

## THE DIVERSITY OF LEAF EPIDERMAL FEATURES IN THE GENUS *HYPTIS* JACQ (LABIATAE) IN WEST AFRICA

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### ABSTRACT

Leaf epidermal morphology of the five species of *Hyptis* (Labiatae) in West Africa has been studied using Light and Scanning Electron Microscopy. Epidermal cells are irregular with undulate or wavy anticlinal walls or rarely polygonal with straight to curved anticlinal walls. In *H. pectinata* and *H. lanceolata*, the adaxial epidermal cells are either irregular or polygonal, an observation which may be accounted for by eco-geographical differences. The periclinal walls consist of irregular ridges and cuticular folds on both abaxial and adaxial surfaces. The adaxial epidermal cells are generally larger than those on the abaxial surface. All taxa have diacytic stomata and are amphistomatic with more stomata on the abaxial surfaces. Stomata may be slightly raised, level with the surface or slightly sunken. The stomata are characterised by the presence of pronounced, overarching cuticular rims. Trichomes are multicellular or rarely unicellular, uniseriate, non-glandular or glandular, unbranched and thin walled. They are usually densely or rarely sparsely distributed on both surfaces of the leaves, and are covered with numerous tubercles. Trichomes vary in size and form even on the same epidermal surface of every taxon. The glands are usually globose in shape. Some characters which are of taxonomic value include the adaxial epidermal cell shape, anticlinal wall pattern, size of stomata, epidermal cell and trichome type. A key is presented for the identification of the species.

**Key words :** Leaf epidermis, *Hyptis*, Labiatae, West Africa

### INTRODUCTION

*Hyptis* Jacq. is one of the larger genera of the family Labiatae comprising about 400 species which grow largely in Tropical America (Riley, 1963) although several of them have spread into the old world tropics as introduced weeds which are sometimes widespread.

The genus is represented by five species in West Tropical Africa (Hutchinson and Dalziel, 1963). *Hyptis*, like most members of the family Labiatae, is of considerable economic importance ranging from yielding useful aromatic essential oils of commerce, medicine, to being ornamentals. Several of its species are in common use in African traditional medicine for the treatment of various ailments. *H. pectinata* (Lian.) Poit. is used in Ashanti, Ghana and Southern Nigeria as a laxative for young children and to ease child-birth while its poultices derived from the leaves are applied for chest abnormalities (Dalziel, 1956). The leaves are used as flavours in soup and in the treatment of fever. When used with *Guiera senegalensis* J. F. Gmel; the mixture helps in the control and treatment of diseases which are accompanied with mucous catarrh in horses. The whole plant of *H. spicigera* Lam. is burned in rooms to repel mosquitoes. It may also be kept under bundles of millet to keep away termites (Dalziel, 1956). In Gambia, the leaves of the same species are used to bath infants (Dalziel, 1956) while its seeds are used as food and in the treatment and control of cold.

An infusion of the dried leaves of *H. suaveolens* Poit. is taken for fever or sometimes as an ordinary beverage. The plant is also tied round the head to relieve headache and applied in the treatment of boils. Furthermore, *H. suaveolens*, apart from

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serving as fodder for cattle, the juice of the pressed leaves and those of *H. brevipes* Poit together with lime juice is drunk for stomach ache (Dalziel, 1956).

The value of the leaf epidermal characters in the identification, classification and delimitation of taxa has been variously emphasized in notable works which include those of Stace (1965), Dilcher (1974), Dehgan (1980), Olowokudejo (1985, 1990, 1993), Olowokudejo and Pereira-Sheteolu (1988), Olowokudejo and Obi-Osang (1993), Olowokudejo and Nyananyo (1990), Pereira-Sheteolu (1992), Sheteolu and Ayodele, (1997) and Ayodele and Olowokudejo, (1997).

This study examines the pattern of variation in the leaf micro-morphological characters of the West African species of *Hyptis* with a view to using these features for the identification of the species. This would help reduce cases of adulteration which sometimes occur when the plants are bought in local markets or collected in fragmentary or sterile forms. This paper is the outcome of part of a wider programme of research into the taxonomy of medicinal plant genera in West Africa being undertaken at the Universities of Lagos and Ibadan, Nigeria. The results of some of the investigations have been published elsewhere (Ayodele and Olowokudejo, 1997; Olowokudejo, 1990; 1993; Olowokudejo and Obi-Osang 1993; Olowokudejo and Nyananyo, 1990; Olowokudejo and Pereira-Sheteolu, 1988). The aim is to provide, through a systematic evaluation of epidermal micro-morphology, reliable taxonomic characters that would facilitate accurate and rapid identification of the various plant samples.

## MATERIALS AND METHODS

Specimens of the five taxa were examined at the Forestry Research Herbarium, Ibadan (FHI) and the University of Ibadan Herbarium (UIH). The list of specimens examined, localities, collectors and respective herbarium number are given in Table 1.

**Scanning Electron microscopy** – Mature leaf samples were rehydrated by boiling in water for 5-10 minutes and then fixed in formalin-acetic-alcohol (FAA) for 24 hours. The samples were later washed in distilled water and dehydrated serially in 50-100% ethyl alcohol. All samples were air-dried and kept in a dessicator.

An area of about 5mm square was taken from a central standard position of each leaf and attached to a labelled stub using double-sided adhesive tape. The material was coated with gold in a Polaron E-5000 sputter coater and examined with a JEOL JSM-T 20 scanning electron microscope at an accelerating potential of 20 Kev. All electron micrographs were made at the Electron Microscopy Unit, Department of Botany, University of Reading, Berkshire, England.

The whole area of the 5mm square sample was examined before suitably representative parts were selected for photography. Each sample was photographed at three magnifications x350, x 750, to reveal the general surface micromorphology, and x2000, to show details of stomata, wall sculpturing and wall deposits. The photomicrographs shown in Plates 1-12 represent the total range of variation found within the genus and are typical of the taxa they depict.

**Light microscopy:** An area, about 5mm – 1cm square was removed from a standard position usually midway between the base and apex of the mature leaf. Each sample was

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soaked in concentrated trioxonitrate V acid (HNO<sub>3</sub>) in capped specimen bottles for a period ranging from 3 – 16 hours depending on the nature of the leaf. The sample was then carefully washed in water and the adaxial and abaxial epidermises teased from the mesophyll using fine forceps and dissecting needles. The membranes were transferred into 50% ethyl alcohol for 2 minutes to harden and then stained in safranin before dehydrating in ethyl alcohol series. Each membrane was mounted in glycerin and the slides sealed with nail varnish to reduce dehydration. Drawings were made using a Wild MI2 microscope fitted with camera lucida.

### Character Assessment:

Thirty randomly selected epidermal cells, trichomes and stomata were measured using a micrometer eye-piece from each surface. Descriptive statistics of mean, standard deviation and standard error were calculated for all variables. One leaf sample per specimen was examined and the number of specimens studied in each species ranges from three to five depending on the geographical distribution of the available specimens.

**Table 1:** Sources of *Hyptis* specimens examined

	<i>Taxa</i>	<i>Collector(s)</i>	<i>Locality</i>	<i>UIH/FHI No</i>
1.	<i>Hyptis spicigera</i>	Odewo and Adedeji	Gombi Rd. Gongola State, Nigeria	FHI 96849
		Soladoye and Ekwuno	Brinin Gwari, Kaduna State, Nigeria	FHI 76292
		Latilo M. G	Yola, Gongola, State	FHI 61410
2.	<i>H. pectinata</i>	Geerling and Bokdam	Bobo-Didasso, Burkina-Fasso	FHI 82423
		Lowe J	Auchi, Edo State	UIH 13267
		Latilo, M. G.	Egbe, Kwara State, Nigeria	FHI 62251
		Ivens G. W.	Iloro, Oyo State	UIH 13727
		Olorunfemi	Jos, Plateau State	UIH 15352
3.	<i>H. suaveolens</i>	Latilo, M. G.	Akwa-Agulu, Onitsha, Nigeria	FHI 27308
		Lowe, J.	23 miles East of Bauchi, Bauchi State, Nigeria	FHI 23170
		Wit. P.	Ibadan, Oyo State, Nigeria	FHI 27891
		Onyeachusim H. D. and A. Binuyo	Ilorin, Kwara State	FHI 58313
4.	<i>H. atrorubens</i>	Baldwin, J. T. (Jr.)	Central Province Sanokwele, Liberia	FHI 9448
5.	<i>H. lanceolata</i>	Morton, J. K.	Osaoduku Akuse, Ghana	FHI 51890
		Nditapha	Marafe-Southern Cameroon	FHI 52621
		Olorunfemi Akampa,	Cross-River State Nigeria	FHI 76292
		Onijamowo and Ariwaodo		
		K.R.M Williamson	Oporoma, Rivers State	UIH 13870
G. Jackson	Zura, Zaria, Kaduna State	UIH 14488		

## RESULTS

### Scanning Electron Microscopy

All the features are observed in the surface view of the abaxial and adaxial epidermises of the leaf taken from a standard level showing mature cells. The periclinal walls consist of irregular ridges and cuticular folds on both abaxial and adaxial surfaces (Plates 1-12). Anticlinal walls are inconspicuous in most taxa, their positions being obscured by the irregular cuticular undulations except in *H. spicigera* (Plates 7 & 8) where the walls are indicated by either shallow or deep grooves.

Table 2: Epidermal characteristics of *Hyptis* species Min. (Mean  $\pm$  s.e.) Max

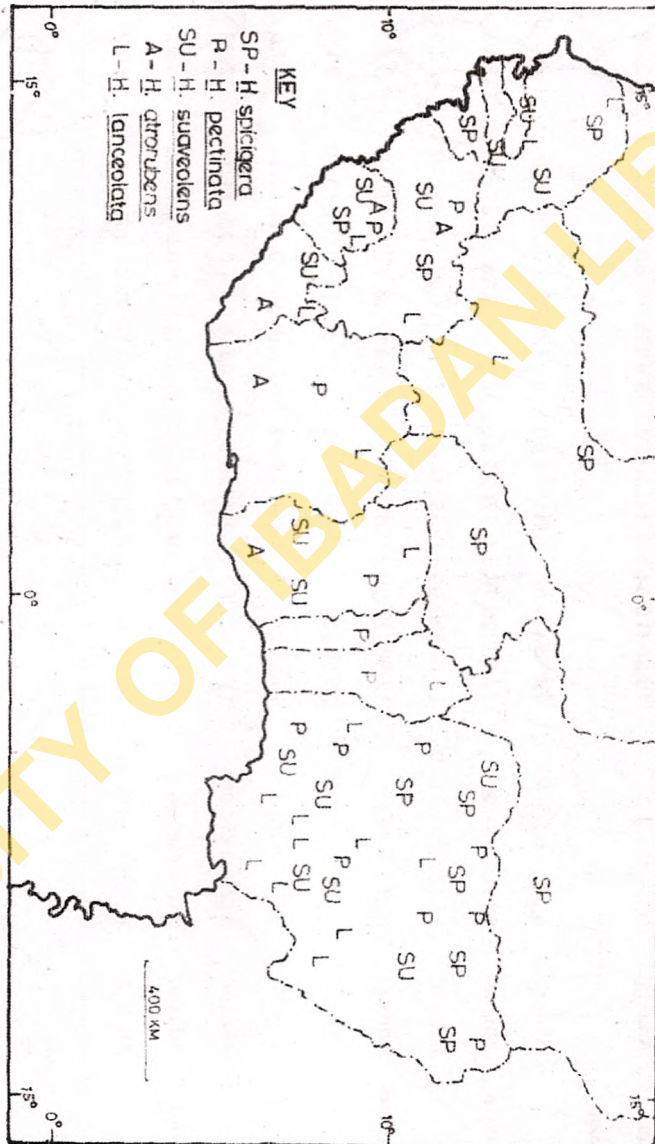
	Taxa	Leaf surface	Epidermal cell shape	Anticlinal cell wall pattern	Maximum epidermal cell width ( $\mu$ m)	No. of epidermal cells/sq.mm
1.	<b>Hyptis spicigera</b>	Adaxial	Irregular	Undulate	18.90 (30.88 $\pm$ 1.59)	54.00 35(47 $\pm$ 0.95) 55
		Abaxial	Irregular	Undulate	13.50 (28.40 $\pm$ 1.48)	48.60 44 (52 $\pm$ 0.78) 59
2.	<b>H. pectinata</b>	Adaxial	Irregular/polygonal	Undulate/curved/straight	18.36 (33.00 $\pm$ 1.83)	49.14 44(51 $\pm$ 0.87) 65
		Abaxial	Irregular	Undulate	19.10 (31.16 $\pm$ 1.41)	48.87 48 (53 $\pm$ 0.59) 59
3.	<b>H. suaveolens</b>	Adaxial	Irregular	Undulate	18.90 (27.27 $\pm$ 1.42)	46.71 38 (44 $\pm$ 0.55) 50
		Abaxial	Irregular	Undulate	15.66 (26.26 $\pm$ 1.20)	41.31 37 (42 $\pm$ 0.61) 49
4.	<b>H. atrorubens</b>	Adaxial	Irregular	Undulate/wavy/curved	21.89 (35.97 $\pm$ 1.69)	59.40 29 (34 $\pm$ 0.61) 40
		Abaxial	Irregular	Undulate	16.47 (32.77 $\pm$ 1.99)	54.00 32 (38 $\pm$ 0.64) 46
5.	<b>H. lanceolata</b>	Adaxial	Irregular/polygonal	Straight/curved/undulate	12.15 (20.24 $\pm$ 0.74)	28.35 43 (48 $\pm$ 0.55) 55
		Abaxial	Irregular	Undulate	8.10 (19.80 $\pm$ 1.29)	35.10 38 (46 $\pm$ 0.70) 54

Table 3: Stomatal and trichome features of *Hyptis* species Min. (Mean ± s.e.) Max

	Taxa	Leaf surface	No of stomata per sq. mm	Stomatal length (µm)		Stomatal width (µm)		Stomatal index %	Trichome distribution
1.	<b>Hyptis spicigera</b>	Adaxial	0 (1± 0.15) 3	13.50 (15.31 ± 0.34)	16.74	5.40 (5.94 ± 0.05)	6.75	2.08	Sparse
		Abaxial	6 (13 ± 0.95) 27	12.83 (14.85 ± 0.35)	21.60	3.57 (5.85 ± 0.22)	8.10	20.00	Dense
2.	<b>H. pectinata</b>	Adaxial	0 (5 ± 0.32) 8	13.50 (20.73 ± 0.77)	25.11	13.10 (15.36 ± 0.67)	18.63	8.93	Sparse
		Abaxial	15 (26 ± 1.43) 39	15.66 (20.99 ± 0.55)	16.74	10.53 (14.77 ± 0.05)	19.17	32.91	Dense
3.	<b>H. suaveolens</b>	Adaxial	0 (2 ± 0.44) 8	12.96 (17.00 ± 0.87)	24.57	5.13 (9.28 ± 0.75)	15.93	4.35	Sparse
		Abaxial	5 (14 ± 0.61) 20	13.50 (17.20 ± 0.75)	21.06	5.67 (9.39 ± 0.34)	13.50	25.00	Dense
4.	<b>H. atrorubens</b>	Adaxial	0 (1 ± 0.26) 4	13.20 (16.29 ± 0.34)	18.90	6.75 (8.36 ± 0.22)	12.15	2.86	Dense
		Abaxial	0 (3 ± 0.66) 20	13.20 (17.83 ± 0.68)	26.46	5.94 (8.70 ± 0.23)	11.16	7.32	Dense
5.	<b>H. lanceolata</b>	Adaxial	0 (2 ± 0.29) 6	13.40 (17.60 ± 0.61)	24.30	5.40 (8.21 ± 0.28)	10.80	3.92	Dense
		Abaxial	15 (25 ± 0.76) 31	12.15 (16.70 ± 0.45)	21.60	5.40 (7.40 ± 0.17)	9.45	35.21	dense

LEGEND TO FIGURES

Fig 1: Geographic distribution of *Hyptis* species in West Tropical Africa.



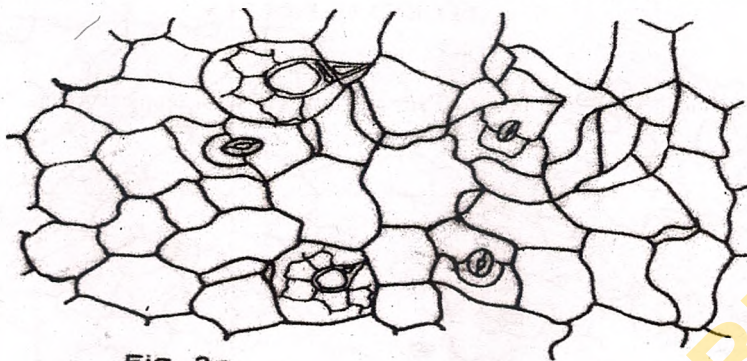


Fig. 2a

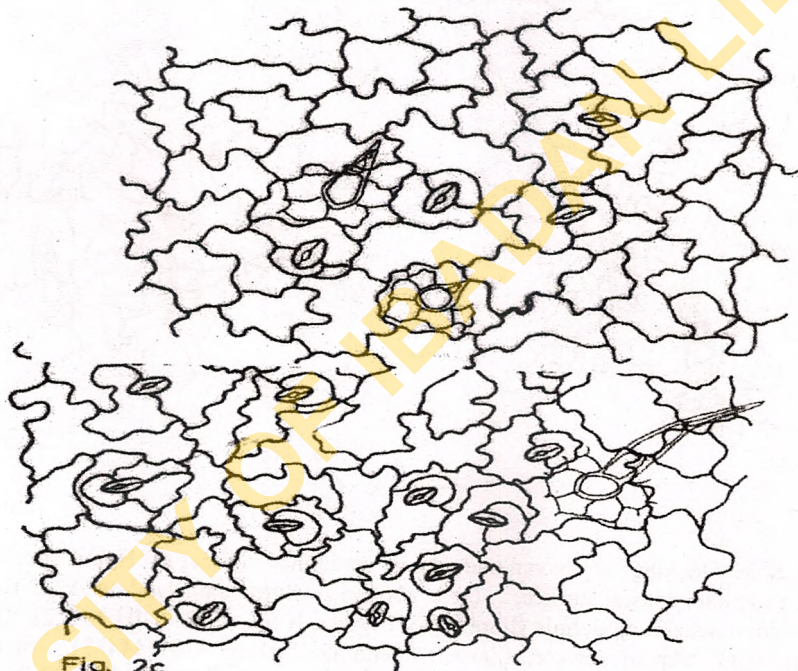


Fig. 2c

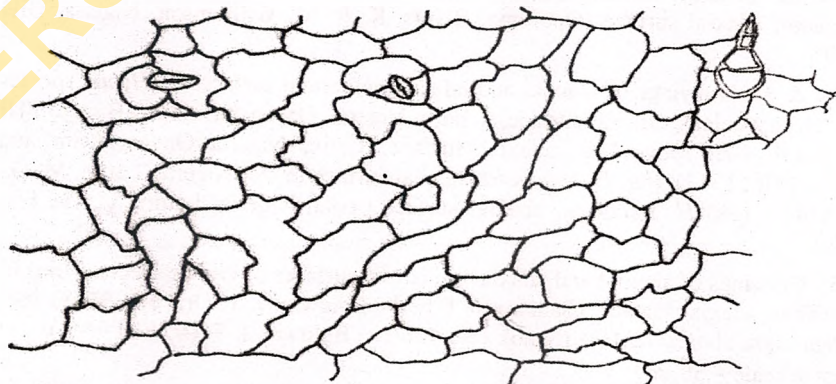


Fig. 3a

50µm



Fig. 3b

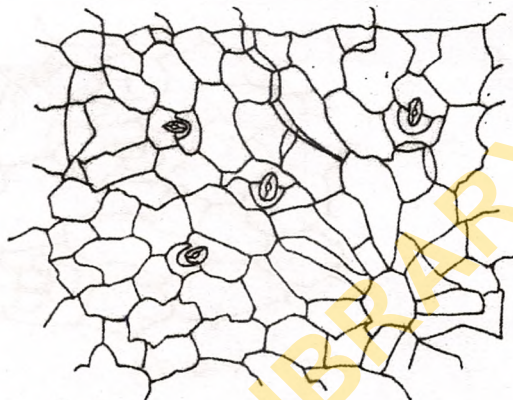


Fig. 3c

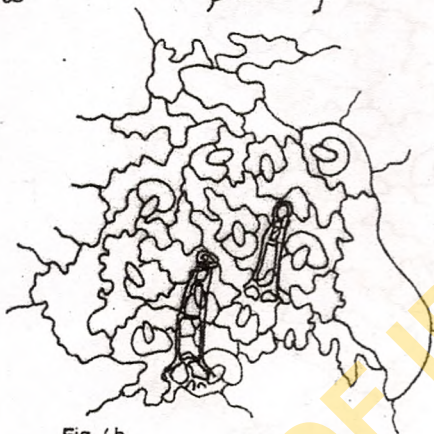


Fig. 4b

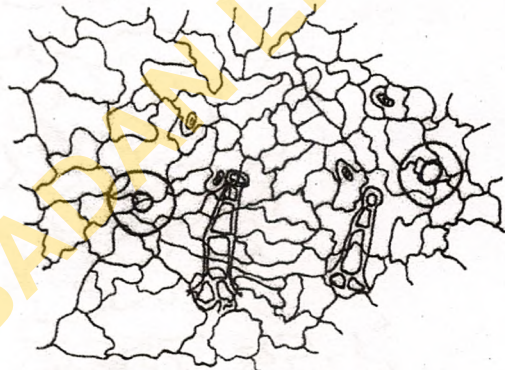


Fig. 4a

50  $\mu$ m

**Figs. 2 & 3:** Drawings of abaxial and adaxial epidermal surfaces of *Hyptis* species. (2a) *H. pectinata*, adaxial surface, (Jos, Nigeria, Olorunfemi, UIH 15352). (2c) *H. pectinata*, adaxial epidermis (Ilorin, Oyo, Nigeria, Ivens, G. W. UIH 13727). (3a) *H. lanceolata*, adaxial surface, (Zaria, Nigeria G. Jackson UIH 14488) (3b) *H. lanceolata*, abaxial surface, (Zaria, Nigeria, G. Jackson UIH 14488) (3c) *H. lanceolata*, adaxial surface (Oporoma, Rivers, K. R. M. Williamson, Nigeria, UIH 13870).

**Figs. 4 & 5:** Drawings of abaxial and adaxial epidermal surfaces of *Hyptis* species (4a). *H. suaveolens*, adaxial surface, (Ilorin, Nigeria, Onyechusim and Binuyo FHI 58313). (4b) *H. suaveolens*, abaxial surface (Ilorin, Nigeria Onyechusim and Binuyo, FHI 58313). (5a) *H. spicigera*, adaxial surface (Yola, Nigeria, Latilo, M. G., FHI 61410) (5b) *H. spicigera*, abaxial surface (Yola, Nigeria, Latilo, M. G., FHI 61410).

**Fig 6:** Drawings of abaxial and adaxial epidermal surfaces of *Hyptis* species. (6a) *H. atrorubens*, adaxial surface, (Sanokwele Liberia, Baldwin, J. T. (Jr), FHI 9448). (6b) *H. atrorubens* abaxial surface (Sanokwele, Liberia, Baldwin, J. T. (Jr) FHI 9448). All same scale = 50 $\mu$ m

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Fig. 5a ,

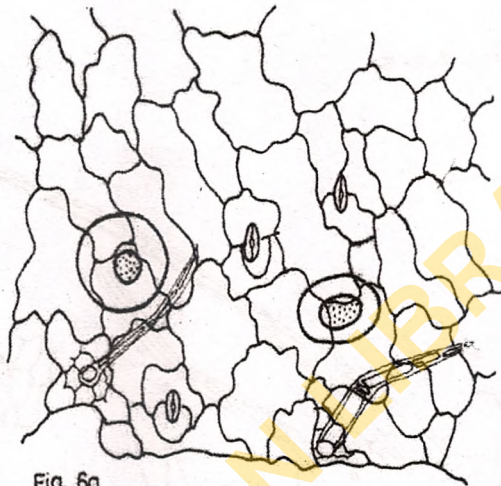


Fig. 6a



Fig. 5b



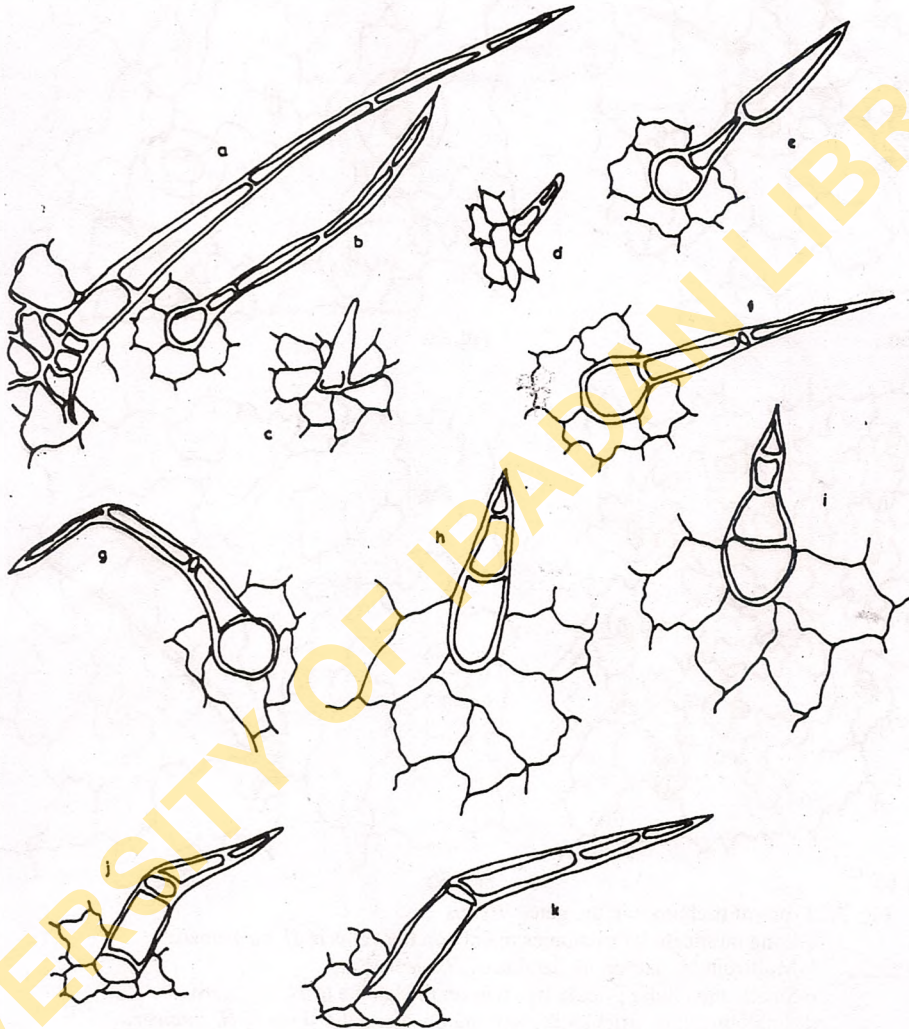
Fig. 6b

Fig. 7: Types of trichomes in the genus *Hyptis*

- a-Long multicellular trichomes mainly on the veins in *H. atropurpurea*
- b-Multicellular hair on the lamina of *H. atropurpurea*
- c-Small, unicellular prickle-like hair on the lamina of *H. spicigera*
- d-Small bicellular prick-like hair mainly along the veins of *H. spicigera*
- e-Short trichome with a collapsed penultimate cell in *H. spicigera*
- f & g.- Short multicellular trichomes in *H. spicigera*
- h & i.- Short and long multicellular trichomes in *H. lanceolata*
- j & k.- Short and long multicellular trichomes in *H. lanceolata*
- i & o - short and long multicellular unbranched trichomes in *H. pectinata*
- l,m,n & p - Short cone-like bi or tricellular trichomes with bulbous bases in *H. pectinata*
- q - Long., multicellular, unbranched trichome in *H. suaveolens*.
- r- Glandular trichomes in *H. suaveolens*
- s- Short usually bicellular trichome in *H. suaveolens*

All same scale =25µm

Fig-7 a-s



25N m

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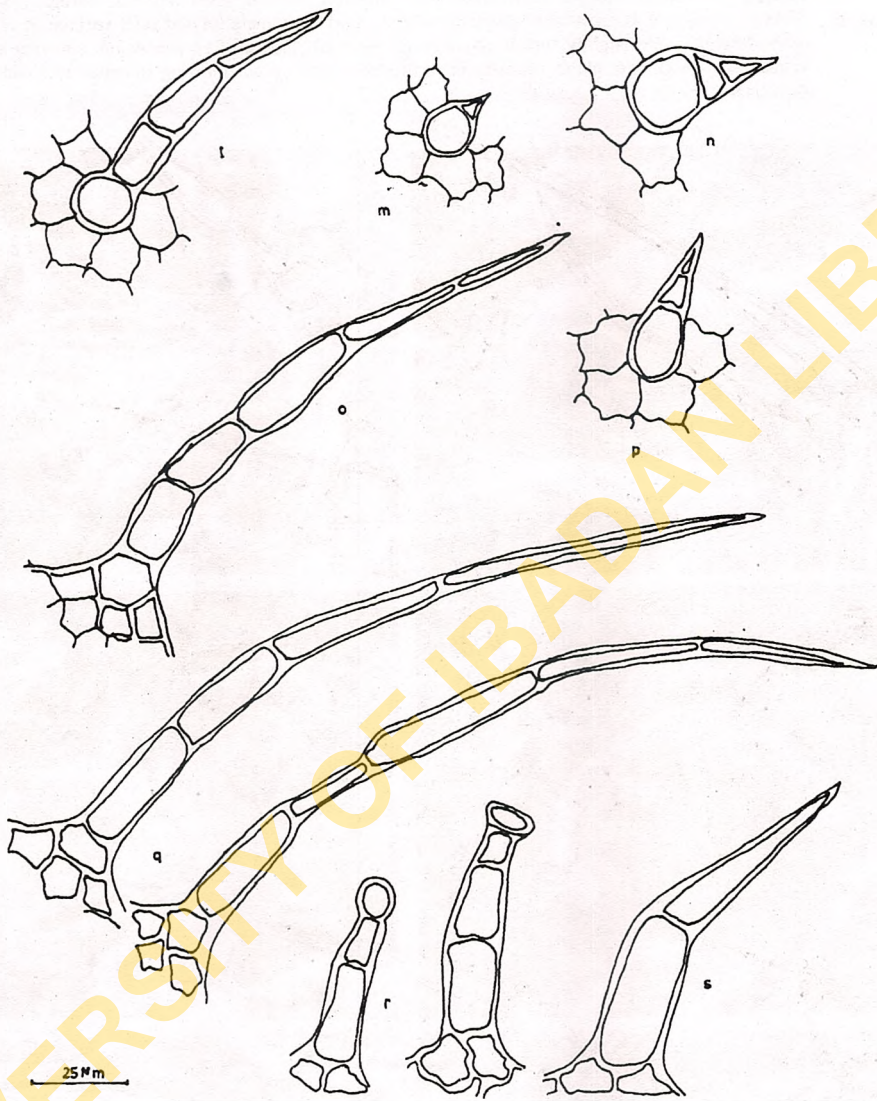
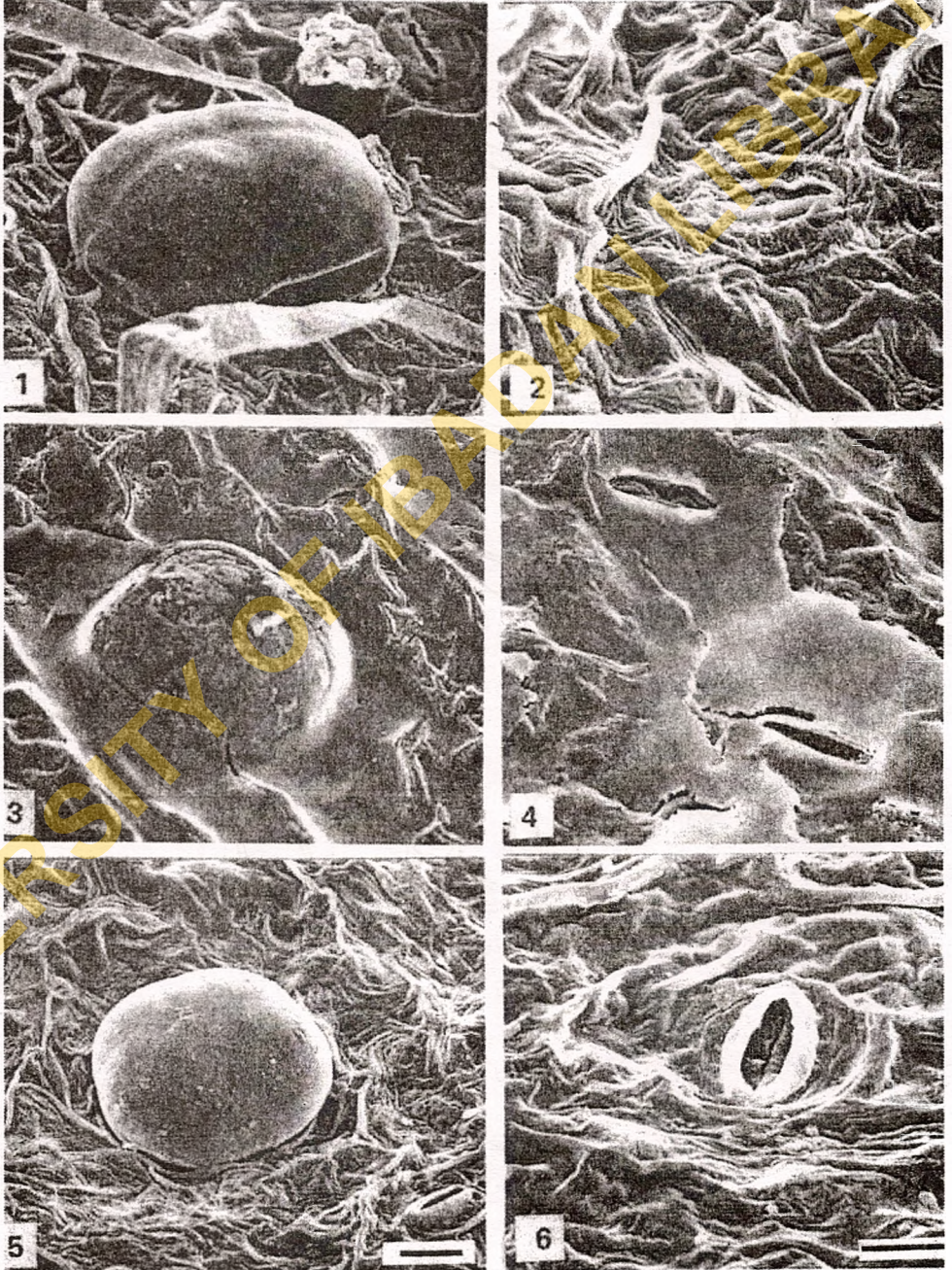


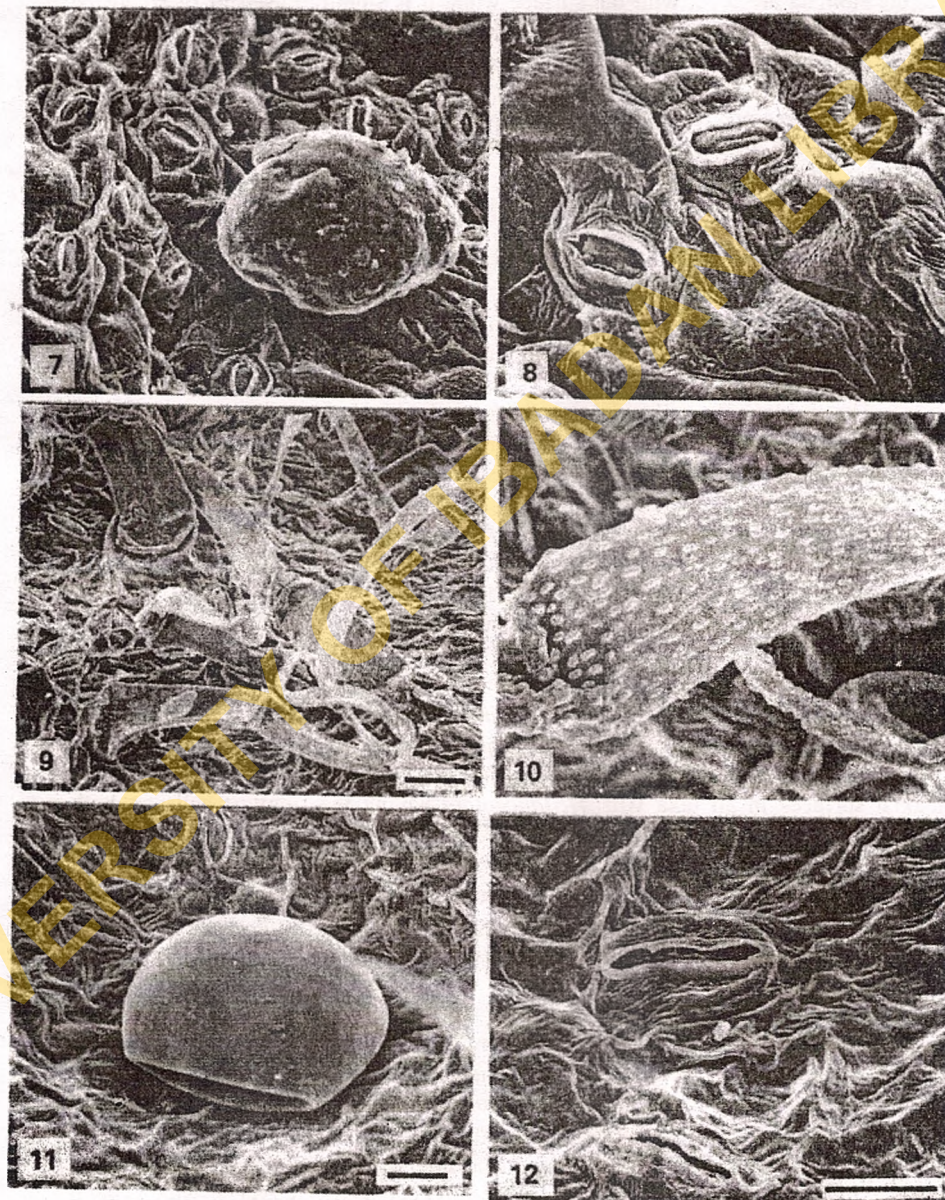
Plate (1) Abaxial surface of *Hyptis suaveolens* showing a globose gland level with the surface, (2)-Adaxial surface of *H. suaveolens* showing stomata level with the surface, (3)-Abaxial surface of *H. atrorubens* showing slightly sunken stomata, (4)-Abaxial surface of *H. atrorubens* showing slightly sunken stomata, (5)-Abaxial surface of *H. lanceolata* showing a slightly sunken globose gland., (6)-Adaxia surface of *H. lanceolata* showing stomata level with the surface. (Scale bar = 10 $\mu$ m )



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Plate (7 & 8 )-Abaxial surface of *H. spicigera* showing slightly raised stomata,(9),Abaxial surface of *H. pectinata* showing hairs covered with numerous tubercles,(10)-Abaxial surface of *H. pectinata* showing trichomes covered with numerous tubercles,(11)-Abaxial surface of *H. pectinata* showing a globose gland level with the surface,(12)-Abaxial surface of *H. pectinata* showing stomata level with the surface.

Scale bar = 10µm



Epidermal glands and stomata constitute the most prominent features of both the abaxial and adaxial surfaces in all species investigated. The glands are located on the surface of the lamina in most taxa but may appear slightly sunken in *H. lanceolata* (Plate 5). The glands are usually globose in shape, multicellular and variable in size as shown in Plates 1 and 5 for *H. suaveolens* and *H. lanceolata* respectively. The stomata may be slightly raised, level with the surface or slightly sunken. In *H. suaveolens* (Plate 2), *H. lanceolata* (Plate 6) and *H. pectinata* (Plate 12), the stomata are level with the surface while it is slightly raised in *H. spicigera* (Plates 7 & 8) and slightly sunken in *H. atrorubens* (Plates 3 & 4). The stomata of all taxa are characterised by the presence of pronounced, overreaching cuticular rims.

Trichomes are found in all specimens examined and are usually uniseriate, unbranched with surfaces which are covered with numerous tubercles as shown in *H. pectinata* (Plates 9 & 10).

Tables 2 and 3 summarise the range of variation in epidermal characteristics as observed by light microscopy. Fig 1 shows the geographical distribution of Hyptis species in West Africa while Figs 2 – 6 are illustrations from the camera lucida drawings of some epidermal characters of the genus. Fig. 7a – s are illustrations of the forms of trichomes in the genus from the camera lucida drawings.

The epidermal cells are usually irregular or rarely polygonal in shape. Irregular cells occur on the lower epidermis of all taxa (Table 2). The adaxial surfaces of *H. atrorubens* Poit., *H. spicigera*, and *H. suaveolens* contain irregular cells while those of *H. lanceolata* Poir and *H. pectinata* contain irregular or polygonal cells (Table 2, Figs 2 – 6). Anticlinal walls are straight, curved or undulate in *H. pectinata* (Fig 2a & c) and *H. lanceolata* (Fig. 3a & c) while in others they are undulate, wavy, or curved in the adaxial surfaces (Table 1, 2, Figs 4, 5, 6). Cells on the abaxial surface of all taxa are characterized by individual walls.

The adaxial epidermal cells are generally larger than the abaxial ones, the former ranging from 20.24  $\mu\text{m}$  in *H. lanceolata* to 35.97  $\mu\text{m}$  in *H. atrorubens* and the latter ranging from 19.80  $\mu\text{m}$  in *H. lanceolata* to 32.77  $\mu\text{m}$  in *H. atrorubens* (Table 2). This shows that *H. atrorubens* has the largest cells on both adaxial and abaxial surfaces in all taxa with *H. lanceolata* having the smallest cells on both surfaces. The number of epidermal cells vary both within and between the species of this genus. It ranges from 34 to 51 on the adaxial epidermis of *H. atrorubens* and *H. pectinata* respectively while on the abaxial epidermis, it ranges from 38 in *H. atrorubens* to 53 in *H. pectinata* thus showing that the abaxial cells are generally but not always higher in number than the adaxial epidermal cells (Table 2).

Leaves of all species are amphistomatic with diacytic stomata occurring on both surfaces (Figs 2-6, Table 3). Stomata are generally more on the abaxial surface than on the adaxial surface ranging from a mean number of 3 in *H. atrorubens* to 26 in *H. pectinata* in the former and 1 in *H. atrorubens* and *H. spicigera* to 5 in *H. pectinata* in the latter. The largest stomata on both surfaces are those of *H. pectinata* with a mean size of 20.73 x 15.36  $\mu\text{m}$  on the adaxial surface and 20.99 x 14.77  $\mu\text{m}$  on the abaxial surface while the smallest were recorded in *H. spicigera* which has a mean size of 15.31 x 5.94  $\mu\text{m}$  on the adaxial surface and 14.85 x 5.85  $\mu\text{m}$  on the abaxial surface. The stomatal index varies from 2.08 in *H. spicigera* to 8.93 in *H.*

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*pectinata* on the upper epidermis while on the lower epidermis; it ranges from 7.32 in *H. atrorubens* to 35.21 in *H. lanceolata* (Table 3).

Trichomes are non-glandular or glandular, uniseriate, multicellular or rarely unicellular, unbranched and thin walled. Some are short-stalked with the base consisting of one or more cells while other are long stalked with the base containing one to two to many epidermal cells. The unicellular trichomes which are prickle like are present only in *H. spicigera* (Fig. 7c). The multicellular trichomes may be short, almost cone-line with bulbous bases as in *H. pectinata* and *H. lanceolata* or long with smooth and thin walls of various lengths as in all species (Fig. 7). Trichomes vary in size and form on each epidermal surface of every taxon (Fig. 7).

### DISCUSSION

The preceding observations and the summaries of character variation in Tables 2 and 3 indicate the taxonomic significance of the micro-morphological characters employed in this study. The occurrence of irregular cells with usually undulate anticlinal walls on the abaxial epidermis of all species and the diacytic stomata type on both surfaces of all species show the affinity of these taxa in the genus. However, some character combinations such as trichome type, adaxial epidermal cell shape, anticlinal wall pattern and sizes of the stomata and epidermal cells are useful in the taxonomic delimitation of the species. *H. atrorubens* and *H. lanceolata* which have the largest and smallest epidermal cells on both surfaces of the epidermis respectively can easily be separated from the other three species of the genus. The larger epidermal cells observed on the adaxial epidermises of the taxa agree with the view of Solereder (1908). The different types of epidermal cell-shape and anticlinal wall patterns observed on the adaxial surface of *H. pectinata* (Fig 2a & c) and *H. lanceolata* (Fig 3a & c) may be the result of eco-geographical differences such as light intensity, atmospheric humidity and pressure (Yapp, 1912, Salisburly, 1927 and Watson, 1942). Much variation in cell wall undulation has been noted in various environmental conditions such that strongly undulate to straight walls are often observed within a single species (Stace, 1965). Stace (1965) has stressed that extreme caution is required if cell-wall undulation is to be used taxonomically. Further studies particularly on the populations of the two species – *H. pectinata* and *H. lanceolata* in their different habitats would reveal the extent to which the cell-wall undulation and cell shape could be used in the taxonomic delimitation of the species. There is no doubt however that these characters have been of taxonomic importance in the present study.

Stomata type is of no diagnostic importance. Diacytic stomata occur on both surfaces and in all taxa. Nonetheless, stomata are generally more on the abaxial than on the adaxial surfaces. This may not be unconnected with the mesophytic nature of all the species. While stomatal distribution is of restricted taxonomic value, stomata sizes a comfortable basis for differentiating *H. spicigera* with its smallest stomata from the other four species. Stomatal index is of taxonomic importance in the genus. The abaxial values clearly distinguish *H. atrorubens* with a comparatively very low value from the other species. Trichome type is of taxonomic importance in the genus. The presence of glandular trichomes in *H. suaveolens* differentiates it from the other species. Moreover, *H. spicigera* has the characteristic small, prickle-like, unicellular, or bicellular trichomes in addition to the long multicellular types recorded in other

species. Stace (1965) is of the view that hairs are constant in a species when present and their form and distribution may be constant and thus useful in diagnosis. Trichome distribution is however of little or no diagnostic value in this genus. It is evident that the characters obtained from this study are important in the identification and confirmation of the identity of the species of this genus in West Africa. The leaf surface patterns have been shown to be of great taxonomic significance and have been demonstrated to be under strong genetic control (Mueller, 1966). Although some authors (Yapp, 1912, Salisbury, 1927 and Watson, 1942) have noted that the variations in them may be under different environmental pressures in different habitats. Cutler (1972) and Cutler and Brandham (1977) have shown that the environment plays very little, if any part, in the determination of the appearance of the leaf. The present study shows the diversity of leaf epidermal characters in the genus *Hyptis*. The different types of the trichomas together with size of stomata, epidermal cell type, shape and antidual wall in the delimitation of the species. Consequently, these characters can be employed in the identification of the species of *Hyptis* even when only the leaf samples are available. The indented dichotomous key presented below allows easy separation of the species.

#### Key to West African species of *Hyptis*

1. Stomata with a mean size more than  $20 \times 15 \mu\text{m}$ , epidermal cells more than 50 on adaxial surface of the leaf ----- *H. pectinata*
1. Stomata with a mean size less than  $18 \times 10 \mu\text{m}$ , epidermal cells less than 49 on adaxial surface of the leaf ---2
  2. Glandular trichomes present ----- *H. suaveolens*
  2. Glandular trichomes absent ----- 3
    3. Epidermal cells with a mean size less than  $31 \mu\text{m}$  on both surfaces ---4
      4. Trichomes small, prickle-like, unicellular --- *H. spicigera*
      4. Trichomes short or long, multicellular ---- *H. lanceolata*
    3. Epidermal cells with a mean size more than  $32 \mu\text{m}$  on both surfaces ----- *H. atrorubens*

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