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Anatomical study of some characters in certain species of genus *Ficus* L. growing in Iraq

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ABSTRACT

The high morphological diversity among species of the genus *Ficus* causes problems in the delimitation of the species. Therefore, there is a difficulty in offering a natural and well organized classification for the species of the genus.

This research was based on the leaf characters of 3 species from *Ficus* growing in Iraq which is (*F. carica*, *F. elasticaa* and *F. religiosa*). All species of *Ficus* have crystals appeared very clear in the epidermis also recorded the stomatal type and found all the species under study have Actinocytic type and characterized by Hypostomatic (stomata on abaxial only). The shape of the guard cell are reniform in all species under study, and the ordinary cells straight walls and ribbed also the cell shapes are rectangular to polygonal as well as the study showed that the unglandular trichomes are normally founded on the *Ficus carica* and *Ficus religiosa* and the species *Ficus elasticaa* was glabrous.

The vertical sections of leaves showing difference characteristics in epidermis and mesophyll in the species under study, the epidermis differ between the species and on this basis can be divided into three groups, the epidermis in all species is composed of oval cells with undulating walls, also the type of mesophyll in the species *F. elasticaa* and *F. carica* are Bifacil and isobilateral mesophyll in the species *F. religiosa*. The spongy layer were consisted from (3-5) rows of ordinary parenchyma cells in all species except the species *F. elasticaa* the spongy layer form was consisted from Aerenchyma cells. The shape of midrib cross section in the species under study were different between them, where the cross sectional shape of the species *F. carica* was quadrilateral shaped and the vascular bundle was crescent shaped also the shape of cross section in the *F. elasticaa and F. religiosa* were look like elongated jar or eye drawn and the vascular bundle were taken the same shape, likewise the vascular bundle were consisted from xylem and phloem and of several layers of sclerenchyma around the vascular bundles.

Key words: *Ficus* , Iraq, leaf anatomy, Moraceae.

INTRODUCTION

Moraceae family is one of the important plant families medically and economically, spread in the tropical and subtropical zone also near the equator regions so little of it spread in the temperate zones [1]. [2] pointed to the family Moraceae and described as a flowering trees which includes about 40 genera and more than 1,000 species, [3] also noted that this family includes about 70 genera and 1,500 species, [4] refer to the Moraceae family were includes about 73 genera which more 1000 species spread in the tropical and subtropical regions, otherwise [5] suggest to the family Moraceae contains 73 genus and 1000 species, and limited deployment in warm tropical areas of the world, the [6] also mention that this family has a (43 -37) and the genera (1400-1100) species and were widespread in the tropical and subtropical zones.

Some studies and research noted to Moraceae family where they were classified for the first time by Liyannous to 1000 species widespread around the world and 150 species of which only widespread in Africa [7] this family divided into genus proportion to the leaves shaped by [8] and classified the species that belong to family based on the anatomical characteristics by some scientists, such as [9, 10, 11, 12, 13 and 14].

In Iraq [3] refer that the Moraceae family included two genus only which were *Morus* and *Ficus*, the last in turn was divided into three species which was *Ficus carica*, *Ficus religiosa* and *Ficus elastica*, this species spread in the north of Iraq in Sulaemaniea, Arbeel, Aqra north of Nineuah and Penjwin also spread in the south and middle of Iraq in different areas where are grown in orchards and private gardens include trees and large shrubs. In the world the *Ficus* spreading in the tropical and subtropical region and more than 1000 species distributed in it [15 and 16].

It is believed that the original home of *Ficus* is the Arabian Peninsula, and after the Islamic conquest the Muslim deployment it to the North Africa and the Mediterranean countries like Spain, Portugal and the south of

France, Italy and Greece, the *Ficus* belonging one of the oldest species of fruits that have appeared on the Quran [17].

[18] pointed out that the *Ficus* is one of the high nutritional value of fruit trees it may great importance, since it has elements of many compounds in fruits like as protein, fiber, vitamins A, B, C, B1, B2, B6 and many metallic elements such as sodium, phosphorus, manganese and magnesium iron, copper, selenium, zinc, and 90% carbohydrates and fiber increased by 9% 5%, as the fruits contain chlorophyll a, B, and a lot of organic acids also leaves contain potassium, calcium,

The economic and environmental value of the types of the genus *Ficus* are limited in that they are planted on roadsides and on landscaping and shade, as well as the *Ficus* rubber extracted from rubber and highly successful normal *Ficus* trees when planted on the roadside in a private coastal cities [19].

[5] refer that *Ficus* leaves effects in lowering blood sugar and treat gout and internal joints and inflammation also mention that it is possible to eat a *Ficus* leaf to get especially iron minerals is also a good source of potassium and contains a good percentage of proteins. [20] explained that the *Ficus* are used fresh and dried juices and wines used the Milky material known Latex in the cheese industry on the other hand the active substances in the *Ficus* have antiseptic and laxative properties and considered one of the agents helping in digestion and in the treatment of certain gastrointestinal diseases and chronic constipation.

Anatomical and chemical studies compare and distinguish between types of sex *Ficus* by [21 and 22], also [23] studied many species from the genus *Morus* and *Ficus* in Pakistan and compare between them in types of epidermis and shape of trichomes spread in the epidermis of leaves.

The present review aims to characterize three species of *Ficus* leaves to identification the important compositions in the cell of the plant leaves like as the stomatal complex, trichomes, crystal and vertical section of leaves, because the *Ficus* used for medicinal purposes so that's very important to know the anatomical characters of this plant.

MATERIALS AND METHODS

Fresh material of *Ficus* was collected from gardens throughout Iraq. The epidermis were prepared followed by washing with distilled water, put it in 10% KOH, then passed through alcohol for 10-15 minute and then stained by 1% safranin for 30-45 minute. Excess stain was washed off with distilled water, dehydrated by ethanol series (70, 95, and 100%) and cleared with pure xylene 10 minute. Finally, the epidermal samples were put on the slides and mounted by cover slides with Dextrin Plasticizer Xylene (D.P.X) artificial mounting medium.

The prestaining and staining procedure was performed according to [24].

The epidermis using stomatal index [25] as follows:

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

All permanent slides were examined by Olympus BH2 light microscope and photographed using Olympus CH3 camera.

RESULTS AND DISCUSSION

1. Study of epidermis:

The surface view of leaf epidermis, the anticlinal walls of adaxial and abaxial epidermis was characterized as straight to little sinuate in all the species under study (Fig. 1), also all the cells of epidermis leaf contains prismatic crystal and only *Ficus carica* and *Ficus elastica* have Cystolith crystal (Fig. 2).

Stomata shape in *Ficus* species was Actinocytic type uniformly Hypostomatic (stomata on abaxial only) and the stomatal surrounded by 4 subsidiary cells in the species *F. carica* and *F. elastica* so surrounded by 6 subsidiary cells in the species *F. religiosa*, also the guard cells have reniform in all species under study. The measurements of epidermal cells were differ between the species under study, where the length of adaxial epidermis reached to 15.5µm as the lowest rate in the *F. elastica* and to 37.5µm as the highest rate in the *F. religoisa* and the width measurements reached to 14µm in *F. elastica* as the lowest rate and to 40.5µm in *F.*

carica, in abaxial epidermis the length measurements reached to 24.5µm as the lowest rate in the *F. elastica* and to 44.5µm as the highest rate in the *F. religiosa* and the width measurements reached to 25.5µm in *F. carica* as the lowest rate and to 43µm in *F. religiosa*, the anticlinal walls of ordinary epidermal cells were normally straight walls and ribbed also the cell shapes are rectangular to polygonal. (Fig. 1) as well as the stomata were different also between the species under study where the length measurements reached to 14.25µm as the lowest rate in the *F. carica* and to 25.5µm as the highest rate in the *F. elastica* and the width measurements reached to 10.5µm in *F. elastica* as the lowest rate and to 15µm in *F. religiosa* (Table 1).

This result conformity of [21 and 22] that studies the morphological characters in epidermis of *Ficus* and described as irregular and polygonal in most of *Ficus* species and comparative the leaf anatomy of *Ficus* species in Nigeria also [26] refer that the stomata found on the lower surface only.

2. Study of Indumentum

The current study found that the indumentum in the species belonging to the genus *Ficus* differ between the species under study, where the species *Ficus carica* and *Ficus religiosa* having unglandular trichomes and the species *Ficus elastica* was glabrous

The unglandular trichomes Uniseriate & Unicellular having soft walls sharp peak in the species *Ficus carica* and rounded peak in the species *Ficus religiosa,* all the trichomes centered around the stem and on the adaxial and abaxial epidermis of leaves in both species *Ficus carica* and *Ficus religiosa* (Fig. 3).

[21] was confirmed this truth which revealed that trichomes distribution in upper and lower leaf and considered that the taxonomic value of the trichomes is an important indicator of classified the *Ficus* species from other.

3. Study the vertical section of leaves:

The vertical sections of leaves showing difference characteristics in epidermis and mesophyll in the species under study, the epidermis differ between the species and on this basis can be divided into three groups as follows:

Group I: Simple and uniseriate epidermis represented in the species (*F. religiosa*).

Group II: Compound and diseriate epidermis represented in the species (*F. carica*).

Group III: Compound epidermis and Maltiseriate from upper and Diseriate from the lower represented in the species (*F. elastica*).

The epidermis in all species is composed of oval cells with undulating walls, it was noted that there is a clear difference in the blade thickness where the average reached to 85µm as lowest value in *F. carica*, while the highest value reached to 530µm in *F. elastica*. It was observed that the mesophyll layer consists of palisade and spongy layer, the type of mesophyll in the species *F. elastica* and *F. carica* are Bifacil (i.e. differentiated into upper palisade parenchyma and lower spongy parenchyma) and isobilateral mesophyll (i.e. differentiated into upper and lower palisade parenchyma with spongy parenchyma between them) in the species *F. religiosa*. The spongy layer were consisted from (3-5) rows of ordinary parenchyma cells in all species except the species *F. elastica* the spongy layer form was consisted from Aerenchyma cells, thickness of spongy tissue was different in the species under study where the average reached to 38µm as the lowest rate in the species *F. carica* and to 97.5µm as the highest rate in the species *F. religiosa* (Table 2). The shape of midrib cross section in the species under study were different between them, where the cross sectional shape of the species *F. carica* was quadrilateral shaped and the vascular bundle was crescent shaped also the shape of cross section in the *F. elastica and F. religiosa* were look like elongated jar or eye drawn and the vascular bundle were taken the same shape, likewise the vascular bundle were consisted from xylem and phloem and of several layers of sclerenchyma around the vascular bundles (Figure 4, 5 and 6).

Table 1. Epidermal cells and stomata dimensions in leaves *Ficus* (in micrometer).

Species	Adaxial		Abaxial						Stomatal index
	Dimension of ordinary epidermal cell		Dimension of ordinary epidermal cell		Dimension of stomata		Dimension of guard cell		
	Length	Width	Length	Width	Length	Width	Length	Width	
F. carica	(45 -32.5) 36.5	(50-27.5) 40.5	(37.5-20) 28	(30-20) 25.5	(17.5-11.5) 14.25	(13.75-10) 11.37	(25-15) 19.37	(7.5-3.75) 5.41	21.88
F. elasticaa	(20-12.5) 15.5	(17.5-12.5) 14	(25-22.5) 24.5	(32.5-25) 28.5	(27.5-22.5) 25.5	(12.5-7.7) 10.5	(40-25) 31.5	(10-3.75) 6.5	32.82
F. religiosa	(50-12.5) 37.5	(42.5-25) 29.5	(67.5 -30) 44.5	(57.5-35) 43	(27.5-20) 24	(15-15) 15	(37.5-20) 29.5	(7.5-3.75) 5.6	38.34

*Note: The numbers in outside brackets represent average and in the brackets represent upper and lower limits.

Table 2. Quantitative the vertical sections of the leaves in *Ficus* (in micrometer).

species	Blade					midrib	
	Blade thickness	epidermis thickness		Palisade thickness	Spongy thickness	Vascular bundle thickness	Number of xylem rows
		Upper	Lower				
F. carica	(187.5-125) 150	(17.5-10) 13.75	(15-7.5) 11.25	(87.5-57.5) 69.15	(50-25) 38	(180 – 130) 157.5	25-15
F. elasticaa	(462.5-575) 530	(67.5-27.5) 50.5	(12.5-7.5) 10	(22.5-12.5) 18.12	(62.5-32.5) 47	(280 – 195) 244.37	60-50
F. religiosa	(250-200) 225	(27.5-17.5) 22.5	(45-25) 33.75	(67.5-37.5) 52.5	(77.5-125) 97.5	(200 – 155) 174	60-55

*Note: The numbers in outside brackets represent average and in the brackets represent upper and lower limits.

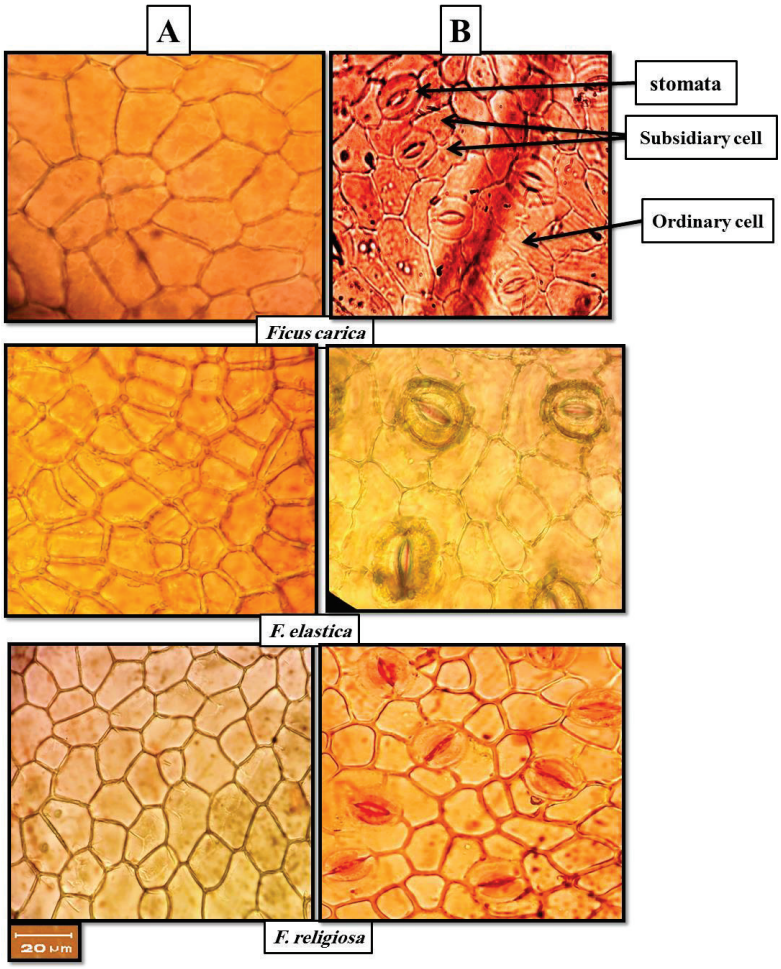

Figure 1. Variation in epidermis leaf among *Ficus* species showed the stomatel complex where A: adaxial surface, B: abaxial surface (scale bar 20 µm).

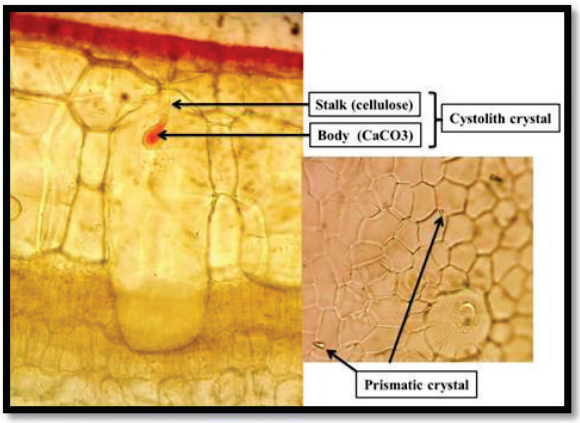

Figure 2: Prismatic and cystolith crystal among *Ficus* species.

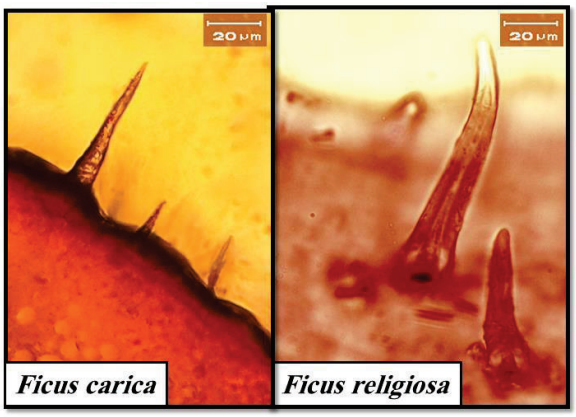

Figure 3: shape of unglandular trichomes among *Ficus* species.

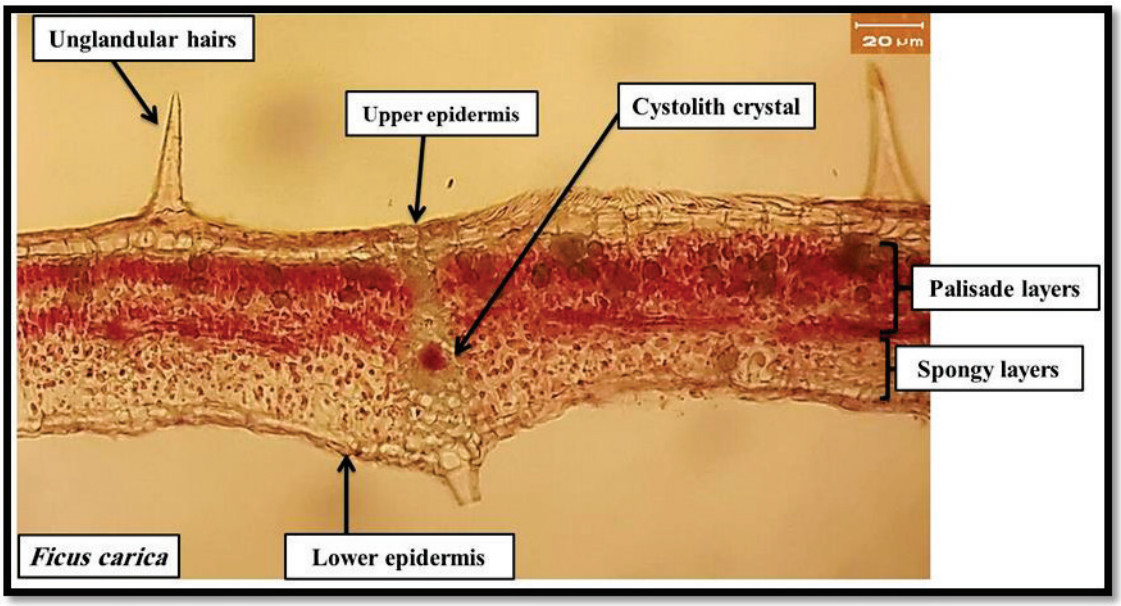

Figure 4: Vertical section in leaf of species *F. carica*.

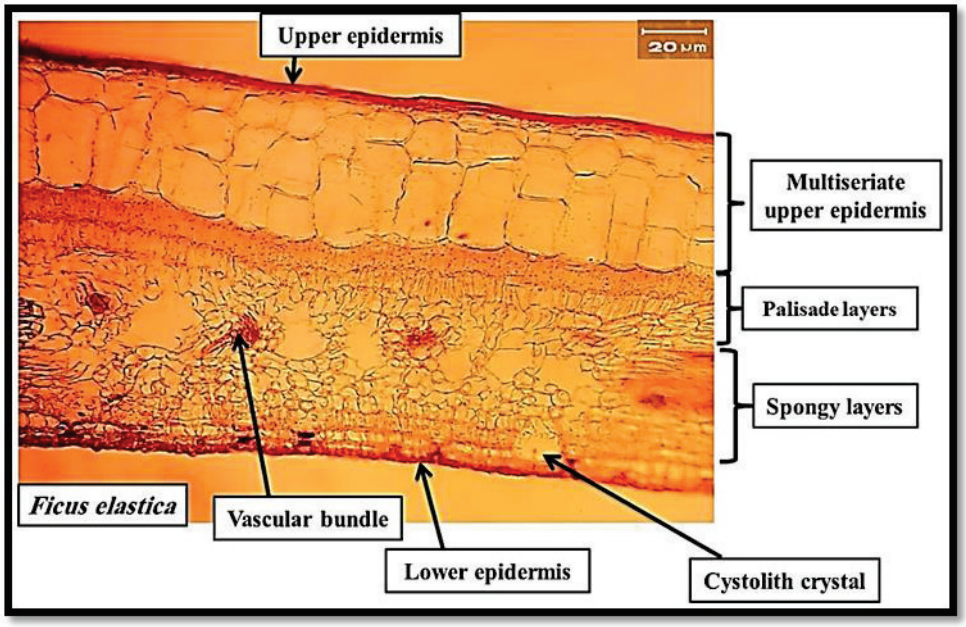

Figure 5: Vertical section in leaf of species *F. elasticaa*.

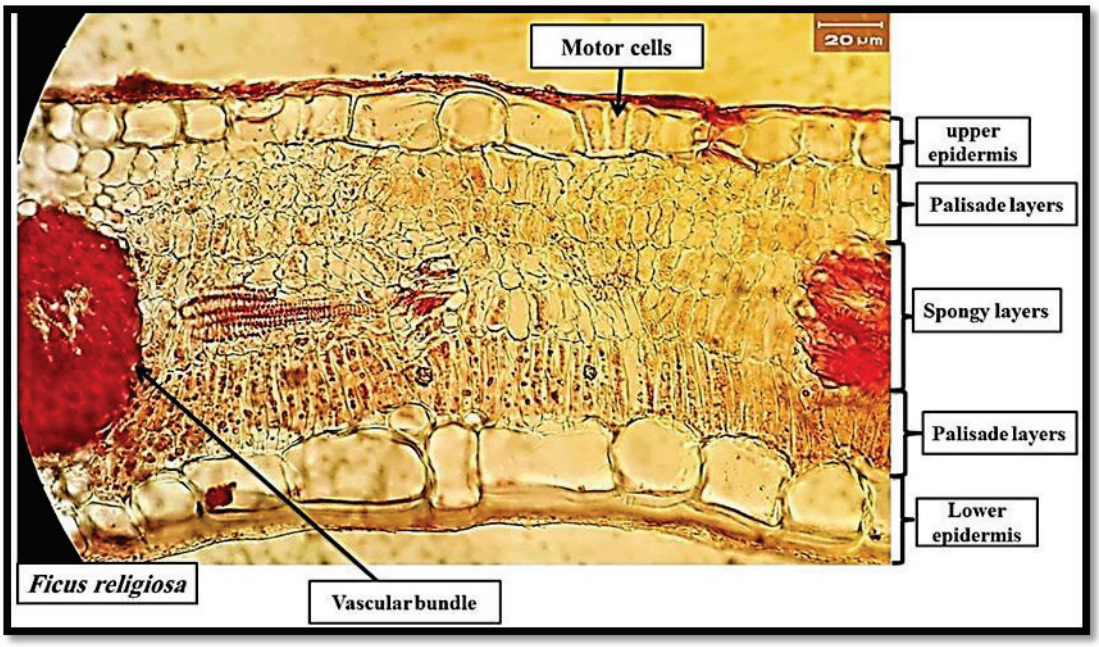

Figure 6: Vertical section in leaf of species *F. religiosa*.

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