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Research Article

Comparative Studies on Morphology and Phytochemical Screening of *Plumbago* Species (Plumbaginaceae)

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ABSTRACT

The genus Plumbago belongs to the family Plumbaginaceae. It is widely distributed in tropical and subtropical regions. The present investigation was carried out to study the quantitative trait variation and phytochemical variation among Plumbago zeylanica and P. rosea. The analysis of morphological data revealed significant differences among phenotypes for all measured traits. Different phytoconstituents such as alkaloid, flavonoids, glycosides, tannins, saponins, terpenoids, phenol and steroids were identified in the ethyl acetate and ethanol extracts. The results will provide preliminary interpretation of morphological characters and phytochemicals of these species.

Keywords: Phenotypic traits, phytochemicals, Plumbago, Plumbaginaceae

INTRODUCTION

Since time immemorial the plant species are identified based on morphological characters. Plants are polymorphic in nature however the plants are quite varying from other organism in their form and structure. Within a single individual, the same parts may express difference in form and structure especially leaves, stems and flowers show variation among themselves. This variation can occur due to positional effects, environmental effects and juvenility[1]. Many biologists put efforts to explore structures in many different plants of the same or different species, which can be compared, measured, counted and described to assess the differences or similarities in plant taxa and thereby can solve the taxonomic problems[1,2].

The genus *Plumbago* L. to the family Plumbaginaceae with two taxa *Plumbago zeylanica* L and *Plumbago rosea* L. In Tamil it is called as Venkodivaeli and Senkodiveli respectively. The plants have been widely distributed in tropical and subtropical regions of India, Australia, Asia and Africa and cultivated in parts of Southern India for its tuberous roots[3]. Traditionally the plants have been used for the treatment of skin diseases, gastrointestinal disorder, arthritic pain[4]. The root of *Plumbago* species is the chief source of chemical compound Plumbagin. Several reports have been proved that Plumbagin possesses various pharmacological activities antimicrobial, antiplasmodial, anticancer and antifertility activity, cytotoxic effects, antimalarial, antioxidant, cordiotonic, antimutagenic, insecticidal activities[5-7] and also used to treat oedema, piles, intestinal worms, leucoderma, secondary syphilis, short leprosy[8,9]. In this study morphological characters and phytochemical analysis of two taxa in the genus *Plumbago* are investigated and compared.

MATERIALS AND METHODS

Collection of plant materials

Two species were selected from the genus *Plumbago* and they are: *P. zeylanica* L. and P. *rosea* L. These two specimens were collected from different location within the Coimbatore district.

Morphological studies

The habit and habitat of each species were recorded. Qualitative morphological characters studied include leaf shape, base and apex, their margins, vein, petioles, arrangements, flower colour, calyx colour, calyx shape, corolla shape, anther shape, ovule placentation, fruit types, their shape were observed and recorded. Quantitative morphological characters measured include plant height, plant spread, length and breadth of leaf, length of petiole, number and length of calyx, number of corolla, length of corolla tube length of anther filament, length of style, number of corpel, size and shape of fruits and number of seeds this was done by the use of a metric ruler and the measurements were taken to the nearest centimeters. Counts were taken of the number of calyx, corolla, corpel, seeds and gynoecium locule. Fresh materials collected in the field were pressed and processed immediately as voucher specimens and they were deposited at Botany Herbarium, Nirmala College for Women, Coimbatore, Tamilnadu, India.

Preparation of plant extracts

To know the presence of major phytochemicals, the shade dried leaves and of the study species were made into a fine powder of 40 mesh size using the pulverizer. Following that, 50 g of the powder was filled in the filter paper and successively extracted using 250 mL solvents viz., Ethy

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acetate and Ethanol by using cold extraction method[10]. The extract was filtered through Whatman No.1 filter paper to remove all undissolved matter, including cellular materials and other constitutions that are insoluble in the extraction solvents.

Preliminary phytochemical studies

The extracts were subjected to preliminary phytochemical tests to determine the groups of secondary metabolites present in the plant material. Alkaloids, Flavonoids, Glycosides, Saponins, Tannins, Terpenoids, Steroids, Phenols were analysed according to standard phytochemical methods as described by Trease and Evans[11], Sofowora[12] and Horbone[13].

Table 1. Morphological characters of *Plumbago zeylanica* and *Plumbago rosea.*

S.No.	Plant characters	*Plumbago zeylanica*	*Plumbago rosea*
1	Habit	Subshrub	Shrub
2	Habitat	Dry deciduous	Deciduous
3	Plant Height	0.5-1 m	0.5–2 m
4	Plant spread (cm)	10-50 cm	11.0 -70.5 cm
6	Leaf length	8 – 15 cm	7.0 - 14.0 cm
7	Leaf breadth	3 – 5.5 cm	4.0 - 8.5 cm
8	Leaf shape	ovate or oblong	oblong-elliptic
9	Leaf arrangement	alternate	alternate
10	Petiole length	0-5 mm	1 cm
11	Leaf base	Amplexicaul	Attenuate
12	Leaf apex	acute	acute
13	Leaf margin	entire	entire
14	Leaf venation	reticulate	reticulate
15	Flower colour	white	Red
16	Flower length	2 cm	4 cm
17	Inflorescence type	Terminal raceme	Scarlet racemes
18	Inflorescence length	6–30 cm	25-60 cm
19	No. of Calyx	5	5
20	Calyx length	7–11 mm	1 cm
21	Calyx colour	Green	Red
22	Calyx shape	Cylindrical	Cylindrical
23	Glands	Present on calyx	Present on calyx
24	Colour of glands	Green	Red
25	No. of Corolla	5	5
26	Corolla tube length	1.5 cm	3.5 cm
27	Corolla shape	Slender and tubular	Obovate
28	Stamen	5	5
29	Filament length	2 cm	3 cm
30	No. of locule	1	1
31	Style	Filiform	Base hairy
32	Style length	1.7 cm	2.2 cm
33	Stigma	5 fid	5 fid
34	Ovary	superior	superior
35	Carpel Number	1	1
36	Ovule Placentation	Marginal	Marginal
37	Fruit size	7.5–8 mm	8.5-9.5 mm
38	Fruit shape	Oblong	Oblong
39	Fruit type	Capsule	capsule
40	Seed numbers	1	1

RESULTS

Morphological characters of the study plants

The morphological characters of *Plumbago rosea* and *P. zeylanica* was described for their variation of the phenotypical traits of the two threatened medicinal plants from Coimbatore district, Western Ghats of Tamilnadu, India. Totally 40 morphological characters of both the species were registered and depicted by microscopical features. The morphological traits were instability in each category of the state and morphological features of plant height, habit, habitat, leaf characters, inflorescence, fruiting and seeds of the both *Plumbago* species were shown in Table 1.

Preliminary Phytochemical screening

P. zeylanica and *P. rosea* leaf extracts (Ethyl acetate and Ethanol) obtained by continuous cold extraction method were subjected to standard qualitative phytochemical tests to identify the presence of chemical constituents (*viz*., alkaloids, flavonoids, glycosides, saponins, tannins, terpenoids, steroids, and phenols). Preliminary phytochemical screening mainly revealed the presence of alkaloid, flavonoid, saponins, tannins, terpenoids and phenols in ethyl acetate extract of *P. zeylanica*; alkaloid, flavonoid, saponins, steroids and phenols in ethanol extract of *P. zeylanica*; flavonoids, glycosides, tannins, and terpenoids in ethyl acetate extract of *P. rosea*; alkaloid, flavonoid, saponins and steroids in ethanol extract of *P. rosea* (Table 2).

Table 2. Preliminary phytochemical analysis of leaf extracts of *Plumbago* species.

S. No.	Phytoconstituents	*Plumbago zeylanica*		*Plumbago rosea*	
		Ethyl acetate	Ethanol	Ethyl acetate	Ethanol
1.	Alkaloids	++	+	-	+++
2.	Flavonoids	++	+	++	++
3.	Glycosides	-	-	+++	-
4.	Saponins	+	+	-	+++
5.	Tannins	+	-	+++	-
6.	Terpenoids	+++	-	+++	-
7.	Steroids	-	+	-	++
8.	Phenols	++	+++	-	-

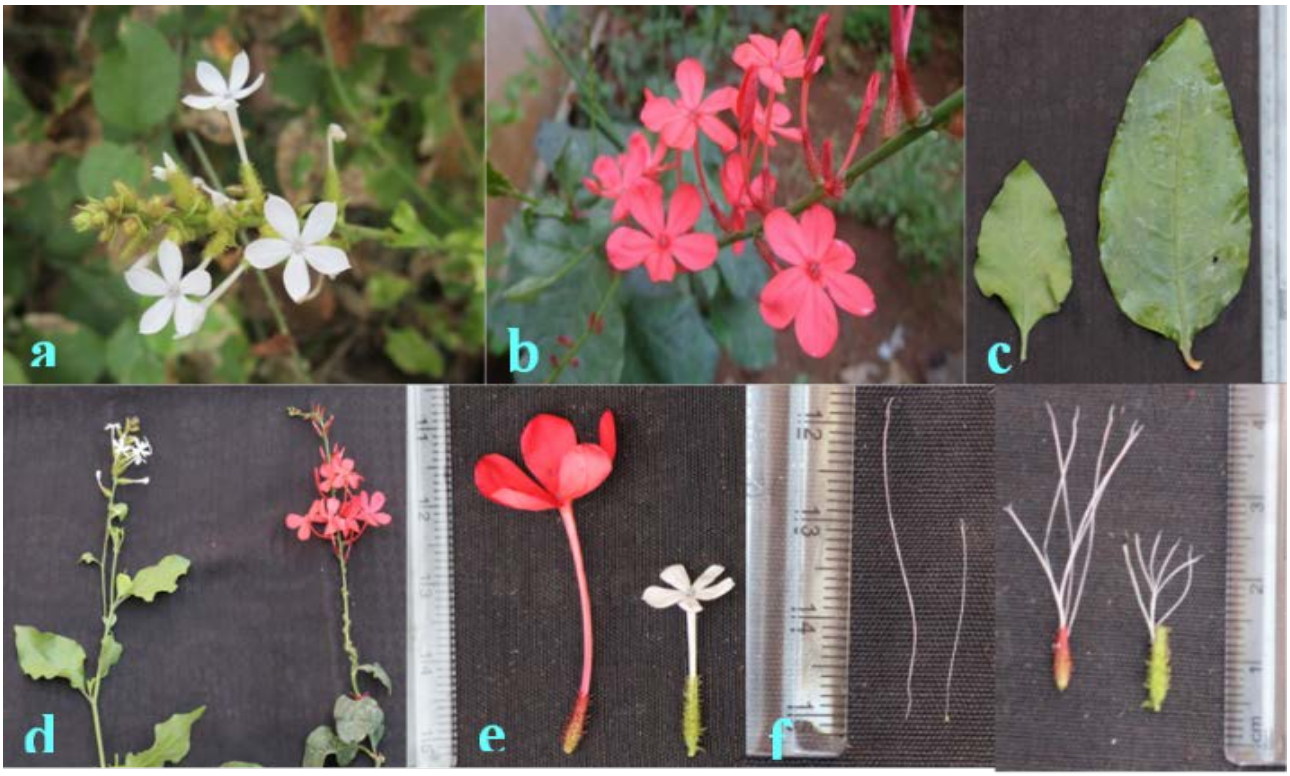

Figure 1. Morphological variations of *Plumbago* species; a &b. habit of *P. zeylanica* and *P. rosea;* c. Size of Leaf; d. Type of inflorescence; e. Length of corolla tube with petals; f. Length of stamens; g. Ovary attached with stamen filament and stigma

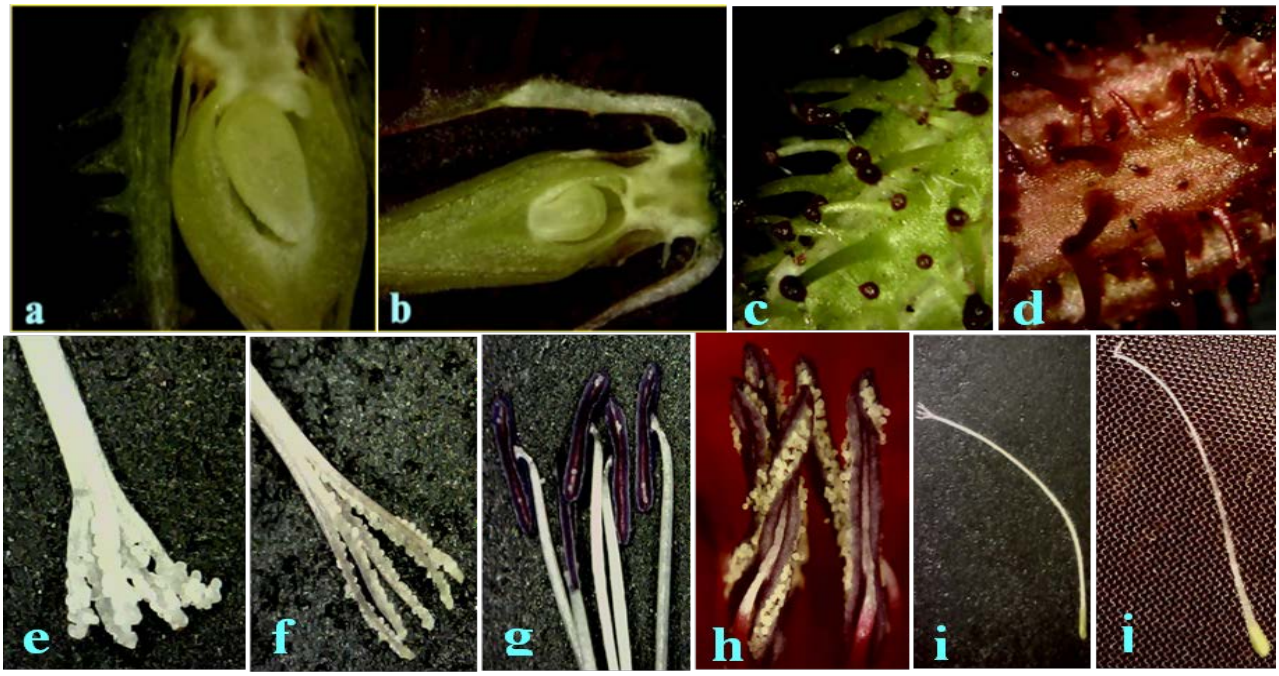

Figure 2. Microscopical observations of *Plumbago* species; a-b. L.S of ovary; c-d. Calyx with glandular trichomes; e-f Enlarged view of anther; g-h Stamen attached with filaments; i-j Style with stigma.

Discussion

Study of morphological characters enhances the taxonomy of the *Plumbago* species. Habit encountered in these species is quite variable, *P. zeylanica* consisting of subshrub and *P. rosea* consisting of shrub. Floral characters are also shows variable among the selected species. Colour is different from one another. *P. zeylanica* is white in colour and *P. rosea* is red in colour. Further, some characters like leaf base, inflorescence type, corolla shape and style of these two species are vary from each other rest of the other studied characters are similar for the study species. This is the indication of closely relativeness of these two species. Ferrero *et al.*[14] studied heterostyly and pollinators in *Plumbago auriculata* as of which they found that flowers of *P. auriculata* show reciprocal heterogamy, with anthers and style differing in lengths between morphs and positioned reciprocally in flowers of both morphs. Therefore, it is evident that there would be variation in style among Plumbaginceae species. Alice Kurian *et al.*,[15] found that highly significance variation in all characters studied in *P. rosea* except leaf size. Scrutiny of the morphological characters could be employed in separating the species and also handy for the selection of high yielding types.

Further, the findings of phytochemical screening of the Ethyl acetate and ethanol leaf extracts of *Plumbago zeylanica* and *P. rosea* revealed the presence of Alkaloid, flavonoids, glycosides, tannins, saponins, terpenoids, phenol and steroids (Table 2). Medicinal plants play an important role for the health benefit of human being in many developing countries[16]. The secondary metabolites have significant activity against infective microorganisms[17,18]. The various phytochemical compounds detected from the leaf extracts are known to have beneficial importance in medicines. Due to the presence of phyto constituents crude medicinal preparations of *Plumbago zeylanica* and *P. rosea* were used in the Indian system of medicine. Recently a number of studies have been carried out on the phytochemistry of plants across the world[19]. It has been reported previously that ethanol extract and petroleum ether extract from the leaves and stem of *Plumbago zeylanica* L. have antimicrobial properties[20]. On the basis of many studies referred above, it is evident that the leaf extract of *P. zeylanica* L. and *P. rosea* L. have a wide range of bioactive secondary metabolites. The information acquired in the present study would be sensible to work out some measures to protect the studied *Plumbago* species and also prevent it from large differentiation in morphological variation.

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