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MORPHOLOGY OF THE LEAF EPIDERMIS AND SYSTEMATICS IN SOME *DISSOTIS* BENTH SPECIES (MELASTOMATACEAE)

H. O. EDEOGA and A. U. EBOKA

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ABSTRACT

Studies on the morphology of the leaf epidermis of some species of *Dissotis* from southern Nigerian were conducted using a light microscope and reported for the first time. This was with the main aim of evaluating their reliability as aids in the systematic identification of these wild, ornamental and medicinal plants. Paracytic stomata were common on the abaxial and adaxial surfaces of all the taxa except in *D. rotundifolia* where the stomata were anomocytic. Trichomes of variable structures and density were found on both surfaces of the leaf in the four taxa investigated. The epidermal cells architecture varied from pentagonal to polygonal in both surfaces of the leaf except in *D. rotundifolia* where they were sinuous and irregular in shape. Other characters of the epidermis that exhibited variation include frequency of stomata, and shapes of basal ends of the trichomes. The significance of these characters in the systematics of the taxa was discussed in view of the controversial and divergent nature of the current opinions on the nomenclature of some *Dissotis* species.

Key words: *Dissotis*, epidermis, Melastomataceae, morphology, systematics, taxa.

INTRODUCTION

The genus *Dissotis* Benth. is in the family Melastomataceae, a family of largely tropical and subtropical plants represented by 240 genera and 3000 species. According to Willis (1985), the family, Melastomataceae is a very natural family usually easy to recognize in vegetation condition by the peculiar leaf veining. Members exist under various conditions and vary much in habit; herbs, shrubs, trees, with usually erect stem, some climbing, some epiphytic, water or marsh plants. The stem is often 4-angled and the leaves are usually decussate, one much larger than other, the smaller one often withering as it grows older. The leaves are usually simple with the veins diverging from base and converging at apex and more or less the same in size, with no true mid-rib.

In West Africa, the family, Melastomataceae is represented by 20 genera of which *Dissotis* has about 37 species. Hutchinson and Dalziel (1966) in their Flora of West Tropical Africa, recognized these species in addition to five other imperfectly known species. In Southern Nigeria, there are four common species of *Dissotis* namely, *D. erecta* (Guill. and Perr.) Dandy; *D. grandiflora* (Sm.) Benth., *D. rotundifolia* (Sm.) Triana; and *D. segregata* (Benth.) Hook f. and they were the *Dissotis* species investigated. The descriptions of the morphological characters of these taxa have been made by Hutchinson and Dalziel (1966) and Akobundu and Agyakwa (1987). *D. erecta* is a shrubby herb up to 5 metres high found both in dry situations as well as by streams. The flowers are purple, red, pink or rarely white. *D. grandiflora* has a stem of 1.5-2.5 metres growing from a woody tuberous base. The flowers are purple and 3-5cm in diameter. *D. rotundifolia* is a common and variable decumbent herb, often in damp places. The flowers are pink or mauve and are about 3-4cm in diameter. *D. segregata* has stem that is 4-angled with bristles at the nodes, shrubby below, 3-5m high and found always at edges of swamps. The flowers are red, blue or purple and about 2cm in diameter.

The *Dissotis* species have been subjected to independent studies and these have led to the revisiting of the systematic positions of some of these taxa (Lowe and Soladoye 1990, Whiffin *et al.*, 1993). For instance Lowe and Soladoye (1990) reported the changing of *Dissotis erecta* (Guill and Perr.) Dandy to *Melastomastrum capitatum* (Vahl) A. & R. Fern., *Dissotis rotundifolia* (Sm.) Triana to *Heterotis rotundifolia* (Sm.) Jac. Fel. and *Dissotis segregata* (Benth.) Hook. f. to *Melastomastrum segregatum* (Benth.) A & R. Fern. In most parts of Nigeria, the *Dissotis* species are weeds of crop plantations, damp places, road sides and waste places (Akobundu and Agyakwa 1987). They also have different medicinal uses among the traditional African medical practioners (Hutchinson and Dalziel, 1966; Gill, 1992; Bartram, 1998; Mnimh, 1996). These *Dissotis* species are also known to be important ornamentally or for feeding animals and even serve as leafy vegetables for human consumption (Oliver, 1959).

The use of leaf epidermal morphology in systematics, is becoming popular just as the use of other markers like DNA sequence, chemical compositions, histochemical attributes and presence/absence of several groups of secondary metabolites. Ahmad (1975) studied the cuticular and epidermal

H. O. EDEOGA, Department of Biological Sciences, Federal University of Agriculture, Umudike, Nigeria.
A. U. EBOKA, Department of Biological Sciences, Federal University of Agriculture, Umudike, Nigeria.

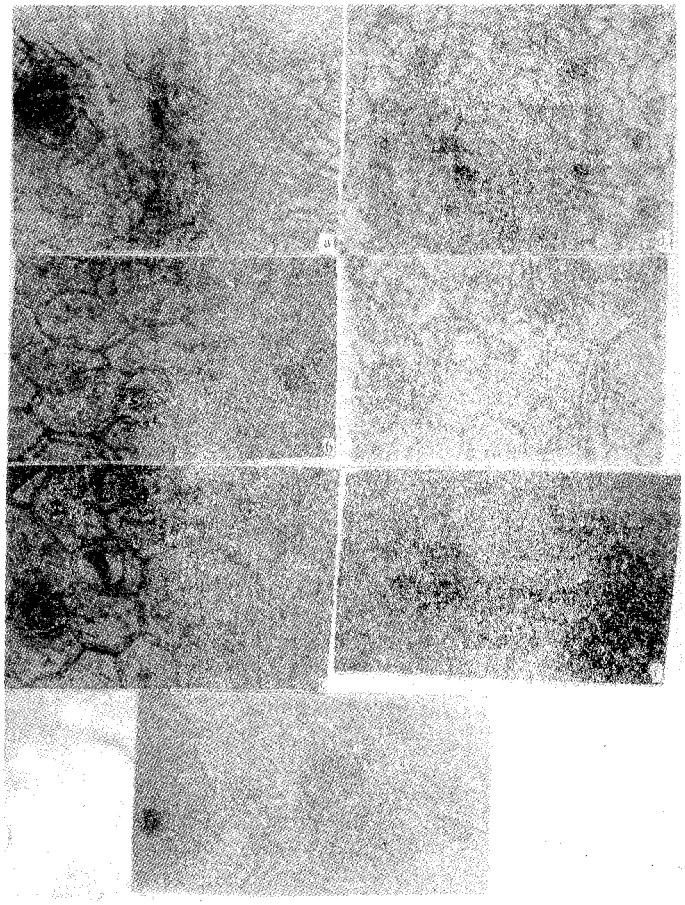

FIG. 1

Lower epidermis

(a) *D. grandiflora* (x 200)
(b) *D. erecta* (x 100)
(c) *D. segregata* (x 100)
(d) *D. grandiflora* (x 100)
(g) *D. rotundifolia* (x 250)
epidermal cells polygonal in shape, stomata paracytic except, in *D. rotundifolia* where it is anomocytic.

Upper epidermis

(e) *D. grandiflora* (x 200)
(f) *D. segregata* (x 200)
Stomata few, trichome with a characteristic basal structure.

structures of some Acanthaceae and noted their relevance in the taxonomy of this group. Gill and Karatela (1985) investigated the epidermal structure and stomatal ontogeny of some Nigerian ferns and agreed that they are important in their recognition. Olowokudejo (1990) compared the morphology of the leaf epidermis in the genus *Annona* and recommended the utilization of this in the identification of the species. Edeoga (1991), Edeoga and Osawe (1996), Edeoga and Ikem (1988) consistently reaffirmed the fact that epidermal and cuticular traits of plants could serve as useful tools exploitable in the systematics of the present day angiosperms.

Apart from the preliminary reports of Espinoza de Peria and Leon (1993) and Whiffin *et al* (1993) on the wood anatomy and taxonomy of some Melastomataceae, excluding any of the members investigated, no report specifically on the epidermal features of the *Dissotis* species had been documented.

This paper therefore reports the epidermal characters in four species of *Dissotis* as observed with a light microscope. It assesses the relevance of, and discusses the extent to which, the different epidermal features of the leaf might be utilized in the systematic consideration of some *Dissotis* species in view of the disagreement in their systematics (Hutchinson and Dalziel, 1966, Lowe and Soladoye, 1990; Akobundu and Agyakwa 1987).

MATERIALS AND METHODS

Specimens of the four species of *Dissotis* found in Southern Nigeria were identified at the Forestry Herbarium, Ibadan, FHI. This abbreviation (FHI) follows Holmgren et al. (1981). Three to ten samples of each species of *Dissotis* investigated were examined using light microscope. An area of 1cm square was removed from a central/standard position (Olowokudejo, 1990), always midway between the base and apex, of the mature and fresh leaves of the four *Dissotis* species (*D. erecta, D. grandifolia, D. rotundifolia* and *D. segregata*). Epidermal preparations were made by boiling these collected specimens of each of the four taxa in different test tubes containing 70% ethanol for 10 minutes. These were allowed to cool and later bleached in 8% sodium hypochlorite solution (NaOCl) for 5 minutes. Epidermal peels were stained with 1% ethanol safranin and temporarily mounted in aqueous glycerol solution (Cutler, 1978). Photomicrographs of the epidermal features were taken from the slides using a Carlzeiss Jenaval microscope fitted with MF. Aks 24 x 36 automatic camera. Thirty randomly selected stomata were measured using a micrometer eyepiece. For the terminology used in this study, see Metcalfe and Chalk (1950).

RESULTS

The epidermal structures are very interesting in all the *Dissotis* species investigated and were summarized in Table 1 and illustrated in Fig. 1. The epidermal cells of these plants vary in morphology and are either polygonal or sinuous. The shape of the epidermal cells in the lower epidermis of *D. segregata* range from pentagonal to polygonal though the hexagonally shaped cells are predominant (Fig.1). The

same pattern of epidermal cells = arrangement was observed in the lower epidermis of *D. grandiflora* and *D. erecta* (Fig. 1a -b). The epidermal cells of the lower epidermis are sinuous or irregular in shape in *D. rotundifolia* and are therefore diagnostic. (Fig. 1g). Paracytic stomata are found in both the upper and lower epidermis of all the *Dissotis* species investigated except in *D. rotundifolia* in which the stomata are anomocytic (Table 1). Unicellular and multicellular trichomes characterize all the species of *Dissotis* studied and all the taxa investigated are amphistomatic since there are stomata in both the upper and lower epidermis. The nature of the basal cells of the trichomes is however interesting since *D. grandiflora* and *D. segregata* have unicellular trichomes anchored on ring-like basal bodies on the lower epidermis (Fig.1d and f). Conversely, the upper epidermis possessed trichomes that lacked these features.

The distribution of stomata in both the upper and lower epidermis also differed among the investigated plants. Thus the stomatal index varied from 12.29% in *D. grandiflora* to 49.18% in *D. rotundifolia*. The stomatal density is therefore, highest on the lower epidermis and lowest on the upper epidermis.

DISCUSSION

The preceding results showed that microscopic features of the upper and lower surfaces of the leaf might be useful in identifying these plants or leaf fragments of the *Dissotis* species which could be otherwise indistinguishable. The variation in epidermal cells = architecture recorded among the investigated taxa is not strange since Olowokudejo (1990) made similar observation in some *Annona* species, pointing out that *A. squamosa* is characterized by sinuate epidermal cells whereas other investigated *Annona* species have irregular epidermal cells with curved anticlinal walls. The situation is similar among the *Dissotis* species investigated since both *D. segregata* and *D. grandiflora* have epidermal cells that are polygonal and regular in shape (Fig. 1c-f) suggesting close affinity between them although these taxa can be separated from each other by a combination of other characters such as stomatal size and index, epidermal cell size and indumentum. The sinuous cells of *D. rotundifolia* distinguishes it from other taxa investigated and more importantly from *D. grandiflora* to which it is most closely related.

Trichome types in these four taxa also constitute important distinguishing features. *D. erecta* and *D. grandiflora* posses prominently multicellular trichomes (Table 1) while unicellular hairs are present in *D. rotundifolia* and *D. segregata*. The four species investigated, could therefore be separated into two groups based on the morphology of their trichomes. This suggestion is in line with those of Edeoga (1991), Edeoga and Osawe (1996) and Edeoga and Ikem (1998)who used the epidermal characters, including trichome morphology, to elucidate the problem of recognition and identification of some members of the family Costaceae, Leguminosae-Caesalpinioideae and Nyctaginaceae. They noted that *Costus afer* was characterized by the presence of multicellular hairs while *C. lucanusianus* had mostly unicellular hairs. Similarly all the *Senna (Syn. Cassia)* species they investigated were reported to have unicellular trichomes. In the same vein, Edeoga and Ikem (1998) observed that *Boerhavia coccinea* could be separated

Table 1: Epidermal characteristics of the *Dissotis* species studied.

	Dissotis rotundifolia		*Dissotis erecta*		*Dissotis segregata*		*Dissotis grandiflora*	
PARAMETER	LE	UE	LE	UE	LE	UE	LE	UE
Stomatal Index (%)	49.18	25.12	45.65	23.1	42.51	26.08	21.58	12.29
Stomatal Type	Anomocytic	Anomocytic	Paracytic	Paracytic	Paracytic	Paracytic	Paracytic	Paracytic
Shape of Epidermal Cell	Sinuous	Sinuous	Pentagonal to Heptagonal	Pentagonal to Heptagonal	Pentagonal to Heptagonal	Pentagonal to Heptagonal	Pentagonal to Heptagonal	Pentagonal to Heptagonal
Trichome Type	Unicellular	Unicellular	Unicellular	Unicellular	Unicellular	Unicellular	Unicellular	Unicellular
Rows of Cell per Trichomes	1	1	3	3	1	1	3	3

KEY: L E = Lower epidermis
U E = Upper epidermis

from *B. diffusa* and *B. erecta* because of the presence of mostly glandular trichomes in *B. coccinea*. *D. segregata* and *D. grandiflora* also differed from other species by the presence of ring-like structures and knobs at the basal cells of trichomes. Apart from this diversity in nature of trichomes, other epidermal and stomatal characteristics of these two species are variable enough to distinguish between them (Table 1).

The anomocytic stomata of *D. rotundifolia* separates it from the other taxa which have paracytic stomata in both the adaxial and abaxial epidermis. Many workers have reported the presence of anomocytic and paracytic stomata in different groups of angiosperms but not in any members of the *Dissotis* species investigated. Such reports include those of Patel and Shah (1991) in Solanaceae, Karatela and Gill (1985) in Convulaceae, Shah and Gopal (1972) in Dioscoreaceae, Olowokudejo and Pereira-Sheteolu (1988) in Lamiaceae, etc.

The two taxa, *D. rotundifolia* and *D. grandiflora* could also be distinguished from the remaining species of *Dissotis* investigated on the basis of the stomatal index values of the upper epidermis (Table 1). The stomatal index values varied from 12.29% to 25.72% in *D. grandiflora* and *D. rotundifolia* respectively while it ranges from 23.01% to 26.08% in *D. erecta* and *D. segregata* respectively. Olowokudejo and Pereira-Sheteolu (1988) found stomatal index values very reliable in distinguishing between the leaves of medicinal species of *Ocimum* from non-medicinal ones.

The distinguishing epidermal features observed in these investigations are of systematic value because they are reasonably constant within each of the taxa investigated despite their wide morphological diversity. Olowokudejo (1990) made similar observation in the genus *Annona*. Thus the epidermal features of these members of Melastomataceae investigated are consistent enough to be used in identification of the individual species of *Dissotis* either in sterile or fragmentary condition. This is important in view of the controversial nature of the current opinions on the nomenclature of these *Dissotis* species (Hutchinson and Dalziel, 1966, Lowe and Soladoye 1990). As a result of these suggested changes in the names of some of these taxa, further investigations in such botanical disciplines as histochemistry, cytology, anatomy, palynology and taximetrics, are necessary steps to be taken so as to clarify the already confused states of the nomenclature of some *Dissotis* species from Nigeria.

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