Botany, Traditional Uses and Pharmacology of *Bukkun Booti* - *Phyla nodiflora* (L.) Greene: An Underexposed Botanical Drug of AYUSH-Unani System

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ABSTRACT

*Bukkun Booti* (*Phyla nodiflora* (L.) Greene; Syn. *Lippia nodiflora* (L.) Michx.), of Verbenaceae, is a fast-growing creeping perennial medicinal herb, has a very long history for human use as it is generally distributed throughout the world. The plant has been traditionally used and recorded in AYUSH-Ayurveda, Unani and Siddha systems of medicine. In the Unani System of Medicine (USM), the *Bukkun Booti* is used for detoxification of the blood. It is useful in *Bawāsīr* (bleeding piles), *Ru’af* (epistaxis), *Hasāh al-Mathāna* (cystolithiasis), *Sozāk* (gonorrhea) ‘Usr al-Bawl (dysuria) and *Hummayat* (fevers). Ethno-medicinally, it has been widely used as a traditional folk medicine to treat and cure ailments by the local tribal and other communities. The entire plant is diuretic, febrifuge, stomachic and astringent; good for ulcers, wounds, asthma, bronchitis, knee-joints and to ladies after delivery. *Bukkun Booti* is a rich source of antioxidants and secondary metabolites, and aerial parts are reported to contain phenolic compounds (flavonoids), which are found to have a broad array of reported pharmacological actions such as; antibacterial, anti-inflammatory, antioxidant, antidiabetic and hepatoprotective properties. The purpose of this review paper is to bring together the available information on the current status and therapeutic uses of *Bukkun Booti* in the Unani System of Medicine and to discuss the botany and importance of the plant on the basis of folk uses, pharmacological activities and chemical constituents. The potential characteristics of *P. nodiflora* could be utilized more efficiently by linking the bridge of traditional uses, pharmacology and phytochemistry through an integrated approach.

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INTRODUCTION

Plant-based medicines have been used for ages in Indian traditional systems of medicine (AYUSH) for promoting healthiness and well-being. The World Health Organization ([WHO, 2000](https://www.who.int/healthinfo/questions/medicines)) defines traditional medicine as “the sum total of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental health conditions.”
mental illness”. Unani System of Medicine (USM) is considered as one of the most age-old systems of medicine, which originated in Greece and stretched itself to Arab countries and finally to India (Husain et al., 2017). The AYUSH systems, besides Ayurveda, Unani System also has a long history in the application of medicinal plants for a cure and therapeutc usages. There are several botanical drugs that are used in common between these two traditional systems for either the same or different therapeutic applications depend upon the formulations and method of preparations.

In USM, the botanical drug either can be used singly or in combinations. There are many botanical drugs that are very useful in Unani, Ayurveda and Siddha systems but little-known to the primary stakeholders. One of these known drugs is Bukkun or Bukkum Booti (Khare, 2007), which is under-explored for protection, cultivation and sustainable utilization as a botanical drug at a commercial level.

Phyla nodiflora (L.) Greene (Syn; Lippia nodiflora (L.) Michx.) is a prostrate marshy herb of the Verbenaceae family, commonly known as Bukkun or Bukkum Booti in Unani System of Medicine (USM) and Jalapippali in Ayurveda. The herb is found in the tropical and sub-tropical region of the globe and Indian subcontinent. Its entire parts have been used as a traditional medicinal cure in Asian and African systems of medicine. The herb found in most of the states throughout India at lower elevations (Cook, 1996), along lakes and dried water bodies. Bukkum Booti grows in open and damp places near ponds, water streams, and paddy fields. Leaves are eatable. Traditionally (folk), the plant is used as a diuretic and febrifuge. A paste or poultice made from the whole fresh plant is used to treat swelled cervical glands, chronic sluggish ulcers and boils. In USM, the whole plant, leaves and roots are used for different actions (Khare, 2007). The present review has been attempted to bring the relevant modern scientific evidence to one platform to understand the importance and usage of Bukkun Booti, specifically in USM. The therapeutic applications and their current status related to pharmacological research and development, botany and important phytochemicals are also discussed in detail.

**Current Scientific Accepted Name**

**Authority**

*Phyla nodiflora* (L.) Greene

**Synonyms**

*Lippia nodiflora* (L.) Michx.

*Verbena nodiflora* L.

**Classification (Bentham and Hooker System)**

| Kingdom          | Plantae – Plants |
|------------------|------------------|
| Division         | Tracheophyta     |
| Class            | Magnoliopsida – Dickotyledons |
| Order            | Lamiales         |
| Family           | Verbenaceae (Verbena family) |
| Genus            | Phyla Lour.      |
| Species          | Phyla nodiflora (L.) Greene |

**Classical Names**

Ayurvedic: Jalapippali, Shaaradi, Shakulaadani, Jalakarnaa

Unani: *Bukkun* or *Bukkum* / *Bukan* Booti

Siddha: Paduthalai

**Vernaculars**

Arabic: Filfil Ma

English: Wild sage, frog fruit, turkey tangle

Hindi: Jal-Buti, Bakkan, Bhuiokra, Chota-okra, Jalapapil

Kannada: Neeruhippali, Neerupipalli, Nelahippali, Malayalam: ana-coluppa, katu-tippali

Marathi: Ratolia, Vakkan

Punjabi: Gorakhmundi

Tamil: Poduthalai, Talamputam

Sanskrit: Vasir Vasuka, Jalakarna

Telugu: Bokenaku, Gajapippala-kada, Mosalipappu, Neeru Pippali Kada

**Habitat and Ecology**

*P. nodiflora* (Lippia) species is found mostly on high-moisture holding clay to clay loam soils in wetland habitats; ranging from marshes to open, damp places near the streams, meadows, river backwaters, the margins of tarns and ditches, with some tolerance of brackish (salty) water. *P. nodiflora* is well adapted to moist clay soils in riverine and floodplain surroundings (Fensham, 1998). It has been observed that the plant grow most profusely on the places which experience flooding of small duration (McCosker, 1994). To cope with the drier conditions, *P. nodiflora* becomes inactive for a period of time. The plant is also capable of tolerating the occasional or regular flood.

**Conservation Status-Threats Information**

*Phyla* species is assessed as Least Concern (LC) as it is prevalent with stable populations and does not face any major threats (Figure 1). As per the available data, there are no known ongoing or future major threats to this species.
Figure 1: Current status of the plant as per IUCN

Figure 2: A. Close view of the inflorescence with globose heads. B. Spathulate leaves along with elongated inflorescence. C. Whole plant with rooting at nodes

Red List Category and Criteria; Least Concern (ver 3.1) Date Assessed; 19 April 2018 Assessor/s: Lansdown, R.V. Reviewer/s: Sayer, C. Contributors: Molur, S., Patzelt, A., Knees, S.G., Bhat, G.K., Gupta, A.K. & Sadasivaiah, B. (Lansdown, 2019)

Justification: *Phyla nodiflora* is a common and widespread species with no known threats. Hence it is assessed as (LC) Least Concern (Lansdown, 2019; IUCN, 2019). Conservation Actions: No conservation action in place or needed.

Botanical Description

A creeping, small, perennial, much-branched herb with rooting at the stem nodes (Figure 2C), subquadrangular, clothed with appressed white hairs, seems nearly glabrous.

Leaves opposite, subsessile, spathulate (Figure 2B), obovate, 1-3 x 0.8-1.5cm, pubescent, base cuneate, apex rounded deeply fleshy, hairy, glabrescent to appressed pubescent and sharply serrate in the upper part (Kirtikar and Basu, 1981)
Inflorescence with sessile flowers, densely packed in long-pedunculated axillary heads which are at first globose heads eventually elongate and becoming spicate and oblong fruits (Figure 2A). Peduncles are 2.5-7.5 cm. long, usually produced from only one axil of each pair of the leaves (Figure 2C).

Calyx membranous, deeply two-lobed, compressed, glabrous on the back. Corolla pale pink, pushed off as a calyptra from ripening fruit. 2 lipped. Upper lip erect, bifid and lower lip 3 lobed. Drupes globose oblong, splitting into two, one-seeded glabrous-pyrenes; seeds minute (Pullaiah et al., 2000). Flowering and fruiting (Fl. & Fr) time; throughout the year

Cultivation and Harvesting Details

Phyla nodiflora thrives in a diverse range of habitats from the subtropics to the tropics and is propagated by seed or division. Its cultivation flourishes in any well-drained moderately fertile soil of low fertility in sunlight.

According to one report, the plant prefers ample moisture, while the other says that the well-grown plant is tolerant to drought. The plant makes a lot of vegetative growth when grown in the shade but does not flower well.

The plant can carpet large areas as it spreads very fast by means of running stems. Bukkun plant is capable of flowering and fruiting round the year.

P. nodiflora is susceptible to the fungi Meliola durantaee and Cercospora lippiae. It can be harvested whenever the need arises as leaves and flowers are in general present throughout the year.

After harvesting the plant parts of Bukkun Booti are usually used fresh but roots and above ground parts may well be dried for future use (Chuakul et al., 2001).

Use and Trade Information

Locally, the Bukkun plant is collected from the wild for domestic medicinal use. It is sometimes grown as an ornamental plant and as a ground cover in tropical to warm temperate regions of the globe.

In India, the infusion of the dried leaves of P. nodiflora species is mentioned as a remarkable remedy for a bronchial cough. Ethno-botanically the decoction of the plant, is used as a wash to boost weak babies to walk (Anonymous, 2001).

The plant is used as febrifuge and diuretic—poultice used as maturant for boils. An infusion of the leaves is given to the mother after delivery (Khare, 2007).
| S. No. | Plant Part Used / Form of Ethnomedicine | Ethnomedicinal Uses and Therapeutics | References |
|--------|----------------------------------------|-------------------------------------|------------|
| 1.     | Whole Plant (Pills)                    | Micturition, dysuria, bleeding piles | (Qureshia and Bhattib, 2008) |
| 2.     | Leaf juice                            | Dandruff, leaf juice mixed and boiled with an equal volume of gingelly oil, is applied twice a week on the head. | (Jeeva et al., 2007) |
| 3.     | Flowers, Leaves or Roots (Crude)       | Oral thrush                          | (Mahwasane et al., 2013) |
| 4.     | Whole Plant (Crude)                    | Nervous disorders, constipation, eczema, heatstroke, rheumatoid arthritis, gonorrhoea, pain, spasms. | (Rahmatullah et al., 2011) |
|        | Leaf and Stem                          | Dizziness, headache, fever           |            |
|        | Stem Bark and Leaf (Crude)             | Back Pain due to fall or Rheumatic pain |            |
| 5.     | Whole Plant (Crude)                    | Common cold                          | (Arulappan et al., 2015) |
| 6.     | Whole Plant (Crude)                    | Jaundice                             | (Prusti and Behera, 2007) |
| 7.     | Whole plant (Paste and juice)          | Paste for boils, swollen cervical glands, and chronic indolent ulcers. The juice is for bleeding gums. | (Ravinder and Vashistha, 2014) |
| 8.     | Stem and Leaf (Paste)                  | Headache (Forehead) Broken bones     | (Mandal et al., 2014) |
|        | Young Stem (Paste)                     |                                      |            |
| 9.     | Whole Plant (Decoction)                | Skin rashes                          | (Coe, 1997) |
| 10.    | Whole plant (Cooked)                   | Edible                               | (Roy, 2016) |
| 11.    | Leaves and Roots (Extract)             | Antibacterial                        | (Basha et al., 2011) |
| 12.    | Whole Plant (Paste)                    | Cure ulcer, burning Micturition and asthma. | (Sardar et al., 2015) |
| 13.    | Whole Plant, Tender stalks, Leaves, Fruits (Crude and Paste) | Diuretic, fever, cold, maturation of boils, useful in children indigestion, piles (control irritation) Fodder for sheep and goats (Capra hircus) | (Awan et al., 2013) |
Table 2: Pharmacological studies on *Phyla nodiflora*

| S. No. | Activity     | Part / Extract / Oil / Compound | Experimental Studies                                                                 | References                        |
|--------|--------------|---------------------------------|--------------------------------------------------------------------------------------|-----------------------------------|
| 1.     | Antibacterial| Methnolic extract               | Ethanol extract exhibited significant antibacterial activity against *S. aureus*, *M. luteus*, *P. mirabalis* by the agar diffusion method. (Balakrishna et al., 1996) |
|        |              | Essential oil                   | Ethanol extract exhibited significant antibacterial activity against *S. aureus*, *M. luteus*, *P. mirabalis* by the agar diffusion method. (Balakrishna et al., 1996) |
| 2.     | Anticancer   | Leaf extract                    | Exhibited induced apoptosis in human lung cancer (NCI-H460) cells showed high antiproliferative activity. (Vanajothi et al., 2012) |
|        |              | Methanolic extract              | Possessed antitumor activity in tumor bearing Swiss albino mice and significantly decreased the tumor volume and increased the life span. (Ashokkumar et al., 2009) |
| 3.     | Antidandruff | Ethanolic extract and isolated compound | Dandruff causing organism (*Malassezia furfur*) was found to be sensitive to all concentrations of the ethanolic extract and isolated compound. (Regupathi and Chitra, 2015) |
| 4.     | Antidiabetic | Methanol extract                | In streptozotocin-induced diabetic rats, a significant increase in the serum insulin level and decrease in fasting blood glucose, glycosylated haemoglobin levels and serum marker enzymes. (Balamurugan and Ignacimuthu, 2011) |
|        |              | γ-sitosterol-isolated from *L. nodiflora* | In streptozotocin (STZ) induced diabetic rats, γ-sitosterol significantly decreased the blood glucose level and glycosylated hemoglobin and increased the insulin secretion in response to glucose. (Duraipandiyan et al., 2011) |
| 5.     | Antifungal   | Crude extracts (ethanol, methanol, ethyl acetate, chloroform) from the leaves and shoots | The extract exhibited the most effective antifungal activities against; *Aspergillus flavus*, *A. niger*, *Paecilomyces varioti*, *Microsporum gypseum* and *Trichophyton rubrum*. (Pirzada et al., 2005) |
| 6.     | Antihyperuricemic | Methanol Extract            | Exhibited uric acid-lowering effect                                                                                         (Cheng et al., 2015) |

Continued on next page
| S. No. | Activity         | Part / Extract / Oil / Compound | Experimental Studies Cell lines / Animal model / Microorganisms | References                  |
|-------|------------------|---------------------------------|---------------------------------------------------------------|-----------------------------|
| 7.    | Anti-inflammatory| Methanolic Extract of Leaves    | The extract exhibited a significant anti-inflammatory and antinociceptive activity in acetic acid-induced writhing in white albino mice. | (Ahmed et al., 2004)         |
|       |                  | Cyclo-pentanophenanthrenol      | The anti-inflammatory potential of cyclo-pentanophenanthrenol has been demonstrated on in vitro inflammation models. | (Balakrishnan et al., 2010) |
| 8.    | Antioxidant      | Methanolic extract              | Exhibited concentration-dependent in vitro antioxidant activity and scavenging activities. | (Durairaj et al., 2008)     |
|       |                  |                                 | The bioactive compound obtained through bioassay-guided, ethyl acetate fraction demonstrated excellent antioxidant activity in vitro. | (Sudha and Srinivasan, 2014) |
| 9.    | Hepatoprotective | Methanolic extracts of leaves    | Protected the liver cells against Lipopolysaccharides (LPS) induced toxicity on HepG2 cells and decreased the apoptotic gene expression. | (Arumanayagam and Arunmani, 2015) |
|       |                  | Methanol Extract                | Exhibited worthy hepatoprotective and antioxidant activity in acute experimental liver injury by paracetamol | (Thamilselvan et al., 2008) |
| 10.   | Hypotensive      | Chloroform, ethyl acetate, methanol and water extracts | Of all, the methanolic extract reduced the systolic blood pressure significantly in uninephrectomized DOCA-salt hypertensive rats. | (Gadhvi et al., 2015)        |
|       |                  | Methanolic extract              | The systolic pressure in DOCA-salt hypertensive wister rats significantly decreased. | (Gadhvi et al., 2012)       |
| 11.   | Neuro-pharmacological | Petroleum, chloroform and ethanolic extracts of aerial part | Ethanolic extract (due to the presence of flavonoids)produced anxiolytic, sedative (central inhibitory) and anticonvulsant effect in mice. | (Thirupathy et al., 2011)    |
Description in Unani Classical Texts

Mizāj (temperament)

Unani scholars and Vaidya have differed in the identification of its temperament (Ashraf, 2011; Ghani, 2006);

1. Hot and Dry
2. Hot and Dry in Second Degree
3. Cold

Part Used

Mostly Leaf / Whole Plant

Dose

One tola (10 g)

Muzir (Adverse/Toxic Effect)

Not suitable for persons with ‘Hot’ temperament. It may cause or aggravate other diseases.

Musleh (Corrective)

Asl (honey) and mirch siyah (Piper nigrum) is used to remove its adverse effects.

Afa’al (Pharmacological Actions in Unani medicine)

As per the Unani classical text (Ghani, 2006) Bukkun Booti is Mubarrad (febrifuge), Musakkin Josh-e-Khoon (neutralize blood), Musaffi-i-Dam (blood purifier), Dafi’a Pasad-i Safra (neutralize bile), Munaffis Balgham (expectorant), Dafe Zeequnnafas (antiasthamatic), Dafe Jaraseem (antimicrobial), Musakkin-e-Alam (analgesic) and Muhallil Waram (resolve inflammation).

Bukkun is also Mudirr-i-Bawl (diuretic) and Mufattite hasat (lithotryptic). The infusion of the leaves is used in Sozish-e-Bawl (burning micturition) Usr-e-Bawl (difficulty in micturition) and Ehtebas-e-Bawl (retention of urine). It is useful in Khafqane Har (palpitation due to heat). It gives strength to the kidney and bladder (Hastae Gurda wa Masana) (Ashraf, 2011; Kabeeruddin, 2007).

Istem’al (Therapeutic Indications in Unani medicine)

Bukkun Booti is useful in Bawāsir (bleeding piles/ hemorrhoid), Ru’af (epistaxis) ‘Usr al-Bawl (dysuria) and Hasāh al-Mathāna (cystolithiasis) Hummayat (fevers) due to Lujufat (infection) and predominance of Balgham (phlegm)and Qula (stomatitis). A poultice of the fresh plant used externally as a paste to ripen boils and to cure inflammation (Muhallil Waram). Also indicated in Su’al (cough), which occurs due to Burudat (cold), ‘Sozāk (gonorrhoea) and used in various other conditions such as; asthma, bronchitis, knee joint pain, hepatitis, and infectious diseases (Ghani, 2006; Kalam et al., 2016).

Ethnomedicinal Uses

P. nodiflora plant is ethno-medicinally used as analgesic/anti-inflammatory/antipyretic diuretic, stomachic, febrifuge and astringent to the bowels; good for ulcers, wounds, asthma, bronchitis, ischury, knee-joints (Mukherjee, 1991). Usually, the plant is given to the women after delivery and kids suffering from indigestion. It is also useful in the treatment of menstrual disorders and respiratory diseases, reported having antimicrobial, antimalarial and antispasmodic action. A paste or poultice is further applied to cure swelling of cervical glands, to erysipelas, burns, and to old sluggish ulcers. It is said to be useful in constipation and the treatment of ischuria, blennorrhoea and lithiasis. An infusion is drunk as a post-partum tonic. An infusion of the whole fresh plant or the root is used in the treatment of fever. Some important information on ethnomedicinal uses has been summarized in Table 1. A survey of the available ethnobotanical literature on P. nodiflora showed that most of the workers had reported the use of the whole plant, followed by leaf (Figure 3), mostly in crude and paste form (Figure 4) of drugs (33 %). Most of the workers reported its ethnomedicinal use for healing purpose (maximum) and to treat different disease conditions, including fever, piles, pain and bleeding gums, gonorrhoea, jaundice and nervous disorders (Figure 5).

Pharmacological Evidence/ Experimental studies

A number of studies showed that P. nodiflora plant exhibited wide-ranging pharmacological properties, including; anti-inflammatory, antioxidant, anticancer, antihyperuricemic, hepatoprotective, antibacterial activity, and anti-fungal (Table 2).

Phytochemicals of Phyla nodiflora

Of many chemical constituents, mostly flavonoids class of chemicals has been isolated from P. nodiflora (Table 3). Phytochemical investigations have revealed the presence of numerous flavonoids from aerial parts, leaves and flower part of the plant. Phyla also contain flavone glycosides-nodiﬂorins (A) and nodiflorins (B), lipiflorins (A) and lipiflorins (B), in addition to flavones including; nepetin, nodiflorin and α-hydroxyluteolin, and glucosides; β-sitosterol and stigmasterol (Khare, 2007).

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| S. No. | Class of Compounds | Name of Chemical Constituent | References |
|-------|-------------------|-----------------------------|------------|
| 1.    | Flavonoids        | 4’-hydroxywogonin; 3,7,4’,5’-tetrahydroxy-3’- methoxyflavone; 7,8,4’-tetrahydroxy-3’- methoxyflavone; cirsiliol; larycitrin; onopordin 6-hydroxy-luteolin-6-sulfate; hispidulin; hispidulin-7,4’-disulfate; jaceosidin; jaceosidin-7-sulfate; jaceosidin-7,4’-disulfate; nepetin-3’,4’-disulfate; nepetin-7-sulfate; nodifloretin-7-sulfate | (Lin et al., 2014; Tomás-Barberán et al., 1987) |
| 2.    | Triterpene        | 3β-19α-di-hydroxy-urs-1,20-(30)-diene Lippiacin; Pomolic acid; Ursolic acid | (Akhtar, 1993) |
| 3.    | Phytosterol       | β-sitosterol; β-sitosterolglucoside 4’, 5’ dimethoxybenzoxystigmasterol; Stigmasterol; stigmasterolglucoside | (Barua et al., 1971; Akhtar, 1993) |
| 4.    | Quinol            | Benzofuranonereglglycolone (or halleridone); hallerone | (Ravikanth et al., 2000) |
| 5.    | Others            | α-ethyl-galactose; nodiflorin A; nodiflorin B; nodifloridin A; nodifloridin B; cornoside | (Rimpler and Sauerbier, 1986; Akhtar, 1993) |

**CONCLUSION**

*Bukkun Booti* (*P. nodiflora*; Syn. *L. nodiflora*) is a little-known but one of the most significant Unani medicinal plant. The current review deliberated the status, botany, therapeutic actions and uses available in classical Unani texts. Furthermore, a wide range of reported modern pharmacological actions and a reasonable amount of phytochemical data endorse the *Bukkun Booti* (*P. nodiflora*) as a promising medicinal plant, which could be utilized judiciously as healing-oriented medicine by adapting an integrative approach, especially to investigate the possible links between traditional uses, pharmacology and phytochemistry.

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**Conflict of Interest**

The authors declare that they have no conflict of interest for this study.

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