International Journal of
Science Inventions Today
www.ijsit.com
ISSN 2319-5436
Research Article

CYSTOLYTH AN INCREDIBLE JEWELS OF MEDICINAL PLANTS OF SOME FAMILIES-A SCIENTIFIC STUDY

Harisha C.R.*, KshitijChauhan, Anantakrushnapalei*****

**Head Pharmacognosy Lab IPGT & RA, Gujarat Ayurved University, Jamnagar.*

** * Ph.D., Scholar, Ayurvedic Pharmaceutical Sciences, IPGT & RA.*

**** Msc(Medicinal plants), Scholar, IPGT & RA, Gujarat Ayurved University, Jamnagar.*

ABSTRACT

The type, morphology, and distribution of Calcium oxalate and Calcium carbonate crystals in mature leaves of five species of five families were studied. All the studied species contain calcium carbonate crystals. Species with both calcium oxalate and calcium carbonate. The calcium oxalate crystals were mainly found as druses or prismatic crystals. Druses were located in the crystal cells of both mesophyll and bundle sheath, but prismatic crystals were found only in cells of the bundle sheath. All calcium carbonate cystolyths were located in the epidermal lithocysts, and the types of lithocysts were related to the number of epidermal layers.

Keywords: Calcium carbonate crystals, Cystolyth, Leaves, Pharmacognosy.

INTRODUCTION

The Calcium oxalate crystals are formed frequently in lower plants and aquatic plants.They are deposited generally on the plant outer surface or in the intercellular spaces. In many plant species calcium crystals are commonly formed under ordinaryconditions. These crystals are structural components in the leaves of many higher plant families.Their type and location are often used in plant taxonomic classification. Calcium oxalate is the most prominently deposited calcium salt. The crystals may occur in different plant organs and in various shapes, e.g. druses, prismatic crystals, raphides, styloides, and crystalands. However, Calcium carbonate crystals are found only in a few families such as Moraceae, Urticaceae, Cucurbitaceae, Cannabinaceae, Acanthaceae and in some of the Combrataceae and Boraginaceae. Well formedcystolyths are seen in the enlarged upper epidermal cells, dissolves in acid[4]. The cystolyths are structures combining wall material, including cellulose and callose, with calcium corbonate[5].In a preliminary investigation of the Moraceae, we found both calcium oxalate and carbonate crystals, which encouraged us to study the specific distribution of differently shaped calcium carbonate crystals in mature leaves of selected species from five different families.

MATERIALS AND METHODS

Collection:

Collection of five samples of five different families leaves were been made as per collection standards[6].

Morphology:

Leaves characters such as shape, size, base, margin, venation etc. are scientifically studied as per taxonomy[7].

Pharmacognostical evaluation:

Transverse sections:

Free hand transverse sections of five leaves through midrib were taken. Firststudied with distilled water then studied stained with phloroglucinol and conc. HCl, microphotographs are taken by using corlzeisstrinocular microscope attached with camera[8]. The acid-etching test was used to identify the chemical compositions of crystals[9].

.

Observation of Cystolyth:

For the observation of cystolyths, leaves studied through transverse sections and also through surface study at distilled water based mountings.

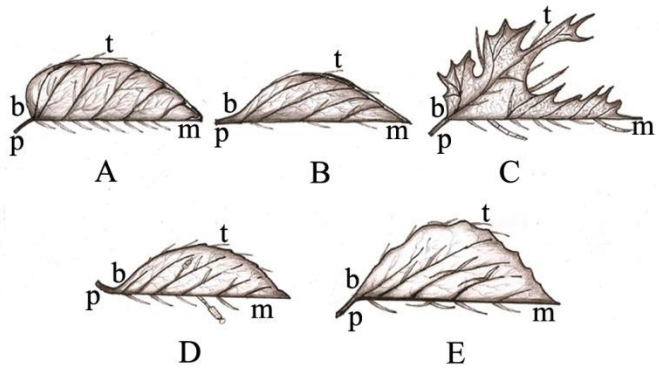
RESULT AND DISCUSION

Five species belonging to five families were selected for study (Table 1). They were collected during 2012. and identified. Morphological ray diagrams were scientifically represented in Plate No.1.

Sr. No.	Botanical Name	Sans. Name	Family
01	*Ficus benghalensis* L.	*Vata*	Moraceae
02	*Barleria prionities* L.	*Sahachara*	Acantaceae
03	*Momordica carentia* L.	*Karavelaka*	Cucurbitaceae
04	*Holoptelia intigrifolia* Pl.	*Chirabilwa*	Ulmaceae
05	*Cordia obliqua* W.	*Sleshmataka*	Boraginaceae

Table 1: Sample Description

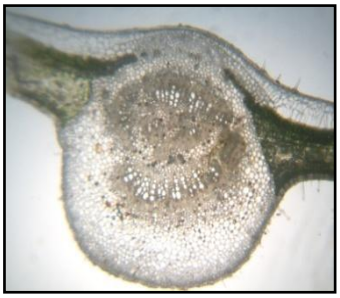
Plate no. 1



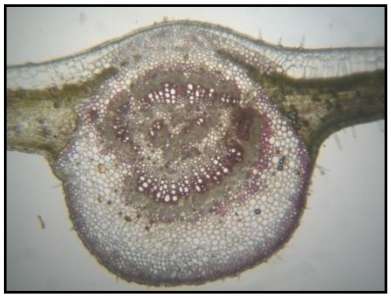
t-trichomes, m-midrib, p-petiole, b- base.
A- *F.bengalensis,* B- *B.prionitis*, C- *M.charantia*,
D- *H.integrifolia*, E-*C.obliqua.*

Plate No 2: Micro photographs

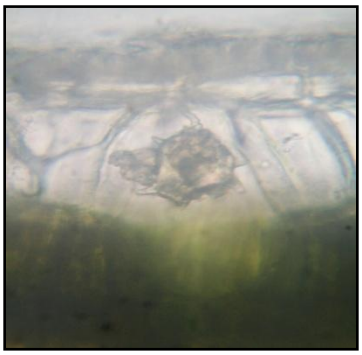
A. *Ficusbengalensis*



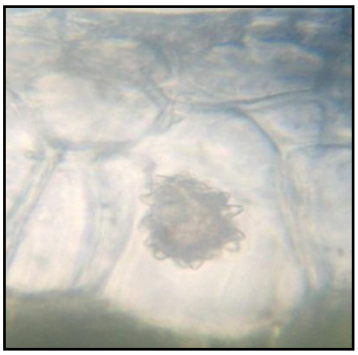
A.1-T.S Through midrib



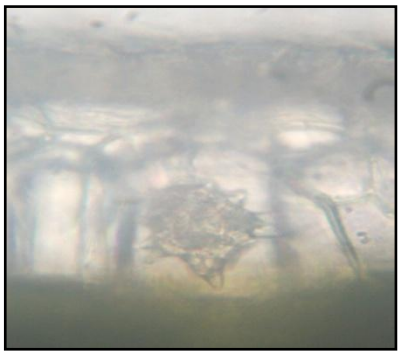
A.2-T.S Through midrib stained



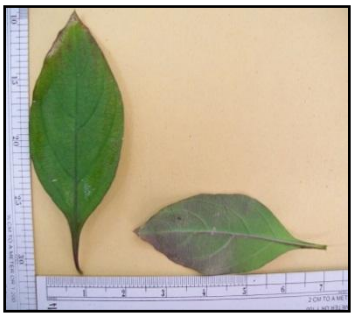
A.3-Cystolyth-upper epidermis



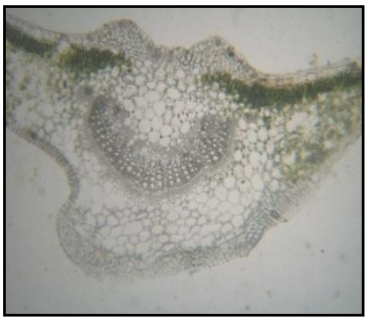
A.4- Cystolyth- sharp edges



A.5- Cystolyth- stalk

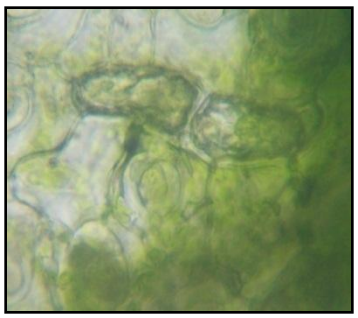


B.-*Barleriaprionitis*

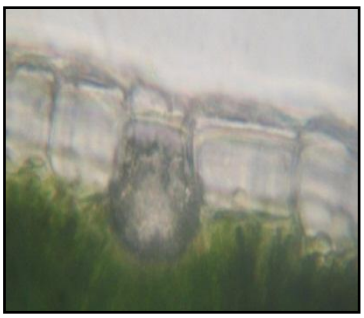


B.1-T.S Through midrib

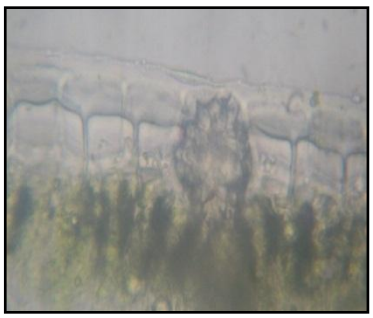
B.2-T.S Through midrib stained



B.3 Paired cystolyth

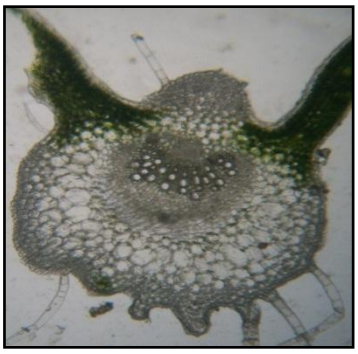


B.4-Cystolyth- lower epidermis

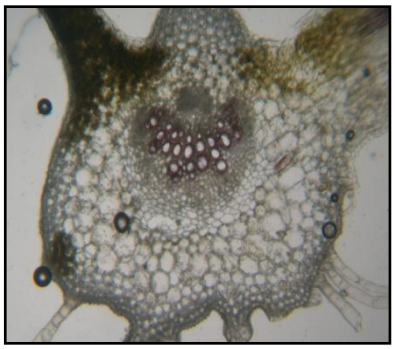


B.5- single cystolyth

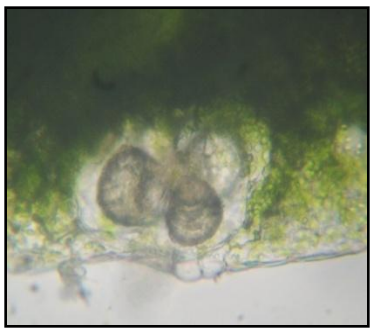
C- Momordica carentia



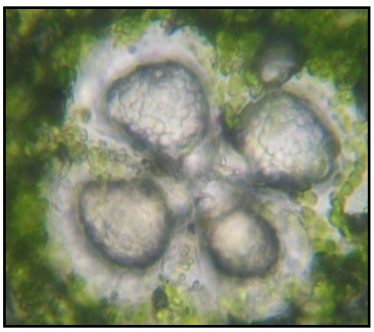
C.1-T.S Through midrib



C.2-T.S Through midrib stained



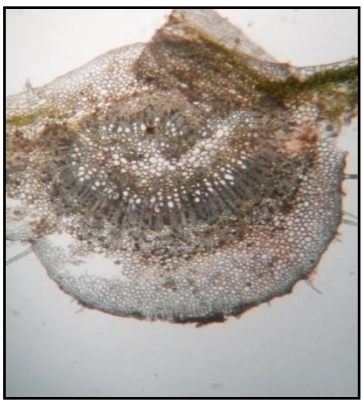
C.3- Tetra Cystolyth



C.4- Cystolyth without sharp edges

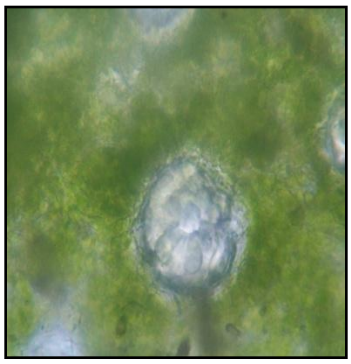
C.5- cystolyth at lower epidermis

D. *Holoptelia intigrifolia*

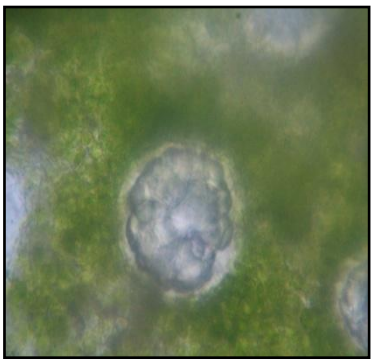


D.1-T.S Through midrib

D.2-T.S Through midrib stained



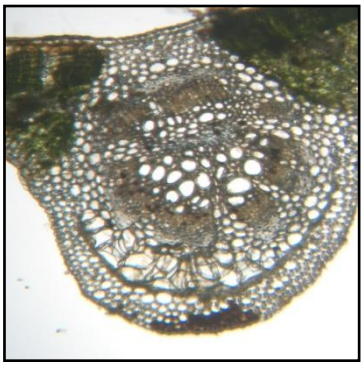
D.3- Single circular cystolyth



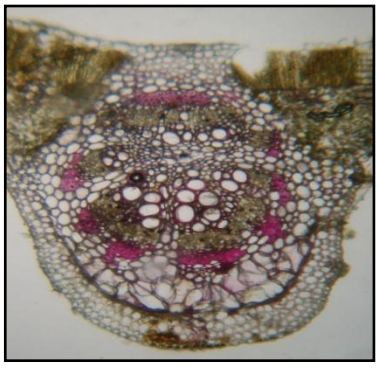
D.4- Cystolyth blunt surface

D.5- Cystolyth with stalk

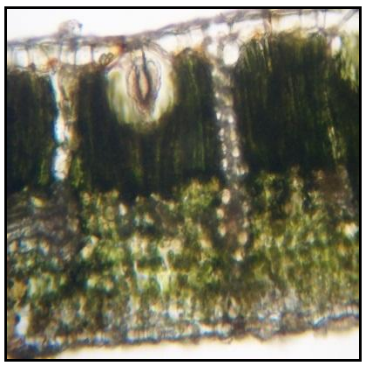
E-*Cordia obliqua*



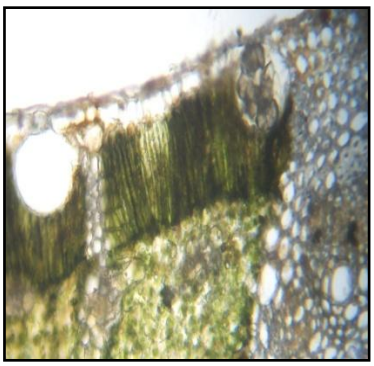
E.1-T.S Through midrib



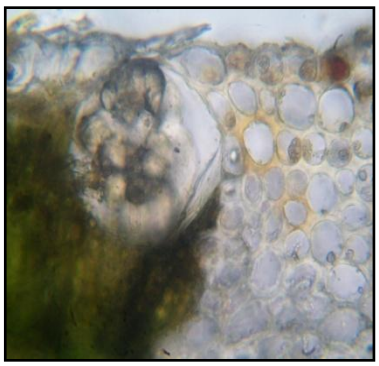
E.2-T.S Through midrib stained



E.3 Cystolyth upper epidermis



E.4- Dissolved cystolyth



E.5- Cystolyth blunt surface

Ficusbenghalensis, L:

Leaves simple alternate, petiolate, petiole measures about 6x14cm, stipulate, stipule early withering, measuring about 4x8 cm, young leaves covered within stipules (vatashringi), stipules fleshy coloured in initially later on turns in to pale yellow, leaf ovate, margin simple, lamina measures about 6x12cm, lamina base cordate to subcordate, dark green above light green below, smooth epidermal hairs present over lower surface, midrib strong at lower surface lateral veins 4-5 and veinlets tended to meet margin of the leaf, many simple trichomes were scattered on both surface. Plate No. 1. A, Plate. 2. Fig. A.

T.S. of leaf:

Transverse section through midrib shows upper and lower single layered compactly arranged barrel shaped epidermis with thick cuticle and some simple trichomes on both surfaces. Lamina shows upper 2-3 layered palisade parenchyma and lowers 5-6 layers of spongy parenchyma. Through midrib shows vascular bundle circularly arranged, bicollatral, some of meristele (2-3) located in the pith region. Vascular bundle surrounded by pericyclicfibres, rest of consists parenchyma cells. Vascular bundle surrounded by thick walled 3-4 layers of sclerenchyma cells. Plate. 2. Fig. A1-A2.

Cystolyth:

Cytolyths were initially originated in upper surface of the leaf and become elongated between the epidermal cells and sometimes between the epidermis and the palisade tissue throughout the section. Above lithocysts neither stoma nor trichomes was observed. Lythocysts are appearing like bunch of grapes inside the cells with prominent stalk. Cystolythmeasures about 180 x 65 µm. The bunch hanged by the stalk crystals were over lapped and with sharp edges. When treated with Conc. HCl. immediately dissolves with effervescence forming empty space. Plate. 2. Fig. A3-A5.

Barleriaprionities, L:

Leaves simple opposite, sessile, measures about 4x9.5cm stipulate, leaf ovate, margin simple, lamina measures about4x8cm, dark green above light green below, smooth epidermal hairs present over lower surface, midrib strong at lower surface lateral veins 4-5 and veinlets tended to meet margine of the leaf, many simple trichomes were scattered on both surface. Plate No. 1. B, Plate. 2. Fig.B.

T.S. of leaf:

Transverse section through midrib shows upper and lower single layered compactly arranged barrel shaped epidermis with thick cuticle and some simple trichomes on both surfaces. Lamina upper 2 layered palisade parenchyma and lowers 5-6 layers of spongy parenchyma loaded by chloroplasts. Through midrib shows bicollatral vascular bundle. Vascular bundle surrounded by thick walled 2-3 layers of sclerenchyma cells. Plate. 2. Fig.B1-B2.

Cystolyth:

Cystolyths were initially originated in upper surface of the leaf between the epidermal cells and sometimes between the epidermis and the palisade tissue throughout the section. Initially cystolyths form at the upper epidermis form rounded structure and later on give two oppositely elongated balloons like structure with prominent stalk. Cystolythmeasures about 160 x 60 µm. The bunch hanged by the stalk crystals were over lapped and without sharp edges. When treated with Conc. Hcl. immediately dissolves with effervescence forming empty space. Plate. 2. Fig.B3-B5.

Holopteliaintigrifolia, Pl:

Leaves simple alternate, petiolate, petiole measures about 6x10cm stipulate, stipule early withering, measuring about 0.3-0.5 cm. petiole twisted and forming light channel on upper surface, stipules two on both surface of petiole, leaf ovate, in young leaves margin serrate later on leaf matures base become simple while end somewhat crenated serrate margin, lamina measures about 6x8cm, dark green above light green below, smooth epidermal hairs (simple and glandular present) over lower surface, midrib strong at lower surface latral veins 4-5 and veinlets strongly network finally divided and reach margine of the leaf, many simple trichomes and glandular present were scattered on both surface. Plate No.1. D, Plate. 2. Fig.C.

T.S. of leaf:

Transverse section through midrib shows upper and lower single layered compactly arranged barrel shaped epidermis with thick cuticle and some simple and multicellular glandular trichomes on both surfaces. Lamina upper 2-3 layered palisade parenchyma and lowers 5-6 layers of spongy parenchyma. Through

midrib shows vascular bundle discontinuous circular ring arranged, bicollatral, centrally located in the pith region. Vascular bundle surrounded by pericyclicfibres, rest of consists parenchyma cells. Vascular bundle surrounded by thick walled 2-3 layers of sclerenchyma cells. Plate. 2. Fig.C1-C2.

Cystolyth:

Cystolyths were initially originated in lower surface of the leaf throughout the section. Initially cystolyths form at the lower epidermis form rounded structure and later on become mushroom like structure with prominent stalk. Cystolythmeasures about 140x35 µm. The bunch hanged by the stalk crystals were over lapped and without sharp edges. When treated with Conc. Hcl. immediately dissolves with effervescence forming empty space. Plate. 2. Fig.C3-C5.

Momardiccharantia, L:

Leaves simple alternate, petiolate, petiole measures about 2-4 cm exstipulate, leaf ovate, marginedeply lobed lobes 3-4, lamina measures about 8x10cm, lamina base cordate to subcordate, dark green above light green below, smooth epidermal hairs present over lower surface, midrib strong at lower surface latral veins 4-5 and veinlets tended to meet margine of the leaf, many simple trichomes were scattered on both surface. Plate No.1. C, Plate. 2. Fig.D.

T.S. of leaf:

Transverse section through midrib irregular in shape and shows upper and lower single layered compactly arranged barrel shaped epidermis with thick cuticle and some simple and multicellular pointed trichomes on both surfaces. Lamina upper one or two layered palisade parenchyma and lowers 2-3 layers of spongy parenchyma. Through midrib shows vascular bundle radially arranged, upper xylem and lower phloem Vascular bundle surrounded by thick walled 2-3 layers of sclerenchyma cells. Plate. 2. Fig.D1-D2.

Cystolyth:

Cystolyths were initially originated in lower surface of the leaf throughout the section. Initially cystolyths form at the lower epidermis form rounded structure and later on divided into two, three and also upto five balloons like structure without prominent stalk. Each cystolythmeasures about 270x50 µm. The bunch hanged by the stalk crystals were over lapped and without sharp edges with airfilled lungs like structure. When treated with Conc. Hcl. immediately dissolves with effervescence forming empty space. Plate. 2. Fig.D3-D5.

Cordia oblique, W:

Leaves simple alternate, petiolate, petiole measures about 6x12cm exstipulate, leaf ovate, margine base simple at the tip serrate to dentate, lamina measures about 6x11cm, dark green above light green below, rough leathery, smooth epidermal hairs present over upper and lower surface, midrib strong at lower surface latral veins 4-5 and veinlets tended to meet margine of the leaf, many simple and bilobed sessile trichomes were scattered on both surface. Plate No.1. D, Plate. 2. Fig.E.

T.S. of leaf:

Transverse section through midrib shows upper and lower single layered compactly arranged barrel shaped epidermis with thick cuticle and some simple and bilobedtrichomes on both surfaces. Lamina upper 2-3 layered palisade parenchyma and lowers 5-6 layers of spongy parenchyma. Through midrib shows vascular bundle circularly arranged centrally forming pith. Vascular bundle surrounded by pericyclicfibres. Xylem present above the phloem, rest of consists parenchyma cells. Vascular bundle surrounded by thick walled 3-5 layers of sclerenchyma cells. Plate. 2. Fig.E1-E2.

Cystolyth:

Cystolyths were initially originated in upper surface of the leaf between the epidermal cells and sometimes between the epidermis and the palisade tissue throughout the section. Initially cystolyths form at the upper epidermis form rounded structure and later on give linear elongated balloons like structure with prominent stalk. Cystolythmeasures about 150x40 µm. The bunch hanged by the stalk crystals were over lapped and without sharp edges. When treated with Conc. Hcl. immediately dissolves with effervescence forming empty space. Plate. 2. Fig.E3-E5.

DISCUSSION

Calcium crystals were observed in all plants investigated (Tables 1). The morphology of cystolith and the distribution of lithocyst are genera and species specific in family acanthaceae[10]. Crystals in moraceae are commonly described in taxonomic literature. Cystolyths were never occupy the whole cell, slightly detached and hanged over by stalk. There are 8 genera and 49 species of moraceae in Taiwan[11].However, there is a shortage of information in the literature on this particular relationship. The presence of crystals is certainly not detrimental to the plant. Physical and chemical conditions, such as temperature, pressure, pH, and ion concentration, may affect crystal growth, habit, and properties[12], but the precise controlling mechanism for crystal formation in plants is still unknown. Factors which control oxalate synthesis and cellular calcium uptake and mobility may affect crystal induction and formation[13]. The presence or abscence of crystals is one of the important characters for understanding the evolutionary relationships of the plant species[14].

CONCLUSION

Article has highlighted numerous results about cell-mediated crystallization of calcium carbonate in plants. Cystolyths are very important role in identification of discussed plants, in systematic, scientific identification character in which identified the microscopical family characters to overcome from the species by studying the shape and size of the cystolyths. Future research in this area will benefit from applying a variety of integrated approaches. There is a critical need for correlative biochemical and biophysical characterization, which may entail traditional approaches such as organelle and membrane isolation and characterization.

REFERENCES

1. Arnott, H. J. and F.G.E. Pautard. 1970. Calcification in plants. In H. Schraer (ed.),Biological Calcification, Cellular and Molecular Aspects. Appleton-Century Crofts, New York. pp. 375–446.
2. Solereder, H. 1908. Systematic anatomy of the dicotyledons. Clarendon, Oxford.Sporne, K. R. 1948. A note on a rapid clearing technique of wideapplication. New Phyto. 47: 290.291.
3. Fahn, A. 1990. Plant Anatomy. 4th ed. Pergamon Press. Oxford. Fassett, N.C. 1940. A Manual of Aquatic Plants. (1st ed.) McGraw-Hill Book Company, Inc.New York and London.
4. Trease and Evans Pharmacognosy 16th edition Saunders, Elsevier, London 562.
5. Katherine Esau Anatomy of seed plants, 2nd edition John wiley& sons Sanat printers, Haryana 208.
6. Ashok Bendre Practical botany. 1st edition, Rastogi publication, Meerut, India. 1-12
7. Gurucharan Singh, Plant systematic. 2nd edition, Oxford & IBH Publishing Co. pvt. Ltd, New Delhi. 64-72
8. Wallis T.E, Text book of Pharmacognosy, 5th Ed, CBS Publishers, New Delhi, 1985. P.571-578.
9. Horner, H. T. and B. L. Wagner. 1992. Association of four different calcium crystals in the anther connective tissue andhypodermalstomium of Capsicum annuum (Solanaceae) during microsporogenesis.
10. Hsieh, C. F. and T. C. Huang. 1974. The acanthaceous plants of Taiwan. Taiwania 19: 19.57.
11. Li, H. L., T. S. Lin, T. C. Huang, T. Koyama, and C. E. Devol (eds.) 1979. Flora of Taiwan. Vol. 6. Epoch Publ. Co. Taipei.
12. Franceschi, V.R. and H.T. Jr. Horner. 1980. Calcium oxalate crystals in plants. Bot. Rev. 46: 361.427.
13. Franceschi, V.R. 1987. Oxalic acid metabolism and calcium oxalate formation in Lemna minor. Plant Cell Environ. 10: 397.406.
14. Franceschi, V.R. and H.T. Jr. Horner. 1980. Calcium oxalate crystals in plants. Bot. Rev. 46: 361.427.