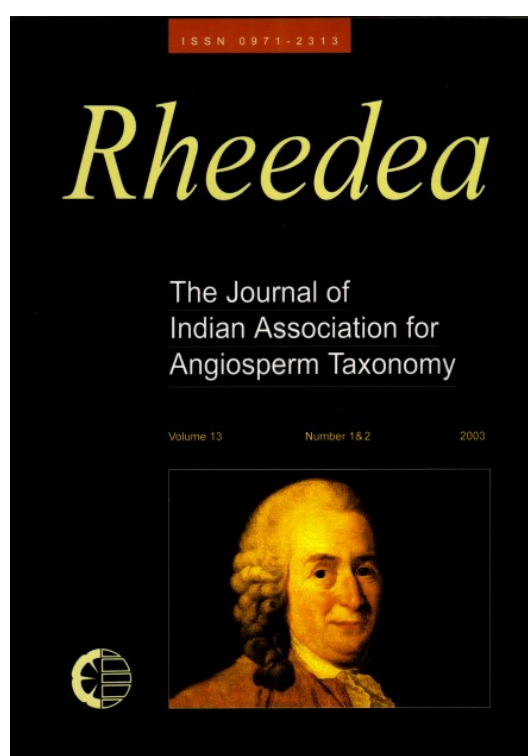




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Chemotaxonomy of Twelve Indian Taxa of *Blumea* DC. (Asteraceae)

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Abstract

The distribution of free amino acids, flavonoids and phenolic acids is studied in twelve species of *Blumea* DC. in order to assess their taxonomic significance. Species are rich in free amino acids. Lanthionine, DL-valine and leucine are present in eleven and proline in nine of the twelve taxa investigated, whereas DL- β -phenyl alanine, L-hydroxyproline and DL-2-amino-n-butyric acid are found specific. Flavonoids are detected in eight taxa while caffeic acid in seven. Much allied *B. oxydonta* DC. and *B. eriantha* DC., and *B. membranacea* DC. and *B. virens* DC. showed dissimilar chemical nature.

Keywords : *Blumea*, Amino acids, Flavonoids, Phenolic acids

Introduction

The genus *Blumea* DC. (Asteraceae- Inuleae- Plucheineae) has always been problematic to students of taxonomy. Hooker (1881) remarked, 'the divisions of the genus proposed here are most unsatisfactory and I fear that the specific diagnoses are not much better. The glabrous or pubescent receptacle is very difficult to see; the size of the heads is tolerably constant; the foliage is sportive to an extraordinary degree, as is the pubescence'. Koster (1941) said, 'often the differences are too trifling to distinguish a separate species. Thus, polymorphous species are inevitable, of which moreover the conception of various authors is different. Their diagnoses of one and the same species are often considerably unlike, one describing the receptacle to be glabrous, the other describing it to be hirsute, etc. They create the dilemma; which is to be considered as a separate species and which is the variety of the polymorphous species'.

Variability in leaf form and uniformity in floral and acheneal characters are really frustrating. The work carried out by Randeria (1960) has solved many taxonomic issues in *Blumea*. Still, it is desirable to search avenues other than the traditional ones for taxonomic delimitations in the genus. This paper presents the chemical profile of twelve taxa of *Blumea* with regard to free amino acids and secondary

metabolites like non-protein amino acids, flavonoids and phenolic acids.

Materials and Methods

Eleven species and one variety of *Blumea* investigated were collected from Maharashtra State and were identified at Botanical Survey of India, Pune (BSI). Voucher specimens are deposited in the herbarium of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad and they are mentioned along with the taxa (see Table 1).

Leaves were dried in shade or in oven at 35-40°C. Amino acids were extracted with 70% ethanol after treating dried leaf powder with chloroform for 24 hrs. The extract was further concentrated by evaporation on water bath. Two dimensional paper chromatography was employed for separation of amino acids following Harborne (1974). Final identification was done by comparing the spots with standard amino acids. Unidentified spots were denoted by their colour and relative positions with the nearest known amino acid. Flavonoids were extracted by methanol and processed for paper chromatography and spectroscopic identification following Mabry *et al.* (1970). Two dimensional paper chromatography was employed for separation and

Table 1. Distribution of Amino Acids in *Blumea*

No	Name of Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
1.	<i>Blumea bifoliata</i> (L.)DC. Rewsa, PYB 1	+	-	-	+	-	+	-	+	-	+	-	+	-	-	-	-	-	-	+	-	7
2.	<i>Blumea eriantha</i> DC. Panwel, PYB 3	-	+	-	+	-	-	-	+	-	-	-	-	+	+	-	-	-	-	+	-	6
3.	<i>Blumea hieraciifolia</i> DC. var. <i>macrostachya</i> (DC.) Hook. f. Panwel, PYB 34	-	+	+	+	-	+	-	+	-	+	-	-	+	+	-	-	-	-	-	-	8
4.	<i>Blumea jacquemontii</i> Hook. f. Chikhaldara, PYB 13	-	-	+	+	-	-	-	+	+	+	-	+	-	-	+	-	-	+	+	-	9
5.	<i>Blumea malcolmii</i> (Cl.)Hook. f. Mahabaleshwar, PYB 5	+	-	+	+	-	+	-	+	+	+	-	-	+	-	+	-	-	+	+	+	12
6.	<i>Blumea membranacea</i> DC. Dhargad, PYB 6	-	-	-	-	-	-	-	+	+	-	-	-	+	+	+	+	-	+	+	-	8
7.	<i>Blumea obliqua</i> (L.) Druce Aurangabad, PYB 7	-	-	+	+	-	-	+	+	+	+	-	+	-	+	-	-	-	+	+	-	10
8.	<i>Blumea oxyodonta</i> DC. Pulgaon, PYB 8	+	-	-	+	-	-	-	+	-	+	-	+	+	-	-	+	-	-	+	-	8
9.	<i>Blumea sinuata</i> (Lour.) Merr. Rewsa, PYB 4	-	+	-	+	-	-	-	+	-	+	-	+	+	+	-	-	-	-	+	-	8
10.	<i>Blumea solidaginoides</i> (Poir.)DC. Rewsa, PYB 9	+	+	-	+	-	-	-	-	-	+	-	-	+	+	-	-	+	-	+	-	8
11.	<i>Blumea virens</i> DC. Thane, PYB 10	-	-	+	+	-	+	-	+	+	+	-	+	+	-	-	-	-	+	+	+	11
12.	<i>Blumea lacera</i> (Burm. f.) DC. var. <i>lacera</i> Thane, PYB 11a	+	-	+	+	+	-	-	+	-	-	+	-	-	-	-	-	-	+	+	-	8

1 DL – Methionine

5 L – Hydroxyproline

9 iso-Leucine

13 Glutamic acid

*17 DL-2-amino-n-butyric acid

2 Serine

6 Threonine

10 Proline

14 DL-Alanine

18 L-Histidine monohydrochloride

3 Lysine hydrochloride

7 Tryptophan

*11 DL – Dopa

15 Glycine

*19 Lanthionine

4 L – Leucine

8 DL- Valine

12 L-Tyrosine

*16 DL- b - Phenyl alanine

20 Unknown - Immediately below
proline – violet – purple spot

* Non-Protein Amino Acids

identification of phenolic acids (Ibrahim & Towers, 1960). Unidentified acids were denoted by their colour and relative positions with the nearest known phenolic acid.

Observations

Amino acids: Twenty different amino acids were identified in twelve taxa of *Blumea* (Table 1). Maximum twelve amino acids were detected in a single species (*B. malcolmii*) and minimum six (*B. eriantha*). DL-valine, L-leucine and lanthionine were the most common amino acids found in eleven and proline in nine out of twelve taxa investigated. L-hydroxyproline and DL-Dopa occurred only in *B. lacera* var. *lacera*, tryptophan in *B. obliqua* and DL-2-amino-n-butyric acid in *B. solidaginoides*.

Flavonoids: Species of *Blumea* appear to be poor in flavonoid content (see Table 2). The investigated species can be grouped into two on the basis of flavonoid distribution: 1. taxa with flavonoids (7 spp.) and 2. taxa without flavonoids (5 spp.). Taxa with flavonoids can be divided as those with only flavones (*B. hieraciifolia* var. *macrostachya*, *B. malcolmii*, *B. obliqua* and *B. sinuata*) and those with

flavones and flavonols (*B. bifoliata*, *B. lacera* var. *lacera* and *B. oxyodonta*).

Phenolic acids: Twenty four different phenolic acids (seventeen known and seven unknown) were found in twelve taxa (see Table 3). Maximum ten phenolic acids were detected in a single species (*B. obliqua*) and minimum three in two species (*B. sinuata* and *B. virens*). Syringic acid was found in all, vanillic in nine and caffeic in seven taxa. Salicylic, *b*-resorcylic, 3-OH, 5-OCH₃ benzoic, *o*-coumaric and phloretic acids were found only in *B. malcolmii*, *B. membranacea*, *B. oxyodonta*, *B. jacquemontii*, *B. solidaginoides* respectively and ferulic and trans-*p*-coumaric acids only in *B. obliqua*.

Discussion

Of the 2,000 species of Inuleae only 5 to 10% are chemically investigated. Data on the distribution of free amino acids in these species are not available. The present study reveals that species of *Blumea* are rich in free amino acids. Proline, a physiologically important amino acid, is found in nine species. Proline accumulation is directly related to water stress condition (Hanson *et al.*, 1977) and is indicative of

Table 2. Distribution of Flavonoids in *Blumea*

No.	Name of Taxa	1	2	3	4	5	6	7
1.	<i>Blumea bifoliata</i> (L.)DC.	-	-	-	+	-	-	+
2.	<i>Blumea eriantha</i> DC.	-	-	-	-	-	-	-
3.	<i>Blumea hieraciifolia</i> DC. var. <i>macrostachya</i> (DC.) Hook.f.	-	+	+	-	-	-	-
4.	<i>Blumea jacquemontii</i> Hook. f.	-	-	-	-	-	-	-
5.	<i>Blumea malcolmii</i> (Cl.)Hook. f.	-	-	-	+	-	-	-
6.	<i>Blumea membranacea</i> DC.	-	-	-	-	-	-	-
7.	<i>Blumea obliqua</i> (L.)Druce	+	+	+	-	-	-	-
8.	<i>Blumea oxyodonta</i> DC.	-	-	-	+	-	-	+
9.	<i>Blumea sinuata</i> (Lour.)Merr.	-	-	-	+	+	-	-
10.	<i>Blumea solidaginoides</i> (Poir.)DC.	-	-	-	-	-	-	-
11.	<i>Blumea virens</i> DC.	-	-	-	-	-	-	-
12.	<i>Blumea lacera</i> (Burm.f.)DC.var. <i>lacera</i>	-	-	-	+	-	-	+

1 Apigenin

4 3', 4'-di OMe Luteolin

2 4'-OMe Apigenin

5 7', 3', 4'-tri OMe Luteolin

3 7, 4'-di OMe apigenin

6 3-OMe Quercetin

the arid habitat where most of these species are found in Maharashtra. Specific amino acids detected in individual taxa can function as taxonomic markers.

Bose *et al.* (1968) studied flavonoids in *B. eriantha*. They noted the presence of Quercetagenin 3,6,7,3'4'-pentamethyl ether. However, we found *B. eriantha* devoid of any flavonoid compound. Possibly, they might have studied different ecotypes or chemotypes of *B. eriantha*. It is not uncommon to find flavonoid chemistry differing with climate or habitat (Giannasi, 1972; Karen & Clifford, 1984). Interestingly, the total absence of flavonoids was observed in five species (Table 2). They may be chemically regarded as the most advanced. Species containing both flavones and flavonols are taken to be relatively primitive while those having flavones alone are considered relatively advanced. Methoxy derivatives of luteolin and apigenin found in *Blumea* are widely distributed in Asteridae (Harborne, 1967). Chalcones and aurones are the important sources of yellow colour pigments in Asteraceae. In Inuleae they are reported from *Gnaphalium* and *Helichrysum* (Harborne, 1977). Although yellow colour is dominant in flowers of *Blumea*, these pigments were absent in the investigated taxa when tested with ammonia.

Among phenolics, caffeic acid is one of the major constituents in Asteraceae (Hegnauer, 1977). However, vanillic acid occurred more frequently than caffeic acid in the taxa studied. *B. eriantha* and *B. oxydonta* are taxonomically very similar. Erect habit and male fertile central florets distinguish the former from the latter. Intermediate forms (e.g. male sterile central florets and erect habit, male fertile central florets and prostrate habit etc.) make this distinction more difficult. However, these two species exhibit distinct chemical profiles.

Chemical profile	<i>B. eriantha</i>	<i>B. oxydonta</i>
<i>Amino acids</i>		
a) DL-methionine, proline tyrosine, DL- b - phenyl alanine	Absent	Present
b) DL-serine, DL-alanine	Present	Absent
<i>Flavonoids</i>		
3',4'-di OMe Luteolin	Absent	Present
<i>Phenolic acids</i>		
a) β - resorcylic, 3-OH, 5-OCH ₃ , unknown no. 1	Absent	Present
b) β -OH benzoic, melilotic β -coumaric	Present	Absent

Likewise, *B. membranacea* and *B. virens* are similar in their external morphology. *B. membranacea* is distinguished from *B. virens* only on the basis of the degree of pubescence (the former being pubescent and the latter almost glabrous) and the slight difference in size of heads. However, they show the following chemical differences.

Chemical profile	<i>B. membranacea</i>	<i>B. virens</i>
<i>Amino acids</i>		
a) L-lysine hydrochloride L-leucine threonine proline, L-tyrosine Unknown.	Absent	Present
b) DL-alanine, glycine DL- β - phenyl alanine	Present	Absent
<i>Phenolic acids</i>		
a) β -OH-benzoic, vanillic	Absent	Present
b) β - resorcylic, proto catechuic melilotic, caffeic unknown 4,7	Present	Absent

Chemical characters also show that *B. oxydonta* and *B. virens* are more advanced than *B. eriantha* and *B. membranacea* respectively.

Elaborate chemical studies may provide better insight to the taxonomy of *Blumea*.

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