HISTO-ANATOMICAL AND ECOLOGICAL ASPECTS ON MEDICINAL SPECIES (*LAMIACEAE*) FROM MEDITERRANEAN CLIMATE

ASPECTE HISTO-ANATOMICE ŞI ECOLOGICE LA PLANTE MEDICINALE (*LAMIACEAE*) DIN CLIMATUL MEDITERANEEAN

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Abstract. *In the present study we discuss several structural features regarding three medicinal species from Lamiaceae: Lavandula dentata L., Rosmarinus officinalis L. and Thymus vulgaris L. Within all histo-anatomical features, attention should be paid on protective and secretory hairs, having a large structural diversity.*
Key words: medicinal, hairs, Mediterranean, gypsophytes

Rezumat. *În lucrarea de față, prezentăm particularitățile structurale pentru trei specii de plante medicinale din familia Lamiaceae: Lavandula dentata L., Rosmarinus officinalis L. şi Thymus vulgaris L. Dintre toate trăsăturile histo-anatomice, reţin atenţia în mod deosebit perii tectori şi secretori, care prezintă o înaltă plasticitate arhitecturală.*
Cuvinte cheie: plante medicinale, peri, mediteraneean, gipsofite

INTRODUCTION

Lamiaceae (Labiatae) comprises about 7000 species included in 230-234 genera (Takhtajan, 2009). A large number of these species have aromatic and medicinal value (De Laage, 2001; Dewick, 2002; Duke et al., 2002; Barnes et al., 2007; Ebadi, 2007), as is the case of taxa discussed in the current study.

The Mediterranean climate is characterized by strong seasonality which involves the association of a drought period when temperatures are at their hottest and a cool (and cold in many areas) moist period (Thompson, 2005).

There is a rich literature related to histo-anatomical features of *Lamiaceae* species; general studies have been conducted especially by foreign botanists (Lemaire, 1882; Mansfield, 1916; Jackson and Snowdon, 1990; Svoboda K. P. and Svoboda T. G., 2000). In Romania, such investigations were focused mainly on anatomy of *Lavandula angustifolia* (Toma and Niță, 1982; Toma and Rugină, 1998; Robu et al., 2011), and *Thymus* (Toma and Berciu, 2007; Berciu and Toma, 2008; Boz et al., 2009). Secretory tissues and secreted volatile compounds have been recently summarized by Burzo and Toma (2012).

However, a large part of investigations conducted until now have a

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predominantly descriptive character. In this work, we try to propose, starting from our results, an interesting discussing context, related to possible ecological implications of secreted volatile oils. Attention should be paid on the fact that we refer on Mediterranean climate with all ecological factors emerging from it (Grigore, Toma, Boşciau, 2011a). In addition, two of investigated species (*Thymus vulgaris* and *Rosmarinus officinalis*) have been collected from gypsic soils that represent striking and incompletely elucidated ecosystems; the nature of plant adaptations vegetating in such soils has been recently critically discussed and questioned (Grigore, Toma, Boşciau, 2011b).

MATERIAL AND METHOD

In this study, we included histo-anatomically observations on three *Lamiaceae* species collected from Spain, in 2010: *Lavandula dentata* L. (collected from Gandia), *Rosmarinus officinalis* L., and *Thymus vulgaris* (collected from gypsic soils in Tuejar). Anatomical investigations were conducted following the standard method fixed by our group working in plant anatomy from Faculty of Biology Iaşi (for a detailed description of this method, see: Grigore, Toma and Boşcaiu, 2010b).

RESULTS AND DISCUSSION

In ***Lavandula dentata***, in the aerial stem (fig. 1), we noticed a relatively thin cortex with an unusual collenchyma and parenchyma in the remaining area. Underneath, a cork (3-4 layers of large cells) and phelloderm (2-3 layers of small cells) follow. Central cylinder is delimited by a discontinuous ring of thin strands of sclerenchymatic fibers, separated by the cells belonging to internal layers of cortical parenchyma. The stele has a secondary structure, derived from the cambium activity: a thick phloemic ring, a very thick xylemic ring, and an internal, thin ring of primary xylem. The lamina has a bifacial-heterofacial structure; it is worth noting the large presence of protecting multicellular, branched hairs (fig. 2); we also noticed secretory, multicellular hairs, with multicellular gland, covered by a prominent cuticle (fig. 2 – note in this case that cuticle is complete, non disintegrated).

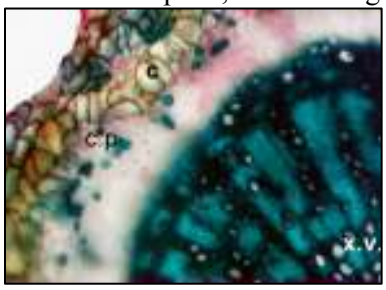

Fig.1 - Cross section through the aerial stem of *Lavandula dentata* (X 200); c – cork; c.p. – cortical parenchyma; x.v. – xylemic vessels

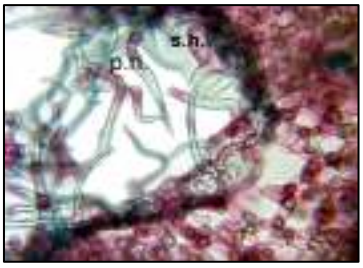

Fig. 2 - Cross section through the lamina of *Lavandula dentata* (X 200); p.h. – protective hair; s.h. – secretory hair

In ***Rosmarinus officinalis*** epidermis of aerial stem presents protective and secretory hairs (fig. 3). The first 3-4 layers underneath epidermis form an angular collenchyma, consisting of cells with moderately thick walls. This area is followed by parenchyma, where several strands of sclerenchymatic fibers may be found (fig. 3). In close proximity to endodermis or pericycle, 1-2 layers of large cork cells are located. The upper epidermis of lamina has secretory and protective hairs (fig. 4).

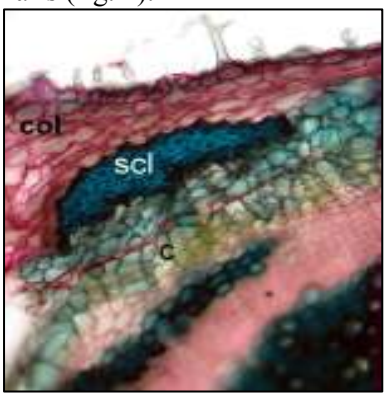

Fig. 3 - Cross section through the aerial stem of *Rosmarinus officinalis* (X 200); col – collenchyma; ck – cork; scl - sclerenchyma

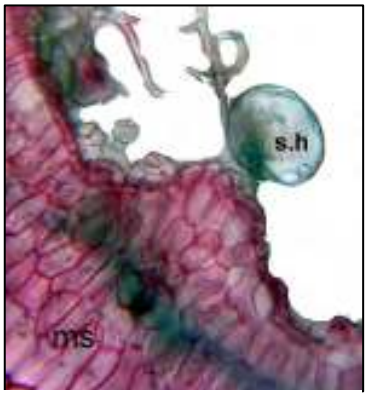

Fig. 4 - Cross section through the lamina of *Rosmarinus officinalis* (X 200); s.h. – secretory hair; ms - mesophyll

Secretory hairs are abundant, different in length, with uni-, bi- or tricellular stalk and spherical unicellular gland. The basal cell of tricellular stalk has thick walls; following the length of stalk, several branches may be evidenced. We also found scattered short secretory hairs with multicellular gland covered by a prominent cuticle. On lower epidermis, multicellular protective hairs are present; they are relatively long, branched with 2-3 unicellular branches in the point where the cells forming the axis of protective hairs are jointed (fig. 5).

In ***Thymus vulgaris*****,** in the aerial stem, the phellogen (derived from pericycle) produced 3-4 layers of cork and 1-2 layers of phelloderm, having intensely and radially flattened cells (fig. 6).

The stele is thick with secondary structure; cambium produced a very thin phloemic ring and two xylemic thick concentric rings, with scattered vessels in the libriform mass (fig. 6). Epidermis of lamina presents protective hairs; some of them are very short, unicellular, with basis clearly flattened (fig. 7), while others are long, unicellular, bicellular, or even tricellular (fig. 8). Secretory hairs are of two types: some of them are longer, with unicellular gland, and others are very short, with multicellular gland, covered by the same cuticle, very prominent (fig. 7).

Fig. 5 - Protective hair on the lamina epidermis of *Rosmarinus officinalis* (X400)

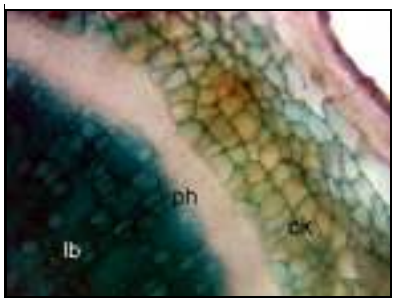

Fig. 6 - Cross section through the aerial stem of *Thymus vulgaris* (X 200); ck – cork; lb – libriform; ph - phloem

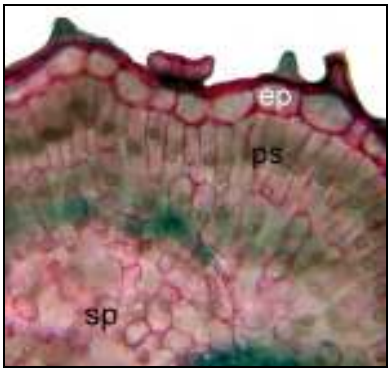

Fig. 7 - Cross section through the lamina of *Thymus vulgaris* (X 200); ep – epidermis; ps – palisade tissue; sp – spongy tissue

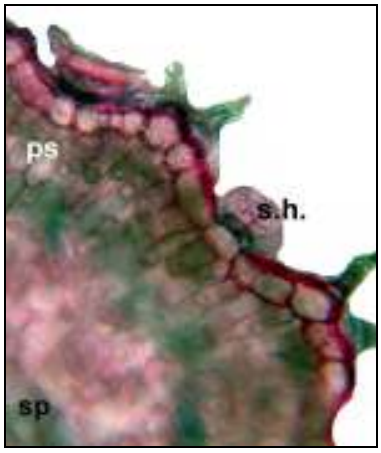

Fig. 8 - Cross section through the lamina of *Thymus vulgaris* (X 200); ps – palisade tissue; sp – spongy tissue; s.h. – secretory hair

All histological features in investigated species are generally circumscribed in the typical structural plan of *Lamiaceae.* Apart from other *Thymus* species from Romania (Berciu, 2007), the aerial stem of *T. vulgaris* shows less significant collenchyma in cortex.

The important challenge is that at least in the case of *T. vulgaris* and *R. officinalis*, their adaptations could be correlated to gypsic soils, where from these taxa have been collected. Although recognized as gypsophytes (Mota et al.¸2010), ecological significance of their histo-anatomical features is still obscure and difficult to specified; this is because *Lamiaceae* is a very heterogeneous taxonomic family and species here included have large ecological spectra.

However, taking into consideration that gypsic soils are mainly specific for Mediterranean climate and secretion of essential oils is an important property

of these species, several ecological correlations may be found.

Aromatic species from *Lamiaceae*, as perennial, evergreen and xeromorphic shrubs are, most likely, the most relevant adaptive profile in respect to ecological factors in Mediterranean. It has been proposed that the presence and accumulation of essential oils may improve tolerance of water constraints and high solar radiation (Thompson, 2005). Moreover, glandular structures containing volatile oils on the leaf surface may enhance tolerance of elevated leaf surface temperature and reduce excessive water loss. The secondary compounds may be reconverted and re-utilized after their release. In some species, neo-methyl glycoside produced by leaves is transported to roots and rhizome where it is converted into other lipid-like metabolites; further, these metabolites may be reutilized in the developing of underground organs. Not in the last, researchers assumed that essential oils might play a role in enzyme maintenance during summer when metabolism and growth are depressed. Other hypothesis suggests that the biosynthesis of essential oils could maintain the appropriate enzyme systems in a state which could allow the rapid reactivation of the metabolic system once favourable conditions for rapid growth occur (Thompson, 2005).

CONCLUSIONS

Secretory hairs and biosynthesis of essential oils – with all associated functions - suggest that their secretion could be involved in an ecological integration of these species in habitats from Mediterranean climate. Other morphological and anatomical features such as perennial, xeromorphic shrub -like appearance could be also related to the ecology of these species.

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