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Studies on The Taxonomic Status of Urena Lobata and Urena Sinuata

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ABSTRACT *The taxonomic status of Urena lobata Linn. and U. sinuata Linn., both used as sources of the Ayurvedic drug Bala is often debated. Therefore plants belonging to these two taxa have been subjected to phytochemical, micromorphological and anatomical studies. It is found that these two plants differ in 17 anatomical and micromorphological characters and nine phytochemical characters indicating that these are two valid species.*

Introduction
Bala is one of the very important ayurvedic rasayana drugs known for its demulcent, aphrodisiac and tonic properties. It is also used against neurological disorders, general debility, urinogenital diseases, tuberculosis and diabetes. Though Sida cordifolia is considered the official drug, a large number of other plants belonging to genera such as Sida, Abutilon, Urena, Pavonia and Grewia are used as **Bala** in various parts of India.

U. lobata Linn. and U. sinuata Linn. are two of the plants used as **Bala** (more specifically **Atibala**) in many places. All the parts of the former species are endowed with many medicinal properties. The root is a popular diuretic in Assam. A decoction of the stem and roots is used in Brazil as a remedy in severe windy colic. A poultice prepared from the roots and leaves are used as emollient. The flowers are administered as a pectoral and expectorant in dry and inveterate coughs. U. sinuata also possesses similar properties. The roots are considered emollient and refrigerant. The leaves are prescribed in inflammation of intestine and bladder. An infusion of the flowers is used in bronchitis (Anon. 1998).

Though Linnaeus considered both U. lobata and U. sinuata as independent species, the taxonomic status of these plants is often debated. The literature survey indicates that the latter is considered often a variety of the former i.e. U. lobata var. sinuata (L.) Hochr. or subspecies U. lobata subsp. sinuata (L.) Borssum. The differences between these two plants mentioned in literature are that in U. lobata, the leaves are divided maximum up to the middle and the sepals are shorter than the epicalyx. In U. sinuata, the divisions of leaves are more than half way down, and the sepals are longer than the epicalyx. (Wagner et al., 1999).

Since the botanical identity of both these taxa is controversial, these plants are subjected to a detailed study on their micromorphological, pharmacognostic and phytochemical characters of various parts such as roots, stem and leaves. The data thus gathered are used in assessing the taxonomic status of both these plants.

Materials and Methods
The plant materials for the study were collected both from Baroda and parts of Kerala. The voucher specimens of the plants were deposited in Herbarium, Department of Botany (BARO), The Maharaja Sayajirao University of Baroda, Vadodara. Phytochemical analysis of roots, stem and leaves of these plants for their secondary metabolites such as alkaloids, flavonoids, steroids and other compounds was done by standard methods of chromatography and spectrophotometry (Harborne, 1984; Daniel, 1991). For pharmacognostic studies also standard methods (Wallis, 1953) were followed.

Results
The distribution of various phytochemicals in different parts of U. lobata and U. sinuata are presented in Table-1. Ephedrine, the proposed active principle of **Bala,** was located in both the plants but in U. lobata it was seen in roots whereas in U. sinuata it was located in leaves. Both the plants contained different flavonoids in that in U. lobata they were 4'-0Me Kaempferol in leaves (the stem and roots were devoid of this compound) and in U. sinuata, kaempferol in leaves and quercetin in stem. Though phenolics acids like vanillic, syringic and melilotic acids were present in both the plants, gallic acid and p-coumaric acid were seen only in former plant while U. sinuata contained ferulic and o-coumaric acids. Anthraquinones were located only in U. sinuata leaf whereas in U. lobata they were absent.

Table: 1. Phytochemical characters differentiating *Urena lobata* from *Urena sinuata*:

	1	2	3	4	5	6	7	8	9	10	11	12
Urena lobata												
1.leaf				+				+	+	+	+	
2.stem								+			+	
3.root	+						+	+			+	
Urena sinuata												
1.leaf	+	+	+			+	+	+				+
2.stem					+	+	+	+				
3.root						+		+	+			

1. Carboxylated tryptamine
2. Anthraquinones
3. Kaempferol
4. 4'-OMe Kaempferol
5. Quercetin
6. Ferulic acid
7. Melilotic acid
8. Vanillic acid
9. Syringic acid
10. Gallic acid
11. ***p***- Coumaric acid
12. ***o***- Coumaric acid

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The pharmacognostic and micromorphological characters in different parts of both the plants are presented in Table 2. Both the plants are found to be entirely different in pharmacognostic characters. The differences were observed in stellate hairs, spongy tissue and in the number of chloroplasts in palisade of leaves; bast fibres, internal phloem and pith of stem; bast fibres, medullary rays and in stelar region of root and in the hypodermis, air cavities, bast fibres of petiole.

Table: 2. Pharmacognostic and micromorphological characters differentiating *Urena lobata* from *Urena sinuata*:

	Leaf	U. lobata	U. sinuata
1.	Stellate hairs Variety	Many, large, densely packed and of different sizes ranging from 20µ-70µ.Glandular trichomes more	Less in number, smaller size (20µ -35µ) Less in number
2.	Spongy tissue	Loosely arranged with large intercellular air spaces	Closely packed with very less intercellular spaces.
3.	Chloroplasts in palisade	At least 10-15 per cell	About 4—5 per -cell
	Stem		
1.	Xylem rays	Frequency is less-4/100µ	Frequency is more. 7/100µ
2.	Bast fibres Arrangement	Lumen uniform M shaped	Large fibres with large lumen & thin walls and small fibers with small lumen& thick walls. In transverse strands
3.	Internal phloem	Absent	Present
4.	Pith	Pith hollow at many places with large air cavities & contains a few thick walled parenchyma with pitted cells.	Pith solid & fully filled with abundant starch grains. Pitted parenchyma absent.
	Root		
1.	Bast fibres	(Heterogeneous) Inner bast fibres are of bigger size and big lumen & the outer with smaller size & smaller lumen.	(Homogenous) Uniform size of lumen.
2.	Medullary rays	Both of thin walled and thick walled cells	Thin walled only
3.	Protoxylem	Ring of sclerenchyma around protoxylem absent	Ring of sclerenchyma around protoxylem present.
4.	Stelar region	Xylem having rings of bigger trachieds alternating with rings of smaller trachieds like growth rings.	Uniform arrangement of trachieds in the xylem.
	Petiole	U. lobata	U. sinuata
1.	Chlorenchymatous hypodermis	Present	Absent
2.	Collenchyma	Angular	Plate or lamellar
3.	Air cavities in Cortical portion	Present	Absent
4	Bast fibres	Absent	Present
5	Sclerenchyma around primary xylem.	Absent	Present
6	Central region	Contains parenchyma with purple coloured inclusions Large air cavities present	Purple inclusions absent Air cavities absent

In the leaves of *U. lobata* the stellate hairs were large (20µ-70µ in diam.) and many; spongy tissues were with large intercellular spaces and palisade cells contained 10-15 chloroplasts each, while in *U. sinuata* stellate hairs were less in number and smaller in size (20µ-35µ in diam.); spongy tissue were packed with very little intercellular spaces and palisade cells contained 4-5 large chloroplasts per cell.

In the case of stem, bast fibres with uniform lumen, absence of internal phloem and hollow pith having large air cavities were seen in the former species whereas in the latter plant the lumen size in the bast fibres differed, the internal phloem was present and the pith was full of parenchyma rich in starch grains.

In U. lobata root, the bast fibres were heterogeneous, medullary rays were made up of both thin walled and thick walled cells, the xylem had rings of bigger cells alternating with rings of smaller cells. In U. sinuata the bast fibres were homogenous, medullary rays were thin walled and xylem consisted of trachieds of uniform size.

The petiole in U. lobata contained chlorenchymatous hypodermis and air cavities in the cortical portion but without bast fibres. In U. sinuata the hypodermis was of parenchyma, air cavities were absent and the bast fibres were present.

Discussion

The data, both from chemistry and pharmacognosy, provide ample proof that these two taxa are valid species. The magnitude of differences, i.e. seventeen characters from anatomy and micromorphology and nine characters from phytochemistry, clearly delineate U. sinuata from U. lobata. The confusion, which was there earlier on the taxonomic identity of these taxa, was due to unavailability of enough qualitative characters.

The dependence on quantitative characters like the division of lamina to the middle and the length of sepals in relation to epicalyx created more confusion than solving the taxonomic puzzle. But the present study provides a large contingent of 26 characters to demarcate one species from another and this case study is a clear proof that the taxonomic evidences are to be sought from all disciplines in solving contentious issues.

From an ecological viewpoint, U. lobata is better suited for a moist environment because of the hollow pith in stem, air cavities in petiole and fewer and smaller stellate hairs. The other species possesses more xerophytic characters like larger and abundant stellate hairs, stem pith rich in starch grains and root with growth rings. It may be inferred that in course of evolution the former species migrated to geographic areas where water content is more while U. sinuata preferred to stay in drier areas.

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Regarding the utility as **Bala** where the roots are commonly sought, Urena lobata can be considered as a better choice because of the presence of Carboxylated tryptamine in it. The data presented here can also be used in quality control measures of **Bala** when these two species are used thus.

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