AYURVEDIC MEDICINAL IMPORTANCE OF SHANKHPUSHPI (*CONVOLVULUS PLURICAULIS*): POTENTIAL COGNITION BOOSTING HERB

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ABSTRACT

India is enriched in a diversity of plants since past times. Herbal plants are indigenous and very potent that consider a gift of nature. Shankhpushpi (*Convolvulus pluricaulis*) is known as a Medhya (brain tonic) Rasayana in the Indian traditional system. The medicinal herb is considered to enhance certain aspects related to intellect and memory improvement. Shankhpushpi is a Sanskrit word that means "the plant with flowers shaped like a conch. It is a perennial herb which seems like morning glory. The shankha is one of Lord Shiva's sacred instruments. It consists of various phytochemical constituents mainly in the form of proteins, amino acids and the alkaloids convolvine. Many types of research have been done on the *Convolvulus pluricaulis* plant and showed various therapeutic and pharmacological activities. It includes nootropic activity, antidepressant, antistress, anxiolytic, antioxidant, antidiabetic, cardiovascular activity and many others. Thus this medicinal plant is playing a vital role in the medical field. The present review is a summary of the phytomedicinal importance of *Convolvulus pluricaulis* in the traditional medicinal system as well as the modern system.

Keywords: *Convolvulus pluricaulis*, Shankhpushpi, Nootropic, Ayurveda, Alcohol

INTRODUCTION

Herbal drugs are gaining popularity in the field of medicine in both developing and developed countries because of their natural origin and fewer side effects [1]. Human recognized their dependence on nature for a healthy life. Humanity has depended on the diversity of plant resources for food, clothing, shelter and medicine to cure myriads of ailments [2]. Plants are the principal source of natural compounds that possess biological and pharmacological activities [3,4,5]. The phytochemical constituents are extracted from the plant. They have been used in both traditional and modern medicine in the world [6,7]. In India, Shankhpushpi is utilized mostly in Ayurvedic pharmacopeia. All the parts of the plant are considered as a therapeutic source for various human diseases. Shankhpushpi was consisting of the whole plant of *Convolvulus pluricaulis*, *Evolvulus alsinoides*, *Citorea ternatea*, *Lavendula bipinnata* and *Canscora decussata*. Plants other than *C. pluricaulis* use the name Shankhpushpi in different parts of the country. Further studies have been established that *Convolvulus pluricaulis* is the plant species that should be taken in the name of Shankhpushpi [8]. *Convolvulus* is a genus of the *Convolvulaceae* family [9]. *Convolvulaceae* is known as the morning glory family of the plants that are covering over 1880 species in 57 types [10]. The quality standard of *C. pluricaulis* was published by the Indian Council of Medical Research [11]. The number of researches proved their scientific potential in the central nervous system, depression, anxiolytic, tranquilizing, antidepressant, antistress, neurodegenerative, anti-amnesia, antioxidant, hypolipidemic, immunomodulatory,

analgesic, antifungal, antibacterial, antidiabetic, antiulcer, antiscatonic, and cardiovascular, antidiabetic, antiulcer, antiscatonic and cardiovascular activity [12]. Shankpushpi is a Sanskrit word that means "the plant with flowers shaped like a conch". According to Hinduism, Shankha is one of the sacred instrument of Lord Shiva. The plant is widely distributed in southern parts of India, Sri Lanka and Myanmar. It is mostly cultivated above an altitude of 1300m. It consists of various phytochemical compounds like xanthenes, triterpenoids, loliolide, sterols and flavonoids [13,14]. Many types of research have been done on the *Convolvulus pluricaulis* plant and showed various therapeutic and pharmacological activities. It includes nootropic activity, antidepressant, antistress, anxiolytic, antioxidant, antidiabetic, cardiovascular activity and many others. Vernacular names and Taxonomy of *Convolvulus pluricaulis* is given in table 1 and 2 respectively.

Table 1. Vernacular names of *Convolvulus pluricaulis*

English	speedwheel
Hindi	Shankpushpi, Aparajit
Sanskrit	Sankhapuspi
Urdu	Sankhali
Punjabi	Shankpushpi
Bengali	Sankhapuspi
Gujarati	Shankhali
Kannada	Bilikanthisoppu
Malayalam	Krsnakranti, Vishnukranthi
Marathi	Shankhabela
Oriya	Krishna-enkranti
Tamil	Sanghupushpam, kakkurattai
Tibetan	Shankpushpi
Telugu	Shankpushpi

Table 2. Taxonomical classification of *Convolvulus pluricaulis*

Taxonomical Rank	Taxon
Kingdom	Plantae
Sub Kingdom	Tracheobionta
Division	Magnoliophyte
Class	Magnoliopsida
Order	Solanales
Family	Convolvulaceae
Genus	<i>Convolvulus</i>
Species	<i>Pluricaulis</i>
Common Name	Shankpushpi

BOTANICAL DESCRIPTION OF CONVULVULUS PLURICAULIS

C. pluricaulis (Figure 1) is a perennial plant. The branches of *C. pluricaulis* are widely spread on the ground and long up to 30 cm. Roots are usually branched, cylindrical, ribbed having some rough stem nodules. Small roots are 1-5cm long, 0.1-.04 cm thick. The color of the root changes from brown to light brown. Stems are cylindrical with hairy nodes and internodes. Leaves are shortly petiolate linear-lanceolate, acute, hairy on both surfaces. Leaves are 10.5-2 cm long and 0.1-0.5cm broad light green in color. Flowers are white or purple. It is solitary or in pairs sessile or sub-sessile in the leaf axis. Fruits are capsuled, oblong globose with coriaceous, pale brown pericarp. Seed are minutely puberulous and brown in color [15].

Figure 1. *Convolvulus pluricaulis* (Shankhpushpi)

GEOGRAPHICAL DESCRIPTION OF CONVULVULUS PLURICAULIS

Convolvulus species are distributed all over the world. But the plant *convolvulus pluricaulis* is mostly cultivated in areas with a Mediterranean climate and in semi-desert regions. In India, *C. pluricaulis* is known from the margins and within the Sahara and Sind desert [16]. It is widely distributed in Gujarat, Konkan, Sindh and Bihar. It is found all over in rainy season [17,18]

PHYTOCHEMICAL CONSTITUENTS OF CONVULVULUS PLURICAULIS

There are various chemical constituents isolated from Shankhpushpi like Carbohydrates-D-glucose, rhamnose, maltose, sucrose and starch. It also contains protein, amino acids and the alkaloids-convolvine, convosine, subhirsine and convolidine along with fatty acid and wax constituents, hydrocarbons, aliphatic and sterol and certain other bio-chemicals [18].

1. Carbohydrates: D-glucose, maltose, rhamnose, sucrose, starch and other carbohydrates [19,20].
2. Fatty acids/ Volatile oil/ Fixed oil: Fatty alcohols [21] and hydrocarbons, 30.9% myristic acid, 66.8% palmitic acid and 2.3% linoleic acid and hextriacontane [22,23].
3. Protein and Amino acids: Proteins and amino acids are also isolated from the plant.
4. Phenolic/Glycosides/Triterpenoid/Steroids: Deshpande et al., reported a chemical examination of the whole plant of *C. pluricaulis* and found the presence of scopoletin, β -sitosterol and ceryl alcohol [5]. Chloroform fraction of this contains 20-oxodotriacontanol, tetratriacontanoic acid and 29-oxodotriacontanol, flavonoid-kampferol, steroids-phytochemical [4]. CP-1 is a phytochemical marker that has been isolated and characterized by the HPTLC technique [24,25,26,27].

Figure 2. Chemical structure of some major constituents of *C. pluricaulis*(Shankpushpi)

TRADITIONAL AND MODERN VIEW

A. AYURVEDIC VIEW

Convolvulus pluricaulis is a common plant in southern India. The herb is quoted to be Soubhagyakarana and Vasikarana in Vedas. There are various synonyms used for shankpushpi in Ayurveda like Nyastika, Subhangakarani, Sahasraparni, samvanani, samuspala, babhru, kalyani etc. According to Acharya Charak Shankpushpi is one of the best "medhya drug" in MedhyaRasayana. Brihtrayi has mentioned Shankpushpi's limited number of times and they did not include it in any Gana or Varga. Dhanvantarinighantu mentioned only one variety of Shankpushpi. Sodhala mentioned both varieties red (Raktapuspika) and blue flowered (Nilapushpa) and Kaiyadevnighantu described two varieties like Shankpushpi and Sarpakshi. Bhavamishra quoted it in two varieties like white (Shvet) and blue (Nila) varieties [28]. The rasa Panchak and description of this herb according to nighantus are mentioned in table no. 3 and table no. 4 accordingly.

Table 3: Rasa Panchak of Shankpushpi [29]

Sanskrit/English	Sanskrit/English
Rasa/Taste	Katu, Kashaya/Astringent, Bitter
Guna/Physical Properties	Guru, Sara, Snigdha, Pichchila/Heavy, oily
Virya/Potency	Ushna/ Hot
Vipaka/Metabolic property	Madhura/ Sweet

Table 4: Description of Shankpushpi in Nighantus

1. DhanvantariNighantu	It quoted this herb in KarviradiVarga. It explained shankpushpi as a medhya and Rasayana drug. It is utilized in Vishachikitsa (toxicity), ApasmarChikitsa (Epilepsy) and Bhootchikitsa (Psychological diseases) [30]
2. KaiyadevNighantu	According to this, Shankpushpi is said to be Medhya and Rasayana. It is also utilized in Apasmar (epilepsy), Kushtha (skin related) , Bhoot, Visha (toxicity) and krimi-chikitsa (parasitic infections) [31].
3. ShodhalNighantu	It quoted Shankpushpi in KarviradiVarga. There is incomplete description of shankpushpi in ShodhalNighantu [32].
4. MadanpalNighantu	Shankpushpi is described in AbhyadiVarga. It is also known as Kiriti, kambumalini, Shankhahuli, Shankhnagni. This is also utilized as Medhya, Rasayana, Intellect promoter and as cognitive drug [33].
5. BhavprakashNighanti	According to this, Shankpushpi is described in GuruchyadiVarga. Shankhavaha, Manglayakusuma are the synonyms given to the plant. It also mentioned shankpushpi to be utilized as medhya (mind rejuvenator), Vrishya (Aphrodisiac), manasroghrit, rasayana, and a cognitive drug. It also to be recommended in Kushtha, krimi and vishachikitsa, shankpushpi is said to be Kasaya and Ushna [34].
6. Raj Nighantu	It described Shankpushpi in Guruchydivarga. It described as a drug that promotes intellect and helps to improve voice quality [35]

Actions of Shankpushpi according to Ayurveda

Medhya – promotes the intellectual capacity

Swarakarini – improves voice

Grahabhootadidoshaghni – useful in diseases of supernatural origin

Rasayani- rejuvenates the body

Kantida- enhances the aura of the body and gives it a healthy look

MajjadhatuRasayana – rejuvenates the nervous tissue

Unmadaghna – alleviates insanity and emotional instability

Vrishya- aphrodisiac

Pachanbala- increases the strength of the digestive system

Chedana- Laxative

Nidrajnana- promotes sleep

Various Formulations of Shankpushpi described in Charak Samhita [36]

PrathamBrahmarasayana, Dwitiya Brahmarasayana, IndraRasayana, MedhyaRasayana, Brahmi Ghrit, Brahmi Ghrit + Shankpushpi, AgstyaHaritaki

Various Formulations of Shankpushpi described in AstangHridya [37]

AgstyaHaritaki, TalvavagunthanVidhi, AstangGhrit, Brahmi Ghrit, Brahma Rasayana, MedhVridhikarRasayana, BrahtiaadiRasayanaYog

Various Formulations of Shankpushpi described in Sharangdhar Samhita [38]

BrahmiaadiSwarasa, Agstyaharitkyaaavaleh, Bindughritam

B. FOLK VIEW

Ethnobotanical research into medicinal plants is becoming an important part of Indian research and has been included in advanced research during recent years. Plants have much relevance to socioeconomic and socio-religious aspects of Human life in India. It is an herb that has been utilized in India for hundreds of years for many disorders such as stress, anxiety and insomnia and promotes longevity and prevents diseases by providing strength and immunity. Shankhpushpi is a Sanskrit word. It is the combination of two words shankh+pushpa in this shankh means a marine shell and Pushpa means flower. Shankha is one of Lord Shiva's sacred instruments often used in ritual worship. Therefore, shankhpushpi means the plant with flowers shaped like a conch. This herb is utilized for centuries in India for the treatment of many ailments like anxiety, insomnia and to promote longevity and prevent diseases by providing strength and immunity. According to literature tribal in Chhindwara, Madhya Pradesh describes the plant as an anthelmintic, good in dysentery and also for cure skin ailments and reduces high blood pressure. The leaves of the plant are recommended for mental disturbance and depression by the locals of Gonda, Uttar Pradesh [39,40,41,42].

MODERN VIEW

In modern times the herbal drugs are preferred more due to their several advantages over modern synthetic drugs made up of inorganic sources. Herbal drugs have negligible adverse impacts on the living systems also these are less expensive than synthetic drugs. But due to increasing market demand for these herbal drugs their quality is getting degraded due to factors like adulteration and contamination [43,44,45]. Unintentional adulteration of herbal drugs is induced by misidentification of species or sometimes by misidentification of plant parts. It is most probably happened due to the conflict in similarities of vernacular names as well as scientific names of various medicinal plants. And this practice is directly or indirectly associated with the degradation of herbal drugs [46]. For instance, *M. malabrica* (false nutmeg) is the most common adulterant which is used in true mace herbal drugs [47]. Intentional adulteration is the primary reason behind the degradation of herbal drugs which is induced to derive maximum profit. It is done by using either orthodox drugs or by the substitution of inferior products or by adding foreign particles which are most commonly called as contaminants such as sand, metals, soil etc. [48,49,50]. Mercury, arsenic, and lead, cadmium, copper and thallium, pesticides, microbes and mycotoxins are the most commonly used contaminants in herbal drugs [51,52,53,54,55,56,57]. Powders, capsules, extracts are the commonly available forms of herbal drugs in the market. Usually, adulterants are added to the herbal drugs either before the processing phase or during the processing phase. Proper quality analysis and standardization protocols are needed to be applied during these phases so that the health risk can be avoided [58,59,60]. Standardization ensures the quantity and quality of the herbal drugs [61]. The most preferred technique in today's time is the standard DNA barcode which significantly works on the identification of species [62]. Shankhpushpi is a potent herb that is used in many medicines currently available in India. The formulations are made up of mixing of many plant extracts or powders including *Convolvulus pluricaulis*. These formulations are complex preparations of compounds medicines and involve several processes. Some preparations have been subjected to clinical trials [63].

Remem (Zydus Industries, India): These medicines are coming in the syrup, tablets. There are 10 species included in this like *Centellaasiatica*, *Celastruspaniculatus*, *Convolvulus pluricaulis*, *Asparagus racemosus*, *Acoruscalamus*, *Embeliaribes*, *Tinosporacordifolia*, *Achyranthesaspera*, *Terminalia chebula*, *Saussurealappa*.

Tirukati: There are 13 species included in this medicine. It included *Bacopamonnieri*, *Convolvulus pluricaulis*, *Centellaasiatica*, *Asparagus racemosus*, *Valerianawallichi*, *Ruerariatuberosa*, *Saussurealappa*, *Embeliaribes*, *Tinosporacordifolia*, *Operculinaturpethum*, *Pavoniaodorata*, *Caryophyllusaromaticus*, *Foeniculumvulgare*.

Ayumeno: It was formulated by Welexlabs, India. 5 species used in this formulation like *Centellaasiatica*, *Convolvulus pluricaulis*, *Celastruspaniculatus*, *Withaniasomnifera*, *Asparagus racemosus*.

Abana (The Himalaya Drug and Co. India): Medicines are coming in the form of tablets and syrup. It included 19 species: *Centellaasiatica*, *Convolvulus pluricaulis*, *Celastruspaniculatus*, *Balsamodedronmukul*, *Ocimum sanctum*, *NardostachysJatamansi*, *Piper longum*, *Carumcopticum*, *Zingiberofficinalis*, *Cyperusrotundus*, *Acoruscalamus*, *Embeliaribes*, *Syzygiumaromaticum*, *Santalum album*, *Elettariacardamomum*, *Foeniculumvulgare*, *Rosa damascene*, *Cinnamomum cassia*, *Crocus sativus*.

Tejras (Sandu Brothers, India): 12 species included in the formulation like *Centellaasiatica*, *Convolvulus pluricaulis*, *Celastruspaniculatus*, *Eclipta alba*, *Cynodondactylon*, *Asparagus racemosus*, *Withaniasomnifera*, *NardostachysJatamansi*, *Acoruscalamus*, *Zingiberofficinalis*, *VetiveriaZizanoides*.

Shankhapushpi (Unjha Pharmacy, India): The formulation comes in the form of syrup and it includes 6 species: *Convolvulus pluricaulis*, *Centellaasiatica*, *NardostachysJatamansi*, *Nepeiahindostana*, *Nepeiaelliptica*, *Onosmabrateatum*.

REPORTED PHARMACOLOGICAL STUDIES OF CONVOLVULUS PLURICAULIS

Various studies have been conducted on this plant to know its pharmaceutical and therapeutic uses. Large-scale clinical studies are still needed to prove the clinical efficacy of this herb, especially in stress-related diseases, neuronal disorders and antidepressants. Some reported studies on *Convolvulus pluricaulis* are shown below:

1. Nootropic Activity: From reported studies, it was investigated that the ethanolic extract of *Convolvulus pluricaulis* and its ethyl acetate and aqueous fractions were possessing nootropic activity. Two doses of 100 and 200 mg/kg/p.o of ethyl acetate and aqueous fractions were given to rats in separate groups. Both the doses of *Convolvulus pluricaulis* proved to be significant for memory and learning in rats [64]. This activity was assessed with passive and active avoidance paradigms using Cook and Weidley's pole climbing apparatus and elevated plus-maze as models.

One more study was conducted to find out the nootropic property of Shankhpushpi. Three plants i.e. *Convolvulus pluricaulis*, *Clitoriaternatea*, *Evolvulusalsinoides* were evaluated for the nootropic activity using RPM, Porsolt's swim despair and actophotometer models. The results showed that all three plants possess nootropic, anxiolytic and CNS- depressant activity but *C. pluricaulis* plant showed a true source for memory enhancement [65].

2. Anxiolytic, Antidepressant, Antistress, Neurodegenerative and Antiamnesic activity: From various studies it was investigated that *C. pluricaulis* possess antagonist activity. The alcoholic extract of *C. pluricaulis* was investigated to cause an antagonist effect against amphetamines and tremorine [66,67].

A study was conducted to evaluate the effect of petroleum ether, chloroform, and ethyl acetate fraction of the ethanolic extract of *C. pluricaulis* on the depressed mice. It was administrated orally for 10 successive days to separate groups of Swiss young male albino mice. The effects on mice's immobility periods were assessed in the forced swim test (FST) and tail suspension test (TST). The result showed that only chloroform fraction in doses of 50 and 100mg/kg significantly reduced the immobility time in both FST and TST [68].

From a reported study it was found that the methanolic extract of the *C. pluricaulis* produced an alteration in the general behavior pattern, reduction in motor activity, hypothermia, reduction in exploratory behavior pattern and suppression of aggressive behavior in the animal model [69].

One more study was conducted on the albino rats to evaluate Antiamnesic property. The dose of *C. pluricaulis* (100mg/100g body weight) was given to the model. The result showed lesser effects than diazepam but higher than that of *Centellaasiaticalinn*, *urban Hydrocotyleasiatcalinn* [70,71,72,73,74,75].

3. Effect on Thyroid Function: One more study was conducted on the hyperthyroid mice. The root extract of *Convolvulus pluricaulis* was administrated in the model for 30 days. It was found that the plant extract-induced inhibition in thyroid function and mediated through T4 to T3 conversion [76,77].

4. Antioxidant activity: Nahata et al., reported that the ethanolic extract of *C. pluricaulis* possesses significant antioxidant activity.

5. Hypolipidemic activity: From a reported study it was found that the ethanolic extract of *C. pluricaulis* possesses hypolipidemic activity. The extract was administrated to Cholesterol fed gerbils. Results showed a reduction in serum cholesterol, LDL cholesterol, triglycerides and phospholipids significantly after 90 days [78].

6. Analgesic Activity: Sharma et al., investigated analgesic activity of *C. pluricaulis* in the mice. The extract of *C. pluricaulis* was caused a reduction in the fighting behavior in the model but didn't show analgesic property although it potentiated morphine analgesia.

7. Antimicrobial activity: *C. pluricaulis* plant was bioassayed by the leaf disc method by feeding deterrence using *Spilosoma oblique* walker as a test insect. A new compound, 29-oxodotriacontanol was isolated from the chloroform fraction of this plant which was found to be a significant antifeedant constituent whereas another compound, tetratriacontanoic acid was discovered for the first time in this plant [79].

8. Antidiabetic Activity: Alam et al., was reported that *C. pluricaulis* plant possesses antidiabetic activity. The extracts were found to be an effective remedy for the treatment of diabetes [80].

9. Antiulcer and anticatatonic activity: Sairam et al., investigated the antiulcerogenic activity of the fresh juice of *C. pluricaulis* in rat model. The model was artificially injected with ethanol and aspirin to cause gastric ulcer in the stomach. *C. pluricaulis* was given orally twice daily in the doses of 375 and 750 mg/kg body weight. Results showed anti-ulcerogenic effects in the rats[81].

10. Effect on Reproductive system: Singh et al., was reported in their study that the juice of the *C. pluricaulis* plant prevents excessive menstruation. The fine paste of the plant is helpful for the treatment of abscesses [82].

11. Cardiovascular activity: From the reported studies it was found that total water-soluble extract of the *C. pluricaulis* plant caused a marked and prolonged hypotension in dogs and also reduced the frog myocardium. Ethanolic extract of the plant exerted a negative

ionotropic action on amphibian and mammalian myocardium. It also deployed spasmolytic activity on smooth muscles [83,84,85]

12. Alcohol Addition: A study was conducted on the mice to investigate the effect of shankpushpi as an anti-addictive drug. The effect of churna of shankpushpi was measured on ethanol withdrawal anxiety in mice model using elevated plus maze. Results showed that shankpushpi churna reversed ethanol withdrawal anxiety and also decreased chronic alcohol consumption in these mice in a GABA receptor-dependent manner [86].

13. Anthelmintic Activity: Shankpushpi is a highly bitter in taste and also known as anthelmintic drug. *In-vitro* study was conducted on the six adult Indian earthworms and cattle worms to evaluate the anthelmintic effect. It was found that shankpushpi is effective on the earthworm and has anthelmintic activity [87].

Table 5: Reported therapeutic and pharmacological properties of *Convolvulus pluricaulis*

S. No.	Extract	Method (<i>in vivo</i> / <i>in vitro</i>)	Pharmacological Activity	References
1	Ethanollic Extract/ Ethyl Acetate	Rat Model	Nootropic Activity	64
2	Alcoholic Extract	<i>In vivo</i> study in Rats	Antagonist	66,67
3	Petroleum ether, chloroform, ethyl acetate fraction of Ethanollic extract	Swiss young male albino mice	Anti-depressant	68
4	Methanollic Extract	Rat Models	Anti-stress	69
5	Root extract	<i>In vivo</i> study in Albino mice	Neurodegenerative	70,71,72,73, 74,75
6	Root extract	<i>In-vivo</i> study in hyperthyroid mice	Effect on thyroid	76,77
7	Ethanollic Extract	<i>In vivo</i> study in cholesterol fed gerbils	Hypolipidemic	78
8	Root extract	Mice Model	Analgesic Activity	79
9	Water soluble extract	<i>In vivo</i> study in Dog/frog	Cardiovascular	83,84,85
10	Root extract	Mice model	Alcohol Addition	86

TOXICOLOGICAL ASSESSMENT

The mice model treated with extracts of *C. pluricaulis* plant showed a sedative effect at doses higher than 200mg/kg and reflected a moderate to the marked decrease in locomotor activity. The activity lasted for 1-2 hours. The decrease in motor activity due to spontaneous motor activity was observed during the study. At a higher dose animals died due to respiratory distress [88].

CONCLUSION

Convolvulus pluricaulis is utilized as folk medicine to cure different diseases. According to the Indian Traditional system (Ayurveda), Shankhpushpi is considered as one of the most significant plant and the best nootropic agent. It is a primary source from where we get carbohydrates, proteins, amino acids, starch and volatile oils. These are the class of phytochemicals that are utilized as the main constituent in numerous formulations endorsed for several ailments. It is referred as an antioxidant, antidiabetic, antagonist, antidepressant, cardiovascular and many others. It is specially used as a cognitive boosting agent. As this herb is very bitter and pungent, so there is a need to develop its herbal formulation with improved taste for better patient compliant.

ACKNOWLEDGMENT

Authors are thankful to the Department of Research and Development of JeenaSikhoPvt. Ltd. ZirakpurPunjab for giving us the opportunity to explore this ancient medicinal plant.

CONFLICT OF INTEREST

None

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