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STRUCTURAL FEATURES OF THE GLANDULAR TRICHOMES AND ELEMENTAL ANALYSIS OF *PLECTRANTHUS ZEYLANICUS* BENTH. (LAMIACEAE)

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Morphological investigations of the secretory hairs on the leaves of *Plectranthus zeylanicus* Benth. (Lamiaceae) were made with the help of Scanning Electron Microscopy and identification of different elements associated with the leaves were carried out by Energy Dispersive Spectroscopy used in correlation with SEM in both *in vivo* and *in vitro* plants. Two types of glandular trichomes were found – peltate glands characterized by a short stalk with a large 4-8 celled head and long stalked capitate glands. The glandular distribution and morphology were almost similar and there is no significant difference in elemental composition in the comparative study of the parent plant and micropropagated plants.

Keywords: Elemental composition; Glandular trichomes; Lamiaceae; Micropropagation; *Plectranthus zeylanicus*; Scanning Electron Microscopy.

Introduction

The Lamiaceae comprise many commercially important essential oil accumulating species. The wide distribution of glandular trichomes over the aerial and vegetative organs of plants of the Lamiaceae is well documented[1-6]. They are recognized as the site of essential oil biosynthesis, secretion and accumulation[3,7]. The essential oil produced by these glandular trichomes may act to protect the aerial parts of the plant against herbivores and pathogens and the biological activity of the secondary metabolites in the secreted products is of interest to the pesticide, pharmaceutical, flavouring and fragrance industries[8].

Plectranthus L' Herit. is a large genus of the Lamiaceae family comprising about 300 species having a wide range of applications as source of essential oils, ornamentals, edible tubers, food flavouring agents, etc. *Plectranthus zeylanicus* Benth. {synonym: *Coleus zeylanicus* (Benth.) Cramer} is a profusely branched, semi-succulent, strongly aromatic herb cultivated as a medicinal plant. The species is used in folk (ayurvedic) medicine for the preparation of a drug, Hribera or Balam which is used as a carminative, tonic and cures dyspepsia, indigestion, dysentery, vomiting, dermatitis, ulcers and bleeding disorders[9]. Jirovetz *et al.*[10] analysed the chemical composition of the essential oil and detected more than 80 compounds with geraniol, nerol and their derivatives as the major ones. In view of the potential pharmacological value of this oil-rich and aromatic species, the present study was carried out to characterize the morphology of its glandular trichomes. Mineral elements play several important roles in plants as structural, catalytic and electrochemical functions that promote physiological health of the plant. Energy Dispersive Spectroscopy provides a means for the qualitative and quantitative analysis to determine elemental composition and their concentration in terms of weight and atomic percentages.

Material and Methods

Plants were collected from Calicut University Botanical Garden, Kerala. The micropropagation was achieved on Murashige and Skooge (MS) medium supplemented with growth regulators in different concentrations and combinations. Agar (0.8%) and sucrose (3%) were used and pH was adjusted to 5.8. Plants regenerated from the callus were transferred into soil.

For Scanning Electron Microscopy, air dried leaf samples were mounted on the specimen stubs and coated with a thin layer of gold. Observations were carried out on a JEOL JSM-5610 LV Scanning Electron Microscope.

Energy Dispersive Spectrometer used in conjunction with the SEM was employed for the characterization of elements. Each element yields a characteristic spectral fingerprint that may be used to identify the presence of that element within the sample. The relative intensities of the spectral peaks may be used to determine the relative concentrations of each element

Table 1. Composition of elements on the epidermal surfaces of the leaves of *P. zeylanicus*.

Element	Adaxial surface				Abaxial surface			
	Weight %		Atomic %		Weight %		Atomic %	
	Parent	*In vitro*	Parent	*In vitro*	Parent	*In vitro*	Parent	*In vitro*
Na K	3.54	-	6.10	-	4.97	-	8.28	-
Mg K	5.65	6.63	9.21	10.99	8.17	11.41	12.86	18.19
Al K	-	2.36	-	3.53	-	-	-	-
Si K	2.25	2.19	3.17	3.14	-	3.11	-	4.29
Cl K	9.44	5.53	10.54	6.29	10.90	8.92	11.78	9.75
K K	40.30	36.33	40.82	37.48	46.65	37.88	45.70	37.56
Ca K	16.77	23.97	16.57	24.12	14.01	18.84	13.39	18.22
Cu K	12.87	13.92	8.02	8.84	5.63	12.49	3.39	7.62
Zn K	9.19	9.08	5.57	5.60	5.35	7.36	3.13	4.36
Cd L	-	-	-	-	4.32	-	1.47	-

in the specimen.

Result and Discussion

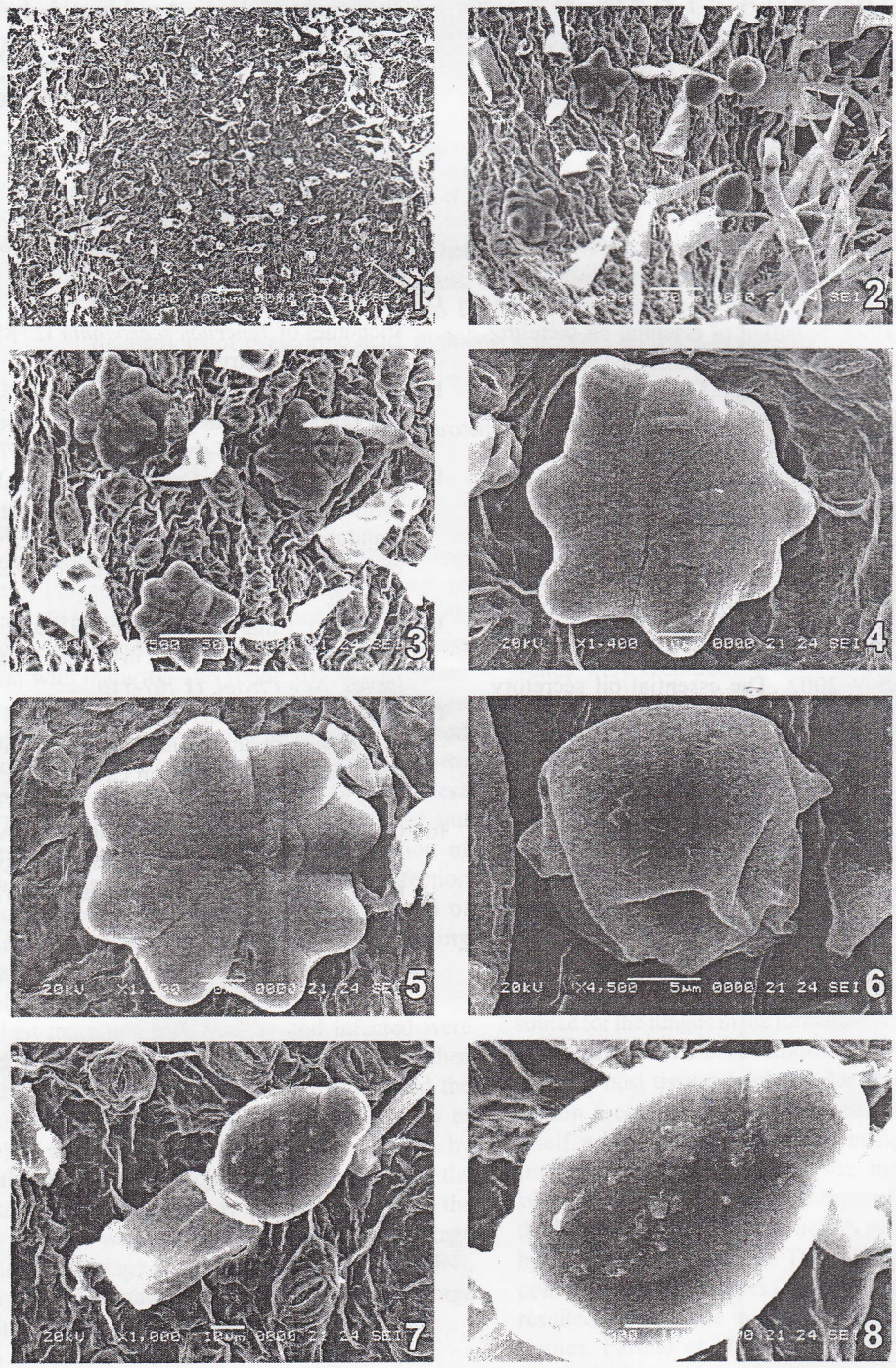
As in plants of most Lamiaceae species, the surface of *Plectranthus zeylanicus* leaves possess glandular and non glandular trichomes on both abaxial and adaxial sides (Fig.1). The glandular trichomes included peltate and capitate types (Fig.2). They are present on both leaf sides, being predominant on the abaxial surface. On the veins, non-glandular trichomes are abundant. The distribution and morphology of the glandular trichomes showed no significant variations in the comparative analysis of the *in vivo* and *in vitro* plants.

Peltate trichomes (Fig. 3-5 and 6) consist of a short stalk cell and a large head with 4-8 secretory cells arranged in a single disc as noticed in other lamiaceous members[4, 5, 11, 12]. The surface of the mature peltate glands appeared to have a more or less spherical shape because the accumulation of secretions in the subcuticular space distended the cuticle at the onset of secretory phase[5, 13]. A mature peltate trichome is about 60 μm (± 10) in diameter at the head.

Capitate trichomes are composed of a long stalk and a globoid or ovoid glandular head (Fig. 7-8). The secretory product accumulates inside the apical cells and in a very small subcuticular space, probably being exuded through cuticle micropores[5]. In maturity the capitate trichomes are about 100μm (±10) in height and the horizontal diameter of the heads is 35μm (±10).

It has been generally assumed that peltate trichomes contain the bulk of the essential oils produced by Lamiaceous members[14-16]. But capitate trichomes also have significant role in the contribution of essential oils[5].

The elements identified using EDS and their weight and atomic percentages are shown in Table 1. They exist as ingredients of diverse structural and biochemical compounds present in the plant tissues. The adaxial and abaxial sides of the leaves show almost simlar elements except cadmium which is present on the lower surface and aluminum on the upper surface only. The absence of sodium and the presence of aluminum are noticed only in *in vitro* derived plants. The concentration of the elements showed slight variations in the abaxial and adaxial surfaces and also among *in vivo* and *in vitro* plants. This may be probably due to the minor differences in the catalytic and electrochemical activities carried out in these surfaces, reflecting the specific physiological nature of the leaf surfaces. Minute differences exhibited by the *in vitro* plants when compared with the parent plant may be due to culture stress induced by the



Figs. 1-8. SEM micrographs showing distribution and types of trichomes on leaves of *P. zeylanicus.*
1. Glandular and nonglandular trichomes; 2. Peltate and capitate hairs; 3-5. Peltate heads at 4-8 celled stage; 6. Mature peltate trichome with a swollen head due to accumulation of essential oil within the subcuticular space; 7-8. Capitate trichome. Drops of secreted material can be seen on the head.

artificial *in vitro* environment.

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