

Review on Punarnava- A Natural Remedy by Ayurveda

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Abstract: *Ayurveda is a sea of knowledge which is widespread not only on the surface but is indeed deep remarkably as well. It emphasises on the preventive aspect of the health and discusses the analysis and management of various physical and mental disorders. While viewing this traditional knowledge, one comes across a very important herb Punarnava (Boerhavia diffusa). It is a trailing herb which is found throughout India. This herb has registered its importance in various formulations as it has been significantly found to be effective in diseases like shotha (inflammation) and pandu (anaemia). The market analysis shows that many different formulations are available in which the punarnava mandur and Punarnava ashtaka kwatha are being prescribed at large In this article, summarization of the various synonyms, morphological properties, pharmacological activities, uses, dose and formulations of the selected drug from classical texts up to modern era is attempted The review indicates that this indigenous medicinal drug has wholesome references in various ancient and modern texts. This plant has proved itself to be beneficial in the past, is a drug of choice nowadays and seems to be effective in future. More research needs to be carried out in formulating new medicine which can contribute to animal life and mankind.*

Keywords: Punarnava, Boerhavia diffusa, Shotha, Pandu, Punarnava ashtaka kwatha

I. INTRODUCTION

The universe is considered to be panchbhautik in nature' and so is the human body. With the upcoming of dvapar, treta and kal yug, the diseases also made their way in the lives of plants, animals and humans as well. The traditional Hindu system of medicine (incorporated in Atharva Veda, the last of the four Vedas), which is based on the idea of balance in bodily systems and uses diet, herbal treatment, and yogic breathing is called as Ayurveda. This science lays stress on the maintenance of equilibrium of Dosha (body humours), Dhatu (body tissues) and Mala (body wastes) for a proper healthy body and mind. Not only the regimens but it also focuses on proper ahaar (diet), nidra (sleep) and brahmcharya for the maintenance of health." In the state of disease, various dietary and medicinal managements have been discussed by the great vaidyas like Acharya Charaka and Acharya Sushruta in their Samhitas .



One of the drugs which is well known and is long established plant in the scientific system of ancient Indian medicine is Punarnava. This plant is found as a perennial spreading herb and as weed in the various parts of Indian states. In Ayurveda, this drug is known to be used as mutravirechniya (diuretic), shothahara (anti-inflammatory), kaashara (antitussive),

varhara (antipyretic), rasayana (rejuvenator) etc. Not only the roots as therapeutic agent but the whole plant of this herb is also being taken as diet by some tribal groups for which mainly the leaves are used. This drug has been cited as bitter, coolant and astringent in nature.

II. SYNONYMS

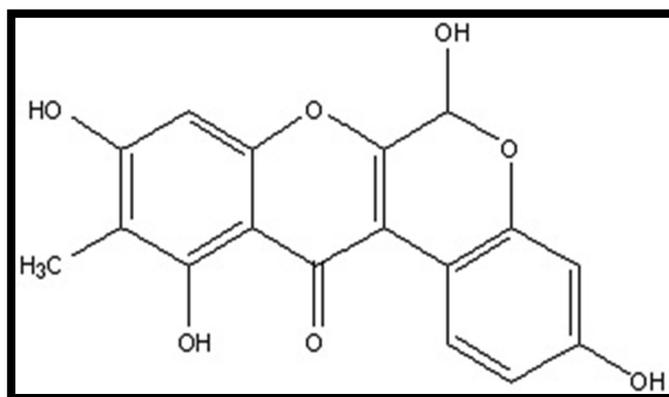
English-Spreading hogweed;
Hindi-Snathikari;
Sanskrit - Punarnava, Raktakanda; T
elugu-Punernava; Bengali - Punarnava;
Tamil - Mukaratee-kirei;
Marathi-Tambadivasu.

Active chemical constituents:

b-Sitosterol, a-2-sitosterol, palmitic acid, ester of b-sitosterol, tetracosanoic, hexacosanoic, stearic, arachidic acid, urosilic acid, Hentriacontane, b-Ecdysone, triacontanol etc.

2.1 Taxonomical Classification

- Kingdom: Plantae
- Class: Dicotyledons
- Order: Thymilae
- Family: Nyctaginaceae
- Genus: Boerhaavia
- Species: diffusa



III. PHARMACOLOGICAL ACTIVITY

3.1 Diuretic and Renal Activity

In vitro studies: the effect of aqueous extract on growth inhibition of struvite crystals, made up of ammonium magnesium phosphate hexahydrate (AMPH), commonly found in urinary stone (calculi) in women. 0.5 and 1.0% extract administration produced 50 and 71.42% decrease in crystal size. The administration of 1.0% extract caused dissolution of crystal by day 4. When studied *in vitro*, 0.5 and 1% extracts have, respectively, shown 88.89 and 138.89% enhanced rate of dissolution in gel at the gel-liquid interface.^[8]



3.2 Anti-Inflammatory Activity

In vivo studies: Mudgal studied the anti-inflammatory effect of aqueous insoluble alcoholic extract of BD in rats. The leaves and flower extracts have shown anti-inflammatory activity by only 55.78% decrease in rat paw edema.^[11] Hiruma-Lima and coworkers evaluated BD leaf extracts (juice and lyophilized decoction) for its toxicity and analgesic-anti-inflammatory activities. Juice and lyophilized decoction of the leaves (both 1000 mg/kg; p.o.) produced 50 and 47% inhibition of abdominal writhing in mice in comparison to dipyrone sodium (200 mg/kg). The juice also increased the latency in hot plate test in mice in comparison to morphine. Another important observation was reversal of action of juice by pretreatment with naloxone (5 mg/kg, i.p.), except for the decoction. So the author proposed the opioid related mechanism of antinociception.^[9] Asadulla isolated β -sitosterol from BD roots and reported 61.29% edema in rats.^[10]



Inflammation is an important use of BD. This plant is also called sothaghni which means that who alleviate inflammation. Almost all the ayurvedic formulations listed in table have uses in inflammation. There are several reports of the use of leaves either intact or in a formulation taken orally or applied locally in cases of scorpion and snake bite or for wound healing. Liriodendrin (eleutheroside E; syringaresinol diglucoside), quercetin, and kaempferol have been reported from various extracts from roots and leaves of the plant and have shown potential for anti-inflammatory activity.

3.3 Anti Fibrinolytic Activity

A study that evaluates the effect of anti-fibrinolytic agents; α -aminocaproic acid (α -ACA), tranexamic acid (AMCA); anti-inflammatory drugs (indomethacin, ibuprofen, naproxen); and plant extract (root extract of *Boerhavia diffusa*) on

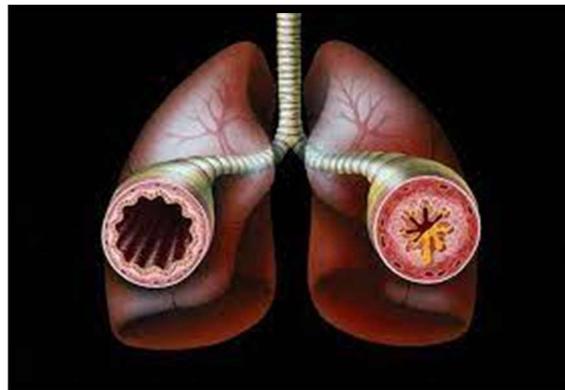
endometrial histology of IUD-fitted menstruating monkeys. It is effective in reducing stromal edema, inflammation, & tortuosity of glands, & in increasing the degree of deposition of fibrin & platelets in the vessel lumen^[12]

3.4 Antiproliferative and Antiestrogenic Activity

Antiproliferative and antiestrogenic properties of methanol extract of *Boerhavia diffusa* in MCF-7 breast cancer cell lines. *Boerhavia diffusa* extracts exhibited a strong inhibitory effect on the proliferation of human breast cancer cells in vitro and the antiestrogenic effects are mediated by ER. Phytochemical studies have revealed the presence of alkaloids, flavonoids, phenols and saponins in BME. The antiestrogenic activity shown by the extract may be attributed to these diverse compounds.^[13]

3.5 Bronchial Asthma

Dried leaves are used in dhoomapana (smoking) in treatment of bronchial asthma. The leaf decoction is an excellent expectorant when decocted with punarnava (*Boerhavia diffusa*) and then combined with ginger juice and black pepper.^[14]



3.6 Antibacterial Activity

A potent antibacterial activity against Gram-positive and Gram-negative bacteria shown by the leaves of *Boerhavia diffusa* might be due to the phytochemicals present in the leaves. Ethanol extract showed inhibitory effect on Gram-positive bacteria such as *S. aureus*, *Bacillus subtilis*, *Streptococcus faecalis*, and *Micrococcus luteus* and all Gram-negative bacteria selected for the study. Umamaheswari et al. (2010) also studied the antibacterial activity of *Boerhavia diffusa* L. leaves. The antimicrobial activity of *Boerhavia diffusa* L. Leaves with different solvent extracts were tested against the Gram-positive and Gram-negative bacterial strains by detecting the zone of inhibition. The ethanol extract of *Boerhavia diffusa* L. leaves showed more activity against Gram-positive and Gram-negative bacteria when compared to other solvent extracts except *V. cholerae*. The results proved the existence of antibacterial activity of *Boerhavia diffusa* L. leaves extract against various human pathogenic bacteria.

3.7 Adaptogen Activity

Adaptogens seem to be useful during both adrenal hyper stress as well as adrenal hypo fatigue. By definition, an adaptogen implies the capability for bi directional or normalizing effects. The most important adaptogens for the adrenals include *Panax Ginseng*, *Siberian Ginseng*, *Ashwagandha*, *Rhodiola*, *Boerhavia diffusa* and Holybasil Leaf Extract. *Boerhavia diffusa* has the ability to support both adrenal over and under activation. In stressful conditions it has demonstrated the ability to buffer the elevations of serum cortisol and prevent the suppression of the immune system that takes place with elevated cortisol. On the other hand, *Boerhavia diffusa* has also demonstrated the ability to improve cortisol levels with end stage adrenal exhaustion.^[26]

3.8 Antimicrobial Activity

The methanol extract of *Boerhaavia diffusa* leaves had significant **in vitro antimicrobial activity**. Hence, further results revealed that among several **pathogenic bacteria**, only *Staphylococcus aureus* was susceptible for *Boerhaavia diffusa*. In *Boerhaavia diffusa*, maximum inhibition was observed in ***Staphylococcus aureus*** followed by *Bacillus megaterium* and *Bacillus cereus*, respectively at 50 µL concentration.

The alcoholic extract of root showed antimicrobial activity against *Staphylococcus aureus* whereas aqueous extract was active against *Escherichia coli* and inactive against *Staphylococcus aureus*.^[20] The phosphate buffer and ether extracts of shoot showed antibiotic activity against *Staphylococcus aureus* and was inactive against *Escherichia coli*.^[21] The alcoholic extract of the plant showed antibacterial activity against *Escherichia coli* in vitro studies.^[22] The seed exhibited antibacterial activity against *Bacillus subtilis*, *Pseudomonas cichorii* and *Salmonella typhimurium* but was inactive against *Escherichia coli*.^[23] The aqueous extract of leaves of *B. erecta* and *B. diffusa* were screened for antibacterial activity against *Alkaligenes viscolactis*, *Aeromonas hydrophilla*, *Cytophaga sp.*, *Escherichia coli*, *Klebsiella aerogenes*, *Pseudomonas aeruginosa*, *Vibrio parahaemolyticus*, *Vib damsela*, *Bacillus cereus* and *Streptococcus pyogenes*. *B. diffusa* failed to exhibit antibacterial activity against all the bacteria but *B. erecta* was found to be active against *Alkaligenes viscolactis*, *Bacillus cereus* and *Streptococcus pyogenes*.

3.9 Chemopreventive Action

In the present study, cancer chemo preventive property of *B. diffusa* was evaluated on 7,12-dimethyl Benz (a) anthracene (DMBA) induced skin papillomagnesis in male swiss albino mice (6-7 weeks old). This leads to the supposition that the inhibition of tumorigenesis by the plant extract might have been executed either by preventing the formation of active carcinogens from their precursors or by augmenting detoxification process, preventing promotional events in the mouse skin through **free radical** scavenging mechanism.^[19]

3.10 Insecticidal Activity

Chemical investigation of the root resulted in isolation of insect moulting hormone which was structurally identified as-ecdysone. Butanol extract of root was bioassayed on housefly (*Musca domestica*) last in star larvae. ^[17] The hexane and acetone extracts of twigs showed insecticidal activity against *Culex p. fatigans* and *Musca domestica* nebulo.^[18]

3.11 Anti-Metastatic Activity

Administration of Punarnavine (40 mg kg⁻¹ body weight) prophylactically (95.25%), simultaneously (93.9%) and 10 days after tumor inoculation (80.1%) could inhibit the metastatic colony formation of melano main lungs. Survival rate of the metastatic tumor-bearing animals were increased significantly by the administration of Punarnavine in all the modalities compared to the metastasis bearing untreated control. These results correlated with the **biochemical parameters** such as lung collagen hydroxylproline, uronic acid, hexosamine, serum sialic acid, serum glutamyl transpeptidase and serum Vascular Endothelial Growth Factor (VEGF) levels and histopathological studies. Punarnavine administration could suppress or down regulate the expression of MMP-2, MMP-signal-regulated kinase) and VEGF in the lung tissue of metastasis-induced animals. Punarnavine could inhibit MMP-2 and MMP-9 protein expression in gelatin zymographic analysis of B16F-10 cells. These results indicate Punarnavine could inhibit the metastatic progression of B16F-10 melanoma cells in mice.^[16]

3.12 Immuno Suppressive Activity

B. diffusa hexane, chloroform and ethanol extracts and two pure compounds Bd-I (eupalitin-3-O-h-D-galactopyranoside) and Bd-II (eupalitin) were evaluated **in vitro** for their effect on T cell mitogen (phytohemagglutinin; PHA) stimulated proliferation of human Peripheral Blood Mononuclear Cell

(PBMC), mixed lymphocyte culture, Lipopolysaccharide (LPS) stimulated **nitric oxide** production by RAW 264.7, PHA and LPS induced IL-2 and TNF- α production, in human PBMCs, superoxide production in neutrophils, human Natural Killer (NK) cell cytotoxicity and nuclear translocation of nuclear factor-k B and AP-1 in PHA stimulated PBMCs. The chloroform and ethanol extracts inhibited PHA stimulated two way MLR, NK cell cytotoxicity as well as LPS induced NO production by RAW 264.7; the hexane extract showed no activity. Bd-1 purified from the **ethanolic extract** at equivalent dose, inhibited PHA-stimulated proliferation of peripheral blood mononuclear cells, two-way MLR and NK cell cytotoxicity as well as LPS induced NO production by RAW 264.7 equally or more effectively than the parent **ethanolic extract**. Bd-I inhibited production of PHA stimulated IL-2 at the protein and mRNA transcript levels and LPS stimulated TNF- α production in human PBMCs; it also blocked the activation of DNA binding of nuclear factor-k B and AP-1, two major transcription factors centrally involved in expression of the IL-2 and IL-2R gene which are necessary for T cell activation and proliferation. Our results report selective immunosuppressive activity of *B. diffusa* leaf. [24] A research is also carried out to evaluate the immunomodulatory properties of this plant extract on various *in vitro* tests such as human Natural Killer (NK) cell cytotoxicity, production of Nitric Oxide (NO) in mouse macrophage cells. RAW 264.7, interleukin-2 (IL-2), tumor necrosis factor- α (TNF- α), Intracytoplasmic Interferon- γ (IFN- γ) and expression of various cell surface markers on human Peripheral Blood Mononuclear Cells (PBMCs). Ethanolic extracts of *B. diffusa* roots inhibited human NK cell cytotoxicity *in vitro*, production of NO in mouse macrophage cells, IL-2 and TNF- α in human PBMCs. Intracytoplasmic IFN- γ and cell surface markers such, as CD16, CD25 and HLA-DR did not get affected on treatment with *B. diffusa* extract. Hence, it demonstrates immunosuppressive potential of **ethanolic extract** of *B. diffusa*. [25]

3.13 Radioprotective Activity

In a study on the effect of the plant in radiation-induced haemopoietic injury in albino mice, pretreatment (in the dose of 260 g kg⁻¹ bw orally for 21 days) to mice exposed to total body irradiation (6 Gy) for 3 min showed significant increase in Hb and total RBC count. After irradiation, there was no fall in RBC count and Hb unlike in controls. The study indicated that the plant had selective effect on the erythroid compartment. [27]

3.14 Drug Interaction

Punarnava may interact with the following medications:

1. Cardiac medications that treat diuresis, vasodilation, and ACE inhibitors.
2. Hypertensive medications
3. Anxiolytics as it may increase their activity. [32]

3.15 Precautions to take with Punarnava

1. Please consult your physician before taking the medication.
2. Not recommended for children below the age of 12 years.
3. Not recommended for pregnant women [32]

3.16 Side Effects of Punarnava

No side effects have been reported or observed in studies by far. The formulations are always prescribed in a course where one medicine neutralizes the toxicity of the other medicine. If you experience any of such side effects, seek immediate medical help from your doctor who has prescribed it to you. They will be the best guide for providing proper treatment to overcome side effects. [32]

IV. CONCLUSION

BD is a plant of repute in traditional as well as ethnobotanical systems of medicine in various parts of world. It contains diverse chemical compounds which have shown therapeutic activities, for example, diuresis, anticancer, anti-

inflammation, hepatoprotection, and immunomodulation. However, it still has not been able to claim its position in herbal market. In the current scenario of plant based medicinal products, BD can prove to be an effective and affordable commodity for hepatoprotection, diuresis, and immunomodulation.

Plants contain thousands of constituents and are valuable sources of new and biologically active molecules possessing bioactivities. In spite of the tremendous strides in modern medicine, numerous natural products from traditional **medicinal plants** have been introduced in the development of theoretical drugs. The objective of this review has been to show the recent advances in the exploration of plant *Boerhaavia diffusa* as phytotherapy and to illustrate its potential as a therapeutic agent. The available information in the literature on the bioactivities of the *Boerhaavia diffusa* shows that the plant contains compounds with strong pharmacological activities of potential clinical relevance and is a popular remedy among the various ethnic groups, Ayurvedic and traditional practitioners for treatment of various ailments. Researchers are exploring the therapeutic properties which are not known.

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