LEAF EPIDERMAL STUDIES IN THE GENUS HYOSCYAMUS L. (SOLANACEAE) IN IRAN

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The foliar epidermis of 12 *Hyoscyamus* species out of 13 species occuring in Iran is described. The most useful anatomical characters are: stomatal occurrence, stomatal index, pattern of anticlinal walls, density and type of trichomes.

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مطالعات اپیدرم برگ در گونه‌های جنس بنگ دانه در ایران

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مطالعات اپیدرم برگ ۱۲ گونه از ۱۳ گونه جنس بنگ دانه در ایران شرح داده می‌شود. بهترین صفات تشریحی عبارتند از: وجود روزنه، اندکس و تیپ روزنه، الگوی دیواره‌های آنتی کلینال، نوع کرکها و میزان آنها، که در این بررسی مورد مطالعه قرار گرفته‌اند.

Introduction

The role of anatomical data in traditional taxonomy has been long recognised since the variation within a species, genus or family is usually reflected in anatomical features as well. The comparative anatomy of leaves has also been shown to be of considerable significance by several workers such as Hagerup (1953), Stace (1984), Cutler (1984), Metcalfe & Chalk (1957), Hickey (1979), Carlquist (1961), Stebbins & Khuscht (1961) and Afolayan & Meyer(1995).

Little microscopis detail has been published on the anatomy of *Hyoscyamus* apart from the work of Metcalfe & Chalk (1957) and Ahmad (1963) on the family *Solanaceae.*

According to Schönbeck-Temesy (in Rechinger 1982) the *Hyoscyamus* is represented in Iran by 18 species. Also, she subdivided the genus into two subgenera. On the basis of recent taxonomic revision Khatamsaz (1998) recognized 13 speices from Iran and made a new subgenus.

In order to attain a deeper insight into this difficult genus and to identify further distinctive characters at different taxonomic levels, we carried out micromorphological studies on epidermis of the taxa of the Iranian flora, except one species.

Accepted species of Iran (Khatamsaz 1998) fall in following subgenera:

a) subgen. *Dendrotrichon* Schönbeck-Temesy: *H. insanus* Stocks, *H. tenuicaulis* Schönbeck-Temesy *H. bournmulleri* Khatamsaz.

b) subgen. *Parahyoscyamus* Khatamsaz: *H. malekianus* Parsa, *H. leptocalyx* Stapf.

c) subgen. *Hyoscyamus*: *H. senecionis* Willd., *H. niger* L., *H. reticulatus* L., *H. squarrosus* Griff., *H. kurdicus* Bornm., *H. arachnoideus* Pojark., *H. turcomanicus* Pojark., *H. pusillus* L.

Materials and methods

Fresh leaf materials were collected in the field from various parts of Iran, fixed in FAA and stored in 70% alcohol. Dried herbaruim material was boiled in water before study. Voucher herbarium specimens as indicated in table 1, are deposited in the herbarium of TARI.

Sizeable portions of the leaves were taken from standard median portion (midway between the tip and the base) including the margins. The cuticle of fresh leaves was peeled off or scraped with a razor blade. The peels of epidermis were stianed in aqueous solution of Carmine or

Table 1. List of *Hyoscyamus* species and voucher herbarium specimens.

Species	Voucher specimens
H. insanus	Kuhzestan: Between Ramhormuz & Behbahan, Baba-Ahmadi pass, 500 m, Khatamsaz 72959.
H. tenuicaulis	Lorestan: Khorramabad to Andimeshk, Pole Zal, 300 m, Khatamsaz 72958.
H. malekianus	Baluchistan: N. of Tagatan, Sardeh, 2150 m, Sandoghdaran 999.
H. leptocalyx	Kermanshah: S. of Kerend, Hookani, Bimar mont., 1500 m, Wendelbo & Assadi 16763.
H. senecionis	Kohgiloyeh: Yasuj, Gardaneh Bijan, 3500 m, Khatamsaz 72984.
H. niger	Tehran: Karaj-Chalous pass, Kandavan, 2400 m, Khatamsaz 72893.
H. reticulatus	Hamadan: Kaboudarahang, 2200 m, Khatamsaz 72936.
H. squarrosus	Tehran: Latian Dam, 1800 m, Dini 2175.
H. kurdicus	Kurdestan: Sanandaj, Abidar mont., 2000 m, Khatamsaz 74014.
H. arachnoideus	Hamadan: 40 km W. of Hamadan, Assadabad, Galeh-bor mont. 2150-2300 m, Khatamsaz 74010.
H. turcomanicus	Khorassan: E. of Bojnoord, Garlog, 1800 m, Khatamsaz 74015.
H. pusillus	Azerbagjan: Tabriz to Marand, Mishudag monts. Yam, 1900-1960 m, Khatamsaz 73031.

Bismark Brown, washed 3-4 times in water and mounted in glycerin gelly. Leitz Optical Photomicroscope (OPM) and Leitz Estereo-Photomicroscope (ESPM) were used for observing and photography.

Observation

The results of the investingation are given in tables 2 and 3. Light micrographs and diagrams of observed variations are depicted in Figs. 1, 2 and 3.

Leaf surface. Cell shape and anticlinal cell wall patterns of both surfaces are almost similar. The cells are irregular, sinuous-walled or undulate in subgenera *Hyoscyamous* and *Parahyoscyamus* (Figs. 1, 2); polygonal, straight walled in subgen. *Dendrotrichon*. Epidermal cell size varies from 40×33.3 μm in *H. senecionis* to 136×60 μm in *H. insanus*.

Stomatal complex. All species are amphistomatic and Cruciferous (Anisocytic) and Ranunculaceous (Anomocytic) types of stomata occur in all the species while Rubiaceous (paracytic) type occur in subgen. *Dendrotrichon* too and only Cruciferous type occur in subgen. *Parahyoscyamus*.

The stomatal index ranges from 15.48 in *H. leptocalyx* to 30.28 in *H. arachnoideus*. The stomatal size of these species ranges from 24.6 μm × 24 μm in *H. turcomanicus* to 47.5 μm × 40 μm in *H. insanus*.

Trichomes. The leaves are pubescent in all the species, although they vary in degree of hairiness; trichomes are glandular or non glandular and they are explained in different subgenera as follows (Fig. 3).

a) subgen. *Dendrotrichon*. The trichomes are 4 types: unbranched eglandular; unbranched glandular; branched glandular; branched eglandular. Trichomes have 2-7-cells. In glandular trichomes head cell is unicellular and in eglandular trichomes head cell is finger like. Branched trichomes have two equal or unequal arms, or dendritic-like.

b) subgen. *Parahyoscyamus*. Trichomes are unbranched with unicellular head cell.

c) subgen. *Hyoscyamus*. Only unbranched trichomes were observed, although they vary in length, number of cell, size and shape of head cell. Trichomes have 2-12 cells. Headed celles in glandular trichomes are uni-or multicellular and finger-like in eglandular trichomes.

Discussion

The results obtained from this study reveal a number of interesting features which are given in tabs. 2 and 3. We found that epidermis and trichomes may provide useful characters for subgeneric classification.

Metcalfe & Chalk (1957) and Ahmad (1963) reported Ranunculaceous and Cruciferous stomata in family *Solanaceae*. The stomatal complex of *Hyoscyamus* species investigated are predominantly Ranunculaceous type and with occurrence of few Cruciferous and paracytic (Rubiaceous) type in subgen. *Dendrotrichon*.

The epidermal cells are variable in shape and waviness of their cell walls and it is not difficult to use such features to distinguish between the subgenera (Figs. 1 and 2).

The trichomes of *Hyoscyamus* L. show differences among the species studied as in the case of *Solanum* (Seith 1979) and

Tabel 2. Epidermal cell characters of *Hyoscyamus* leaves; P= Paracytic; As= Anisocytic; Am= Anomocytic.

Taxa	cell shape	anticlinal cell wall pattern	epidermal cell size (μm)	stomatal types	stomatal cell size (μm)	stomatal index	branched trichome	unbranched trichome	head cell type in glandular hair	cell no. of eglandular hair	celll no. of glandular hair
H. insanus	polygonoal	straight	83×66	As,Am,P	47.5×40	19.86	+	+	unicellular	2-4	2-4
H. tenuicaulis	"	"	136×60	As,Am,P	38.6×30	21.93	+	+	"	2-4	2-4
H. malekianus	irregular	sinuous undulate	150×60	As	31×25.5	21.68	-	+	"	2-8	2-8
H. leptocalyx	"	"	110×73.33	As,Am	33.5×31	15.48	-	+	"	2-8	2-6
H. senecionis var. *senecionis*	"	"	40×33.3	"	27.5×26	24	-	+	uni-multi cellular	8-12	3-6
H. niger	"	"	53.3×36.6	"	34.6×28	16.29	-	+	"	2-8	3-5
H. reticulatus	"	"	66.6×39.5	"	29.3×21.3	24.72	-	+	"	2-8	2-5
H. squarrosus	"	"	90×70	"	29.3×22	29.41	-	+	"	1-7	2-6
H. kurdicus	"	"	66.6×40	"	28.6×26	26.21	-	+	"	2-8	2-6
H. arachnoideus	"	"	63.3×46.6	"	34×28.6	30.28	-	+	"	3-8	4-6
H. turcomanicus	"	"	83×50	"	24.6×24	24.48	-	+	"	2-8	2-8
H. pusillus	"	"	133.3×56.6	"	48.34	21.8	-	+	"	2-8	2-6

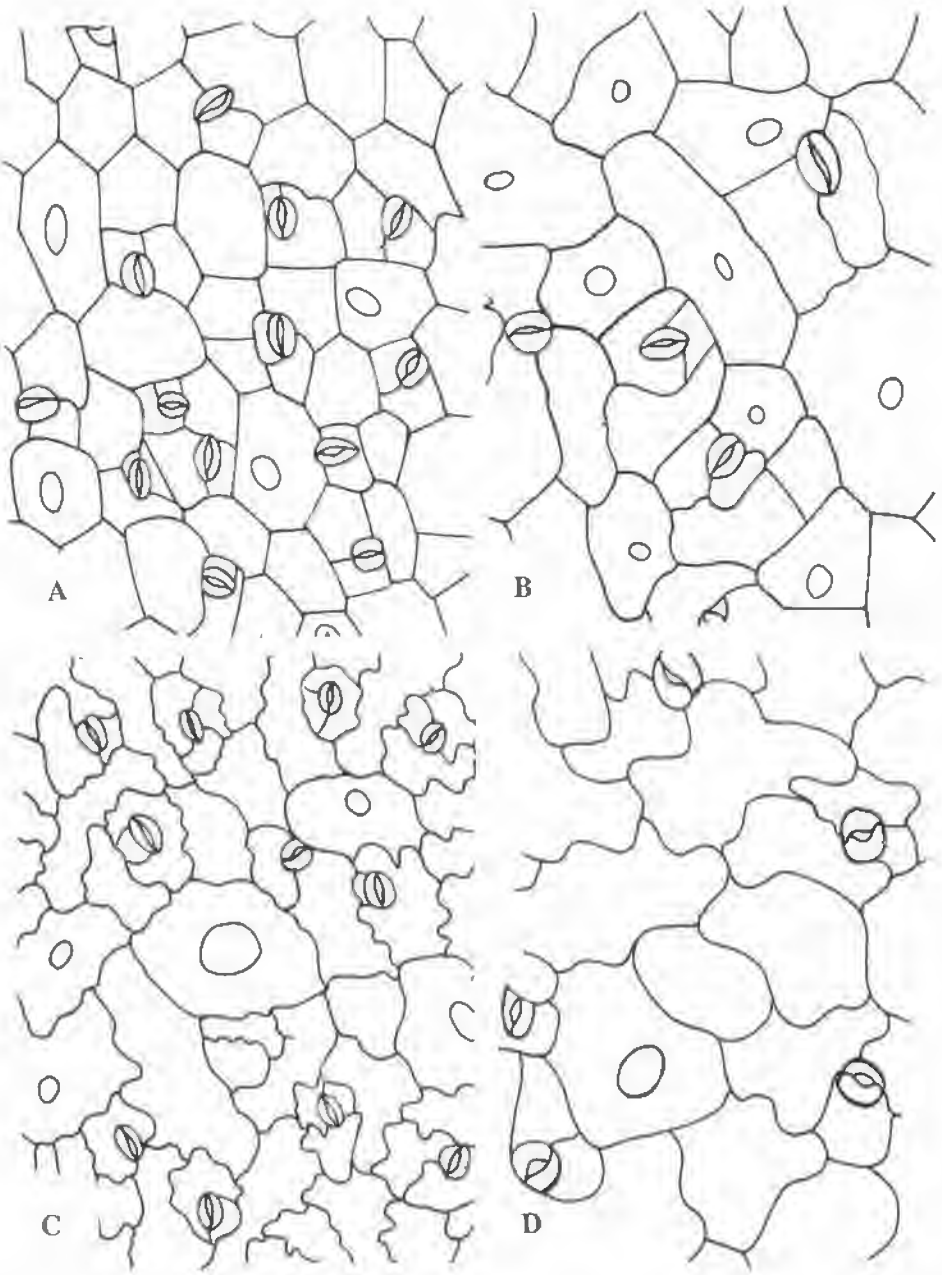

Fig. 1. Leaf epidermal cells of *Hyoscyamus* species. A. *H. insanus*; B. *H. tenuicaulis*; C. *H. malekianus*; D. *H. leptocalyx*.

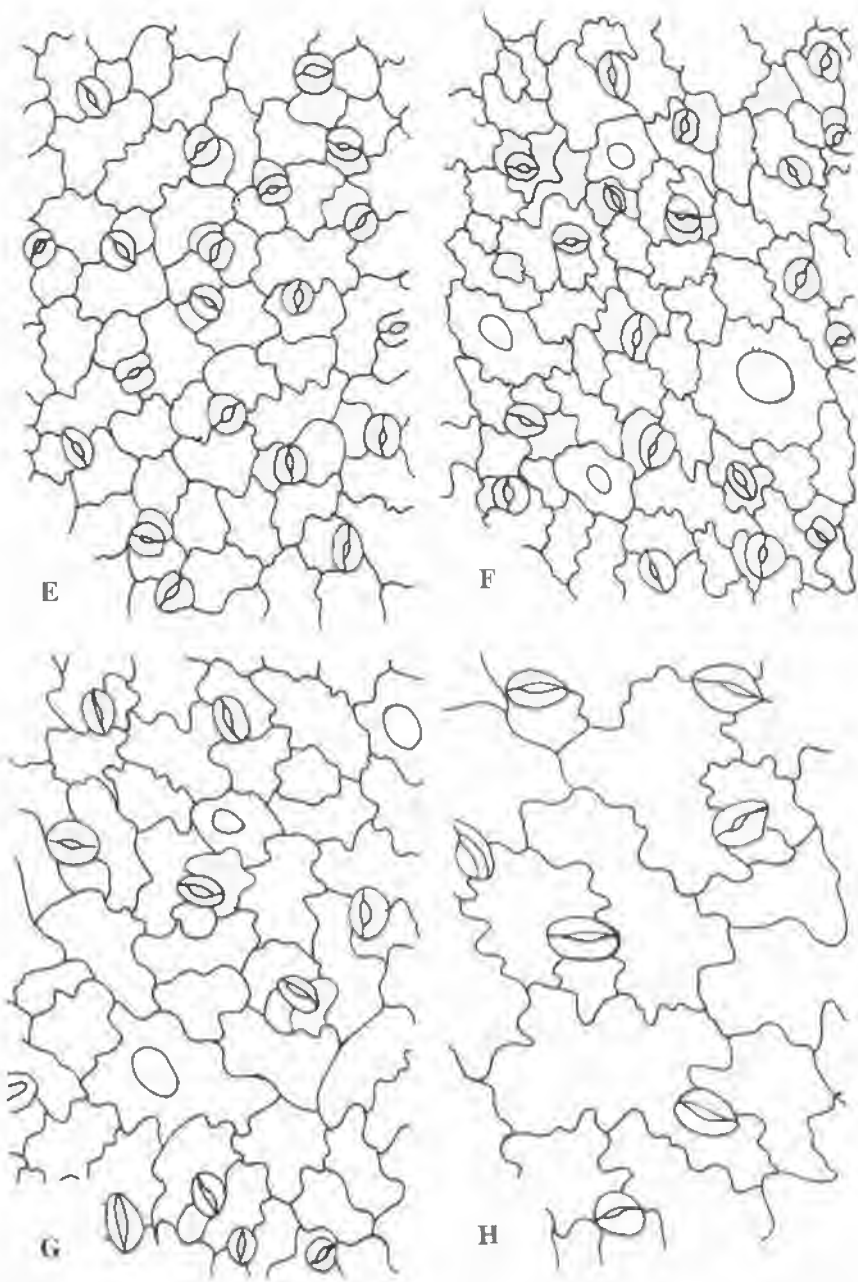

Fig. 2. Leaf epidermal cells of *Hyoscyanus* species. E. *H. kurdicus;* F. *H. senecionis;* G. *H. squarrosus;* H. *H. pusillus.*

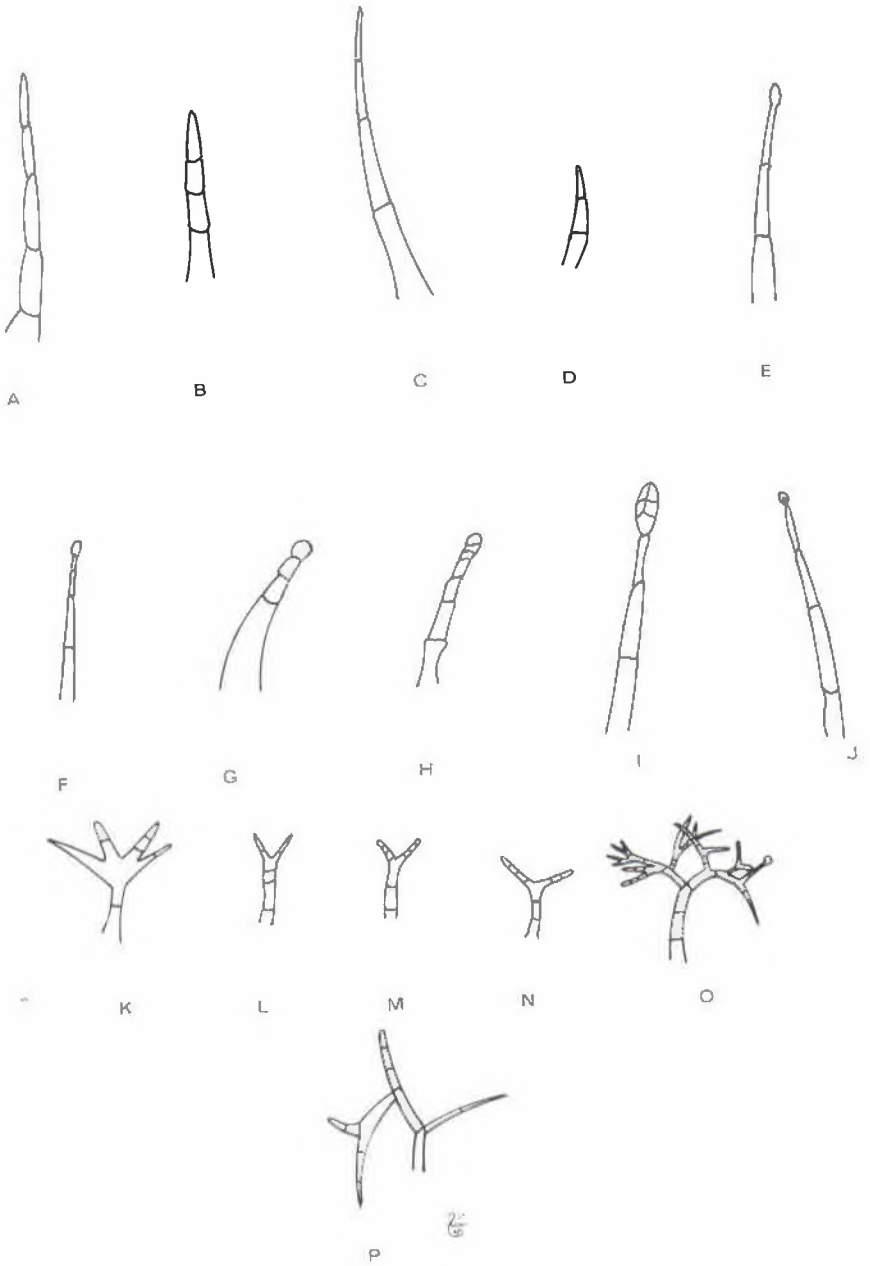

Fig. 3. *Hyoscyamus* trichomes. A-D. non glandular hairs; E-J. glandular hairs; K-P. branched hairs.

(Seith & Sullivan 1990) is found to be appropriate taxonomic character for the *Hyoscyamus*. The trichomes found in the Iranian *Hyoscyamus* species are divided into two hair classes; The first class is unbranched hairs, with or without glandular tip; second class is branched to dendritic hairs, with or without glandular tip. Type of trichomes can be successfully used for the delimitation of the subgenera and species (Fig. 3).

This anatomical study supports the classification which was based on the morphology (Khatamsaz 1998) and also cyto-morphological studies (Sheidai & al. in press).

Achnowledgment

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Table 3: Comparative epidermal characters of the three subgenera of *Hyoscyamus*.

Subgenera	cell shape	anticlinal cell wall pattern	epidermal cell size (µm)	stomatal cell size (µm)	stomatal index	branched trichome	unbranched trichome	stomatal type	headed cell in glandular hair
Hyoscyamus	irregular	sinuous undulate	40-133.3	33.3-73.3	27.48	21-34	16.29-30	-	+	Am.As	multi-unicellular
Parahyoscyamus	"	"	150-100	40-60	31	25	21.68	-	+	As	unicellular
Dendrotrichon	polygonal	straigth	83-136	60-66	37-47	30-40	19.86-22	+	+	Am.As.P	"

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