

## Comparative Study between some Species of *Cassia* and *Senna* from Fabaceae Family Using Leaf Epidermal Characters

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### Abstract

The important taxonomic significance was obtained from this study helped to comparative species under the two genera *Cassia* and *Senna* grown in Iraq. The aim was to confirm some useful diagnostic features that may be used in comparison between the two genera. Our results detect important features that are helpful in the identification of each species. These include presence of stomata only in the lower surface of the leaves in the species of *Cassia* and in the species *S. singueana* in addition presence the Paracytic type pattern in it and differed from the rest species of *Senna*, so in the results of the current study was treated with this species as one of the types of *Cassia* depending on the old classification, so the species of two genus appeared differ in the shape of anticlinal walls of the ordinary epidermal cells, also found that the genus *S. artemisioides* was unique in the presence Actinocytic stomata pattern on the upper and lower surfaces, this feature considered an important to distinguishing it from the rest of the species, in addition this pattern absence in the species of *Cassia* and which helps to differentiate between the two genus under studies. The hairs in both genus species which Unicellular uniseriate type and from many sections of plants species collected from Iraq we not found multicellular hairs in the species under study.

**Keywords:** *Cassia*, *Senna*, Epidermal features, Stomata pattern, Hairs.

### Introduction

*Cassia* Linn. Is a very large genus that includes about 500 to 600 species [1]. It is considered the largest of the Fabaceae family in the subfamily Caesalpinioidea [2]. In Iraq, it contains about 9 cultivated species relative to Flora of Iraq [3]. Huge studies and work on this genus were carried out by [4,5] who led to the other classification of the genus *Cassia* and on the basis of these two studies the genus is subdivided into three subgenera *Cassia*, *Senna*, and *Lasiorhagma*.

After these studies the classification studies by [6] subjected the genus *Cassia* to some nomenclatural and taxonomic changes that finally led to the splitting of the genus into two genera *Cassia*, *Senna* and *Chamaecrista*. Some taxonomists like as [7,8, 9] have they confirmed to the taxonomic of anatomical characters and they provide additional features, besides with the other characters [10, 11 and 12]. Have confirmed that the leaves feature is perhaps the most anatomically diverse organ in dicotyledons and can provide the variety of anatomical

characters that can be used as useful taxonomic features. This work aims to supply the overall description and add new information to comparative between *Cassia* and *Senna* species by using the anatomical features of leaves epidermis.

### Material and Methods

#### Collection of Plant Material

Samples were collected from the herbal garden from middle and west of Iraq in the month of April-May 2016. The plant material was identified and authenticated by flora of Iraq, the species of *Cassia* include (*C. fistula*, *C. nodosa* and *C. singueana*) and the species of *Senna* include (*S. artemisioides*, *S. occidentalis* and *S. surattensis*).

#### Microscopically Investigation

The epidermis prepared to follow by [13]. At the first clearing the epidermis of leaf by distilled water, put in 0.5% sodium hypochlorite for 10 min to remove the chlorophyll pigments, then put in ethanol

alcohol for 10-15 min, finally, the samples were put on the slides and covered by cover

slides then fixed by Olympus KRÜSS light microscope then photographed using Olympus Am scope camera.

To find the stomatal index follows [14] as:

$$\text{Stomatal index} = \frac{\text{number of stomata}}{\text{number of stomata} + \text{number of ordinary epidermal cells}} \times 100$$

## Results

### Study of Epidermis

The measurements of the ordinary epidermal cell and stomata complex appear it in the Table 1 and 2, so the shape of leaves epidermis and stomatal complex appear it in the Figure 1 and 2. The surface view of upper epidermis leaf appear varied in the anticlinal wall of ordinary epidermal cell in the species of *Cassia*, the results showed that the species *C. fistula* have straight anticlinal wall are and it appear undulate in the species *C. nodosa* and *C. singueana*. The lower epidermis of *Cassia* species consists of stomata and the anticlinal walls of ordinary epidermal cells are undulate in all species.

The species belonging to the genus *Senna*, noted that the upper and lower epidermis is consist of stomata and depending on the shape of the anticlinal walls of the upper and lower epidermis can be divided into two groups: the first group, the anticlinal wall are straight include *S. artemisioides* and *S. surattensis*, the second group the anticlinal walls are undulate includes *S. occidentalis* As for leaves and distribution the stomata complex in it, the *Cassia* species have hypostomatic type that's mean free of stomata and the stomatal complex are Paracytic type in all species and the leaves in the *Senna* species Amphistomatic type that's mean the both upper and lower epidermis consist of stomata and the type of stomata

complex are Actinocytic type in the species *S. artemisioides* and Anisocytic type and Paracytic type in the species *S. occidentalis* and *S. surattensis*.

### Study of Leaf Surface (Indumentum)

The measurements of hairs appear in the Table 3, so the shape of hairs appears it in the Figure 3 and 4. All the species of *Cassia* consist of eglandular hair uniseriate & unicellular in shape and varied in shape of peak and nature of walls, The eglandular hairs in the species *C. fistula* have two type of hairs one of them straight hairs with acute peak and smooth walls so the other hairs curved with rounded peak and smooth walls too, as for the species *C. nodosa* the hairs have acute peak and curved like hook and the walls granular and rough, also the species *C. singueana* characterized by straight hairs with acute peak and smooth walls. The species of *Senna* also consist of eglandular hair uniseriate & unicellular in shape and varied in shape of peak and nature of walls, the species *S. artemisioides* characterized by found two type of hairs one of them straight hairs with acute peak and the other one rounded peak with smooth walls for both of them. The species *S. occidentalis* the hairs straight with acute peak with smooth walls and the species *S. surattensis* characterized by curved hairs or straight with acute peak and smooth walls.

**Table 1: Variations in the characteristics of the epidermis leaf of the species *Cassia* and *Senna* (measured by micrometer)**

species	Upper surface		Lower surface		Nature of walls	
	length of epidermal cells	Width of epidermal cells	length of epidermal cells	Width of epidermal cells	Upper surface	Lower surface
<i>C. fistula</i>	19.2-22.6(20.8)	10.2-16.5(13.2)	16.4-20.2(18.1)	11.1-17(13.8)	Straight	Undulate
<i>C. singueana</i>	26.1-31.9(28.7)	14.5-19.6(16.7)	16.3-20.7(18.1)	10.3-16.9 (13.1)	Undulate	Undulate
<i>C. nodosa</i>	24-28.9(25.7)	22.1-26.5(24.2)	32-35.6(34.2)	41.3-46.5 (43.7)	Undulate	Undulate
<i>S. artemisioides</i>	25.2-29.3(27.1)	15.4-20.6(17.7)	26.5-30.9(28.2)	18.2-23.6 (20.6)	Straight	Straight
<i>S. occidentalis</i>	38.1-43.7(40.8)	23.3-27.1(25.4)	37.4-43(39.9)	12.3-26.6 (23.5)	Undulate	Undulate
<i>S. surattensis</i>	20.5-26.5(23.2)	14.3-19.4 (16.75)	31.5-36.8(33.5)	16.3-23.8 (19.5)	Straight	Straight

\* Numbers outside the parentheses represent upper and lower limits and inside the parentheses represents the rate of 10 readings

**Table 2: Measurements of the stomatal complex in the species *Cassia* and *Senna* (measured by micrometer)**

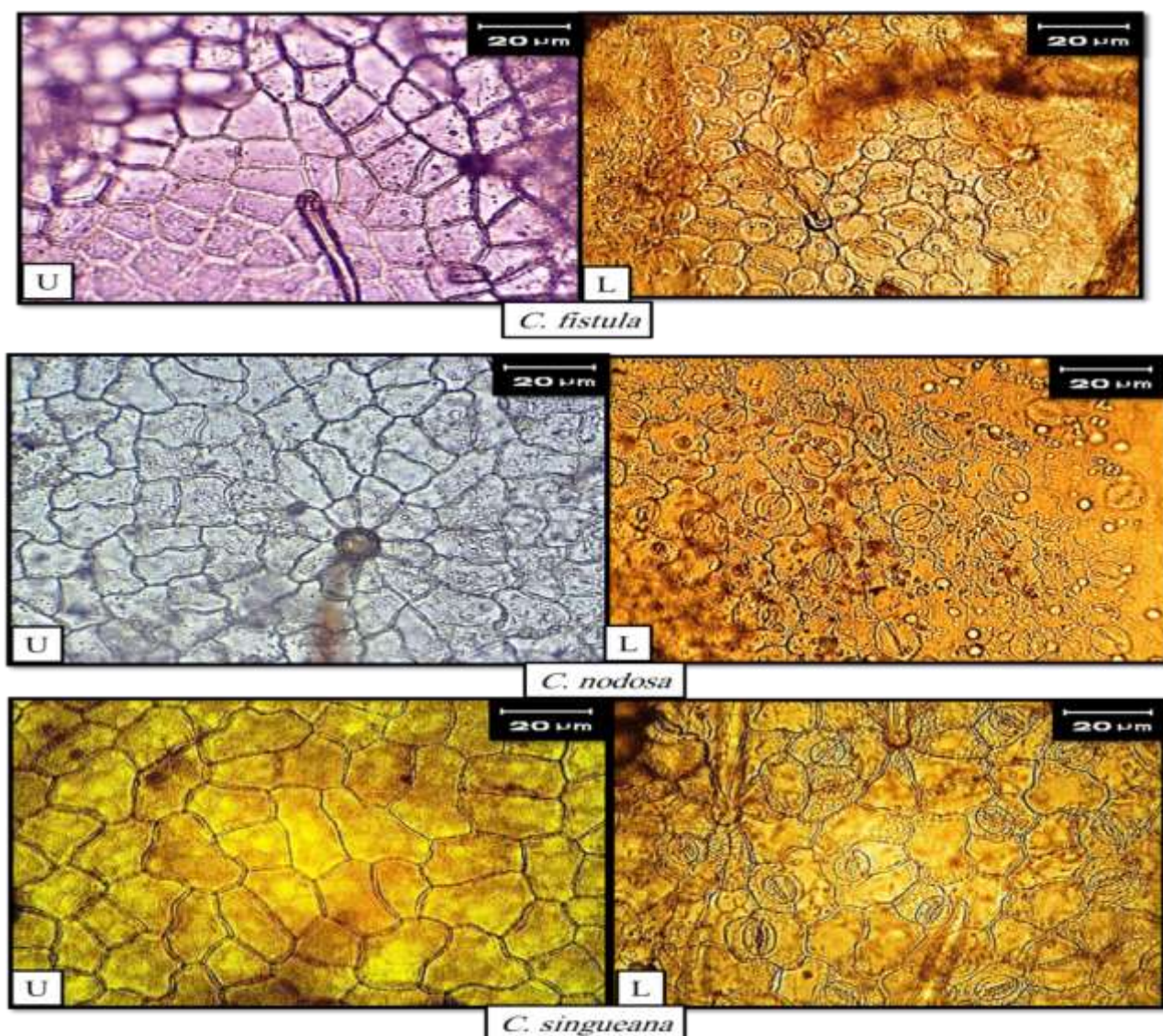
Species	Upper epidermis		Stomatal index	Lower epidermis		Stomatal index
	Length of stomata	Width of stomata		Length of stomata	Width of stomata	
<i>C. fistula</i>	-	-	-	16.4-20.7(18.4)	(14.3) 15.9-13.7	20
<i>C. singueana</i>	-	-	-	10.2-14.6(12.5)	7.4-11.4(9.3)	20
<i>C. nodosa</i>	-	-	-	13.3-17.5(15.3)	10.1-14.6(12.1)	20
<i>S. artemisioides</i>	22.1-26.6(24)	17.5-21.5(19.2)	16.6	33.2-37(35.2)	14.5-18.9(16.4)	18
<i>S. occidentalis</i>	15.5-21.4(17.8)	9.7-12.9(11.5)	20	16.2-20.5(18.1)	12.5-16.7(14.3)	16.6
<i>S. surattensis</i>	10.4-16.7(13.3)	11.1-15.5(13.0)	20	15.3-18.7(17.2)	10.1-16.5(13)	20

\* Numbers outside the parentheses represent upper and lower limits and inside the parentheses represents the rate of 10 readings.

**Table 3: Measurements of hairs in the species *Cassia* and *Senna* (measured by micrometer)**

Species	Type of hairs	Length of hairs
<i>C. fistula</i>	Curved hairs with rounded peak and smooth walls & Straight hairs with acute peak and smooth walls	653.3-729.5 (691.2)
<i>C. nodosa</i>	Curved hairs (hook like) with acute peak and granular and rough walls	468.1-587.8 (527.5)
<i>C. singueana</i>	Straight hairs with acute peak and smooth walls	210.2-400 (305.5)
<i>S. artemisioides</i>	Straight hairs with acute peak and smooth walls & Straight hairs with rounded peak and smooth walls	810.4-1239.9(986.2)
<i>S. occidentalis</i>	Curved hairs with acute peak and smooth walls	450.4-637.9 (543.5)
<i>S. surattensis</i>	Straight hairs with acute peak and smooth walls & Curved hairs with acute peak (hook like) and smooth walls	325.5-570.8 (447.5)

\* Numbers outside the parentheses represent upper and lower limits and inside the parentheses represents the rate of 10 readings



**Figure 1: Stomata and ordinary epidermal cells in upper and lower epidermis of *Cassia* species, when the U: upper epidermis and L: lower epidermis**



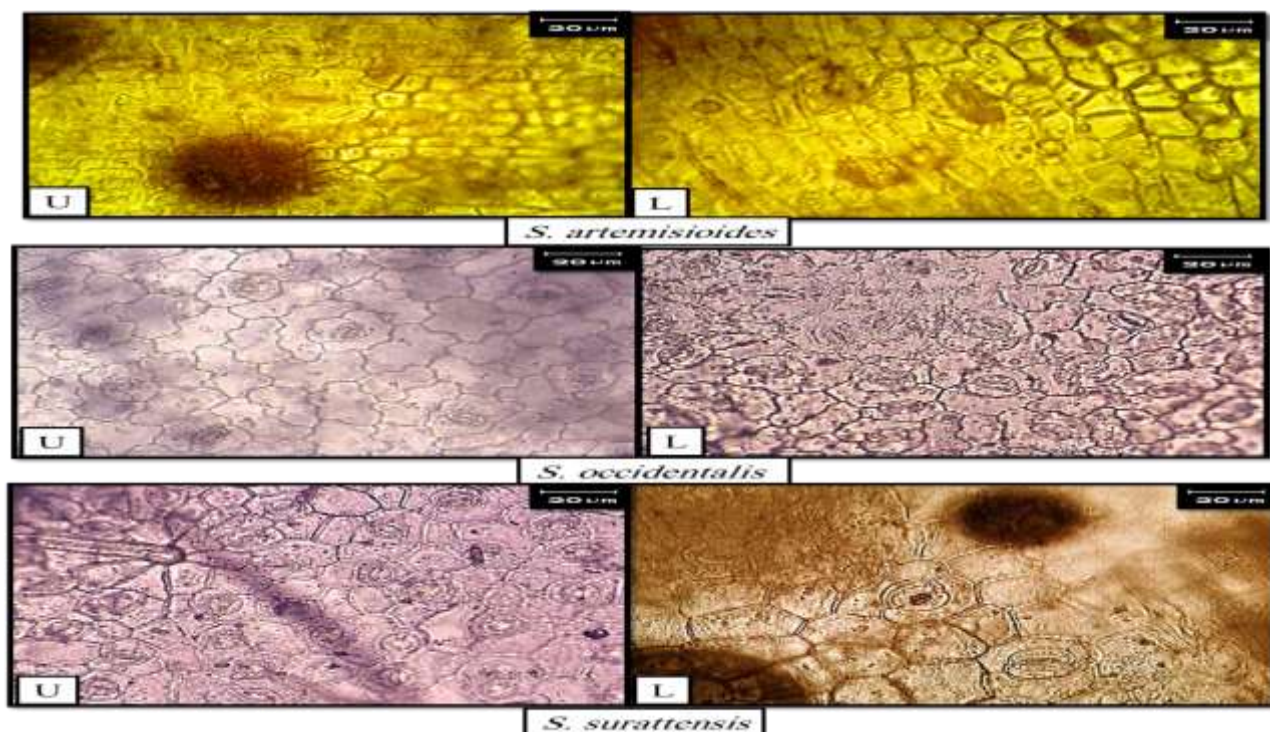


Figure 2: Stomata and ordinary epidermal cells in upper and lower epidermis of *Sennaspecies*, when the U: upper epidermis and L: lower epidermis

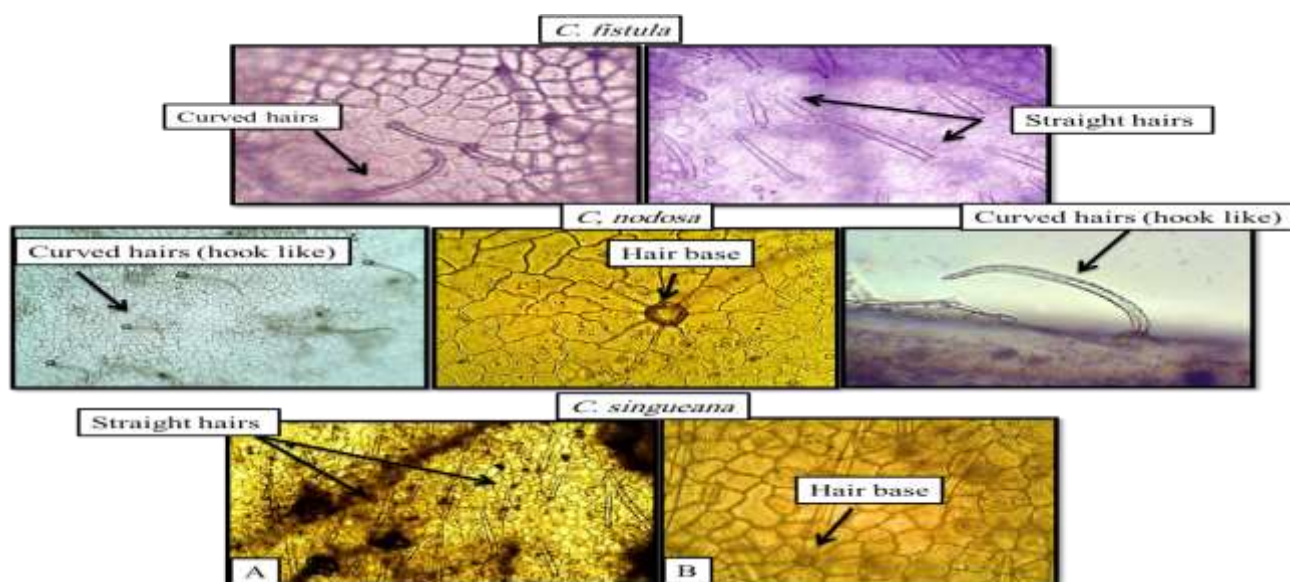


Figure 3: type of hairs in the *Cassia* species

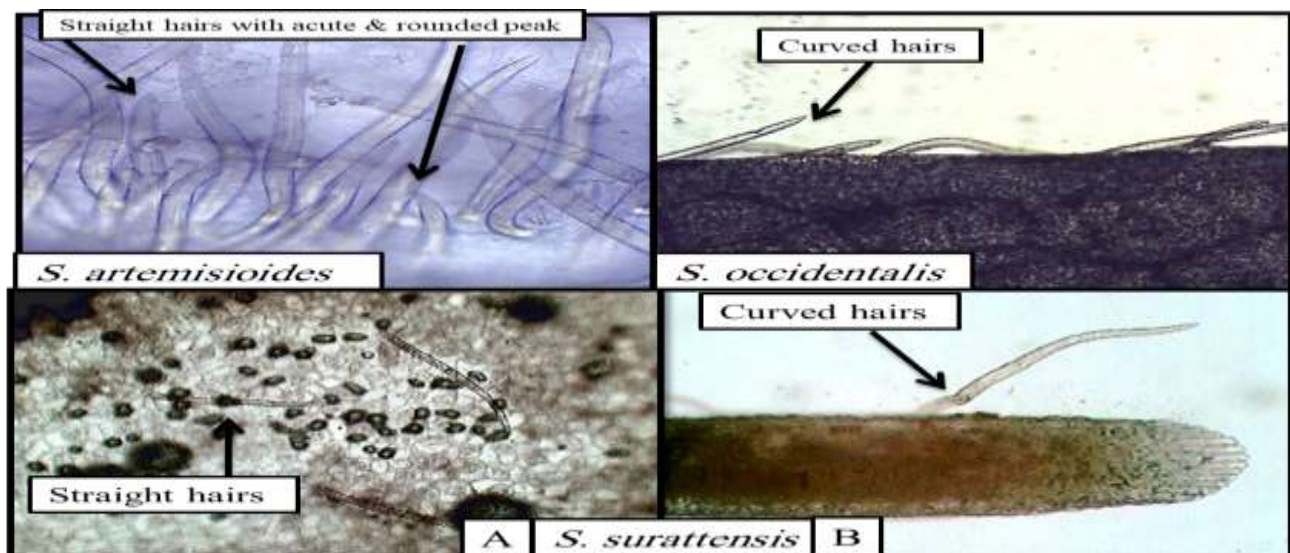


Figure 4: type of hairs in the *Senna* species

## Discussion

The results obtained have important taxonomic significance when showed that the species *S. singueana* have an anatomical similarity with the species of *Cassia* by the presence of stomata only in the lower surface of the leaves in addition presence the Paracytic type pattern in it and differed from the rest species of *Senna*, so in the results of the current study was treated with this species as one of the types of *Cassia* depending on the old classification without adoption the classification of the [15], because of the anatomical characteristics consider importance in diagnose, isolate and put species in their correct taxonomic position and understand relationships that do not the phenotypic traits appear it [16], especially the anatomy of the leaves are important in determining the close relationships of taxonomic hierarchies [11 and 17], in addition study of [18] that confirm in their studies of some Species in *Cassiinae* using leaf epidermal characters that differs between *Cassia* and *Senna* by founded the stomata in upper and lower and prove that this point very important to a comparison between the two genera so depending on this feature they were separated into two genera. Also these results agreed with [19 and 20].

Also the species of two genus appeared differ in the shape of anticlinal walls of the ordinary epidermal cells and this results agree with [21]. In addition, the cellular and genetic studies have shown many results that support the classification of the two American taxonomists [22] where *C. singueana* was not included in the reclassified species [23 and 24].

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From the results also found that the genus *S. artemisioides* was unique in the presence Actinocytic stomata pattern on the upper and lower surfaces, this feature considered an important to distinguishing it from the rest of the species, in addition this pattern absence in the species of *Cassia* and which helps to differentiate between the two genus under studies, these results were agreed with a study [25] who refer to the Actinocytic pattern exists only in the *Senna* species.

The study highlighted the differences between species in the indumentum of parts of plants in terms of forms of hairs, density and lengths, which had an important taxonomic value, the hairs in both genus species which Unicellular uniseriate type and the results agreed with a study of [18 and 26] that indicated the presence of unicellular glandular hairs in *C. fistula*, and the same studies mentioned the presence of eglandular multicellular hair in the species *S. surattensis* and *S. sulfureae* but in this study and from many sections of plants species collected from Iraq we not found this type of hairs.

## Conclusion

In conclusion, in spite of the overlapping kind of the features measured which still mention to the closeness of the two genera *Cassia* and *Senna*, this work obviously justifies the separation between of the *Senna* and *Cassia* genus thereby confirm the work of [5]. However, in future work can use additional techniques, such as protein studies or plastids DNA by molecular technical and others could be helped to improve the present studies to the taxonomy of these genera.

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