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Status of Family Asclepiadaceae in Rajasthan

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ABSTRACT

The Asclepiadaceae are mostly herbs and shrubs with white sap comprising about 250 genera and 2,000 species, many of which are lianous and some of which are cactuslike succulents with reduced leaves. The leaves are simple and nearly always opposite or whorled; minute stipules are present. The flowers are bisexual, nearly always actinomorphic, and usually include an elaborate crown or corona of nectariferous appendages between the corolla and sexual parts. The calyx consists of 5 distinct or basally connate sepals. The inner perianth is a 5-lobed sympetalous corolla. The androecium and gynoecium are nearly always adnate into a gynostegium with five highly modified stamens and a massive, 5-lobed stigma. The anthers usually produce paired sacs of pollen called pollinia that are transferred as a unit during pollination. The gynoecium consists of a single compound pistil of two nearly distinct carpels that are separate at the level of the ovaries and styles and are united only by a single massive stigma. The ovaries are distinct, nearly always superior, and each has a single locule with numerous marginal ovules. The fruit is a follicle. Seeds usually have a tuft of hairs at one end. The present study deals with status of family Asclepiadaceae in Rajasthan.

KEYWORDS: *asclepiadaceae, rajasthan family, herbs, shrubs, flowers, seeds, stigma, locule, pollinia*

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INTRODUCTION

Rajasthan is the largest state in India, geographically lies between 23°3' to 30°12'N longitude and 69°30' to 78°17'S latitude and is rich in diversity of medicinal plants1. Numerous literatures show the medicinal values of different plants standing from the age of Vedas. A lot of work has been also been done on ethnomedicinal plants used for various ailments by different tribal communities and researchers in Rajasthan.

Gymnema sylvestre belongs to family Asclepiadaceae, is also known as 'gurmar' or 'sugar destroyer' (If the leaves of the plant are chewed, the sense of taste for sweet and bitter substances is suppressed). *Gymnema sylvestre* is a slow growing, perennial, medicinal woody climber found in Rajasthan. The bioactive compounds of plant have antidiabetic, atherosclerotic, antimicrobial, antiarthritic, antibiotic, hypolipidaemic, immunostimulatory, hepatoprotective, anti-hyperglycemic, antipyretic, diuretic, anti-inflammatory, wound healing and anticancer properties.[1,2]

Gymnema sylvestre is a traditional medicinal plant, with reported use as a remedy for diabetes mellitus, stomachic and diuretic problems. Its use has been indicated in adenopathy, cough, asthma, alexipharmic, anthelmintic, astringent, biliousness, bronchosis, cardiopathy, conjunctivosis, cornea, dysuria, digestive, emetic, expectorant, fever, furunculosis, glycosuria, hemorrhoid, hepatosplenomegaly, inflammation, jaundice, leukoderma, rheumatismopacities, ophthalmia, and worm. The roots of *Gymnema sylvestre* has also been used in snake bite, boil, constipation, and water retention, epilepsy, pain, high cholesterol, IDDM, NIDDM and obesity.

Gymnema sylvestre

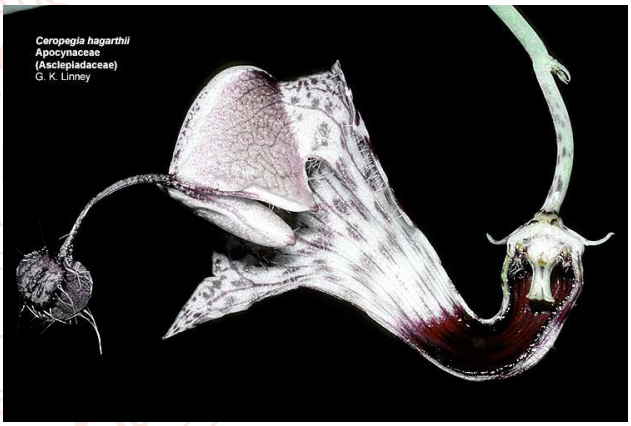
Calotropis procera

Asclepias speciosa, milk weed. The opposite leaves and copious white sap seeping from damaged leaf. These are typical flowers for the family. Note the reddish reflexed corolla lobes. The very tips of 2 or 3 sepals are scarcely visible between corolla lobes. Just above the short corolla tube is the whorl of hooded and horned appendages that make up the corona. The green and pink gynostegium is in the center of the flower. One of the five grooves of the gynostegium in the central flower is clearly visible. The pair of pollen sacs and the connecting gland that was present in this area of the gynostegium has been removed by a visiting insect. The gland would have been directly above the groove and it would have been attached to one pollen sac in each of the depressions visible on each side and slightly above the groove. The gland in the next counterclockwise position is still in place and is barely visible on the right side of the tip of the lower right coronal horn

Asclepias speciosa

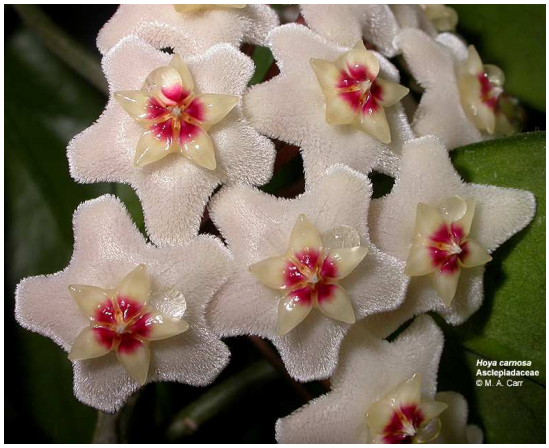
Calotropis gigantea, crown flower. The "crown" of this flower is used in leis. The dark gland at each of the 5 points around the massive stigma is attached to two pollen sacs, one from each of two adjacent anthers. *Calotropis procera*, small crown flower.

Ceropegia haygarthii. Zygomorphic flowers such are this are rare in the family. The corolla on this one has been sectioned to reveal the gynostegium deep inside the tube. The pollination syndrome in this case includes trapping the visiting insect for a period of time. Note the milky sap oozing from the cut surfaces.[3,4]



Ceropegia haygarthii

Hoya bicarinata, wax plant, pua-hoku-hihi. Vine from S. China with roots appearing along the stems. Leaves shiny, thick; flowers in clusters at leaf axils, fragrant, waxy, used for leis. *Hoya carnosa,* wax flower. In this species the corollas are fuzzy and the waxy coronas partially obscure the gynostegium. The glands connecting adjacent pollen sacs are visible as tiny dark specks in the grooves between the coronal appendages.



Hoya carnosa

Stephanotis floribunda. This sweetly scented vine has tubular flowers that hide the gynostegium. It may be seen in the cut-away view in the second photo. The ant in the third photo is "trapped" on the gynostegium; one leg is stuck in each of two of the grooves. It is apparently not strong enough to free itself by dislodging the pollinia attached to the glands at the narrow end of the grooves.[5,6]

Stephanotis floribunda

Discussion

Asclepiadaceae is also known as milky weed family. As per APG II, family Asclepiadaceae is now treated as a subfamily Asclepiadoideae under family Apocynaceae. APG stands for Angiosperm Phylogeny Group, which is an informal international group of systematic botanists who work together for an agreement on the taxonomy of flowering plants as per the latest phylogenetic studies.

Number of genera: This family includes 384 genera and about 2900 species

Propagation type: Fruit (dehisced) or seed

Distribution: The members of this family are widely distributed in tropical and sub-tropical regions of the world. They are especially found in the drier parts of Africa and South America. In India this family is represented by 53 genera and about 250 species. These plants occur mostly in Himalayas, southern and western India.

Vegetative characters

Habitat: Members of this family are mostly mesophytes and some xerophytes are also known in this family.

Habit: These plants are perennial herbs *(Asclepias),* Shrubs *(Calotropis)* or woody climbers *(Tylophora, daemia, Leptademia). Dischidia,* is an epiphytic climber. Sometimes the plants are succulent *(Hoya)* or xerophytic with Cactus like habit *(Stapelia).*

Root system: The members of this family have tap root system. Perennial root stock is commonly present and sometimes the roots are fleshy and tuberous.

Stem: Stem is erect, branched and woody in lower portions. The vascular plants are bi-collateral and the plants contain milky juice present in branching laticiferous tubes.

Leaf: The leaves are opposite, decussate, simple entire and extipulate. In Xerophytes (*Stapelia)* leaves are reduced to spines or scales. A thick waxy covering is found on the leaves of *Calotropis procera.* The petiole is pulvinous in *Cryptostegia grandifolra.* In *Dischida,* one of the pair of leaves is modified into a pitched to collect debris and water.

Floral characters

Inflorescence: The inflorescence is usually a dichasial cyme, arising in the leaf axil or sometimes it is a racemose or umbellateas in *Asclepias* and *Calotropis*.[7,8]

Flower: The flowers are perfect, hermaphrodite, bracteates, bracteolate, complete, bisexual, actinomorphic, pentamerous and hypogynous. The flowers are comparatively large in *Stapelia*.

Calyx: The calyx consists of five sepals which are united below to form short calyx tube. It shows imbricate or valvate type of aestivation.

Corolla: The corolla has five united petals (gamopetalous) which may be rotate (*Calotropis*) or companulate or funnel form. They show valvate or twisted aestivation. The corolla tube is in the form of corona with ring of hairs or scale. In *Ceropegia* the straight or curved corolla is swollen at the base. The corolla lobes are valvate or generally twisted to right. The corolla tube is with a corona which is in the form of a ring of hairs.

Androecium: Stamens are five, epipetalous and inserted at or near the base of the corolla tube. The filaments may be free or may be united to form a tube round the style.

Gynoecium: The gynoecium is bicarpellary and the ovaries of the two carpels are free. The styles are united at their apices and the stigma has five lateral surfaces. The ovary of each carpel is unilocular with single placenta bearing numerous anatropous pendulous ovules. The placentation is marginal.

Pollination: The flowers are perfectly adapted for entomophily or pollination by insects. The pollination mechanism in this family is unique in many ways in view of complicated structure of the flower.

In subfamily Periploceae, the pollen is transferred on to the spoon shaped translators which have a sticky basal disc. The insect while returning from the flower carries the whole translator. The pollen contents may

get deposited on the stigmatic surface when the same insect visits another flower.

In subfamily Euasclepiadeae, the insect visiting the flower for nectar traps its legs or proboscis between the osmotically elastic anther wings. The insect while returning carries the sutured corpusculum along with pollen. When this insect visits another flower, the pollen is transferred to the receptive surface of the stigma.

Fruit: The fruit is of two follicles which are close together or divergent. They vary in shape and are membranous to woody.

Seed: The seeds are flattened and commonly bear a terminal tuft of white long silky hair. They help in dispersal. The endosperm is dense and embryo is large.[9,10]

Implications

In Rajasthan, maximum usage is of *Calotropis* is a large, bushy shrub with decussate, obovate, coriaceous, auriculate, leaves with acute, subsessile apices extraaxillary, umbellate, panicale inflorescene with purple corolla and erect lobes. The morphological studies revealed the leaves to be subsessile, 6-15 cm by 4.5-8 cm, broadly ovate, ovate-oblong, elliptical, or obovate, acute, pubescent when young and glabrous on both sides on maturity. By virtue of their photosynthetic machinery, leaves serve as a sink for several metabolites and as an important source of several bioactive compounds. The macroscopic and microscopic evaluation of leaves of *Calotropis procera*, the quantitative estimation of leaf constants, ash values, and fluorescence, and preliminary phytochemical screening of the leaf powder would be of considerable use in the identification of this drug. Empirical knowledge about medicinal plants plays a vital role in primary health care and has great potential for the discovery of new herbal drugs. These findings may be useful to supplement existing information with regard to the identification and standardization of *Calotropis procera*, even in the powdered form of the plant drug, to distinguish it from substitutes and adulterants. These studies also suggested that the observed pharmacognostic and physiochemical parameters are of great value in quality control and formulation development. In conclusion, the present study may be useful to supplement information with regard to its identification and, standardization, and in carrying out further research and revalidation of its use in the Ayurvedic System of Medicine.[8,9]

Results

Extraction of tubers of *Ceropegia bulbosa* Roxb. var. lushii (Grahm) Hook.f. at accelerated pace in the past quarter of the century has marginalized this narrow endemic species of Asclepiadaceae family in the Indian desert. It is medicinally important, the tubers are nutritive and edible and the leaves are digestive and a cure for dysentery and diarrhea. In order to know its present status, an extensive survey was undertaken for five years (2009-14) using remote sensing and ground truthing. A base map was prepared using GIS open source software Quantum GIS 16 using GPS survey collection points, requiring GIS layers to create map. GIS layers of areas of occurrence were created. This map along with topographic sheets of 1:50,000 were used for field traversing and ground truthing. This data was plotted on this map to show its distribution and density. Within these potential sites, field traverses were undertaken to locate its occurrence where its sampling revealed its subdominant status. A map showing its distribution revealed shrinking in its area of occurrence.

Sarcostemma viminale (L.) R.Br. and *Ceropegia bulbosa* Roxb. belongs to the milkweed family i.e. Asclepiadace, distributed in various habitats in semi-arid region of Thar desert of Rajasthan. This work was carried out to explore morphological pecularities of whole plant of both the representatives of the family. *Sarcostemma viminale* (L.) R.Br. is used to cure diarrhoea, oedema, stomach problems and tuberculosis. *Ceropegia bulbosa* is used to cure deafness, tubers are used in the treatment of kidney stone, urinary tracts diseases and they are eaten by ladies to enhance fertility and viability. Pollinial apparatus is a signifi cant feature of Asclepiadaceae to characterize species and genera. Morphological study revelaed principle characteristic differences and similarities in both the representatives plants. True xerophytic features of *Sarcostemma viminale* (L.) R.Br. are, presence of milky latex, highly reduced leaves, green globarous stem, and strong tap root affi xed fi rmly in stony and rocky substratum in association with other xerophytic plants of stressed conditions. *Ceropegia bulbosa* Roxb. var. bulbosa and var. lushii (Grah.) Hook.f. is perennial, twining, herb of sandy substratum, bearing tubers, needs support of other xerophytic bushes/ shrubs. Both the representative genera under study are almost endangered. Since no report on systematic and comparative morphological analysis of whole plant of both the representatives is available, an effort has been made to prepare a protocol to provide the keys for taxonomy and better understanding of flora.[10]

The family Asclepiadaceae is unique due to the presence of pollinia and milky latex. Present investigation reveals several interesting

morphological similarities and differences in both plants belonging to same family, even some differences have been observed in two varieties of same genus i.e. *Ceropegia bulbosa*. The author has reported differences right from habitat that occurs till seed formation. All the plants under study have successfully adapted to harsh and stressed climate by showing remarkable adaptation like leaf less condition, lanceolate-linear leaves reducing transpiring zone, green stem substituting the absence of leaves. Twinning habit also protects them against strong winds of Thar. Thick texture of leaves of *Ceropegia* supports them against high wind currents. *Ceropegia* is therefore example of a large genus that has diversifi ed despite an apparently functionally specialized *Sarcostemma* is a genus that shows peculiar morphological features to adapt in Thar desert. We always have reported it growing in association with *Euphorbia caducifolia*, most probably it facilitates *Sarcostemma* for its survival and shows commensalistic relationship. Rationale of this 'proxy' is Darwins idea that congeneric species are similar in many habits and constitituation, have high overlapping niches and therefore compete more strongly than species of distant genera. It has been demonstrated that most species germinate well at conspecific and congeneric sites and less well at confamilial and distant relative sites. Leaf less habit, photosynthetic substitution, presence of more amount of latex, strong tap root and rocky - stony habit preference are some of the strategies that the plant adapt to stay in stressed climatic conditions. Both the plants under study are typically endangered so they need most care and conservation. Recently *Ceropegia* species have attracted attention of several workers due to its rare occurrence, it is difficult to propagate, cultivate and maintain in gardens and hence its conservation is a major challenge to biologists (Sagar et al., 2014). Once the description of plant forms is available then the role played by genes and proteins in the maintenance or stability of shapes will be better understood, it strongly needs an elaborative and theoretical approach towards morphology rather than sophisticated experimentation that may be required later on to unveil molecular status.[11]

Conclusion

Sarcostemma viminale (L.) R.Br. (Asclepiadaceae), an endangered medicinal plant distributed in various habitats in semi-arid region of Thar Desert of Rajasthan. Present study is focused on the extraction of bioactive compounds from the flowers of this plant by Gas chromatography mass spectrometry (GC-MS) using Methanol and chloroform as solvents. Flowers were collected from hilly and stony regions from xeric and harsh conditions of Indian Thar Desert of Rajasthan, during the month of July-September. The phytochemical compounds were investigated using Perkin-Elmer gas chromatography-mass spectrometry, while the mass spectra of the compounds found in the extract were matched with the National Institute of Standards and Technology library. Maximum % area is found for 24-Norursa-3, 12-diene is present in maximum amount (26.25%) with retention time (RT) =39.441 min, followed by Tetracontane (20.68%) with RT=30.275min in the methanolic extract. Lup-20(29)-en-3-ol, acetate, (3.beta.)- is present in maximum amount (35.70%) with retention time (RT) =38.569 min, followed by Tetracontane (15.24%) with RT=29.678 min in the chloroform extract of flowers of *Sarcostemma viminale* (L.) R.Br. Flowers of *Sarcostemma viminale* (L.) R.Br. shows important pinpoint pharmacological activity. These bio-active constituents can be used by pharmaceutical or other drug designing industry to find a novel drug and pharmacologically active constituents justifying the use of this plant to treat many ailments.[12]

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