Comparative Studies of Boerhaavia Diffusa L. and Boerhaavia Verticillata Poir. (Nyctaginaceae)

ARADHANA BAJPAI AND J. K OJHA
Department of Dravyaguna
Institute of Medical sciences, B.H.U.
Varanasi – 221 005

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ABSTRACT : Comparative taxonomical and phytochemical studies of B. diffusa ands B. verticillata are described in this article.

INTRODUCTION

Boerhaavia L. is a genus of some 40 tropical and subtropical species of herbs\(^1\) Two species of the genus, namely B. Diffusa and B. Verticillata is economically important because both the species have been used since time immemorial as an important about herbal diuretic by Ayurvedic physicians of India \(^2-6\). The problem of accurate identification and dearth of information about numerous medicinal plant species is not well documented and have hampered the optimal utilization of these crude drugs. This is especially the case when dealing with closed related species of same genus. This is also true for genus boerhaavia as both white and red flowered boerhaavia are taken as B.diffusa \(^2-7\). Thus absence of proper identification and adulteration of the plant species may change desirable therapeutic respons and sometimes may not be suitable in a given clinical situation.

B. Diffusa and B. verticillata, commonly known as ‘Punarnava’ are perennial weed of family Nyctaginaceae. Phytochemistry of Punarnava was first time reported by Ghosal\(^7\), after that Chopra\(^8\), Agrawal\(^9\) and surange et al \(^10\) reported large quantities of potassium salt and an alkaloid called punarnavine. The roots of this herb have been used in ancient Ayurvedic medicine as diuretic and in renal disorders since centuries \(^11\). Ayurvdic physicians still use this herb in a variety of renal disorders and the Indian pharmacopoeia describes it as a diuretic \(^12\). Singh and udupa \(^13\) Singh \(^14\) and Bajpai \(^15\) have conducted clinical trials of the drug using modern parameters of assessment and found it to be useful in renal and urinary tract diseases. The root (crude) of this plant is highly effective in cases of chronic pyelonephritis and urinary tract infections (U.T.I) in animals and man \(^16\)
singh et al \(^17\) showed significant teratogenic potential in B. diffusa.

These highly reputed therapeutic claims of the drug drew our attention to explore comparative taxonomical as well as phytochemical details of B. diffusa and B. verticillata.

MATERIALS AND METHODS

Plants of B. diffusa and B. verticillata were collected from department of Dravyaguna, Banaras Hindu University campus. Varanasi. Department of Dravyaguna Banaras Hindu University campus,
Varanasi. Department of Dravyaguna helped in identifying both the plants and uses. Conformation of vernacular names of medicinal plants was done by showing live plant specimens to various herbalists. Voucher specimens were prepared and identified with the help of floras (18-21) and also by comparing them with identified specimens deposited in the Herbarium, department of Dravyaguna (HDG). Voucher specimens were deposited there along with author’s field notes and number under the name of HDG.

In the preliminary phytochemical screening as values, extractive values and solubility were determined as per Indian pharmacopoeia (22). Further extracts of both the plants were analysed for the presence or absence of various chemical constituents.

RESULTS AND DISCUSSION

Taxonomical studies:

Boerhaavia L. is a genus of some 40 tropical and subtropical species of herbs (18) of which B. Diffusa (Rakta Punarnava) and B. verticillata (swet punarnava) are reputed for its medicinal uses.

Boerhaavia diffusa L. (Family: Nyctaginaceae)
Syn: B.repens
Habit: A diffuse herbaceous perennial (19).
Root: Large, fusiform.
Stem: Prostrate or ascending, reaching 2-3 feet long, divaricately branched, slender cylindric, thickened at nodes, minutely pubescent or nearly glabrous often purplish.
Leaves: Arranged in unequal pairs at each node, ½-11/1 in long, ovate, oblong or suborbicular, green and glabrous above, white beneath, base rounded or subcordate, margins subundulate, often pink petioles about as long as blade.
Flowers: Minute, subcapitate, 4-10 together in small bracteolate umbels forming slender, long –stalked, axillaries and terminal panicles; bracteoles lanceolate, acute. Perianth 1/8in long; tube glandular, hairy; limb funnel shaped, dark pink with 5 narrow vertical banks outside.
Stamens: 2-3, slightly exerted.
Fruit: 1/8 in long, clavate 5-ribbed, furnished with large glands along the ribs.

Distribution: Throughout India, Sri Lanka, Tropical and subtropical Asia Africa and America(20).

Boerhaavia verticillata Poir (Family: Nyctaginaceae)
Syns: B. stellata Wight; B. scandens grah.
Habit: A decumbent herbaceous perennial (19).
Root: Elongate, stout, branched, tap root system.
Stem: Prostrate long , pale, terete glabrous(21), divaricately branched, slender .
Leaves: At each node in unequal pairs opposite, thick, nearly as broad as long, ovate, obtuse, mucronate, glabrous white sinuate, margins base cordate, ½ in-13/4 in long, distinctly petioled, ½-3/4 in long slender.
Flowers: In long peduncled racemes, arranged in distant few flowered whorls on a slender rachis, pedicels long and slender, bracteoles small, ovate oblong acute deciduous Perianth 1/3 in long gamotepalous white, ovarial part of the tube1/2 in long, constricted above the ovule,
pentaloid portion funnel-shaped, lobes of the limb 2-fid.

**Stems**: 3. slightly exserted.

**Fruit**: 1/8 in long 5-ribbed, clavate, furnished with large semi-globose glands round t corwn.

**Distribution**: India (Punjab, Hissar, Rohtak), Sind and in drier parts of the western peninsula, also in Afghanistan and Baluchistan, extending westwards to Syria and tropical Africa\(^{(19)}\).

Phytochemical studies: Preliminary phytochemical screening indicated that extractive value was maximum in methanol minimum in benzene for both the species. Also values were high for B verticillata (Table -1)

| Table 1- Percentage Extractive Value |
|--------------------------------------|
| Solvent     | Extractive Value B. diffusa | B. verticillata |
| Benzene     | 0.85 ± 0.02                | 0.87 ± 0.04    |
| Chloroform  | 0.90 ± 0.05                | 0.93 ± 0.07    |
| Methanol    | 8.98 ± 0.69                | 960 ± 0.85     |

| Table 2- Percentage Ash Value |
|-------------------------------|
| Ash Value         | B. diffusa | B. verticillata |
| Total Ash         | 11.04 ± 0.63 | 10.20 ± 0.42   |
| Acid Insoluble Ash | 3.12 ± 0.18  | 2.01 ± 0.08    |

| Table 3- Percentage of Solubility |
|-----------------------------------|
| Solubility  | B. diffusa | B. verticillata |
| Water      | 5.22 ± 0.69 | 5.61 ± 0.62    |
| Alcohol    | 5.35 ± 0.60 | 5.20 ± 0.58    |

± = Standard error

Phytochemistry revealed that as content was more in *B. diffusa* when compared with *B. verticillata* (Table-2) Table -3 depicts that solubility in water is higher in B. verticillata, but solubility in alcohol is more in case of B. diffusa.

Analysis of Phytochemical constituents:

The powdered plant material was subjected to continuous hot extraction in a Soxhlet apparatus and the extracts so obtained were subjected to preliminary phytochemical screening \(^{(22, 24)}\). The presence of various phytoconstituents were detected.
The results obtained are compiled in Table-4

**Table 4- Phytochemical constituents of B. diffusa and B. verticillata**

| Phytochemical | Benzene E | Chloroform E | Methanol E |
|---------------|-----------|--------------|------------|
|               | B.D       | B.V.         | B.D        | B.V.       | B.D | B.V. |
| Alkaloids     | -         | -            | -          | -          | ++  | ++  |
| Sterols       | +         | ++           | +          | ++         | -   | -   |
| Phenols       | -         | -            | -          | -          | +   | +   |
| Glycosides    | -         | -            | -          | -          | ++  | +   |
| Reducing sugars | -       | -            | -          | -          | ++  | +   |
| Amino acids   | -         | -            | -          | -          | +   | +   |
| Flavonoids    | -         | -            | -          | -          | +   | +   |

Key: E=Extract; B.D = B. diffusa; B.V. = B. verticillata; += Present; -= Absent

**Quantitative Estimation of Phytoconstituents**

The preliminary phytochemical screening indicated the presence of alkaloids, sterols, glycosides, phenols, etc. These phytoconstituents were estimated using various methods (23,25). The results obtained were as follows.

**Table -5- Quantitative estimation of Phytoconstituents (%w/w)**

| Phytoconstituents | B. diffusa | B. verticillata |
|-------------------|------------|-----------------|
| Alkaloids         | 2.74       | 3.11            |
| Fibre             | 3.51       | 3.23            |
| Total reducing sugars | 6.04    | 5.26            |
| Glycosides        | 7.42       | 5.80            |

**CONCLUSION**

*B. diffusa* and *B. verticillata* are perennial weed with thick roots that grow in deserted land and can be cultivated in gardens. The root of these herbs have been used in ancient Ayurvedic medicine as diuretic since centuries. Taxonomical characters revealed the two different species of Boerhaavia. A survey of literature reveals tat the active principle of punarnava’ is an alkaloid *B. verticillata* is also rich in alkaloid content. All the parameters that have been considered in this study could be used of rte authentication of the crude drugs.

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