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PHYSICAL CHARACTERIZATION OF *COSTUS SPECIOSUS* (KOENIG EX RETZ.) SMITH – A WELL KNOWN AYURVEDIC DRUG PLANT

P. Y. BHOGAONKAR, *V. D. DEVARKAR AND S. K. LANDE

GOVT. VIDARBHA INSTITUTE OF SCIENCE AND HUMANITIES, AMRAVATI. M.S.

* SHRI CHHATRAPATI SHIVAJI COLLEGE, OMERGA DIST. OSMANABAD M.S

devarkar28@gmail.com

ABSTRACT:

Ayurveda plays an important role in the life of people from India for health and longevity. The study of plants used in the ayurvedic preparations always encourages undertaking new aspect of study. *Costus speciosus* (Koenig ex Retz.) Smith, commonly known as 'Keyu' or 'Kust' is ayurvedic drug plant of repute used to treat various ailments. It is also used in folk medicine in various parts of India. All plant parts are used as medicine. Though an important medicinal plant, no anatomical data is available for drug characterization. Drug characterization is important to understand purity of the drug. Here an attempt is made to study the macro and micromorphology of all plant organs in details. Flowers are characterized by presence of eye shaped nectaries on bracts and multicellular, yellow coloured juicy trichomes on petaloid stamen; anatomically also several characteristic features are exhibited by plant which are unique to the species. Stomatal index significantly vary at upper (5.58%) and lower epidermis (10.59%), respectively.

KEY WORD: *Costus speciosus* (Koenig ex Retz.) J. E. Smith, Macromorphology, micromorphology, Plant anatomy.

INTRODUCTION:

Costus speciosus (Koenig ex Retz.) J. E. Smith (Zingiberaceae) is a well-known Ayurvedic medicinal plant; commonly called 'Crepeginger'. In Sanskrit it is known as 'Keyu' or 'Canda' and in Hindi as 'Kust'; however, it should not be confused with 'Kushtha' - *Saussurea lappa* (Deche) Sch.-Bip. (Khare 2007). In ayurveda rhizomes are used as medicine; they are bitter, astringent, cooling, purgative, anthelmintic, depurative, febrifuge, expectorant, tonic and aphrodisiac; useful in vitated conditions of khapa and Pitta, burning sensation, flatulence, leprosy, skin diseases, asthma and anaemia (Warrier *et al.* 1995). It is widely used by rural and tribal people for similar purposes and also on snake- bite and bite of rabid dog and jackel (Jain and Tarafder, 1970). Rhizomes are used as vegetable and also pickled. Drinks

are prepared from leaves and flowers (Hajra and Baishya, 1981; Ammal and Prasad, 1984). Korkus of Melghat (Dist. Amravati, M.S. uses rhizome powder mixed with honey for whooping cough and paste applied on tonsillitis externally (Devarkar, 2001).

Leaves are used to control diabetes; diabetic people eat one leaf daily to keep their blood sugar low (Benny, 2004). Daisy *et al.* (2008) found hexane extract of rhizome to possess antihyperglycemic and hypolipidemic activity. Costunolide isolated from the plant significantly decreases HbA1c, serum total cholesterol, triglyceride, LDL-cholesterol and at the same time increases plasma insulin, tissue glycogen, HDL-cholesterol and serum protein (Eliza *et al.* 2009). Bavarva and Narasimhacharya, (2008) had found rhizome extract reverse diabetes and its complications; the extract is also found to improve hepatic antioxidant enzyme activity acting on neurotransmitters and monoamine oxidase activity (Varma and Khosa, 2009a). Binny *et al.* (2010) proved anti-inflammatory and antipyretic properties of the rhizome; they also possess significant hepatoprotective activity against carbontetrachloride induced hepatotoxicity (Varma and Khosa, 2009b). Aqueous extract of rhizome is shown to possess antimicrobial activity against *staphylococcus aureus* (Saraf, 2010). Rhizomes are edible and traditionally are used as tonic. Devi and Urooj (2010) have studied their nutritional and antioxidant potential. They show high content of several antioxidants like ascorbic acid, β -carotene, α -tocopherol, glutathione, phenol and flavonoids.

Being a medicinal plant of repute, good amount of information is available about its chemistry (Rastogi and Mehrotra, 2004 and Inoue and Ebizuka, 1996 and Saraf, 2010). However, no information is available about its anatomy. Here an attempt is made to study detailed morphology and anatomy of the plant.

MATERIALS AND METHODS:

Plant material was collected in the month of August, 2010 from Melghat region of Dist. Amravati (Maharashtra). External morphology and anatomy of root, stem and leaf was studied during September, 2010 to February, 2011. Freshly hand-cut sections were observed under microscope and camera lucida sketches were made (p1a-g & p2 h-t). Leaf constants such as stomatal frequency, stomatal index, stomatal size and epidermal cell size (Table I.), palisade to spongy ratio (as seen in transverse section), PR value were determined (Kokate *et al.* 1998). At least 10 readings were taken from different leaves to determine each constant.

RESULTS:

Costus speciosus (Koenig ex. Retz.) J. E. Smith. In Trans. Linn. Soc.1:249.1800; Hook f. Fl. Brit. India. 6 : 249.1892; (Korku.- Bhumka, Mar.- Jangli adrak, Kan. - Cangalvakostu).

Macromorphology

Perennial, erect herb, 2-3m tall; root stock creeping, tuberous. Stems more or less woody at base, unbranched, spirally twisted in upper part. Leaves alternate, spirally arranged, sub sessile, base sheathing forming a complete tube around stem (leaf sheath long, travels along the next internode thus lamina becoming free not at the same internode but at second higher node); lamina 20-30x 9.6-10 cm, oblong or oblanceolate-oblong, acute or acuminate, glabrous above, silky pubescent beneath, margin thinly membranous. Flowers large, white, bracteate and bracteolate; in dense capitate spikes. Bracts 2.5-2.7x1.4-1.6 cm, strongly keeled on back, apex acute, mucronate, persistent, turning deep crimson red in fruiting; one large aliform nectary present on keel below the mucrona, secreting good amount of nectar (several ants visiting nectary can be seen any time). Bracteole 1.3-1.5x1-1.2 cm, reddish green, strongly keeled, persistent. Calyx about 3cm long, fused to form short tube above ovary, lobes 3, reddish, acute, mucronate, strongly keeled. Petals white, free, imbricate, 4.6-4.8 x 2.3-2.4 cm, finely pubescent outside, mucronate, mucrona pink. Petaloid staminodes showy, large, white, fused, infundibuliform, open along one side, margin fimbriate; functional stamen single, filament petaloid, white, 4.9x1.1 cm, extended beyond anther lobes, thinly hairy outside, densely hairy on inner side beyond anther lobes, apex yellow. Trichomes unicellular, simple and multicellular glandular (p2 n-r). Anther lobes about 8x3mm, placed apart with narrow gap, small membranous appendages present at base. Ovary inferior, triangular, strongly angled, somewhat flat on one side; placentation axile; style 3.9-4 cm long, passing through gap between anther lobes; stigma funnel shaped, fimbriate, hairy on margin and inner surface. Capsules trigonous-globose, 2 cm in diam., red. Seeds black, aril white. (p1) Trichomes on petaloid filament yellow, unicellular, simple and multicellular glandular, juicy (p2 n-r).

Occurrence –Throughout India in moist hilly places in monsoon.

Micromorphology

Root - Cylindrical, somewhat fleshy; stele polyarch; pith small, cells becoming thick walled. Epiblemma getting retained for long time along with hairs. Outer cortex 5-6 layered; cells polygonal, thick-walled, compactly placed. Inner cortex 5-8 layered; cells thin-walled, enclosing small intercellular places. Pericycle single layered, endodermis with casparian strips; in later stage innerwalls of cells becoming uniformly thick-walled. Secondary cambium originates between outer and inner cortex cutting off thick-walled cells on outer side and thin-walled cells on inner side (p1a).

Rhizome- Epidermis gets peeled off very early. Ground tissue parenchymatous. Vascular bundles hadrocentric, scattered in ground tissue. During secondary growth cambium originates in inner layers of ground tissue, outside the zone of vascular bundles, producing secondary vascular bundles to the inner side only. Individual vascular bundles also grow by establishment of cambium around each bundle that cuts off secondary storage parenchyma to the outside storing starch. Cork cambium is produced in

outer layers of ground tissue. It gives cork cells to the outer side and few layers of thin-walled ground tissue containing brownish pigment to the inner side (p1b-c).

Stem - Cylindrical. Epidermal cells small, thickly cutinized and cuticularized. Ground tissue parenchymatous divided into two distinct zones by a ring of sclerenchyma. Vascular bundles scattered; few in the outer zone, numerous in inner zone, some embedded in sclerenchymatous ring. Bundles hadrocentric; each consisting of single vessel and a patch of phloem surrounding the vessel. A sclerenchymatous sheath or cap is associated with each vascular bundle (p1d-f).

Leaf- Leaf sheath long, enclosing one internode, free at next node. Epidermis of leaf sheath contains anthocyanin; cells polygonal; stomata paracytic monocyclic and paracytic hemibicyclic as well as tetracytic (p1g). Lamina amphistomatous; epidermis cutinized and cuticularised; cells polygonal, those of lower epidermis bluntly angled. Stomata are with subsidiary cells roughly in two cycles. In upper epidermis they are hexacyclic with inner cycles of two subsidiary cells parallel to guard cells, while outer cycle of four cells -2 lateral and 2 anteroposterior. In lower epidermis octacytic stomata with a pair of parallel subsidiary cells on each side of guard cells, few paracytic stomata also present (p2h-i). Lower epidermis with soft hairs; trichomes unicellular and multicellular (2-4 celled) uniseriate (p2s-t). Epidermis followed by a layer of hypodermis on both sides; cells parenchymatous, much larger below upper epidermis. Mesophyll differentiated into palisade and spongy parenchyma; palisade 2-layered, cells of lower layer shorter than upper; spongy parenchyma 2-3 layered, cells loosely arranged. Vein embedded in mesophyll. Vein bundles surrounded by non-chlorophyllose parenchymatous sheath and palisade cells around the sheath; parenchymatous sheath incomplete in minor veinlets. Cuboidal oxalate crystals present in upper epidermis as wells in cells of upper hypodermis (p2j-k).

Midrib- Large. Ground tissue parenchymatous. One or two layers of chlorenchymatous mesophyll are continuous on adaxial side of midrib, separated from epidermis by few layers of parenchyma. Some vascular bundles are present in a series, abutting the chlorenchymatous zone. Some vascular bundles scattered in the abaxial ground tissue. Bundles hadrocentric, surrounded by sclerenchymatous, multilayered sheath. Cuboidal crystals present in the cells of adaxial ground tissue. Unicellular trichomes present on lower epidermis (p2l-m).

DISCUSSION:

Costaceae include four genera; *Costus* with 100 species being the dominant one. Costaceae are characterized by- i. stem with narrow cortex followed by fibrous cylinder in which few vascular bundles may be embedded and some abutting it, ii. main bundle arch of petiole and midvein facing the adaxial side, iii. trichomes not sunken and being multicellular and uniseriate, iv. stomata para or tetracytic, v.

raphides lacking but calcium oxalate occurring in other shapes, silica occurring both in stem and aerial leaves(Dahlgren 1985).

Costus speciosus agrees with most of the family features, but differs in absence of silica bodies. Further the species is characterized by- i. multicellular secretory floral trichomes, ii. Development of cork cambium in root, iii. vascular bundles of stem and rhizome hadrocentric, iv. Each vascular bundle of rhizome producing secondary storage parenchyma around each bundle, v. stomata showing additional subsidiary cells, vi. epidermis followed by large celled hypodermis on both sides, vii. presence of cuboidal oxalate crystals in cells of upper epidermis and hypodermis, viii. palisade two layered. Thus anatomically *Costus speciosus* (Koenig ex Retz.) Smith shows many characteristic features which are not noted for the family. This also shows that existing anatomical data for the family is very scanty and needs to be enriched with further studies.

CONCLUSION:

Though anatomy of *Costus speciosus* (Koenig ex. Retz.) J. E. Smith agrees in general with most of the, several features were found to characterize the species. Present data produce will help to establish identity of drug material.

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Table I : Details of Leaf constants

A. Epidermis	Upper Epidermis	Lower Epidermis
Epidermal cells size	$88.80 \pm 1.564 \times 49.58 \pm 0.496 \times 8 \pm 1.513 \mu\text{m}$	$70.54 \pm 1.277 \times 35.02 \pm 0.642 \times 6 \pm 1.211 \mu\text{m}$
Stomata size	$47.11 \pm 0.388 \times 18.99 \pm 0.859 \mu\text{m}$	$37.49 \pm 0.315 \times 19.98 \pm 0.517 \mu\text{m}$
Stomatal frequency	$6.6/\text{mm}^2$	$36.80/\text{mm}^2$
Stomatal index	5.58 %	10.59 %

B. Palisade : Spongy (PS ratio)– 1 : 1.1

C. Pallisade : Epidermis (PR ratio) – 1 : 7.5

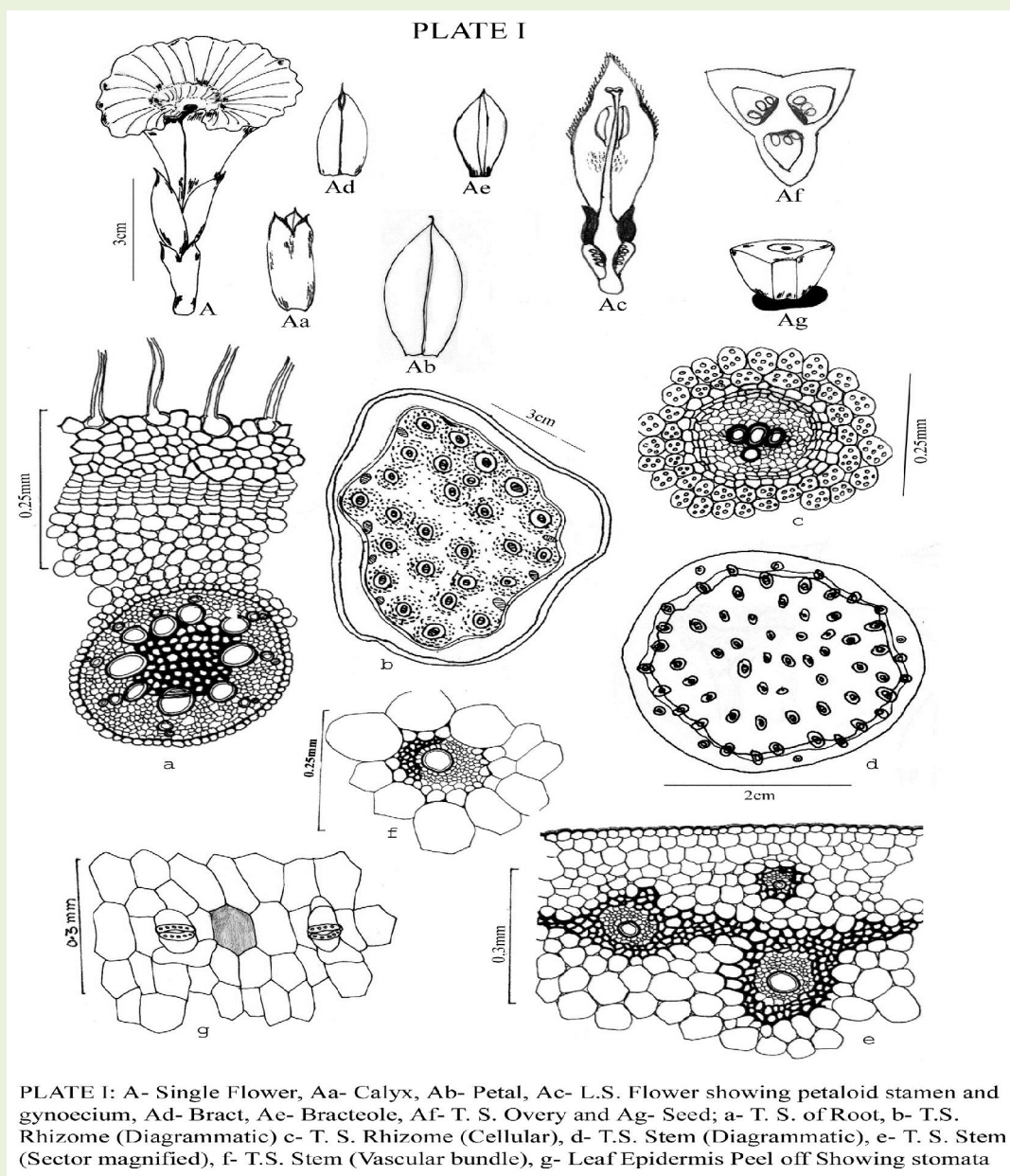


PLATE II

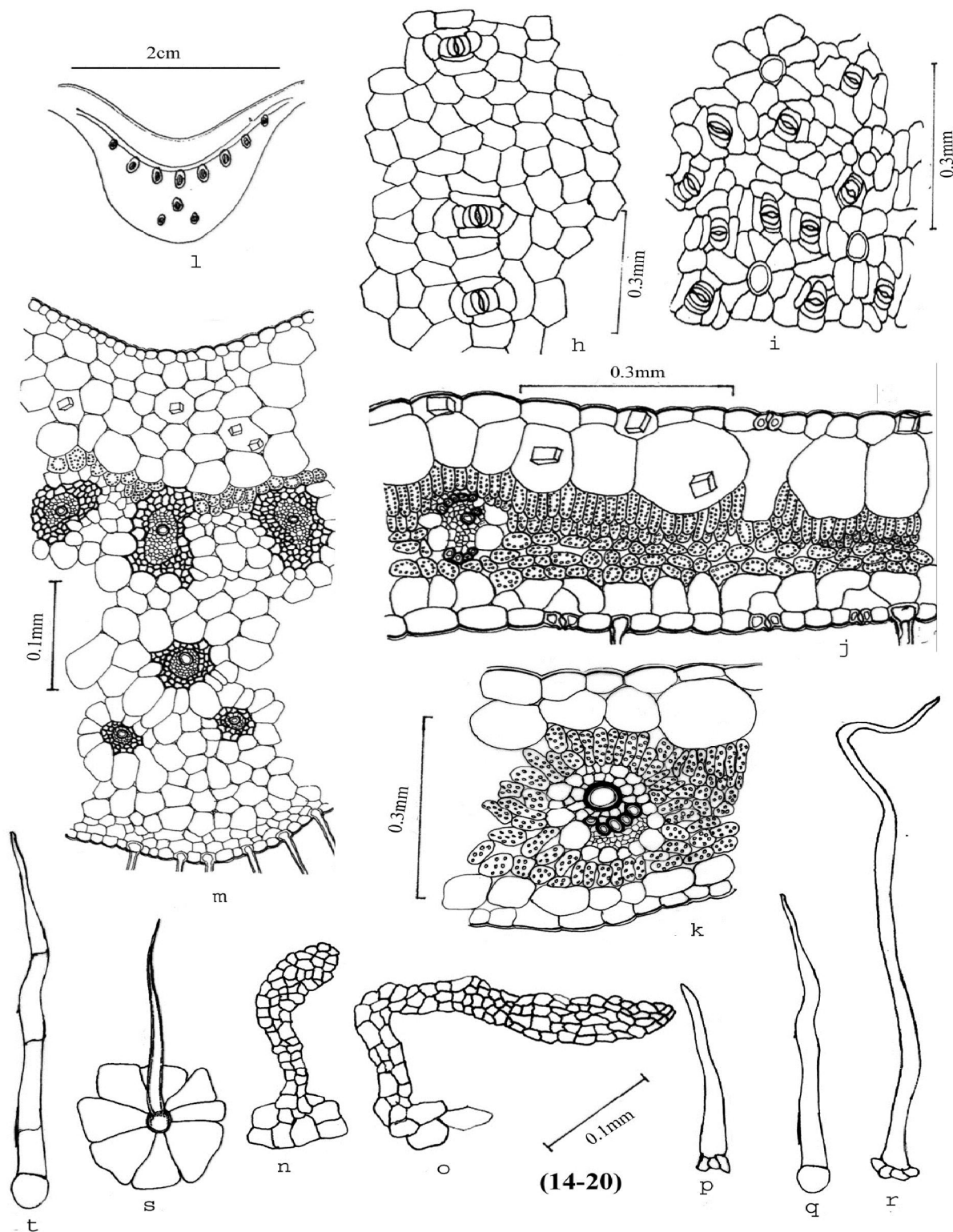


PLATE II : h- Leaf (upper epidermis) with stomata, i- Leaf (Lower epidermis) with stomata, j- T. S. leaf lamina with cuboidal crystals, k- T. S. Leaf lamina showing Vascular bundle, l- T.S. Leaf midrib (Diagrammatic), m- T. S. Leaf midrib (Sector magnified), n-t - Various types of unicellular & multicellular trichomes.

PLATE III



Costus speciosus (Koenig Ex Retz.) Smith in bloom