

Plant Anatomy

STUDIES IN LAMIACEAE

IV. FOLIAR APPENDAGES IN *Ocimum* L. AND THEIR TAXONOMIC SIGNIFICANCE

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Dermotypes of ten species of *Ocimum* L. have been studied in detail. The sixteen types of trichomes observed, fall under four major categories: (1) capitate glandular; (2) Non-glandular uniseriate filiform; (3) Non-glandular biseriate filiform, and (4) non-glandular capitate. Two new types of trichome have been reported for the Lamiaceae for the first time. On the basis of trichome types, different species of *Ocimum* can be identified though, in external morphology, venation pattern, nodal anatomy and leaf anatomy they resemble one another, except *O. sanctum* which has a two-layered palisade. A key has been presented.

INTRODUCTION

The use of epidermal appendages in taxonomy has been well recognized. (Metcalf & Chalk, 1950; Metcalf, 1963, etc.). Carlquist (1961) has stressed the need for describing the entire trichome complement of a given taxon. A number of recent studies on epidermal appendages attest their taxonomic importance in the delimitation of species (Cowan, 1950; Goodspeed, 1954; Roe, 1971; Singh *et al.*, 1975; Ramayya & Rao, 1977). During a study of the family Lamiaceae, various types of foliar trichomes were observed in *Ocimum* L. A detailed study of ten species of *Ocimum*, therefore, was undertaken to assess their systematic importance.

Seeds of ten species of *Ocimum* were procured from Solan (Plant Introduction Section, I. A. R. I.), Kurukshetra and Oakmont, U. S. A. (Table I). The plants were raised in the botanical garden and mature leaves were fixed in F. A. A. Epidermal peelings were prepared following the technique of Boulos and Beakbane (1971). In addition to the peelings, vertical sections of leaves were cut at a thickness of 10 μ and customary methods of dehydration, embedding and staining were followed for further observation and verification.

OBSERVATIONS

Sixteen types of trichomes have been observed in different species of *Ocimum* (Table I). They fall under four major categories: (1) capitate glandular; (2) non glandular uniseriate filiform; (3) non glandular biseriate filiform; (4) non-glandular capitate. Each of them is further divided on the basis of shape. A brief description of each type is given below:

TABLE I

S. No.	Name of the species	Type I Capitate glandular					Type II Non-glandular uniseriate filiform					Type III Non-glandular biseriata filiform				Type IV Non-glandular capitate				
		a	b	c	d	e	a	b	c	d	e	f	a	b	c	d	a	b	c	d
1.	<i>Ocimum americanum</i> L.	+	-	+	+	+	+	+	-	+	-	-	+							
2.	<i>O. basilicum</i> L.	+	+	+	+	-	+	-	-	+	-	-	-				-	-	-	-
3.	<i>O. canum</i> Sims.	+	-	+	+	-	+	+	-	+	+	-	-				-	-	-	-
4.	<i>O. carnosum</i> Link & Otto Ex. Benth.	+	-	+	+	-	+	+	-	+	-	+	-				-	-	-	+
5.	<i>O. citriodorum</i> Blanco.	+	+	+	-	-	+	+	+	+	-	-	-				-	-	-	-
6.	<i>O. crispum</i> Thumb.	+	-	+	-	-	+	-	-	+	-	+	-				+	-	-	-
7.	<i>O. gratissimum</i> L.	+	-	+	+	-	+	+	-	+	-	-	-				+	-	-	-
8.	<i>O. kiltmandascharicum</i> Guerk	+	-	+	+	-	+	+	+	+	+	-	-				-	-	-	-
9.	<i>O. minimum</i> L.	+	-	+	+	-	+	+	-	+	-	+	-				-	-	-	-
10.	<i>O. sanctum</i> L.	+	+	+	+	+	+	+	-	+	+	-	+				-	-	+	+

+ Present : - absent

Type-I. Capitata Glandular Trichomes

Type-Ia : *With unicellular head and one or two-celled short stalk* :—

Foot : one-celled; Stalk : one or two-celled, each cell short, broader than long, lateral walls straight or biconcave or biconvex; Head : one-celled, globose, thin walled, distinctly cutinised contents translucent (Fig. 1).

Types-Ib : *With unicellular head and two or three-celled elongated stalk* :—

Foot : one-celled, slightly projected; Neck : one-celled, short; Stalk : two or three-celled, each cell elongated, longer than broad; Head : one-celled, globose thin walled, contents translucent (Fig. 5).

Type-Ic : *With four-celled head and one-celled stalk* :—

Foot : one-celled; Stalk : one-celled, cell broader than long, lateral walls biconvex; Head : four-celled, cells globose or peltate, thick walled distinctly cutinized, contents dense, translucent or opaque (Figs. 2-4).

Type-Id : *With sixteen-or more-celled head and two-celled stalk* :—

Foot : two-celled; Stalk : two-celled, each cell short and placed side by side; Head : sixteen-or more-celled, forming a rosette, thin-walled, contents thin, translucent (Figs. 6, 7).

Type-Ie *With uniseriate clavate head and one-celled stalk* :—

Foot : one-celled, Stalk : one-celled, short; Head : four-celled uniseriate, outer walls convex, thin-walled, cutinized contents glandular, translucent (Figs. 8, 9).

Type-II. Non-Glandular Uniseriate Filiform Trichomes

Type-IIa : *Bicelled* :—

Foot : one-celled (sometimes two-celled), projected, slightly broad; Body : one-celled, straight or curved, apex tapering, acute or subacute, walls thin, distinctly cutinized (Fig. 10).

Type-IIb : *Conical filiform trichome* :—

Foot : one-or two-celled; Body : three to seven-celled, uniseriate, conical, curved, lateral walls straight, convex or concave, apex acute, terminal cell elongated, contents thin. (Fig. 11).

Type-IIc : *Speared filiform trichome* :—

Foot one or two-celled; Body : three-or four-celled, uniseriate, apex acute, one or two basal cells much elongated, terminal cell small, wall thin or moderately thick, contents dense (Fig. 12).

Type-IIId : *Simple filiform* :—

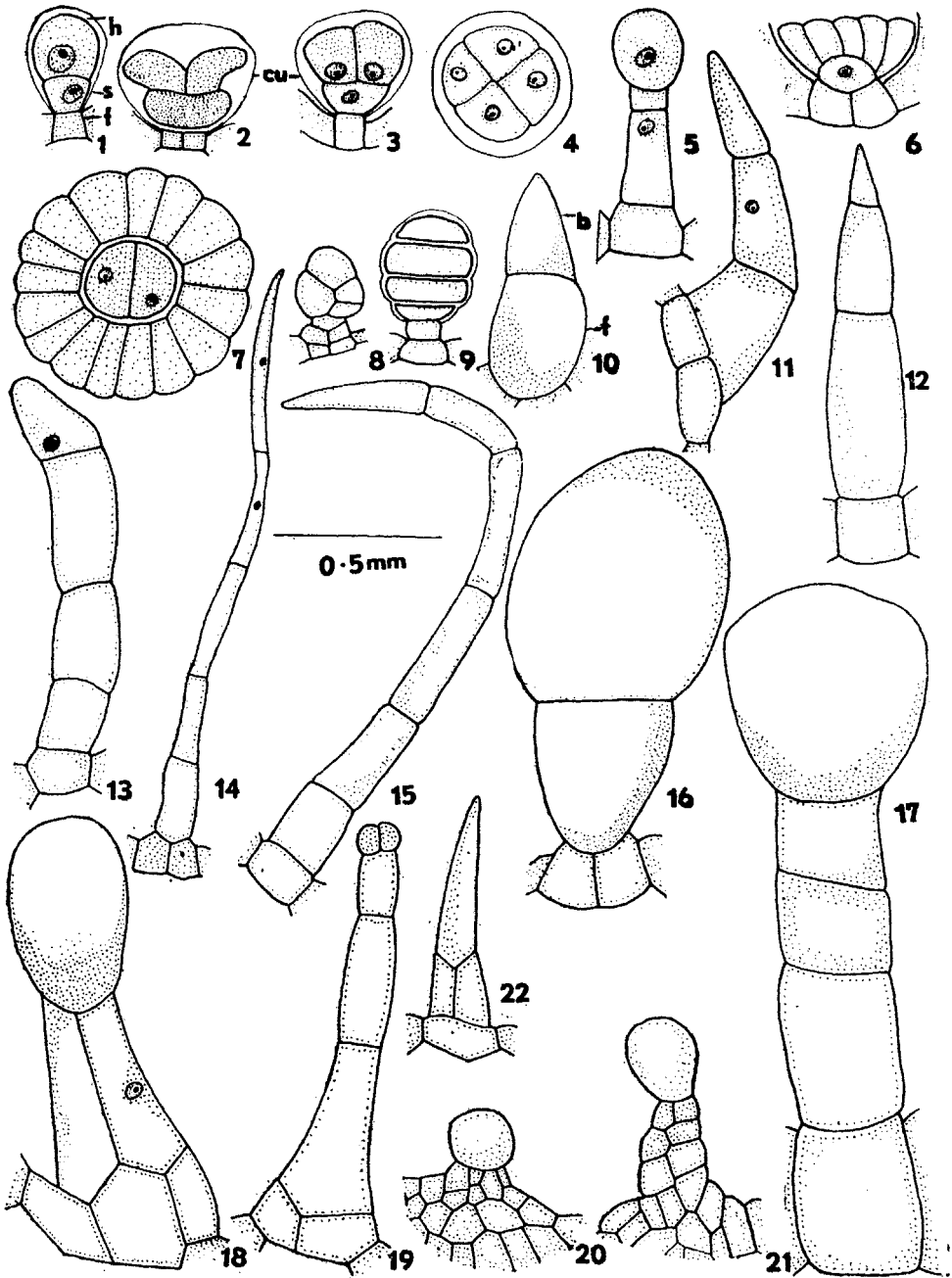
Foot : one-or two-celled, slightly projected; Body : three-to twelve-celled, uniseriate filiform, tapering above, acute apex, lateral walls straight or slightly curved, constricted, thin-walled, maximum length up to 2075 μ (Figs. 13, 14).

Type-IIe : *Falcate filiform* :—

Foot : one-celled; Body : three to eight-celled, uniseriate, sickle-shaped, constricted tapering, acute apex, upper few cells curved, thin walled, cutinized, contents translucent (Fig. 15).

Type-IIIf : *Truncate filiform trichome* :—

Foot : two-celled; Stalk : one-celled, elongated, lateral walls slightly convex; Head : unicellular with truncate rounded apex, contents thin, vacuolated (Fig. 16).



FIGS 1-22. : 1-9. Glandular trichomes of *Ocimum* 1, with one-celled head and one-celled stalk; 2-4, with four celled head and two-celled stalk; 5, with one-celled head and 2 or 3-celled elongated stalk; 6-7, with 16 or more celled head and two-celled stalk; 8-9, with uniseriate clavate head; 10-22, non-glandular trichomes of *Ocimum*; 10, Bicelled; 11, conical filiform; 12, speared filiform; 13-14, simple filiform; 15, falcate filiforms; 16, truncate filiform; 17, uniseriate capitate with one-celled head; 18, biseriante capitate with one-celled head; 19, uniseriate capitate with two-celled head; 20-21, multiseriate capitate; 22, biseriante filiform; [*b*, body; *cu*, cuticle; *f*, foot; *h*, head and *s*, stalk].

Type-III *Non-Glandular Biseriate Filiform Trichomes*

Type-IIIa : *Biseriate filiform trichome* :— Foot : one-celled; Body : two-to four-celled, base of the trichome biseriate and apex uniseriate, tapering, acute contents thin (Fig. 22).

Type-IV : *Non-Glandular Capitata Trichomes*

Type-IVa : *Uniseriate capitata with one-celled head* :— Foot : one-celled; Stalk : two-to four-celled, cells isodiametric, broader than long; Head : one-celled, oblong, vacuolated (Fig. 17).

Type-IVb : *Uniseriate capitata with two-celled head* :— Foot : two-celled, projected; Stalk : three-or four-celled, cells elongated; Head : two-celled, cells globose and small, contents translucent (Fig. 19).

Type-IVc : *Biseriate capitata with one-celled head* :— Foot : two-celled; Stalk : two-to four-celled arranged in two rows; Head : one-celled, oblong, vacuolated (Fig. 18).

Type-IVd : *Multiseriate capitata with one-celled head* :— Foot : many-celled; Stalk : many-celled, multiseriate, scale like; Head : one-celled small, globose, thin-walled (Figs. 20-21).

The nodal anatomy of all the ten species depicts unilacunar one-trace condition (Gupta & Bhambie, 1977). Gross morphology, venation pattern, petiole and leaf anatomy of all the ten species have been worked out. In gross morphology there are minor differences in shape, texture, etc., however, in petiolar anatomy they simulate each other. In venation pattern there is much overlapping in shape, size and absolute number of vein-islets and vein-ending termination as in *Salvia* (Gupta & Bhambie, 1978). Leaf anatomy is exactly similar in all the species except *O. sanctum* which possess a two-layered palisade in contrast to other species having a single-layered palisade.

RESULTS AND DISCUSSION

Metcalf and Chalk (1950) have reported the occurrence of seven types of trichomes in Lamiaceae but only one type of foliar appendage has been referred in the genus *Ocimum*. Three types of floral trichomes, i.e. uniseriate non-glandular, multicellular glandular with one-celled head and many-celled head have been described for *O. basilicum* by Mathur (1961). The systematic importance of trichomes in the family Lamiaceae has been emphasized earlier by Metcalf & Chalk (1950), but their identification value at the specific level in *Lavandula* (Bhatnagar & Dunn, 1963) and *Salvia* (Bhatti & Dunn, 1962; Singh *et al.*, 1975) has been stressed only in the last decade. Singh *et al.* (1975) have observed 16 types of floral trichomes in 12 species of *Salvia* and have prepared a key for their identification on the basis of trichome morphology.

In the present study 16 types of glandular and non-glandular trichomes have been listed, which on the basis of shape and to some extent size, have been

further classified into four major categories. A range in the size of multicellular uniseriate trichomes from 70 to 2075 μ has been recorded in *O. citriodorum* and hence this character cannot be considered as reliable and consistent. Some species are, however, characterized by their long hairs, e.g. *O. kilimandascharicum* (1250 μ) *O. crispum* and *O. citriodorum* (2075 μ). Uniseriate clavate glandular trichomes and multiseriate capitate trichomes have been reported for the first time for this family. The former is met within two species (Table I), while the latter is restricted to the leaf of *O. sanctum* which can also be identified from the rest in having two layers of palisade.

The importance of trichomes determining the relationships of families, genera or species has been recognised in the literature (see Metcalfe & Chalk, 1950; Carlquist, 1961; Metcalfe, 1963, 1969; Ramayya & Rajagopal, 1971; Radford *et al.*, 1974; Singh *et al.*, 1974, 1975; Rao & Ramayya, 1977). Considerable diversity in the trichomes of ten species of *Ocimum* has been noted although all of them grow and flourish well in the mesophytic environment at Kurukshetra. This shows that their occurrence is a persistent character as some of the species belong to diverse phytogeographical regions. The trichome types provide useful criterion for the identification of different species of *Ocimum* as is born out by a tentative key that follows.

A KEY FOR THE IDENTIFICATION OF DIFFERENT SPECIES OF *Ocimum*

A. Uniseriate capitate trichomes present :

Biseriate at the base and uniseriate above type present :

Multiseriate capitate type present *O. sanctum*

Multiseriate capitate type absent *O. americanum*

Biseriate at the base and uniseriate above type absent.

Truncate filiform type present *O. crispum*

Truncate filiform type absent *O. gratissimum*

B. Uniseriate capitate trichomes absent :

Truncate filiform type present.

Biseriate capitate type present *O. carnosum*

Biseriate capitate type absent *O. minimum*

Truncate filiforms type absent.

Speared filiform type present.

1-celled head and elongated stalk

type present *O. basilicum*

1-celled head and elongated stalk

type absent *O. canum*

Speared filiform type absent.

Many celled head and 2-celled stalk

type present *O. kilimandascharicum*

Many celled head and 2-celled stalk

type absent *O. citriodorum*

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*Original not seen.