



RESEARCH ARTICLE

PHARMACOGNOSY

**FOLIAR MICROMORPHOLOGICAL STUDIES ON SOME MEMBERS OF THE  
FAMILY FABACEAE**

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**ABSTRACT**

Twenty-nine plants belonging to the family of Fabaceae were investigated for their foliar trichome characters. Five plants were found glabrous, and the rest showed both glandular and non-glandular trichomes, which ranged from unicellular to multicellular structures. Three plants contained both glandular and non-glandular trichomes whereas four contained only the former and the rest non-glandular trichomes. These trichome characters being specific to the plants containing them are diagnostic features which can also be utilized as biomarkers to recognize the drug plants and to identify the plants in vegetative state.



## KEY WORDS

Fabaceae, micromorphological characters, glandular trichomes, non-glandular trichomes, biomarkers, taxonomy.

## INTRODUCTION

The family Fabaceae is one of the largest families among Angiosperms which is extensively studied for anatomical as well as epidermal characters<sup>1-6</sup>. Carlquist<sup>7</sup>, Metcalfe<sup>8</sup> and Stace<sup>9</sup> had stated that the leaf characters are the most varied anatomical features in Angiosperms. These features can be employed as useful taxonomic characters. Leaf or foliar and floral micromorphological characters are considered as some of the primary diagnostic features in segregating the major groups of plants. In fact, the leaf characters are considered as second to those of flowers and fruits in taxonomic studies. Foliar and floral epidermal characters are used successfully in the delimitation of a number of taxa<sup>10-13</sup>. Cutler<sup>14</sup> had stated that apart from the usefulness of those characters in taxonomy, they are also used efficiently in the identification of fossil specimens, specifically the leaf impressions in Paleobotany. In addition to this, the epidermal micromorphological features help in

authentication of foliar drugs in pharmacognosy and thus serve as biomarkers<sup>15</sup>. Chandra *et al*<sup>16</sup> had emphasized of the significance of epidermal morphology and arrangement of phylogenetic considerations. Looking into the importance of these characters, in the present work, 29 plants, belonging to Fabaceae, are subjected to an analysis of micromorphological features in their leaves with a view to find out, the relevance of these characters, in identifying the taxa and if possible, defining the taxonomic affinities.

## MATERIALS AND METHODS

All the 29 plants screened were collected from in and around Vadodara, Gujarat, India. For studying the trichomes, epidermal peels were taken out manually with the help of a blade and stained with safranin. Stained peel was mounted in glycerine and then observed under the microscope.

## RESULTS AND DISCUSSION



S.No.	Plant name	Glandular trichome					Non-glandular trichome				
		unicellular	multicellular trichome differentiated into head and stalk			multicellular sessile trichome	unicellular		two-celled	three-celled	medifixed
			head two-celled and stalk one celled	four-eight celled head and one celled stalk	12-celled and one celled stalk		16-celled head and one celled stalk	base flat			
1.	<i>Indigofera cordifolia</i> Heyne ex Roth.						+			+	
2.	<i>Indigofera tinctoria</i> L.									+	
3.	<i>Indigofera enneaphylla</i> L.									+	
4.	<i>Indigofera trita</i> L.									+	
5.	<i>Crotalaria retusa</i> L.	+									
6.	<i>Alhagi camelorum</i> Fisch.	+									
7.	<i>Crotalaria ternatea</i> L.	+									
8.	<i>Teramnus labialis</i> (L.f.) Spreng.					+					
9.	<i>Pongamia pinnata</i> (L.) Pierre.								+		
10.	<i>Tephrosia villosa</i> (L.) Pers.						+		+		
11.	<i>Desmodium triflorum</i> (L.) DC.		+				+		+		
12.	<i>Desmodium velutinum</i> (Willd.) DC.		+		+				+		
13.	<i>Dolichos lablab</i> L.			+		+	+			+	
14.	<i>Stylosanthes hamatus</i> (Linn.) Taub.									+	
15.	<i>Crotalaria medicagenia</i> Lamk.							+			
16.	<i>Alysicarpus vaginalis</i> (L.) DC.							+			
17.	<i>Melilotus indica</i> (L.) All.							+			
18.	<i>Tephrosia purpurea</i> (L.) Pers.							+			
19.	<i>Crotalaria sericea</i> Retz.							+			
20.	<i>Tephrosia tenuis</i> Wall. ex Dalz.							+			



21.	<i>Crotalaria leptostachya</i> Benth.	+
22.	<i>Sesbania grandiflora</i> (L.) Poir.	+
23.	<i>Crotalaria hirsuta</i> Willd.	+
24.	<i>Mucuna pruriens</i> (L.) DC.	+

The distribution and characteristics of trichomes in 24 members of the Fabaceae is presented in Table I. Out of the total 29 plants studied, five plants viz. *Canavalia ensiformis*, *Aeschynomene indica*, *Desmodium gangeticum*, *Rhynchosia bracteata* and *Sesbania aculeata* are found glabrous. Of the remaining 24 plants with trichomes, seven possessed various unicellular and multicellular glandular trichomes. Unicellular glandular trichomes were seen in three plants, i.e., *Alhagi camelorum*, *Crotalaria retusa* and *Clitoria ternatea*. *Alhagi camelorum* possessed oblong thin walled trichome whereas *Crotalaria retusa* had spindle shaped (pointed at the ends) trichome (Fig I and II). In *Clitoria ternatea* elongated obovate trichome was present with slightly warty walls. Glandular trichomes of the remaining four plants were multicellular differentiated into a head and a stalk or sessile. The trichome of *Dolichos lablab* had a biseriolate

two or four tiered head and a single celled stalk. In addition, this plant contained two types of non-glandular trichomes; one unicellular and the other linear and three-celled. The unicellular trichome here was curved at the tip while the three-celled trichome had a very long apical cell and two-square shaped lower cells. The glandular trichomes of *Desmodium velutinum* had one or three tiered heads. This plant also possessed characteristic non-glandular trichomes having single basal cells and very long narrow pointed apical cells, which was smooth or warty. The glandular trichomes of *Desmodium triflorum* had two-celled heads. The non-glandular trichomes of this plant were of two types; one two-celled with a spreading small basal cell and a narrow pointed apical cell. The second type of trichome was unicellular and curved. Trichomes of the fourth plant *Teramnus labialis* were sessile, flat, linear and four-celled.

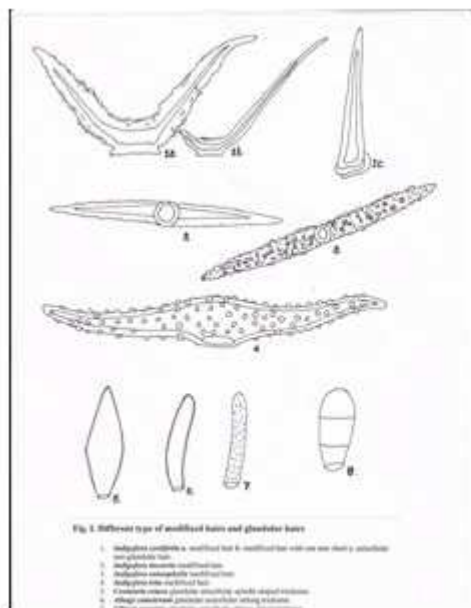


Fig. 1. Different type of modified hairs and glandular hairs

- A. Bifurcated hair with a thick wall and a broad lumen
- B. Peltate hair with a thick wall and a broad lumen
- C. Glandular hair with a thick wall and a broad lumen
- D. Glandular hair with a thick wall and a broad lumen
- E. Glandular hair with a thick wall and a broad lumen
- F. Glandular hair with a thick wall and a broad lumen
- G. Glandular hair with a thick wall and a broad lumen

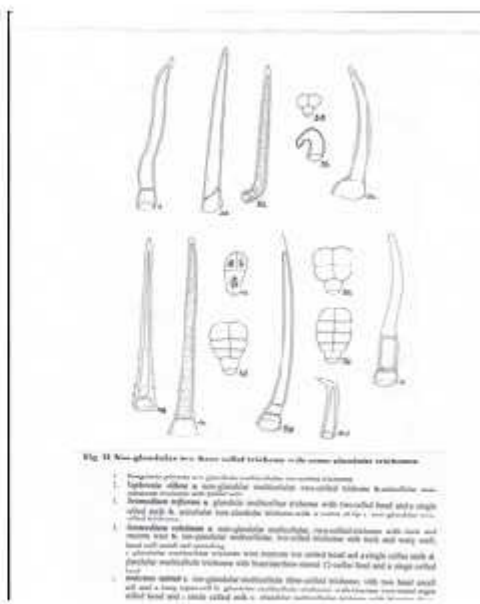


Fig. 2. Non-glandular hairs with three basal trichomes with some additional trichomes

- A. Unicellular hair with a thick wall and a broad lumen
- B. Unicellular hair with a thick wall and a broad lumen
- C. Unicellular hair with a thick wall and a broad lumen
- D. Unicellular hair with a thick wall and a broad lumen
- E. Unicellular hair with a thick wall and a broad lumen
- F. Unicellular hair with a thick wall and a broad lumen
- G. Unicellular hair with a thick wall and a broad lumen

All the remaining 17 plants possessed only non-glandular trichomes. The four species of *Indigofera* were characterized by medifixed hairs (Fig. I). The hairs of each of these plants were distinct in one or other features. The hair in *Indigofera trita* had a thick and papillate wall and very broad lumen. *Indigofera cordifolia* possessed 'L' shaped medifixed hairs having one arm shorter than the other, though 'V' shaped trichomes also were present. They had warty thick walls and broad lumen along with conical tips and a distinguished circular base point by which they were attached. In addition, the plant contained a non-glandular unicellular trichome. The trichomes of other species of *Indigofera*; *I. tinctoria* and *I. enneaphyla* had thick warty walls with broad lumen. Both these species had flat, sessile, medifixed hairs, but that of *I. enneaphyla* was constricted in the middle (both arms almost spindle shaped) and more warty compared to that of *I. tinctoria* where the middle portion of hair was the broadest.

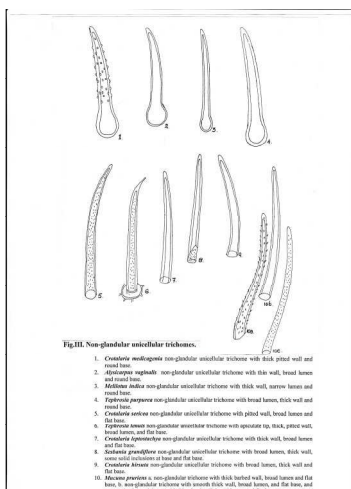
Of the remaining 13 plants, three, *Tephrosia villosa*, *Stylosanthes hamatus*, and *Pongamia pinnata* possessed a very characteristic two-three celled trichome, having one or two basal square or rectangular cells and a long pointed

apical cell. A number of trichomes of *Tephrosia villosa* had an oblique partition wall separating the two basal cells. This plant, in addition, contained a unicellular long pointed warty trichome having a marked curve at the base also. *Stylosanthes hamatus* possessed a three-celled trichome in which the middle cell was rectangular filled with yellowish brown inclusions and a basal oval cell. Large prismatic crystals, one each in every epidermal cell, are another added feature of this plant. *Pongamia pinnata* possessed a trichome similar to that of *Tephrosia villosa* but the entire structure was wavy in appearance.

Of the remaining 10 plants, six showed simple unicellular trichomes with a flat base and whereas those of other four plants possessed a round base (Fig. III). Trichomes of the former group were pitted or smooth walled. Pitted walls were present in three, *Tephrosia tenuis*, *Crotalaria sericea* and *Mucuna pruriens*. *Tephrosia tenuis* had a trichome with an extended apiculate tip whereas *Mucuna pruriens* possessed smooth walled and barbed walled trichome in addition to pitted walled trichome. Remaining plants having trichomes of flat base,

i.e., *Crotalaria hirsuta*, *Crotalaria leptostachya* and *Sesbania grandiflora* had smooth wall. Of these *Sesbania grandiflora* contained some cell inclusions at the base. The trichomes in *Crotalaria hirsuta* had broad lumen. The remaining four plants containing unicellular trichomes with round bases were *Crotalaria medicagenia*, *Alysicarpus vaginalis*, *Tephrosia*

*purpurea* and *Melilotus indica*. Of these, *Crotalaria medicagenia* had papillate walls and rest had smooth walls. Trichomes of both *Alysicarpus vaginalis* and *Tephrosia purpurea* had broad lumens, but the walls of the latter plant were very thick when compared to that of the former. The trichomes in *Melilotus indica* possessed a narrow lumen and thick wall.



An artificial key for identification of the members of the Fabaceae is prepared based on the trichome characters.

**Artificial key for identification of some members of the Fabaceae based on trichome characters]**

1. Plant tomentose/hirsute; with glandular and/or non-glandular trichomes:
  2. Glandular trichomes present:
    3. Glandular trichomes unicellular:
      4. Wall of the trichomes warty (pitted).....*Clitoria ternatea* L.
      4. Wall of the trichome smooth:
        5. Glandular trichome spindle shaped (pointed at both ends).....  
*Crotalaria retusa* L.
        5. Glandular trichome oblong.....*Alhagi camelorum* Fisch.
    3. Glandular trichome multicellular:
      6. Trichome differentiated into head and stalk:
        7. Head two celled:
          8. Stalk of the trichome broad merging with the head making the trichome club shaped.....*Desmodium velutinum* DC.
          8. Trichome differentiated into a broad two-celled head and a narrow one-celled stalk.....*Desmodium triflorum* DC.
        7. Head multicellular.....*Dolichos lablab* L.
      6. Trichome multicellular sessile.....*Teramnus labialis* (L.f.) Spreng.
  2. Glandular trichome absent; non-glandular trichome present:
    9. Non-glandular trichome unicellular:
      10. Trichome medifixed:
        11. Medifixed type of trichomes only present:
          12. Trichome wall papillate.....*Indigofera trita* L.
          12. Trichome Wall warty:
            13. Ends of the trichome broad.....  
*Indigofera enneaphylla* L.
            13. Ends of the trichome conical.....*Indigofera tinctoria* L.
        11. Medifixed hair present along with unicellular simple trichome.....*Indigofera cordifolia* Heyne. ex Roth.
      10. Trichome linear, not medifixed:
        14. Unicellular trichome without any swollen base:
          15. Wall warty or pitted:
            16. Tip of the trichome apiculate.....*Tephrosia tenuis* Wall. ex Dalz.
            16. Tip of the trichome simple conical:
              17. Only one type of pitted unicellular trichome.....  
*Crotalaria sericea* Retz.
              17. Three type of unicellular trichome; one pitted; second smooth walled and third barbed walled .....  
*Mucuna pruriens* DC.
          15. Wall smooth:
            18. Lumen empty throughout the trichome:
              19. Wall thick; lumen narrow.....*Crotalaria leptostachya* Benth.
              19. Wall thin; lumen broad.....*Crotalaria hirsuta* Willd.
            18. Lumen containing cell inclusions at the base.....  
*Sesbania grandiflora* Poir.
        14. Unicellular trichome with a swollen base:
          20. Wall of the trichome warty (papillate); lumen broad.....  
*Crotalaria medicagenia* Lamk.
          20. Wall of the trichome smooth:
            21. Lumen broad.....*Alysicarpus vaginalis* DC.
            21. Lumen narrow:
              22. Wall very thick.....*Tephrosia purpurea* Pers.
              22. Wall thin; lumen very narrow at apex.....  
*Melilotus indica* (L.) All.
      9. Non-glandular trichome two or three celled:
        23. Trichomes homogenous:
          24. Two celled trichome.....*Pongamia pinnata* Pierre.
          24. Three celled trichome .....*Stylosanthes hamatus* Taub.
        23. Trichomes of two types; unicellular pitted trichome and 2-celled trichome.....*Tephrosia villosa* Pers.
1. Plants glabrous.....*Sesbania aculeata* Poir., *Canavalia ensiformis* DC., *Rhynchosia bracteata* Benth., *Desmodium gangeticum* DC. and *Aeschynomene indica* L.



## CONCLUSION

A glance at the identification key prepared indicates the utility of the trichome characters in identifying 24 members of the Fabaceae out of the 29 plants studied. These characters are present in the vegetative state and therefore, are available throughout the year for any student of taxonomy. These characters can also aid in identifying the stem or the leaves in any of the useful parts used as a drug or raw material and thus can serve as biomarkers for the plant in question. These biomarkers are of immense importance in case of drug plants where there is a rampant adulteration of the genuine material with easily available adulterants. The closely

available species of a drug plant are the ones used for adulterating a genuine medicinal plant. It is at this point the trichome characters are of immense importance, in that even the very closely related species also can be distinguished by their trichome characters and this facility is not available with any other biomarker whether it is chemical or biochemical. The micromorphological characters, thus, should be a welcome addition to any taxonomic description.

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