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Some Morphological Structural Studies of Cucurbitaceous Tendrils under Arid Conditions

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Abstract: This study was carried out at Khulis, Khulis Governorate, Makkah region, on the first of April during the growing season of 2007, to study the morphology and anatomy of tendrils in different eight of cucurbit genera. The results showed a great variation among the most tested cucurbit genera concerning the twisting, branching, number of tendrils per node and presence of tendril trunk. Also, shape of transverse sections were ovate, sinuate-rhombic, sinuate-emarginate oblong, emarginate-ovate, spherical, notched-ovate and reniform. Furthermore, presence of collenchymatous, sclerenchymatous tissues, number of vascular bundles in Transverse Section (TV) and arrangement of vascular bundles varied according to the studied species. It could be conclude from this research that there are a numerous of qualitative traits of tendrils which plays an important role in identification of cucrbitaceous plants for examples; the twisting, branching, transverse section shape, collenchymatous tissue, scleranchymatous tissue, tylosis and arrangement of vascular bundles.

Key words: Cucurbitaceae, tendrils, genera

INTRODUCTION

Metcalfe and Chalk (1950) pointed out that the family of Cucurbitaceae is noted for its rapid vegetative growth. Most of its members are tropical. Many species are provided with tendrils of which those in *Cucumis* have been interpreted as metamorphosed leaves, while, those in other genera are homologous with stems bearing leaves. Tendrils become coiled round cylindrical supports which they come into contact, but from anchoring pads when in contact with flat surfaces. In addition, Tucker and Hoefert (1968) studied the apical meristem of the grape tendril and found that it possesses several remarkable features: bilateral symmetry, a minimal number of appendages and an exceedingly brief period of apical meristem activity. The cellular configuration of the apex changes from tunica-corpus to zonate, as rudimentary leaves and branch-tendril apices are initiated. Eventually, the apical meristem of the tendril itself ceases meristematic activity and differentiates as a large hydathode. Typical spongy epithem tissue, copious xylary tissue and water pores in the epidermis characterize the hydathode. Numerous of vascular bundles passes traverse the tendril length and terminate in enlarged tracheary elements adjacent to the epithem. Cessation of meristematic activity follows lowered mitotic division rate in the summit and accelerated differentiation below and within the meristem. On the other hand, Shah and Dave (1970) and Fahn (1974) showed that tendril may develop from extra-axillary or from part or all of a stem, leaf or petiole.

Moreover, formation and growth of tendrils in plants were controlled by a numerous of physiological factors for examples: Auxins, divalent cations, protons, H_2O_2, Jasmonic Acid (JA) and Gibberellic acid (Jaffe, 1975; Klusener *et al*., 1998; Boguslawa *et al*., 1999; Engelberth, 2003; Zhang *et al*., 2008) and endogenous factors for examples: genetic factors (Prajapati and Kumar, 2002; Ishimaru *et al*., 2007) and structural factors for examples: Microtubuli (MT) play the most important role in the perception of thigmic stimuli in tendrils (Engelberth, 2003).

Meloche *et al*. (2007) observed a cortical band of fiber cells originate de novo in redvine tendrils when these convert from straight, supple young filaments to stiffened coiled structures in response to touch stimulation. They analyzed the all walls of these fibers and found that the fiber cell wall consists of a primary cell wall and two lignified secondary wall layers (S1 and S2 and a less lignified gelatinous (G) layer proximal to the plasmalemma. The fiber cell walls are highly enriched in cellulose, callose and xylan. Lignin is concentrated in the secondary wall layers of the fiber and the compound middle lamellae/primary cell wall but is absent from the gelatinous layer. Also, they indicated that these fibers play a central role in tendril function, stabilizing its final shape after coiling and generating the tensile strength responsible for the coiling. This theory is further substantiated by the absence of gelatinous layers in the fibers of the rare tendrils that fail to coil. Moreover, Bowling and Vaughn (2008) determined the nature of the adhesive tendril of *Parthenocissus quinquefolia*. They showed that after touch stimulation epidermal cells of the tendril elongate toward the support substrate, becoming papilate cells. The adhesive appears as highly heterogeneous, raftlike structure and consists of pectinaceous, rhamngalacturonan components surrounding a collosic core. In addition, more mobile components, composed of arabinogalactans and mucilaginous pectins, intercalate both the support and the tendril, penetrating the tendril to the proximal ends of the papillate cells. Following adherence to the support, the anticlinal walls of the papillate cells are devoid of rhamnogala cturonan side-chain reactivity.

This study intended to explore the morphological and anatomical variation of the tendrils of different eight cucurbit genera. Tendrils are very important because it helps in vertical plant growth; consequently; it is possible to reduce the intervals between the cultivated plants and increasing number of plants in cultivated area unit.

MATERIALS AND METHODS

A field experiment was performed on the first of April during the grown season of 2007 at Khulis, Khulis Governorate, Makkah region, to study morphology and anatomy of various eight cucurbit genera tendrils. These various genera were:

- *Citrullus colocynthis*
- *Citrullus vulgaris* var. Giza 3
- *Cucumis dudaim* Ananas harest Fl
- *Cucumis dudaim* var. Cantaloupe angar choice
- *Cucumis dudaim* var. Melon jaune cahaaria. French
- *Cucumis dudaim* var. Ismailawy
- *Cucumis melo* var. Flexuosus
- *Cucurbita maxima*

The seeds of the different genera were sown in plots in a complete randomized design with three replicates. The seeds of each species were sown in hills, 50 cm in sandy soil. The usual agricultural methods for cucurbit cultivation, i.e., fertilization, irrigation etc. were followed. The following data were obtained:

Morphological characters: The coiling, branching, number of tendrils per node and presence of trunk.

Anatomical characters: Studying the characters of transverse sections of tendrils, killing and fixation in FAA (50%), dehydration with xylol alcohol, infiltration and embedding in pure paraffin wax (MP 54-58°C) were carried out as described by Johansen (1940). Using a rotary microtome, serial sections (10 μ) were obtained and stained with safranin and light green (Corgan and Widmoyer, 1971). Sections were microscopically examined for making microphotographs which can be explored for the internal characters of each.

RESULTS AND DISCUSSION

Morphological characters: It is show in Table 1 and Fig. 1a-h that the twisted tendril was in *Citrullus colocynthis*. While, it was unbranched in most of the studied cucurbit genera (Fig. 1a-g). In addition, the polychasium and the trunk tendrils were recorded in *Cucurbita maxima* genus only (Fig. 1h). On the other hand, the twisted tendril at its apex was found in both *Cucumis dudaim* var. Ismailawy and *Cucumis melo* var. Flexuosus (Fig. 1f, g). Also, the semi- twisted tendril at its apex was observed in both *Cucumis dudaim* Ananas harest Fl and *Cucumis dudaim* var. Cantaloupe angar choice (Fig. 1c, d). In the same time, the untwisted tendril at its apex was shown in *Citrullus vulgaris* var. Giza 3, *Cucumis dudaim* var. Melon jaune cahaaria (French) and *Cucurbita maxima* (Fig. 1b, e, h). Moreover, number of tendrils per node were two in *Citrullus vulgaris* var. Giza 3 (Fig. 1b) and one for all other tested genera (Fig. 1a-h).

Anatomical characters: It is clearly shown from (Table 2, Fig. 2a-h) the shape of transverse section was ovate in both *Citrullus colocynthis* and *Cucumis melo* var. Flexuosus (Fig. 2a, g), sinuate- rhombic as in *Citrullus*

Table 1: Some morphological characters of the tendrils of the different eight examined cucurbit genera

	Recording data							
Genera	Twisted tendril.	Unbranched tendril.	Polychasium tendril.	Twisted at its apex.	Semi-twisted at its apex.	Untwisted at its apex	No. of tendrils per node	Presence of trunk for tendril.
Citrullus colocynthis	+	+	-	-	-	-	1	-
Citrullus vulgaris var. Giza 3	-	+	-	-	-	+	2	-
Cucumis dudaim Ananas harest F1	-	+	-	-	+	-	1	-
Cucumis dudaim var. Cantaloupe angar choice	-	+	-	-	+	-	1	-
Cucumis dudaim var. Melon jaune cahaaria-French	-	+	-	-	-	+	1	-
Cucumis dudaim var. Ismailawy	-	+	-	+	-	-	1	-
Cucumis melo var. Flexuosus	-	+	-	+	-	-	1	-
Cucurbita maxima	-	-	+	-	-	+	1	+

+: Present, -: Absent

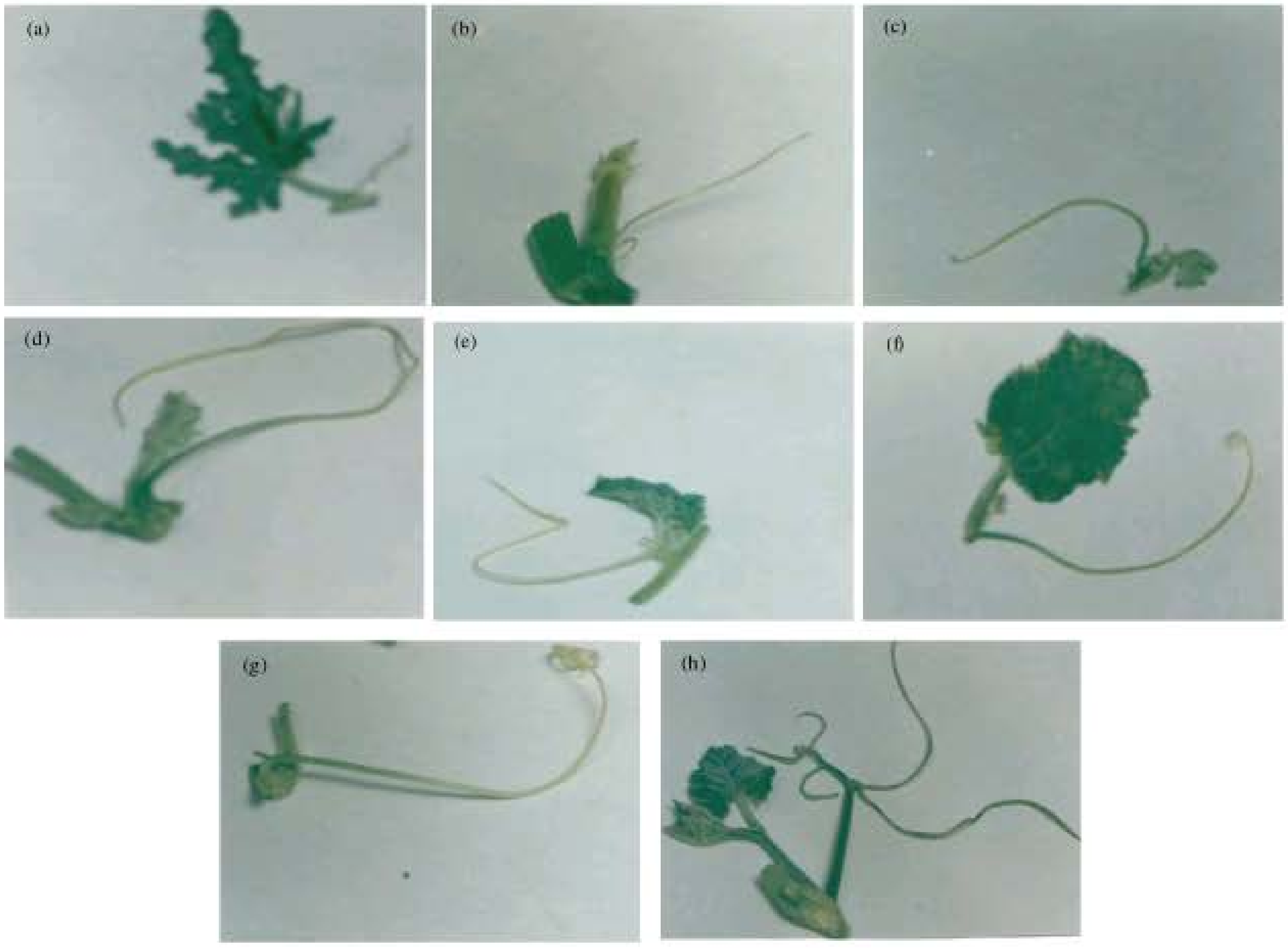

Fig. 1: Photographs showing the morphological characters of eight different cucurbit genera tendrils. (a) *Citrullus colocynthis*, (b) *Citrullus vulgaris* var. Giza 3, (c) *Cucumis dudaim* Ananas harest Fl, (d) *Cucumis dudaim* var. Cantaloupe angar choice, (e) *Cucumis dudaim* var. Melon jaune cahaaria (French), (f) *Cucumis dudaim* var. Ismailawy, (g) *Cucumis melo* var. Flexuosus and (h) *Cucurbita maxima*

Table 2: Some anatomical characters of tendrils of the different eight examined cucurbit genera

	Recording data						
						Arrangement of vascular bundles	
Genera	Shape transverse section	Presence of collenchyma beneath the epidermis	Presence of sclerenchyma beneath the epidermis	No. of vascular bundles in transverse section	Presence of tylosis in xylem vessels	Aggregated in center	Peripheral
Citrullus colocynthis	Ovate	+	_	9	_	_	+
Citrullus vulgaris var. Giza 3	Sinuate-rhombic	+	_	6	_	_	+
Cucumis dudaim Ananas harest F1	Sinuate emarginate oblong.	_	+	5	_	_	+
Cucumis dudaim var. Cantaloupe angar choice	Emarginate ovate	+	_	7	_	_	+
Cucumis dudaim var. Melon jaune cahaaria-French	Spherical	_	_	1	+	+	_
Cucumis dudaim var. Ismailawy	Notched ovate	_	+	5	_	_	+
Cucumis melo var. Flexuosus	Ovate	_	_	6	_	_	+
Cucurbita maxima	Reniform	_	+	5	_	_	+

+: Present, -: Absent

vulgaris var. Giza 3 (Fig. 2b), sinuate emarginate oblong as in *Cucumis dudaim* Ananas harest Fl (Fig. 2c), emarginate ovate as in *Cucumis dudaim* var. Cantaloupe angar choice (Fig. 2d), spherical, notched ovate for *Cucumis dudaim* var. Melon jaune cahaaria (French) as in Fig. 2e and *Cucumis dudaim* var. Ismailawy (Fig. 2f)

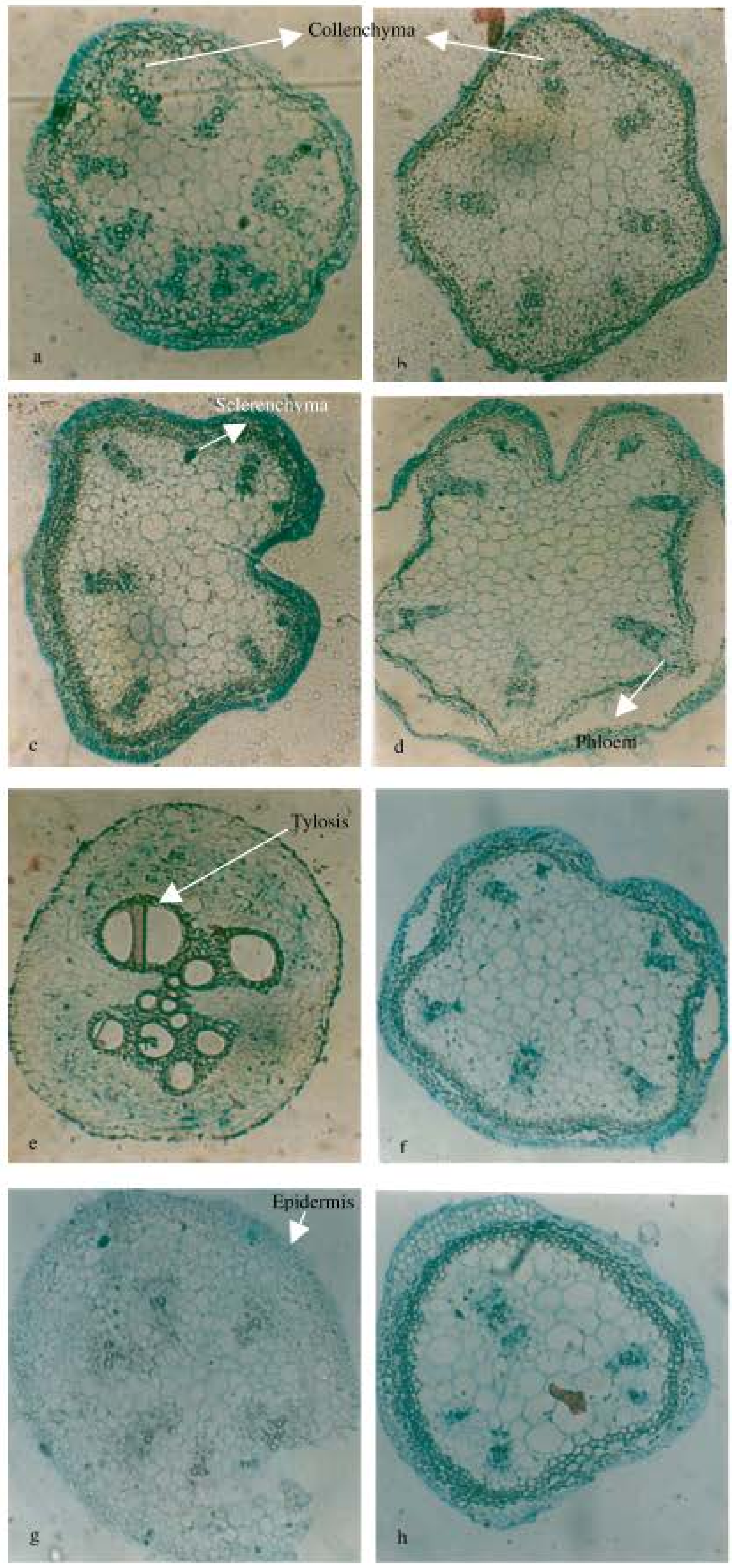

Fig. 2: The anatomical characters of eight different cucurbit genera tendrils (x 16). (a) *Citrullus colocynthis*, (b) *Citrullus vulgaris* var. Giza 3, (c) *Cucumis dudaim* Ananas harest Fl, (d) *Cucumis dudaim* var. Contaloupe angar choice, (e) *Cucumis dudaim* var. Melo jaune cahaaria (French), (f) *Cucumis dudaim* var. Ismailawy, (g) *Cucumis melo* var. Flexuosus and (h) *Cucurbita maxima*

reniform for *Cucurbita maxima* (Fig. 2h). Moreover, presence of collenchymatous tissue beneath the epidermis was shown in *Citrullus colocynthis* (Fig. 2a), *Citrullus vulgaris* var. Giza 3 (Fig. 2b) and *Cucumis dudaim* var. Cantaloupe angar choice (Fig. 2d). Whereas, presence of sclerenchymatous tissue beneath the epidermis noticed in *Cucumis dudaim* Ananas harest F1 (Fig. 2c), *Cucumis dudaim* var. Ismailawy (Fig. 2f) and *Cucurbita maxima* (Fig. 2h). In addition, number of vascular bundles in transverse section was either 9 for *Citrullus colocynthis* (Fig. 2a) , 6 for *Citrullus vulgaris* var. Giza 3 (Fig. 2b) and *Cucumis melo* var. Flexuous (Fig. 2g), or 5 for *Cucumis dudaim* Ananas fiarest Fl (Fig. 2c) *Cucumis dudaim* var Ismailawy (Fig. 2f) and *Cucurbita maxima* (Fig. 2h) and 7 for *Cucumis dudaim* var. Cantaloupe angar choice (Fig. 2d), as well as, 1 for *Cucumis dudaim* var. Melon jaune cahaaria (French) in (Fig. 2e). Also, presence of tylosis in xylem vessels and its aggregation in center were observed in *Cucumis dudaim* var. Melon jaune cahaaria (French) as in (Fig. 2e). Arrangement of vascular bundles was peripheral in all the studied genera except, in *Cucumis dudaim* var. melon jaune cahaaria (French) in (Fig. 2e). Similar results were reported by Klusener *et al*. (1998), Engelberth (2003) and Ishimaru *et al*. (2007) who showed that tendrils of different plants are differ in morphological characters.

In general, it could be concluded from this study that, a great variation was found among the most studied cucurbitacoeus tendrils; especially, the twisting, branching, transverse section shape, presence of collenchymatous and sclerenchymatous tissue and number of vascular bundles in transverse section.

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