



A SYNOPTIC OVERVIEW ON *BOERHAVIA DIFFUSA* FOR ITS MEDICINAL IMPORTANCE

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Abstract

Punarnava (*Boerhavia diffusa*) belongs to family Nyctaginaceae. It is also named as spreading hog weed and used comprehensively in Ayurvedic system of medicine to cure diseases like *Hridya rog* (cardiac disorders), *Pandu* (anaemia), *Vayasthapanal/Rasayana* (rejuvenator), *Sotha* (inflammation with swelling), *Mutravahshortogat vikar* (urinary tract disorders), *Jwara* (fever), *yonirog* (vaginal disorders), *sutikarog* (female disorder), *kustharog* (skin diseases) *mrida bhakshana janya rog* (disorders originated due to eating of clay), *Basti karma* (enema), *balarog* (disorders of children's), *madhumeha* (anti-diabetic) etc. Its synonyms, morphology, therapeutic potential is described in *Ayurvediya Samhitas* and *Nighantus*. In this synoptic work attempt has been done to summarize the synonyms, therapeutic potential and phytoconstituents of *Punarnava* (*Boerhavia diffusa*).

Keywords: *Punarnava*, *Boerhavia diffusa*, *Diffusa*, spreading hog weed

Introduction

Herbs play an essential function in our everyday life. They have been the most effective source of drugs in olden days (Ekor, 2014). Even nowadays herbs are similarly essential to modern drugs as they have got fewer side effects whilst in comparison to synthetic medicines (Sen & Chakraborty, 2019). The growing belief on the use of medicinal plants within the industrialized societies were traced to the extraction and improvement of several medicines and chemotherapeutics from these plants in addition to from traditionally used rural herbal remedies (Ekor, 2014; Kim, Lee, Jerng, & Choi, 2019).

As per *Ayurveda* literature it is consider that entire universe is *panchabhautik* in nature and so is the human beings (Baragi, Patgiri, & Prajapati, 2008; Samal, 2013). The science believes on the maintenance of equilibrium of *Dosha* (the body humours), *Dhatu* (the body tissues) and *Mala* (the body wastes) for healing, prevention and longevity of healthy human body and mind (Sivananda, 2006). So, for attaining the health, it accentuates on the preventive measures stated for daily regimen with seasonal regimen. It has been also

emphasis on balanced *ahaar* (diet), *nidra* (sleep) and *brahmcharya* (celibacy) for the maintenance of health (Chandaliya, Chandaliya, Tukaram, & Vinayak, 2015; Sastri, 2013).

Boerhavia diffusa (*Punarnava*) turned into named in the honor of Dutch physician Hermann Boerhaave on the 18th century (Banjare, Prasad, & Naik, 2012). The genus *Boerhavia* L. (Family: Nyctaginaceae) consists of 40 tropical and sub-tropical species (Heywood, Moore, Richardson, & Stearn, 1993) found growing wild in diverse terrestrial habitats, ranging from managed grass-lands, wastelands, agroecosystems to large forest gaps. *Punarnava* (*Boerhavia diffusa*); Itself indicates that bring back to life and renews the human body. It is herbaceous/ Perennial/Seed propagated plant (Rajpoot & Mishra, 2011). The all parts of plant are well acknowledged for its therapeutic potential and have a long history of practice by indigenous and tribal people in India (Mishra, Aeri, Gaur, & Jachak, 2014). The therapeutic potential of this plant is able to treat number of human ailments which is well described in *Ayurvedic* literature (Sahu, Damiki, Nilanjan, & Dubey, 2008).



Boerhavia diffusa (plant)



Boerhavia diffusa (root)

Classical review of *Punarnava (Boerhavia diffusa)*

The details of various opinions regarding *gana/varga* and synonyms mentioned by ancient scholar is tabulated in the Table 1

Table 1: *Punarnava gana (group)* classification and synonyms in *Ayurvedic* literature

Sr. No.	Text Name	Gana (group)	Synonyms
1	<i>Charka Samhita</i> (Sastri, 2013)	<i>Swedopaga, Anuvasanopaga, Kasahara, Vayasthapana,</i>	<i>Punarnava, Mahavarshabhu, Vrishchiva, Dirghavarshabhu, Shvetamula, Raktavrinta, Vaishakha, Shinati, Varshaketu</i>
2	<i>Sushrut Samhita</i> (Bhishagratna, 1911)	<i>Vidaarigandhadi, Vatashanshamana varga, Tikta varga, Shaka varga</i>	<i>Punarnava, Rishabhketu, Mahavarshabhu, Vrishchiva, Dirghavarshabhu, Shvetamula, Raktavrinta, athillaka, Vaishakha, Shinati, Kshudravarshabhu</i>
3	<i>Astanga Sangraha</i> (Vidyanath, 2006)	<i>Viprakirna varga, Vidarigandhadi Gana,</i>	<i>Punarnava, Varshaketu, Vrishchiva, Shvetamulaka, Varshabhu, Dirghapatra, Vikasa, Kathillaka, Sunadik, Raktapushpa, Vishakha, Mandalacchada</i>
4	<i>Bhavprakash Nighantu</i> (Chunekar & Pandey, 2004)	<i>Guduchyadi varga</i>	<i>Arunaa, Kshudravarshabhu, Raktapushpaka, Shilatika, Shothaghni, Varshaketu,</i>
5	<i>Shodhala Nighantu</i> (Sharma, 1978)	<i>Guduchyaadi varga</i>	<i>Mahavarshabhu, Pravrusaayani, Raktapushpaka, Shivatika, Shophaghni, Varshabhu, Varshaketu</i>
6	<i>Dhanvantari Nighantu</i> (Kamat, 2002)	<i>Guduchyaadi varga</i>	<i>Deerghapatraka, Kathillaka, Kshudravarshabhu, Shivatika, Vrushchira</i>
7	<i>Madanpal Nighantu</i> (Pandey, 2012)	<i>Abhayadi varga</i>	<i>Arunaa, Kathillaka Kruraka Kshudravarshabhu, Raktapushpaka, Tikta, Shivatika, Varshaketu</i>
8	<i>Aadarsh Nighantu</i> (Bapalal, 1999)	<i>Punarnavadi Varga</i>	<i>Raktapunarnava, Vishakha, Katilla, Kathila, Shothaghni, Mahavarsabhu</i>
9	<i>Kaiyadeva Nighantu</i> (Sharma & Sharma, 1979)	<i>Aushadhi varga</i>	<i>Deerghapatraka, Shophaghni, Varshabhu, Vrushchiva</i>
10	<i>Raja Nighantu/ Nighantu Raja or Abhidhana Cudamani</i> (Tripathi & Dwivedi, 2006)	<i>Parpatadi varga</i>	<i>Raktapunarnava, Krura, Mandalpatrika, Raktakanda, Varshketu, Lohita, Raktapatrika, Vaishakhi, Raktavarshabhu, Shophaghni, Raktapushpika, Viksvara, Vishaghni, Pravrishenya, Sarini, Varshabhav, Shorapatra, Sammitadruma, Punarnav, Nav, Nachya</i>
11	<i>Hrdaya dipaka Nighantu</i> (Sharma, 1977)	<i>Dvipadi Varga</i>	<i>Punarnava, Vrishchiva, Varshabhu, Shivatika</i>
12	<i>Priya Nighantu</i> (PV, 2004)	<i>Shatpushpadi Varga</i>	<i>Punarnava, Varshabhu</i>

Modern review of *Punarnava (Boerhavia diffusa)* (Bhowmik, Sampath, Srivastava, Paswan, & Sankar, 2012; Rajpoot & Mishra, 2011; Sahu *et al.*, 2008; Stevens, 2016)

In modern era all the crude drugs are classified and studied according to their taxonomy classification. In view of this classification, the *Punarnava (Boerhavia diffusa)* is categorized as-

Domain : Eukaryota

Kingdom : Plantae

Sub-kingdom : Tracheobionta – Vascular plants

Phylum : Spermatophyta

Subphylum : Angiospermae

Class : Dicotyledonae

Subclass : Caryophyllidae

Order : Caryophyllales

Family : Nyctaginaceae

Genus : *Boerhavia*.

Species : *Boerhavia diffusa*.

Latin name : *Boerhavia diffusa* Lim.

Ethnobotanical Uses (Apu *et al.*, 2012; Ayyanar, Sankarasivaraman, & Ignacimuthu, 2008; Banjare *et al.*, 2012; Bhowmik *et al.*, 2012; Choudhary, Singh, & Pillai, 2008; Hussein & Dhabe, 2018; Mishra *et al.*, 2014; Nayak & Thirunavoukkarasu, 2016; Patil & Bhalsing, 2016; Rajpoot &

Mishra, 2011; Sahu *et al.*, 2008; Samy, Thwin, Gopalakrishnakone, & Ignacimuthu, 2008)

Ethnic population at *Purulia (West Bengal)* eat that plant as vegetable. In Assam region it leaves are normally available in market and people eating it after cooking. Its roots are recommended for the treatment of piles by the residents of the *Garhwal Himalaya (Uttaranchal)*. Root paste is used as remedy for bloody dysentery by the *Bhils* of the *Jhabua (Madhya Pradesh)*. The decoction described to treat nodules in the human body. *Sahariya* tribe at Lalitpur (*Uttar Pradesh*) use it for the treatment of leukorrhea, rheumatism and stomach ache. At *Ambikapur (Madhya Pradesh)* it is described to use for the treatment of elephantiasis. The tribal of *Indo-Nepal Himalayan terai* region harvest that for medicinal purposes like flushing out the renal system, treat seminal weakness and blood pressure.

At Brazil it uses in for albuminuria, beri-beri, bile insufficiency, cystitis, edema, gallbladder problems, gallstones, guinea worms, hepatitis, hypertension, jaundice, kidney disorders, kidney stones, liver disorders, liver support, nephritis, renal disorders, snakebite, spleen (enlarged) and gonorrhoea.

At Iran it uses in edema, gonorrhoea, hives, intestinal gas, jaundice, joint pain, lumbago, nephritis, and as an appetite stimulant, diuretic and expectorant.

At Nigeria it uses in abscesses, asthma, boils, convulsions, epilepsy, fever, guinea worms, as expectorant and laxative.

At West Africa it uses in abortion, guinea worms, menstrual irregularities and as aphrodisiac.

At Philippines it uses in fever, purgative, diuretic and vermifuge.

At Ghana it uses in Asthma and Boils.

Controversial Status (Nair, 2004; Saroya, 2013; Sastri, 2013; Sereena, Balachandran, & Shree, 2011; P. Sharma, 1978; T, 1980; B. Tripathi, 1994)

Punarnava has been known to be a controversial plant in *Ayurvedic* literature. In *Vedic* period there is no controversy about this drug. But in *Samhita* period *Punarnava*, *varshabhu*, *Kathillaka*, *Vrishchiva*, *Vrishchira* and *Vrishchika* have been described together in several places which indicates that these all are separate drugs having similar properties and actions. In some places we have also found the words like *Punarnave dwe* and *dwi Varshabhu* means two types of *Punarnava* and *Varshabhu* respectively.

The commentators have muddled the subject and created the controversy of *Punarnava*. *Chakrapani* considered *Kathillaka* as *Punarnava* (*Ch.Su.27/96*) and *Vrishchira* as *Sweta Punarnava* (*Ch.Su. 4/23*). While *Dalhana* interprets *Varshabhu* as *Punarnava* (*S.S.Su.46*), *Sweta Punarnava* (*S.S.Su.21*) and *Rakta Punarnava* (*S.S.Chi.23*).

In *Nighantu* all these drugs are described as synonyms to each other *Sodhala nighantu* describes other variety of *Punarnava* i.e. *Vaishakha*, which is having profused branches with red margins around the leaves. Botanically 3 species of *Boerhavia* have been used as *Punarnava* in the different parts of India viz. *B.diffusa*, *B.erecta* and *B.rependa*. *Sharma P.V.* standardized that *Rakta Punarnava*

is *B. diffusa* and *sweta Punarnava* is *B. verticillata* on the basis of through literature and pharmacological study.

Rasa Panchak: (P. Sharma, 1998; Vaidya Gogte, 2009)

Rasa	<i>Madhur, tikta, Kashaya</i>
Guna	<i>Ruksha</i>
Veerya	<i>Ushna</i>
Vipak	<i>Madhur</i>
Dosha karma	<i>Vata har</i>

Description: (Anonymus, 2001)

(A) Macroscopic

- **Stem:** color of the stem is greenish purple; stem is stiff and their shape is cylindrical. At the nodes stem is swollen. Stem of *punarnava* is slightly globrous, minutely pubescent. It is long more than a meter. Prostrate divaricately branches are there.
- **Root:** root is well developed, fairly long and somewhat tortuous, their shape is cylindrical and 0.2 to 1.5 cm in diameter. Root is of yellowish brown to brown color. Their surface is soft to touch but it is rough due to the presence of minute longitudinal striations and root scars present over it. Fracture is short and taste is slightly bitter. No distinct odour is there.
- **Leaves:** leaves are opposite in unequal pairs, larger leaves are 25-37 mm long and small leaves are 1-18 cm long ovate, oblong or suborbicular. Their apex is oblong or slightly pointed. Base is subcordate or rounded. Color of the leaves is green and the above surface is glabrous and whitish below surface. Margin is entire or subundulate. Dorsal sides of the leaves are pinkish in certain cases. Texture of the leaves is thick and long petiole.
- **Flowers:** flowers are very small and their color is pink. Flowers are shortly stalked and nearly sessile. 10-15 cm long, present in small umbells. Arrange on slender and long stalks. Shape of the flowers is like funnel and 2-3 stemens are present.
- **Fruit:** one seeded nut, shape is round. 6mm long clavate, seeds are 5 ribbed and viscidly glandular.

(B) Microscopic (Anonymus, 2001; Meena *et al.*, 2010)

- **Stem:** in the transverse section of stem, it shows an epidermal layer which contains multicellular uniseriate glandular trichomes. It consists of 9-12 stalked cells and it also contains ellipsoidal head. Cortex layer is also present which consist of parenchymatous cells. Endodermis is indistinct. Pericycle is 1-2 layered and consist of thick walled containing isolated fibers. Stele region is consists of vascular bundles which joined together in the form of ring.
- **Root:** in transverse section of roots, cork is present which is composed of thin walled tangentially elongated cells and outer few cells are with brown walls. 1-2 layers of thin walled cells of cork cambium. Secondary cortex is consists of 2-3 layers of parenchymatous cells which is followed by cortex and composed of 5-12 thin walled layers, oval to polygonal cells. Xylem is composed of vessels, tracheids and fibers, calcium oxalate crystals and starch grains are also present in between them.
- **Leaves:** in the transverse section anomocytic stomata is present in the both sides, they are numerous and having

short hairs. On veins and margin 3-4 celled are present. Only single layer of palisade is present and 2-4 layers of spongy parenchyma is present and small air spaces is present. Calcium oxalate crystals are present and in mesophyll orange red resinous matter is present. Palisade ratio 3.5-6.5, stomatal index 11-16, vein islet number 9-15.

- **Powder :** The powder shows characters like cork cells in surface view, acicular crystals of calcium oxalate up to 50 μ in length, prismatic crystals of calcium oxalate about 25 μ in length, thin long narrow fibers with sharp pointed ends and narrow lumen measuring up to 800 μ in length, simple to 5-compound oval to rounded starch grains measuring up to 15 μ in length, simple pitted vessels up to 200 μ in length and few parenchyma with starch grains. The leaf of plants upper and lower epidermis show the presence of numerous multicellular glandular hairs and anomocytic stomata. Palisade is one layered, spongy parenchyma 2-4 layered, cells polyhedral or isodiametric in shape with distinct intercellular spaces.

Identity, Purity and Strength: (Anonymus, 2001)

Foreign matter	NMT 2%
Total ash	NMT 15%
Acid insoluble ash	NMT 6%
Alcohol soluble extractive	NMT 1%
Water soluble extractive	NMT 4%

Phytochemistry: (Anonymus, 2001; Apu *et al.*, 2012; Banjare *et al.*, 2012; Bhope, Gaikwad, Kuber, & Patil, 2013; Bhowmik *et al.*, 2012; Pradhan *et al.*, 2020; Sahu *et al.*, 2008)

Punarnava (*Boerhavia diffusa*) contains number chemical compounds i.e. flavonoids alkaloids, steroids, triterpenoids, lipids, carbohydrates, proteins and glycoproteins. Punarnavine, boeravinone A-F, hypoxanthine, ursolic acid, punarnavoside, lirodendrin, arachidic acid, α -sitosterol, palmitic acid, ester of β -sitosterol, tetracosanoic, hexacosanoic, stearic, hentriacontane, β -Ecdysone.

Adulterants and Substitutes: (Goyal *et al.*, 2010; Mahesh, Kumar, Ranganath, & Devkar, 2012)

Punarnava (*Boerhavia diffusa*) are habitually adulterated with *Varshabhu* (*Trianthema portulacastrum*). *Punarnava* and *Varshabhu* probably have similar therapeutic potential but vary widely in their stomatal index and palisade ratios. *Varshabhu* (*Trianthema portulacastrum*) owning higher values than *Punarnava* (*Boerhavia diffusa*).

Pharmacological Activities:

- 1) **Analgesic and anti-inflammatory activity:** (Borrelli *et al.*, 2006; Hiruma-Lima, Gracioso, Bighetti, Robineou, & Brito, 2000; Murti, Panchal, & Lambole, 2010)
Plant lyophilized decoction and fresh leaf juice use to determine their antinociceptive effect using acetic acid induced abdominal writhing (chemical) model and hot plate (thermal) analgesic test. *B. diffusa* roots methanol extract was able to inhibit the contractions induced by acetylcholine (ACh) in the isolated guinea pig ileum.

- 2) **Antibacterial activity:** (A Agrawal, Srivastava, Srivastava, & Srivastava, 2004; Akinnibosun, Akinnibosun, & Ogedegbe, 2009; Desai, Desai, Navdeep, Arya, & Pooja, 2011)

Experimental studies showed that the aqueous, ethanolic and methanolic extracts of *B. diffusa* (leaf) has substantial antibacterial property against gram-positive and gram-negative pathogenic bacteria's.

- 3) **Antistress /Adaptogenic/ Immunomodulatory Activity:** (Mungantiwar, Nair, Kamal, & Saraf, 1997; Mungantiwar *et al.*, 1999; Sumanth & Mustafa, 2007)

Studies confirms the adaptogenic potential of *B. diffusa* root aqueous extract on Escherichia coli-induced abdominal sepsis, macrophage phagocytic activity in mice and on cold and forced swimming stress in rat.

- 4) **Hepatoprotective activity:** (Chandan, Sharma, & Anand, 1991; Gulati, Agarwal, & Agarwal, 1991; Rawat, Mehrotra, Tripathi, & Shome, 1997)

Extracts of the aerial part and roots of the plant show potential for hepatoprotection against CCl₄, country made liquor, thioacetamide and acetaminophen-induced hepatotoxicity in rats.

- 5) **Anti-convulsant activity:** (Adesina, 1979; Akah & Nwambie, 1993; Kaur & Goel, 2011; Lami, Kadota, Kikuchi, & MoMosE, 1991)

B. diffusa widely used in epilepsy in Nigerian folk medicine. Isolated compound 'liriodendrin' from the methanolic root extract reported as calcium channel antagonistic activity which was verified later in male Swiss albino mice model.

- 6) **Bronchial asthma:** (Kala, Kumar, & Gauthaman, 2009)
Dried leaves of the *Punarnava* are used as dhoomapana for the treatment of asthma. Leaf decoction is reported for its expectorant properties when combined with ginger juice and black pepper.

- 7) **Anticancer Activity:** (Srivastava, Saluja, & Chopra, 2005)

A dose-dependent *in-vitro* cytotoxic effect of root extract and leaf in HeLa and U-87 tumor cell lines was reported.

- 8) **Antifungal activity:** (Anurag Agrawal, Srivastava, & Srivastava, 2003)

In-vitro studies: Ethyl acetate root extract shown mycelial growth inhibition for *Microsporum gypseum* (78.83%), *M. fulvum* (62.33%), and *M. canis* (42.30%) in that order at 1mg/mL. The increase in concentration of extract also inhibited sporulation.

- 9) **Anti-viral activity:** (Awasthi & Verma, 2006; Lohani, Jan, & Verma, 2007)

Isolated glycoprotein with a molecular weight of 16–20 kDa when administered by foliar spraying in the field, it protects crops against natural infection by plant viruses.

- 10) **Antioxidant activity:** (Rachh *et al.*, 2009)

In-vitro studies: Ethanolic and methanolic extracts of the dried root showed good antioxidant activities in terms of ferric reduction and hydrogen peroxide quenching in comparison to ascorbic acid.

- 11) **Antiuro lithiatic Activity:** (Balaji, Banji, & Banji, 2015; Chowdhury & Sen, 1955; Gujral, Saxena, & Mishra, 1955; Han, Mutter, & Nasser, 2019; Pareta, Patra, Mazumder, & Sasmal, 2011; Patil & Bhalsing, 2016; Sawardekar & Patel, 2015)

Plant extract possess diuretic properties. The extract inhibited CaOx nucleation, aggregation and crystal formation in the synthetic urine *in-vitro* on addition of

NaOx. The lithogenic treatment caused polyuria, weight loss, hyperoxaluria and impairment of renal function which was prevented by plant extract.

12) Antifertility: (Seth, Khanna, Chaudhary, Singh, & Sarin, 1986)

Orally administered root extract (50% aqueous and ethanolic) in experimental monkeys able to stop intrauterine contraceptive device (IUCD)-induced bleeding.

13) Antidiabetic activity: (Bhatia, Kinja, Bishnoi, Savita, & Gnaneshwari, 2011; Gholap & Kar, 2004; Nalamolu, Boini, & Nammi, 2004; Pari & Satheesh, 2004)

The observations indicated that *Boerhavia diffusa* and its leaf extracts with various solvents revealed the antihyperglycemic activities in alloxan and streptozotocin induced hyperglycemic in experimental rats.

Conclusion

From the above assessment we can able to conclude that the plant *B. diffusa* consist with the wide range of biologically active molecules accountable for various type of therapeutic activity. In spite of the various developments and improvements in the field of modern medicine, presently amply natural products from traditional medicinal plants have been familiarized in the development of generic drugs. In addition, many products comprising with herbal extracts are marketed in the Asian arcade as substitutes or supplements of modern medicine. Recent years, ethnobotanical and traditional uses of natural compounds, particularly from plant derivation received considerable attention as they are well confirmed with their efficacy and safety. The accessible information in the literature for bioactivities of the *B. diffusa* shows that the plant comprehended with therapeutic potential and clinical relevance. It is a widespread remedy among the various folkloric groups, Ayurvedic and traditional practitioners for treatment of various ailments. It is widely used in management of problems associated with urinary tract. It is used by ethnic people of world as excellent anti-inflammatory, heart tonic, kidney tonic, jaundice, general fever, obesity, kill intestinal worms, night blindness and helps to remove mucous from bronchial tubes hence it is effective against asthmatic conditions also.

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