



SURFACE EPIDERMIS OF LEAF AND INDUMENTUM FOR FIVE SPECIES OF THE GENUS *GALIUM* IN IRAQ

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Abstract

The current investigation included study of leaf surface epidermis beside indumentum for the species *Galium aparine* L., *G. ceratopodium* Boiss, *G. setaceum* Lam., *G. spurium* L., and *G. tricornatum* Dandy, the study showed that paracytic type of stomatal complex is the only type occur in leaf. The indumentum compose of eglandular hairs vary in their apices, length and occurrence of different part of plant body.

Key words : Rubiaceae, *Galium*, Leaf surface, Epidermis, Indumentum.

Introduction

Galium L. is one of the largest genera belonging to the family Rubiaceae from dicotyledons which is the fourth largest family (Al-Kateb, 1988), comprise of 563-611 genus and 10900-13150 species (Simpson, 2010). In Iraq *Galium* L. represented by (23) species (Townsend and Guest, 1980). Some of *Galium* species such as *G. aparine* possessed antimicrobial, anticancer and hepatoprotective effect (Al-Snafi, 2018), and the species have been also traditionally used for its antioxidant, anti-inflammatory and cardio effects in the folk medicine (Bradic *et al.*, 2018).

There are few anatomical studies about this genus such as (Hemcinschi *et al.*, 2008) which include anatomy of vegetative organs, surface epidermis of leaf and trichomes, and the study of (Abdel-Khalik *et al.*, 2008) included anatomical study of (11) species of *Galium* in Egypt, besides the study of (Gharab and Al-Mousawi, 2013) about vascularization of leaves, and stem of the species *G. aparine* and the study of (Bowling *et al.*, 2008) include trichome structure and composition in mericarp of *G. aparine*, (Rancic and Petanovic, 2002) studied of *G. mollugo* leaves, (De Toni and Mariath, 2011) studied developmental anatomy of flowers and fruits of species from *Galium*.

Materials and Methods

Fresh specimen were collected from different regions

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in Iraq. The upper and lower surface and leaf epidermis where stripping off by hand using forceps and then transferred to a slide containing a drop of safranin-glycerine, then covered with a cover slide and examined under light microscope to study stomatal complex and ordinary epidermal cells, in term of their shapes, walls shapes, stomatal type, the dimensions of the cells and stomata were measured by ocular micrometre. The indumentum studied in different plant parts and examined under light microscope to study their types length, apices and other characters.

Results and Discussion

Surface epidermis

Ordinary epidermal cells

The ordinary epidermal cells on the upper and lower surface were polygonal in *G. cetacum* and *G. ceratopodium* and irregular shape in the other species, this agree with Hemcinschi *et al.*, (2008), the anticlinal walls in the upper surface were semistraight to oblique in *G. ceratopodium* and *G. aparine*, and straight to semi-straight in *G. setacum* and undulate in other species. While the outer and inner walls were semi-straight in *G. setacum* and *G. ceratopodium*, and undulate in other species.

In the lower surface of leaf anticlinal walls were straight to oblique in *G. certopodium*, straight to semi-straight in *G. setacum* and oblique to undulate in *G. tricornatum* and undulate in other species, while the outer and inner tangential walls were undulate in *G. setacum*

Table 1: Dimensions of stomatal complex and ordinary epidermal cells of leaves in *Galium* species, measured by micrometre

S. No.	Species	Stomatal complex				Ordinary epidermal cell			
		Adaxial		Adaxial		Adaxial		Adaxial	
		Length	Width	Length	Width	Length	Width	Length	Width
1	<i>G. aparime</i>	-	-	53.5 (37.5-67.5)	37.5 (35-42.5)	112.5 (100-125)	62.5 (50-75)	100 (87.5-112.5)	57.50 (50-75)
2	<i>G. ceratopodium</i>	58.5 (50-67.5)	60 (50-62.5)	37.5 (32.5-42.5)	37.5 (32.5-42.6)	135 (112.5-175)	50 (37.5-62.5)	97.5 (87.5-100)	43 (37.5-50)
3	<i>G. setaceum</i>	30 (20-37.5)	29.5 (25-37.5)	30 (25-37.5)	33 (30-37.5)	132.5 (100-150)	28.5 (25-37.5)	52.5 (50-62.5)	24 (20-30)
4	<i>G. spurium</i>	-	-	62.5 (50-70)	42 (37.5-50)	102.5 (87.5-112.5)	73.5 (62.5-87.5)	129 (100-157.5)	68 (50-80)
5	<i>G. tricornatum</i>	50 (37.5-62.5)	39 (37.5-42.5)	39 (50-42.5)	55 (50-62.5)	42.5 (37.5-50)	95 (75-125)	42.5 (25-62.5)	43.5 (37.5-50)

The numbers between two brackets represented the minimum and maximum limited and the numbers outside the brackets represented the mean.

Table 2: Types and length of trichome on different organs of plants in the species of *Galium* measured by micrometre.

S. No.	Species	Stem		Leaf		Fruit	
		Type	Length	Type	Length	Type	Length
1	<i>G. aparime</i>	A	102.6 (100-150)	B	330 (200-400)	B	760 (700-850)
2	<i>G. ceratopodium</i>	A	68 (60-80)	A	118 (90-140)	-	-
3	<i>G. setaceum</i>	-	-	A	44 (30-50)	A	75 (70-80)
4	<i>G. spurium</i>	A	60 (30-80)	B	280 (220-350)	B	474 (400-550)
5	<i>G. tricornatum</i>	A	96 (80-110)	A	108 (80-130)	-	-

The numbers between two brackets represented the minimum and maximum limited and the numbers outside the brackets represented the mean.

and *G. tricornatum*, undulate to sinuate in *G. aparine*, semi-straight to slightly undulate in *G. ceratopodium* and sinuate in *G. spurium* and this agree with the averages of dimensions vary between in the upper surface species, the minimum averages of length (425) μm in *G. tricornatum*, and the maximum averages (135) μm in *G. ceratopodium*, while the minimum average of width were (28.5) μm in *G. setaceum* and maximum average were (95) μm in *G. tricornatum*, in the lower surface the minimum average of dimensions were (52.5×24) μm in *G. setaceum* while the maximum average were (129×68) μm in *G. spurium*.

Stomata

The leaves of *G. aparine* and *G. spurium* were hypostomatic (the stomata occur on the lower surface only) while the leaves of the other species were amphistomatic (the stomata occur on both surface of leaf), the guard cells were elongate kidney shape in all species, while stomatal aperture elongated elliptical in upper

epidermis in *G. setaceum* and *G. tricornatum*, in lower surface included *G. setaceum* and *G. aparine*, the stomatal aperture were oblong shape in upper epidermis of *G. ceratopodium* and lower epidermis included *G. tricornatum*, *G. spurium* and *G. ceratopodium* in the upper epidermis, the minimum dimensions of stomata were (30×29.5) μm in *G. setaceum* while the maximum average were (58.5×38) μm in *G. ceratopodium*, in lower surface epidermis the minimum average dimension were (30×33) μm in *G. setaceum* and the maximum average

were (62.5×42) μm in *G. spurium* the type of stomata in all species are paracytic and this agree with Metecalf and Chalk (1950) and Hemcinschi *et al.*, (2008).

Indumentum

The indumentum of the species comprise of eglandular simple unbranched hairs distributed on different parts of plant body, there are two types of hairs:

- Unicellular hairs with acuminate apex with long and short length, without cavity.
- Unicellular long hair with hooked apex, having cavity reach, to hair apex in *G. aparine* while in *G. spurium* reach to three quarter hair length.

In stem the first of hairs was found (the short one) and heading down, the minimum average length were (60) μm in *G. spurium* and the maximum average were (102.6) μm in *G. aparine*. In leaf both types (A, B) of hairs were found as follow:

Type (A) unicellular acuminate apex hair heading to

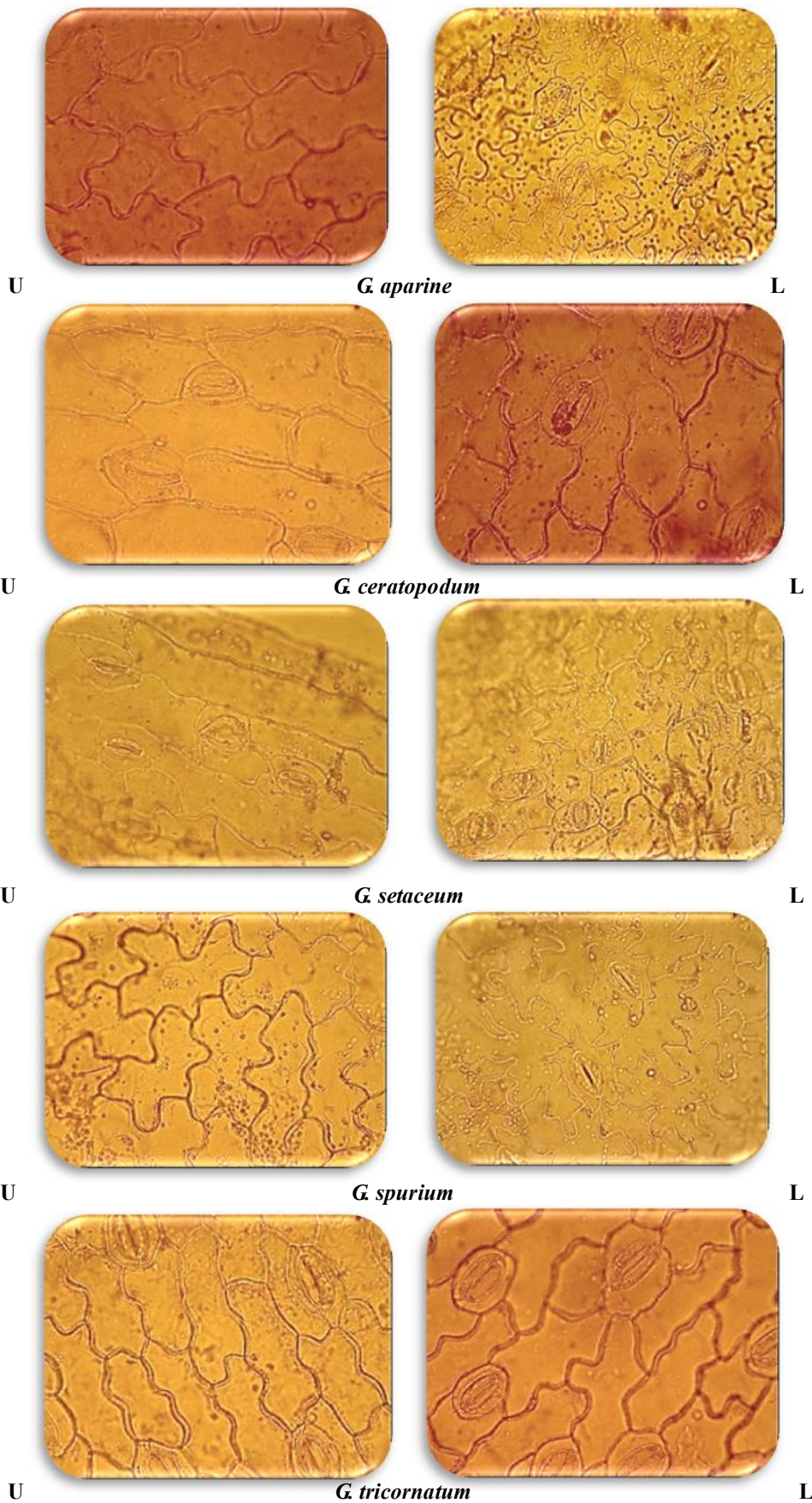
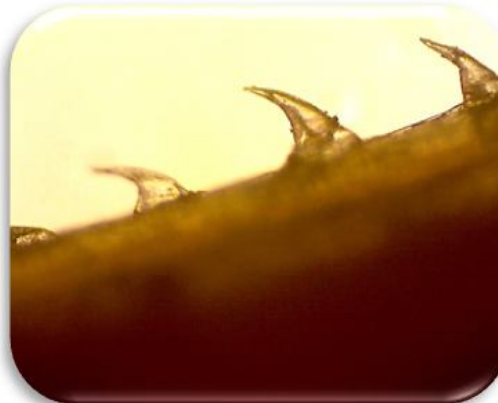


Plate 1 : Ordinary epidermal cells and stomatal complex in *Galium* species (400X). U: Upper surface, L: Lower surface.

Type B (*G. aparine*)Type A (*G. setaceum*)Plate 2: Types of Trichomes in *Galium* species (40X)

leaf apex in *G. setaceum*, and heading to leaf base in *G. tricornatum* and *G. ceratopodium*, the maximum average length reach to (118) μm in *G. certomodum* and the minimum average were (44) μm in *G. setaceum*.

Type (B) unicellular long hair hocked apex heading to leaf apex in *G. aparine* the hairs distributed on the leaf margin and upper surface.

While in the lower surface occur in midrib only in *G. spurium* found in leaf margin and upper surface, the minimum average of length were (280) μm in *G. spurium* and the maximum average were (330) μm in *G. aparine*.

In fruits both type (A) and (B) occur, unicellular long hair with acuminate apex in *G. setaceum* the average of hairs length reach to (70) μm while in *G. aparine* and *G. spurium* the long unicellular hair with hocked apex found the average length of hairs was (474) μm in *G. spurium* and (760) μm in *G. aparine* the result agree with Bauer *et al.*, (2011) of their study on *G. aparine* [9] mentioned that *G. aparine* famous for its ability to adhere to other objects due to the presence of numerous trichome surrounding the stem, mericarps and leaf, these trichomes serve as an efficient vector for the movement of propagules via animals, the result agree also with the study of Elkordy and Schanzer (2015).

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