

Achene slime content in some taxa of *Matricaria* L. (Asteraceae)

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Abstract – The achenes of *Matricaria aurea* and two varieties of *M. chamomilla* (var. *chamomilla* and var. *recutita*) have slime cells on the surface and they are characterized by slime envelope formation during hydration. The slime in these taxa is composed of pectins and cellulose. The slime could play important role in the distribution and colonisation of new habitats in *Matricaria* taxa.

Key words: achene, slime, cellulose, pectin, *Matricaria*

Introduction

Matricaria L. is a small genus of the tribe Anthemideae with 6 species and mostly distributed in Europe, northern Africa, Macaronesia, western, south-western and central Asia, western North America (OBERPRIELER et al. 2007). The wide range of geographical distributions and the diversity of habitats such as disturbed meadows, vacant lots, areas along roads and railroads, waste and dry areas in which *Matricaria* occurs may result in different adaptations to diverse environments.

The taxonomy of *Matricaria* is controversial and very confused. Depending on the authors, several species are classified in either *Matricaria* or *Tripleurospermum*. Therefore, they have been confused with each other, both taxonomically and nomenclaturally (JEFFREY 1979, XIFREDA 1985, KERGUÉLEN et al. 1987, POBEDIMOVA 1995, APPLEQUIST 2002).

Achene morphology has been demonstrated to be paramount importance for the taxonomy of these genera (KYNOČLOVA 1970). *Matricaria* is characterized by achenes that are obovoid-oblong, circular to slightly dorsiventrally flattened in the cross-section, with 3–5 adaxially arranged thin ribs that are sometimes furnished with longitudinal resin canals and are covered with myxogenic (slime, mucilage producing) cells mainly on their abaxial sur-

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face and on the adaxial ribs (OBERPRIELER et al. 2007). However, the slime content of the achenes in the genus has not been studied so far. The aim of this study has been to examine the slime characteristics of the achenes.

Materials and methods

Plant material

The mature achenes of *Matricaria aurea*, *M. chamomilla* var. *chamomilla* and *M. chamomilla* var. *recutita* were collected from a native environment (Tab. 1). Plant vouchers have been deposited in the herbarium of Karedeniz Technical University Biology (KTUB) or H. Inceer collections.

Tab. 1. The origin of the materials studied

Taxon	Locality	Voucher
<i>Matricaria aurea</i> (Loefl.) Sch. Bip.	C6 Gaziantep/Sanlıurfa: Between Nizip and Birecik, Dutlu, roadsides, near cultivated area, 440 m a.s.l., 08.v. 2007.	Inceer 322
<i>M. chamomilla</i> L.var. <i>chamomilla</i>	C1 Muğla: Marmaris, between Marmaris and Köyceğiz, roadsides, 20 m a.s.l., 18. iv. 2007.	Inceer 305
<i>M. chamomilla</i> L. var. <i>recutita</i> (L.) Fiori	C1 Muğla: Marmaris, between Kizilkaya and Fethiye, roadsides, 24 m a.s.l., 18. iv. 2007.	Inceer 307

Slime identification by chemical reactions

The behaviour of the fruit after wetting was observed and tests on the ability of its coat to hydrate were performed. Wetting experiments, with tap water, were performed at room temperature for 1–5 min, which was sufficient for the achenes to hydrate (KREITSCHITZ et al. 2009). Methylene blue and safranin staining were carried out to identify the slime type. The images were taken using Leica DM 4000 microscope and a Leica DFC 490 digital camera.

Results

The wetting experiments show that slime cells on the surface of the pericarp produce mucilage after which the achenes are surrounded by a slime envelope. The slime is a distinct gel-like envelope. It belongs to a cellulosic type representing a heterogenous system. Staining with methylene blue and safranin dyes demonstrate that the *Matricaria* slime consists of a pectinous matrix and a cellulosic skeleton (Fig. 1).

Methylene blue and safranin staining showed a characteristic pattern. Methylene blue revealed a very faint blue envelope around the achene while an orange-red coloration of the slime was obtained with safranin (Fig. 1). Staining produced almost the same colour in both pectin and cellulose. Cellulosic threads or fibrils forming a characteristic radical skeleton around the achene were clearly visible, whereas the pectin color was spread homogeneously within the envelope.

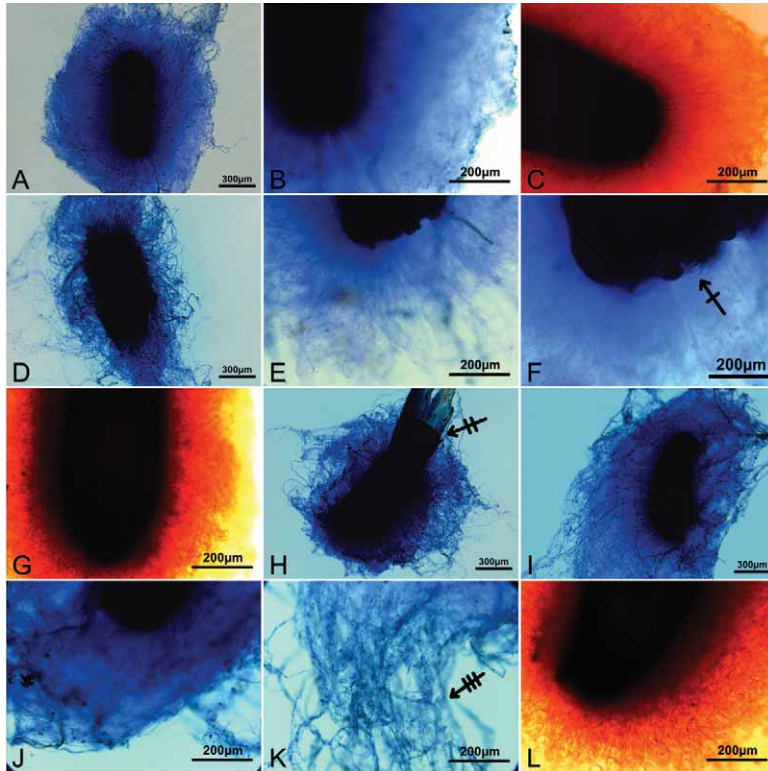


Fig. 1. Slime envelope in the achenes of *Matricaria*. **A-B** – *M. aurea* (methylene blue). **C** – *M. aurea* (safranin). **D-F** – *M. chamomilla* var. *chamomilla* (disc, methylene blue). **G** – *M. chamomilla* var. *chamomilla* (disc, safranin). **H** – *M. chamomilla* var. *chamomilla* (ray, methylene blue). **I-K** – *M. chamomilla* var. *recutita* (methylene blue). **L** – *M. chamomilla* var. *recutita* (safranin). Arrow with a line indicates slime cell, arrow with two lines indicates pappus, arrow with three lines indicates cellulose threads.

Discussion

The results obtained from micro-staining reactions demonstrated that the *Matricaria* slime is of the cellulosic type, consisting of two components i.e., pectin and cellulose. This is the first report on the slime structure of *Matricaria*. The staining results correspond to already published data in *Artemisia* and *Eragrostis* (BRODA 1971, GERLACH 1972, BRAUNE et al. 1975, O' BRIEN and MCCULLY 1981, KREITSCHITZ and VALLÈS 2007, KREITSCHITZ et. al. 2009, Tab. 2). In the literature, the presence of slime has been reported for many other angiosperm genera, e.g. in *Brassica*, *Salvia*, *Plantago*, *Linum*, *Anthemis*, *Artemisia* and *Matricaria* (MUHLETHALER 1950, YOUNG and EVANS 1973, GRUBERT 1974, GRUBERT 1982, KREITSCHITZ and VALLÈS 2007). The cells producing slime could be arranged in isolated rows on the fruit surface, as in *Anthemis*, *Artemisia* and *Matricaria* (GRUBERT 1974). In addition, GRUBERT (1982) emphasized that proper epidermal cells of the pericarp have produced the slime in *M. chamomilla*. The present results confirm that slime cells on the surface of the pericarp produce the slime.

Tab. 2. Slime staining in *Artemisia* and *Eragrostis* species

Staining	Target	Obtained color	Literature data	References
Methylene blue	Pectin	Blue	Blue	GERLACH (1972)
	Cellulose	Violet-blue	Violet, blue	BRODA (1971 in KREITSCHITZ and VALLÈS 2007)
Safranine	Cellulose	Orange	Orange-red	BRAUNE et al. (1975), O'BRIEN and MCCULLY (1981), KREITSCHITZ et al. (2009)
	Pectin	Orange-red	Red,	KREITSCHITZ and VALLÈS (2007)
			orange-red	KREITSCHITZ et al. (2009)
		Orange	KREITSCHITZ et al. (2009)	

The relative amount of slime is different in the studied taxa (Fig. 1). Differences in slime production can result from habitat diversity of the taxa. Such a relationship was reported in Lamiaceae (MOSQUERO et al. 2004). The achene of *M. aurea* growing in particularly dry habitats has higher amounts of slime in the envelope than the other taxa. High slime production in the achene may be an advantageous adaptive feature facilitating germination.

The functional significance of the slime in seeds and/or fruits has been reported in many works. It plays an important role in the control of germination, mostly in plants that grow in conditions of water deficiency in arid and semiarid environments, thus facilitating intake and maintenance of the water (KREITSCHITZ and VALLÈS 2007). Furthermore, it can delay germination due to impeded penetration by oxygen. Slime helps in fruit or seed dispersal and in the defence against pathogens (FAHN and WERKER 1972, KOROBKOV 1973, YOUNG and EVANS 1973, YOUNG and MARTENS 1991, HUANG and GUTTERMAN 1999, HUANG et al. 2000). *Matricaria chamomilla* var. *chamomilla* and var. *recutita*, which are the most widespread taxa of the genus, occur in diverse habitats such as dry and wet environments, roadsides, field margins and ruderal places as a weed. *Matricaria aurea* also grows on limestone deposits, sand, saline land, flood-plain meadows with stony soil, sometimes as a weed. It is assumed that the presence of slime cells on the surface of the achenes could play an important role in the dispersal and competitive ability of these taxa.

In some particular cases, production of slime on the fruit and or seed surface may also be an adaptation to ruderal, disturbed environments (YOUNG and EVANS 1973, KREITSCHITZ and VALLÈS 2007). The presence of a slime envelope is associated with a short life cycle and facilitates the quick colonization of such places (KREITSCHITZ and VALLÈS 2007). This study confirmed this kind of adaptation in *Matricaria*, which is an annual. Similar adaptive mechanisms are present in many common annual weeds colonizing ruderal habitats, e.g. *Lepidium flavum*, *L. nitidum*, *Plantago lanceolata*, *Cardaria draba* (YOUNG and EVANS 1973) *Arabidopsis thaliana* (WESTERN et al. 2000) and *Artemisia annua*, *A. biennis* and *Neopallasia pectinata* (KREITSCHITZ and VALLÈS 2007).

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