

Review Article

PHARMACOLOGICAL PROPERTIES OF *BOERHAAVIA DIFFUSA* - A REVIEWKrishna Murti^{1*}, Mayank A. Panchal,² Vijay Lambole²¹Asst. professor, Department of Pharmacology, Vidyabharti Trust College of Pharmacy, Umrah, Gujarat, India.²P.G. Student, Department of Pharmacognosy, Vidyabharti Trust College of Pharmacy, Umrah, Gujarat, India.²Department of Pharmacology, Vidyabharti Trust College of Pharmacy, Umrah, Gujarat, India.Corresponding author's E-mail: krishnamurti74@yahoo.co.in

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ABSTRACT

The present review describes the morphological, phytochemical and pharmacology aspects of *Boerhaavia diffusa* (Nyctaginaceae). The whole plant or its specific parts (leaves, stem, and roots) are known to have medicinal properties and have a long history of use by indigenous and tribal people in India. *B. diffusa* is used as an Ayurvedic medicine in India and Unani medicine in Arab countries for the treatment of diabetes, stress, dyspepsia, abdominal pain, inflammation, jaundice, enlargement of spleen and congestive heart failure. The medicinal value of this plant in the treatment of a large number of human ailments is mentioned in Ayurveda, Charaka Samhita, and Sushrita Samhita. The medicinal value of this plant in the treatment of a large number of human ailments is mentioned in Ayurveda, Charaka Samhita, and Sushrita Samhita. So, an overview of phytochemical and pharmacological properties is given in the present paper.

Keywords: *Boerhaavia diffusa*; Pharmacognosy; Phytochemistry; Pharmacological profile.

INTRODUCTION

Boerhaavia diffusa is a herbaceous member of the family Nyctaginaceae. It is widely distributed in the tropics and subtropics. It has a long history of uses by indigenous and tribal people and in Ayurvedic or natural herbal medicines¹. *Boerhaavia diffusa* L. is a wild perennial herb which may be encountered in different terrestrial habitats, ranging from managed grasslands, wastelands, agro-ecosystems to large forest gaps. The species of *Boerhaavia* ('Punarnava') have been in use for medicinal purpose in different parts of India.

The whole plant and preferably the roots are effectively used to cure several diseases including Jaundice². The root and aerial parts of *Boerhaavia diffusa* were used in Ayurveda for the treatment of diabetes. It has many ethnobotanical uses (the leaves are used as vegetable; the root juice is used to cure asthma, urinary disorders, leukorrhea, rheumatism, and encephalitis), and is medicinally used in the traditional, Ayurvedic system. Besides, the *B. diffusa* plant is reported to possess many pharmacological, clinical, and antimicrobial properties. Punarnava is an herb, which is very useful for curing kidney diseases. It has English name also called spread hogweed. It is very useful in curing all type of health problems.

Botanical name: *Boerhaavia Diffusa*

Family: Nyctaginaceae

Common name: Hog weed, Pig weed, Horse purslane, Tar vine

Part used: Root, Leaves and seeds

Habitant: Grows as common weed.

Product offered: Roots



Boerhaavia diffusa

The genus *Boerhaavia* has several species, and is distributed in the tropical, subtropical, and temperate regions of the world³. It is found in Australia, China, Egypt, Pakistan, Sudan, Sri Lanka, South Africa, USA and in several countries of the Middle East. Out of the 40 species of this genus, 6 species are found in India – *B. diffusa*, *B. chinensis*, *B. erecta*, *B. repens*, *B. rependa*, and *B. rubicunda*. *Boerhaavia diffusa* is also indigenous to India; it is found throughout the warmer parts of the country up to an altitude of 2000 m in the Himalayan region. It grows well on wastelands and in fields after the rainy season⁴. The plant is also cultivated to some extent in West Bengal⁵.

MORPHOLOGY

Boerhaavia diffusa is a perennial creeping weed, prostrate or ascending herb, up to 1 m long or more having spreading branches. The plant grows profusely in the rainy season, and mature seeds are formed in



October-November. Due to its sticky nature, the plant gets stuck on the clothes of human beings and on the legs of animals, which helps in its dispersal from one place to another.

Roots: The roots are stout and fusiform with a woody root stock. It has a large root system bearing rootlets. The tap root is tuberous, cylindrical to narrowly fusiform to conical or tapering, light yellow, brown or brownish gray. It is thick, fleshy and very bitter in taste. Some workers have studied the regeneration of this plant through tissue culture. Induction of adventitious shoots using stem explants of *B. diffusa*⁶. Roots were also regenerated from the leaf segments of *B. diffusa* when cultured in vitro. These roots contained 0.15% alkaloid punarnavine. Increase in levels of indole- acetic acid (IAA) in MS medium reduced the number of roots regenerated from the leaf segment, their length and alkaloid content⁷.

Leaves and seeds: The shape of the leaves varies considerably - ovate-oblong, round, or subcordate at the base and smooth above. Margins of the leaves are smooth, wavy, or undulate. The upper surface of the leaves is green, smooth, and glabrous, whereas it is pinkish white and hairy beneath. Leaves are up to 5.5 × 3.3 cm² in area. The seeds germinate before the onset of the monsoon.

Flowers and Fruits: Flowers are minute. Usually fascicled or subumbellate on the ultimate branchlets, pink, and about 1.5 mm long. Fruit is glandular, narrowly oblong-obovoid, about 3 mm long. Fruit is glandular, about 3 mm long. Flowers are subcapitate, present 4–10 together in small bracteolate umbels, forming axillary and terminal panicles. These are hermaphrodite, pedicellate, and white, pink, or pinkish-red in color. Bracts are deciduous and involucrate. A perianth is present in the place of a calyx and corolla, which is tubular in shape, the tube being short and narrow at the base and funnel-shaped at the top and constricted above the ovary. There are five lobes, which are small and acute. Two or three stamens are present and are slightly exerted. The stigma is peltate. The achene fruit is detachable, ovate, oblong, pubescent, five-ribbed and glandular, anthocarpous, and viscid on the ribs⁸.

PHYTOCHEMISTRY

The *Boerhaavia diffusa* plant contains a large number of such compounds as flavonoids, alkaloids, steroids, triterpenoids, lipids, lignins, carbohydrates, proteins, and glycoproteins. Punarnavine C₁₇H₂₂N₂O m.p. 236–237°C⁹⁻¹¹, boeravinone A-F¹²⁻¹⁴, hypoxanthine 9-L-arabinofuranoside¹⁵, ursolic acid¹⁶, punarnavoside¹⁷, liirodendrin¹⁸, and a glycoprotein having a molecular weight of 16– 20 kDa¹⁹ have been isolated and studied in detail for their biological activity.

Punarnava also contains β-Sitosterol, α-2-sitosterol, palmitic acid, ester of β-sitosterol, tetracosanoic, hexacosanoic, stearic, arachidic acid, ursolic acid, Hentriacontane, β-Ecdysone, triacontanol etc.

Phytochemical screening of the roots from garden-grown in vivo plants of *B. diffusa* of different ages revealed that the maximum alkaloid content (2%) accumulated in the roots of 3-year-old mature plants. The herb and roots are rich in proteins and fats. The herb contains 15 amino acids, including 6 essential amino acids, while the root contains 14 amino acids, including 7 essential amino acids. Plant contained large quantities of potassium nitrate, besides punarnavine²⁰.

Previous studies reported the presence of flavonoids, alkaloids, steroids, triterpenoids, lipids, lignins, carbohydrates, proteins and glycoproteins in *B. diffusa*²¹⁻²³. The present study also correlated with the aforesaid studies. These phytochemicals present in leaves extracts might be responsible for the antibacterial activity. It is not surprising that there are differences in the antimicrobial effects of different solvent extracts due to the phytochemical properties and differences among species.

PHARMACOLOGICAL ACTIVITIES

Anti bacterial activity:

B. diffusa leaves have potent antibacterial activity against various Gram-negative and Gram-positive bacteria which might be due to the phytochemicals present in the leaves.

Ethanol extract showed inhibitory an effect on gram-positive bacteria like *S. aureus*, *B. subtilis*, *S. faecalis*, *M. luteus* and all gram-negative bacteria selected for the present study. Methanol extract showed inhibitory effect against all gram-positive bacteria selected for the present study except *M. luteus* and gram-negative bacteria like *K. pneumoniae*, *P. vulgaris*, *S. marcescens* and *S. flexneri*²⁴. The antibacterial activity of the various extracts of the stem bark of *Prosopis cineraria* (Linn.) Druce, was evaluated by the agar well diffusion method²⁵.

Hypoglycemic activity:

An alcoholic extract of the whole plant of *B. diffusa* exhibited hepatoprotective activity against experimentally induced carbon tetrachloride hepatotoxicity in rats and mice. Study investigating the effect of oral administration of an aqueous solution of *B. diffusa* leaf extract on normal and alloxan-induced diabetic rats showed a significant decrease in blood glucose and a significant increase in plasma insulin levels in normal and diabetic rats. The effect was more prominent than glibenclamide. The chloroform extract of *B. diffusa* leaves produced dose-dependent reduction in blood glucose in streptozotocin-induced NIDDM rats comparable to that of glibenclamide and this supports the traditional usage of the plant by Ayurvedic physicians for the control of diabetes. Study of leaf extract of *B. diffusa* produced dose-dependent reduction in blood glucose probably through rejuvenation of pancreatic β-cells or through extrapancreatic action²⁶.

Anti-nociceptive activity:

In the acetic acid-induced abdominal writhing in mice, pre-treatment of the animals with naloxone (5 mg/kg,



i.p.) significantly reversed the analgesic effect of morphine and juice but not that of decoction. It is reported that the active antinociceptive principle of *B. diffusa* is present mainly in the juice of fresh leaves and has a significant antinociceptive effect when assessed in these pain models²⁷.

Hepatoprotective activity:

Aqueous root extract of *B. diffusa* (2ml/kg) possessed marked hepatoprotective activity against thioacetamide induced hepatotoxicity and marked protection against a majority of serum parameters like, GOT, GPT, ACP and ALP but not GLDH and bilirubin. Study also proved that aqueous form of drug (2ml/kg) administration has more hepatoprotective activity than the powder form²⁸.

Antiproliferative and antiestrogenic activity:

Antiproliferative and antiestrogenic properties of methanol extract of *Boerhaavia diffusa* (BME) in MCF-7 breast cancer cell lines²⁹.

Anti-inflammatory activity:

Ethanol extract of leaves at dose of 400mg/kg exhibited maximum anti-inflammatory effect with 30.4, 32.2, 33.9 and 32% with carrageenin, serotonin, histamine and dextran induced rat paw edema models, respectively. Ethanol extract of stem bark also exhibited COX-1 and IC₅₀ value of 100ng/ml proving the drug use in the treatment of inflammatory condition³⁰. Anti-inflammatory activity was assessed using extract of latex of plant by using a carragenan induced inflammatory model³¹.

Anticonvulsant activity: Study showed the crude methanolic extract of *B. diffusa* and its liriiodendrin-rich fraction showed a dose-dependent protection against PTZ-induced convulsions³².

Antistress / Adaptogenic / Immunomodulatory activity:

Study of ethanol extracts of roots of *B. diffusa* showed increased stress tolerance in swim endurance test and cold restrains stress. Immunomodulatory activity was shown by increased carbon clearance, indicating stimulation of the reticuloendothelial system. There was an increase in DTH response to SRBC in mice, corresponding to cell mediated immunity and indicating stimulatory effects on lymphocytes and accessory cell types³³.

CONCLUSION

The multiple benefits of *Boerhaavia diffusa* made it a true miracle of nature. Numerous studies have been conducted on different parts of *Boerhaavia diffusa*, but this plant has not yet developed as a drug by pharmaceutical industries. A detailed and systematic study is required for identification, cataloguing and documentation of plants, which may provide a meaningful way for the promotion of the traditional knowledge of the herbal medicinal plants. In view of the nature of the plant, more research work can be done on

humans so that a drug with multifarious effects will be available in the future market.

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