.S of the root was circular in outline with a large central woody region. The cork was poorly developed and consisted of 2 to 3 rows of rectangular thin walled cells. The secondary cortex was made up of 5 to 8 rows of comparatively large polygonal compactly packed, thin walled parenchymatous cells wherein the

isolated vascular bundles laid. The vascular bundles were circular and separated by two to three rows of thin walled radially elongated parenchyma, some of them with reddish brown tanniniferous contents. The vascular bundles were made of outer 2 to 4 layers of phloem followed by 8 to 9 layers of xylem and devoid of medullary rays. The central portion of root were dominated by wood. The phloem were 4 to 6 layers thick and made up of usual elements of phloem. Wood consisted of vessels, tracheids, fibers and rays. Mostly vessels were found solitary and dominated in the centre. Medullary rays were thin walled and radially elongated. Vessels were many distributed throughout or occurring singly or in groups. Vessels and tracheids were simple and bordered pitted. Protoxylem showed annular and spiral thickening.

**Root : T.L.S (Fig.34)**

Cork cells appeared thin walled rectangular. Parenchyma showed the deposition of reddish brown tanniniferous contents. Fibers were thin walled. xylem rays were thin walled and pitted. The vessels had thick bordered pits with slit like openings.

**Root : R.L.S (Fig.35)**

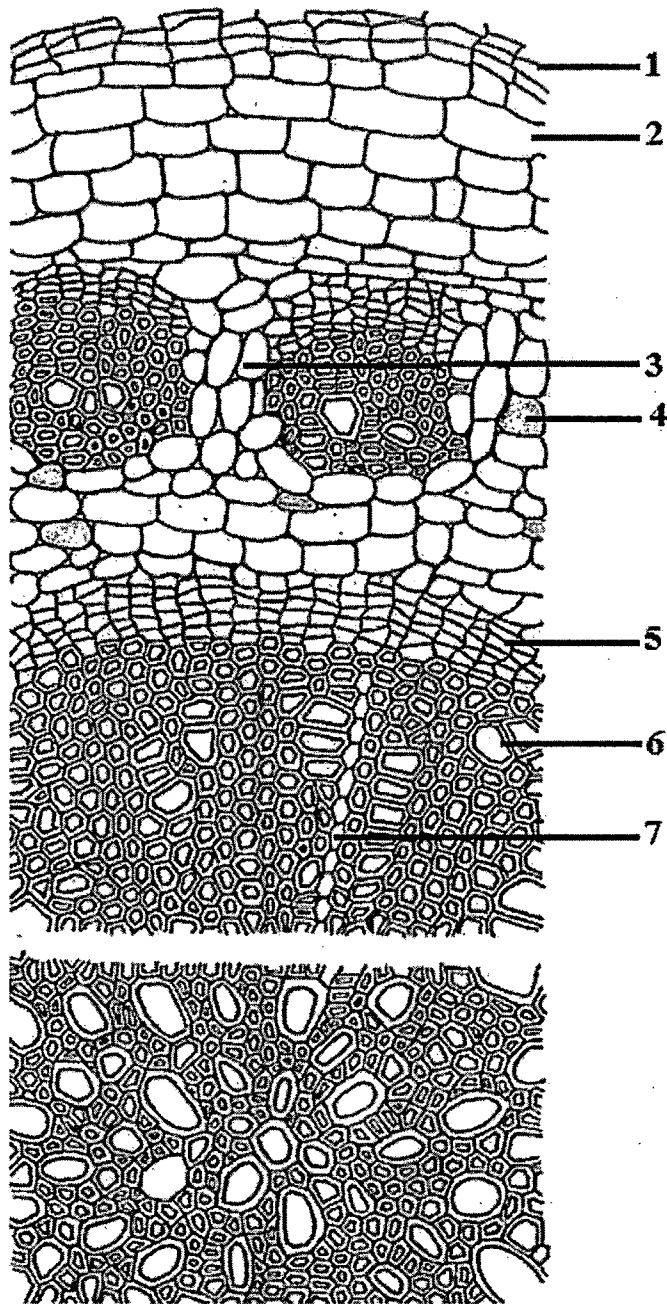
Cork cells appeared thin walled rectangular. The cortical parenchyma were polygonal in shape. Ray cells appeared rectangular. The xylem rays were thin walled. Protoxylem showed annular thickening.

**Leaf micromorphology**

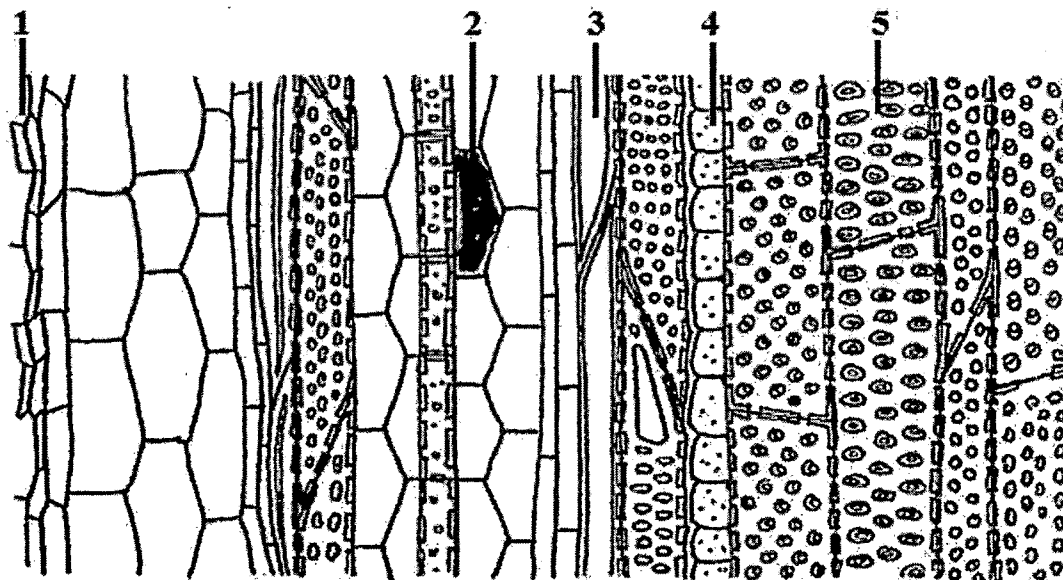
The stomata were of anomocytic type. The stomatal index was 7-10.

**Leaf : T.S (Fig.36)**

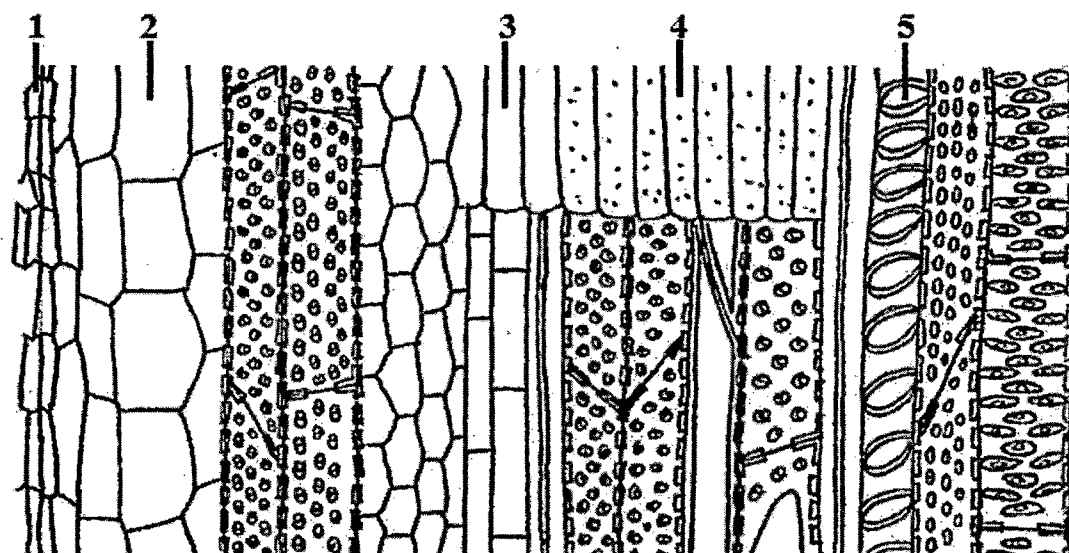
The T.S. of **midrib** showed the large polygonal shaped epidermal cells covered by thick cuticle. The outer walls were thick and papillose. The stomata occurred on both the surfaces and the guard-cells were accompanied by subsidiary cells. The guard-cells were elevated and the front cavity was placed in a depression formed by the papillose outer epidermal walls. The cells of the ground tissues on the both sides were elongated and the lateral walls were wavy, the cells were compactly arranged and some of them were filled with chlorophyll, reddish brown contents and rosette crystals. The central vascular bundle were capped by thick walled sclerenchymatous sheets on both sides. The cells outside the sclerenchymatous sheets contained chlorophyll concentrated towards inner sides. The trichomes were found present on both lower and upper epidermis in traces.



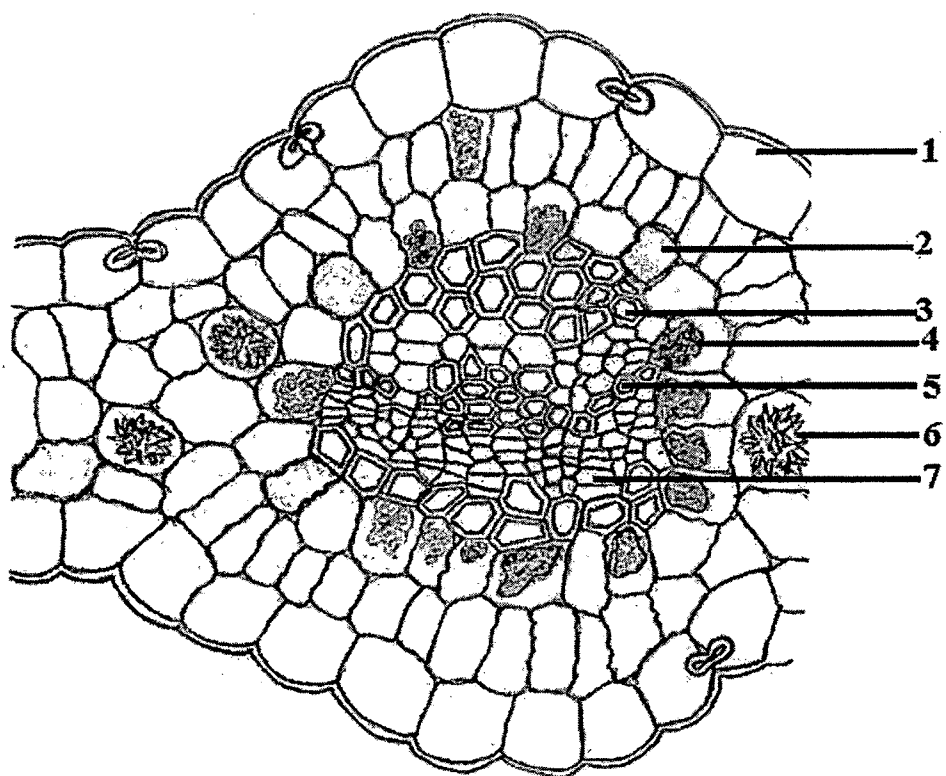
**Fig.33.** *Polycarpea corymbosa* root, T.S: 1. Cork, 2. Cortex, 3. Thin walled parenchyma separating two vascular bundles, 4. Parenchyma with reddish brown contents, 5. Phloem, 6. Vessels 7. Xylem rays.



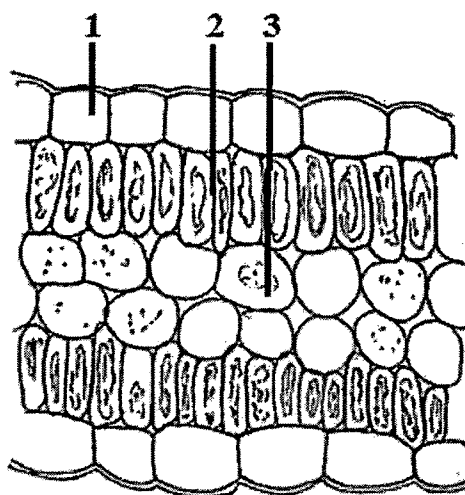
**Fig.34. *Polycarpea corymbosa* root, T.L.S:**1. Cork, 2. Parenchyma with reddish brown contents, 3. Thin walled fiber, 4. Thin walled xylem rays, 5. Vessels with thick bordered pits.



**Fig.35. *Polycarpea corymbosa* root, R.L.S:**1. Cork, 2. Cortical parenchyma, 3. Phloem rays, 4. Xylem rays, 5. Vessels with annular thickenings.



**Fig.36. *Polycarpea corymbosa* leaf, T.S:** 1. Epidermis with thick cuticle, 2.Chlorenchyma, 3. Parenchyma with reddish brown contents, 4. Sclerenchyma, 5.Xylem, 6. Rosette crystal, 7. Phloem .



**Fig.36.a. *Polycarpea corymbosa* leaf lamina,T.S:** 1. Epidermis with thick cuticle, 2. Palisade cells, 3. Spongy parenchyma.

In the **lamina portion (Fig.36.a)** the epidermal cells were barrel shaped and with thick cuticle. Mesophyll was isobilateral consisted of palisade and spongy tissues. The palisade was single layered and was packed with chloroplasts. The spongy tissues contained loosely arranged parenchyma with intercellular spaces.

**Stem : T.S (Fig.37)**

The epidermis consisted of polygonal cells covered with a thick cuticle. The outer and inner walls of the cells were greatly thickened. The hypodermis consisted of one or two layers chlorenchyma. The cortex was 3 to 6 layered made up of thin walled tabular cells, many with deposition of reddish brown tanniferous contents. The pericycle was a continuous ring made up of small rectangular thick walled sclerenchyma with few thick walled parenchyma. The phloem was a narrow zone consisting of usual elements of phloem. Secondary xylem consisted of vessels, tracheids, fibres and wood parenchyma. Fibre tracheids were found in patches. The xylem rays were absent. Vessels were boarded pitted. Reticulate thickened vessels and tracheids were also common here. The centre pith was made up of thick walled parenchyma arranged loosely.

**Stem : T.L.S (Fig.38)**

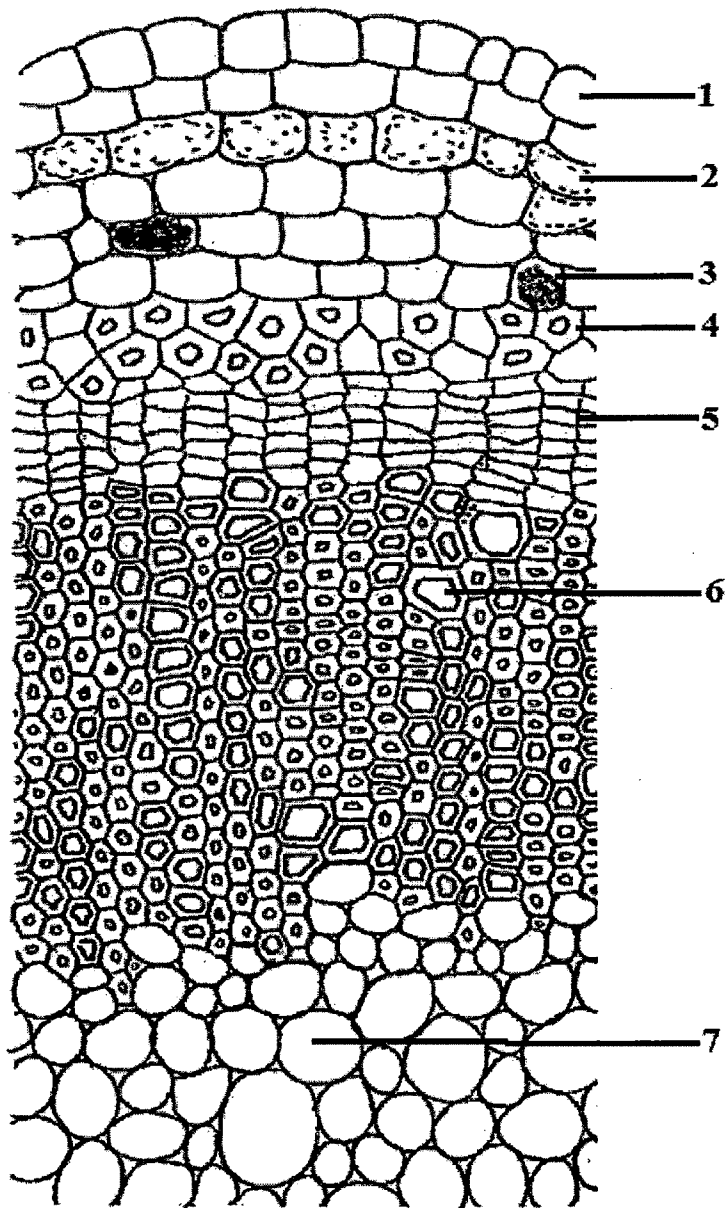
Epidermal cells were barrel shaped with thick cuticle. The cells of chlorenchyma were upright polygonal adjoining a cells containing reddish brown contents. Fibers were straight and narrow lumened. The phloem cells were also showed the deposition of reddish brown contents. Vessels were boarded pitted and pits arranged alternately followed by reticulate thickened vessels.

**Stem : R.L.S (Fig.39)**

Epidermal cells showed outer and inner thickened walls. Scleranchyma were thick walled. The fibre tracheids were with narrow lumen and simple pitted. The protoxylem showed spiral thickened vessels. The pith cells appeared large rectangular and were thick walled.

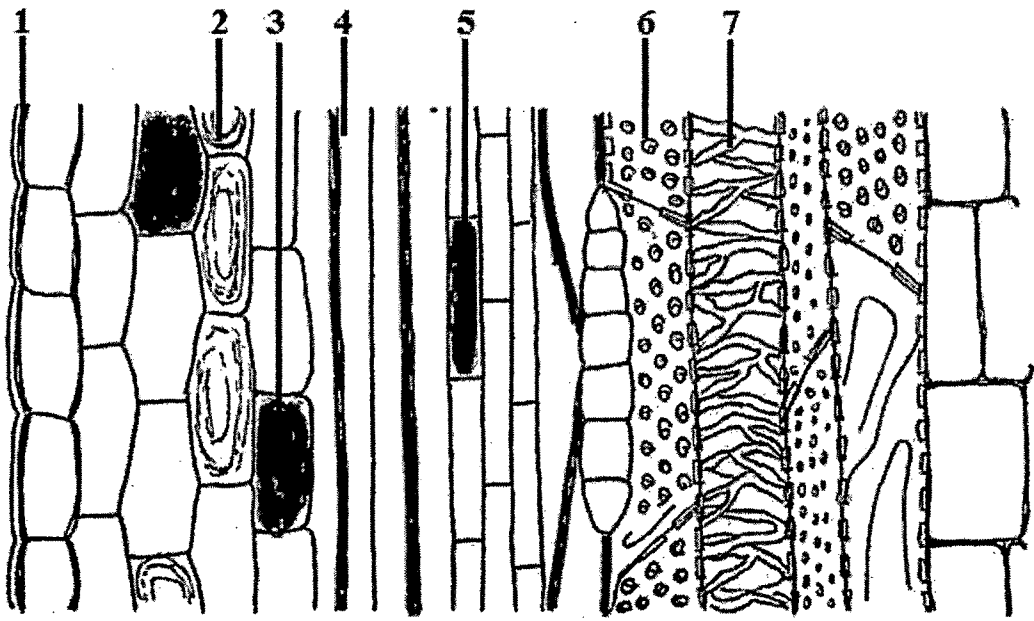
**Powder study (Fig.40)**

The components present in the powder were parenchyma containing reddish brown contents, branched trichomes, rosette crystals, thick walled narrow lumen fibers and boarded pitted vessel. The branched trichomes found in powder are derived from the flowers present in the material. Leaves contained very rare branched trichomes.

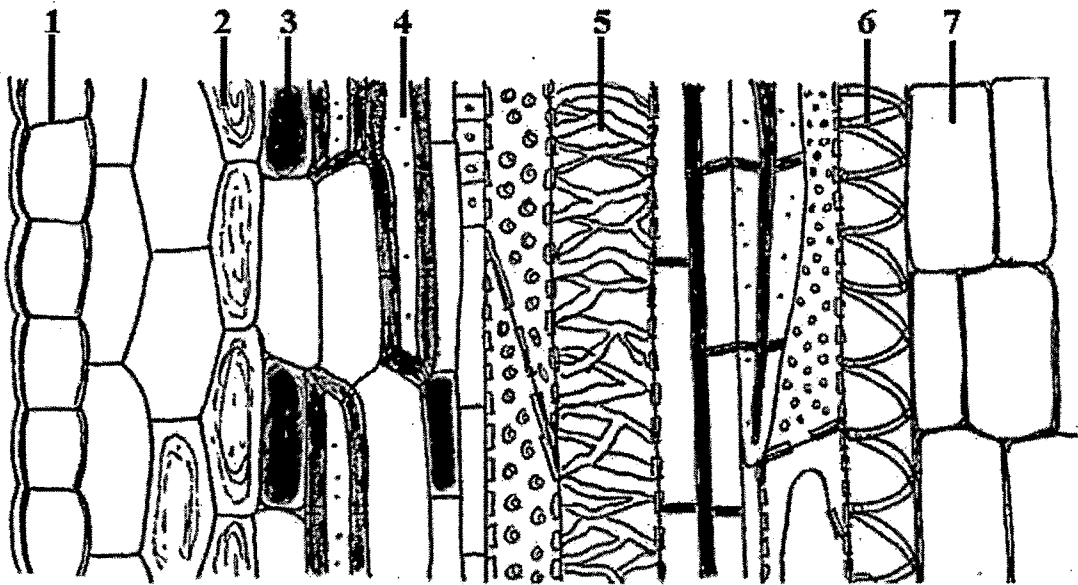


**Fig.37.** *Polycarpea corymbosa*stem, T.S: 1. Epidermis with thick cuticle, 2.Chlorenchyma, 3. Parenchyma with reddish brown contents, 4. Sclerenchyma, 5.Phloem, 6. vessel, 7. Pith.

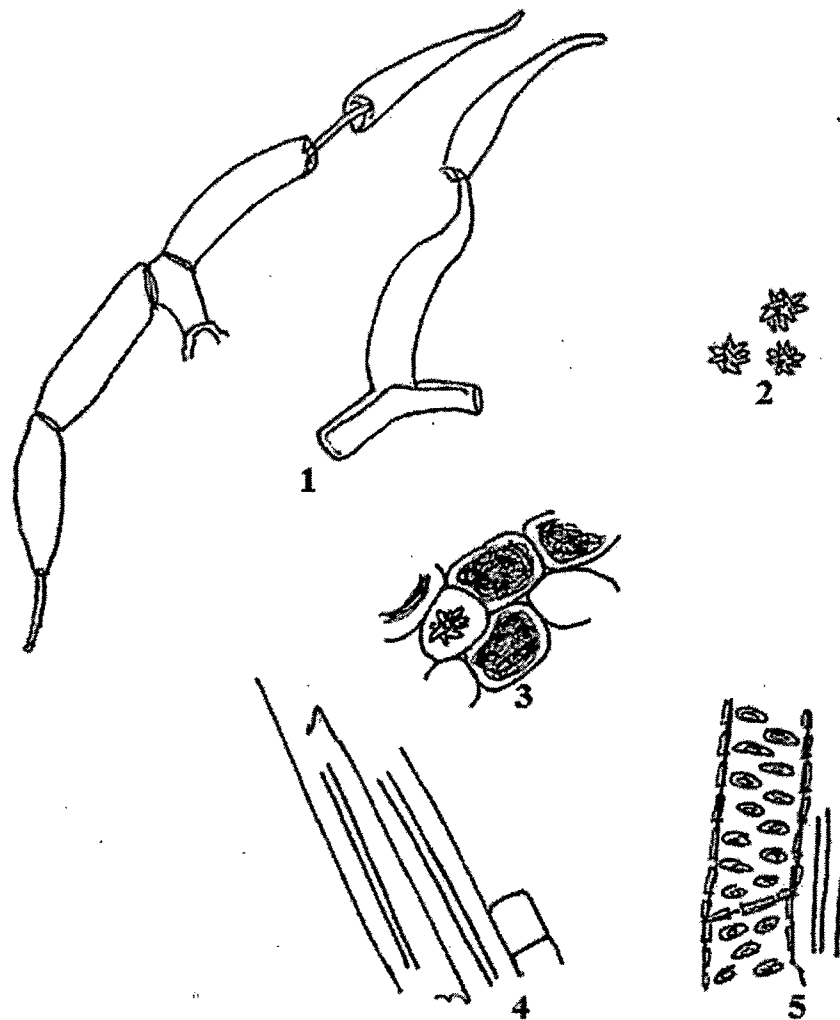




**Fig.38. *Polycarpea corymbosa* stem, T.L.S:** 1. Epidermis with thick cuticle, 2.Chlorenchyma, 3. Parenchyma with reddish brown contents, 4. Fiber , 5. phloem with deposition of reddish brown contents, 6. Boarded pitted vessel, 7. Reticulate thickened vessel, 8.Pith.



**Fig.39. *Polycarpea corymbosa* stem, R.L.S:** 1.Epidermis with thick cuticle, 2.Chlorenchyma, 3. Parenchyma with reddish brown contents, 4. Sclerenchyma, 5.Reticulate thickened vessel, 6. Spiral vessel, 7. Pith.



**Fig.40. *Polycarpea corymbosa* powder study:** 1. Branched trichomes, 2. Rosette crystals, 3. Parenchyma containing reddish brown contents, 4. Thick walled narrow lumened fibers 5. Bordered pitted vessel.

### **Distinguishing features**

#### **Pharmacognostic markers :**

##### **Root**

1. Parenchyma containing reddish brown contents.
2. Absence of rays.
3. Annular and spiral thickened vessels.

##### **Leaf**

1. Outer walls of epidermis were thick and papillose.
2. Anomocytic type of stomata.
3. Parenchyma containing reddish brown contents. .
4. Vascular bundle were capped by thick walled sclerenchymatous sheets.
5. Rosette crystals.

##### **Stem**

1. The outer and inner walls of the epidermal cells were greatly thickened.
2. The hypodermis was chlorenchymatous.
3. Parenchyma containing reddish brown contents.
4. Pericycle continuous and was sclerenchymatous.
5. Absence of rays.
6. Reticulate thickened vessels.
7. Pith parenchyma thick walled.

#### **Phytochemical markers**

1. Apigenin.
2. Acacetin.
3. 3'- OMe luteolin.
4. 7,3-di OMe quercetin.

**Physico-chemical analysis:**

**Table: 6.** Values obtained for the proximate analysis.

| Sr.No. | Parameter                   | Mean $\pm$ SD (%)* |                    |                  | Average (%) |
|--------|-----------------------------|--------------------|--------------------|------------------|-------------|
|        |                             | Summer             | Monsoon            | Winter           |             |
| 1.     | Total Ash Content           | 4.69 $\pm$ 0.27    | 4.92.86 $\pm$ 0.23 | 4.98 $\pm$ 0.19  | 4.86        |
| 2.     | Acid Insoluble Ash content  | 0.49 $\pm$ 0.07    | 0.42 $\pm$ 0.07    | 0.48 $\pm$ 0.09  | 0.46        |
| 3.     | Alcohol soluble extractives | 4.29 $\pm$ 0.23    | 3.92 $\pm$ 0.38    | 4.63 $\pm$ 0.09  | 4.28        |
| 4.     | Water soluble extractives   | 15.34 $\pm$ 0.14   | 15.02 $\pm$ 0.28   | 15.09 $\pm$ 0.20 | 15.15       |

\*Each value is a mean of 3 reading

### 3.f. *Rungia repens* (L.) Nees.( Acanthaceae )

**Sanskrit :** Parpata, Parpatha.

**Vernacular Names:**

Gujarati : Parpat.

Hindi : Kharmor, Kharmar.

Kannada : Kodagasaale Gida, Kodaga Saale Gida.

Marathi : Ghatipitpapada.

Tamil : Kodagasalai, Kotacuri, Cataikkaranti, Kotaculi, Kotakacalai, Maram.

Telugu : Palakavelli.

#### **Distribution and habitat**

The plant is a spreading decumbent herb found throughout India mostly as a weed in moist places. ( Gamble 1921, Saxena *et.al*, 1995).

#### **Morphological features.**

Stems usually decumbent, often rooting near the base, then erect, slender, subterete, glabrous or puberulous. Leaves upto 5 cm long, subsessile or shortly petiolate, oblong-lanceolate, acute, lineolate on both sides, glabrous or nearly so, base usually tapering, less commonly rounded and unequal-sided; main nerves about 6 pairs; petioles rarely reaching upto 0.4 cm long. Flowers in erect terminal usually pubescent, imperfectly 1-sided spikes, upto 8 cm long; bracts broadly elliptic, pubescent, cuspidate, much imbricate, the margins thinly scarious, ciliate; bracteoles linear-lanceolate, acute, with scarious margins, minutely pubescent. Calyx puberulous, divided to the base; segments lanceolate-subulate. Corolla 2-lipped, 1.5 cm long; upper lip oblong, emarginated; lower lip shortly 3-lobed. Stamens 2; anthers 2-celled, the cells often superpose, the lower cell often with a white basal appendage, lower anther cells with a white appendage at the base. Disk annular or shortly copular. Ovary 2-celled; ovules 2 in each cell; style filiform; stigma minutely 2-fid. Capsules ovoid-oblong, acute, compressed, with scarious faces and hard edges, pubescent. Seeds suborbicular, rugose with concentric furrows, pale-brown.

#### **Action and uses:**

The herb is used in the treatment of cough and fever and is also credited with vermifugal and diuretic properties (Trease and Evans, 2002). Fresh, bruised leaves are mixed with castor oil and applied to scalp to cure *Tinea capitis* , a scaly fungoid

infection, usually occurring amongst children ( Anon.1996, Anon.1999, Kirtikar and Basu, 1994, Nadkarni and Nadkarni,2002).The juice of the leaves is considered cooling and aperients, and is given to children suffering from smallpox. Bruised leaves are applied to relieve pain and reduce swelling. In Bihar, the roots are used as a febrifuge by the tribal population (Anon.1996,Trease and Evans, 2002). There are also reports that it is of use as diuretic and vermifuge (Anon.1999).

#### **Previous Phytochemical reports**

The hydroalcoholic extract of leaf is found to contain phytosterols, terpenes, tannins, flavonoids and carbohydrates(Swain *et al.*,2008).Investigation on the flavonoid pigments in ivory-white and pale yellow flowers showed the presence of luteolin and chrysoeriol (3'-O-methyluteolin) and their glucosides ( Sankar *et.al*,1964) . Flowers with deep yellow tubular portion and bluish pink spots contain isosalipurposide (2'-glucosyloxy-4,4',6'-trihydroxychalcone), luteolin and its 7-glucoside. The bluish pink colour is due to the presence of delphinidin-3,5-diglucoside(Seshadri and Vydeeswaran,1972).

#### **Previous pharmacognostic reports:**

Very little data available on pharmacognosy of this plant. Only T.S of various parts of the plant has been studied (Jyothi *et.al.*, 2010).

In the present work roots, stem and leaves of this plant has been subjected to phytochemical and pharmacognostic studies.

#### **Materials and methods**

The plant material was collected from Timbi in outskirts of Baroda, Gujarat. Phytochemical analysis 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 plant is found to contain flavonoids such as quercetin, 7'- methoxy quercetin and kaempferol. The phenolic acids were vanillic, syringic, ferulic (*cis*- and *trans*-isomers), gentisic and protocatechuic acids. The flowers of the plant contained the anthocyanin delphinidin , flavonol kaempferol, and its 4'-OMe

derivative, while the phenolic acids located were vanillic, *p*-coumaric and *p*-hydroxybenzoic acids. Mucilage amounted to 7.3% consisting of ribose and xylose. The plant also showed the presence of unidentified alkaloids and steroids.

### **Pharmacognosy**

#### **Root : T.S (Fig.41)**

The T.S of the root was circular in outline with a large central woody region. The cork was poorly developed and consisted of 2 to 4 rows of rectangular to slightly tangentially elongated thick walled cells. The secondary cortex was very narrow consisting of two zones, outer zone of two to four rows of comparatively large polygonal compactly packed, thin walled parenchymatous cells and inner small rectangular cells; many of which were found filled with rosette crystals(6-8 $\mu$ m). Endodermis was prominent and thick walled. Some of the phloem parenchyma cells at the outer region contained rosette crystals. Wood consisted of vessels, tracheids, fibers and rays. Outer wood was dominated by vessels and tracheids while inner by wood fibers. Medullary rays were thin walled and radially elongated. Vessels were many distributed throughout or occurring singly or in groups.

#### **Root : T.L.S (Fig.42)**

Cork cells appeared rectangular with wavy walls. The medullary rays were compressed spindle shaped and thin walled and simple pitted. Fibers showed scanty pits on their walls. The vessels had 3-4 rows of alternate bordered pits with slit like openings.

#### **Root : R.L.S (Fig.43)**

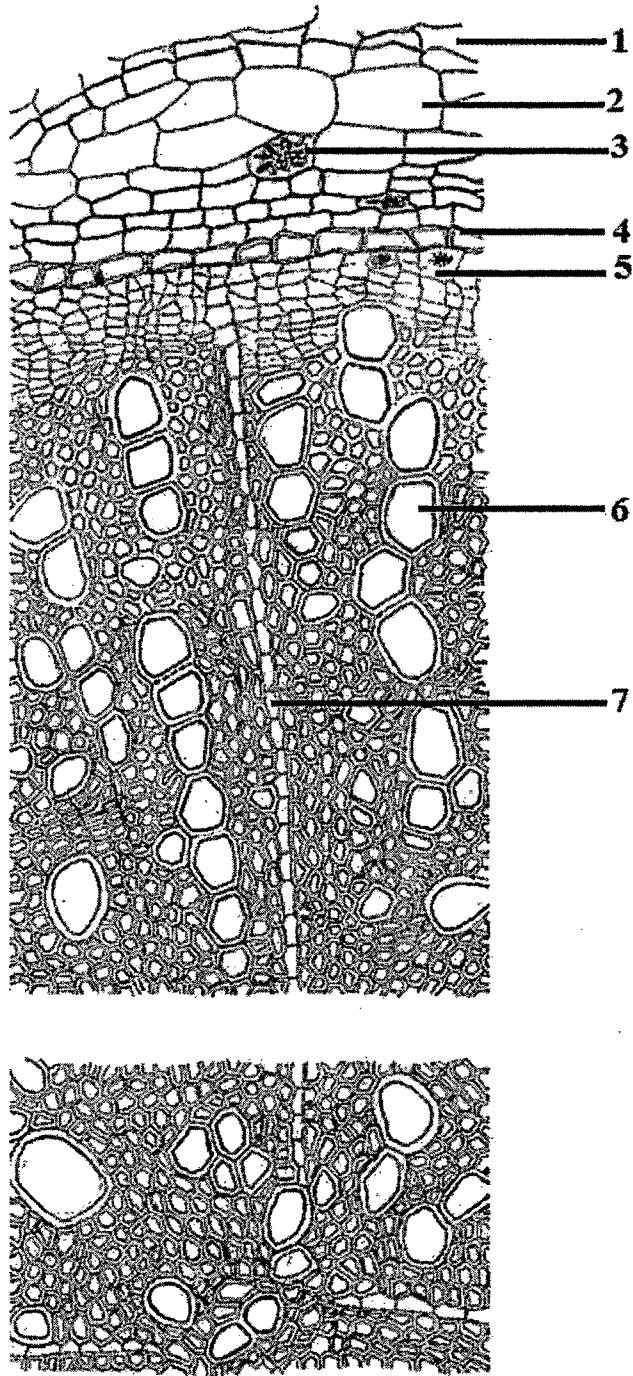
The phloem parenchyma contained rosette crystals. Ray cells appeared rectangular. The xylem rays were pitted. Here the vessels were more in number and in a groups surrounded by fiber tracheids from both the sides.

### **Leaf micromorphology**

The stomata were of diacytic type. The stomatal index was 16-18. The trichome index was 9-12. The trichomes were thick-walled unicellular as well as multicellular uniseriate showing broad basal cell, blunt tip and the warty walls. Unicellular and glandular trichomes were rare.

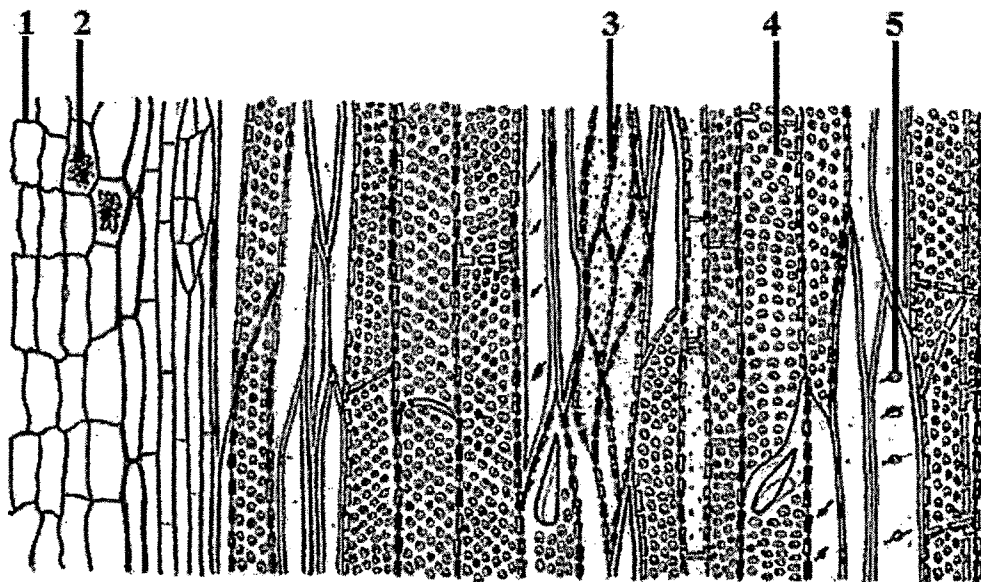
#### **Leaf : T.S (Fig.44)**

The **midrib portion** was characterized by a concave bulge on the upper side and hemispherical bulge on the lower side. The epidermal cells were polygonal in

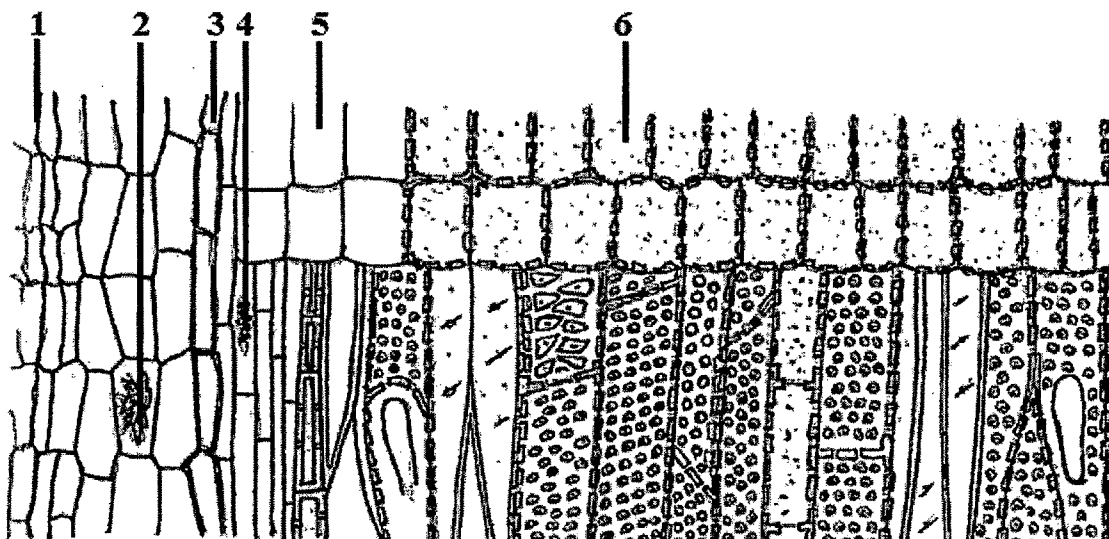


**Fig.41. *Rungia repens* root, T.S :** 1. Cork, 2. large polygonal Parenchyma, 3. Parenchyma with rosette crystals, 4. Endodermis, 5. Phloem with rosette crystals, 6. Vessels 7. Xylem rays.





**Fig.42.** *Rungia repens* root, T.L.S:1. Cork cells with wavy walls, 2. Rosette crystal, 3.Compressed spindle shaped medullary rays,4. Vessels with alternate bordered pits, 5. Fibers with scanty pits.



**Fig.43.** *Rungia repens* root, R.L.S:1. Cork cells, 2. Rosette crystal, 3.Thick walled endodermis, 4. Phloem with rosette crystals, 5. Phloem rays, 6. Xylem rays.

shape covered by thick cuticle. Some of the cells were showed the deposition of globules. The hypodermis on both upper and lower regions made up of angular collenchyma. The ground tissue was parenchymatous and the cells on the upper side were rounded to hexagonal and compactly arranged. The vascular bundle was crescent shaped with 4-7 rows of tracheids, followed by 5-7 layers of phloem. Below this were large parenchymatous cells. The trichomes were found present on both lower and upper epidermis.

In the **lamina portion** the epidermal cells were barrel shaped and some of the cells showed deposition of globules. The mesophyll consisted of palisade and spongy tissues. The palisade was single layered and was finely packed with chloroplasts. The spongy tissues contained loosely arranged parenchyma with intercellular spaces.

**Stem : T.S (Fig.45)**

The epidermis consisted of polygonal cells covered with a thin cuticle and contained thick-walled unicellular as well as multicellular uniseriate trichomes with broad basal cells. The tip of the trichomes were blunt and the walls were warty. Cystoliths were found present in epidermis at regular intervals. Some of the epidermal cells showed the deposition of globules. The hypodermis was 3-4 layered made up of lamellar collenchyma. The cortex consisted of 5-7 layers of large elongated parenchyma, few of these cells were typical pitted sclerenchymatous and found in a pairs wherein the adjoining walls were straight. The endodermis was single layered and side walls of the cells showed the casparian thickenings. The pericycle was a discontinuous ring made up of small rectangular thick walled cells. The phloem was a narrow zone consisting of usual elements of phloem. Secondary xylem consisted of vessels, tracheids, fibres and xylem rays. Tracheids and fibre layers were intercepted by the continues rows of vessels. The xylem rays were uniseriate to triseriate. The protoxylem in the Pith region was surrounded by the thin walled pitted parenchyma. The central region of pith contained compactly arranged isodiametric thin walled parenchyma.

**Stem : T.L.S (Fig.46)**

Epidermal cells were rectangular bearing trichomes and cystolith followed by thick walled collenchyma. The cells of endodermis were polygonal in shape and the side walls of which were thickened. The phloem cells were rectangular in shape. Xylem rays were pitted and biseriate. The fibre tracheids were with broad lumen. The

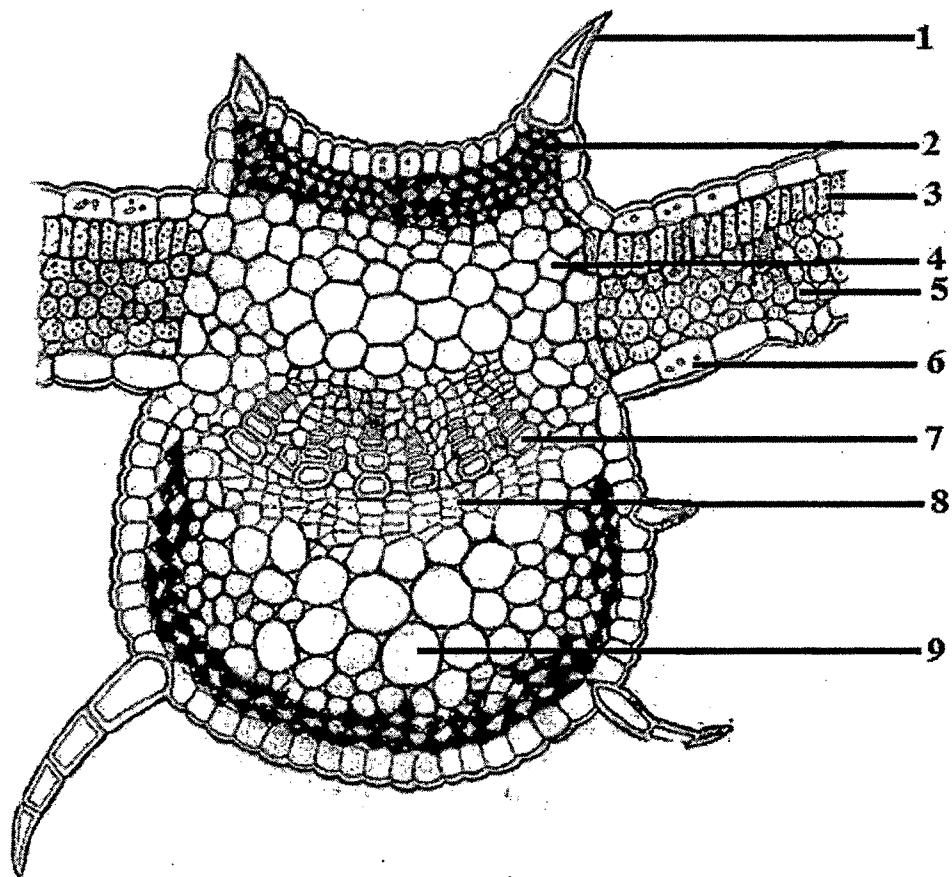
pith cells appeared squarish to rectangular, thin walled and some of these cells showed pits on their walls. Protoxylem was very prominent with spiral thickening.

**Stem : R.L.S (Fig.47)**

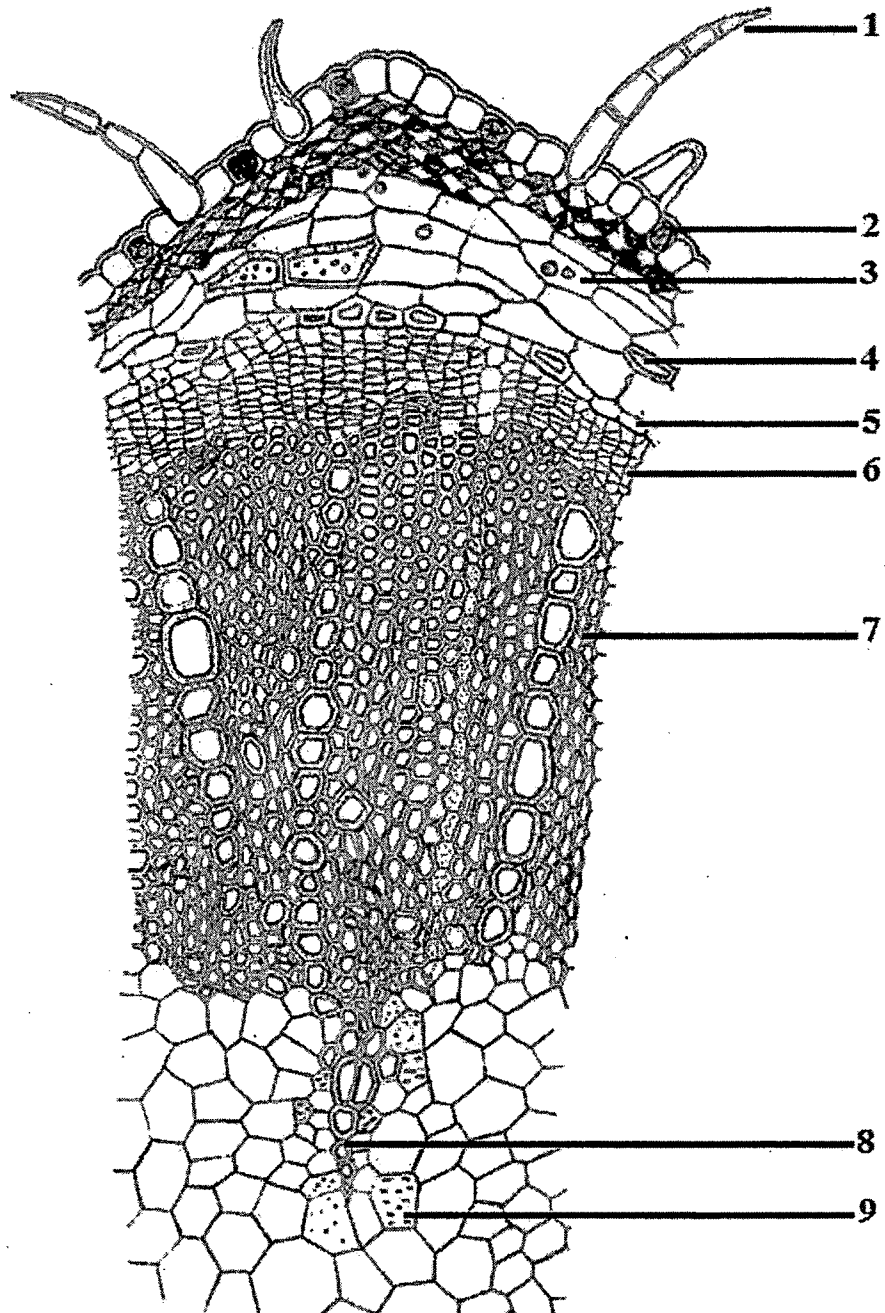
Cortical sclerenchyma were polygonal, thick walled and with simple pits, lying one above the another in a rack. Xylem rays also were polygonal and thick walled. The walls of vessels were with bordered pits and also showed annular thickening.

**Powder study (Fig.48)**

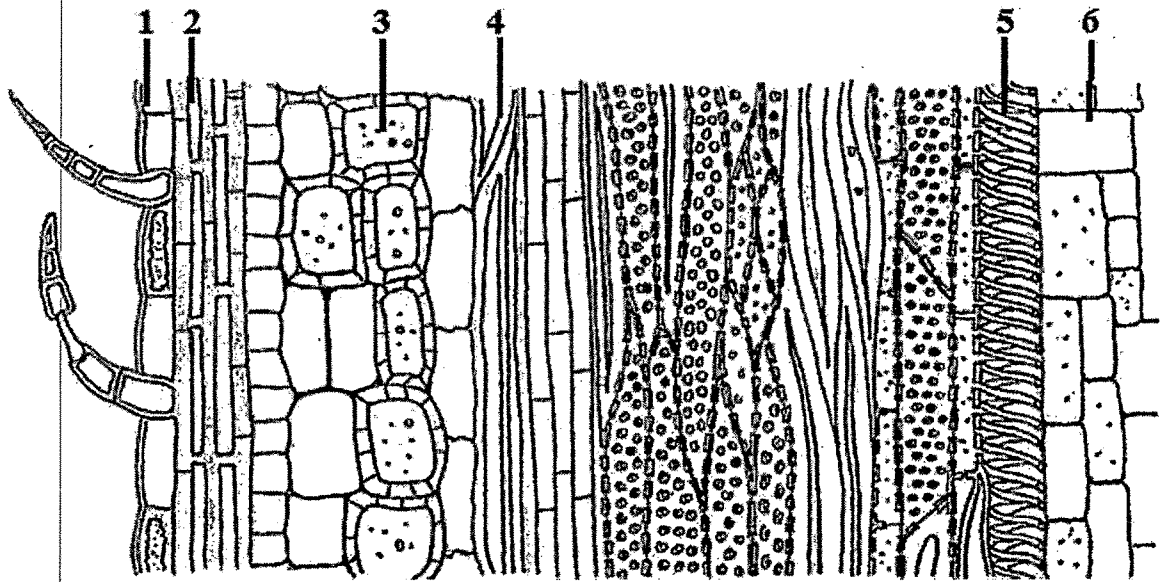
The components present in the powder were thick-walled unicellular as well as multicellular uniseriate trichomes having broad basal cell and warty walls with blunt tip, fragments of parenchyma with diacytic stomata ,sclereids, thin walled cortical parenchyma, broad lumen fiber, ray parenchyma, fiber tracheids, boarded pitted and spiral vessel.



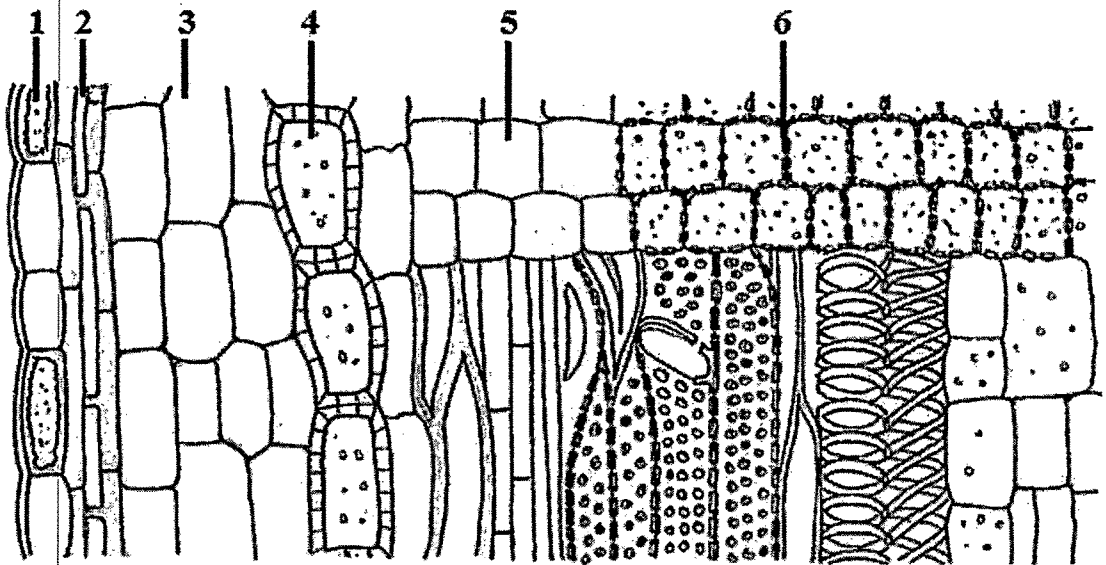
**Fig.44.***Rungia repens* leaf, T.S: 1. Trichome with broad basal cell, 2. lamellar collenchyma, 3. Palisade, 4. Hexagonal parenchyma, 5. Spongy parenchyma, 6. Epidermis with deposition of globules, 7. Xylem, 8. Phloem, 9. Ground tissue.



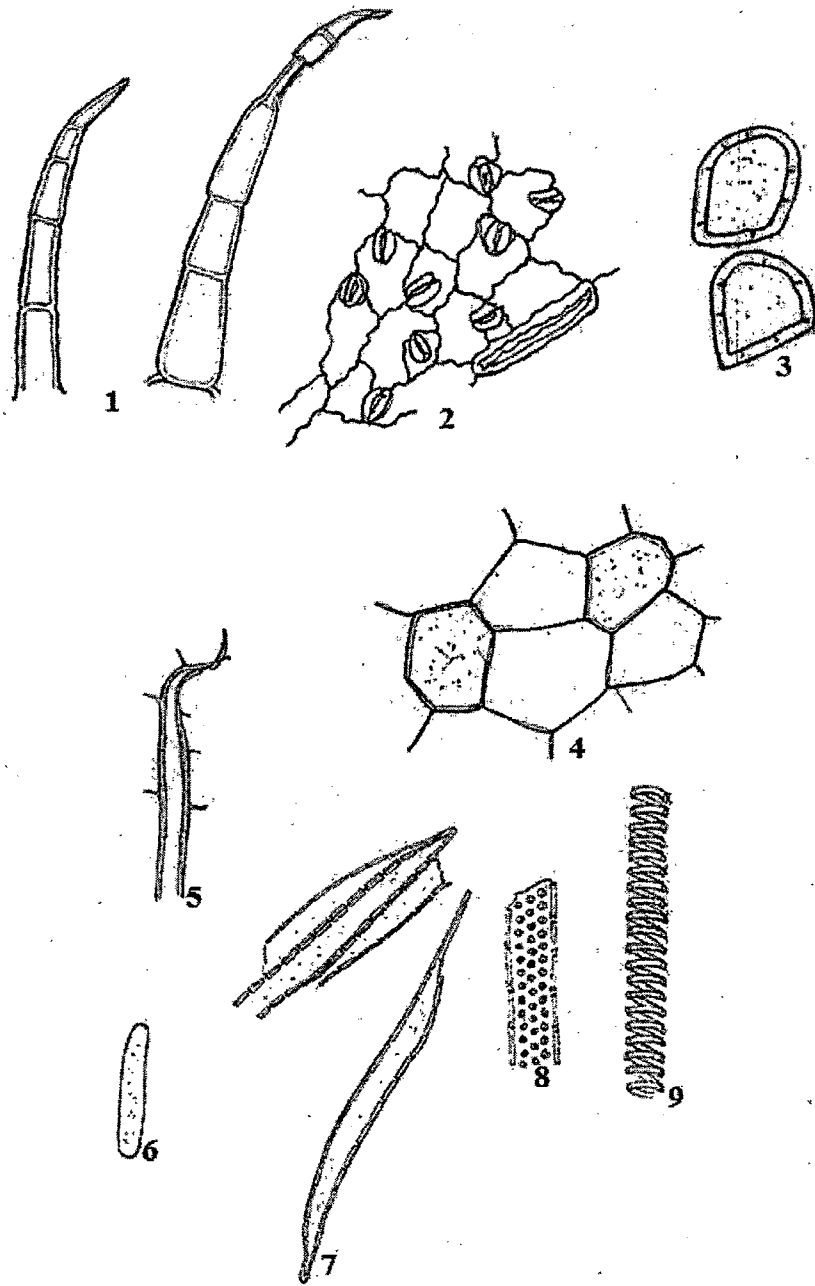
**Fig.45.***Rungia repens* stem, T.S: 1. Multicellular uniseriate trichome 2.Epidermal cell with cystolith, 3. Globules in parenchyma cells. 4. Sclerenchyma, 5. Pericycle, 6.Phloem, 7. xylem, 8. Protoxylem, 9.Pitted parenchyma.



**Fig.46.** *Rungia repens* stem, T.L.S: 1.Epidermal cell with cystolith and hair, 2.collenchyma. 3. Sclerenchyma, 4. Pericyclic fibers, 5. Protoxylem, 6. Pitted parenchyma.



**Fig.47.** *Rungia repens* stem, R.L.S:1.Epidermal cell with Cystolith, 2.Collenchyma, 3.Parenchyma, 4. Sclerenchyma, 5.Phloem rays, 6.Pitted xylem rays.



**Fig.48.***Rungia repens* , powder study: 1.Trichomes, 2. Epidermal fragment with stomata, 3.Sclereids, 4.Cortical parenchyma, 5. Broad lumened fiber,6. Ray parenchyma, 7.Fiber tracheids, 8. Boarded pitted vessel, 9. Spiral vessel.

### Distinguishing features

#### Pharmacognostic markers :

##### Root

4. Cortical parenchyma cells bearing rosette crystals.
5. Thick walled prominent endodermis.
6. Phloem parenchyma cells containing rosette crystals.

##### Leaf

6. Deposition of cystoliths and globules in the epidermis.
7. Diacytic type of stomata.
8. Thick-walled unicellular as well as multicellular uniseriate trichomes with broad basal cell, blunt tip and warty walls.

##### Stem

8. The epidermal cells showed the deposition of globules.
9. Thick-walled unicellular as well as multicellular uniseriate trichomes with broad basal cell, blunt tip and warty walls.
10. Hypodermis 3-4 layered of lamellar collenchyma.
11. Pitted schlerenchyma in a pairs wherein the adjoining walls were straight

#### Phytochemical markers

1. Kaempferol.
2. Quercetin.
3. 7'- methoxy quercetin.
4. 4'-OMe kaempferol.
5. Ferulic (*cis*- and *trans*-isomers) acid.

#### Physico-chemical analysis:

**Table:7.** Values obtained for the proximate analysis.

| Sr.No. | Parameter                   | Mean $\pm$ SD (%)* |                  |                  | Average (%) |
|--------|-----------------------------|--------------------|------------------|------------------|-------------|
|        |                             | Summer             | Monsoon          | Winter           |             |
| 1.     | Total Ash Content           | 12.28 $\pm$ 0.33   | 12.86 $\pm$ 0.06 | 12.32 $\pm$ 0.29 | 12.49       |
| 2.     | Acid Insoluble Ash content  | 0.98 $\pm$ 0.05    | 1.04 $\pm$ 0.04  | 0.92 $\pm$ 0.1   | 0.98        |
| 3.     | Alcohol soluble extractives | 14.47 $\pm$ 0.83   | 13.62 $\pm$ 0.91 | 13.66 $\pm$ 0.89 | 13.92       |
| 4.     | Water soluble extractives   | 18.46 $\pm$ 0.42   | 18.33 $\pm$ 0.34 | 18.30 $\pm$ 0.30 | 18.36       |

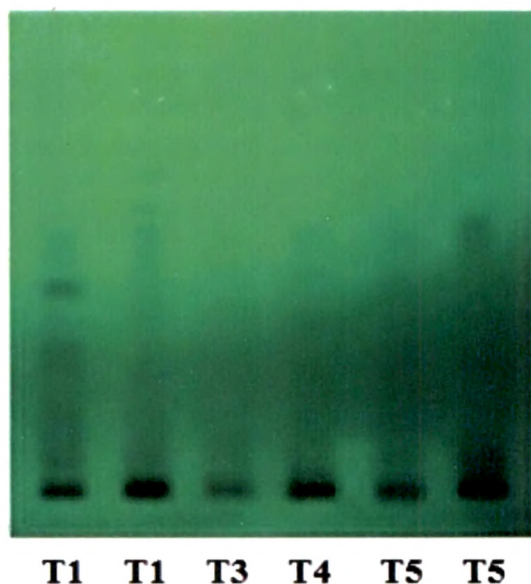
\*Each value is a mean of 3 reading



### 3.g. HPTLC fingerprinting and Physo-chemical analysis of *Fumaria parviflora* and its substitutes/adulterants

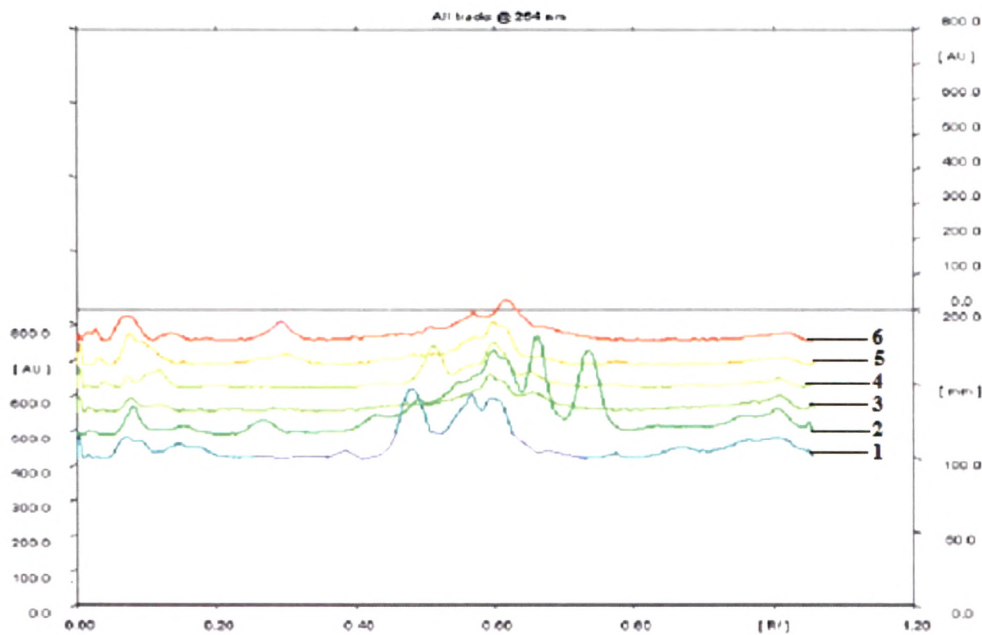
#### HPTLC fingerprinting

**Figure 49.a :** HPTLC chromatogram of *Fumaria parviflora* and its substitutes/adulterants. (UV 254 nm).



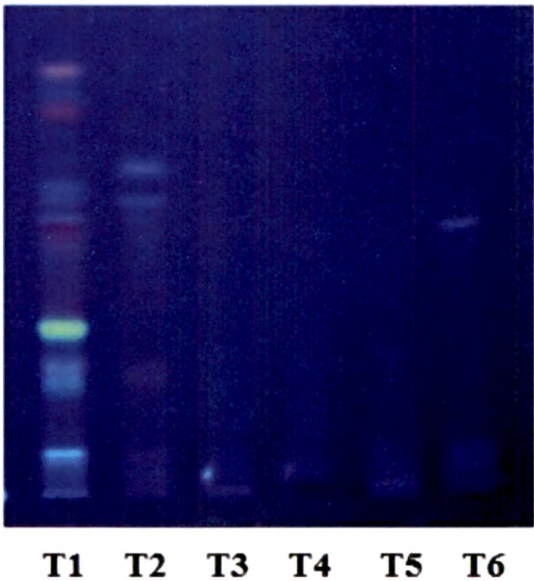
(a).T1-*Fumaria parviflora*, T2- *Justicia procumbens*,T3-*Rungia repens*,T4-*Polycarpea corymbosa*, T5-*Peristrophe bicalyculata* ,T6-*Oldenlandia corymbosa*.

**Figure 49.b:** HPTLC chromatogram of *Fumaria parviflora* and its substitutes/adulterants.



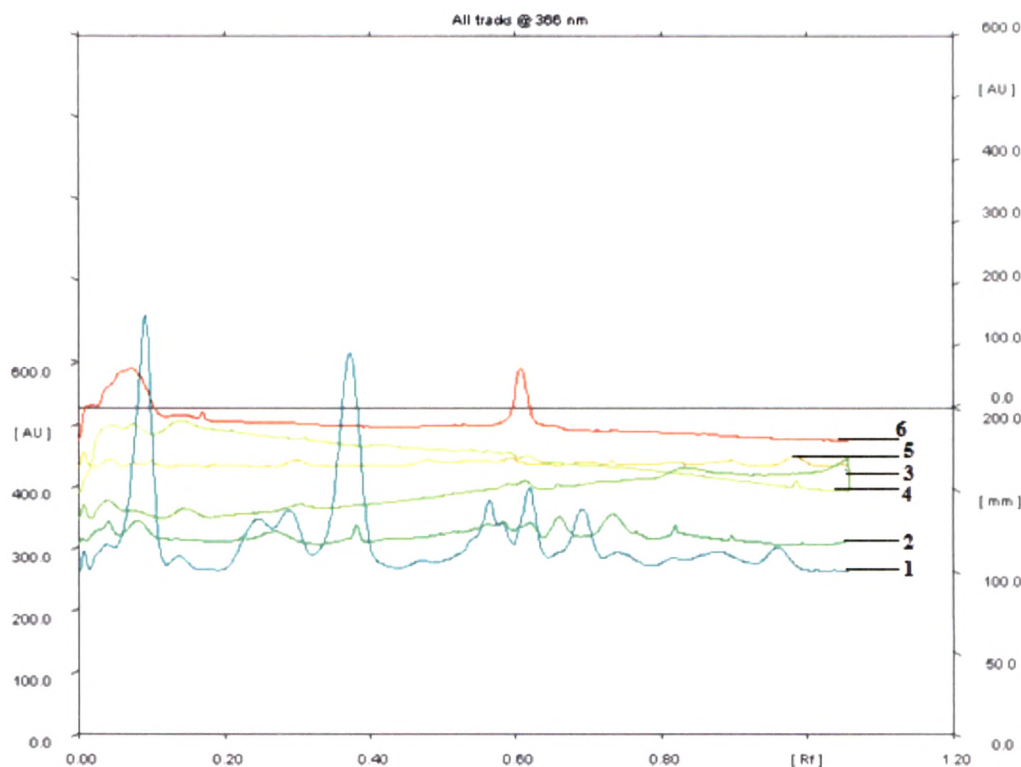
(b).1-*Fumaria parviflora*, 2-*Justicia procumbens*,3-*Rungia repens*,4-*Polycarpea corymbosa*, 5-*Peristrophe bicalyculata* ,6-*Oldenlandia corymbosa*.

**Figure 50.a:** HPTLC chromatogram of *Fumaria parviflora* and its substitutes/adulterants (UV 366 nm).



(a).T1-*Fumaria parviflora*, T2-*Justicia procumbens*,T3-*Rungia repens*,T4-*Polycarpea corymbosa*, T5-*Peristrophe bicalyculata* ,T6-*Oldenlandia corymbosa*.

**Figure 50.b:** HPTLC chromatogram of *Fumaria parviflora* and its substitutes/adulterants (UV 366 nm).



(b).1-*Fumaria parviflora*, 2-*Justicia procumbens*,3-*Rungia repens*,4-*Polycarpea corymbosa*, 5-*Peristrophe bicalyculata* ,6-*Oldenlandia corymbosa*.

HPTLC profile of *Fumaria parviflora* showed the presence of 13 peaks when observed under UV 254 nm (fig.49.b) and 15 peaks when observed under UV 366 nm (fig.50.b). There were 3 major peaks found under UV 254 nm at  $R_f$  0.48,  $R_f$  0.56 and  $R_f$  0.59 while 2 under UV 366 nm at  $R_f$  0.09 and  $R_f$  0.37. The *Justicia procumbens* showed the presence of 14 peaks and *Rungia repens* 8 peaks while *Polycarpea corymbosa*, *Peristrophe bicalyculata* and *Oldenlandia corymbosa* showed the presence of 9 peaks when observed under UV 254 nm (fig.49.b) while under UV 366 nm (fig.50.b); *J. procumbens*, *R. repens*, *P. corymbosa*, *P. bicalyculata* and *O. corymbosa* showed the 12,9,7,5 and 3 peaks respectively.

HPTLC profile of *F. parviflora* and its substitute/adult observed under UV 254 nm (fig.49.b) showed that *J. procumbens* was similar in 3 peaks but differed in 11 peaks, *R. repens* was similar in 1 peak and differed in 6 peaks. *P. corymbosa*

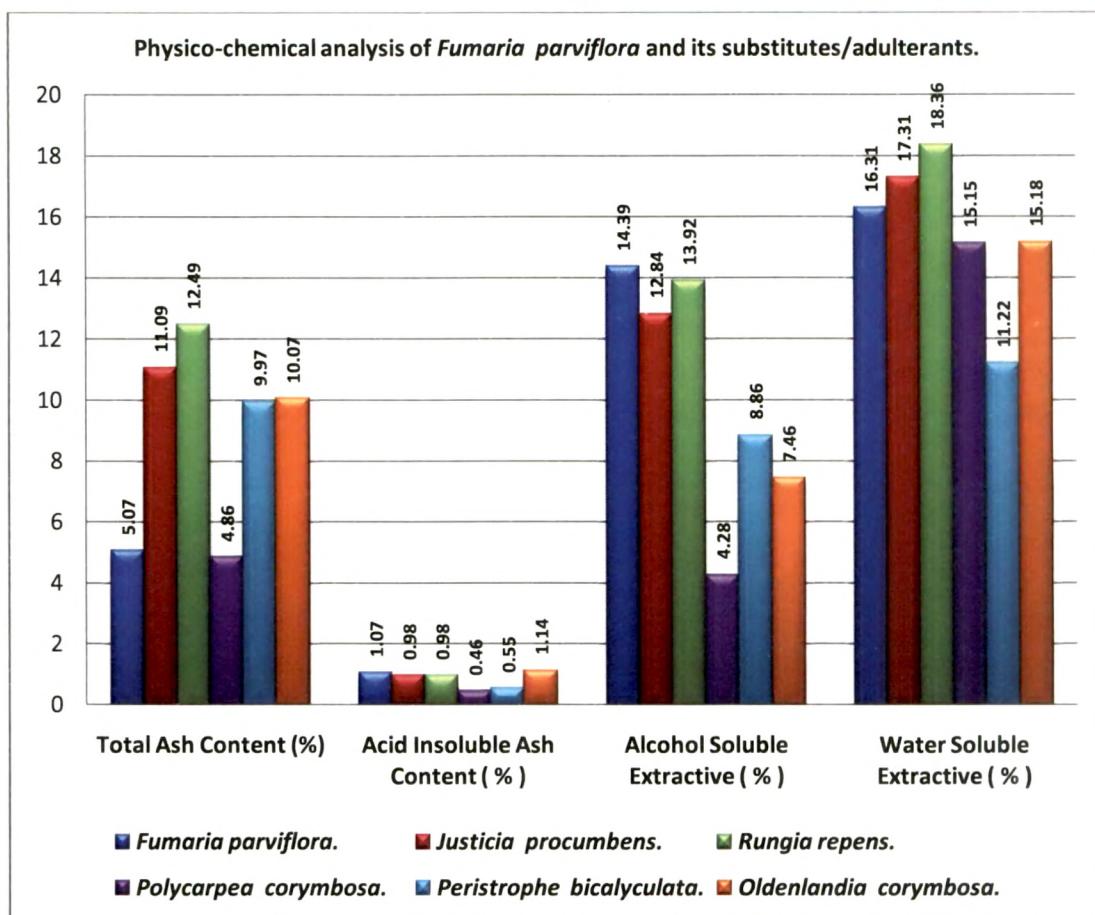
similar in 1 peaks but differed in 8 peaks while *P. bicalyculata* and *O. corymbosa* were similar in 2 peaks but differed in 7 peaks.

HPTLC profile of *F. parviflora* and its substitute/adultarunts observed under UV 366 nm (fig.50) showed that *J. procumbens* was similar in 4 peaks but differed in 8 peaks, *R.repens* was similar in 3 peaks and differed in 6 peaks. *P. corymbosa* similar in 2 peaks but differed in 5 peaks and *P. bicalyculata* similar in 2 peaks but differed in 3 peaks while *O.corymbosa* was not show any peaks similar to that of *F. parviflora* but differed in having 3 peaks.



## Physico-chemical analysis

Physico-chemical analysis of *Fumaria parviflora* and its substitutes/adulterants.



### Total ash content

Total Ash Content of *Fumaria parviflora* (5.07 %) along the material collected in different season does not show significant variation ( Table-2 ) while the closest value to the substitute/adulterant is *Polycarpea corymbosa* (4.86 %). Other substitute/adulterant have higher ash values i.e. *Peristrophe bicalyculata* (9.97 %), *Oldenlandia corymbosa* (10.07 %), *Justicia procumbens* (11.09 %) and *Rungia repens* (12.49 %).

### Acid insoluble ash content

Acid insoluble ash content of *Fumaria parviflora* (1.07 %) along the material collected in different season does not show significant variation ( Table-2 ) while the closest value to the substitute/adulterant in descending order is *Oldenlandia corymbosa* (1.14%), *Justicia procumbens* (0.98%), *Rungia repens* (0.98%), *Peristrophe bicalyculata* (0.55 %) and *Polycarpea corymbosa* (0.46 %).

Amongst all substitutes/adulterants of *Fumaria parviflora*, the *Polycarpea corymbosa* showed the closest value of total ash content which showed that the *P. corymbosa* was more close to *F. parviflora* as compared to other substitutes/adulterants of *F. parviflora*.

#### **Alcohol soluble extractive**

Alcohol soluble extractive value of *Fumaria parviflora* (14.39%) along the material collected in different season does not show significant variation ( Table-2) while the closest value to the substitute/adulterant was of *Rungia repens* ( 13.92%). The values of *Justicia procumbens*, *Peristrophe bicalyculata*, *Oldenlandia corymbosa* and *Polycarpea corymbosa* was found to be 12.84%, 8.86% , 7.46% and 4.28% respectively.

#### **Water soluble extractive**

Water soluble extractive value of *Fumaria parviflora* (16.31 %) along the material collected in different season does not show significant variation ( Table-2) while the closest value to the substitute/adulterant was of *Justicia procumbens* ( 17.34%), however the *Rungia repens* showed the maximum extraction (18.36%), while values of *Oldenlandia corymbosa*, *Polycarpea corymbosa* and *Peristrophe bicalyculata* was found to be 15.18 %, 15.15 % and 11.22 % respectively.