

# Comparative Studies on Leaf-Epidermal Features of *W. Somnifera* and *W. Obtusifolia* – Highly Medicinal Species of India

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## Abstract

The leaf-epidermal features of *Withania somnifera* and *Withania obtusifolia* were studied with the main aim of evaluating their reliability in determining interspecific relationships among these two species. Both the species are Perennial shrub. The height of *W. somnifera* is 110–125 cm, while *W. obtusifolia* is 100–115 cm. The two species tend to share common attributes in the stem, leaf and the floral morphology, when they are grown in same habitat. The stem of the two species is erect-branched from base, yellowish-green and texture. The attributes such as stomata types are different for the two species studied. This study confirms that leaf-epidermal features are useful in the systematic and biological consideration of *W. somnifera* and *W. obtusifolia*, since these two species are morphologically similar.

**Keywords:** Morphology; Leaf epidermis; *Withania*; Solanaceae; Systematics

## Introduction

The genus *Withania* belongs to the family Solanaceae. Members of this family are mostly herbs and shrubs. Some of the recent reports recorded as 85 genera and 2,200 species (Ahmed, 1964; Patel, 1969). The genus *Withania* is systematically placed into the division Magnoliophyta, class magnoliopsida, order solanates and family Solanaceae (Heiser and Smith, 1953). *W. obtusifolia* and *W. somnifera*, are of well-known medicinal plants in this family. *W. somnifera*, is known as “Aswagandha” in Ayurveda and is used in the treatment of tuberculosis and arthritis. It is also known as “Indian ginseng”. Among the various plants Aswagandha is considered to be one of the most important medicinal plant distributed in Maharashtra, Gujarat, Rajasthan, Madhya Pradesh, Uttar Pradesh, Punjab, Himachal Pradesh, Jammu and Kashmir and Tamilnadu. Plants belonging to the genus *Withania* are distributed throughout the world. Earlier taxonomist recorded a single species (tetraploid), *W. somnifera* from the wild. Extensive field survey and critical perusal of literature revealed the presence of additional diploid species of *W. obtusifolia* in the natural population (Tirupura Sundari *et al.*, 1999). *Withania* species are perennial shrub with branched and non branched tap root system. The stem is herbaceous, erect and hairy; leaves are alternate, simple and the fruit is a berry. The use of morphological and leaf-epidermal features has been found to be greater interest in taxonomy. An excellent review of the application of morphological features in systematic studies is shown in the works of Okwulehi and Okoli (1999); Chakrabarty and Gupta (1981); Olowokudejo (1990); Edeoga and Eboka (2000); Edeoga and Ikem (2001); Stern (2000). The use of leaf-epidermal features (epidermal cell, stomata and trichome) in systematics has become too distinctive and have been used as a great taxonomic tool of family, genus and species. This study assesses the relevance of morphological and leaf-epidermal features of *W. somnifera* and *W. obtusifolia* to evaluate the reliability of these characters in the systematic consideration of the *Withania* species studied.

## Materials and Methods

The *W. somnifera* and *W. obtusifolia* of these plants were collected from Perambalur and Thanjavur districts of Tamilnadu on January, 2009 for Morphological studies. It has mature leaves of each species. The fresh materials were taken using Nikon 60 digital camera and characters of the two species were divided into vegetative and floral morphology.

For the leaf-epidermal features of *Withania* plant species studied were examined using light microscope. Photographs of different magnifications were taken with Nikon Labphot 2 Microscopic unit. For normal observations Bright field was used. For the study of crystals, starch grains and lignified cells, polarized light was employed. Under the polarized light, they appear bright against dark background. Magnifications of the figures are indicated by scale-bars. Descriptive terms of the anatomical features are as given in the standard Anatomy books (Cutler, 1978). The Epidermal preparations were made by boiling the collected materials of each of the two species in different test tubes containing 70% ethanol for 10 min. These were allowed to cool and later bleached in 8% sodium hydrochlorite (NaHCl) for 5 min. Epidermal peels were stained with 1% ethanol-safranin and temporarily mounted in aqueous glycerol solution (Cutler, 1978). Photo micrographs of the epidermal features were taken from the slides using a light microscope fitted with vivitar v-335 camera.

## Results

The leaf-epidermal features of *W. somnifera* and *W. obtusifolia* were investigated and summarized in Table 1 and 2 (Figs. 1a–d) for the morphology. The vegetative results of the two species studied showed that the habit and height of *W. somnifera* is perennial shrub and 125 cm while the habit and height of *W. obtusifolia* is perennial shrub and 100–115 cm, respectively (Table 1). The habits still confirm the shrub

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Fig. 1a Habit of *Withania obtusifolia*



Fig. 1b Habit of *Withania somnifera*

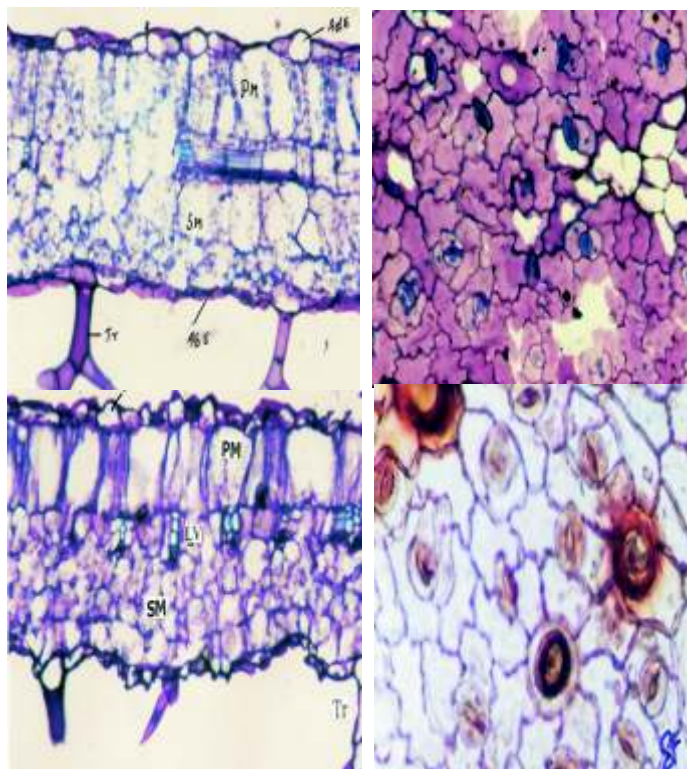


Fig. 1c Leaf-epidermal morphology of *Withania obtusifolia*

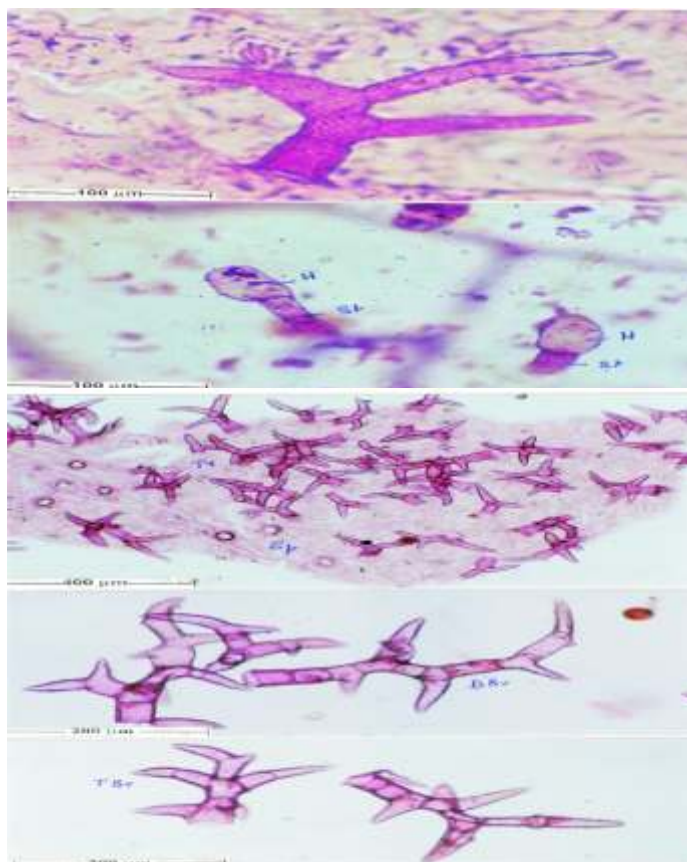


Fig. 1d Leaf-epidermal morphology of *Withania somnifera*

Character	<i>Withania somnifera</i>	<i>Withania obtusifolia</i>
Habit	Perennial shrub	Perennial shrub
Height	125cm	100 - 115cm
Stem	Erect branched	Erect branched
Colour	Green	Green
Leaf arrangement	Alternate	Alternate
Leaf shape	Elliptic ovate to broadly ovate	Elliptic obtuse
Leaf type	Simple	Simple
Stomata	Animocytic	Paracytic
Trichome	Non glandular	Glandular and Non glandular tri

Table 1 Vegetative characters of the two *Withania* species studied

(AdH – Abaxial hump, EC- Epidermis Cells, Col – Collenchyma, Pm – Palisademesophyll, SM – Spongy mesophyll, Tr – Trichome, X – Xylem, AdE – Adaxial epidermis, GT – Ground of the midrib, H - Head, St – Stalk.)

Collection number	Species	Locality	Collector(s)	Place of deposition
001	<i>Withania obtusifolia</i>	Karudamangalam, Perambalur District Tamil Nadu	M.Senthil Kumar A. Aslam	College Garden Jamal Mohamed College, Trichy Tamil Nadu
002	<i>Withania somnifera</i>	Pulavarnatham Thanjavur District Tamil Nadu	A. Aslam M. Senthil Kumar	College Garden Jamal Mohamed College, Trichy Tamil Nadu

Table 2 list of *Withania* species from which fresh materials were collected

nature of this species. But the leaf has elliptic obtuse characters in *W. obtusifolia* but elliptic characters in *W. somnifera*. The leaf arrangement is alternate in both species of *W. somnifera* and *W. obtusifolia*

The result of the leaf-epidermal features of *W. somnifera* and *W. obtusifolia* were investigated. The shape of the epidermal cells of the upper and lower surfaces is irregular and sinuous in both species studied. The two *Withania* species were amphistomatic having stomata at both the adaxial (upper) and abaxial (lower) surfaces of the leaf. The distribution of stomata on both the upper and the lower surfaces of the leaves of the species studied revealed anomocytic or paracytic type of stomatal arrangement. The trichomes are differ from the two species, the glandular and non-glandular trichomes are present in the *W. obtusifolia* but in case *W. somnifera* are presence of non-glandular trichome occur in the lower- leaf epidermis.

## Discussion

The leaf-epidermal features of *W. somnifera* and *W. obtusifolia* were studied showed some characteristic that could be used for taxonomic decision. Morphologically, the vegetative features of habit and height of *W. somnifera* distinguish it from *W. obtusifolia*. The observation is in line with earlier works of Okwulehi and Okoli (1999); Edeoga and Eboka (2000) who used comparative morphology of different species in establishing relation among various species. The result of leaves arrangement showed alternate shape in both *W. somnifera* and *W. obtusifolia*. But leaf types are different from two *Withania* speices. That type observation is supported by the works of Edeoga and Eboka (2000), in *Dissotis* (Okeke and Nwachukwu, 2001) in *Euphorbiaceae*. The result of the leaf-epidermal studied indicates that the shape of epidermal cells of the *Withania* species studied. Similarly, the two species are amphi-stomatic with more stomata on the lower surface (abaxial) than the upper surface (adaxial). The stomatal index result is not strange since Olowokudejo (1990) found stomatal index valuable and very reliable in distinguishing between the leaves of medicinal species of *Ocimum* from non-medicinal ones. The trichomes are taxonomic conclusion due to their in different in both species. The anomocytic and paracytic type of stomata found in the two *Withania*

species indicates that the species are phylogenetically related (Nwachukwu and Mbagwu, 2006).The morphological (vegetative and floral) and leaf-epidermal features of the species studied confirm the interspecific relationships between *W. somnifera* and *W. obtusifolia* in their stem, leaf, flower, fruit, seed, stomatal type. The leaf, flower arrangement and fruit shape are distinguishing morphological and leaf-epidermal features observed in these investigations are of systematic value because they are reasonably constant in the species studied. Olowokudejo (1990) made similar observation in the genus *Annona*. The purpose of this study is to show that application of morphological features has proven to be of immense assistance in interpreting problems related to plant classification. Thus, the necessity of including the results from the morphological and leaf epidermis with data derived from other botanical disciplines remain vital when formulating conclusions on the systematic of the *Withania* species.

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