



Morphological, organoleptic and powder microscopic studies in *Cosmostigma cordatum* (Poir.) M. R. Almeida

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Abstract

Cosmostigma cordatum (Poir.) M. R. Almeida, Apocynaceae is a twining climber, it is used in Ayurvedic and traditional medicine in a number of countries. Traditionally this plant used for the treatment of ulcerous sores, dyspepsia, wounds, chronic fever, diabetes etc. Its leaves are used by tribals as a vegetable. The objectives of the present study were to describe and analyse the morphology, organoleptic characters and powder microscopy of *C. cordatum*. The results showed that the characteristics of plant morphology were in accordance with the existing description in literatures. Characteristics of inflorescence are specific characters of morphological aspect of this plant. In powder microscopy, it was observed that multicellular trichomes of falcate type, epidermal fragments (upper and lower), calcium oxalate crystals (rosette and prismatic), starch grains, xylem vessels with spiral and pitted thickenings, fibres, brown contents etc. were seen in the leaf powder. In the leaf powder analysis, it was observed that anisocytic stomata in the lower epidermal fragments. Therefore, the results based on the morphological, organoleptic and powder characteristics can serve as useful parameters for the proper identification of the drug and will validate the use of plant in traditional medicine.

Keywords: *Cosmostigma cordatum*, falcate trichome, calcium oxalate crystal, rosette crystal, prismatic crystal, pitted vessel, spiral vessel, lignified fibres

Introduction

Each plant has a specific quality and can be used to treat a disease. *Cosmostigma cordatum* is a climber found in moist deciduous and deciduous forests, small forests and grasslands in the Western-Eastern Ghats of India. It is commonly known by the name *Cosmostigma racemosum*. The plant has been used in traditional medicine for various therapeutic purposes. It is a medicine for ulcers in traditional medicine. *Cosmostigma cordatum* is a green milk weed climber found in almost all districts of Kerala. In Malayalam it is referred to as Vattuvalli or Vattolam ^[1].

The homotypic synonyms of *C. cordatum* are *Hemidesmus cordatus* (Poir.) Schult. and *Periploca cordata* Poir. The heterotypic synonyms are *Aclepias racemosa* Roxb., *Cosmostigma acuminatum* Wight, *Cosmostigma racemosum* Wight, *Cosmostigma racemosum* var. *glandulosum* Costantin, *Tylophora punctata* Kostel etc. *Cosmostigma cordatum* is a medicinal plant belonging to the family Apocynaceae ^[2].

Cosmostigma cordatum is a climber with small greenish flowers with brown dots ^[3]. It is also called green milkweed climber. Milkweed is named for its milky juice comprised of a latex containing alkaloids and several other complex compounds including cardenolides. Milkweeds are ecologically significant being an important nectar source for bees and other insects, and a larval food source for monarch butterflies and a variety of other herbivorous insects including beetles, moths, and true bugs. At the same time milkweeds use three primary defences to limit damage caused by herbivore: hairs on the leaves, latex fluids and cardenolide toxins ^[4]. Also, milkweeds are found beneficial to nearby plants by repelling some pests like wireworms and

by using chemical defence against many predators. Many milkweeds also contain cardiac glycoside poisons to inhibit animal cells from maintaining a proper K⁺, Ca⁺ concentration gradient. Many tribals of South America and Africa use arrows poisoned with these glycosides in hunting. Some of the milkweeds may cause death when animals consume the plant more than 10% of their body weight ^[5].

Plant morphology is a branch of botany. The morphology of plants has been studied since ancient times. In biology, morphology is the branch that deals with the form of living organisms. For plants, plant morphology or phytomorphology is the study of the physical form and external structure of plants. Morphology deals with the form and structure of plants. It is concerned with both gross, external features and minute, internal details. Morphology considers the interrelationships of the groups forming the larger units of classification, but does not deal with species, the study of which belongs to taxonomy. One of the main objectives of morphology is the determination, so far as possible, of lines of descent ^[6]. Morphological characters also provide characteristics that can easily be used for identification ^[7]. Microscopic techniques used in the examination of structural and cellular features in order to determine their botanical origin. These methods are useful in identifying species with similar morphological characters. Today, there is a variety of methods available to authenticate herbal drugs, ranging from simple morphological examination to physical and chemical analysis, and DNA molecular biology. Due to cost, powder microscopy is the most practical method for primary authentication. Botanical microscopy is a unique, valuable, rapid and cost-effective

assessment tool, and plays an important role in the authentication and assessment of medicinal plants [8].

The objectives of the present study were to investigate the morphological, organoleptic characters and powder microscopy in *C. cordatum*.

Materials and Methods

Collection and identification

The whole plant of *Cosmostigma cordatum* was collected from different parts of Kerala. The samples were authenticated for its botanical identity at the Department of Botany, University of Kerala, Kariavattom campus, Thiruvananthapuram (BOT/KUBH/167/24).

Morphological Analysis

The morphological study includes type, size, shape, apex, margin, venation, base, petiole and surface of leaves of *C. cordatum* by observing them as such and also by using dissecting microscope [9].

Organoleptic characters

Organoleptic characters such as colour, odour and taste were noted by observing the leaf powder [10].

Powder microscopy

The leaves of *C. cordatum* were dried in shade then powdered and stored in air tight container. About 0.5gm of the finely powdered sample was mounted in glycerine at room temperature for 2h and observed under 10X and 40X objective of bright field microscope (Meswox, India) for powder characteristics. Photomicrographs of diagnostic characters were captured using attached camera [11].

Results

Systematic position (APG IV Classification)

Kingdom: Plantae
Phylum: Streptophyta
Class: Equisetopsida
Subclass: Magnoliidae
Order: Gentianales
Family: Apocynaceae
Genus: *Cosmostigma*
Species: *Cosmostigma cordatum*



Fig 1: Inflorescence of *Cosmostigma cordatum*

Morphology

The species is a twining glabrous climber. The general habitat of the plant was recognized as moist deciduous forests, scrub jungles and sacred groves. Roots are light brown in colour and scabrous, 0.25 to 1 inch in diameter, fracture is starchy. Stem are glabrous, stout and terete. Leaves are simple, opposite, glabrous, membranous, ovate,

acuminate at the apex and cordate at the base. Nerves anastomosing at the margin. Leaves 7.5 - 12.5 cm by 5 - 7.5 cm. Petioles 1.5- 3.8 cm long. Flowers small, in axillary or lateral racemose cymes with rather long peduncles, bisexual, 8 mm across, many together, slender, pubescent; corolla greenish-yellow with brown dots, outer corona lobes orbicular, emarginated, membranous; inner corona similar to outer. The inflorescence of *Cosmostigma cordatum* is racemose to corymbose type. The width of inflorescence is 3-4 cm. The peduncles of flowers arise from the leaf axils or just outside them and are sometimes equal or exceed the length of petioles. Peduncle is between the petioles of leaf pair. Peduncle and pedicel are brightly green in colour. 3-4 mm in height without pedicel; 9 mm in width when blossoming. Calyx consists of 5- partite; united at the base, 1 mm in length, tip obtuse and with membranous ciliate margins.; glands in pairs between the lobes. Bright green in colour. Corolla has 5 petals, forming into a bell- shape short tube, 3-4 mm in length, 2-3 mm in width, rotate, deeply 5-fid, lobes 3mm long, obtuse, surface glabrous, greenish yellow with brown dots. The lobes slightly overlapping to the right; corona processes erect, membranous, adnate to the base of the staminal column and shorter than the anthers, truncate, bifid, trifid or slightly toothed Staminal column very short, arising from near the base of corolla. 5 anthers are attached to the lateral side of stigma. Stamen and pistil form a gynostegium. Anthers with a round inflexed membraneous appendicle. The anther is protected by corollines corona. The tips of corollines corona wrap the stigma. Diameter of stigma is 2 mm. Pollen masses are slightly curved, erect, clavate, waxy, attached to the hard pollen- carriers by long slender twisted caudicles. Ovary has 2 carpels. 1 mm in length. Style is thick; style apex is broad, flat, 5 angled with a wavy rim slightly umbonate in the centre (Figure 1). Fruit of 2 or 1 large, lanceolate, blunt, smooth, follicular mericarps. Seeds 1.3 cm long, ovate, margined, ending in a silky coma; cotyledons flat, elliptic. The flowering and fruiting season is May to July. Leaves, Root bark, Flowers etc. are the useful plant parts. The leaves and flowers generate a gentle aroma which can be compared with that of chilly leaves.

Organoleptic Characters

The texture of leaf powder was fine powder and the odour was characteristic odour. The colour was dark green and the taste was slightly bitter. The physical parameters like state, nature, odour, taste, touch, flow, property, and appearance revealed as given in Table 1.

Table 1: Organoleptic characters of *C. cordatum*

| Sl. No. | Specification | Character |
|---------|---------------|----------------------|
| 1 | State | Solid |
| 2 | Nature | Fine powder |
| 3 | Odour | Characteristic odour |
| 4 | Touch | Rough |
| 5 | Flow Property | Non-Free flowing |
| 6 | Appearance | Dark green in colour |
| 7 | Taste | Bitter in taste |

Powder microscopy

The following cellular characters were observed in the *C. cordatum*. Multicellular trichomes of falcate type, epidermal fragments (upper and lower), Calcium oxalate crystals (rosette and prismatic), starch grains, xylem vessels with spiral and pitted thickenings, fibres, brown contents etc. were seen in the powder.



Fig 2: Falcate trichome



Fig 3: Elongated non-glandular trichome with basal cells

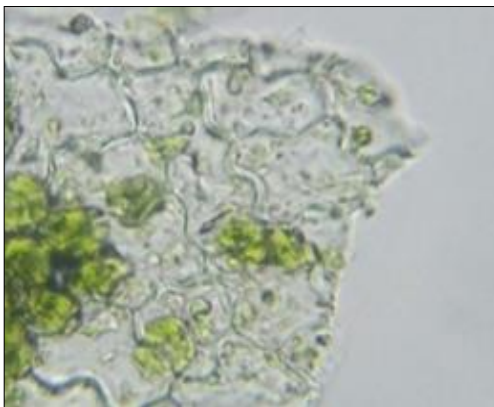


Fig 4A: Wavy epidermis

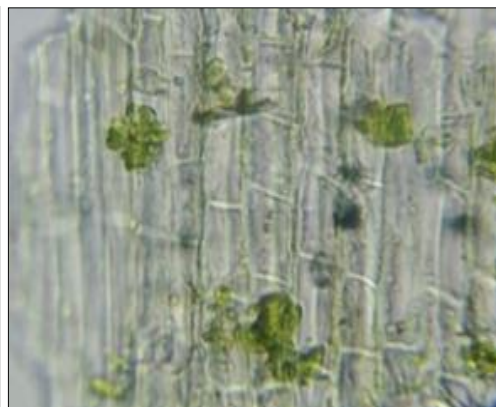


Fig 4B: Longitudinal view of epidermal cells



Fig 5: Anisocytic stomata



Fig 6: Rosette calcium oxalate

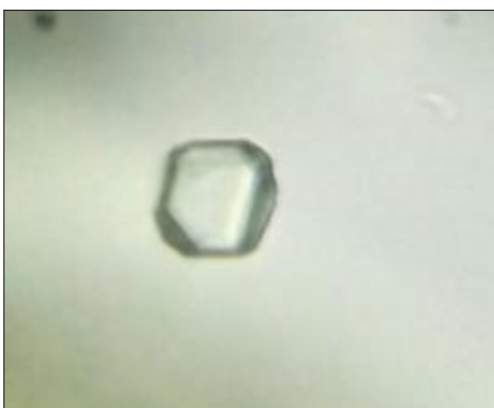


Fig 7: Prismatic crystal

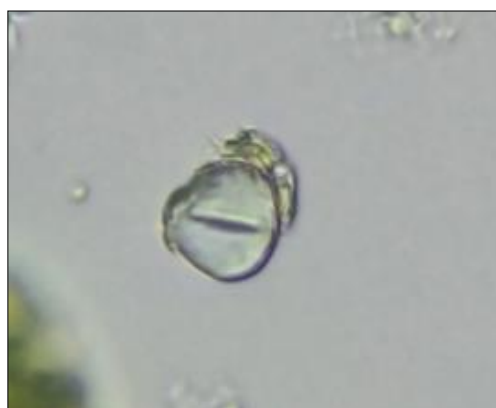


Fig 8: Simple starch grain with hilum

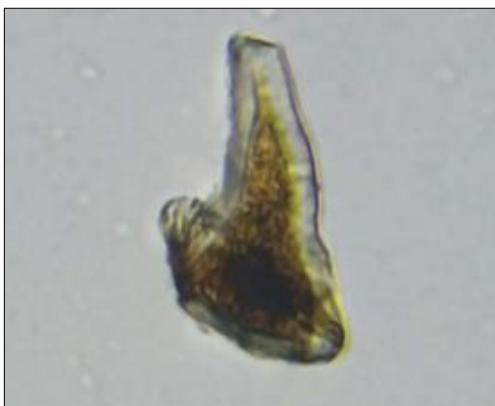


Fig 9: Brown content



Fig 10: Pitted vessel



Fig 11: Spiral vessel



Fig 12: Fragment of pitted fibre



Fig 13: Lignified fibres

Discussions

Cosmostigma racemosum was proposed by Robert Wight in 1834. Now the correct name for the particular species is *Cosmostigma cordatum* (Poir.) M. R. Almeida. According to Bentham and Hooker system of classification this plant belongs to the family Asclepiadaceae and now this plant belongs to the family Apocynaceae according to APG IV system of classification. Now the plant name *Cosmostigma racemosum* is a synonym of *Cosmostigma cordatum*.

The present study of morphological evaluation and powder microscopy on the leaves of *Cosmostigma cordatum* has laid down standard parameters for proper identification, authentication and for distinguishing the material from its adulterants and substitutes. The study also contributes to the documentation of the organoleptic characters of the leaves of *Cosmostigma cordatum* which are consumed as a vegetable by some tribals.

In a study the species is described as a climbing herb, stem glabrous, leaves 6- 10 x 3-5 cm, racemose to 2.5 cm long. flowers 8 mm across, many together, slender, pubescent; corolla greenish-yellow with brown dots, outer corona lobes orbicular, emarginated, membranous; inner corona similar to outer. The general habitat of the plant was recognized as moist deciduous forests, scrub jungles and sacred groves. The leaves and flowers generate a gentle aroma which can be compared with that of curry leaves ^[1]. According to this study fresh leaves and flowers have a chilly like odour.

According to a study the flowers of *Cosmostigma cordatum* was small, flat and wheel-like with five petals. Petals were long, ovate, yellowish-green with reddish brown speckles. Having erect pollinia, and also flowers was axillary or sub-lateral (Figure 1). Fruits was oblong and bluntly pointed. Flowering and fruiting season is April to June ^[12].

According to this study the flowering and fruiting season is May to July.

Widodo (2014) [7] stated that the structure of corona is important for distinguishing *Cosmostigma* from non *Cosmostigma*. The additional description data of *C. cordatum* flower morphology contributed by this study are the position of petals (aestivation) toward each other and the structure of corollines corona in anther [7]. De Craene and Wanntorp (2011) [13] stated that data of flower morphology are very good clarifying components in systematic research and the key or the main tool for developing phylogeny concept, expanding and enriching the understanding of evolution and significance of organs in evolution [13]. In the present study, major morphological features include glabrous stem, cordate leaves and racemose to corymbose type of inflorescence (Figure 1).

Cosmostigma cordatum and *Wattakaka volubilis* are morphologically very similar plants in same family Apocynaceae. One of the synonyms of *Wattakaka volubilis* is *Dregea volubilis*. In the present study, the organoleptic analysis showed that the fine leaf powder in solid state, was a characteristic order, rough texture, non-free flowing property, dark green colour and bitter taste (Table 1). In a study the texture of powder leaves of *Dregea volubilis* was fine powder and the odour was pleasant aromatic. The colour was yellowish green and the taste was slightly bitter [14].

In the present study, *Cosmostigma cordatum* leaves powder showed that falcate trichome, elongated non-glandular trichome with basal cells, wavy epidermis with polygonal cells, anisocytic stomata, rosette calcium oxalate crystals, prismatic crystal, simple starch grain with hilum, brown content, pitted and spiral xylem vessels, fragment of pitted fibre and lignified fibres (Figure 2 to Figure 13). According to a study in powder microscopy of leaf of this plant revealed the presence of fibres, annular vessels from vascular bundles, druse and prismatic crystals, trichomes and group of sclereids [15].

The morphology and powder characteristics of *C. cordatum* can be used for confirmation and checking at the levels of species, genus, and tribe in the existing classification hierarchy and for clarification of its phylogenetic relationship in each level of taxon. The authentication of herbal drugs and identification of adulterants from genuine medicinal herbs are essential for both pharmaceutical companies as well as public health and to ensure reproducible quality of herbal medicine [16].

The observations of the study on the powder of leaf can serve as useful parameters for the proper identification of the drug. The dried sample in the powdered form gives characteristic features of the drug under a microscope after proper treatments. The microscopical examination of epidermal trichome and calcium oxalate crystals is extremely valuable for authentication of crude drug [17].

Conclusion

The present work was undertaken with a view to lay down standards which could be useful to detect the authenticity of this medicinally useful *C. cordatum*. Morphological studies and powder microscopic studies can be useful to substantiate and authenticate the plant by using microscope. Species authentication of *C. cordatum* and other members of Apocynaceae can be done by comparing data of powder microscopy and structure of plant morphology. The results

of the present study serve as a valuable source of information and provide suitable standards for identification of this medicinally important plant drug material for future investigations and applications.

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Conflict of Interest

The authors declare no conflicts of interest.

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