

## STOMATAL STUDIES OF SOME SPECIES IN THE FAMILY SOLANACEAE

Ananta Krushna Palei<sup>1</sup>, Harisha CR<sup>2\*</sup>

1. PG Scholar, Dept. of Medicinal Plants, I.P.G.T & R.A., Gujarat Ayurved University, Jamnagar, Gujarat, India.
2. Head, Dept. of Pharmacognosy, I.P.G.T & R.A., Gujarat Ayurved University, Jamnagar, Gujarat, India.

### Abstract

Family solanaceae of about 90 genera and 2800 species distributed in tropical and temperate regions. 15 genera and over 90 species have been reported from India. Family characters are greatly depending on morphological and anatomical characters. Stomata play an important role in identification of family members. Stomatal number, stomatal index and quantitative microscopy of stomata are more or less similar in most of the species in the family. For the first time scientific investigations are done on stomatal number, index size of different plants of same family. The results show that anisocytic type of stomata are dominant and the quantitative microscopy also show that anisocytic stomata, stomata covered with 3 subsidiary cells, upper epidermal stomata are closed.

**Key words:** Solanaceae; Epidermis; Stomata; Pharmacognosy.

### \*Address for correspondence:

Dr. Harisha C.R.

Head, Dept. of Pharmacognosy,

I.P.G.T. & R.A., Gujarat Ayurved University, Jamnagar, Gujarat, India - 361008.

E-mail: [harishkumar33@ymail.com](mailto:harishkumar33@ymail.com)

Received: 02 May 2012; Revised: 22 May 2012; Accepted: 25 May 2012

### INTRODUCTION

Solanaceae members like *Withania somnifera* Dun. (Ashwagandha), *Solanum nigrum* Linn. (Kakamachi), *Physalis minima* Linn. (Aspotaka), *Datura metel* Linn. (Dhatra) are taken in the present study.

Stomata (stoma, a mouth) are very minute openings formed in the epidermal layer of green aerial parts of the plant, particularly in the leaves. Roots and non-green parts of the stem are free from them. Each stoma is surrounded by the semi lunar cells known as the guard cells. The term 'stoma' is often applied to the stomatal opening and the guard cells. The guard cells are living and always contain chloroplasts, and their inner walls are thicker and outer walls are thinner. They guard

the stoma or the passage, i.e. they regulate the opening and closing of it like lips. Under normal conditions the stomata remain closed at night, i.e. in the absence of light and they remain open during the daytime when active transpiration (evaporation of water) takes place from the surface of the leaf under certain conditions such as high temperature, dryness of the air, blowing of dry wind and deficient supply of water in the soil. The opening and closing of the stomata are due to the movement of the guard cells, and the movement is mainly connected with two factors- light and water. In the presence of light the guard cells absorb water from the neighbouring cells, expand and bulge in an outward direction and the stoma opens. In the absence of light the guard cells lose water and become flaccid and the stoma closes. The

intensity of light also directly affects the degree of stomatal opening.<sup>[1]</sup> To evaluate leaves of solanaceae members microscopically, stomatal number and stomatal index are studied.

### Development of stomata:

Stomata begin to develop in a leaf shortly before the main period of meristematic activity in the epidermis is completed and continue to arise through a considerable part of the late extension of the leaf by cell enlargement. In leaves parallel venation, as in most monocotyledons and with the stomata arranged in longitudinal rows, the formation of stomata begins at the apices of the leaves and progresses in the downward direction. In the netted veined leaves, as in most dicotyledons, differential stages are mixed in a mosaic fashion.<sup>[2]</sup>

### Function and Distribution:

The solanaceae members like Aswagandha, Kakamachi, Aspotaka, Dhatura, stomata are abundant in the lower epidermis of the dorsiventral leaf none (or sometimes comparatively few) are present in the upper epidermis.<sup>[3]</sup>

### Types of stomata:

Depending upon the type of guard cells and arrangement of subsidiary cells, stomata are divided into 64 different types among 6-7 types are very common in nature.<sup>[4]</sup>

- 1. Paracytic or rubiceous or parallel-celled stomata:** This type of stomata comprises two guard cells covered by two subsidiary cells, the long axes of which are parallel to that of stoma, e.g. coca and Senna leaves.
- 2. Diacytic or caryophyllaceous or cross-celled stomata:** The guard cells are covered by two subsidiary cells, as in case of paracytic stoma, but the arrangement of subsidiary cells on the guard cells is at

right angle to that of stoma, e.g. Peppermint, Spearmint and Vasa.

- 3. Anisocytic or cruciferous or unequal-celled stomata:** The number of guard cells is two as in all other cases. But, the guard cells are covered by three subsidiary cells, of which one is markedly smaller than the other two, e.g. Belladonna and Dhatura.
- 4. Anomocytic or ranunculaceous or irregular celled stomata:** In this type, stoma is surrounded by varying number of subsidiary cells resembling other epidermal cells, e.g. Buchu, Digitalis and Lobelia.
- 5. Actinocytic or radiate-celled stomata:** The two guard cells are surrounded by a circle of radiating, subsidiary cells. e.g. Priyala.
- 6. Gramineous stomata:** The gramineous stoma possesses guard cells of which the middle portions are much narrower than the ends so that the cells appear in surface view like dump-bells. They are commonly found in Gramineae and Cyperaceae of monocotyledons.
- 7. Coniferous stomata:** They are sunken and appear as though suspended from the subsidiary cells arching over them in their median parts the guard cells are elliptical in section and have narrow lamina. At their ends they have wider lamina and are triangular in section. The characteristics of these guard cells are that their walls and those of the subsidiary cells are partly lignified and partly non-lignified.

## MATERIAL AND METHODS

### Collection

Solanaceae members, *Withania somnifera* Dun. (Ashwagandha), *Solanum nigrum* Linn. (Kakamachi), *Physalis minima* Linn. (Aspotaka), *Datura metel* Linn. (Dhatura) are

taken in the study. The fresh leaves used for the study are collected from the Botanical garden of Gujarat Ayurved University Jamnagar.

#### **Macroscopy:**

Morphology of the leaves i.e. Size, shape margin etc. were recorded as per API standard.

#### **Organoleptic characters:**

Organoleptic characters i.e. colour, odour and taste were recorded separately.<sup>[5]</sup>

#### **Surface study:**

Carefully both the upper and lower epidermis were peeled off by freehand treated with chloral hydrate soln. and were studied and microphotographs were taken with camera attached the Carl Zeiss binocular microscope.<sup>[6]</sup>

#### **Stomatal Index:**

Number of stomata and stomatal index of the both surfaces of leaves were scientifically observed and values taken by trial and error method as per API standard.<sup>[7]</sup>

#### **Quantitative microscopy:**

Both the leaf surfaces are studied by peeling method. 1<sup>st</sup> cleared with chloral hydrate and mounted with glycerine. All samples of stomata are recorded individually and its type and arrangement. Samples of stomata are scientifically measured by trial and error methods on both the surfaces finally mean value are taken by Carl Zeiss binocular microscope with software as per API standards.<sup>[7]</sup>

## **OBSERVATION AND RESULTS**

### ***Withania somnifera* Dun. (Ashwagandha)**

Leaves simple, alternate, petiolated, ovate, margin complete, tip acute, dark green above, light green below, reticulate venation, base slightly unequal measures about 10 x 7cm, odour horse urine and astringent in taste. (Fig A)

In the upper epidermis very less number of stomata were found when compared to the lower epidermis. Each stomata covered with 3 unequal sized subsidiary cells and stomata are closed. The stomata and subsidiary cells are heavily loaded by chlorophyll pigments. The size of the stomata and the epidermal cells vary in size. The lower epidermis with numerous stomata, each with 3 somewhat equal subsidiary cell containing chlorophyll pigments, stomata are in open condition. Stomata somewhat bulged. Stomata type anisocytic. (Fig A1 – A4)

### ***Solanum nigrum* Linn. (Kakamachi)**

Leaves simple, alternate, leaf base unequal, margin complete, dark green above, light green below, venation reticulate and measures about 9x 4 cm. (Fig B)

In the upper epidermis less number of stomata compared then lower epidermis. The lower epidermis have numerous stomata, and are open two large guard cells with three unequal sized subsidiary cells, subsidiary cells margin are wavy and loaded with chloroplast pigments. Whereas upper epidermis stomata somewhat closed, the size of stomata and subsidiary cells lesser then that of lower epidermis. Stomata type Anisocytic. (Fig B1 – B4)

**Physalis minima Linn. (Aspotaka)**

Leaves simple, alternate, petiolated, ovate, margin complete, tip acute, dark green above, light green below, reticulate venation, base unequal measures about .. 10 x 5.cm odour horse urine and astringent in taste. (Fig C)

Upper epidermis consists less number of stomata. The lower epidermis have numerous stomata and are open with two large guard cells and three somewhat unequal sized epidermal cells, epidermal cells margin are wavy and loaded by chloroplast pigments. Whereas upper epidermis stomata somewhat closed, the sized of stomata and subsidiary cells lesser then that of lower epidermis. Stomata type anisocytic. (Fig C1- C4)

**Datura metel Linn. (Dhatura)**

Leaves simple, alternate, petiolated, ovate, margin complete, tip acute, dark green

above, light green below, reticulate venation, base highly unequal measures about 15 x 12.cm odour horse urine and astringent in taste. (Fig D)

The Upper epidermis consists less number of stomata. The lower epidermis have numerous stomata, and are open two large guard cells with three unequal sized epidermal cells, epidermal cells margin are wavy and loaded by chloroplast pigments. Whereas upper epidermis stomata somewhat closed, the sized of stomata and subsidiary cells lesser then that of lower epidermis. Stomata type anisocytic. (Fig D1-D4)

**Quantitative microscopy, stomatal index and stomatal number:**

Each stomata and guard cells scientifically measured, stomatal index taken and stomatal no. also calculated. Results were tabulated in table 1 & 2.

**Table 1: Stomatal Index of some species in the family solanaceae**

Sl. No.	Plant	Stomatal Index		Stomatal number	
		U.E Sq mm	L.E Sq mm	U.E Sq mm	L.E Sq mm
1	Dhatura	11.5-17.4 to 20.0	21.5-22.5 to 24.0	54-80	90-125
2	Kakamachi	10.5-15.4 to 18.0	20.5-21.5 to 23.0	44-70	70-100
3	Aspotaka	12.4-19.5 to 24.0	23.5-24.5 to 26.0	60-100	95-130
4	Ashwagandha	12.5-19.8 to 25.0	24.5-25.5 to 26.0	65-125	100-140

U.E - Upper Epidermis                      L.E - Lower Epidermis

**Table 2: Quantitative Microscopy (stomata)**

Sl. No	Characters	Dhatura	Kakamachi	Aspotaka	Ashwagandha
1	Length in µm	U.E.-11.95	U.E.-12.01	U.E.- 11.50	U.E.- 12.50
		L.E.- 10.25	L.E.- 11.40	L.E.- 10.75	L.E.- 12.25
2	Breadth in µm	U.E.- 9.67	U.E.- 9.50	U.E.- 9.80	U.E.- 9.72
		L.E.- 9.78	L.E.- 9.75	L.E.- 10.10	L.E.- 10.05
3	Radius µm <sup>2</sup>	U.E.-93.21	U.E.-93.50	U.E.- 93.80	U.E.- 93.87
		L.E.- 93.20	L.E.- 93.35	L.E.- 93.50	L.E.- 93.60
4	Epidermal cell µm <sup>2</sup>	U.E.-206.15	U.E.-212.94	U.E.-204.78	U.E.-209.24
		L.E.-203.19	L.E.-203.19	L.E.-195.14	L.E.-205.55

U.E - Upper Epidermis, L.E – Lower Epidermis

**Figure 1: Stomatal study of some species in the family solanaceae**

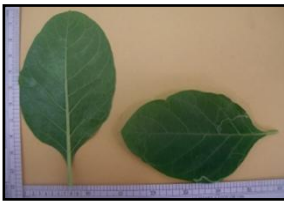


Fig.A-Ashwagandha



Fig.B-Kakamachi



Fig.C-Aspotaka



Fig.D-Dhatura



Fig.A1-Ash.le

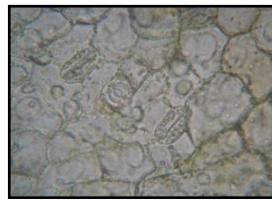


Fig.A2-Ash ue



Fig.A3-Ash ue



Fig.A4-Ash le

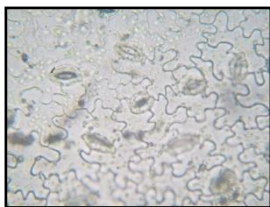


Fig.B1-Kak.le

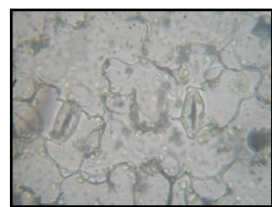


Fig.B2-Kak. Ue



Fig.B3-Kak. Le



Fig.B4-Kak. ue



Fig C1-Asp.le



Fig C2-Asp.le



Fig C3-Asp.ue



Fig C4-Asp.le

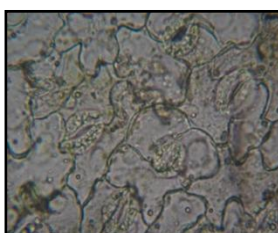


Fig.D1-Dat.ue



Fig.D2-Dat.le



Fig D3- Dat.ue



Fig.D4-Dat.le

Ash – Ashwagandha; Kak – Kakamachi; Asp – Aspotaka; Dat – Dhatura;

le – Lower epidermis; ue – Upper epidermis

## DISCUSSION

Stomata play very important role in the species identification. In this study also reveals that stomata of all 4 samples of solanaceae family show anisocytic type of stomata. In upper epidermis stomata are mostly closed, where as that of lower epidermis stomata are opened and somewhat bulged. The quantitative microscopic study shows that not much more variation in size, length, breadth, subsidiary cells. The stomatal number also slightly varies in all the 4 species.

## CONCLUSION

Quantitative parameters of leaves are relatively constant. These parameters are being reported for the first time, could be useful in the preparation of monograph; characters significantly deviate from the accepted standard above would then be rejected as contaminated, adulterated or downright fake. Hence it is more significant in standardization of crude drugs.

## ACKNOWLEDGEMENTS

The author expresses sincerely thanks to the Institute of Post Graduate Teaching and Research in Ayurveda, Gujarat Ayurved University for their Encouragement, co-operation, support, suggestions and affection throughout my studies.

## REFERENCES

1. Heber W. Yongken. Pharmaceutical Botany, 5<sup>th</sup> ed. Dehradun: International book distributors; 1986.p.235-238.
2. Katherine Esau. Anatomy of seed plants, 2<sup>nd</sup> ed. New Delhi: Wiley India Pvt. Ltd.; 2007.p.92-95.
3. Khandelwal KR. Practical Pharmacognosy techniques and experiments. 13<sup>th</sup> ed. Pune: Nirali Prakashan; 2005.p.157.
4. Pandey BP. Plant anatomy. New Delhi: S. Chand & company Ltd; 2006.p.136-145.
5. Anonymous. Indian Pharmacopoeia, Vol. 2. New Delhi: Government of India; 1996.p.186-189.
6. Johansen DA. Plant Microtechnique. New York: Mc Graw Hill; 1940.p.120.
7. Evans WC. Trease and Evans Pharmacognosy. London: WB Saunders; 2002.p.15, 474.

Source of Support: Nil

Conflict of Interest: None Declared