## Comparison on Epidermal Characters of Leaves from Some Members of Family Solanaceae

# Khin Lay Nwe<sup>1</sup>, Moe Zin Zin Thet<sup>2</sup>

## Abstract

The investigation on the epidermal features of leaves from six species belonging to the family Solanaceae has been undertaken from Hpa-an township, Kayin State. The collected specimens were *Capsicum annuum* L., *Cestrum nocturnum* L., *Datura fastuosa* var. *alba* (Nees.) Clarke., *Lycopersicon esculentum* Mill., *Physalis micrantha* Link, Enum. and *Solanum violaceum* Ortega, Hort. respectively. The foliar epidermal peels were taken from the both surfaces of leaves. All the investigated species showed anomocytic types of stomata which were abundantly found. The similarities and differences were observed in the cell shape and anticlinal walls of the species. Differences were also found in trichome types. These microscopical characteristics were useful in identification of the species of family Solanaceae.

Keywords: epidermal features, leaves, Solanaceae, similarities and differences

### Introduction

The Solanaceae family distributed primarily in tropical America and South America (Lawrence, 1951). This family is occurring throughout the world (Dassanayake, 1987).

Solanaceae is a very important economic family (Dassanayake, 1987 and Mukherjee, 2000). Most members of the family are poisonous due to the presence of tropane or steroid alkaloids. Solanaceae are the source of several pharmaceutical drugs, and some are powerful narcotics (Judd *et al.*, 2002).

Kundu and Gupta (1964) stated that the use of microscopy of leaves in distinguishing taxa in Solanaceae. In the present study, epidermal characteristics of the leaves of the six species belonging to the family Solanaceae were studied, described and compared.

The aims of the research are to examine and compare the epidermal characters of leaves from some members of Solanaceae. To achieve this aim, the objectives are to reveal the epidermal characters by studying the surface view of leaf and to present the similarities and differences of the epidermal characters of leaves from six species of Solanaceae family from Hpa-an township, Kayin State.

### **Materials and Methods**

All the specimens were collected from Hpa-an township, Kayin State. The foliar epidermal peels were taken from the both surfaces of leaves (Figure 1). The shape of cells, type of stomata, along with the type and arrangement of hairs on adaxial and abaxial epidermis were determined by using light microscope.



A. C. annuum L. B. C. nocturnum L. C. D. fastuosa var. alba (Nees.) Clarke. D. L. esculentum Mill.
E. P. micrantha Link, Enum. F. S. violaceum Ortega, Hort.

Figure 1. Upper surface and Lower surface of Leaves. (i. upper surface, ii. lower surface)

<sup>&</sup>lt;sup>1</sup> Associate Professor, Dr., Department of Botany, Mawlamyine University

<sup>&</sup>lt;sup>2</sup> Lecturer, Dr., Department of Botany, Mawlamyine University

## Results

The epidermal features of leaves from six species belonging to the family Solanaceae were presented in Table 1 - 3 and Figure 2 - 7.

Table 1. Epidermal Characters of Lamina and Midrib of Studied Species

	Lamina				Midrib		
Species	Cell Shape (anticlinal walls)		Stomata Type		Cell Shape	Stomata Type	
	Upper	Lower	Upper	Lower	Upper and	Upper	Lower
	Surface	Surface	Surface	Surface	Lower	Surface	Surface
					Surface		
Capsicum	wavy	wavier	anomocytic	anomocytic	rectangular	-	anomocytic
annuum L.		-	-	-	to polygonal		
Cestrum nocturnum L.	wavier	wavier	-	anomocytic	or polygonal or irregular	anomocytic	-
Datura fastuosa var. alba (Nees.) Clarke.	wavy	wavier	anomocytic and anisocytic	anomocytic	rectangular to polygonal	-	-
Lycopersicon esculentum Mill.	slightly wavy	wavier	anomocytic and anisocytic	anomocytic and anisocytic	rectangular to polygonal	anomocytic and anisocytic	anomocytic and anisocytic
<i>Physalis</i> <i>micrantha</i> Link, Enum.	wavy	wavier	anomocytic	anomocytic	rectangular to polygonal	-	-
<i>Solanum</i> violaceum Ortega, Hort.	slightly wavy	wavier	anomocytic and anisocytic	anomocytic and anisocytic	rectangular to polygonal	-	-

## **Table 2. Epidermal Characters of Petiole of Studied Species**

	Cell Shape	Stomata Type		
Species	Upper and Lower Surface	Upper Surface	Lower Surface	
Capsicum annuum L.	rectangular to polygonal		anisocytic	
Cestrum nocturnum L.	rectangular to polygonal	-	anomocytic	
Datura fastuosa var. alba (Nees.) Clarke.	rectangular to polygonal	anomocytic	anomocytic	
<i>Lycopersicon esculentum</i> Mill.	rectangular to polygonal	-	anomocytic	
<i>Physalis micrantha</i> Link, Enum.	rectangular to polygonal	anomocytic	anomocytic	
<i>Solanum violaceum</i> Ortega, Hort.	rectangular to polygonal	-	-	

# **Table 3. Types of Trichomes of Studied Species**

Species	Trichome Types
Capsicum	(1) non-glandular simple unicellular trichome, (2) non-glandular uniseriate
annuum L.	multicellular hook warty trichome, (3) non-glandular uniseriate
	multicellular with 2 arms, (4) glandular trichome with unicellular stalk and
	multicellular head

Cestrum	(1) glandular trichome with unicellular stalk and multicellular head,
nocturnum L.	(2) glandular trichome with multicellular stalk and multicellular head,
	(3) papillae
Datura	(1) non-glandular uniseriate multicellular trichome, (2) non-glandular
<i>fastuosa</i> var.	unicellular barrel-shaped trichome, (3) glandular trichome with unicellular
alba (Nees.)	stalk and multicellular head, (4) glandular trichome with multicellular stalk
Clarke.	and multicellular head
Lycopersicon	(1) non-glandular simple unicellular trichome, (2) non-glandular uniseriate
esculentum	multicellular trichome, (3) glandular trichome with unicellular stalk and
Mill.	multicellular head, (4) glandular trichome with multicellular stalk and
	multicellular head, (5) peltate hair, (6) peltate gland
Physalis	(1) non-glandular simple unicellular trichome, (2) non-glandular unicellular
micrantha	barrel-shaped trichome, (3) non-glandular uniseriate multicellular trichome,
Link, Enum.	(4) glandular trichome with unicellular stalk and unicellular head,
	(5) glandular trichome with unicellular stalk and multicellular head,
	(6) glandular trichome with multicellular stalk and multicellular head
Solanum	(1) non-glandular simple unicellular trichome, (2) non-glandular uniseriate
violaceum	multicellular trichome, (3) non-glandular multiseriate multicellular
Ortega, Hort.	trichomes, (4) non-glandular porrect stellate trichome, (5) non-glandular
	multiangulate stellate trichomes with stalk, 2 – 8 arms, stalk multiseriate
	and multicellular, (6) glandular trichome with unicellular stalk and
	multicellular head, (7) glandular trichome with multicellular stalk and
	multicellular head



**A.** Upper surface of lamina showing epidermal cells and stoma (st). **B.** Lower surface of lamina showing epidermal cells and stomata (st). **C.** Upper surface of midrib showing epidermal cells and warty trichome (tr).



**D.** Lower surface of midrib showing epidermal cells and trichome (tr). **E.** Upper surface of petiole showing epidermal cells and trichomes (tr). **F.** Lower surface of petiole showing epidermal cells and stomata (st).



**G**. Glandular trichome. **H**. A terminal portion of forked warty trichome. **I**. Non-glandular warty trichome (**tr**) and glandular trichome (**gl**).

Figure 2. Epidermal Characters of Leaves of Capsicum annuum L.



**A.** Upper surface of lamina showing epidermal cells and papillae (**pl**). **B**. Lower surface of lamina showing epidermal cells and stomata (**st**). **C.** Upper surface of midrib showing epidermal cells and stoma (**st**).



**D**. Lower surface of midrib showing epidermal cells. **E**. Upper surface of petiole showing epidermal cells. **F**. Lower surface of petiole showing epidermal cells.



G. Papilla. H. Glandular trichome. I. Glandular trichome.

Figure 3. Epidermal Characters of Leaves of Cestrum nocturnum L.



**A**. Upper surface of lamina showing epidermal cells and stomata (**st**). **B**. Lower surface of lamina showing epidermal cells and stomata (**st**). **C**. Upper surface of midrib showing epidermal cells, non-glandular uniseriate multicellular trichome (**tr**) and glandular trichome (**gl**).



**D.** Lower surface of midrib showing epidermal cells. **E.** Upper surface of petiole showing epidermal cells, stoma (**st**) and trichome (**tr**). **F.** Lower surface of petiole showing epidermal cells and trichome (**tr**).



**G.** Glandular trichome with unicellular stalk and multicellular head. **H.** Glandular trichome with multicellular stalk and multicellular head. **I.** Non-glandular barrel shaped trichome. **J.** Non-glandular uniseriate multicellular trichome.

Figure 4. Epidermal Characters of Leaves of Datura fastuosa var. alba (Nees.) Clarke.



**A**. Upper surface of lamina showing epidermal cells, stomata (**st**) and trichome (**tr**). **B**. Lower surface of lamina showing epidermal cells and stomata (**st**). **C**. Upper surface of midrib showing epidermal cells and stoma (**st**).



**D.** Lower surface of midrib showing epidermal cells, stoma (st) and trichome (tr). **E**. Upper surface of petiole showing epidermal cells and trichome (tr). **F.** Lower surface of petiole showing epidermal cells, trichome (tr) and stoma (st).



G. Glandular trichome with unicellular stalk and multicellular head. H. Non-glandular uniseriate multicellular trichomes. I. Peltate hair. J. Peltate gland.

Figure 5. Epidermal Characters of Leaves of Lycopersicon esculentum Mill.



**A**. Upper surface of lamina showing epidermal cells and stomata (st). **B**. Lower surface of lamina showing epidermal cells and stomata (st). **C**. Upper surface of midrib showing epidermal cells, non-glandular trichome (tr) and glandular trichome (gl).



**D.** Lower surface of midrib showing epidermal cells and trichome ( $\mathbf{tr}$ ). **E.** Upper surface of petiole showing epidermal cells, stoma ( $\mathbf{st}$ ) and simple trichome ( $\mathbf{tr}$ ). F. Lower surface of petiole showing epidermal cells, non-glandular simple trichomes ( $\mathbf{tr}$ ) and glandular trichome ( $\mathbf{gl}$ ).



**G.** Glandular trichome with bicellular stalk and multicellular head. **H.** Non-glandular uniseriate bicellular trichome. **I.** Non-glandular simple unicellular barrel shaped trichome. **J.** Non-glandular uniseriate multicellular trichome.

## Figure 6. Epidermal Characters of Leaves of Physalis micrantha Link, Enum.







**D.** Lower surface of midrib showing epidermal cells. **E**. Upper surface of petiole showing epidermal cells. **F.** Lower surface of petiole showing epidermal cells.



**G.** Non-glandular stellate trichomes. **H.** Non-glandular stellate trichome. **I.** Base of non-glandular stellate trichome with multicellular stalk and glandular trichome with unicellular stalk and multicellular head (gl). **J.** Glandular trichome with unicellular stalk and multicellular head.

## Figure 7. Epidermal Characters of Leaves of Solanum violaceum Ortega, Hort.

### **Discussion and Conclusion**

Epidermal characters of six species belonging to the family Solanaceae had been investigated in this research. The epidermis of lamina composed of three types of cells, epidermal cells as the main mass of epidermal tissue, guard cells of the stomata and trichomes. Epidermal cells are thin-walled and parenchymatous.

In surface view of lamina, anticlinal walls of epidermal cells were slightly wavy in upper surface in *Lycopersicon esculentum* Mill. and *Solanum violaceum* Ortega, Hort.. but wavy in *Capsicum annuum* L., *Datura fastuosa* var. *alba* (Nees.) Clarke. and *Physalis micrantha* Link, Enum.; wavier in *Cestrum nocturnum* L.; anticlinal walls wavier in lower surface of all of the studied species.

In this research, stomata in adaxial and abaxial surfaces of the studied species were anomocytic type in *Capsicum annuum* L., *Physalis micrantha* Link, Enum. and abaxial surfaces of *Cestrum nocturnum* L., and anisocytic and anomocytic types stomata were found in *Datura fastuosa* var. *alba* (Nees.) Clarke., *Lycopersicon esculentum* Mill. and *Solanum violaceum* Ortega, Hort., these characters were in agreement with Metcalfe and Chalk (1972). They mentioned that the stomata are, in many cases, ranunculaceous, but cruciferous and caryophyllaceous types occur in certain genera of Solanaceae.

In the midrib and petiole surfaces of all studied species, the epidermal cells are thin-walled and rectangular to polygonal in shape and elongated along the axis but in midrib surface of *Cestrum nocturnum* L., upper and lower epidermal cells were dissimilar in shape. The cell walls are straight in all species but *Cestrum nocturnum* L. was straight and beaded wall. In the midrib surface, stomata were sometimes occurred in *Capsicum annuum* L., *Cestrum nocturnum* L., and *Lycopersicon esculentum* Mill.. In the petiole surface, stomata were sometimes occurred in *Capsicum annuum* L., *Cestrum nocturnum* L., *Datura fastuosa* var. *alba* (Nees.) Clarke., *Lycopersicon esculentum* Mill. and *Physalis micrantha* Link, Enum.

In this study, many kinds of trichomes were found in all the species. Nonglandular simple unicellular trichomes were observed in *Capsicum annuum* L., *Lycopersicon esculentum* Mill., *Physalis micrantha* Link, Enum. and *Solanum violaceum* Ortega, Hort.. Non-glandular simple unicellular barrel-shaped trichomes were observed in *Datura fastuosa* var. *alba* (Nees.) Clarke. and *Physalis micrantha* Link, Enum.. Non-glandular uniseriate multicellular trichomes were found in *Datura fastuosa* var. *alba* (Nees.) Clarke. and *Physalis micrantha* Link, Enum. Non-glandular uniseriate multicellular trichomes were found in *Datura fastuosa* var. *alba* (Nees.) Clarke., *Lycopersicon esculentum* Mill., *Physalis micrantha* Link, Enum. and *Solanum violaceum* Ortega, Hort.. Non-glandular uniseriate multicellular trichome were occurred in *Capsicum annuum* L.. Non-glandular multiseriate multicellular trichome, non-glandular multiangulate stellate trichomes with unequal arms and multiseriate multicellular stalk, and non-glandular porrect stellate trichomes were observed in *Solanum violaceum* Ortega, Hort.. Glandular with unicellular stalk and unicellular globose head was only occurred in *Physalis micrantha* Link, Enum.. Glandular with unicellular stalk and multicellular globose or slightly elongated head was found in all of the species studied. Glandular with multicellular stalk and multicellular globose head was observed in *Cestrum nocturnum* L., *Datura fastuosa* var. *alba* (Nees.) Clarke., *Lycopersicon esculentum* Mill., *Physalis micrantha* Link, Enum., and *Solanum violaceum* Ortega, Hort.. Peltate gland and peltate hair were only found in *Lycopersicon esculentum* Mill..

Among the studied species, *Cestrum nocturnum* L. was the only one species having papillae. The presence of papillae was specific characteristics of *Cestrum nocturnum* L. This type of trichome agreed with that of Metcalfe and Chalk (1972).

The types of trichomes found in *Datura fastuosa* var. *alba* (Nees.) Clarke. were in agreement with that of Thein Kywe (1974).

The types of trichomes occurred in leaves of *Lycopersicon esculentum* Mill. were in agreement with that of Santra *et al.* (1999) but they recorded that only multicellular, uniseriate hairs.

The types of trichomes were found in *Solanum violaceum* Ortega, Hort. which were agreed with San Wai Aung (2010), she mentioned that four types of trichomes were found in *Solanum violaceum* Ortega, Hort. but in this study seven types of trichomes were recorded.

The epidermal characters of all the species studied such as shape of epidermal cells, distribution of stomata in the surfaces and types of trichomes were the characteristics of individual species. These characters can be considered as a good diagnostic feature for the identification of species on the basis of epidermal characters of leaf anatomy. Moreover, it is hoped that the present study will contribute the useful information and provide the partial fulfillment for family Solanaceae.

#### Acknowledgements

The authors would like to thank to Dr Aung Myat Kyaw Sein, Rector, Mawlamyine University and Professor Dr Marlar Aung, Head of Botany Department, Mawlamyine University, for their kind permission to carry out this research paper.

#### References

Dassanayake, M. D., 1987. Flora of Ceylon, Vol. VI. Amerind Publishing Co. Pvt. Ltd., New Delhi.

Evert R. F., 2006. Esau's Plant Anatomy. Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function, and Development. 3<sup>rd</sup> ed., A John Wiley & Sons, Inc., Publication, Canada

Fahn, A., 1974. **Plant Anatomy**. 2<sup>nd</sup> ed. Pergamon Press, Oxford.

Judd, W. S., Christopher S. Campbell, Elizabeth A. Kellogg, Peter F. Stevens and Michael J. Donoghue, 2002. Plant Systematic. A Phylogenetic Approach. 2<sup>nd</sup> ed. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts U.S.A.

Lawrence, G. H. M., 1951. Taxonomy of Vascular Plants. The Macmillan Company, New York.

- Metcalfe, C. R. and L. Chalk, 1950. Leaves, stem, and wood in relation to taxonomy with notes on economic uses. Vol. I, Clarendon Press, Oxford, New York.
- Metcalfe, C. R. and L. Chalk, 1972. Anatomy of the Dicotyledons. Leaves, Stem, and Wood in Relation to Taxonomy with Notes on Economic Uses. Vol. II, Clarendon Press, Oxford.
- Metcalfe, C. R. and L. Chalk, 1979. Anatomy of the Dicotyledons. 2<sup>nd</sup> ed. Vol. I, Systematic Anatomy of Leaf and Stem, with a brief History of the Subject. Clarendon Press Oxford, New York.
- San Wai Aung, 2010. Comparative Morphological and Anatomical Characteristics of Twelve *Solanun* Species. PhD, Dissertation. Department of Botany, University of Mandalay.
- Santra S. C., T. P. Chatterjee and A. P. Das., 1999. College Botany. Practical, Vol. I. New Central Book Agency (P) Ltd., India.
- Thein Kywe Maung, 1974. The Morphology and Anatomy of the Burmese Species of the Genus *Datura*. MSc Thesis. Department of Botany, Arts and Science University, Rangoon.