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A Taxonomic Study of some Species in *Cassiinae* (*Leguminosae*) using Leaf Epidermal Characters

Sefiu Adekilekun SAHEED, Herbet Chukwuma ILLOH

Obafemi Awolowo University, Department of Botany, Ile-Ife 220005, Nigeria; saheed@oauife.edu.ng

Abstract

Foliar epidermal characters of ten species from the genus *Cassia* L. Emend. Gaertner, *Senna* Miller and *Chamaecrista* Moench found in South Western Nigeria were studied. The aim was to establish some useful diagnostic features that may be employed in combination with other characters as intra or inter-specific or generic tools for their delimitation. Our results revealed exciting features that are helpful in the identification of each species. These include guard cell area, stomatal index and frequency, presence or absence of trichomes, types of trichomes, as well as their length on epidermal surfaces and wall types. These results, therefore suggest diagnostic features that were found on the epidermal surface that can be employed to justify the separation of the new genera *Senna* and *Chamaecrista* from their initial genus *Cassia*.

Keywords: *Cassia*, *Chamaecrista*, epidermal features, guard cell area, stomatal index, *Senna*, trichomes

Introduction

Initially *Cassia* Linn is a very large genus that is comprised of about 500 to 600 species (Airy-Shaw, 1973). It is probably the largest of the leguminous genera in the sub family Caesalpinioidea. The genus *Cassia* ranks among the 25 largest genera of the dicotyledonous plants (Irwin and Turner, 1960) and in West Africa, it contains about 22 species aside from the introduced or cultivated ones (Hutchison and Dalziel, 1958). Monumental work on this genus was carried out by Bentham (1971) and Bentham and Hooker (1976) work which led to further classification of the genus *Cassia* and. On the basis of these two works the genus is further subdivided into three subgenera: the *Cassia*, *Senna* and *Lasiorhegma*.

This classification was the case until when Irwin and Barneby (1981) subjected the genus to some nomenclatural and taxonomic changes that eventually led to the splitting of the genus into smaller genera viz: *Cassia*, *Senna* and *Chamaecrista*. Irwin and Barneby (1981) relay their work on the argument that while *Cassia* sens. lat. is clearly an isolated group, the differences between the three groups within it are as large or even larger than those which delimit some genera elsewhere in the *Leguminosae* family. However, Lock (1988) observed that series of problems have arisen because of the name changes following the work of Irwin and Barneby (1982). This is because many workers especially on the African flora would probably prefer to continue to use *Cassia* in its broad sense. This would within reason be acceptable if there was no overlap between floras of Africa and South America. Interestingly, many species of the genus are widespread in the tropics through dispersal or deliberate introduction, hence confusion will definitely set in as several species will be given different names on different continents (Lock, 1988).

Therefore, there is a serious need to find distinctive diagnostic characters that will complement and enhance the delimitation and classification of these recent genera. Several specialists (Metcalfe and Chalk, 1950, 1979; Naik and Nirgude, 1981; Palmer and Tucker, 1981) have stressed the taxonomic value of anatomical characters. They provide additional features, which along with other characters are of great taxonomic value in the classification and identification of plants. Carlquist (1961), Metcalfe (1968) and Stace (1984) have stated that the leaf is perhaps the most anatomically varied organ in angiosperms and it provides a variety of anatomical features that can be employed as useful taxonomic characters.

This paper aims to provide a comprehensive description and add to scanty information that is available in literatures on the anatomy of *Cassia*, *Senna* and *Chamaecrista* species. With this work, we hope to verify the taxonomy of the recently upgraded genera using anatomical features as diagnostic characters as well as providing additional information on the anatomy of these species.

Materials and methods

In this work, 10 species from three genera were studied and they are listed in Tab. 1. The specimens were collected from different locations within the South-Western part of Nigeria (10° 00' N, 8° 00' E) confirmations of collected specimens and herbarium studies were carried out at the Obafemi Awolowo University Herbarium (IFE) and the herbarium at the Forest Research Institute of Nigeria, Ibadan (FHI).

Tab. 1. Summary of important anatomical features on adaxial surface of *Senna*, *Chamaecrista* and *Cassia* genera

	Epidermal cells		Anticlinal wall								Trichome	
Character / Species	Length (μm)	Width (μm)	Straight (mostly)	Deeply sinuous	Few undulate	Straight to undulate	Stomata	Guard cell arean (μm^2)	Stomata index (%)	Stomata frequency (mm^{-2})	Non glandular	Glandular and Non -glandular
Senna												
S. alata	25-50	12-37	+	-	+	-	+	117.8-147.3	7.0-10.3	81-102	+	-
S. hirsuta	35-80	30-55	-	+	-	-	+	196.4-216	7.7-13.2	12-51	-	+
S. obtusifolia	27-55	15-30	+	-	-	-	+	68.7-78.5	14.3-17.1	108-165	-	-
S. occidentalis	42-67	15-42	+	-	+	-	+	117.8-196.4	18.9-30	78-102	-	-
S. sophera	35-67	15-40	+	-	+	-	+	235.6-343.6	13.3-23.3	96-135	-	-
Chamaecrista												
C. kirkii	25-67	10-40	-	-	-	+	+	117.8-176.7	7.4-12.0	96-129	-	+
C. mimosoides	30-57	12-37	-	-	-	+	+	73.6-117.8	23.1-28.2	108-144	-	+
C. rotundifolia	30-90	10-42	+	-	+	-	+	73.6-117.8	20.8-28.3	105-192	+	-
Cassia												
C. fistula	15-40	7-22	-	-	-	+	-	-	-	-	+	-
C. siberiana	12-35	7-17	-	-	-	+	-	-	-	-	+	-

Epidermal peels of most of the specimens were obtained manually using forceps and dissecting needles, fragile and difficult materials were obtained using the procedure previously described (Adedeji and Jewoola, 2008). Specimens were processed for anatomical study using standard anatomical procedures (Illoh, 1995; Adedeji and Jewoola, 2008). Images were viewed and captured on an Olympus BH-2 compound microscope fitted with a JVC KYF70B digital camera, specific characters were measured with the aid of calibrated ocular micrometer while selected images were exported to Corel Draw 12 for presentation.

Guard cell area (GCA) was calculated by multiplying the length and width of guard cells by Franco's constant (0.7854). Stomatal number or frequency was calculated (this is the average number of stomata per square millimeter of leaflets). Stomatal index (SI), which is the percentage proportion of the number of stomata (the guard cell) to the other epidermal cells present on a leaflet portion (Dilchar, 1974) was also calculated. This is obtained using the formula: $S.I. = [S/(E+S)] \times 100$, where S = nr. of stomata per unit area, E = nr. of ordinary epidermal cell plus the subsidiary cells in the same unit area.

Twenty different measurements were conducted for each parameter per species and the values were later grouped into a range, where applicable.

Results and discussion

Genus Senna

S. alata (L.) Roxb

Adaxial epidermal cells are elongated, polygonal or irregular in shape (Fig. 1A), while sizes range from 25μm-50μm long and 12.5-37.5μm wide (Tab. 1). Stomata are present, mostly paracytic (Fig. 1A), occasionally anomocytic, elliptic in shape, sizes are variable, guard cell area (GCA) 117.8-147.3 μm^2 stomata index (SI) 7.0-10.3%, stomata frequency (SF) is 81-102 mm^{-2} (Tab. 1) and subsidiary cells are the same size as ordinary epidermal cells (Fig. 1A). Trichomes are non-glandular (Fig. 1A), sparsely distributed, multicellular, uniseriate, while size ranges from 70-85 μm long and 10-17.5 μm wide (Tab. 1). Druses

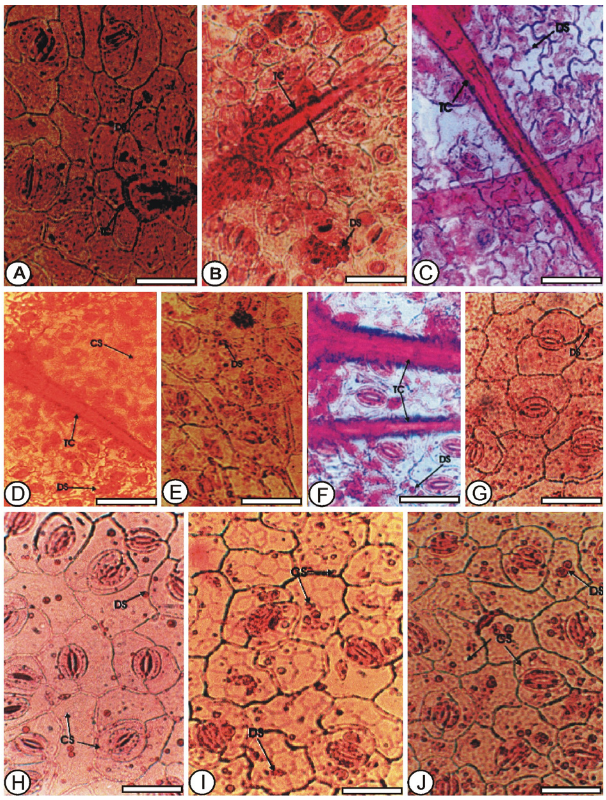

Fig. 1. Anatomical features found in adaxial and abaxial epidermal surfaces of *Senna* species. Scale bars: = 21 μm

of calcium oxalate are present (Fig. 1 A). Abaxial epidermal cells are irregular in shape (Fig. 1 B), sizes variable, 30-75 µm long and 7.5-25 µm wide (Tab. 2). Stomata are present abundant, mostly paracytic and occasionally anomocytic, the shape is elliptic (Fig. 1 B), sizes are variable, GCA 73.6-147.3 µm^2 , SI 25-28.6%, SF ranges between 165-255 mm^{-2}. Trichomes, non-glandular are present, multicellular uniseriate (Fig. 1 B), are more abundant than on the adaxial surface, size ranges from 55-112.5 µm long and 12.5-17.5 µm wide (Tab. 2).

S. hirsuta L.

Adaxial epidermal cells are irregular in shape (Fig. 1 C), sizes variable 35-80 µm long and 35-55 µm wide (Tab. 1). Stomata are abundant, paracytic, elliptic to oval in shape (Fig. 1 C), GCA 196.4-216 µm^2; SI 7.7-13.2% while SF is 12-51 mm^{-2} (Tab. 1). Non-glandular and glandular trichomes are present. There are also non-glandular simple simple multicellular, uniseriate, very long and abundant (Fig. 1 C); sizes range from 207-925 µm long and 110-50 µm wide (Tab. 1). The glandular trichome is stalked with a globular head, about 125-225 µm long (data not shown). Abaxial epidermal cells are irregular in shape (Fig. 1 D), sizes 40-165 µm long and 12.5-42.5 µm wide (Tab. 2). Stomata are abundant, paracytic, elliptic in shape (Fig. 1 D); sizes variable, GCA 117.8-216 µm^2, SI 15.2-25.6%, SF 156-231 mm^{-2} (Tab. 2). Glandular and non-glandular trichomes are present. Non-glandular types are abundant, uniseriate and very long (Fig. 1 D), sizes are 255-900 µm long and 10-42.5 µm wide. It is glandular with a globular head and stalked, size ranges from 87.5-282.5 µm long.

S. obtusifolia (L.) Irwin and Barneby

The adaxial epidermis is mostly polygonal to irregular in shape (Fig. 1 E), sizes range from 27.5-55 µm long and 15-30 µm wide (Tab. 1). Stomata are present, mostly paracytic, some gradations toward anomocytic type encountered, the shape is elliptic (Fig. 1 E). GCA 68.7-78.5 µm^2, SI 14.3-17.1%, SF 108-165 mm^{-2}. The surface is glabrous and druses of calcium oxalate are present. The abaxial surface has epidermal cells that are irregularly shaped with slightly wavy walls, narrow elongated cells with straight walls are also encountered. Sizes vary from 37.5-80 µm long and 17.5-40 µm wide (Fig. 1 F). Stomata are present, mostly paracytic, sometimes anomocytic, elliptic in shape. GCA 58.9-132.5 µm^2, SI 18.2-22.8%, SF 168-220 mm^{-2} (Tab. 2). Non-glandular trichome is present, unicellular and long. Sizes vary from150-737.5 µm long and 7.5- 12.5 µm wide. Calcium oxalate druses are present.

S. occidentalis (L.) Link

Adaxial epidermal cells are irregularly shaped, sometimes they are elongated or rectangular (Fig. 1 G). Epidermal cell size varies from 42.5-67.5 µm long and 15-42.5 µm wide (Tab. 1). Stomata are present, paracytic and generally elliptic in shape with variable sizes (Fig. 1 G). GCA is 117.8-196.4 µm^2, SI is 18.9-30%, while SF is 78-102 mm^{-2} (Tab. 1). Trichomes are absent but druses are present. Epidermal cells on the abaxial surface are dome-shaped; sometimes they appear polygonal (Fig. 1 H), sizes vary from 37.5-90 µm long and 12.5-51 µm wide (Tab. 2). Stomata is present, all paracytic, generally elliptic in shape (Fig. 1H). GCA 103.1-294.5 µm^2, SI 24.2-34.1%, SF 156-201 mm^{-2} (Tab. 2). Trichomes are present, but there are only glandular types, sparsely distributed, stalked, multicellular types, the length ranges from 92.5-180 µm long (Tab. 2). Druses and crystal sand are present.

Tab. 2. Summary of important anatomical features on abaxial surface of *Senna*, *Chamaecrista* and *Cassia* genera

	Epidermal cells		Anticlinal wall								Trichome		
Character / Species	Length (µm)	Width (µm)	Straight (mostly)	Deeply sinous	Few undulate	Straight to undulate	Stomata	Guard cell area(µm^2)	Stomata index (%)	Stomata frequency (mm^{-2})	Non glandular	Glandular and Non -glandular	Glandular only
Senna													
S. alata	30-75	7-25	+	-	+	-	+	73-147	25-28	165-255	+	-	-
S. hirsuta	40-165	12-42	-	+	-	-	+	117-216	15-25	156-231	-	+	-
S. obtusifolia	37-80	17-40	-	-	+	-	+	58-132	18-22	168-220	+	-	-
S. occidentalis	37-90	12-51	+	-	+	-	+	103-294	24-34	156-201	-	-	+
S. sophera	27-55	15-30	-	-	+	-	+	235-353	28-33	135-201	-	-	+
Chamaecrista													
C. kirkii	35-62	12-45	-	-	-	+	+	58-206	12-24	135-168	-	+	-
C. mimosoides	45-65	12-45	-	-	-	+	+	73-157	23-28	135-168	-	+	-
C. rotundifolia	42-95	12-42	-	+	-	-	+	88-117	21-28	168-225	+	-	-
Cassia													
C. fistula	10-160	5-17	-	+	-	-	+	68-107	25-33	135-198	+	-	-
C. siberiana	7-42	5-17	-	-	-	+	+	89-157	9-16	165-216	+	-	-

S. sophera (L.) Roxb.

Epidermal cells of the adaxial surface vary in shape, mostly polygonal but they are irregular sometimes (Fig. 1 I). Cell sizes are variable 35-67.5 µm long and 15-40 µm wide (Tab. 1). Stomata are present, paracytic, mostly elliptic in shape (Fig. 1 I). GCA 235.6-343.6 µm², SI 13.3-23.3%, SF 96-135 mm⁻² (Tab. 1). Trichomes are absent; druses and crystal sand are present. On abaxial surface, the epidermal cells are polygonal to irregular in shape (Fig. 1 J). Sizes are variable from 27.5-55 µm long and 15-30 µm wide (Tab. 2). Stomata are present, essentially paracytic and elliptic in shape (Fig. 1 J). Stomatal size are variable, GCA 235.6-353.4 µm², SI 28.1-33.3%, SF 135-201 mm⁻² (Tab. 2). Only a glandular trichome is present, they are sparsely distributed; druses and crystal sand are equally present.

Genus Chamaecrista

C. kirkii (Oliver) Standley

Adaxial epidermal surface is made of cells that are irregularly shaped (Fig. 2 A), their sizes vary from 2-67.5 µm long and 10-40 µm wide (Tab. 1). Stomata are present, mostly paracytic but sometimes anomocytic, they are elliptic in shape some may be oval to round (Fig. 2 A). GCA 117.8-176.7 µm², SI 7.4-12.0%, SF 96-129 mm⁻² (Tab. 1). The glandular and non-glandular trichomes are present. Glandular trichome is stalked could be as long as 50 µm. However, non-glandular trichomes are mainly distributed along the margin (Fig. 2 C), they are multicellular, uniseriate and they are relatively short with narrow lumen, their size ranges from 62.5-125 µm long and 12.5-17.5 µm wide. Epidermal cells on the abaxial surface are equally irregularly shaped (Fig. 2 B), their sizes ranges from 35-62.5 µm long and 12.5-45.0 µm wide. Stomata are present, mostly paracytic and sometimes anomocytic, they are elliptic in shape. GCA is 58.9-206.2 µm², SI 12.2-24.1%, SF 135-168 mm⁻² (Tab. 2). Glandular and non-glandular trichomes are present; they are as those found on the abaxial surface, the glandular type could be up to 75 µm long and non-glandular sizes ranges from 50-67.5 µm long and 7.5-12.5 µm wide. Druses and crystal sand are also present (Fig .2 B).

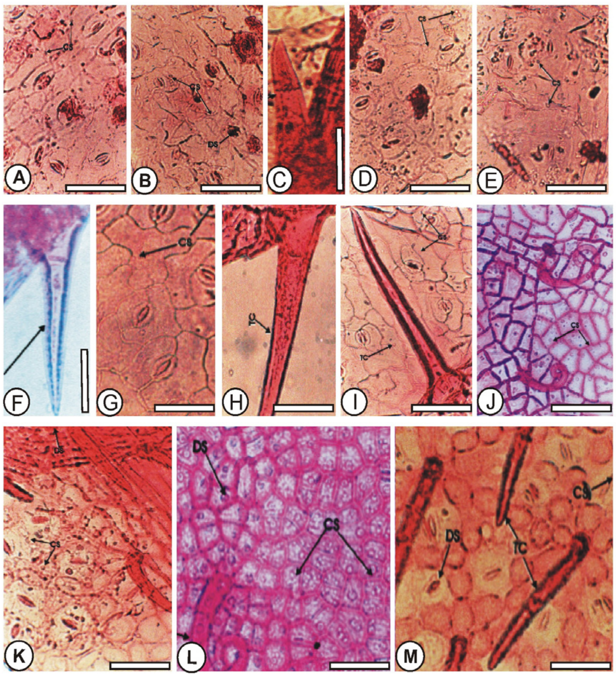

Fig. 2. Anatomical features observed in both adaxial and abaxial epidermal surfaces of species in *Chamaecrista* genus (A -I); and *Cassia* genus (J-M). Scale bars: = 21 µm

C. mimosoides (L.) Greene

Adaxial epidermal cells are irregularly shaped but sometimes they are polygonal (Fig. 2 D), their sizes vary from 30.0-57.5 µm long and 12.5-37.5 µm wide (Tab. 1). Stomata are present, mostly paracytic, sometimes anomocytic, they are elliptic in shape and at times they may be oval (Fig. 2 D). GCA 73.6-117.8 µm², SI 23.1-28.2%, SF 108-144 mm⁻² (Tab. 1). Glandular and non-glandular trichomes are present, glandular types are distributed mostly on the lamina surface; they are stalked and could be as long as 40 µm. Non-glandular ones are distributed on the lamina margin, they are unicellular, simple with a narrow lumen (arrowed -Fig. 2 F), sizes ranges from 62.5-250.5 µm long and 7.5- 12.5 µm wide. Crystals and few a druses are present. On the abaxial surface, the epidermal cells are irregularly shaped, while sometimes they are polygonal (Fig. 2 E). Epidermal cell sizes ranges from 45-65 µm long and 12.5-45 µm wide (Tab. 2). Stomata are present, mostly paracytic, sometimes anomocytic, they are elliptic in shape sometimes they may be oval (Fig. 2 E), GCA is 73.6-157.1 µm², SI 23.1-28.2%, SF 135-168 mm⁻² (Tab. 2). Glandular and non-glandular trichomes are present and distributed as found on the adaxial surface; the glandular ones could be as long as 40 µm and non-glandular ones about 62.5-250.5 µm long and 7.5-12.5 µm wide (Tab. 2). Druses and crystal sand are present.

C. rotundifolia (Pers.) Greene

The epidermal cells on the adaxial surface are irregularly shaped sometimes they are polygonal (Fig. 2 G), with sizes that range from 30.0-90 µm long and 10-42.5 µm wide (Tab. 1). Stomata are present, mostly paracytic, sometimes anomocytic and they are elliptic in shape at times they may be oval. GCA 73.6-117.8 µm², SI 20-28.3%, SF 105-192mm⁻² (Tab. 1). Only non-glandular trichomes are present, they are mainly distributed on the lamina margin of the leaflets, they are multicellular and uniseriate (Fig. 2 H), sizes ranges from 17.5-220 µm long and 7.5-13.5 µm wide (Tab. 1). Crystal sand and druses are present. Abaxial epidermal cells are also irregularly shaped (Fig. 2 I), their sizes vary from 42.5-95 µm long and 12.5-42.5 µm wide (Tab. 2). Stomata are present, mostly paracytic, occasionally anomocytic, elliptic in shape (Fig. 2 I). GCA 88.4-117.8 μm^2, SI 21.6-28.3%, SF 168-225 mm^{-2} (Tab. 2). Only non-glandular types of trichomes are present. They are as those found on the adaxial surface, about 37.5-900 μm long and 7.5-37.5 μm wide. Crystal sand is present and more widely distributed than on the adaxial surface.

Genus Cassia

C. fistula L.

Adaxial epidermal cells are mostly rectangular to square in shape sometimes polygonal (Fig. 2 J), their sizes variy from 15-40 μm long and 7.5-22.5 μm wide (Tab. 1). Stomata are absent. Non-glandular trichomes are present, they are simple, multicellular, short, rolled to form crozier-like ending (Fig. 2 J), sizes ranges from 62.5-12.5 μm long and 5-17.5 μm wide (Tab. 1). Crystals sand is present in abundance and randomly distributed. On the abaxial surface, the epidermal cells are rectangular to polygonal in shape (Fig. 2 K), the size of the epidermal cell ranges from 10-160 μm long and 5-17.5 μm wide (Tab. 2). Stomata is present, all paracytic, they are elliptic in shape (Fig. 2K), GCA is 68.7-107.9 μm^2, SI 25-33.9%, SF 135-198 mm^{-2} (Tab. 2). Non-glandular trichomes are abundant, they are short and unicellular (Fig. 2K) size ranges from 30-200 μm long and 7.5-15 μm wide (Tab. 2). Scanty druses are present, crystal sand is abundant, they are small but arranged orderly near the anticlinal wall.

C. siberiana DC

Epidermal cells are mostly square to rectangular sometimes polygonal to irregular in shape (Fig. 2 L), sizes ranges from 12.5-35 μm long and 7.5-17.5 μm wide (Tab. 1). The surface is glabrous as stomata are absent. Trichomes are present, as they are non-glandular uniseriate, multicellular, some are rolled to form crozier-like ending, others just curved or sometimes straight, sparsely distributed (Fig. 2 L). Trichome sizes ranges from 67.5-157.5 μm long and 7.5-12.5 μm wide (Tab. 1). Druses are present while sand crystals are distributed in virtually all the cells. The abaxial epidermal cells are polygonal to oval in shape (Fig. 2 M), size ranges from 7.5-42.5 μm long and 1.3-2.5 μm wide (Tab. 2). Stomata is present, paracytic, elliptic in shape (Fig. 2 M), GCA is 98.2-157.1 μm^2, SI 9.6-16.7%, SF 165-216 mm^{-2} (Tab. 2). Trichomes are present, non-glandular widely and abundantly distributed, multicellular, uniseriate tapering at the apex (Fig. 2M) size varies 57.5-275 μm long and 7.5-12.5 μm wide (Tab. 2). Few druses are present and crystal sand is sparsely distributed.

Many researchers (Palmer and Gerberth-Jones, 1986; Illoh, 1995; Adedeji and Illoh, 2004; Adedeji and Jewoola, 2008; Santos *et al*., 2008) have previously stressed the taxonomic significance of leaf epidermal characters. The current study of the epidermal characters of the three genera is quite significant because they distinctly separate the taxa under study. The shape of the epidermal cells is mostly irregular sometimes polygonal or rectangular, few elongated in both *Senna* and *Chamaecrista* genera while it is rectangular to square sometimes polygonal to oval in the *Cassia* genus. The length of the epidermal cells is clearly delimiting with *Cassia* having the smallest cell size (12.5-40 μm) while the length in *Senna* (25-80 μm) and *Chamaecrista* (25-90 μm) species are close. The overlap in these ranges perhaps still explain the affinity in their relationship despite the recent taxonomic divergence. The anticlinal wall is equally helpful in distinguishing the three genera and eventually some few species. While it is mostly straight with few undulate in most species of *Senna* except in *S. hirsuta* where it is deeply sinuous, it is generally straight to undulate in both *Chamaecrista* and *Cassia*, except in *C. rotundifolia* where it is mostly straight with few undulations (Tab. 1 and 2).

Cuticular examination revealed the presence of stomata on the surfaces of the leaflets in most species with higher frequency on the abaxial surface. The paracytic type of stomata is common to all sub genera in *Cassia* and various gradation towards anomocytic condition are found in organs such as fruits, corolla and anther (Okpon, 1969b). Paracytic type of stomata occurs in all the three genera examined in this work, this is in agreement with the work of Okpon (1969a and b), however, anomocytic stomata were encountered in all the species of *Chamaecrista* and in only two species of *Senna*; *S. alata* and *S. obtusifolia*. The actinocytic condition (stomata surrounded by many subsidiary cells) is considered as probably derived from the paracytic forms and this have so far been found in the genus *Senna*, Okpon (1969b) has reported an actinocytic type of stomata in the subgenus *Senna* especially in the section *Psilorhegma* which are plants of tropical Australia, South East Asia and islands of the Pacific.

The leaves are amphistomatic in both *Senna* and *Chamaecrista* genera, but it is hypostomatic in *Cassia* species. This also corresponds to the findings of Okpon (1969a and b). In addition, the guard cell area (GCA) which is quantitative in nature, it is nevertheless of taxonomic interest. GCA is relatively high in *S. sophera* (235.6-353.4 μm^2) while it is low in *S. obtusifolia* (58.9-132.5 μm^2) in both adaxial and abaxial surfaces; others are of intermediate values in *Senna* genus. In *Chamaecrista* GCA is closely ranged though *C. kirkii* has the highest (58.9-206.2 μm^2) while *C. rotundifolia* has the lowest (73.6-117.8 μm^2), similarly in the *Cassia* genus where *C. siberiana* has the highest range (98.2-157.1 μm^2) and *C. fistula* has the lowest (68.7-107.9 μm^2).

Whilst the stomata frequency (SF) varies considerably with the age of the leaf, the stomata index (SI) is highly constant for any given species (Olatunji, 1983; Adedeji and Jewoola, 2008). In this study, SI is helpful in species delimitation; in *Senna* genus, *S. alata* has the lowest SI on the adaxial surface (7.0-10.3%) while *S. obtusifolia* has the lowest on the abaxial surface (18.2-22.9%), it is the highest in *S. occidentalis* on both surfaces (adaxial-18.9-22.9%;

abaxial-24.2-34.1%). In *Chamaecrista* genus, *C. kirkii* has the lowest range on both surfaces (adaxial-7.4-12.0%; abaxial-12.2-24.1%), but *C. rotundifolia* and *C. mimosoides* have a very close range, whereas in *Cassia* genus *C. fistula* has the highest (25-33.9%) while *C. siberiana* has the lowest (9.6-16.7%).

Many plant groups show great diversity in their indumenta, some of which are of taxonomic importance. While ecological variations may affect the degree of hairiness, the type of hair is usually constant in many species or species group (Okpon, 1969a) and many researchers have found the presence or absence and types of trichomes on the epidermal surfaces as classificatory tools (Rollins and Shaw, 1973; Adedeji *et al*., 2007). Metcalfe and Chalk, 1979 has long suggested that the types of epidermal trichomes can frequently delimit species, genera or families in plant. Differences in trichome types were employed by Isawumi (1989) to delimit species in the *Vernonia* genus.

In this study, the presence or absence of trichomes, as well as their types can be useful in characterizing the genera and species. In the genus *Senna*, trichomes are encountered only on the abaxial surfaces of *S. obtusifolia*, *S. occidentalis* and *S. sophera*, while both surfaces of *S. alata* and *S. hirsuta* have trichomes (Tab. 1 and 2). The presence of non-glandular trichomes in *S. obtusifolia* separates it from *S. occidentalis* and *S. sophera* that possesses glandular trichomes. The pubescent taxa can be delimited by the presence of non-glandular trichomes on both surfaces of *S. alata* and the possession of both glandular and non-glandular trichomes on both surfaces of *S. hirsuta*. The two types of trichomes were present in *Chamaecrista* genus, *C. kirkii* and *C. mimosoides* has both types on their two surfaces while *C. rotundifolia* has only non-glandular ones on its surfaces. In the two species of *Cassia* studied, there is a presence of distinct crozier-like, non-glandular trichomes only on their adaxial surfaces while simple multicellular, uniseriate trichomes are present on their abaxial surface. Although quantitative, the variations in trichome length observed in this study can be reasonably employed in delimiting the species.

Conclusions

In conclusion, despite the overlapping nature of the characters measured which still points out to the relative closeness of these genera and their species, this work clearly justifies the separation of *Senna* and *Chamaecrista* from their initial *Cassia* genus thereby supporting the work of Irwin and Barneby (1981). However, it is not oblivious of the fact that further techniques, such as protein profile studies and others could be carried out to fine-tune the present contributions to the taxonomy of these genera and their species.

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