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Distinguishing Micro-characters of Medicinal Plant: *Euphorbia hirta* L. and their Significance

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Abstract

The distinguishing microcharacters of various parts of *Euphorbia hirta* L. has been investigated. Root is diarch. In old root xylem has roundish, angular, solitary vessel elements and uniseriate xylem rays. In young stem 18-20 collateral vascular bundles are observed in ring. Vascular cambium produces secondary vascular tissues. Epidermal surface of stem, lamina, midrib and petiole is covered by multicellular, uniseriate, filiform, cylindrical and bent trichomes. Stomata are Anomocytic. Node is trilacunar three stress. A single large roundish collateral strand is present in the center of midrib which is completely or partially encircled by latex cells. Petiole has 3 small collateral vascular bundles arranged in a crescentic manner. Distinguishing characters have significance in solving taxonomic problems and importance in identification of crude drugs from this taxon.

Keywords: Distinguishing micro characters, *Euphorbia hirta*; Medicinal plant, anatomy, pharmacognosy

Introduction

The family Euphorbiaceae also known as spurge family is one of the most diversified families of flowering plants. Many plants of a family Euphorbiaceae are useful medicinally. *Euphorbia hirta* L. is distributed in tropical and subtropical countries (Mac, 1982) ^[1] and common in India, Sri Lanka and Australia (Sood *et al.*, 2005) ^[2]. The plant is an erect annual herb with hairy stems and milky latex and is commonly available in road sides, west places, gardens, fields and forest edges (Shah, 1978) ^[3]. It is useful to treat gonorrhoea, jaundice, pimples and tumours (Patil *et al.*, 2009) ^[4]. Juice obtained by plant is used in colic pain (Maiti, 1968) ^[5] and blood dysentery (Gogoi and Borthakur, 2001) ^[6]. Root is beneficial for nursing mothers deficient in milk. (Williamson, 2002) ^[7] and given to allay vomiting (Pounikar *et al.*, 2013) ^[8]. The present work was carried out on the anatomy of various organs *viz.*, root, stem, lamina, midrib, petiole and trichomes and their significance in taxonomy and pharmacognosy.

Materials and Methods

Different organs of *Euphorbia hirta* L. Lamk. were collected from the field of South Gujarat region of India. Their small pieces were fixed in FAA (Formaldehyde – Alcohol – Acetic acid) and preserved in 70% ethanol. The small pieces of various organs were processed for microtomy. 8 - 10 micron thin transections were taken and stained with safranin O and FCF fast - green. For the stomatal studies, epidermal peels were taken with the help of forceps and stained with Delafield's hematoxylin and mounted in glycerin, jelly. (Berlyn and Miksche, 1976, Pal *et al.*, 2013, 2015) ^[9, 10]. The microphotograph were taken on axion scope A₁ Photomicroscope of Carl Zeiss.

Results

Stem

In young stem 16 - 18 collateral vascular bundles are observed in a ring. Pith is made up of parenchyma cells. Pericycle is formed by alternate groups of fibers and parenchyma cells (Fig. 1A). Epidermis is consisted of small rectangular or tubular cells on which a thick and wavy cuticle is present. Hypodermis of collenchyma is observed below epidermis (Fig. 1B). Epidermal surface is covered by large number of E glandular, multicellular, uniseriate, filiform, cylindrical and bent trichomes. Stem has cortex of 6 - 8 layers. Scattered latex cells are present in the cortical region (Fig. 1A).

In old stem secondary vascular tissues are produced. Secondary xylem has solitary vessel elements or found arranged in radial groups of 2 - 4. Xylem fibers are abundant and xylem rays are uni - biseriate (Fig. 1C, Fig. 2A).

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Root

It is composed of cortex of 4 - 6 layers of parenchyma and tetrarch xylem. Rarely xylem is diarch. Pith is scanty or absent (Fig. 2D).

Vascular cambium forms larger amount of thick walled, polygonal or rectangular fibers, roundish, angular, solitary vessel elements and uniseriate rays (Fig. 2B). The secondary phloem appears deformed or compressed (Fig. 2C).

Nodal Anatomy

One median and two lateral leaf traces are observed in the nodal region with three leaf gaps for a leaf. Node is trilacunar three trace (Fig. 3A).

Leaf

Lamina

Lamina is dorsiventral. Single layer of palisade cells is present on adaxial side and spongy cells are arranged in 4 - 5 abaxial layers. Lamina has smaller collateral strands in the middle region which are surrounded by latex cells. Latter contain chloroplasts and appear green (Fig. 3B).

Lamina is amphistomatic with anomocytic stomata on both surfaces. The stomatal apertures are field up with cutin in many stomata. Wall of epidermal cells is highly sinuous on both surfaces (Fig. 3C).

Midrib

Midrib has parenchymatous ground tissue except adaxial region where palisade cells of lamina are extended. A single large roundish collateral strand is present in the center which is completely or partially encircled by latex cells (Fig. 3B).

Petiole

Petiole has parenchymatous ground tissue and three small collateral vascular bundles arranged in a crescentic manner. Scattered latex cells are present in the ground tissue of petiole (Fig. 3D). Trichomes similar to the stem are present in lamina, midrib and petiole (Fig. 3D).

Discussion

The earlier researches devoted to the anatomy of family Euphorbiaceae worth mentioning here are that of Gaucher (1902) [12] and Dubard and Viguier (1905) [13]. Certain workers published literature on the various aspects of the anatomy of the *Euphorbia* species for vegetative organs (Metcalf and Chalk, 1950; Kakkar and Paliwal, 1972; Gales and Toma, 2006a; Gales *et al.*, 2008; Jafari and Nasseh, 2009; Ahmad *et al.*, 2010) [14-18].

Epidermal features of family Euphorbiaceae have been documented by Metcalfe and Chalk (1950) [14]; Dehgan (1980) [20]; Baruah and Nath (1997) [21]; Raju and Rao (1977) [22]; Inamdar and Gangadhara (1978) [23]; Kakkar and Paliwal (1974a) [24]; Thakur and Patil (2011) [25].

According to Metcalfe and Chalk (1950) [14] the leaves in the Euphorbiaceae are amphistomatic or stomata are confined to lower surface depending upon the species. The leaves in most of the species of *Euphorbia* are amphistomatic (Inamdar and Gangadhara, 1978 [23]; Yakob Zokian, 2006 [26]; Aworinde *et al.*, 2009) [27] except *Euphorbia milli* (Essiett *et al.*, 2012) [28], *Euphorbia pulcherrima*, *Euphorbia heterophylla* (Aworinde *et al.*, 2009) [27] where stomata are present in abaxial surface. In *Euphorbia hamiltonii* (Zahra *et al.*, 2014) [29] the stomata are restricted to only adaxial surface. Present study showed that *Euphorbia hirta* leaves are amphistomatic similar to the reports of earlier workers (Inamdar and Gangadhara, 1978, Aworinde *et al.*, 2009) [23, 27].

Essiett *et al.* (2012) [28] reported five types, anomocytic, anisocytic, staurocytic, brachyparacytic and laterocytic stomata on both surface of the leaves of *Euphorbia hirta*. Zahra *et al.* (2014) [29] observed only anisocytic stomata whereas Aworinde *et al.* (2009) [27] found anomocytic stomata on both the surfaces of the leaves of this species. According to this study also only anomocytic stomata are observed in *Euphorbia hirta* and leaves are amphistomatic. This observation also supports the finding of Kandalkar *et al.* (2009) [30] who pointed out the presence of only anomocytic stomata in *Euphorbia hirta*.

According to Gales and Toma (2006b) [31] trichomes found in *Euphorbia* were simple, unicellular or multi cellular, uniseriate. Kakkar and Paliwal (1974b) [32] as well as Aldhebani and Jury (2013) [33] presented the same observations. Sereena and Shahida (2015) [34], Yakoub Zokian (2006) [26] and Essiett *et al.* (2012) [28] reported only multicellular uniseriate trichomes in *Euphorbia hirta* which was in accordance to the present investigation.

The presence of laticifers is a useful distinguishing character in the genus *Euphorbia* (Metcalf and Chalk, 1950; Aldhebani and Jury, 2013) [14, 33]. The value of laticifers types as taxonomic marker in systematic comparisons between and within families has been established by Carlquist (1961) [35]. The laticifers system of the mature *Euphorbia* plant was explained by Gaucher (1898, 1902) [36, 12]. In present study of *Euphorbia hirta*, laticifers were found in stem, lamina, midrib and petiole regions similar to the observations of Yakoub Zokian (2006) [26], Gales and Toma (2006a) [16] and Jafari and Nasseh (2009) [18].

In *Euphorbia nerifolia* mesophyll tissue is differentiated into 2 - 3 layered adaxial zone of radially elongated palisade cells and wider abaxial spongy mesophyll cells revealed the differentiated dorsiventral lamina (Sharma and Pracheta, 2013) [37]. The mesophyll is differentiated in the palisade layers and spongy layers in *Euphorbia granulate* and *Euphorbia hirta*, but it is undifferentiated in *Euphorbia helioscopia* and *Euphorbia pepulus* (Yakoub Zokian, 2006) [26]. Present work confirms the observations of Yakoub Zokian (2006) [26] about *Euphorbia hirta* where mesophyll is consisted of a single layer of palisade cells and 4 - 5 layers of spongy cells.

Essiett *et al.* (2012) [28] reported two type of xylem in the primary roots of *Euphorbia*. It is triarch in *Euphorbia helioscopia*, *Euphorbia platyphyllos*, *Euphorbia taurinensis* and *Euphorbia falcata* ssp. *acuminata* whereas tetrarch in *Euphorbia virgata* and *Euphorbia agraria* var. *euboea*. *Euphorbia hirta* root has normally tetrarch xylem. Old root of this species has uniseriate xylem rays. This confirms the observations of Arya *et al.* (2009) [38].

From the present investigation it is found that the various parts of stem of *Euphorbia hirta* viz., epidermis, hypodermis, cortex, pith resemble with the other species of *Euphorbia* described by Gales and Toma (2006b) [31] except number of vascular bundles. According to Gales and Toma (2006b) [31] the number of collateral strands in different *Euphorbia* species varies from 30 - 35 whereas *Euphorbia hirta* is characterised by the presence of 18 - 20 vascular strands.

From the anatomical studies of various species of *Euphorbia* by Sehgal and Paliwal (1974) [39] revealed the occurrence of three main types of nodal organization, viz., unilacunar single trace, bilacunar two trace and trilacunar three trace. They further suggested that trilacunar three trace node is more frequent than the other types. According to present work *Euphorbia hirta* is characterised by the presence of trilacunar three trace node.

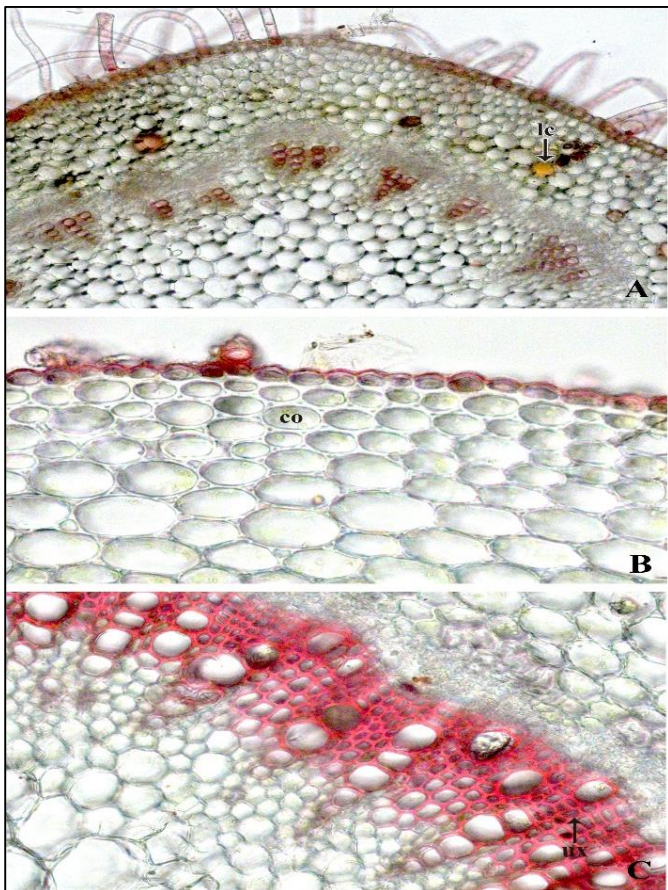


Fig 1 A - C, transactions. A - C, stem; A, C, X480; D, X800. (co - collenchyma; lc - latex cell; ux - uniseriate xylem rays.).

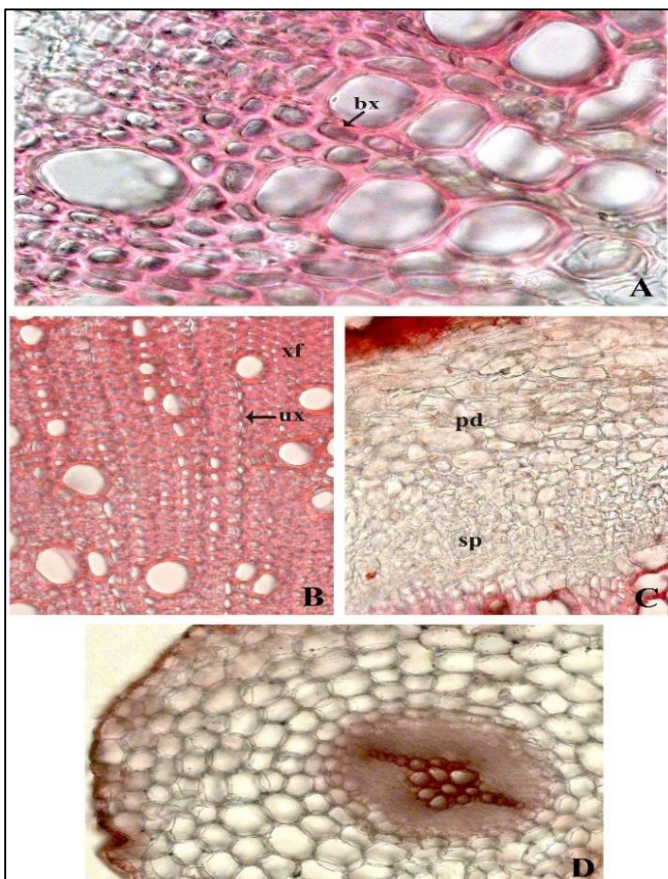


Fig 2: A - D, transactions. A, stem; B - D, root. A, X800; B - D, X480. (bx - biseriate xylem rays; pd - phelloderm; sp - secondary phloem; ux - uniseriate xylem rays; xf - xylem fibers.).

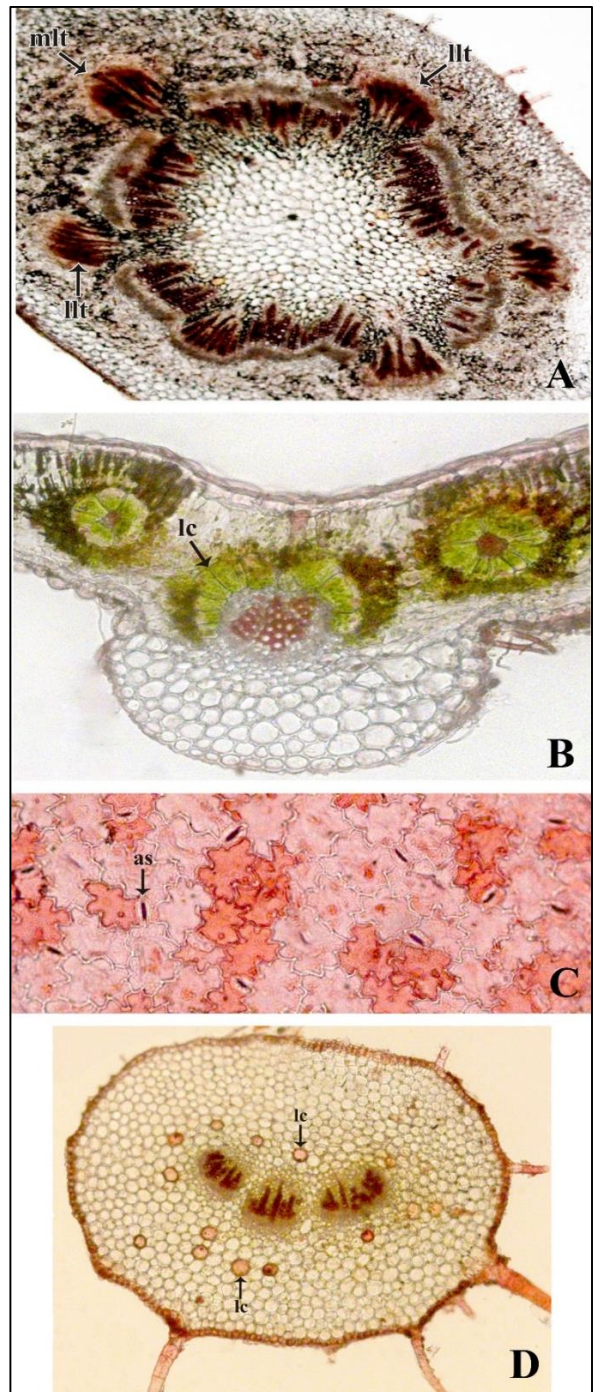


Fig 3: A - D, transactions. A, node; B, lamina with midrib; C, surface view of epidermis of Lamina; D, petiole. A, X800; B, C, X480; D X80. (as - anomocytic stomata; lc - latex cell; lit -lateral leaf trace; mit - median leaf trace.).

Conclusion

Present study shows that *Euphorbia hirta* L. exhibits following distinguishing micro-characters which can be utilized taxonomically and also have significance in pharmacognosy.

- Stem has 18 - 20 collateral strands in a ring.
- Xylem rays are uni or biseriate in stem.
- Node is trilacunar.
- Latex cells are present in stem, lamina, midrib and petiole.
- Leaf is amphistomatic with anomocytic stomata.
- Vascular bundle of midrib is completely or partially surrounded by latex cells.
- Eglandular multicellular uniseriate filiform, cylindrical and bent trichomes are observed on stem, lamina and petiole.

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