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PHARMACOGNOSTIC STUDY OF *ASCLEPIAS CURASSAVICA* LINN.

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ABSTRACT

Asclepias curassavica L. (Family : Asclepiadaceae), commonly known as 'Kakatundi' is an important Ayurvedic drug used as emetic, astringent, anthelmintic and a remedy in piles and gonorrhoea. All the parts are used in the indigenous system of medicine. The present investigation deals with the macro-microscopical structure of the leaf, micro chemical tests, quantitative study, study of the powdered drug, fluorescence analysis and determination of physical constant values. Leaf is dorsi-ventral, stomata present on both the surfaces. Latex is present in laticifers.

Asclepias curassavica L. (Family : Asclepiadaceae) is a perennial herb indigenous to West Indies and South America. This plant is often grown in gardens and has naturalized in many parts of India. Information has been obtained from various regional circles of Botanical Survey of India and also from Central National Herbarium, Calcutta, that this plant occurs in Sikkim, Bengal, Assam, Meghalaya, Manipur, Nagaland, Uttar Pradesh, Himachal Pradesh, Punjab, Maharashtra, Tamil Nadu, Karnataka and Kerala, *i.e.* almost throughout India from sea-coast to the temperate Himalayas upto about 2000 m. The flowering and fruiting take place from January to December depending on the locality.

It is commonly known as 'Kakatundi' (Hindi & Sanskrit) 'Kurki' (Marathi) and 'Bankarpas' (Bengali). In Jamaica, it is called 'Blood flower' owing to its efficacy in dysentery. West Indian colonists called it 'Bastard or Wild ipecacuanha', (Chopra *et al.*, 1949; 1958). All the parts of the plant *viz.* roots, stems, leaves and flowers are used in the indigenous system of medicine. Bhandari (1946), Sharma (1956) and Nadkarni (1954) have regarded *Asclepias curassavica* as 'Kakatundi' of Ayurveda. The whole plant is considered as emetic, styptic, purgative and the root is used as astringent and a remedy in piles and gonorrhoea. The juice of leaves is used as anthelmintic, sudorific for arresting haemorrhages and gonorrhoea. A significant *in vitro* inhibitory activity against the human carcinoma cells of nasopharynx has been shown by the extract of this plant from Costa-Rica and Mexico. The plant latex has laso been reported to be bactericidal. The United States Pharmacopoeia in various revisions has recognized the roots of three species of *Asclepias* (Hassan, 1952; Chopra, *et al.*, 1958; O'shaughnessy, 1841; Dutt, 1922; Sharma, 1954; Biswas & Ghosh, 1951; Bhandari 1946).

The drug has been the subject of good deal of chemical and pharmacological inevstigation. Dymock (1891) reported that Dr. Guimaracs (1881) found it to act directly upon the organic muscular system and especially upon the heart and blood vessels causing great constriction of the latter and distension of the larger arteries. It contains Vincetoxin and an active principle named asclepine or asclepiadine, a yellow amorphous glycoside, which is, when fresh soluble in water and emetic in action. Roots act first as purgative and subsequently astringent

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(Chopra, *et al.*, 1969). From the leaves of this plant of Brazilian origin, Tschesche *et al.* (1958, 1959) reported the isolation of four new cardenolides-clepogenin, asclepogenin, curassavogenin and ascurogenin along with uzarigenin, corotoxigenin, coroglaucigenin and a glycoside, uzarin. Kupchan *et al.* (1964) isolated calotropin, a glycoside of calotropagenin, as the cytotoxic principle of this plant. Another glycoside, curassavicine, has been reported from this plant grown in subtropical zones of Yunan, China. Singh & Rastogi (1969) reported, that the alcoholic extract of this plant showed a high order of cardiotonic activity. Further in 1971, they have worked out on the structure of Asclepin and some observations on the NMR-spectra of calotropis glycosides. Patnaik and Dhawan (1971) compared the pharmacological actions of Asclepin, a new glycoside from *Asclepias curassavica* with several known glycosides like digoxin, lanatoside c, peruvoside etc. in several species of animals. A single dose of Asclepin persisted upto 96 hours (35%) while digoxin persisted only upto 72 hours (32%). The cumulative toxicity of Asclepin was lower than that of digoxin. It showed spasmogenic activity in isolated guineapig ileum preparation at 10^{-8} g./ml.

In view of the importance of *Asclepias curassavica*, Hassan *et al.* (1952 a & b) studied the toxicology, pathology, pharmacology and chemistry of this genus and conducted pharmacognostical investigation and histological studies on the roots of six species of *Asclepias*. A greater part of their investigation deals with the comparative histology of the roots and stem. They have also worked on the gross characteristics and histological features, palisade ratio and vein islet numbers of the leaves of *A. tuberosa, A. sepioca, A. incarnata* and *A. curassavica*.

It is worth mentioning that data with regard to palisade ratio and also vein-islet numbers as observed in the present investigation differ with that of Hassan *et al.* (1952 a & b). While they have reported 4.00, 4.00 and 4.50 as the palisade ratio for base, middle and apex respectively, the readings recorded in the present investigation are 5.00, 6.75 and 3.50. The figures for vein-islet numbers for the base, middle and apex have been reported by them to be 13.00, 13.20 and 13.70 respectively while the present investigation shows figures of 8.00, 7.00 and 9.00 for the corresponding regions. The authors' figures are based on the study of the materials collected at different places in India as detailed under material and methods.

Certain details as observed in the present investigations, supplement the data known so far and suitably illustrate the same. These include a comprehensive macroscopical study of the leaf, some microscopical details of the leaf, study of the powder, fluorescence analysis and physical constants of the powdered drug. The results have been enumerated in Tables.

MATERIAL AND METHODS

Plant materials of *Asclepias curassavica* were collected at different places in India, *viz.*, Agastmuni (Mandakini valley, Garhwal Himalaya. 700 m, 11.6.1972, Coll. no. 3691); Khandala (880 m, 23.3.1970, Coll. No. 2427); Garhi, Dehra Dun (650 m, 18.8.1964, Coll. No. 437) collected by *B. N. Mehrotra*; Coorg (*S. L. Nayar* 4223). All the specimens are lodged at the herbarium of Central Drug Research Institute, Lucknow. Fresh leaves were also obtained from plant growing in the campus of CDRI, Lucknow.

The macro- and microscopical structures of leaf were studied. Quantitative study of the leaf, such as palisade ratio, vein islet numbers and stomatal indices were determined. The histochemical tests were performed according to Johansen (1940) and Kay (1938). The study of the powder was done and the behaviour of powder on treatment with different chemical reagents was

observed (Table II). The fluorescence characters of the powdered drug were observed under ultra-violet light according to the method given by Chase and Pratt (1949) and Kokoski *et al.* (1958). The extractive values were determined by the method given in Indian Pharmacopoeia (Ann. 1966).

Macroscopical structure (Plate I): The leaves are opposite or whorled upto 11 cm by 2.5 cm or so, oblong-lanceolate, thin, membranous, narrowed at both the ends, but pointed towards apex with dried tip and entire margin, softly pubescent on both surfaces, more on midrib and margin.

Plate I: A twig of *Asclepias curassavica*

Lateral vein 13-20 pairs and anastomosing near the margin. The upper surface is green but pale beneath. Texture is soft silky while fresh, but papery herbaceous on drying. Taste sharp, slight bitter afterwards, odourless. Petiole 5-7 mm, pubescent.

Microscopical structure (Plate II, Figs. 1-8): A transverse section of the petiole shows a concavo-convex outline. The epidermal cells are thick-walled and cubical in shape, externally covered with thick cuticle. Some of the epidermal cells elongate to form uniseriate multicellular, trichomes 2-4 celled long. The epidermis is followed by 4-5 layers of collenchyma and the rest of the layers are parenchyma. The parenchymatous cells are tangentially elongated and few cells towards the stele are collapsed. They form a continuous layer. The stele consists of crescent shaped vascular bundles. The xylem occupies the central position of the bundle, consisting of spiral and reticulate type of vessels, tracheids and parenchyma. Intra-xylary phloem is present consisting of sieve tubes, companion cells and phloem parenchyma. The cambium is present in between the xylem and phloem. Laticifers in singles containing latex are present in the cortex and phloem region Rosette crystals of calcium oxalate are scattered in the parenchyma (Fig. 5).

Mid-Rib (Figs. 2-8): Midrib represents a concavo-convex structure. The epidermis is externally covered by thick ridged cuticle. The epidermal cells are slightly smaller than those of petiole, some of these elongate to form non-glandular trichomes like those of the petiole. On the ventral side, near the centre, below the epidermis is 3-4 layers of collenchyma, followed by 4-5 layers of parenchyma. While in the rest of the portion towards the arm, the palisade layers in continuation with mesophyll are present. On the dorsal side, there is 5-6 layers of collenchyma. A few layers of parenchyma just below the collenchyma consist of compressed cells forming almost a continuous layer. These cells are irregular in shape and tangentially elongated. Laticifers in singles containing latex and rosette

crystals of calcium oxalate are present in the parenchymatous region. An arc of vascular tissue appears near the centre of the midrib. It consists of bi-collateral bundle consist-

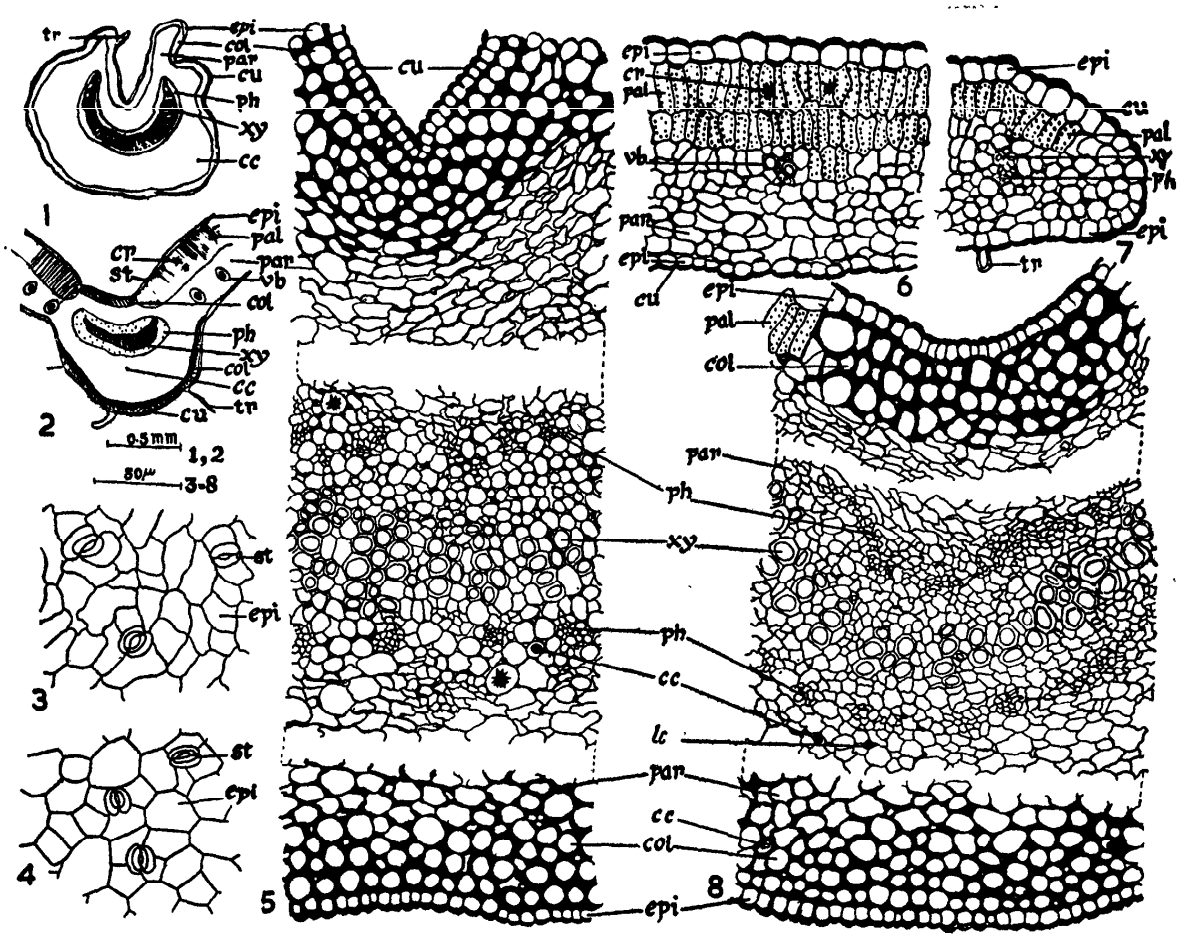

Plate II: Figs. 1-8: Transverse section of *Asclepias curassavica* showing microscopical characters.

1. Diagrammatic representation of t.s. of the petiole. 2. Digrammatic representation of the t.s. of leaf. 3. Upper surface of the leaf showing stomata. 4. Lower surface of the leaf showing stomata. 5. A portion of the t.s. of petiole showing detail structure. 6 & 7. A portion of the t.s. of leaf passing through the laminar region showing detail structure. 8. A portion of the t.s. of leaf passing through the midrib region showing detail structure. col, collenchyma. cc, cell contents. cu, cuticle. cr, crystals. epi, epidermis. lc. laticiferous cell. par, parenchyma. pal, palisade cells. ph, phloem. st, stomata. tr, trichome. vb, vascular bundle. xy, xylem.

ing of usual elements of xylem and phloem. The laticifers are distributed in the phloem region. They are thin walled, non-articulated and contain latex.

Lamina (Figs. 2, 6, 7): The leaf presents a dorsiventral structure. The transverse section passing through the laminar region, shows a single layer of epidermis, surrounded by thick cuticle on each surface. 1-3 layers of palisade cells just below the upper epidermis are present. The epidermal cells are tangentially elongated. Stomata are present on both the surfaces. They are mainly ranunculaceous surrounded by 3-5 subsidiary cells or rubiaceous. Twin stomata, half stomata and giant stomata are also observed. In surface view, the epidermal cells are straight-walled and polygonal in shape on the upper surface (Figs. 3-4). The epidermal cells elongate to form glandular and non-glandular trichomes (Plate III, Figs. 1-2). The trichomes are uniseriate, multi-cel-

lular 2-4 celled. Mesophyll consists of 1-2 layers of palisade cells and 4-8 layers of spongy parenchyma traversed by vascular bundles. The spongy cells are more or less

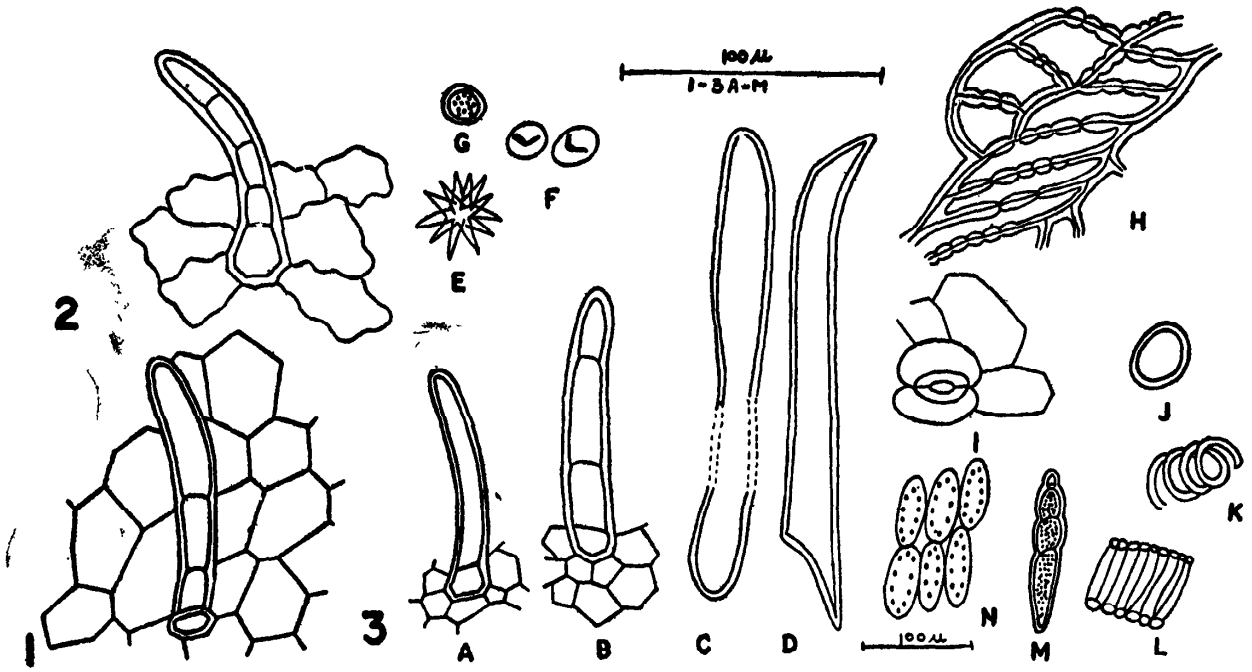

Plate III: Figs. 1-3: Trichomes and powder of *Asclepias curassavica*

1-2. Trichomes in surface view. 3. A-N-Powder showing different tissues. A-B-Trichomes. C-D-Fibres. E-Crystal. F-Starch grains. G-Laticiferous cell. H-Thickwalled parenchyma. I-Stomata. J-Thickwalled cell. K-L-Vessel. M-Glandular trichome. N-Palisade cells.

isodiametric with inter-cellular spaces. Laticifers are present in this region. The mesophyll consists of only parenchymatous cells at the margin. Running through the mesophyll are found bigger and smaller veins in various planes. The veins are mostly embedded and the larger ones are usually trans-current.

Cell contents: The latex is present in the laticifers. Rosette crystals of calcium oxalate are present in the lamina as well as petiole.

QUANTITATIVE STUDY

The leaves were subjected to quantitative determinations *viz.* palisade ratio, stomatal index, stomatal number, epidermal number, vein islet and vein termination numbers. The data are enumerated in Table I.

TABLE I : *Determination of quantitative values*

	Base	*Middle*	*Apex*	*Range of variation*	*Average value of species*
Palisade ratio	5.00	6.75	3.50	3-7	5.83
Stomatal index (Lower epidermis)	14.79	14.93	5.32	5-25	11.68
Stomatal index (Upper epidermis)	19.64	11.54	16.92	8-20	16.33
Epidermal cells/sq. mm (Lower epidermis)	19.17	16.68	17.95	16-19	17.96
Epidermal cells/sq. mm (Upper epidermis)	22.00	10.25	11.80	10-22	14.68
Vein-islet numbers	8.00	7.00	9.00	7-9	8.00
Vein termination numbers	21.00	20.00	21.33	20-21	20.44

EXAMINATION OF POWDERED LEAF

Powdered leaf is blackish green in colour, odour indistinct with astringent taste. Microscopically it shows fragments of epidermal cells, palisade tissue, fibers, vessels and thickwalled parenchymatous cells. Unicellular as well as multicellular nonglandular and glandular trichomes, giant-stomata and cells containing tannin, starch grains and crystals of calcium oxalate are also present. The behaviour of powder on treatment with different chemical reagents has been recorded in Table II.

TABLE II : *Behaviour of powdered leaves on treatment with different chemical reagents*

Sl. No.	*Reagents*	*Behaviour of powder*
1.	Picric acid	No change
2.	Lactic acid	Reddish brown
3.	Nitric acid (sp.gr. 1.42)	No change
4.	Hydrochloric acid (sp. gr. 1.16)	Brown
5.	Sulphuric acid (80%)	Blackish brown
6.	Acetic acid	Black with yellow tinge
7.	Ferric chloride (5% Ag. Soln.)	Black
8.	Iodine solution	Dark brown
9.	Sudan III	Red

FLUORESCENCE ANALYSIS

Powders of the leaves were examined under ultra-violet light and the fluorescence characters were recorded in the Table III.

TABLE III : *Fluorescence character of the powdered leaf of Asclepias curassavica**

S. No.	*Treatment*	*Fluorescence*	*Colour/Range**
1.	Powder as such	Strong yellow green	7.5 gy 6/8
2.	Powder mounted in nitro cellulose	Strongly yellowish green	10.0 gy 6/9
3.	Powder treated with NaOH in methanol	Strong yellowish green	5.0 gy 7/10
4.	Powder treated with NaOH in methanol, dried and mounted in nitro-cellulose	Strong yellowish green	10.0 gy 6/9
5.	Powder treated with HCl	Strong yellowish green	7.5 gy 6/8
6.	Powder treated with HCl, dried and mounted in nitro-cellulose	Strong yellow green	7.5 gy 7/9
7.	Powder treated with NaOH in water	Strong yellow green	7.5 gy 7/9
8.	Powder treated with NaOH in water dried and mounted in nitro-cellulose	Strong yellow green	10.0 gy 6/9
9.	Powder treated with nitric acid diluted with an equal volume of water	Strong yellow green	7.5 gy 7/9
10.	Powder treated with H_2SO_4 diluted with an equal volume of water	Strong yellow green	7.5 gy 7/9
11.	Powder treated with antimony trichloride	Storng yellow green	7.5 gy 6/8

*According to Nickerson colour fan published by Munsell Colour Co., 1957.

PHYSICAL CONSTANTS

The total and acid insoluble ash values, alcohol and water soluble extractive values are determined and recorded in Table IV.

TABLE IV : *Determination of Physical constants*

	Percentage
Total ash	14.66
Acid insoluble ash	1.23
Alcohol soluble extractive	0.80
Water soluble extractive	15.7

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