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Comparative Morphoanatomy of *Piper betle* L. cultivars in India

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Abstract

The study presents comparative morpho-anatomical information of 10 common cultivars of Piper betle species available in India. The ten cultivars show some structural similarities. Four layered upper and two layered lower epidermis was observed in all the varities of P. betle studied. Crystals and oil reserves were found in the epidermal cells. The Kapoori Tuni variety has more stomatal and trichome frequency. Multi cellular tector trichomes were seen on the abaxial face of midrib. Presence of parenchymatous bundle sheath was observed in all the varities but it was sclerenchymatous in Jaleswar. The developments of tracheoids idioblasts from the vessel elements have been noticed. These tracheoids are suggested to have store water. They are connected to the vein endings in the leaves and cortex in the petiole. These characteristics are typical xeromorphic anatomy of leaves which could be preserved the aroma and shelf-life longivity of betel leaves.

Keywords: *Piper betle* cultivars, multilayered epidermis, bundle sheath, tracheoid.

INTRODUCTION

Piper betle L.(betel vine, Pan) an indigenous medicinal plant, has a folk (Siddha and Ayurvedha) reputation in the rural areas of southern India, a member of the piperaceae. The plant is dioeciously, shade loving perennial root climber. There are about 125 to 150 cultivars of betel vine in India [1, 2]. Significance of *P. betle* leaves have been explains in relation to each and every plethora of human life from the dawn of civilization. These leaves are traditionally used for chewing in their natural raw condition which is a product called 'pan'. The vine is raised by vegetative propagation from the cuttings. Usually the male plants are cultivated throughout India for harvesting green leaves. The nomenclature of betelvine is the general craze with growers to name the varieties after their village or town[3]. Despite the importance of this important crop,

very little anatomical studies has been done on the leaves of P. betle cultivars [1, 3, 9, 10, 11 & 12]. Hence the present study is aimed to provide the detailed information about the anatomical features of leaves of certain P. betle cultivar.

MATERIALS AND METHODS

In the present study nine cultivated varieties of *P. betle* leaves were collected from All India Coordinated Research Project Centre on Betelvine, Lucknow, Uttar Pradesh, and one variety from Tuni, East Godavari Dist. A.P. The taxonomic identities of these plants were determined with the help of authenticated specimens available in the Herbarium of NBRI, Lucknow(Table-1)and (Fig.1).

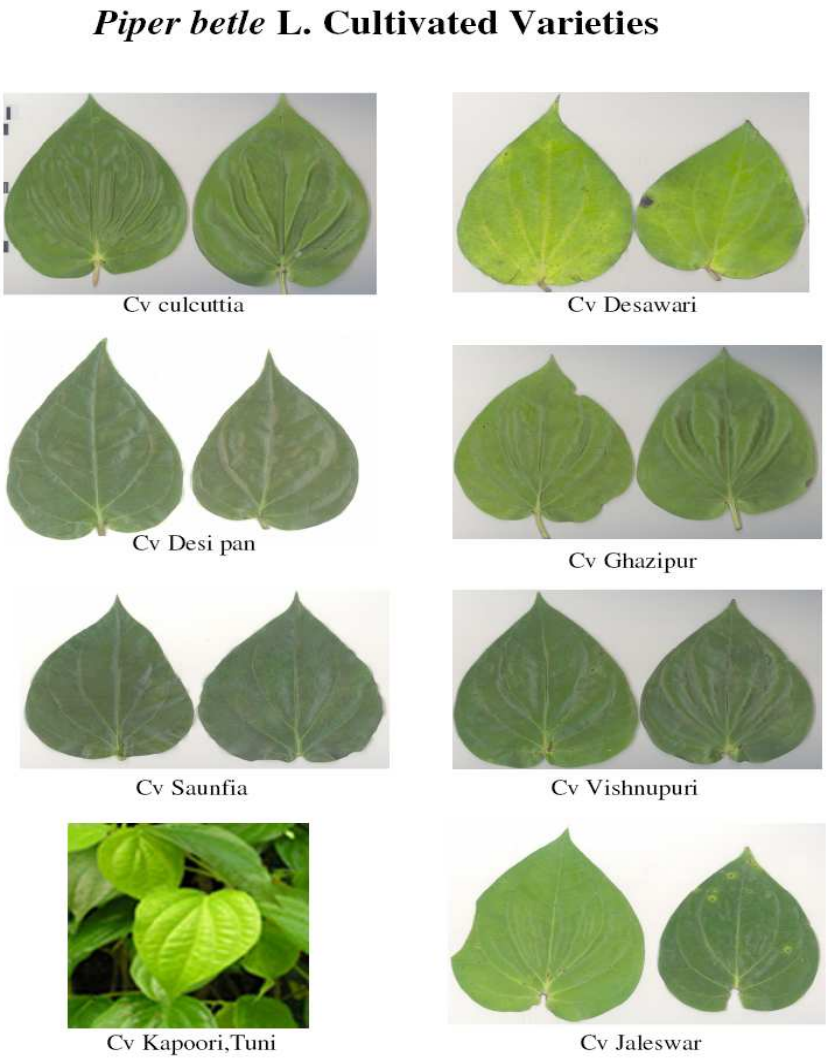

Figure: 1

The examined foliar regions were the petiole, lower third of the blade, midrib and epidermal tissue systems. The epidermal peels were prepared by using traditional methods[4]. The results

were registered by botanical illustration and photos taken by means of the Olympus Binocular BX 40 optical microscope.

Table -1 Comparative leaf morphology of *Piper Betle* cultivar

S. No.	Name of Cv and Origin	Colour & Texture of Leaf	Length (cm)	Width (cm)	Nature of leaf tip	No. of Secondary veins
1.	*P. betle* L. Cv.Calcuttia. Madhya Pradesh	Yellowish green. Glossy Upper Surface and Coriacious	8	7.5	Acute	*7*
2.	*P. betle* L. Cv. Desipan Uttar Pradesh	Dark Green Glabrous	7.5	5	Curved Acuminate leaf tip	5 Intra marginal veins Present, asymmetric
3.	*P. betle* L. Cv. Desawari Uttar Pradesh	Greenish, Yellow, Glabrous	8.5	7	Curved Acuminate leaf tip	5
4.	*P. betle* L. Cv. Ghazipur West Bengal	Dark Green, Glossy Upper Surface and Coriacious	14	12	Acute	*7*
5.	*P. betle* L. Cv. Bangladeshi West Bengal	Dark Green Coriacious	13	11	Acute	*7*
6.	*P. betle* L. Cv. Benarasi Uttar Pradesh	Dark green, Glossy Upper Surface & Coriacious	13	11.5	Acute	*7*
7.	*P. betle* L. Cv. Jaleswar. Madhya Pradesh.	Yellowish Green, Glossy Upper Surface & Coriacious	15	14	Acute	*7*
8.	*P. betle*, L. Cv. Vishnupuri Pan. Madhya Pradesh	Dark Green, Coriacious	15	14	Acute	*7*
9.	*P. betle* L. Cv. (Kapoori)Tuni Andhra Pradesh	Light green glabrous	12.5	7.5	Acute	*7*
10.	*P. betle*, L. Cv. Saunfia Pan Madhya Pradesh	Dark Green Coriacious	9.5	7	Acuminate	7

RESULTS

The morphological units studied are shown in Table-1(Fig-1). They have a multiple epidermis in both the adaxial and abaxial surfaces with glandular, tector trichomes respectively (Figs. 2a & 3 e). All the cultivated varieties of P. betle leaves studied shows four layered upper and two layered lower epidermis (Fig. 2f). The cuticle is thick on the upper epidermis and thin on the lower epidermis. The cells of the outer epidermal layers on both sides of the leaf are small, that possess tannins and oils. The sub epidermal cells on the abaxial side are enlarged and they store water. Crystal and oil reserves are found in the subepidermal cells on both sides.

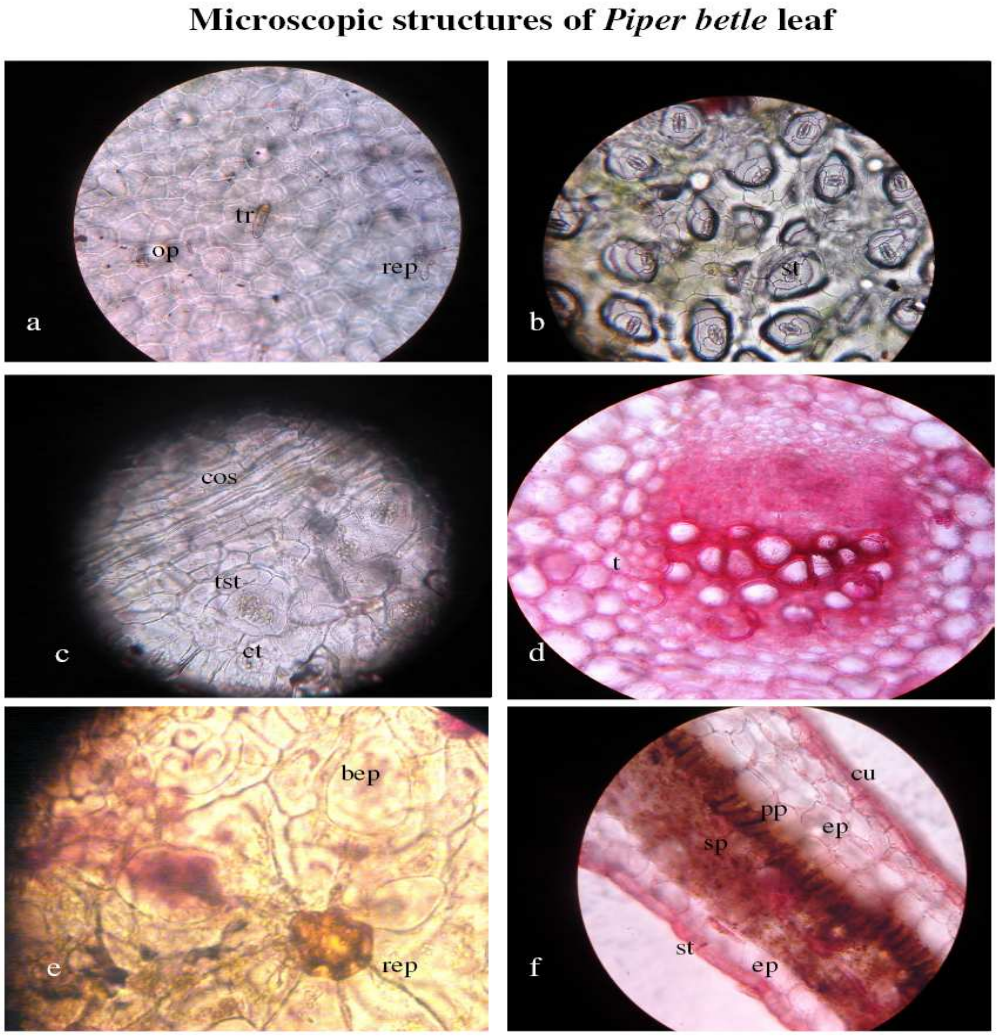

Figure 2

(a) Adaxial side of the epidermis, in face view showing glandular trichomes(tr). (b) Abaxial side of the epidermis in face view showing tetracytic stomatal(st) complex. (c) Adaxial side of the epidermis showing costal cells(cos), conjugation tubes(ct), and twin stomata(tst). (d) Tracheoids(t) from xylem of petiole (e) P. betle cv. Jaleswar abaxial side of the epidermis in face view showing cyclocytic stomatal(cst) complex, balloon like epidermal cells(bep), rosette of epidermal cells(rep). (f) transverse section of leaf lamina showing mulitiple epidermises(ep) on abaxial, adaxial sides and dorsiventral mesophyll. (pp and sp).

The leaves are hypostomatic, tetra-cytic stomatal complexes are common which is the characteristic feature of the Piperaceae (Fig. 2b). Occasionally stomatal complexes are cyclocytic but twin stomata and just aposed type are also seen (Fig. 2e). Conjugation tube like structures is present between the twin stomata in Kapoori-Tuni variety (Fig. 2c).

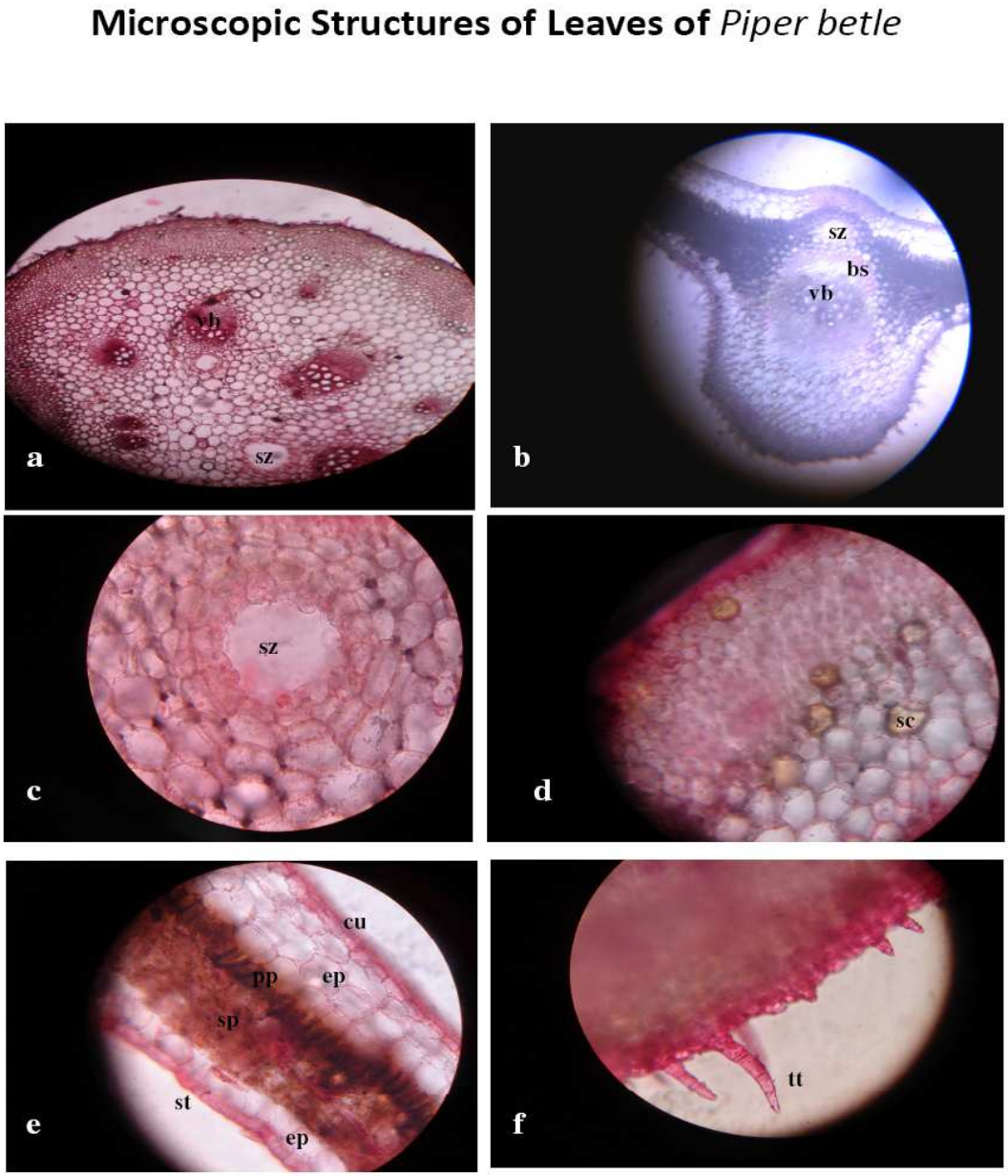

Figure 3

a.Petiole anatomy of leaf with many vascular bundles (vb); b.Cross section of P. betle Cv. Jaleswar with bundle sheath (bs).; c.Schizogenous (sz) oil cavity of leaf, d.Secretary cells (sc); e. multiple epidermis (ep) on abaxial and adaxial sides with heterogenous; mesophyll palisade parenchyma (pp) and spongyparenchyma(sp); f.Petiole epidermal cells with tector trichomes (tt).

The trichomes are glandular which have unicellular apical cell and a short pedicel. The pedicle has thicker wall, surrounded by 5 or 6 epidermal cell arranged in a rosette disc like manner. The apical cell of trichome is slightly pointed or clavate shaped. Presence of twin glandular trichomes is common in Kapoori Tuni variety. Tector trichomes are multicellular and uniseriate and are

more restricted at the mid rib and petiole regions (Fig. 3f). Kapoori-Tuni cultivar variety leaves have more stomatal and trichome frequency than the other varieties.

All the varieties of the species studied have a heterogenous mesophyll with a single palisade parenchyma layer (Fig-2f) and three to four compactly arranged spongy parenchyma is observed. The blade margin is similar in all the varieties studied where the subepidermal cell layer is collenchymatous at the mid rib, projects strongly on the abaxial surface. It contains one conjoint, collateral vascular bundle with a parenchymatous bundle sheath with slerenchymatous patches on the phloem and xylem faces in all except in Cv. Jaleswar, where it is slerenchymatous (Fig-3b). In the lower mesophyll region, parenchyma with oil cells was observed. The Schizogeneous secretory canal on the adaxial surface was present in all the cultivars of the species (Fig. 3 d).

The cross section of petiole has two layered epidermis with thick cuticle, secretory, tector trichomes with pointed extremities whose periclinal walls are thick. In the cortex both parenchyma and collenchyma occur in longitudinal strips. Cortical collenchyma is subepidermic

The central cylinder of petiole composed of scattered vascular bundles of different dimensions and devoid of endodermis and pericycle. Two large schizogenous oil cavities are found in the medullary regions (Fig. 3c). Crystals and oil reserves are observed in the cortical collenchyma and in parenchyma regions of the petiole. The crystals are mostly prismatic types (Fig-3a). Tracheoid idioblasts like structures have been noticed from the vessel elements of midrib and petiole (Fig-2d). These tracheoids are suggested to store water [8] and they are connected to the vein endings present in the leaves and cortex in the petiole. These characteristics are typical of xeromorphic anatomy of leaves.

DISCUSSION AND CONCLUSION

Dorsiventral, hypostomatic, tetracytic stomatal complexes with heterogenous mesophyll, were previously reported characters of piperaceae [4,5,6,7]. However Nascimento and Vilhena – Potiguara (1999) recorded a cyclocytic complex in the *Piper hispidinervium* leaf [9], Which are found in Kapoori Tuni and Jaleswar varieties. They have a multiple epidermis in both the adaxial and abaxial surfaces with glandular, tector trichomes respectively. In this study a clear distinction showed between Kapoori Tuni from other landraces. The different landraces also distinguished earlier on the basis of the leaf essential oils and random amplified polymorphic DNA [1,9]. The betel leaves are aromatic with varied taste, ranging from sweet to pungent due to the presence of essential oils [10]. The literature cited that essential oil constituents are the sources of many pharmacological activities. The presence of oils, help to reduce transpiration, modify the heat and inhibit fungal infections [11]. In this study it is important to notice the biological sources of these essential oils in the leaves as glandular trichomes, oil cells and the Schizogenous canals lined with secretory epithelial layer at the midrib and in petiole [12] which is the first of its kind and there is no leading literature to correlate the essential oil yielding plants with xeromorphic anatomy.

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