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STUDY OF FOLIAR ANATOMICAL BIOMARKERS AND ITS SIGNIFICANCE IN *COMMIPHORA WIGHTTI*- A MEDICINAL PLANT MENTIONED IN ATHARVAVEDA

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Abstract- *Commiphora wightti* Arnott belonging to family Burseraceae, is a medicinal plant mentioned in Atharvaveda. In Atharvaveda, it is described as "Agni-sthana", used to treat rheumatism, obesity and atherosclerosis. A detailed study of the leaf epidermis along with the petiole was undertaken in search of useful and stable taxonomic characters. The study revealed several interesting and novel anatomical biomarkers which will be useful in the correct identification of the plant and finding the adulterants. Distinctive anatomical characters include presence of trichomes on leaf epidermal surfaces and petiole, hypostomatic leaf surfaces, anomocytic stomata, elongated epidermal cells parallel to the veins with the absence of any cuticular striations on both leaf and petiole. The different trichome types have differing organographic distributions with the same species. This can be useful in the identification of the species and even their corresponding organs, which would be of interest to pharmacognosists.

Index Terms- Anatomical biomarkers, Atharvaveda, *C. wightti*, Trichomes

Introduction

The famous French philosopher Voltaire had said "The Vedas are the most precious gift for which the West has ever been indebted to the East". Atharvaveda is a sacred text of Hinduism and one of the four Vedas. It derives its name from the Rishi Atharvan who made a significant contribution in composition of Atharvaveda. *Commiphora wightti* Arnott belonging to family Burseraceae, is a medicinal plant mentioned in Atharvaveda. 3rd mantra of 4th chapter of Atharvaveda describes the insecticidal properties of guggul (*Commiphora wightii* Arnott). Second mantra of 38th suktas emphasizes the importance of guggul and tells us that with the use of it, all diseases disappear like deer and its sweet smell makes us free from diseases. It is also used in treating rheumatism, obesity, neurological and urinary disorders. Also there is a wide respect and therapeutic Ayurvedic applications of this plant, considered the most important for the removal of "Ama" i.e. toxic substances which accumulate as a result of sluggish digestion and circulation associated with a slowing of metabolism (Rout *et al*., 2012). Due to lack of conservation of natural habitat, the plants will live into shortage and people are using alternate or different species in the name of original plants. For example, instead of gum of Guggul (*Commiphora wightti*), gum of Shallaki (*Boswellia serrata*) is used. Micro-morphological parameters of different plant parts have been used as aids in the taxonomical recognition of species (Kathiresan et al., 2011). Hence the present investigation has been carried out to provide a detailed account of anatomical biomarkers and its significance for identifying the correct species.

Review of Literature

In determining relationship between different genera, families, orders and other taxonomic categories, the anatomical characters are most useful. Anatomical data have also solved several phylogenetic problems. Anatomical structures are most likely to provide evidences concerning inter- relationships of larger groups such as families and also helping to establish real affinities of their uncertain taxonomic status. There are large numbers of anatomical characters of systematic importance but as pointed out by Metcalfe and Chalk (1950), the systematic anatomist must rely on those characters which are less plastic. The importance of micro-morphological features (anatomical biomarkers) for the taxonomic consideration of angiosperms is now well established (Ramayya, 1972; Tomlinson, 1979; Ogundipe and Akinrinlade, 1998 and Parveen *et al*., 2000). The first summary of the systematically more useful anatomical characters with an evaluation of their importance was provided by Fritsch (1903). The utility of foliar epidermal features in distinguishing taxonomic groups was clearly established (Stace, 1965, 1984; Dilcher, 1974; Raju, 1981; Rao and Raju, 1985, 1988; Mohan, 1994; Bhatia, 1984; Jones, 1986 and Manohari, 2004). The taxonomic relevance of the foliar epidermal characters of angiosperms has been well documented (Parveen *et al*., 2000; Yasmin *et al.*, 2009; Celka *et al.*, 2006 and Zou *et al.*, 2008). The leaf epidermal cells are of significant taxonomic importance. Solereder (1908), Netolitzky (1932) and Metcalfe and Chalk (1950) have provided useful information on the structure, function and classification of trichomes with their significance in comparative anatomical studies. They have proved more useful to taxonomists at generic and specific level. Kaikade (2018) studied the leaf architecture of *C. wightti* as one of the pharmacognostic tools. But the detailed anatomical biomarkers of *C.wightti* is not studied yet and hence the present study dealt with the foliar anatomical biomarkers of *C. wightti* with its significance.

Materials and Methods

For the present study, the leaves of *C. wightti* were collected from RDIK and NKD College, Badnera, District Amaravati, Maharashtra, India. Epidermal peels were studied from mature leaves of both fresh and preserved materials. Epidermal peeling of leaves and other vegetative parts was directly done mechanically by forcep or by scrapping with the help of razor blade. The prepared peels were stained with 1% aqueous saffranin followed by mounting in 50% glycerine. The quantitative analysis of stomatal complex was made by calculating stomatal frequency, size of stomata and epidermal cells and stomatal index from random sampling of 5- different peels. The stomatal index for leaves was calculated according to the method of Salisbury (1927). Other parameters include stomatal shape, distribution and orientation. Stomatal classification is based on the morphological classification recorded by Baranova (1992). To get an integrated picture of the trichome types and their organographic distribution varied temporary micro-preparations viz. epidermal peels, mounts of cleared whole organs or their portions, scrapping and transections were used. The observation was made directly under compound microscope and camera lucida sketches were made.

Result and Discussion

Petiole:

Epidermal features in surface view: (Fig. 1)

Epidermal cells: polygonal, slightly isodiametric- unisodiametric, 28×24µ; walls- thin, straight, end wall- oblique- straight; orientation- longitudinal to long axis of organ. Cuticular striation absent. Cells/ unit area- 38-40

Stomatal complex: surface astomatic

Trichome complex:

I. Non-glandular Uniseriate filliform:

1. Uniseriate conical: (Fig. 4)

1.1 Body- ovate- conical; 96x36µ; narrower, slightly bend at apex; sub-acutely pointed; base rounded; content- finely granular; walls- thin, smooth; seated upon single epidermal cell.

2. Multicellular conical: (Fig. 5-6)

2.1 Body-3-celled; 64x40µ; lower and middle cells sub-equal, broader than longer; terminal cell bend at apex; apex rounded; base flat; content- finely granulated, lateral wall convex; cross wall straight; lumen narrower; surface smooth; seated upon vertical division wall between two adjoining epidermal cells.

2.2 Body- 4- celled; 108x40µ; lower three cells sub- equal; seated upon vertical division wall between two adjoining epidermal cells.

II. Uniseriate glandular capitate:

1. Long stalked capitate: (Fig. 7-10)

1.1 Foot- 2- celled, squarish- polygonal; content- hyaline; stalk- multicellular, uniseriate, 4- celled, cells of equal length and breadth, squarish; lateral wall- straight, smooth and thin; content- finely granulated. Head multicellular, globose, lower two cells rectangular, broader than long; uppermost two cells small, squarish, adjoining to each other; content- dense; 104x44µ

1.2 Foot- 2- celled, not sunken, cells rectangular; content- hyaline; stalk-5- celled, slightly narrower than base of head; cells squarish, terminal cell- rounded; lateral wall straight to slightly convex, smooth; content- finely granular; neck cells-2, squarish; content- finely granular. Head- globose, 2- celled; content- dense; cells- semilunar, appearing dumbbell shape at top view;112x44µ

1.3 Foot- 2- celled, pentagonal- polygonal, content- hyaline. Stalk- 5- celled, much long, uniseriate, cells of varied length, second last cell shortest; lateral wall- convex, smooth, thin, slightly constricted at cross wall; cross wall- straight, thin, content- fine granular. Head- 1- celled, capitate with fine content, hair inserted on common wall of two adjoining, slightly raised cells; 288x60µ

1.4 Foot- 1- celled, rectangular, content- hyaline. Stalk-6- celled cells of varied length. Head- capitate; 328x68µ

2. Capitate sessile or shortly stalked: (Fig. 11-12)

2.1 Foot- 1- celled, rectangular, content- hyaline; stalk- 1- celled, polygonal; lateral wall- straight, thin, smooth; content- hyaline. Head- 1- celled, globose, content- dense; 28x18µ

2.2 Foot-1- celled, rectangular, content- hyaline; stalk- 2- celled, basal cell longer than terminal cell, basal cell elongated, terminal cell squarish; lateral wall- thin, convex to rounded, cross wall- curved, smooth; content- hyaline; head- 1- celled, globose, content dense 40x24µ

Lamina:

Epidermal features in surface view:

Adaxial surface: intercostals cells comparatively bigger than those of abaxial surface, 44×32µ; walls- straight- slightly wavy; orientation- various to long axis of organ; costal cells- distinct, uniform, elongated; walls straight, parallel to plane of veins. Cuticular striations absent. Cells/unit area-23

Abaxial surface: intercostals cells smaller than those of adaxial surface, 40×28µ; walls- wavy; orientation- various to long axis of organ; costal cells- similar to that of adaxial surface. Cuticular striations absent. Cells/ unit area- 30

Stomatal complex: surface hypostomatic

Adaxial surface: surface astomatic (Fig. 2)

Abaxial surface: stomatal distribution- on intercostals area and near veins; orientation- various to long axis of organ; shape- rounded- oval, guard cells almost equal. Distribution- non-specific. Type- Anomocytic, Size- 44×40µ, Frequency-5, stomatal index- 14.28% (Fig. 3).

Trichome complex:

I. Non-glandular uniseriate filliform:

1. Uniseriate conical: (Fig. 13-14)

1.1 Body- tapering, longer than broad; 84x32µ; acutely pointed at apex; base- sub- rounded; content- granular, not obliterated; wall- moderately thick, straight; surface-rough; lumen- moderately broad; seated on single epidermal cell.

1.2 Body- falcate conical; 94x28µ; seated upon single epidermal cell.

2. Multicellular conical: (Fig. 15-17)

2.1 Body- 2-celled, lower cell much longer, hyaline; terminal cell short, acutely pointed at apex, base flat; content- granular; lateral wall straight; cross wall- straight- concave; lumen- narrower; surface- smooth; seated upon single ordinary epidermal cell; 110x32µ

2.2 Body- 2-celled, lower cell bulbous, longer than broader, terminal cell sharply pointed at apex; content- finely granular; 52x20µ

2.3 Body- 3-celled, lower cell cylindrical, longer than others, wall- convex, content- finely granular; middle and upper cell- oval, sub-equal, wall- concave, cross wall- straight- concave, content- much granular, seated upon vertical division wall of two epidermal cells; 112x36µ

II. Uniseriate Glandular capitate:

1. Long stalked capitate: (Fig. 18-20)

1.1 Foot-1-celled, protruding; hyaline; stalk-4-celled, all cells sub-equal, hyaline, lateral wall- thin, straight to curved, cross wall- concave to curved, surface- smooth, lumen- broad; head-1-celled, cordate, dense,72x28µ

1.2 Foot-2-celled, rectangular, hyaline; stalk-4- celled, basal cells sub-equal, much elongated, hyaline, terminal one is smallest, rounded, dense, wall- thick, concave to curved, surface- smooth, lumen- broad; head-1- celled, globose, dense;104x40µ

1.3 Foot-4-celled, adjacent to each other, rounded to horizontally elongated, hyaline; stalk-2- celled, basal cell much longer than terminal cell, elongated, hyaline; head-1-celled, globose, slightly bend at apex, dense; 96x32µ

2. Capitate sessile or shortly stalk: (Fig. 21-24)

2.1 Foot- 4- celled, unisodiametric, hyaline; stalk- 3- celled, lower two cells oval in shape, upper cell-squarish, lateral wall- straight to concave, thin and smooth, content- finely granulated; head- capitate, 1-celled, dense,68x28µ

2.2 Foot-2-celled, horizontally elongated, hyaline; stalk-3-celled, basal cell bigger than sub-terminal and terminal cell, hyaline, lateral wall- straight to curved, cross wall- concave, lumen- narrow; head-1- celled, globose, dense, 36x20µ

2.3 Foot-1- celled, rectangular, hyaline; stalk-1- celled, elongated, lateral wall- straight, thin and smooth, content- hyaline; head-2- celled, cordate content- dense, 32x20µ

2.4 Foot-1- celled, not sunken, hyaline; stalk- 2- celled, adjacent to each other, finely granular; head-peltate, large, many celled content dense, 28x20µ

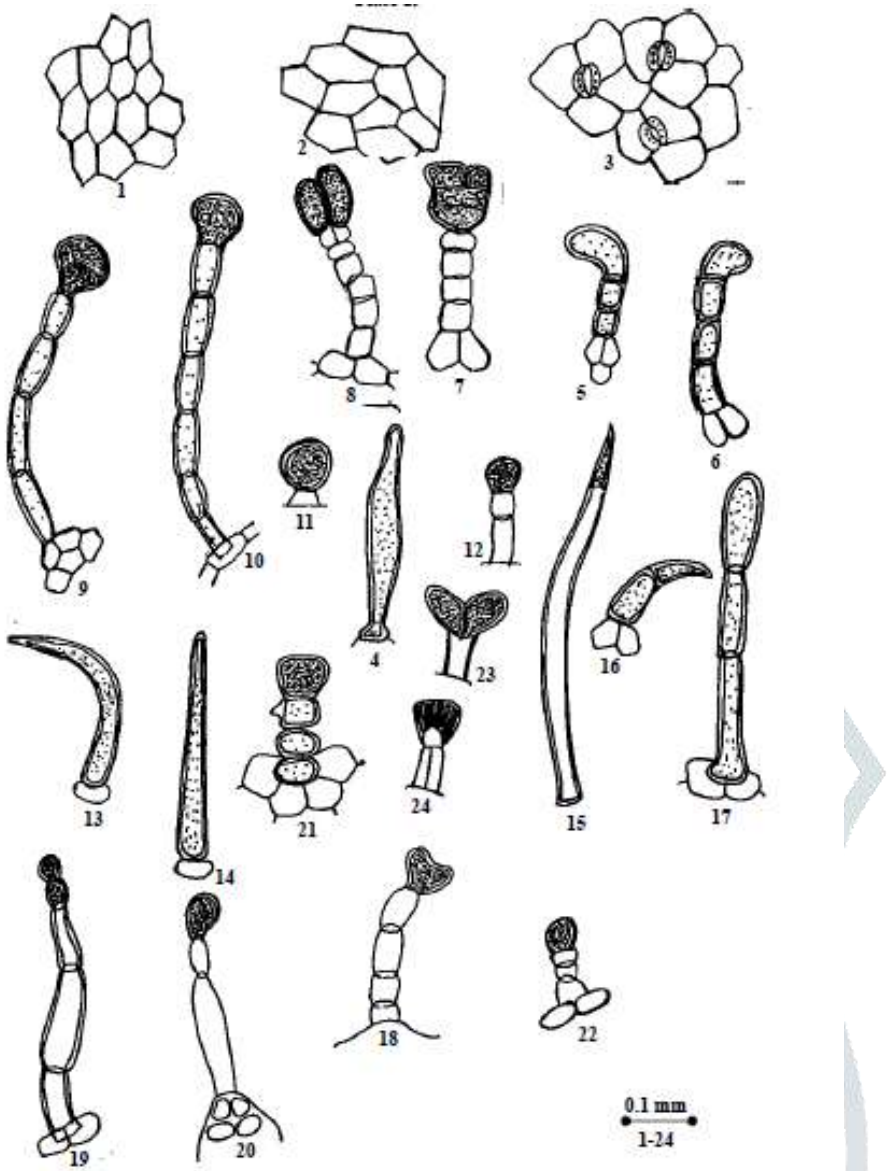

Figure: Commiphora wightti- Petiole and leaf (Text figure 1-24)

Leaf epidermal tissue characteristics have an important role in taxonomy and determining the number of plant genera and species (Scatena *et al*., 2005 and Uphof, 1962). The epidermis possesses a number of important diagnostic characters that offer valuable clues for identification, like size, shape and orientation of stomata, guard cells and subsidiary cells, structural peculiarities of epidermal cells walls, distinctive or specialized form of numerous families (Bhatia, 1984; Stace, 1984 and Jones, 1986). In the present study, foliar anatomical biomarkers of *C. wightti* were investigated, in which both qualitative and quantitative aspect were evaluated.

The present study proved very helpful in the configuration of foliar anatomical biomarkers that can be used as an important taxonomic tool for the identification of correct plant species and finding the adulterants.

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