



Research Article

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PHARMACOGNOSTIC AND ANATOMICAL STUDIES OF *ANTIGONON LEPTOPUS* HOOK. AND ARN.: A PROMISING MEDICINAL CLIMBER

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Received on: 07/12/12 Revised on: 22/01/13 Accepted on: 10/02/13

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DOI: 10.7897/2277-4343.04219

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ABSTRACT

The evaluation of quality and purity of crude drugs by means of various parameters is the most important aspect of pharmacognosy. The present study deals with pharmacognostic characterization of *Antigonon leptopus* Hook. and Arn. of the family Polygonaceae. The tubers of it are used by the tribal people as tonic and nutritious food. The parameters like micromorphological, anatomical, phytochemical and physical constants have been employed for the pharmacognostic evaluation of different parts of this plant. The stomata are of anisocytic type and amphistomatic. Stomatal indices are 11.08 and 12.13 in upper and lower surfaces respectively. Palisade ratio is 5.5. Trichomes are of both nonglandular and glandular types. Methanolic extracts of leaf indicate presence of alkaloids, flavonoids, tannins, saponins, anthraquinone, etc. Ash value and moisture content of the leaves were found to be 20.68% and 76% respectively. This study will provide some diagnostic features by which the crude drug of this plant can easily be identified.

Key Words: Pharmacognostic and anatomical studies, *Antigonon leptopus* Hook. and Arn.

INTRODUCTION

Plants have been playing a vital role in curing the diseases and ailments of human being from the time immemorial. Herbal medicines are gradually being popular for primary health care of the human's world-wide because of their efficacy, easy availability, no or very negligible side effect and low price. Approximately 2,400–3,000 medicinal plants species are in use in different Indian systems of medicine including Ayurveda and many of those plants are constantly being screened for their biological activity¹. Many of the important medicinal plants in India have pharmacognostically characterized and they have been enumerated in standard literature on pharmacognosy². It is also found that pharmacognostic studies in lesser known medicinal as well as ethnomedicinal plants are very meager. In this context, the present study has been undertaken to evaluate this lesser known ethnomedicinal plant pharmacognostically including its morpho-anatomy. The leaves of the investigated plant have been considered here in this investigation because leaves are commonly used by the tribal and common people for curing the diseases. Use of micromorphology and anatomy is now a recognized tool in the field of plant systematics³⁻⁵. Importance of epidermal characters in general and those of trichomes in particular and comparative wood anatomy are widely employed in taxonomic consideration of angiosperms⁶⁻¹⁰. Ontogeny and structure of stomata are now also considered as an important taxonomic character for many of the angiospermic taxa¹¹⁻¹⁴. Different members of the family Polygonaceae have been studied anatomically by the previous workers with special emphasis on stem and leaf epidermal micromorphology¹⁵⁻¹⁷. Chemical analysis and biological assays are very important aspects in pharmacognostic evaluation of medicinal plants¹⁸⁻²¹. The

detailed pharmacognostic study of this member of the family Polygonaceae has not yet been done. Therefore, in this investigation the foliar micromorphology, stem xylem elements, phytochemical screening and physical evaluation of this ethnomedicinally important taxon have been carried out. This investigation will provide some useful markers for identification of the crude drug obtained from the investigated climber.

MATERIAL AND METHODS

Plant Material

Antigonon leptopus Hook. and Arn.

Family-Polygonaceae

Herbarium voucher number: S.Saha 49 (Visva- Bharati Herbarium).

Common English name: Coral Vine.

Botanical characters: A large extensive handsome climber with woody base and tuberous root. Stem angled, slightly thickened at the node, finely pubescent. Leaves alternate, usually 4.5-12 × 2.6-5.5 cm, cordate-ovate or hastate-ovate, entire or undulate, obtuse or acute, mucronate, hoary, base cordate; with prominent reticulate vein. Flowers are small, showy, numerous in axillary and terminal racemes which terminate into tendrils. Perianth segments oblong-lanceolate, three outer ones larger, margin finely ciliate, 0.8-1 cm, and bright pink. Stamens are 8, filaments basally connate into a short ring. Style 3, stigma capitate. Fruits are achene, 8 mm long, conical, rounded at base. Seeds with deep longitudinal grooves.

Flowering and fruiting time: August to January.

Distribution: It is native of South America and is growing in tropical climate including India.

Table 1: Stomatal features

Plant taxa	Leaf surface	Stomatal type	Stomatal length (µm)	Stomatal width (µm)	Stomatal index (SI)	Stomatal frequency/mm ²
<i>Antigonon leptopus</i>	Upper	Strictly anisocytic	21.77	16.66	11.08	212.916
	Lower	Mainly anisocytic, few anomocytic and diacytic	22.22	17.29	12.13	238.437

Table 2: Xylem elements characters

Structure	Type	Stem	Root
Vessel Elements	Type of perforation plate	Simple	Simple
	Arrangement of perforation plate	Transverse or oblique	Transverse or oblique
	Pit	Simple	Simple
	Arrangement of pit	Oblique and alternate	Oblique and alternate
	Tail	Present	Present
	Length (µm)	145.75	177.336(type-I) 134.42(type-II)
	Breadth (µm)	75.05	39.51(type-I) 136.64(type-II)
	Frequency /mm ²	27.53	16.66
Tracheids	Wall thickening	Spiral	Pitted
	Diameter (µm)	32.95	17.143
	Frequency /mm ²	22.03	25
Fibres	Ends	Pointed	Pointed
	Pittation	Absent	Present
	Septation	Absent	Present
	Length (µm)	882.6	427.55
	Diameter (µm)	19.123	17.108
	Frequency /mm ²	60.80	62.5

Table 3: Microchemical and histochemical tests

Tests/Reagents	Tests for	Nature of changes	Degree of changes		Histochemical localization test (stem part)
			(Shoot)	(Root)	
Dragendroff's reagent	Alkaloids	Orange brown ppt	+	++	Vascular bundle, sclerenchyma.
Wagner's reagent	Alkaloids	Orange brown ppt	+	++	Epidermis, cortical, xylem, pith.
Hager's solution	Alkaloids	Yellow ppt	++	++	Cortex, vascular bundle.
Ninhydrin	Amino acid	Purple colour	+	+	Sclerenchyma
10% NaOH	Flavonoids	Magenta colour	+	+++	Xylem, cortex.
Salkowski test	Steroids and triterpenoids	Reddish-blue and green fluorescence	-	-	-
Benedict's reagent	Reducing sugars	Brick red ppt	+++	+++	Vascular bundle, pith.
Kedde reagent	Glycoside	Blue colour	++	+++	Outer layer of cortex and vascular bundle.
Iodine solution	Cellulose	Blue colour	++	++	Epidermis, cortex, vascular bundle.
10% aqueous potassium dichromate solution	Tannins	Yellowish-brown ppt	+++	+++	Cortex, vascular bundle, Hypodermis.
10% aqueous lead acetate solution	Tannins	Yellow ppt	+++	+++	Outer cortex, sclerenchyma, vascular bundle.
5% aqueous ferric chloride solution	Tannins	Greenish-black colour	+++	+++	Epidermis, cortex, vascular bundle, pith.
1% lead acetate	Saponins	White ppt	++	+++	Outer cortical layer.
Borntrager's test	Anthraquinone	Pink colour	+	++	Vascular bundle.

- = Absent ; + = Present

Habit and habitat: Perennial terrestrial climber; growing as common weed along the railway track, on the hedges, tree top and in fallow lands. Occasionally found in the gardens as an ornamental plant.

Parts used: Root tuber.

Medicinal uses: Tubers are used as tonic and nutritious food.

Chemical constituents: Information not available.

For the study of foliar epidermis, leaf samples were cleared following the Bokhari's method²². The cleared leaf samples were then mounted on the slide with a drop of 10% glycerine and 1% aqueous safranin solution and observed under compound light microscope. For wood elements study, the stem pieces were macerated following

the standard method²³; washed several times, teased with needles, stained in safranin, mounted on the slides with 10% glycerine and observed under microscope. The drawings of the foliar micromorphological characters and stem xylem elements were made with the help of camera lucida and measurements were taken with standardized ocular micrometer in each case. Finally, the leaf powder was extracted (Soxhlet extraction) with 90% methanol and these extracts were used for different chemical colour reaction tests for identification of different phytochemical groups. Physical constants and the UV fluorescence nature of the powder were studied following the standard methods¹⁹.

Table 4: UV fluorescence nature of the drug powder

Materials and treatments	In fluorescence light	In ordinary light
Shoot powder		
Powder as such (Scraped on filter paper with powder)	Reddish brown	Soil colour
Treated with 50% nitric acid	Dark maroon	Orange
Treated with 5% potassium hydroxide in water	Brown	Deep reddish brown
Treated with 1N hydrochloric acid	Nevi blue	Olive green
Treated with dilute 80% sulphuric acid	Reddish brown	Yellowish brown
Treated with antimony trichloride	Brownish red	Faded yellow
Treated with acetone	Reddish orange	Green
Treated with methanol	Lemon yellow	Light yellowish green
Treated with ethanol	Brownish orange	Green
Root powder		
Powder as such (Scraped on filter paper with powder)	Grayish green	No change
Treated with 50% nitric acid	Dark maroon	Orange
Treated with 5% potassium hydroxide in water	Blackish green	Reddish brown
Treated with 1N hydrochloric acid	Blackish green	Olive green
Treated with dilute 80% sulphuric acid	Blackish green	Yellowish brown
Treated with antimony trichloride	Faint greenish	Cream colour
Treated with acetone	Yellow lemon	Cream colour
Treated with methanol	Yellow lemon	Cream colour
Treated with ethanol	Yellow lemon	Straw colour

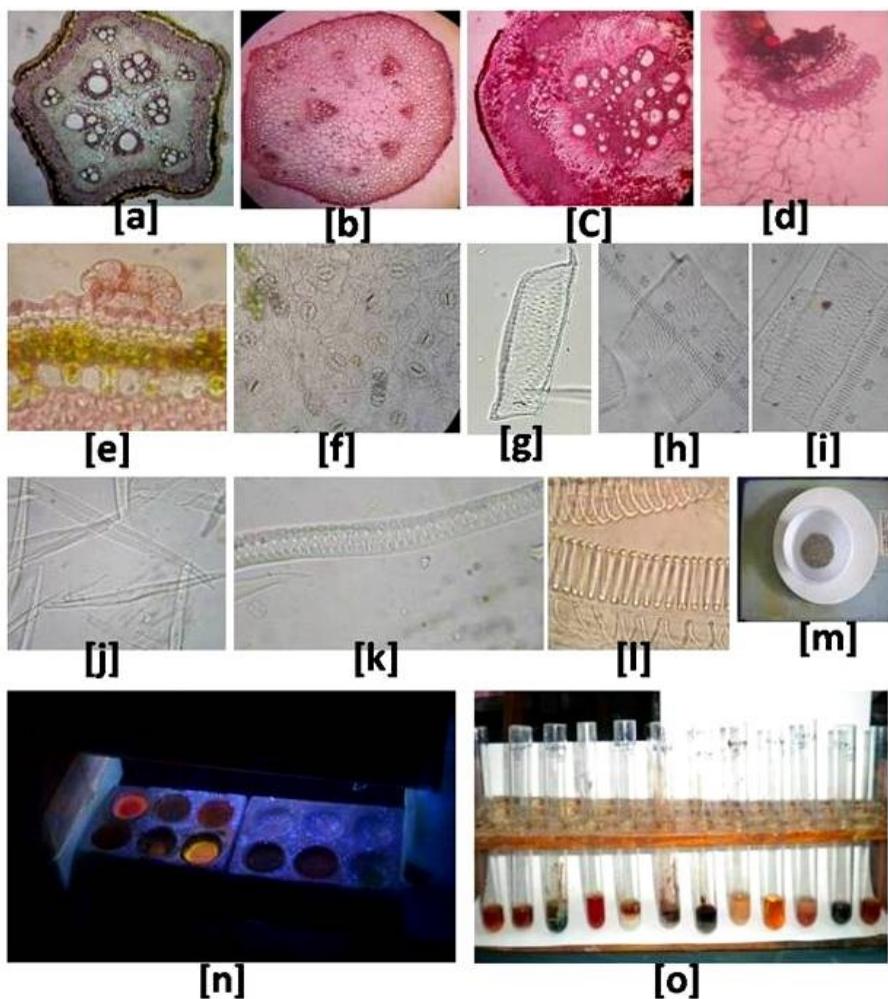


Figure [a] T.S. of stem, [b] T.S. of petiole, [c] Portion of T.S. of root, [d] Portion of T.S. of tuber, [e] Glandular trichome, [f] Lower epidermal surface, [g] Vessel element of stem, [h] and [i] Vessel element of root, [j] Portion of fibres of root, [k] A portion of tracheid of root, [l] A portion of tracheid of stem, [m] Ash of shoot portion, [n] Spot test under UV light (365nm) and [o] Colour reaction test.

RESULTS

Micromorphology

General description along with measurement of the epidermal cells, stomata, trichomes, and crystals are given below.

Epidermis: Epidermal cells are irregular in shape and cell wall outlines are strictly wavy in both the surfaces. The size of the upper epidermal cell is $43.81 \mu\text{m} \times 37.62 \mu\text{m}$ and it is $45.25 \times 25.11 \mu\text{m}$ on the lower surface. Cell frequencies in both upper and lower surfaces are $947.14/\text{mm}^2$ and $1596.92/\text{mm}^2$ respectively. Palisade ratio is 4.36.

Stomatal complex: Stomata are present on both surfaces of the leaf i.e. leaves are amphistomatic. In the upper surface, stomata are anisocytic type; whereas on the lower surface they are mainly anisocytic type along with few diacytic type stomata. Stomatal size in the upper surface is $21.7 \mu\text{m} \times 16.66 \mu\text{m}$ and in the lower surface, it is $22.218 \mu\text{m} \times 17.29 \mu\text{m}$. In the upper stomatal frequency is $212.916/\text{mm}^2$ and it is $238.437/\text{mm}^2$ in lower surface. Stomatal index is 11.08 in the upper surface and it is 12.13 in lower surface (Table 1).

Trichomes: Trichomes are of both non-glandular and glandular types. Non-glandular, uniseriate trichomes are present on both upper and lower surfaces of the leaf. Size of this structure is $35.178 \mu\text{m} \times 10.183 \mu\text{m}$. Frequency is $41.66/\text{mm}^2$. Glandular trichomes are multicellular, stalked and present on the both surfaces. The size of this structure is $47.509 \mu\text{m} \times 19.144 \mu\text{m}$. Their frequency is $20.83/\text{mm}^2$. Trichome index is 2.74.

Crystals: Small, sphaeroidal, crystals of Ca-oxalate are found in some cells of cortex and pith of the petiole. The diameter of crystals is $31.25 \mu\text{m}$ and crystal frequency is $26.04/\text{mm}^2$.

Xylem elements

General description along with measurements of the xylem elements of stem and root have been presented below.

Stem: The vessel elements are with simple, oblique to transversely placed perforation plate. Pits are simple. Tails are present in some of the vessel element. Size is $145.75 \mu\text{m} \times 75.05 \mu\text{m}$ and frequency is $60.80/\text{mm}^2$. Tracheids are with spiral sidewall thickening. Diameter of the tracheid is $32.95 \mu\text{m}$ and frequency is $22.03/\text{mm}^2$. Fibres are typically libriform type with pointed ends. Septa and pits are completely absent. Size of the fibre is $882.6 \mu\text{m} \times 19.123 \mu\text{m}$; frequency is $27.53/\text{mm}^2$ (Table 2).

Root: The vessel elements here are of two types - one type is very long ($39.51 \mu\text{m} \times 177.336 \mu\text{m}$) with narrow width and another type is very short ($136.64 \mu\text{m} \times 134.42 \mu\text{m}$) with greater width. Frequency of the vessel elements is $16.66/\text{mm}^2$. Perforation plates of the vessel elements are simple, oblique to transversely place. Here pits are simple and arranged both in opposite and alternate rows. Tails are found in some of the elements. Tracheids

are very long with pits on the sidewall. Diameter of the tracheid is $17.143 \mu\text{m}$ and frequency is $25/\text{mm}^2$. Fibres are septate with pointed ends. Pits are present. Size of the fibre is $427.55 \mu\text{m} \times 17.108 \mu\text{m}$ and its frequency is $62.5/\text{mm}^2$ (Table 2).

Stem Anatomy

The transverse section of the stem is circular in outline with 5 ridges and 5 grooves. Following tissue organization from periphery towards the center of the stem is observed (Figure a).

Epidermis: Epidermis is uniseriate with compactly arranged epidermal cells and cuticle is thin here. Both non-glandular and glandular trichomes are present on epidermis.

Cortex: The cortex is massive and differentiated into three distinct zones. The first zone is collenchymatous hypodermis of two-cell thick, lying just beneath the epidermal layer. Two layers of chlorenchyma cells are present beneath the hypodermal layer. Characteristic single layer continuous starch sheath present just below the chlorenchyma zone.

Pericycle: It is a wavy, thick layer of sclerenchyma cells present below the starch sheath. At the grooved region of the stem, the pericycle layer is four celled in thickness and it is six celled thick at the ridged zone.

Vascular bundles: They are collateral, conjoint and open type with phloem and xylem. Vascular bundles are arranged in two rings. Small vascular bundles are present at the ridged region and the larger ones are present at the grooved region of the stem. They are connected by a secondary vascular cambium ring. In the xylem, few small vessels are radially arranged.

Pith: At the centre of the stem, massive pith is present. Cells of it are very large, isodiametric and parenchymatous with profuse intercellular spaces.

Petiole anatomy: The outline of petiole in transverse section is horse-shoe shaped. Epidermis is single layered and cells are compactly arranged. Cuticle is thin. Non-glandular trichomes are present in the epidermis. 3-4 layers of collenchyma cells present just below the epidermal layer. Altogether 7 vascular bundles are arranged in 'U' shaped manner. A comparatively larger bundle is present below the open end of 'U'-shaped arrangement. Those 7 bundles are arranged in alternate manner of one smaller bundle with larger one. At the centre large parenchyma cells with intercellular spaces forming pith (Figure b).

Root anatomy: The transverse section of root is more or less circular in outline and shows following features from periphery to its centre. A few cell thick cork layer present at the periphery. Cork cells are polygonal, thick walled without any intercellular spaces. A narrow cortical zone present just below the cork layer consisting of smaller sized parenchymatous cells. Below the cortical zone, a multiseriate layer of very thick walled sclerenchymatous

zone is present that is dotted with 1-2 vessels at the periphery. Solid mass of primary xylem located at the centre. Primary xylem consists of many metaxylem and protoxylem elements which are showing the mixed type arrangement. Above primary xylem cambium cells are present in discontinuous ring (Figure c).

Tuber anatomy: The transverse section of a tuber shows a few cell thick cork layer present at the periphery. Cork cambium layer present just below the cork layer. Patches of sclerenchyma present in the cortical zone. Size of parenchymatous cells is gradually increasing towards the centre and central parenchymatous cells are very large which contain many storage substances. Intercellular spaces are profuse here among the parenchyma cells. Many small vascular patches are observed in this storage tissue mass of parenchyma (Figure d).

Microchemical evaluation of the powdered drug

Through the phytochemical tests of the methanolic extracts of shoot and root parts, some important phytochemical groups have been detected in both the cases which confirm the medicinal properties of this plant. In the shoot extract, the detected phytochemical groups are tannins, alkaloids, flavonoids, reducing sugars, saponins, glycosides, anthraquinone, etc. Among these phytochemical groups tannins are present in higher amount. The phytochemical groups detected in shoot part are found in root also. In root, the concentration of tannins, alkaloids, flavonoids, saponins, glycosides is higher than shoot (Table 3).

Histochemical Study

Histochemical study of the stem indicates presence of various phytochemical groups localized in different tissue zones of it. Vascular bundles and cortical zone of the stem are the sites where comparatively a large number of phytochemical groups have been observed than the other tissue zones of the stem. Chemical groups found in these tissue zones are alkaloids, tannins, glycosides, saponins, flavonoids, etc. (Table 3).

Physical Evaluation

Physical constant

Ash Value

- Total ash - 20.68%
- Water soluble ash – 46.42%
- Acid soluble ash – 81.48%
- Moisture Content - 76 % (in fresh form).

Fluorescence analysis

The drug powder treated with different chemical reagents gives characteristic colour when seen under UV light and it is compared with the colour observed under ordinary light. In presence of acetone, methanol and ethanol the powder drugs in ordinary light showed green, olive green and green colour respectively; but under UV light (365 nm) the same drug samples gave prominent bright reddish orange, lemon yellow and brownish orange permanent fluorescence colour respectively which are quite distinct from the colour of ordinary light (Table 4).

DISCUSSION

The present study reveals that foliar epidermal features, stem and root xylem element characters, primary phytochemical screenings and physical evaluation are of some importance in identification of this investigated plant species in its fresh as well as dried form. Some of the general anatomical characters of the investigated plant conformed to the features identified in the other members of the family Polygonaceae earlier by different workers^{15,16}.

Stomata of investigated plant are mainly of anisocytic type and sometime very rarely diacytic stomata are present on lower surface of the leaf. Studies in stomata can have a great taxonomic as well as pharmacognostic value in proper identification of different plant taxa including medicinal plants^{11,12,19}. In this plant, the differences in stomatal size and frequency on both the surfaces have been found. Stomatal frequency of the lower surface is higher (238.437/ mm²) than the upper surface. There is a marked difference between stomatal indices of upper (11.08%) and lower (12.13%) surfaces of the leaf which is a distinct feature of this plant.

Trichome features are also very important in proper identification of the plants and considered as one of the valuable taxonomic markers now²⁴. Epidermal trichomes of the investigated plant are non-glandular and glandular types. Trichome indices of the non-glandular and glandular trichomes are 20.83% and 41.66% respectively. Vessel elements of root of the investigated plant show a characteristic feature in respect of their size. One group of element is long and narrow and another one is very wide and short. Septate fibres are observed in the root which indicates a distinct feature for identification of it. The arrangement and number of vascular bundles in the petiole may sometimes provide the diagnostic feature for identification of the plant species. Here in the petiole, altogether 7 vascular bundles are found and they are arranged in 'U' shaped manner which can be used as a marker for identification of this species of Polygonaceae. Chemical analysis and biological assays are considered as important aspects in pharmacognostic evaluation of the medicinal plants^{19,21}. Through phytochemical tests of methanolic shoot extract of this plant, it is found that the important phytochemical groups like alkaloids, glycosides, flavonoids, anthraquinone, tannins, saponins, etc. are present in this plant which confirms its medicinal properties. Another phytochemical study on flowers of *Antigonon leptopus* revealed that presence of volatile oil, carboxylic acid, glycoside, carbohydrate, terpenes²⁵. It corresponds with some of the phytochemical groups observed in present study. The physical constants like ash value (20.68%), moisture content (76%) and UV fluorescence characters of the powder drug of this plant can also be used as important characters for proper identification of crude drug of it. Finally some diagnostic features have been given below which can be employed for easy identification of *Antigonon leptopus* in its fresh as well as dried form.

Diagnostic features

1. Stomatal indices of upper and lower surfaces are 11.08 and 12.13 respectively.
2. In petiole, number of vascular bundles is 7 and arranged in 'U' shaped manner.
3. Septate fibres are present in the root.
4. Ash Value- total ash - 20.68%

ACKNOWLEDGEMENT

We are very grateful to the Head, Department of Botany, Visva-Bharati, for providing the necessary laboratory facilities.

REFERENCES

1. Bhukani DS. Biologically active compounds from some Indian plants, in Proc 5th Int Soc Hort Sci Med Arot Sp Plts. Ed. SK Chatterjee. Darjeeling, India; 1985. p. 1-4.
2. Mitra R. Bibliography on Pharmacognosy of medicinal plants. Economic Botany Information Service, National Botanical Research Institute. Lucknow, India. 1985. p.1-735.
3. Rahaman CH, Ghosh A and Mandal S. Studies on ethnomedicinal uses of plants by the tribals of Birbhum district, West Bengal. Indian J Environ and Ecoplan 2008; 15 (1-2): 71-78.
4. Choudhury S, Rahaman CH and Mandal S. Studies on leaf epidermal micromorphology and wood elements of four medicinally important species of *Cassia* L. J Botan Soc Beng 2008; 62 (2): 67-80.
5. Choudhury S, Rahaman CH and Mandal S. Studies on foliar epidermal micromorphology and preliminary phytochemical screening of three medicinally important taxa of the family Vitaceae. Sci and Cult 2009; 75 (7-8): 294-300.
6. Cutler DF. In VH Heywood and DM Moore. Systematic anatomy and embryology, recent development. Current Concepts in Plant Taxonomy. London, UK: Academic Press; 1984. p.107 – 131.
7. Ogunipe OT, Olatunji OA. The leaf anatomy of the species of *Cochlospermum* Kunth. (Cochlospermaceae) in West Africa. FeddesRepertorium 1991;102:183-187. <http://dx.doi.org/10.1002/fedr.19911020306>
8. Mukherje KK, Roy M, Saha, PK and Ganguly SN. Surface morphology of tea (*Camellia sinensis* L.) leaves. Phytomorphology 2000; 50: 125-131.
9. Parveen NS, Murthy KSR and Pullaiah T. Leaf epidermal characters in *Crotalaria* sp. (Papilionoideae) from Eastern Ghats. Phytomorphology 2000; 50: 205-212.
10. Banerjee A, Rahaman CH, Kar RK and Mandal S. Micromorphology of foliar epidermis of some tropical tree legumes. Phytomorphology 2002; 52(2 and 3): 223-230.
11. Inamdar JA. Epidermal structure and ontogeny of Caryophyllaceae stomata in some Acanthaceae. Bot Gaz 1970; 131: 261-268. <http://dx.doi.org/10.1086/336540>
12. Kothari MJ, Shah GL. Epidermal structure and ontogeny of stomata in the Papilionaceae. Bot Gaz 1975;136:372-379. <http://dx.doi.org/10.1086/336829>
13. Ahmed KJ. In B Singh and M.P. Singh, Stomatal features of Acanthaceae, Structure, Function and Ecology of Stomata. Dehradun, India: DN Sen, 1979.p. 43-60.
14. Rajagopal T. Distributional patterns and taxonomic importance of foliar stomata. Indian J Bot. 1979; 2: 63-69.
15. Metcalfe CR and Chalk L. Anatomy of Dicotyledons. Vol.2. Oxford, UK: Clarendon Press; 1950.
16. Metcalfe CR, Chalk L. Anatomy of Dicotyledons. Vol.1, 2nd edn. Oxford, UK: Clarendon Press; 1979.
17. Berry E. A Standardization of *Digitalis* preparations. Pharm. J. 1919; 103: 69-71.
18. Trease GE, Evans WC. Pharmacognosy. 11th ed. London Bailliere Tindall: English Language Book Society; 1978.
19. Trease GE, Evans WC. Pharmacognosy. 12th ed. London Bailliere Tindall: English Language Book Society; 1985.
20. Evans WC. Trease and Evans' Pharmacognosy. 15th ed. London Bailliere Tindall: English Language Book Society; 2008.
21. Harborne JB, Williams CA. Recent advances in the chemosystematics of the Monocotyledons. Phytochemistry. 1994;37(1):3-8. [http://dx.doi.org/10.1016/0031-9422\(94\)85004-6](http://dx.doi.org/10.1016/0031-9422(94)85004-6)
22. Bokhari MH. Morphology and Taxonomic significance of foliar sclereids in *Limonium*. Notes Royal Bot Gard. 1970; 30: 43-53.
23. Johansen DA. Plant Microtechnique. New York:Mc Graw-Hill, 1940.
24. Leelavathi PM, Ramayya N. Structure, distribution and classification of plant trichomes in relation to taxonomy II. Caesalpinioideae, Indian J For. 1983; 6: 43-56.
25. Bolla ND, Bhogaballi PK. Preliminary Phytochemical Screening and Antibacterial Studies of the Flowers of *Antigonon leptopus*. Annals of Biological Research. 2010; 1 (4): 229-233.

Cite this article as:

Saha Sathi and Rahaman Chowdhury Habibur. Pharmacognostic and anatomical studies of *Antigonon leptopus* Hook. and Arn.: A promising medicinal climber. Int. J. Res. Ayurveda Pharm. 2013; 4(2):186-191

Source of support: Nil, Conflict of interest: None Declared