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## A Comparative Anatomical study of two species of *Albizia* L. cultivated in Iraq

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### Abstract:

The current research included a comparative anatomical study of the epidermis of the stem, leaf, calyx, and corolla of two species of *Albizia lebbek* (L.) Benth. and *Albizia julibrissin* Durazz cultivated in Iraq, and a comparison of cross-sectional sections of each of the stems, leaflets, petiole, pulvinus and fruits, in addition to the venation system, as well as a study of the cuticle ornamentation of the leaflets, corolla, and fruits using a scanning electron microscope, which is the first study in Iraq. The study revealed the importance of these characters in isolating the two species, especially the anticlinal walls of upper epidermis of leaflets, characteristics of pulvinus, leaflet especially those of vascular bundles while other features of limited taxonomic value as the outline of sections and epidermis of the stem.

**Keywords:** *Albizia lebbek*, *Albizia julibrissin*, Cross sections, Epidermis, Cuticular ornamentation.

### Introduction

The genus *Albizia* Druzz. Belong to the family Mimosaceae, which is a very important family economically [1]. This

family comprises 56 genera and about 3000 species widely distributed in tropical and subtropical regions [2; 3] including ornamental trees as *Albizia*, *Leucaena*, *Acacia* or Shrubs sometimes grown as hedges such as *Prosopis juliflora*, *Acacia farnesiana*, [1], rarely herbs or climbers [2]. The genus *Albizia* is of more than 160 species of mostly fast growing subtropical or tropical trees and shrubs. The leaves deciduous, bipinnate, alternate, leaflet many, somewhat oblique. Flowers in globes heads, Sepals 5-toothed, Petals 5, connate. Stamens numerous, exerted, showing, Fruit Strap-Shaped Pod without pulp.

*Albizia* is an important forage, timber and medicinal plants. Some species are cultivated as ornamental for their altercative flowers [2;3;4]. Some species are used as food plants by larvae of moths in the genus *Endolita* [3;4].

In Iraq, the family is represented by five genera and only eleven species. The two types of *Albizia* (*A. lebbeck*(L.) Benth. and *A. julibrissin* Durazz.) are cultivated as ornamental trees. Also, they have medicinal important as antioxidant [5] and anti-inflammatory [6] and used for making furniture [7]. The Literature survey showed that there is no comprehensive anatomical study of the two species of *Albizia* in Iraq, so the aim of this research was to study the anatomical characteristics of the two species of *Albizia* cultivated in Iraq.

## **Material and Methods**

### **Sample collection and identification**

The two plants samples of the genus *Albizia* were collected from different localities of Babylon. Then the samples were kept in 70% ethyl alcohol until used in the study. For species identification, flora of Iraq [1]. As for the epidermis of stem, leaflet, calyx and corolla were prepared by peeling method mentioned by [8] and stained by Safranin 1% for 2 minutes, while for the transverse sections of the stems, leaflet, petiole, pulvinus and fruits using paraffin wax method. The dried samples of the leaflet, corolla and fruit were coated with gold and examined by a Dutch-made scanning electron microscope at the College of Science / University of Kufa.

## **Results and Discussions**

### **1-Epidermis:**

#### **1.1 Stem:**

Epidermis of small cells, oblong in shape. This feature is agreeing with [9, 10] Anticlinal walls were curved-straight and pitted in both of the two species, shape of anticlinal wall is important and confirmed by the study of [11]. Epidermis cells of 10-20  $\mu\text{m}$  in width and 25-37.5  $\mu\text{m}$  in length in *A. lebbeck*, and 10-22  $\mu\text{m}$  in width and 12.5-55  $\mu\text{m}$  in length in *A. julibrissin*. Stomata are anomocytic in shape, as mentioned by [12]. Mean of stomatal length range from 26.2-27.5 $\mu\text{m}$  and width from 16.2-17.5  $\mu\text{m}$  (Table 1, Figure 1).

Table 1: Quantitative and qualitative data of stem, leaflet, Calyx and Corolla epidermis of the studied species.

Species	Surface	Observed stomatal complex	Dimensions of epidermal cells		Dimensions of Stomata		Stomata l index	Cell shape
			Length (µm)	Width (µm)	Length (µm)	Width (µm)		
<i>Albizia lebeck</i>	St	Anomocytic	25-37.5 (31.25)	10-20 (15)	25-30 (25)	12.5-20 (16.25)	3	curved-straight
	Ad	----	12.5-37.5 (25)	17.5-37.5 (27.5)	-----	-----	----	undulate
	Ab	paracytic and Anisocytic	12.5-32.5 (22.5)	15-22.5 (21.25)	15-22.5 (18.75)	11.25-17.5 (14.375)	29	curved-straight
	Ad (Ca)	Paracytic and Anisocytic	27.5-45 (36.25)	23-53.25 (38.125)	25-30 (27.5)	17.5-22.5 (20)	4	curved
	Ab (Ca)	Anomocytic and Anisocytic	24-60.5 (42.25)	20-30 (25)	17.5-27.5 (22.5)	16.25-23.75 (20)	3	curved-straight
	Co	Anomocytic	22.5-65 (43.75)	22.5-40 (31.25)	22.5-27.5 (25)	17.5-22.5 (20)	5	curved-straight
<i>Albizia julibrissin</i>	St	Anomocytic	12.5-55 (33.75)	10-22.5 (16.25)	22.5-30 (26.25)	15-20 (17.5)	4	curved-straight
	Ad	----	21.5-55 (38.125)	17.5-40 (28.75)	-----	-----	-----	undulate
	Ab	paracytic and Anisocytic	15-42.5 (28.75)	17.75-39 (28.25)	16.25-22.5 (19.375)	13.75-17.5 (15.625)	31	undulate
	Ad (Ca)	Anisocytic	22-43 (32.5)	27.5-45 (22.5)	20-29 (24.5)	15-20 (17.5)	1	curved-straight
	Ab (Ca)	anomocytic	32.5-48 (40.25)	22.5-41 (31.75)	22.5-27.5 (25)	17.5-25 (21.25)	2	curved-straight
	Co	paracytic	33.75-57.5 (45.625)	25-45 (35)	20-30 (25)	20-26.25 (32.125)	4	curved-straight

\*Ad: Adaxial surface of leaflet; Ab: Abaxial surface of leaflet; St: Stem epidermis ; Ad(Ca): Adaxial surface of calyx; Ab(Ca): Abaxial surface of calyx ; Co: corolla epidermis

1.2 Leaflet:

The shape of anticlinal walls of epidermis cells are similar on both surface of the leaflet in *Albizia lebeck* Which was undulate, but unlike in *Albizia julibrissin* which was undulate on the a baxial surface and straight – curved on the a daxial surface. Stomatal are restricted to the lower surface (abaxial), thus, the leaflet is of hypostomatic type. This feature was confirmed by [13; 14] but differ with [15]. Type of stomata are paracytic & Anisocytic. Mean of stomatal length range from 14.3-15.6  $\mu\text{m}$  and width from 18.7-19.3  $\mu\text{m}$ . [Table 1, Figure (1,2)].

1.3 Calyx:

Adaxial surface have epidermis cells with curved anticlinal walls in *Albizia lebeck* and straight – curved in *Albizia julibrissin*, but abaxial surface have similar anticlinal walls which was straight – curved. Stomatal on the abaxial surface are anisocytic in both of the two species in addation to the Anisocytic in *Albizia lebeck*. Stomatal on the abaxial surface are Anomocytic in both of the two species, in addition to the Anisocytic in *Albizia lebeck*. Calyx have valuable characteristics as mentioned by [9; 16;17]. (Table 1, Figure 2).

1.4 Corolla:

Anticlinal walls of corolla epidermis is similar in the two species of *Albizia* which were straight- curved. Stomatal types are Anomocytic in *Albizia lebeck* 22.5-27.5  $\mu\text{m}$  length and 17.5-22.5 $\mu\text{m}$  in width. Which in *Albizia julibrissin* it was Paracytic, 20-30  $\mu\text{m}$  length, 20-26.25  $\mu\text{m}$  in width. Taxonomic importance of this characteristics was. (Table 1, Figure 2).



Fig. 1: Ordinary epidermal cells Stem epidermis and stomatal complexes of *Albizia* species(400X)

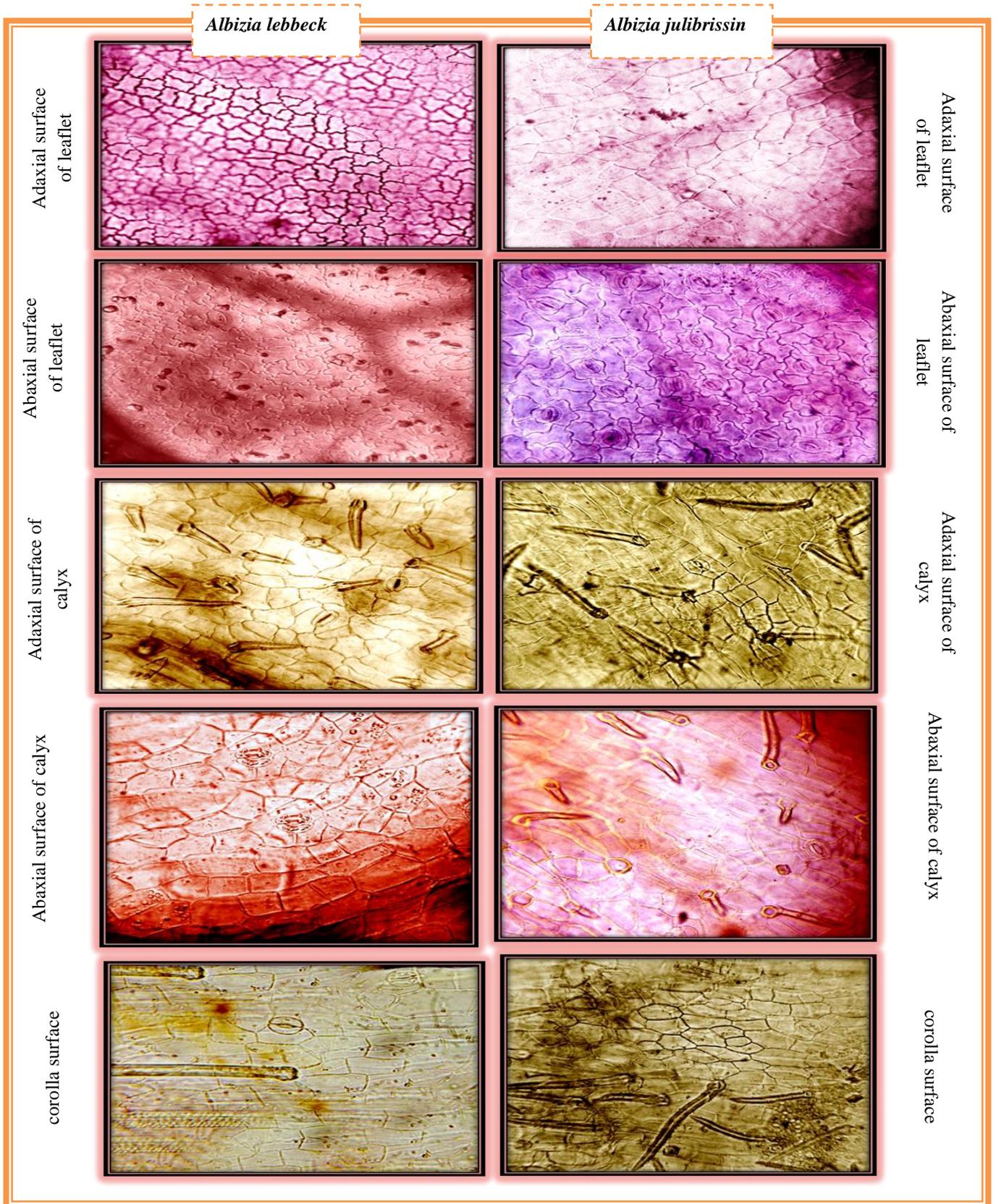


Fig.2: Ordinary epidermal cells and stomatal complexes of *Albizia* species (400X).

1.5 Cuticular ornamentation:

Cuticle ornamentation of leaflet is similar in the two species of *Albizia* which was finely cellular- papillate. In corolla cuticular ornamentation was reticulate in *Albizia lebbeck* and finely cellular –papillate in *Albizia julibrissin* [18] showed taxonomic importance of microphology corolla of *Albizia* L. Cuticular ornamentation of fruit was dissimilar in both species. Which was reticulate in *Albizia lebbeck* and pitted in *Albizia julibrissin*, this feature was confirmed by [19]. (Figure 3).

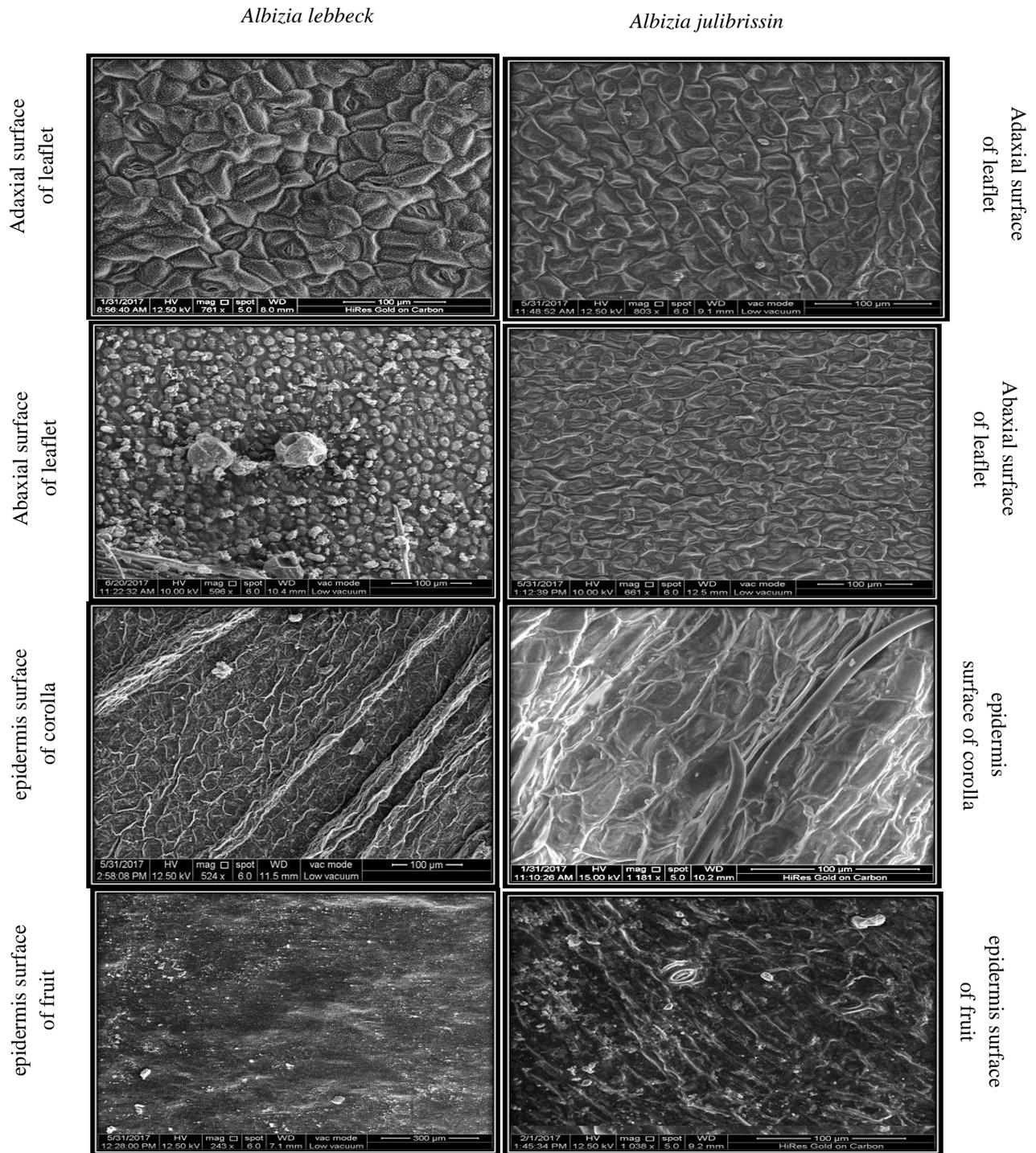


Fig. 3: Characteristic of surface micromorphology of the studies species using Scanning Electron Microscope

## 2-Cross –sections

### 2.1 Stem:

Cross section of stem is round- angulate in shape in both of the two species of *Albizia*. The outer most layer consist of epidermis cells quadrate- rectangular in shape. The average thickness of cuticle ranges from 2-62  $\mu\text{m}$  in *Albizia julibrissin* to 4.12  $\mu\text{m}$  in *Albizia lebbeck*. The average thickness of epidermis range from 10.6  $\mu\text{m}$  in *Albizia julibrissin* to 11.8 $\mu\text{m}$  in *Albizia lebbeck*. Our study agrees with some other studies as [20]. Cortex consists of 3-4 rows of Angular collenchyma cells and 6-8 rows of parenchyma cells in *Albizia julibrissin*, while in *Albizia lebbeck*, the cortex composed of 2-4 rows of Angular collenchyma cells, and 3-4 rows of parenchyma cells. Presence of angular collenchyma mentioned by [21] in their study for some Leguminosae species. Vascular cylinder consist of obovate- widely obovate vascular bundle, biocollateral, (20-18) per section in *Albizia lebbeck* and (22-24) bundles per section in *Albizia julibrissin*, pith composed from thin parenchyma cells in both of the two species of *Albizia*. (Figure 4).



Fig.4: Showing cross-section of stem anatomy of *Albizia* species (40X &100X).

**2.2 Leaflet:**

The outer most layer of the cross section of the leaflet consists of epidermis cells obovate in shape in *Albizia lebbeck* and rounded in *Albizia julibrissin*. Mesophyll usually differentiated in to in to palisade layer with 61.2  $\mu\text{m}$  thickness in *Albizia lebbeck* and 43.5  $\mu\text{m}$  thickness in *Albizia julibrissin*, spongy layer with 43.7  $\mu\text{m}$  thickness in *Albizia lebbeck*, but in *Albizia julibrissin* have 50 $\mu\text{m}$ . Number of vascular bundles is similar in the two species which is (4-5) (Figure 6).

**2.3-Petiole:**

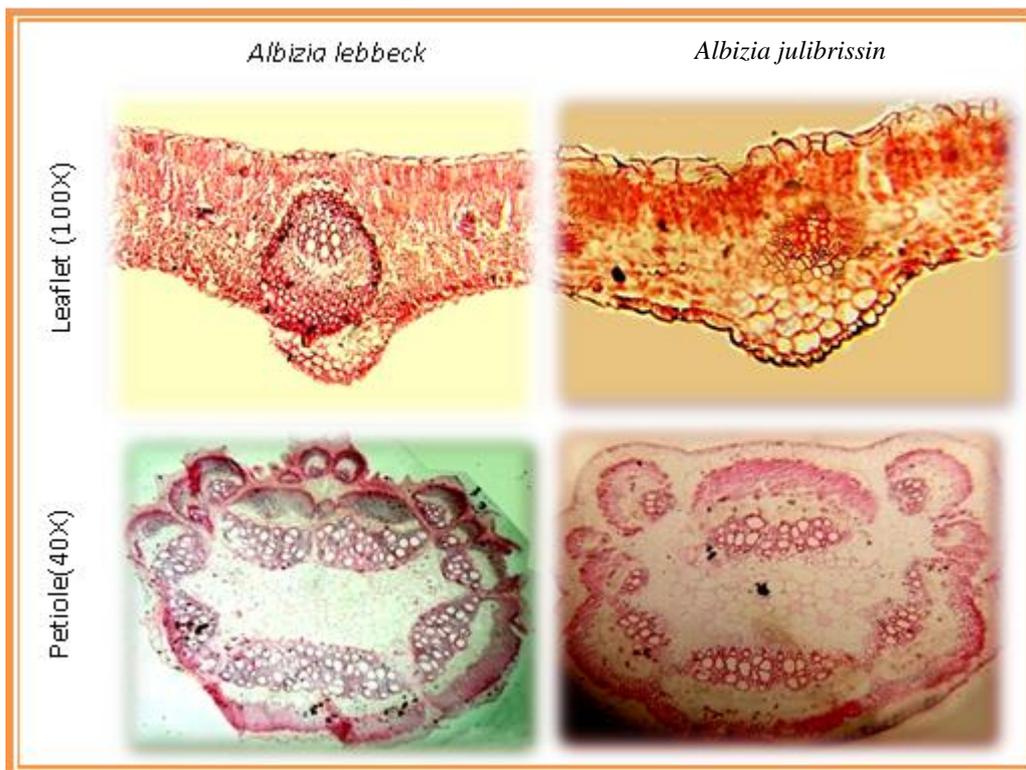
Petiole cross section was similar in both species which is circular or semi-circular in shape. Epidermis is composed of quadrate –rectangular cells. Thickness average of cuticle range from 3.1 $\mu\text{m}$  in *Albizia lebbeck* to 4.3 $\mu\text{m}$  in *Albizia julibrissin*, Thickness of epidermis range from 8.7 in *Albizia lebbeck* to 10.6 $\mu\text{m}$  in *Albizia julibrissin*. Cortex of 4-5 rows angular collenchyma cells, and 2-3 rows of parenchyma cells in *Albizia lebbeck*, while in *Albizia julibrissin*, the cortex has 3-4 rows of angular collenchyma cells and 2-3 rows of parenchyma cells. Petioles of the two species of *Albizia* had vascular system which composed from discrete vascular bundles, 12-13 bundles in *Albizia lebbeck* and 10-11 bundles in *Albizia julibrissin*. A number of accessory bundles on the adaxial side of the petiole were common. Pith composed of a thin- walled parenchyma cells with wide intercellular space. These characteristics of petiole was confirmed by some authors such as [9; 17],(Figure 5).

**2.4- Pulvinus:**

The outline shape of cross section was a like in the two species which is simulate- rectangular. Epidermis is composed of quadrate- rectangular parenchyma cells, stomata usually absent. Thickness average of epidermis range from 11.2 in *Albizia julibrissin* to 16.2  $\mu\text{m}$  in *Albizia lebbeck*. Thickness of cuticle is a like in both of the two species which was 4.3 $\mu\text{m}$ . Cortex consist of 17-18 rows in *Albizia lebbeck* and 17-19 rows in *Albizia julibrissin*. Vascular bundles variable in size, bicollateral (7-8) bundle per section in *Albizia julibrissin*, But in *Albizia lebbeck* it is undifferentiated. pith composed of a thin- layer parenchyma cells (Figure 6).

**2.5- Fruit:**

Cross section of fruit has bone-shape in the two species of *Albizia*. Thickness average of the exocarpe was 10  $\mu\text{m}$  in *Albizia lebbeck* and 7.5 $\mu\text{m}$  in *Albizia julibrissin*, mesocarp with two type of cells, collenchyma in 1-2 rows in *Albizia julibrissin* and 1-5 rows in *Albizia lebbeck*, while parenchyma has 6-8 rows in *Albizia julibrissin* and 12-14 rows in *Albizia lebbeck*. Endocarp with cells type of sclerenchyma in *Albizia julibrissin* and parenchyma in *Albizia lebbeck*. (Figure 6)



**Fig.5:** Showing cross-section of Leaflet and petiole anatomy of *Albizia* species

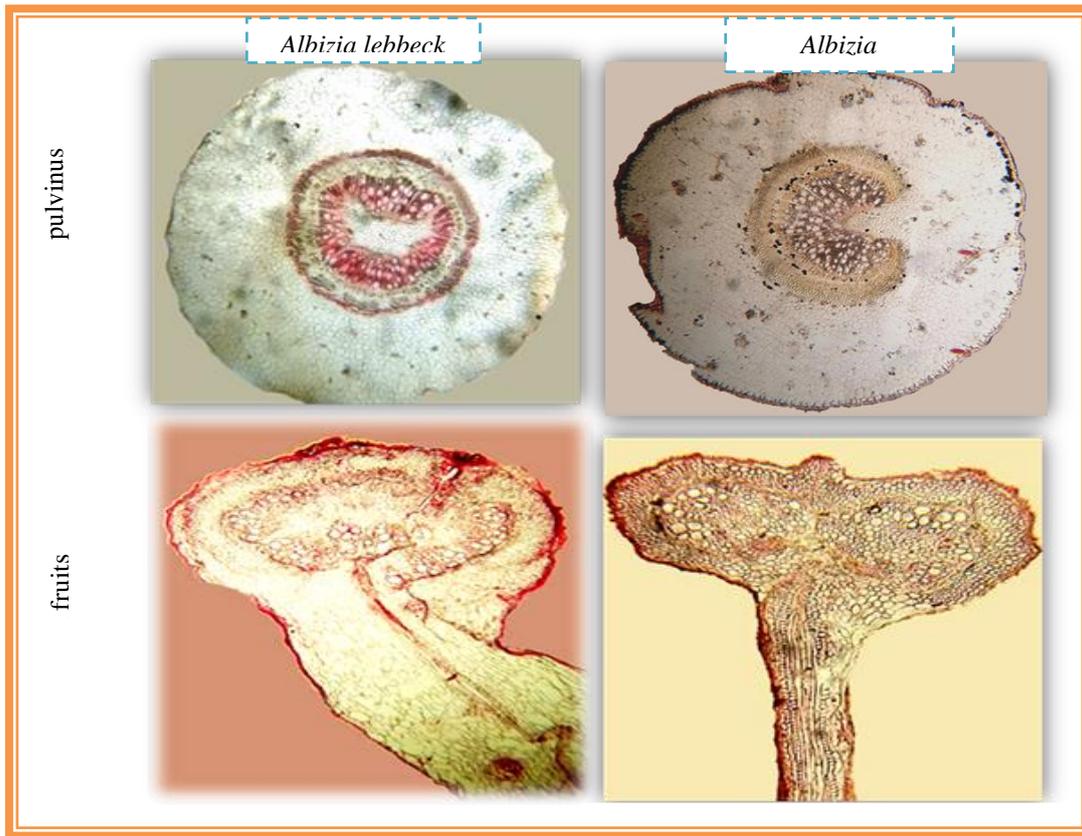


Fig. 6: Showing cross-section of pulvinus and fruits anatomy of *Albizia* species(40X)

**Venation:**

Venation type usually pinnate Brochidodromous in *Albizia lebbeck* in which secondaries not terminating at the margin, but in *Albizia julibrissin* secondaries terminating at the margin and thus called cladodromous this characteristic is mentioned by [22]. Figure (7).

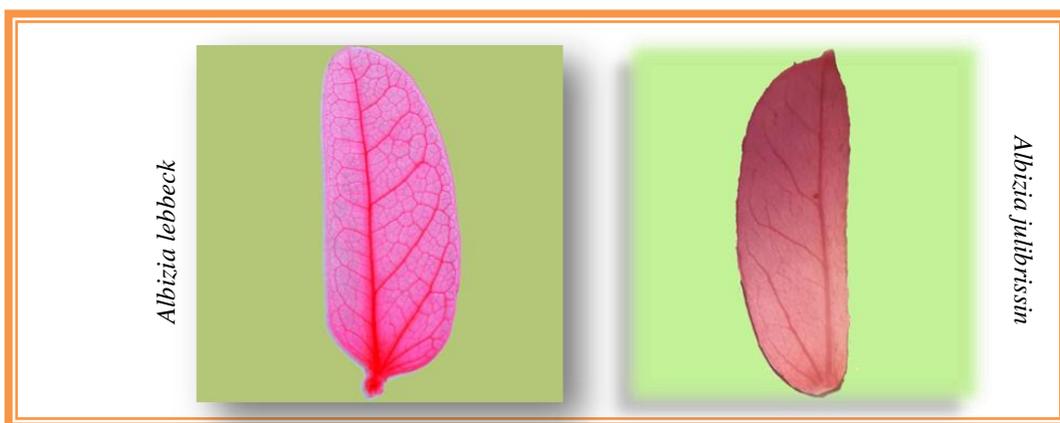


Fig. 7: Venation of *Albizia* species

**Conclusions**

In the current contribution detailed microscopy of the of stem, leaflet, Calyx and Corolla epidermis of *Albizia lebbeck* is provided (Figures 1-2). In addition, a comparative study of anatomy of stem, leaflet, Calyx and Corolla epidermis of *Albizia julibrissin* is provided in the same formats mentioned. Cuticle ornamentation of leaflet is similar in the two species of *Albizia*. In corolla cuticular ornamentation was reticulate in *Albizia lebbeck* and finely cellular –papillate in *Albizia julibrissin* showed taxonomic importance of microphology corolla of *Albizia*. Cuticular ornamentation of fruit was dissimilar in both species. The vascular bundles pulvinus in *Albizia lebbeck* is undifferentiated. Fruit endocarp with cells type of sclerenchyma in *Albizia julibrissin* and parenchyma in *Albizia lebbeck* Venation type usually pinnate Brochidodromous in *Albizia lebbeck* while in the *Albizia julibrissin* is called cladodromous.

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### **Author Contributions Statement**

The first author is responsible for working the steps of the experimental work, results analysis and correction the manuscript, while the second author is responsible for writing the manuscript and Revision.

### **Declaration of competing interest**

The authors declare there are no competing interests

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