Leaf Epidermis of some *Polygonum* Species (Polygonaceae) in Thailand

กายวิภาคศาสตร์ผิวใบของพืชสกุลผักไผ่น้ำบางชนิดในประเทศไทย

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Abstract

The leaf epidermis of five sections in 16 taxa of *Polygonum* L. in Thailand is investigated to determine its taxonomic significance. The results show that the specimens are divided into two groups using the stomatal types. The first group is distinguished by tetracytic or both tetracytic and anisocytic stomatal types, which are found in five taxa of sections *Bistorta* and *Cephalophilon*. The second group is characterized by paracytic or both paracytic and anisocytic stomatal types, which are found in 11 taxa of sections *Avicularia*, *Echinocaulon* and *Persicaria*.

บทคัดย่อ

ศึกษากายวิภาคศาสตร์ผิวใบของพืชสกุลผักไผ่น้ำในประเทศไทยจำนวน 16 แทกซา จากการลอกผิวพบว่าชนิดของปากใบสามารถนำมาใช้จำแนกพืชที่ศึกษาเป็น 2 กลุ่ม ได้แก่ กลุ่มที่ 1 มีปากใบแบบเตตระไซติก หรือเตตระไซติกปนกับแอนไอโซไซติก พบในพืชหมู่ *Bistorta* และ *Cephalophilon* จำนวน 5 แทกซา ขณะที่กลุ่มที่ 2 มีปากใบแบบพาราไซติก หรือพาราไซติกปนกับแอนไอโซไซติก พบเฉพาะในหมู่ *Avicularia Echinocaulon* และ *Persicaria* ซึ่งมีจำนวนทั้งหมด 11 แทกซา โดยผลดังกล่าวข้างต้นสามารถใช้ประกอบเป็นข้อมูลพื้นฐานสำหรับการจำแนกกลุ่มทางด้านอนุกรมวิธานของพืชสกุลนี้ต่อไปในอนาคตได้เป็นอย่างดี

Keywords: stomatal types, leaf epidermis, *Polygonum*, Thailand
คำสำคัญ: ชนิดของปากใบ ผิวใบ พืชสกุลผักไผ่น้ำ ประเทศไทย

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Introduction

The *Polygonum* L., a relative large genus, belongs to family Polygonaceae. The most recent information of *Polygonum* is reported by The Forest Herbarium, Royal Forest Department (2001) in which 18 species are recognised. The genus is mostly distributed in northern Thailand. The taxonomic study of the genus has traditionally been based on morphological similarity with emphasis on a few distinct characters. The systematic relationship within the genera is still confused (Steward, 1930).

Haraldson (1978) worked on the anatomy and taxonomy of subfamily Polygonoideae and revealed many peculiar characteristics. The anticlinal wall shape was undulate, straight or arched, the epidermal cells were often polygon and isodiametric shaped, often rich in tannins and probably secretory cells only appeared on the adaxial surface. More recently, Curtis and Lersten (1994) recognised two internal cavity types in the genus viz. epidermal cavity and subepidermal cavity complexes that enclosed a drop of secreted oil. Haraldson (1978) and Munshi and Javeid (1986) suggested that there were three stomatal types: anomocytic, anisocytic and paracytic. In addition, not only another stomatal type, namely cyclocytic, was found in a lamina (Ayodele and Olowokudejo, 2006) but also stomatal index (Kapoor et al., 1971; Munshi and Javeid, 1986) was reported.

Trichomes had been studied by Metcalfe and Chalk (1957) and Munshi and Javeid (1986) and where of two types; glandular and eglandular trichomes were recognised. Whereas, Haraldson (1978) pointed to the trichomes as being useful for distinguishing characters, 13 trichomes types in various parts of the plant were described and illustrated.

The aim of the study was to add more data on leaf anatomy and especially to evaluate the taxonomic significance of the *Polygonum* in Thailand.

Material and Methods

Sixteen taxa of *Polygonum* in Thailand were collected and deposited at Khon Kaen University Herbarium (KKU). Fresh leaves were fixed and preserved in 70% alcohol. Samples of each were prepared by mechanical scraping in the centre of the mature lamina, passed through the tertiary butyl alcohol series to dehydrate, stained with 1% safranin and mounted on slides under coverslips affixed with DePeX artificial mounting medium. The samples were observed and photographed with an Olympus BH_2 light microscope. For the stomatal index, the epidermal structure for each taxa was obtained using the formula of Salisbury (Mushi and Javeid, 1986): $[S/E+S] \times 100$, where S denotes the number of stomata per unit area and E is the number of epidermal cells in the same unit area. The stomatal number was counted using a micrometric ocular. The data analysed is shown in Tables 1-2 and Figures 1-14. The descriptive terminology follows Haraldson (1978) and Metcalfe and Chalk (1957).

Results

The species are listed according to their taxa in Table 1 and the distribution of anatomical data observed is shown in Table 2.

General anatomy of leaf epidermis

In general, epidermal cell shape in both adaxial and abaxial surfaces are rectangular to polygon, square and bone-shaped. The adaxial epidermal cells are usually slightly larger than the abaxial side. The anticlinal cell walls are straight

(Figures 9, 10 and 12), arched (Figures 11, 13 and 14) and undulate (Figures 15 and 16) on both surfaces. Reticulate (Figure 7) and striate ornamentation (Figure 8) of the cutin sculpture appears in some species. Most of the taxa present globular internal cavities in either surface (Figure 12).

The stomata are always anisocytic (Figures 11 and 15), paracytic (Figures 13 and 16), tetracytic (Figures 14 and 15) and a few cyclocytic (Figure 14). In most taxa, both lamina surfaces are more or less dense, consisting of different numbers of stomata. Only *P.* sp. 2 has no stomata on the adaxial surface. The stomatal index on the adaxial side of all species is less than the abaxial surface except in *P. glabrum*. Subsidiary cells are variably shaped in the surface view: dome-shaped, trapezoid, rectangular and elliptic.

Three types of multicellular trichomes were found: 1. eglandular trichome, stiff trichome tapering on the top (Figures 1 and 2), 2. glandular trichome, not stiff trichome, globular head (Figure 6) and 3. peltate, glandular trichome (Figures 3, 4 and 5). All occurred on either side or both sides of the lamina.

Discussion and Conclusions

The leaf epidermis of *Polygonum* species has many typical common characters as seen by Metcalfe and Chalk (1957) and Haraldson (1978); all have multicellular, glandular and peltate trichomes. Most of the taxa present globular internal cavities in either surface as in the study of Curtis and Lersten (1994). Long hairs tapering at the top are found in five species: *P. barbatum*, *P. chinense* var. *hispidum*, *P. flaccidum*, *P. minus*, *P. orientale*, *P. tomentosum* and *P.* sp. 1. Especially, a glandular trichome with globular head is present only in *P. strigosum*. Haraldson (1978) reported the latter trichomes were less common on the leaves and were usually found on the peduncle of several *Persicaria* species.

A large value of stomatal index in the taxa are found to be more numerous in the abaxial than in the adaxial side. The index varies from a comparatively low 0.14% in both *P. chinense* var. *chinensei* and *P. flaccidum* to a high value of 64.28% in *P. plebeium* on the adaxial side. On the abaxial surface, the lowest index of 2.06% is also recorded in *P. plebeium* as in the work of Ayodele and Olowokudejo (2006).

The presentation of cutin sculpturing in some species is striate ornamentation which is in agreement with the observation of Kapoor et al. (1971), except that *P. paleaceum* in this study has reticulate ornamentation that has never been reported.

Four stomatal types: anisocytic, paracytic, cyclocytic and tetracytic are present. The taxa studied can be divided into two groups based on the presence of stomatal types as follows:

Group 1, with distinct tetracytic stomata; sections *Bistorta* and *Cephalophilon* that include taxa *P. paleaceum*, *P. chinense* var. *chinense*, *P. chinense* var. *hispidum*, *P. chinense* var. *malaicum* and *P.* sp. 2.

Group 2, with distinct paracytic stomata; sections *Avicularia*, *Echinocaulon* and *Persicaria* that include taxa *P. barbatum*, *P. flaccidum*, *P. glabrum*, *P. minus*, *P. odoratum*, *P. orientale*, *P. pedunculare*, *P. plebeium*, *P. strigosum*, *P. tomentosum* and *P.* sp. 1.

In addition, comparative epidermal characteristics of the closely related species are provided:

P. chinense var. *chinense* and *P.* sp. 1: the former has distinct tetracytic stomata and the

anticlinal wall in the abaxial surface is arched, while distinct paracytic stomata and undulate anticlinal walls are found in the latter.

P. tomentosum and *P.* sp. 2: distinct tetracytic stomata and the undulate anticlinal walls in the abaxial side are found in *P. tomentosum*. The latter has obviously paracytic stomata and arched anticlinal walls in the adaxial surface were also represented.

The results show clustering of characters which could be useful to classify the taxa into broad groups. More anatomical information needs further investigation: work on the transverse section is especially necessary.

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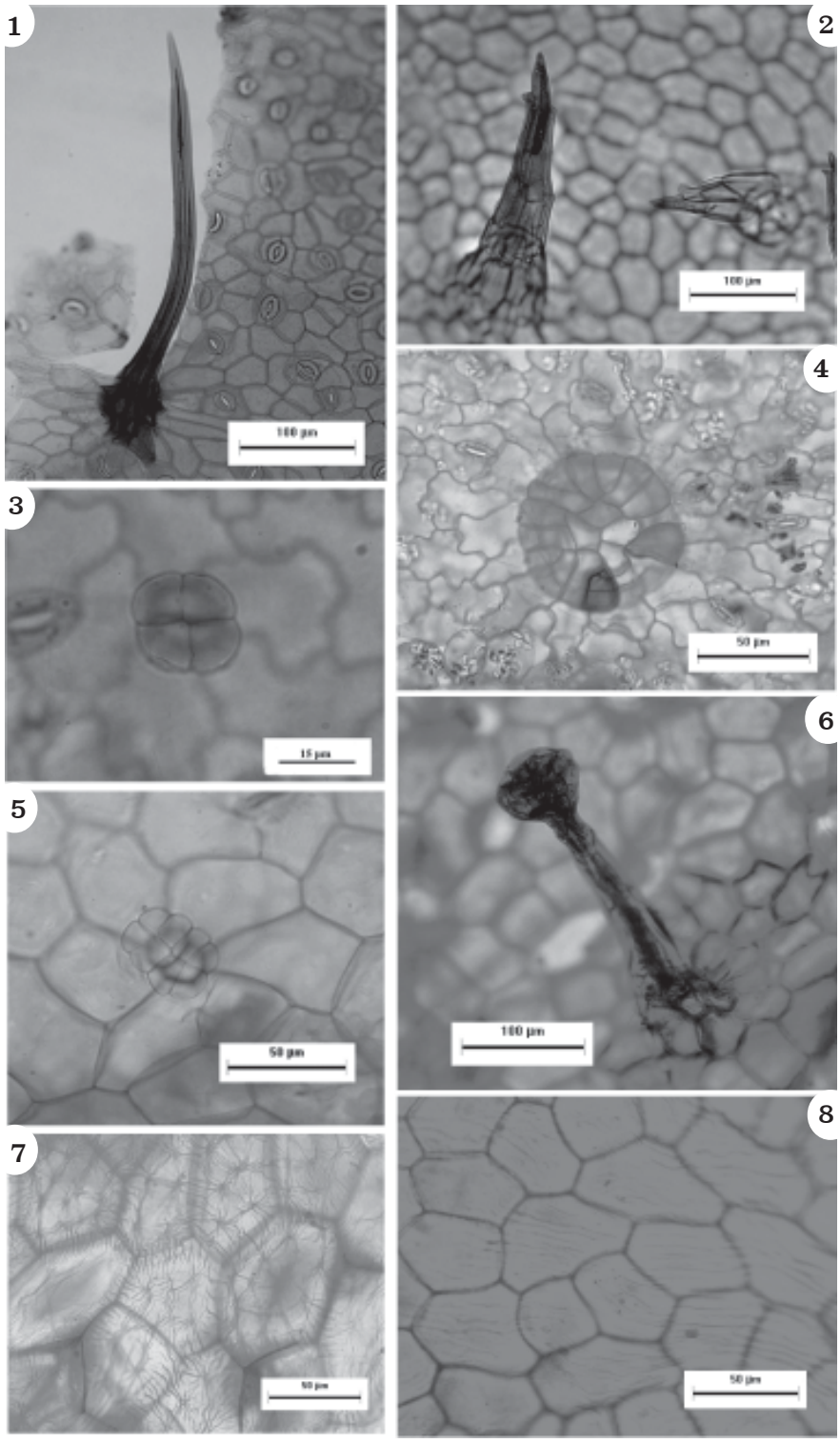
Table 1. List of species investigated, with location of voucher specimens which are deposited at KKU.

Sections	Taxa	Location	Voucher specimens
1. *Avicularia*	*P. plebeium* R.Br.	Mae Hong Son	*C. Kantachot* 371
2. *Bistorta*	*P. paleaceum* Wall. ex Hook.f.	Chiang Mai	*C. Kantachot* 420
3. *Cephalophilon*	*P. chinense* L. var. *chinense* *P. chinense* var. *hispidum* Hook.f.	Phetchabun Loei	*C. Kantachot* 307 *C. Kantachot* 238
	P. chinense var. *malaicum* (Danser) Steward	Chiang Mai	*C. Kantachot* 343
	P. sp. 2	Chiang Mai	*C. Kantachot 368*
4. *Echinocaulon*	*P. pedunculare* Wall. ex Meisn.	Nong Khai	*C. Kantachot* 396
	P. strigosum R.Br.	Loei Mae Hong Son	*C. Kantachot* 290 *C. Kantachot* 356
5. *Persicaria*	*Polygonum barbatum* L.	Chiang Rai	*C. Kantachot* 245
	P. flaccidum Meisn.	Lampang	*C. Kantachot* 241
	P. glabrum Willd.	Sakon Nakhon	*C. Kantachot* 313
	P. minus Huds.	Khon Kaen	*C. Kantachot* 255
	P. odoratum Lour.	Chiang Rai	*C. Kantachot* 318
	P. orientale L.	Songkhla	*C. Kantachot* 235
	Polygonum tomentosum Schrank,	Songkhla	*C. Kantachot* 234
	P. sp. 1	Chiang Rai	*C. Kantachot* 317

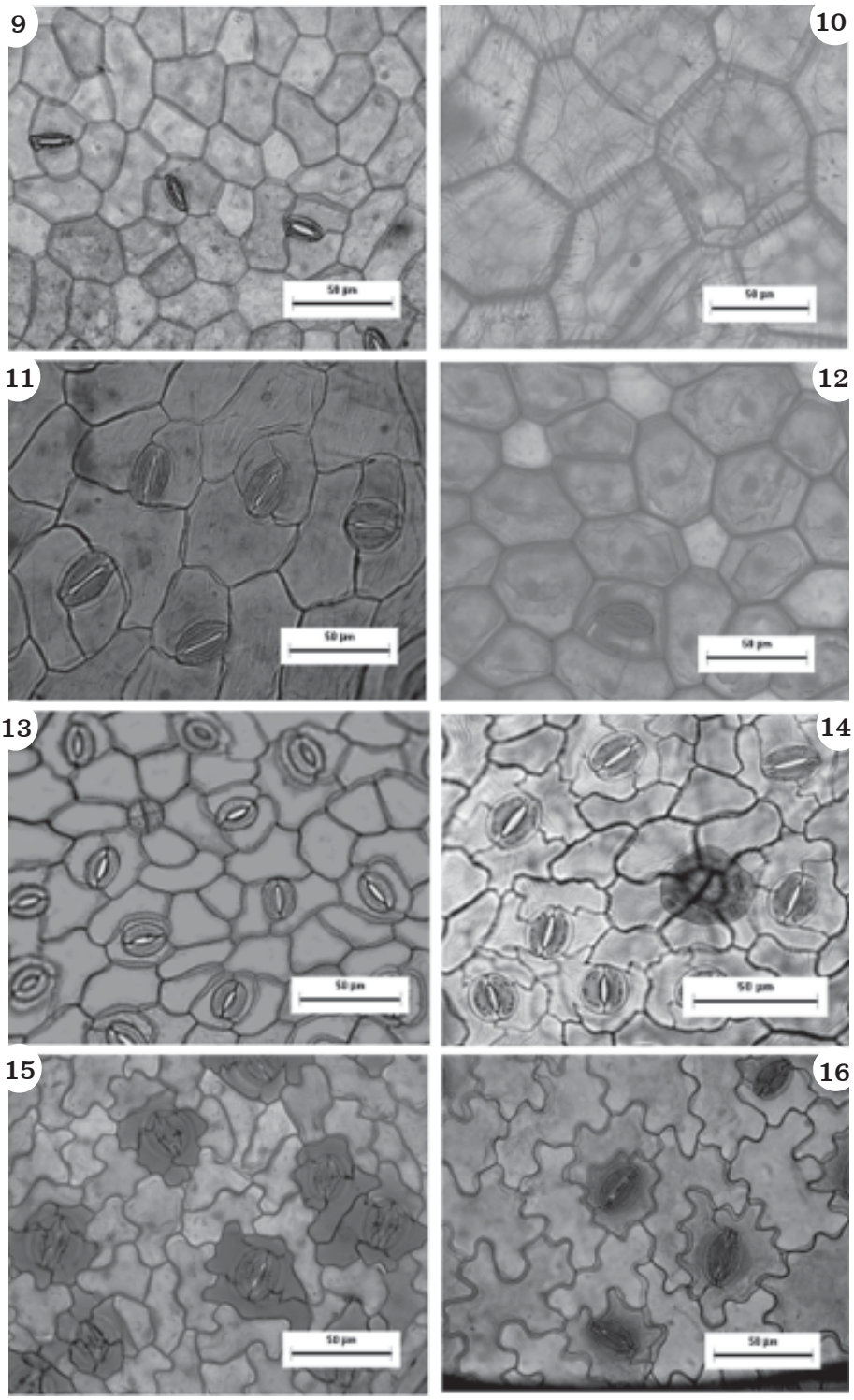
Table 2. Leaf Epidermis and distribution of stomata.

Taxa	Anticlinal cell wall		Stomatal type		Stomatal Index (%)	
	adaxial	abaxial	adaxial	abaxial	adaxial	abaxial
Polygonum barbatum	straight	arched	ani, pa	pa, ani	9.66	26.04
P. chinense var. *chinense*	straight	arched	tet	ani, tet	0.14	8.33
P. chinense var. *hispidum*	straight	undulate	tet	ani, tet	0.21	33.10
P. *chinense* var. *malaicum*	arched	undulate	tet, cyc	tet, ani, cyc	0.63	21.80
P. flaccidum	arched	undulate	pa	pa	0.14	15.56
P. glabrum	straight	straight	pa, ani	pa, ani	27.91	19.33
P. minus	straight	undulate	pa, ani	pa, ani	5.64	23.71
P. odoratum	straight	undulate	pa	pa	6.10	35.24
P. orientale	straight	undulate	ani, pa	ani, pa	20.17	34.00
P. paleaceum	straight	straight, arched	ani, tet, cyc	ani, tet	1.32	3.98
P. pedunculare	arched	arched, undulate	pa	pa	0.88	2.06
P. plebeium	arched	arched, undulate	ani, pa	ani, pa	64.28	64.42
P. strigosum	straight	arched, undulate	pa	pa	1.51	28.39
P. tomentosum	straight	undulate	ani, pa	ani, pa	19.57	29.11
P. sp. 1	arched	undulate	ani, pa	pa	9.81	34.58
P. sp. 2	straight	arched	absent	ani, tet	absent	21.80

ani = anisocytic, ano = anomocytic, cyc = cyclocytic, pa = paracytic, tet= teracytic



Figsures 1-8. Trichomes and cutin sculpture. 1) *P. barbatum* 2) *P. chinense* var. *hispidum* 3 -4) *P. minus* 5) *P.* sp. 1 6) *P. strigosum* 7) *P. paleaceum* 8) *P.* sp. 2



Figures 9–16. Adaxial surface (9–12) and abaxial surface (13–16).
9) *P. minus* 10) *P. paleaceum* 11) *P. plebeium* 12) *P. strigosum* 13) *P. barbatum*
14) *P. chinense* var. *hispidum* 15) *P. chinense* var. *malaicum* 16) *P.* sp. 1