Science World Journal Vol 6 (No 3) 2011
www.scienceworldjournal.org
ISSN 1597-6343

Full Length Research Article

EPIDERMAL MORPHOLOGY OF WEST AFRICAN OKRA *Abelmoschus caillei* (A. Chev.) Stevels FROM SOUTH WESTERN NIGERIA.

*OSAWARU, M. E.; DANIA-OGBE, F. M.; CHIME, A. O. & OGWU, M. C.

Department of Plant Biology and Biotechnology, Faculty of Life Sciences, University of Benin, Edo State, Nigeria.
*edwinosawaru@yahoo.com

ABSTRACT

A study of the micro-morphology of 53 accessions of West African Okra was undertaken using light microscopy techniques. Results showed that epidermal cells are polygonal, isodiametric and irregularly shaped with different anticlinal cell wall patterns. Stomata type is 100% paracytic and 100% amphistomatic in distribution among the accessions studied. Stomatal indices ranged from 12.23 to 24.34 with 43.40% accessions ranging between 18.00 to 21.00. Stomatal were more frequently on the abaxial surface. Similarly, stomata on the abaxial surface are relatively larger than those of the adaxial surface and stomatal pore sizes also showed similar trend. Trichomes were widely distributed, eglandular, solitary and unicellular types are recorded. These occur in three forms namely, unicellular filiform, unicellular conical and stellate hairs. Variations observed in the structure and distributions of the trichomes were discussed. These micro-morphological features are regarded diagnostic in this species-*caillei* rather for circumscription among accessions studied.

Keywords: Epidermal cell, Stomata, Trichomes, West Africa Okra, Light microscopy.

INTRODUCTION

West African Okra [*Abelmoschus caillei* (A. Chev.) Stevels] synonyms *Hibiscus manihot L.* var. *caillei* A. Chev., *H. manihot* L, *Abelmoschus manihot* (L.) Medik, *H. esculentus* L., *A. esculentus* (L.) Moench. belongs to the family malvaceae. It is a vegetable commonly distributed in humid West and Central Africa, where it highly grown in traditional agriculture. In the production system, it constitutes towards a major economic activity for women, as a cash crop in the local economy and important in the population that include it in their diet. When prepared into sauce, West African Okra facilitates the consumption of starchy foods which are the main diet of Africans (Schippers, 2000).

WAO has been reported to have medicinal and industrial potentials (Osawaru, 2008). The extracted mucilage has been reported as plasma replacement or blood volume expander and the leaves used as a basis for poultice, as an emollient, sudorific, antiscorbulic and to treat dysuria. Alcohol extract from leaves can eliminate oxygen free radicals, alleviate renal tabular-interstitial diseases, improve renal function and reduce proteinuria (Siesmonsma & Hamon, 2002). It has been reported to prevent cancer and heart disease (Idu, 2009), mucilage in midwifery and in trado-medicinal practices to ward off evil spirit (Obire, 2002).

The industrial applications are numerous, the mucilage is been added as size to gaze certain paper used in confectionary. The fibres from stem are suitable for spinning in rope and for manufacturing paper and cardboards (Chevalier, 1940). Charrier (1984) and Obire, (2002) reported the local use of the fibres for making fishing lines for game traps and sponges.

The current interest in okra has arisen because of a perceived ambiguity in the status of the cultivated and wild species of the Abelmoschus section particularly the group known as West African Okra. The group is quite diverse and shows a wide range of morpho-agronomic characters displayed in same and different ecogeographical, adaptive, and environmental conditions (Osawaru, 2008). The group also shares a wide range of similar traits with the cultivated common Okra (*A. esculentus*). Consequently, there appears to be confusion about their classification, which often leads to mis-identification and uncertainty among taxonomists and hinders breeders selection effort. However, this taxon was first described by Chavalier (1940) as a taxon resembling *A. esculentus* and later elevated to a district species by Stevels (1988) on the basis of gross morphology.

This present study seek to clarify the complexity expressed by the diverse range of morpho-agronomic characters of the species among the accessions collected from South Western Nigeria through the epidermal characteristics and establish uniformity among accessions on the basis of epidermal morphology.

MATERIALS AND METHODS

Fresh plant materials were collected from 53 accessions of West African Okra on field trial (Osawaru, 2008) by 9.00am from the experimental ground, University of Benin, Benin City (6.20^{0}N, 5.47^{0}E).

Epidermal peels were obtained from fresh leaves, petioles, stems and fruits of the plant as outlined by Nyawaume & Gill (1991). The leaves and petioles were abscised at the seventh node while the stem peels were obtained from a slight cut on the tenth internodes. Peels from fruit were taken from the third fruit. Foliar peels were obtained at the right side of the adaxial surface and left side of the abaxial surface of the leaves. Temporary slides were prepared.

Stomata types and epidermal cells were studied with the light microscope. Stomatal counts were taken from 10 plants of the same accession at x400. To evaluate stomatal index, this was calculated using the method outlined by Mbaye *et al*., (2001).

$$IS = \frac{a_i}{a_i + b_i} \times 100$$

IS = stomata index

a_i = number of stomatal at that surface
b_i = number of epidermal cell at that surface

Stomatal index for amphistomatous accessions is obtained from the mean of values from both surfaces, while for hypostomatous accessions, it is obtained from values on either of the surface where stomata are present. Terminology of mature stomata adopted is after Dilcher (1974).

Trichomes were studied with the light microscope using terminology and the method outlined by Rao & Rao (1992). Types, position or occurrence, dimensions and abundance were made from 10 views from 10 plants of the same accession at X400. Line drawings for stomata, epidermal cells and trichomes were made at a magnification of X400 from at least 10 views.

RESULTS

The accessions studied using light microscopy together with their foliar epidermal structures and stomatal features are shown in

Tables 1 and 2. Epidermal cells structures and stomatal complexes are presented in figures 1-3 at a magnification of X400.

Foliar epidermal trichomes, types and distribution is presented in Table 3 and Figs 4-6.

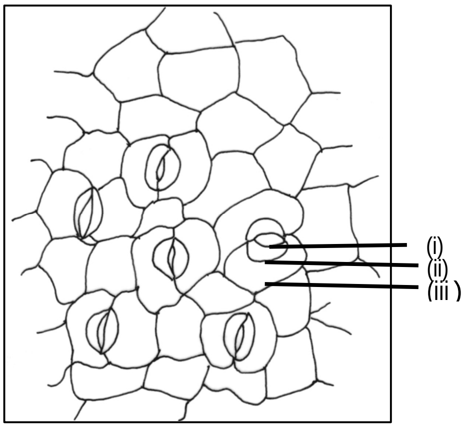
TABLE 1. SUMMARY OF EPIDERMAL STUDIES OF 53 ACCESSIONS OF WEST AFRICAN OKRA.

	Cell shape		Nature of cell wall pattern		Stomatal measurement			Stomatal measurement		
					Adaxial surface			Abaxial surface		
Accessions/taxa	Adaxial surface	Abaxial surface	Adaxial surface	Abaxial surface	Length (µm)	Breadth (µm)	Pore size (µm)	Length (µm)	Breadth (µm)	Pore size (µm)
1	Isodiametric	Isodiametric	Slightly straight	Slightly straight	26.7	17.3	13.6	31.2	22.2	13.9
2	Polygonal	Isodiametric	Straight	Slightly straight	20.3	18.4	9.3	33.4	21.3	10.7
3	Isodiametric	Isodiametric	Slightly straight	Slightly straight	24.0	12.4	10.9	25.0	12.5	11.9
4	Polygonal	Polygonal	Slightly straight	Slightly straight	27.8	13.4	9.6	26.0	13.5	9.9
5	Isodiametric	Isodiametric	Slightly straight	Slightly straight	25.1	16.2	9.4	29.7	16.3	10.9
6	Isodiametric	Isodiametric	Slightly straight	Slightly straight	29.7	16.5	10.9	30.1	16.8	13.6
7	Polygonal	Isodiametric	Straight	Slightly straight	26.3	17.2	11.2	28.3	18.2	12.1
8	Isodiametric	Isodiametric	Slightly straight	Slightly straight	27.2	19.8	7.2	30.2	23.0	10.2
9	Isodiametric	Isodiametric	Slightly straight	Slightly straight	21.2	20.1	11.2	28.1	21.4	12.4
10	Polygonal	Irregular	Straight	Sinous	25.1	16.4	9.7	30.1	17.5	10.7
11	Polygonal	Irregular	Slightly straight	Sinous	30.3	13.7	9.2	31.2	15.7	10/2
12	Irregular	Irregular	Sinous	Sinous	26.6	15.0	11.0	28.6	18.2	11.4
13	Isodiametric	Isodiametric	Slightly straight	Slightly straight	27.7	16.2	10.4	30.7	16.5	13.9
14	Polygonal	Isodiametric	Straight	Straight	26.4	13.8	10.2	30.3	15.8	12.3
15	Polygonal	Irregular	Straight	Sinous	27.3	16.7	11.4	30.3	17.2	12.1
16	Polygonal	Polygonal	Straight	Straight	30.1	15.2	9.8	33.1	16.7	11.2
17	Irregular	Irregular	Sinous	Sinous	28.3	17.2	11.1	33.2	18.2	13.1
18	Polygonal	Isodiametric	Straight	Straight	27.8	16.2	10.2	30.4	18.7	11.3
19	Polygonal	Irregular	Straight	Sinous	25.9	18.3	11.2	31.8	16.7	11.4
20	Irregular	Irregular	Sinous	Sinous	26.7	16.3	9.9	30.2	18.5	10.7
21	Polygonal	Irregular	Straight	Sinous	27.1	18.2	10.1	30.5	18.3	11.2
22	Polygonal	irregular	Straight	Sinous	26.9	18.1	9.7	30.1	20.3	13.0
23	Iso diametric	Isodiametric	Slightly straight	Slightly straight	29.3	18.7	10.5	30.2	19.7	11.3
24	Iso diametric	Isodiametric	Slightly straight	Slightly straight	27.8	17.3	10.3	30.5	19.3	12.5
25	Iso diametric	Isodiametric	Slightly straight	Slightly straight	29.8	16.7	11.2	33.2	20.4	12.8
26	Polygonal	Polygonal	Straight	Slightly straight	28.3	19.4	10.1	31.7	20.5	11.3
27	Polygonal	Polygonal	Slightly straight	Slightly S	28.3	19.4	12.3	302	18.7	12.2
28	Polygonal	Polygonal	Straight	Straight	25.7	16.7	11.2	28.9	18.2	11.7
29	Polygonal	polygonal	Straight	Straight	27.8	17.5	11.5	33.2	19.7	11.3
30	Irregular	Irregular	Sinous	Sinous	23.8	16.7	10.1	29.5	18.8	11.5
31	Irregular	Irregular	Sinous	Sinous	29.7	17.7	11.0	33.2	18.5	11.1
32	Polygonal	Polygonal	Straight	Straight	28.4	18.3	12.6	30.7	18.8	13.7
33	Polygonal	Polygonal	Straight	Straight	27.4	16.4	11.1	30.2	18.1	12.3
34	Polygonal	Polygonal	Straight	Straight	29.3	18.7	10.2	31.3	19.2	12.1
35	Polygonal	Polygonal	Straight	Straight	27.3	15.4	9.3	29.2	18.7	11.5
36	Polygonal	Polygonal	Straight	Straight	29.2	18.7	10.2	31.4	18.3	10.3
37	Polygonal	Polygonal	Straight	Slightly straight	26.9	18.2	11.2	29.7	16.4	11.2
38	Polygonal	Polygonal	Straight	Slightly straight	25.3	18.2	10.7	29.4	17.7	11.2
39	Polygonal	Polygonal	Straight	Slightly straight	27.2	17.4	12.3	30.7	18.2	13.0
40	Polygonal	Polygonal	Straight	Slightly straight	24.7	16.3	11.2	28.3	19.2	12.5
41	Polygonal	Polygonal	Straight	Slightly straight	29.5	19.3	13.3	32.2	18.7	13.7
42	Polygonal	Polygonal	Straight	Slightly straight	23.2	17.1	10.5	27.4	18.2	11.9
43	Polygonal	Polygonal	Straight	Straight	24.7	15.2	10.7	28.1	19.2	12.7
44	Polygonal	Polygonal	Straight	Straight	26.1	14.4	11.3	31.5	18.8	13.7
45	Polygonal	Polygonal	Straight	Straight	27.4	18.3	11.7	30.3	21.1	12.8
46	Polygonal	Polygonal	Straight	Straight	23.5	15.7	11.3	28.2	17.5	11.5
47	Polygonal	Polygonal	Straight	Straight	24.7	16.5	12.0	33.2	20.4	13.2
48	Polygonal	Irregular	Straight	Sinous	22.6	15.6	12.1	25.2	16.7	13.1
49	Isodiametric	Isodiametric	Slightly straight	Slightly straight	26.7	17.2	11.0	27.0	17.6	14.2
50	Isodiametric	Isodiametric	Slightly straight	Slightly straight	27.0	15.0	11.3	30.4	15.8	12.2
51	Isodiametric	Isodiametric	Slightly straight	Slightly straight	29.7	16.5	10.9	30.1	18.6	14.6
52	Isodiametric	Isodiametric	Slightly straight	Slightly straight	27.5	13.4	11.3	31.3	18.7	9.5
53	Isodiametric	Isodiametric	Slightly straight	Slightly straight	25.7	18.3	10.4	30.2	19.1	11.1

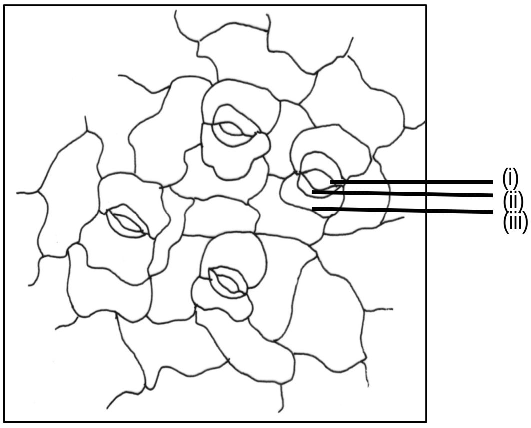
TABLE 2. STOMATAL COMPLEX, INDEX AND CELL COUNTS FOR 53 ACCESSIONS OF WEST AFRICAN OKRA.

Accessions/taxa	Nature of foliar/ materials used	Distribution of stomata on the leaf surface	Morphological type of stomata	Epidermal count/field		Stomatal counts/field		
				Adaxial surface	Abaxial surface	Adaxial surface	Abaxial surface	Stomatal index
1	Fresh	Amphistomatic	Paracytic	85	91	15	25	18.28
2	Fresh	Amphistomatic	Paracytic	97	117	11	21	12.71
3	Fresh	Amphistomatic	Paracytic	83	109	17	28	18.72
4	Fresh	Amphistomatic	Paracytic	63	121	12	36	19.47
5	Fresh	Amphistomatic	Paracytic	89	111	07	23	12.23
6	Fresh	Amphistomatic	Paracytic	87	130	10	24	12.95
7	Fresh	Amphistomatic	Paracytic	111	165	23	45	19.30
8	Fresh	Amphistomatic	Paracytic	71	93	9	40	20.67
9	Fresh	Amphistomatic	Paracytic	101	129	26	35	20.19
10	Fresh	Amphistomatic	Paracytic	111	173	30	36	19.26
11	Fresh	Amphistomatic	Paracytic	90	155	18	26	15.29
12	Fresh	Amphistomatic	Paracytic	114	128	21	32	17.78
13	Fresh	Amphistomatic	Paracytic	81	173	07	50	15.19
14	Fresh	Amphistomatic	Paracytic	56	150	06	26	12.23
15	Fresh	Amphistomatic	Paracytic	80	130	11	27	14.65
16	Fresh	Amphistomatic	Paracytic	81	111	18	37	21.59
17	Fresh	Amphistomatic	Paracytic	121	179	12	42	14.01
18	Fresh	Amphistomatic	Paracytic	71	130	13	43	20.17
19	Fresh	Amphistomatic	Paracytic	70	145	20	41	22.13
20	Fresh	Amphistomatic	Paracytic	74	180	12	24	12.86
21	Fresh	Amphistomatic	Paracytic	73	150	09	58	19.43
22	Fresh	Amphistomatic	Paracytic	101	138	11	53	19.75
23	Fresh	Amphistomatic	Paracytic	102	130	12	31	14.89
24	Fresh	Amphistomatic	Paracytic	80	111	14	22	15.72
25	Fresh	Amphistomatic	Paracytic	74	139	13	47	20.11
26	Fresh	Amphistomatic	Paracytic	14	114	29	34	21.84
27	Fresh	Amphistomatic	Paracytic	123	137	18	25	14.10
28	Fresh	Amphistomatic	Paracytic	100	185	9	58	16.07
29	Fresh	Amphistomatic	Paracytic	105	119	12	31	15.47
30	Fresh	Amphistomatic	Paracytic	110	120	14	22	13.39
31	Fresh	Amphistomatic	Paracytic	86	101	14	28	17.86
32	Fresh	Amphistomatic	Paracytic	102	142	23	41	20.40
33	Fresh	Amphistomatic	Paracytic	111	192	25	51	19.69
34	Fresh	Amphistomatic	Paracytic	69	98	10	33	18.93
35	Fresh	Amphistomatic	Paracytic	71	92	13	30	20.04
36	Fresh	Amphistomatic	Paracytic	100	187	21	42	17.85
37	Fresh	Amphistomatic	Paracytic	90	131	21	45	22.23
38	Fresh	Amphistomatic	Paracytic	101	147	17	38	17.48
39	Fresh	Amphistomatic	Paracytic	103	137	15	37	17.00
40	Fresh	Amphistomatic	Paracytic	91	133	18	40	19.82
41	Fresh	Amphistomatic	Paracytic	93	103	21	37	22.43
42	Fresh	Amphistomatic	Paracytic	75	119	14	30	17.93
43	Fresh	Amphistomatic	Paracytic	89	117	17	35	19.54
44	Fresh	Amphistomatic	Paracytic	73	112	15	43	22.24
45	Fresh	Amphistomatic	Paracytic	74	131	11	41	18.39
46	Fresh	Amphistomatic	Paracytic	80	141	09	50	18.14
47	Fresh	Amphistomatic	Paracytic	100	173	11	31	12.56
48	Fresh	Amphistomatic	Paracytic	95	130	17	42	19.80
49	Fresh	Amphistomatic	Paracytic	73	101	18	41	24.34
50	Fresh	Amphistomatic	Paracytic	80	175	13	35	15.34
51	Fresh	Amphistomatic	Paracytic	93	119	15	39	18.02
52	Fresh	Amphistomatic	Paracytic	97	163	21	43	19.34
53	Fresh	Amphistomatic	Paracytic	80	93	14	30	19.64

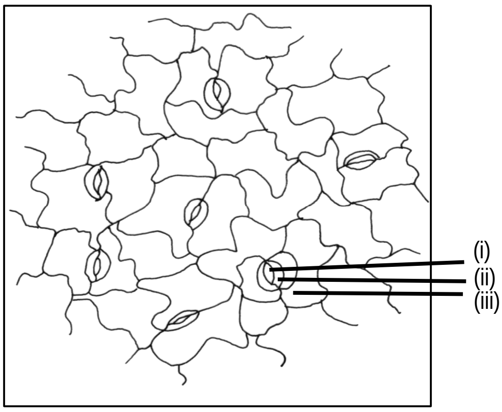
The epidermal cells showed variation in shape. Three types of cell shapes, polygonal, isodiametric and irregular were recorded from adaxial and abaxial surfaces of the foliar materials. Polygonal cell shape type accurate is represented in (Fig. 1a), isodiametric (Fig. 1b) and irregular (Fig. 1c).



X400
FIG. 1a. POLYGONAL



X400
FIG. 1b. ISODIAMETRIC



X400
FIG. 1c. IRREGULAR

NOTE: (i) = Stomatal pore, (ii) = Guard cell and (iii) = Subsidiary cell

Epidermal cell shape and stomatal complex as seen in abaxial and adaxial surfaces in some accessions of West African Okra from some States in southwestern Nigeria.

Variations in epidermal cell shape of both adaxial and abaxial surfaces observed were classified into five groups (Fig. 2). The largest group (41.5%) had polygonal epidermal cells on both adaxial and abaxial leaf surfaces (Table 1 and Fig 1a) closely followed by the second group (28.30%) with isodiametric on both surfaces (Table 1 and Fig. 1b). The third group (13.2%) had polygonal cells on the adaxial and irregular cells on abaxial surface. The last two groups had irregularly shaped (9.4%) cells on both surfaces (Table 1 and Fig. 1c) and polygonal cells on adaxial and isodiametric cells on abaxial surfaces with 7.5%.

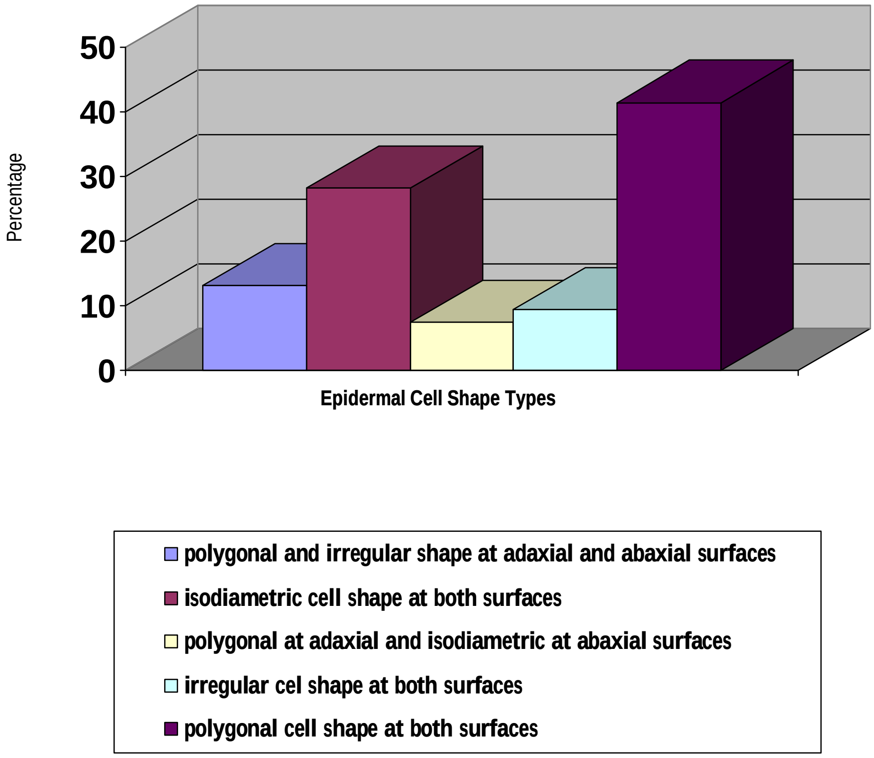


FIG. 2. CELL SHAPE ON ADAXIAL AND ABAXIAL EPIDERMAL SURFACES OF 53 ACCESSIONS OF THE WEST AFRICAN OKRA.

The epidermal cell walls of the accessions studied are variable. Three wall types are observed. They may be straight, slightly straight or sinous on either surface or on both surfaces.

Stomata occur on both surfaces of the leaves but more frequently on the abaxial surface. All accessions are amphistomatous. The range of stomata on the adaxial surface varies from 6-30 while on the abaxial surface the number varied from 21-58. All accessions had paracytic type stomatal complex. Stomata indices ranged from 12.23-24.34. These indices are put in ranges. The frequency of the accessions in stomatal ranges is presented in Fig. 3. The highest frequency is observed in the range of 18.01-21.00.

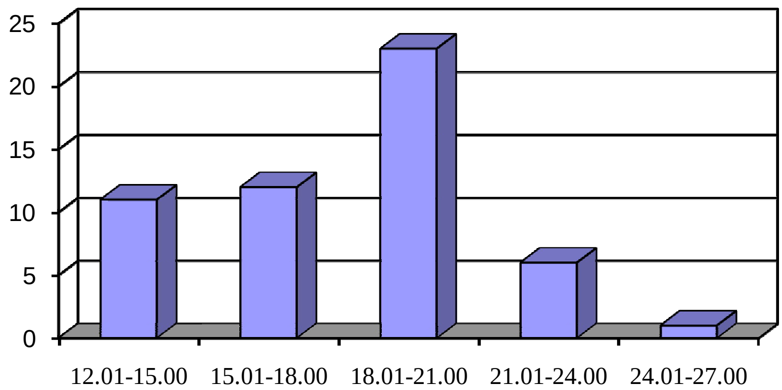


FIG. 3. FREQUENCY OF STOMATAL INDEX AMONG 53 ACCESSIONS OF WEST AFRICAN OKRA FROM SOUTHWESTERN NIGERIA.

The stomatal dimensions varied in both surfaces of the leaves of the accessions investigated. Stomata recorded on the abaxial surfaces were relatively larger than those on the adaxial surfaces. Similarly, the pore sizes also showed the same trend. Length/breath ratio ranged from 21.2 – 30.1/13.4 – 20.0µm on the adaxial surface and 25.0 – 33.4/13.5 – 23.0µm on the abaxial surface. The pore sizes ranged from 9.3 – 13.6µm on the adaxial surface and 10.2 – 14.6µm on the abaxial surface. Variations in distribution and trichome type observed are presented in Table 3.

Science World Journal Vol 6 (No 3) 2011
www.scienceworldjournal.org
ISSN 1597-6343

TABLE 3. VARIATION IN THE TRICHOME DISTRIBUTION, DIMENSION AND TYPES AMONG 53 ACCESSIONS OF WEST AFRICAN OKRA.

Trichomes type	Accession	Distribution							Measurement		State	Form
		Leaf			Stem	Petiole	Fruit					
		Ab	Ad	M			Groove	Ridge	Length (μm)	Breadth (μm)		
Unicellular filiform hair	All	+	+	-	-	+	-	-	20-40	5-10	Solitary	Eglandular
Unicellular conical hair Fig. 5a	All	+	+	+	+	+	+	-	41-63	7-11	Solitary	Eglandular
Unicellular conical hair Fig. 5b	All except fruit on accessions 3,5 45	+	+	+	+	+	-	+	70-80.0	11-17	Solitary	Eglandular
Unicellular macroform conical hair Figs. 5c and 5d	All	-	+	+	+	+	-	+	1200-1700	25-37	Solitary	Eglandular
Stellate hairs	All	+	+	-	+	+	-	-	800-1100	25-32	Stellate	Eglandular

+ = Present, - = Absent, Ab = Abaxial, Ad = Adaxial, M = Mid-rib

Three trichome types were observed on the accessions studied. Some of these trichome types are solitary and eglandular, while others are stellate and eglandular. These trichomes are:

1. **Unicellular filiform hairs**. Foot slightly bulbous and distinct from the body, not embedded in the epidermis, wall thin and smooth with dense cytoplasmic content. Vary from 20 - 40 µm in length and 5 – 10 µm broad at base or foot, bristle and sharp. Present on both leaf surfaces and on stem. Fig. 4.

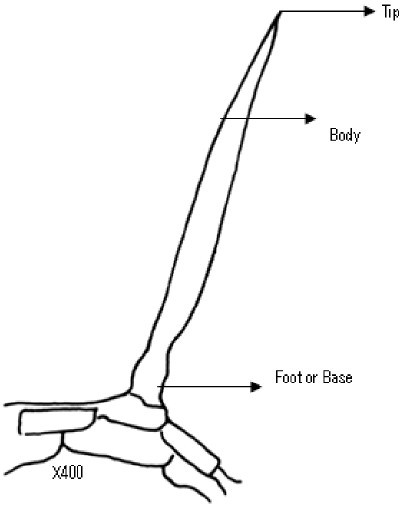


FIG. 4. UNICELLULAR FILIFORM HAIR OF WEST AFRICAN OKRA FROM SOME STATES IN SOUTHWESTERN NIGERIA.

2. **Unicellular conical hair**: Three forms were observed, based on length/breadth and the orientation of foot or base.

i. Unicellular, minute, foot not embedded in epidermal cells, slightly thick and smooth wall with thin cytoplasmic content, pointed at distal end, varied from 41 µm - 63 µm in length and 7-11 µm broad at base. Present on both leaf surfaces, stem, petiole and the groove on fruit (Fig. 5a).

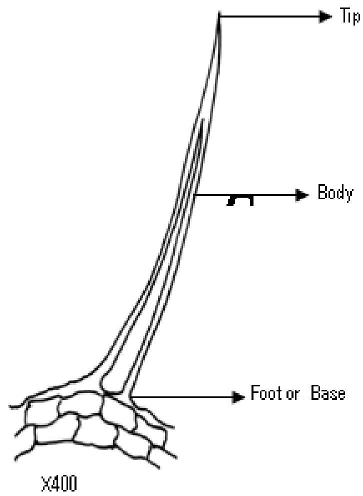


FIG 5a. UNICELLULAR CONICAL HAIR OF WEST AFRICAN OKRA

Unicellular, vary from 70µm - 80 µm in length, and 11-17 µm broad at foot or base. Foot may be slightly embedded in the epidermial cell or on the epidermis, thick walled, vacuolated cytoplasmic cavity and pointed at distal. Present on the ribs of leaves of both surfaces, ridges of fruits, petiole and stem. Fig. 5b.

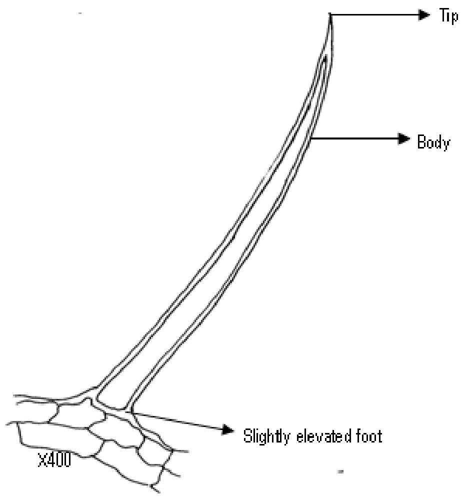


FIG. 5b: UNICELLULAR CONICAL HAIR OF WEST AFRICAN OKRA.

Unicellular macroform conical hair, length and breath variable, usually from 1200 µm - 17000 µm in length and 25-37 µm broad at base. Foot on top of epidermial cell (Fig. 17c) or slightly depressed in the epidermial cell (Fig. 17d). Wall thick and smooth, pointed at distal end and vacuolated. Present on grooves of petiole midrib, stem and on the adaxial surface of leaf. Sometimes on fruit ridges (Figs. 5c and 5d).

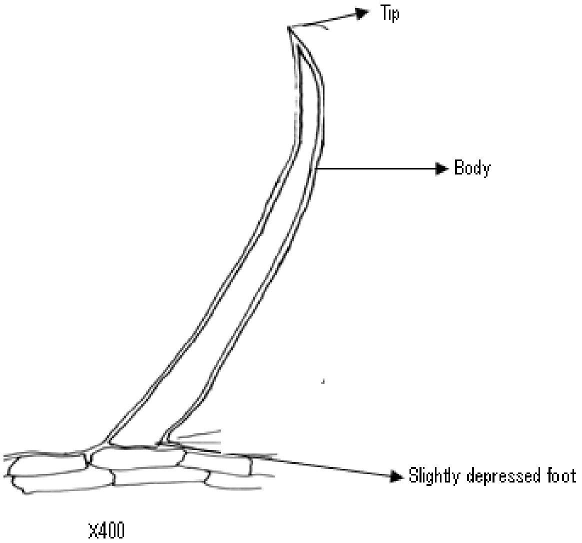


FIG 5c. UNICELLULAR MACROFORM HAIR OF WEST AFRICAN OKRA.

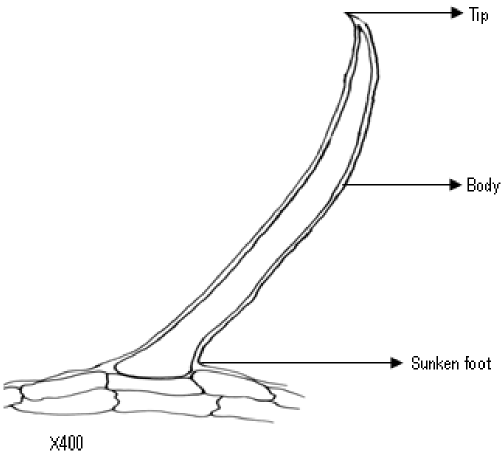


FIG. 5d. UNICELLULAR MACROFORM CONICAL HAIR OF WEST AFRICAN OKRA.

3. **Stellate hairs**: Multiradiate hairs of about 4-7 unicellular conical forms, wall thick and highly vacuolated or lack cytoplasmic content. Each ray of stellate hairs ranges from 800 µm - 1100 in length and 25-32 µm broad, pointed at distal end and slightly sunken in the epidermis. Present on leaf surfaces, petiole and stem. It could be clustered or aggregated (Figs. 6a and 6b).

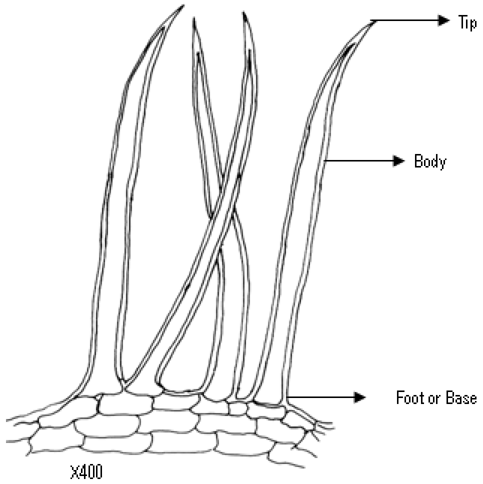


FIG. 6a: CLUSTER OF UNICELLULAR STELLATE HAIRS OF WEST AFRICAN OKRA.

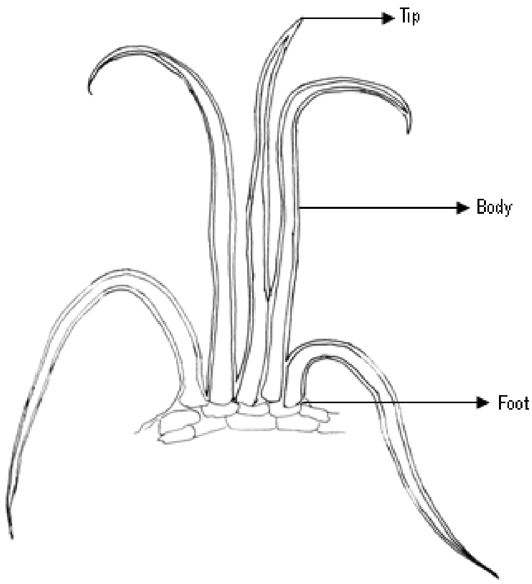


FIG. 6b: AGGREGATED UNICELLULAR STELLATE HAIRS OF WEST AFRICAN OKRA.

DISCUSSION

The epidermal features, viz epidermal cells, stomatal complexes, distribution reported in angiospermic species are also observed among the 53 accessions of West African okra studied. However, the study showed high similarity among accessions. Stomatal complex was paracytic and distribution amphistomatic. Studies carried out by Soladoye (1982), Gill *et al.,* (1982), Karatela & Gill (1984a, 1984b), Dania-Ogbe & Osawaru (1988), Nyawuame & Gill (1991) and Osawaru *et al.,* (2004) have showed immense values of epidermal characteristics in taxonomic decisions. In this study, the pattern of variation in the epidermal characteristics (stomatal complex and distribution) among the fifty-three accession of *A. caillei* is limited as features are similar hence the taxonomic usefulness is therefore limited for remodelling these accessions of the species. However Gill *et al.,* (1982) stated that no stomatal type is typical for any genus. Dania-Ogbe & Osawaru (1988) viewed that stomata can be of diagnostic characters. Osawaru *et al*., (2004) defined character as an attribute possessed by a given organisms which could be drawn from morphological, anatomical, physiological, behavioural and cytological sources that make such organism distinct and unique among other similar organisms. Metcalf & Chalk (1950) Dania-Ogbe & Osawaru (1988) documented various stomatal complexes and distribution among genera and species in Malvaceae. This present study showed and reported similar pattern of stomatal complex and distribution (paracytic and amphistomatic) in the genus-*Abelmoschus*, species *caillei* among fifty three accessions. This stomatal complex and distribution is suggested as a diagnostic feature of *A. caillei* as they are highly expressed and consistent among the accessions. The taxonomic value may be more valued if the pattern of development is studied.

Epidermal cell shape showed significant difference. Polygonal, isodiametric and irregular walls types were reported in the study. Cutter (1978), Stace (1989), Soladoye (1982), Karatela & Gill (1984a) agreed and stated that plant cells are delimited by cell walls and these walls are responsible for the characteristic shape of cells. Esua (1965), Nyawuame & Gill (1991) opined that the nature of walls among epidermal cells may be related to stress that occurs during its formation. No study has reported the taxonomic values of epidermal wall in any angiospermic species. However, this study aligned with that of Esua (1965) and Nyawuame & Gill (1991).

Stomatal size varied considerably. From this study, no relationship could be established between stomatal size and accessions from different ecological zone (Accessions were collected from different ecological zone). Stomatal size varied with growth habit (Gill *et al*., 1992). However, stomatal size could not be typically associated with growth habit as all the accessions were shrubby in growth.

Many studies showed that stomatal frequency differs in different parts of a leaf, different leaves of a plant and different plants of a species (Osawaru, 1985). In this study, leaves selected for studies are taken from comparable position on the plant (7th node). Cutter (1978), Mbaye, *et al.,* (2001) reported that the stomatal index value is found to be reasonably constant for any particular species. In this study, stomatal indices have been considered and put in ranges (Table 3). These values spread over the fifty three accessions as there appears to be clear out difference in the ranges. This appears to be unhelpful in the delimination and classification of the accessions of the species. However, greatest numbers of the accession investigated about (51%) have stomatal index value in the 14.51-19.60 range. This range is probably the balance for effective gaseous exchange without excessive water loss through transpiration hence the persistency of the crop plant in the dry season with fewer or no rains and without irrigation within the study area (southwestern Nigeria).

The importance of stomata characters in taxonomy varies in different groups of plant (Stebbins & Khush, 1961; Paliwal, 1966; Shah, 1967). This is more valued when the pattern of development is studied (Shah & Gopal, 1969; Gill *et al*., 1982).

Various studies have been attempted in angiospermic trichomes on the basis of structures and ontogeny (Weiss, 1867; De Bary 1884; Solereder, 1908; Cowan, 1950; Metcalfe & Chalk, 1950; Ramaya, 1962, 1981; Osawaru, 1985, Rao & Rao, 1992, Osawaru *et al.,* 2004). These studies attempted to classify trichomes to reflect phytogenetic classification of angiosperms. Stace (1989), Rao & Rao (1992) noted that trichomes offer more valuable taxonomic information than all epidermal elements because of their diversity in structures as well as distribution. In this study, structures and distribution of trichomes are reported (Table 3, Figs. 4-6).

Three structural categories were reported in this study (Fig. 4, 5 and 6). These categories are mainly unicell of various types-filiform, conical and stellate hairs present on the vegetative and fruit parts of the accessions studied. All the trichomes are similar in cell composition but differ in size, (Table 3), nature of foot and degree of cell vacuolation. The trichomes reported here possess simple foot which could be similar to the epidermal cell or slightly projected above the epidermis. The wall of the filiform unicellular hairs is thin and smooth with densely thickened cytoplasmic content, whereas, other hairs have thick walls, smooth and highly vacuolated. These trichomes are similar to the earlier trichomes reported in Malvaceae by Metcalfe & Chalk (1950), Ramaya (1972), Leelavathi & Ramayya (1983), Osawaru (1985), Rao & Rao (1992).

In addition to these hair types reported in this study, various non-gladular trichome types, uniseriate filiform, uniseriate macroform, multiseriate (multicellular) have been reported in genera like *Hibiscus, Gossypium, Malva* e.t.c in the family Malvaceae (Metcalfe & Chalk, 1950; Ramayya, 1981 and Judd *et al*., 1999). From this study, the taxon stands apart from some genera in this family. But the ubiquitous presence of unicellular form exclusively in this taxon is interesting and may be taxonomically significant.

However, the prevalence of these features is suggested of limited taxonomic importance among the accessions of this taxon and could not be used for limiting the accessions but of diagnostic value for the accessions of this taxon.

Distribution of trichomes on leaf surfaces and fruit in the accession studied is interesting. The abaxial surfaces among the accessions in the taxon possess unicellular filiform hairs whereas the adaxial surfaces are conspicuously with conical macroform hairs uniquely on the ribs. On the fruit, the grooves are densely covered with unicellular conical hairs. This is responsible for the downsy nature of fruits. The ridges are strictly and sometime sparsely covered with macroform conical hairs which sometimes make the fruit spiny. This nature of fruit hinders harvesting process when using bare finger and also choice of consumption by farmers. Selection by farmer may lead to the extinction of accessions with the hair type on fruit.

Ramayya (1981), Rao & Rao (1992) and Wood (1949) noted that in order to understand the value of trichome taxonomically two system were suggested-glabrous and pubescence stated. All accessions of the taxon studied are pubescent with hairs on both vegetative parts and fruit. This is adopted in this study. It is clearly demonstrated that trichome distribution in the accessions studied is widely occurrence hence taxonomically significant to place them as pubescence taxon. Further studies are necessary to throw more light on the realignment and circumscription of the accessions studied in this species-*caillei*.

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