

Available online on 15.06.2021 at <http://jddtonline.info>

Journal of Drug Delivery and Therapeutics

Open Access to Pharmaceutical and Medical Research

Copyright © 2021 The Author(s): This is an open-access article distributed under the terms of the CC BY-NC 4.0 which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited



Open Access Full Text Article



Review Article

An Ayurvedic Herbal Plant '*Bryonia laciniosa*' with its Ethnomedicinal Significance

Kaurav Hemlata*¹, Choudhary Shailja², Chaudhary Gitika³

Shuddhi Ayurveda, Jeena Sikho Lifecare Pvt. Ltd. Zirakpur 140603, Punjab, India

Article Info:



Article History:

Received 09 April 2021
Review Completed 26 May 2021
Accepted 03 June 2021
Available online 15 June 2021

Cite this article as:

Kaurav H, Choudhary S, Chaudhary G, An Ayurvedic Herbal Plant '*Bryonia laciniosa*' with its Ethnomedicinal Significance, Journal of Drug Delivery and Therapeutics. 2021; 11(3-S):137-141
DOI: <http://dx.doi.org/10.22270/jddt.v11i3-S.4889>

*Address for Correspondence:

Kaurav Hemlata, Shuddhi Ayurveda, Jeena Sikho Lifecare Pvt. Ltd. Zirakpur 140603, Punjab, India.

Abstract

Bryonia laciniosa is one such plant that is also known by the name of shivlingi as its seeds resemble the 'shivling' icon of Lord Shiva. This plant is mainly known for its seeds and is used in various ayurvedic drug formulations as an important ingredient. In Ayurveda and the folklore culture, shivlingi plant is used to treat various types of diseases such as cholera, bronchitis, constipation, diabetes, inflammation, paralysis, snake bites, abdominal diseases and mainly used as an aphrodisiac agent. In homeopathy, the *B. laciniosa* plant is used as an important ingredient in the formulation of anti-inflammatory drugs. Also, the plant is used to treat gastrointestinal, rheumatic, respiratory, liver, infectious diseases and metabolic disorders. Besides this, shivlingi plant is associated with therapeutic potential which includes analgesic, antidiabetic, antioxidant, androgenic, antitumor, fertility and antipyretic properties. In this review article, the reported pharmacological properties of the plant have been described along with the plant utilization in folklore and ayurvedic medicinal system.

Keywords: Ayurveda, Shivlingi, Folk view, Pharmacological properties

Introduction

Bryonia laciniosa is also known by the name of 'Shivlingi' as the upper surface of the seeds has a marking and morphology which resembles 'Shivling' icon of Lord Shiva¹. In Greek, the word *Bryonia* means 'to sprout' which refers to the vigorous growth of herbaceous stem². It is an annual plant that is distributed throughout India, Philippines and some parts of Africa. It is categorized under Vrishya Rasayana in the Ayurvedic medicinal system. It belongs to the family *Cucurbitaceae*. The plant is mainly used for medicinal purposes. Traditionally, the shivlingi plant is used to treat inflammation, inducing diuresis and as a tonic³. The plant parts are also used to treat bronchitis, cholera, carbuncles, colic, convulsions, cough, delirium, fertility, paralysis and snakebite⁴. The seeds of the plant are used to cure sterility, female infertility, oligospermia, constipation, diabetes, obesity and weight loss⁵. The fruits of the plant are used to treat leukoderma, abdominal disease and inflammation⁶. Also, the roots of the plant are associated with kidney stone removal, diuretic, antitumor and hepatoprotective properties⁷. The plant holds a significant value in pharmacology as well. It is associated with various therapeutic potential such as antipyretic, anti-diabetic, anti-hyperlipidemic, anti-oxidant, spermatogenic, aphrodisiac, fertility booster and is used as a uterine tonic^{8,9,10}. However, the plant is considered as an endangered species due to its overexploitation by the people for medicinal purpose. Table

no. 1 & 2 represents the vernacular names and taxonomical classification of the plant.

Table 1 Vernacular names of *B. laciniosa* plant

Gujarat	Shiva lingani
Bengal	Shiva lingani
Hindi	Gargumaru, Ishwara lingi, shivalingi
Malayalam	Neohmaka
Marathi	Shivlingi, Vaduballi
Sanskrit	Pastambhini, Bakapushpha, Shiva Mallika
Telugu	Lingadanda
English	Indian bryony, Lollipop climber
Kannada	Linga tondeballi, Lingatonde balli, Lingatonde, Shivalinga
Tamil	Iyaveli/Iyviral
Siddha	Iyaveli, iyaviraali
Nepal	Ghurmi iahara, Ghuru



Figure 1 *Bryonia laciniosa* (shivlingi)

Table 2 Taxonomical classification of *B. laciniosa*

Taxonomical Rank	Taxon
Kingdom	Plantae
Sub-kingdom	Tracheobionta
Superdivision	Spermatophyta
Class	Magnoliopsida
Subclass	Dilleniidae
Order	Violales
Family	Cucurbitaceae
Genus	<i>Bryonia L.</i>
Species	<i>Bryonia laciniosa</i> Linn.

Botanical Description

Bryonia laciniosa belongs to the family *Cucurbitaceae*. It is an undershrub climber consists of various tendrils. The stem of

the plant is grooved, slender, glabrous and heavily branched with a bad foul smell. The leaves of the plant are simple, alternate, 10-15 cm long and about as broad, membranous, smooth, scabrid and green, deeply cordate at base, acute, 5 lanceolate. Tendrils are striated, glabrous and slender. Petioles are 2.5-3.7 cm long. Both male and female flowers are present that are regular and green-pale-yellow. Male flowers are quite distinct, contain 3 stamens and 3-6 small fascicles. Female flowers are few, formed in cluster, solitary in the same axils with 5 petals that are fused about ¼ way up, acute, pubescent and with oval-oblong segments. The calyx is 205 mm long, glabrous, teeth subulate. Corolla is oblong, acute, pubescent and 3-4 mm long. Fruits are smooth, globose, subsessile, 1.8 to 2.5 cm in diameter, green with white blotched stripes in unripe form and turn to bright red-orange color when mature. Seeds are yellowish-brown and 5-6 mm long¹¹.

Geographical Distribution

The plant is distributed in countries like Nepal, Pakistan, Thailand, South Japan, Sri Lanka, Philippines, Indonesia, Tropical Africa, Australia, Bhutan, China and Philippine islands. In India, it is found in the states of Bihar, Jharkhand, Andhra Pradesh, Goa, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Chhattisgarh, Maharashtra, Manipur, Rajasthan, Tamil Nadu, Tripura and Uttar Pradesh¹².

Phytochemical constituents of *B. laciniosa*

The main chemical constituent present in the plant is Bryonin. The seeds of the plant contain saponin molecules, flavonoids, phenolic acids, sugars, punicic acid, goniiothalamine and glucomannan¹³. The polysaccharides and fatty acids were isolated from the pulp part of the plant¹⁴. These polysaccharides include d-glucose, d-mannose and L-arabinose in the ratio of 5:3:4. However, detailed studies on the phytochemical screening of the plant is not reported yet. Figure no. 2 represents the phytochemical structures of *B. laciniosa* plant.

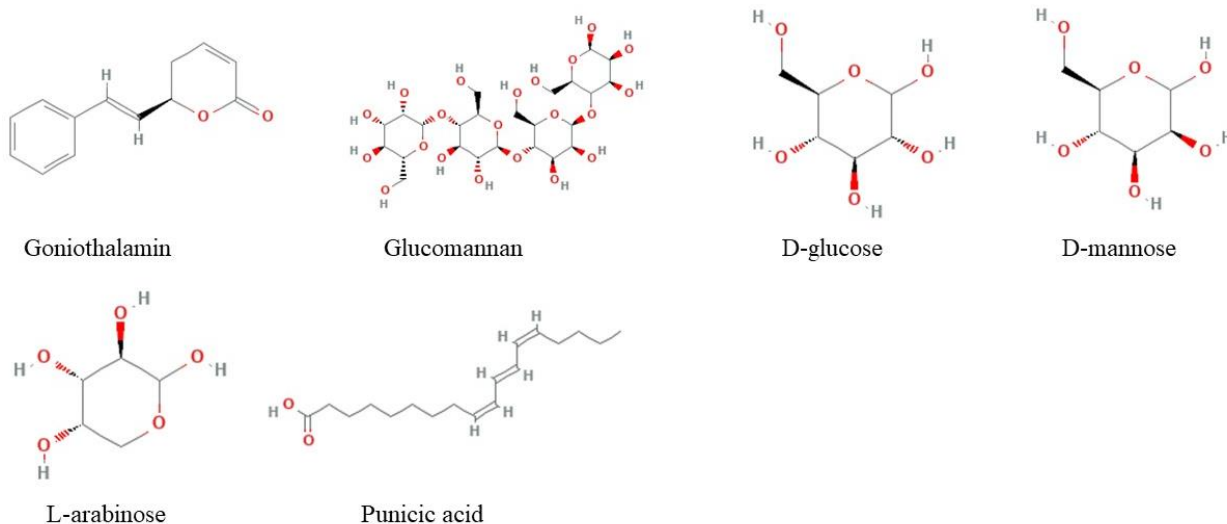


Figure 2 Phytochemical structures of *B. laciniosa* (shivlingi) plant

Traditional and Modern View

a) Ayurvedic View: In Ayurveda, *B. laciniosa* is categorized under Vrishyarasayana (for maintaining sexual performance and fertility). The seeds of the plant are used as an important

ingredient in the ayurvedic formulation 'Strirativallabhugpak'. In ancient scriptures, Strirativallabhugpak is used as a reproductive and aphrodisiac tonic which is also used to improve sexual behavior¹⁵. The seeds of the plant promote conceiving.

Although, this formulation is associated with anti-inflammatory, anti-diabetic, analgesic, antipyretic and analgesic activities¹⁶. The whole plant is bitter and acts as a laxative agent. Ayurvedic practitioners use shivlingi seeds to treat obese or overweight patients, swelling during the premenstrual and menstrual period, light menstruation and feeling of heaviness in the lower abdomen. Also, the *B. laciniosa* plant acts as a Vajikaran Rasayana that is used to treat impotence and other sexual disorders. The rasapanchak (properties) of the plant are shown in table no. 3.

Table 3 Rasapanchak (properties) of *B. laciniosa* plant

Sanskrit / English	Sanskrit/ English
Veerya / Potency	Ushna / Hot
Vipak / Metabolic property	Katu / Pungent
Guna / Physical property	Laghu / light, ruksha / dry, tikshna / sharp
Rasa / Taste	Katu / pungent, Tikta / bitter

Actions and Properties¹⁷

Kaphashamak: It alleviates the aggravated Kapha dosha. It also reduces the blockage of several channels in the body by clearing the excess Kapha and Ama.

Pittavardhak: It increases Pitta dosha.

Vranshodhan: It is associated with wound healing property.

Shothahara: It is used as an anti-inflammatory agent.

Madhumeh: It is used to treat diabetes and act as an antidiabetic agent.

Medahar: It is associated with an anti-obesity property.

Swaskashara: It is used to treat asthma.

Garbhdharan: The seeds of the plant are used to promote conceiving.

Jwarghna: It acts as an antipyretic agent.

Alpaartab: It is used to treat oligomenorrhea and regulates the menstrual cycle.

Kashtaartab: It is used to cure dysmenorrhea.

Vajjikaran: It acts as an aphrodisiac agent.

Garbhshyashothahara: It is used to treat oligospermia.

b) Folk view: In folklore, *B. laciniosa* plant is used to cure liver, gastrointestinal, rheumatic, respiratory, metabolic and infectious disorders^{18,19}. In homeopathy, the plant is used as a significant ingredient in the formulation of anti-inflammatory drugs. In India, the seeds of the plant are used to promote conception in women. The roots of the plant in combination with the roots of *Michelia champaca* are used to cure asthma and promote conception. Also, the plant parts are used against snake bites. In the folklore system, the leaves of the plant are used to cure bronchitis, carbuncles, colic, cholera, cough, convulsions, delirium, fertility, snake bites and paralysis. In India, the flowers of *B. laciniosa* are offered to Lord Shiva as the floral morphology of the plant is same as the deity of the lord called Shivalinga²⁰.

c) Modern View: As per WHO, herbal medicines are defined as plant-derived drugs or formulations which contain raw or processed ingredients from one or more plants. The consumption or utilization of herbal drugs has increased

world widely. The risks associated with herbal medicines are still notable with the increased market demand. The contamination, lack of standardization, adulteration and other factors result in adverse effects and influence the quality of herbal medicines²¹. Many other practices are incorporated in the trade market of herbal drugs in modern times which are directly or indirectly degrading the quality of herbal medicines. One of them is the use of artificially manufactured material that looks like the original drug. This is the most common practice of adulteration in the case of expensive herbal drugs^{22,23}. Due to the presence of several adulterants, the rate of toxicity has increased and also the high cost is the associated factor of adulteration²⁴. As per WHO, if more than 5% of the original drug is admixed with other substances even if they are extracted from the same plant would be rejected²⁵. And the endangered species of the plant needs to be protected and conserved for future use to lower down the adulteration rate. Also, the standardization and authentication of the herbal drugs need to be maintained.

Reported therapeutic and Pharmacological Properties

From various reported studies, it was found that the *Bryonia laciniosa* plant is associated with various therapeutic and pharmacological properties. Some of the studies are described below.

Antimicrobial: The ethanolic extract of the leaf, stem, seed and fruit of *B. laciniosa* plant was examined for antimicrobial activity against different pathogenic microorganisms by the agar well diffusion method. The leaf and stem extracts of the plant showed antimicrobial activity against different gram-positive and gram-negative bacteria. Significant growth inhibitory effect of each extract was observed in *Staphylococcus aureus*, *Micrococcus luteus* and *Bacillus cereus*. The minimum inhibitory effect was reported by the stem extract of the plant against gram-positive and gram-negative bacteria. From this study, it was concluded that *B. laciniosa* plant has been used as an antimicrobial agent²⁶.

Antibacterial: The aqueous extract of the polysaccharides component isolated from the *B. laciniosa* leaf was examined for the antibacterial activity against *Staphylococcus aureus*, *S. pyogenes*, *E. coli* and *K. aerogenes* at a dosage of 1.25 mg/ml, 3.12 mg/ml, 6.25 mg/ml and 12.5 mg/ml. The extract showed antibacterial activity against *E. coli* at a minimum dosage of 6.25 mg/ml²⁷.

Analgesic: The alcoholic extract of the dried aerial parts of *B. laciniosa* was examined for analgesic activity in the mice model using Eddy's hot plate analgesio meter. The model was administered with the standard drug and placed on an electrically heated plate at 550C +/- 0.50C and the time was noted. The same test was carried out in the animals administered with the plant extract. Results showed a significant analgesic activity after 30 to 60 minutes when compared with the standard drug. *B. laciniosa* treated group exhibit an increase in response time to pain stimuli when compared to the control group i.e. the increase in response time was from 5.83 to 8.50 seconds at 30 minutes and from 5.67 to 10.5 seconds after 1 hour of treatment²⁸.

Anti-inflammatory: The chloroform extracts of the *B. laciniosa* leaves were evaluated for anti-inflammatory activity against carrageenan, dextran, serotonin and histamine-induced rat paw oedema and cotton pellet induced granuloma (chronic) models in rats. The oral administration of the plant extract in the mice model was performed by carrageenan peritonitis test. Results showed significant anti-inflammatory activity of the plant extract

against the mice model at a dosage of 50, 100 and 200 mg/kg in a dose-dependent manner. The extract showed maximum inhibitory effect (52.4%) at a dosage of 200 mg/kg after 3 hr. of drug treatment in the animal model while the standard drug showed 62.1% of inhibition. In the case of dextran-induced paw oedema, the chloroform extract exhibits significant inhibition (34.4, 43.2, 52.1%) in a dose-dependent manner as compared to the control group. In histamine and serotonin-induced paw oedema, 54.9 and 52.3% of inhibition was exhibited by the chloroform extract at a dosage of 200 mg/kg whereas 59.8 and 59.5% of inhibition were shown by indomethacin. In the cotton pellet-induced granuloma (chronic model), the decreased rate of granuloma tissue was exhibited by CEBL (chloroform extract of *B. laciniosa*) (200 mg/kg) at 50.1 and 57.3% respectively. The inhibition of peritoneal leukocyte migration at a dosage of 50, 100 and 200 mg/kg was also inhibited by CEBL²⁹.

Androgenic: The ethanolic extract of *B. laciniosa* seeds was examined for the androgenic activity against the male albino rat model. The groups of male albino rats were orally administered with the plant extract at a dosage of 50, 100 and 150 mg/kg body weight per day for 28 days. Results showed an increase in body weight, prostate, seminal vesicle, epididymis and weight of testis. A significant increase in sperm count, fructose level, serum testosterone, luteinizing hormone levels and spermatogenesis was also observed. Thus showed androgenic activity²⁰.

Antipyretic: The methanolic extract of the plant was evaluated for the antipyretic activity against standard animal model by evaluating normal body temperature and yeast-induced hyperpyrexia. Results showed a significant decrease in the body temperature up to 4 hours after the administration of the extract. Thus showed antipyretic activity¹⁰.

Antidiabetic: The ethanolic extract and the saponin fraction of the *B. laciniosa* seeds were evaluated for the antidiabetic activity in neonatally streptozotocin-induced diabetic rats for 10 weeks. Results showed a significant reduction in the glucose level, cholesterol, triglycerides, low-density lipoprotein, high-density lipoprotein, serum creatinine, serum urea and decline in the aspartate transaminase and alanine transaminase activities was also observed. Also, a significant increase in catalase, superoxide and levels of glutathione was noticed in n-STZ diabetic rats³⁰.

Anti-asthmatic: The alcoholic extract of the plant was evaluated for the anti-asthmatic activity by mesenteric mast cell count by the Atopic allergy method in rats. The number of intact and disrupted mast cells, in ten randomly selected fields for each tissue, was counted. Results showed an increase in granulation percentage in *B. laciniosa* treated samples compared to the control group of samples³¹.

Antioxidant: The chloroform extract of the *B. laciniosa* fruits was examined to evaluate *in vitro* antioxidant activity using DPPH (1,1-diphenyl-2-picryl-hydrazil), ABTS, hydrogen peroxide and FRAP assay³². Results showed a degree of reduction of absorbance which was recorded using UV-Vis spectrophotometer at 517 nm where ascorbic acid (AA), 95% ethanol and DPPH solution were used as standard and control samples respectively³³.

Antitumor: The experimental study was conducted in a mice model to evaluate the antitumor activity of the methanolic extract of the plant. The extract was administered in the mice model for 14 days after 24 h of tumor inoculation in a dosage of 62.5, 125 and 250 mg/kg. Results showed a significant decrease in the tumor volume and viable cell count thereby increasing the life span of EAC-

bearing mice. The increase in the levels of glutathione (GSH), superoxide dismutase (SOD), catalase and decrease in the level of lipid peroxidation was also observed³⁴.

Toxicity: The hexane extract of *B. laciniosa* plant was studied for the cytotoxicity at different dosages i.e. 62.5 µg/ml, 125 µg/ml, 250 µg/ml, 500 µg/ml, and 1000 µg/ml in MCF-7 cell line using MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl-2H-tetrazolium hydrobromide) assay. It was observed that the hexane extract of the plant showed cytotoxicity in a dose-dependent manner and increases with increased concentrations. The maximum cytotoxicity evaluated was 75.25 ± 2.4 % at 1000 µg/mL concentration with an IC₅₀ value of 453.33 ± 1.6 µg/ml³⁵.

Conclusion:

From the literature study, it was found that shivlingi plant is of great medicinal importance. It is considered an excellent remedy for infertility treatment. Mainly the seeds of the plant are utilized for the medicinal purpose. In the ayurvedic and folklore medicinal system, the seeds of the *B. laciniosa* plant are used to treat various ailments such as male and female infertility, obesity, weight loss, diabetes, inflammation, constipation and abdominal diseases. From the reported studies, it was found that the plant is associated with various therapeutic and pharmacological properties such as antidiabetic, androgenic, anti-asthmatic, antipyretic, antibacterial and antimicrobial activities. However, the plant is not explored much for its phytochemical constituents and therapeutic properties. So, the plant needs more attention from researchers and scientists for more experimental studies and clinical research to identify its pharmacological properties which will be beneficial in the development of important therapeutic drugs.

Acknowledgement

Authors are very thankful to the Department of Research and Development of Jeena Sikho Lifecare Pvt. Ltd. Zirakpur, Punjab for giving us opportunity to explore this ancient medicinal plant.

Conflict of Interest: None

References:

- Panda H. Handbook on herbal medicines. Asia Pacific Business Press Inc.; 2004.
- Kirtikar KR, Basu BD. Indian medicinal plants. Vol II, 2nd edn. Dehradun. International Book Distribution. 1987.
- Vijayashalini P, Anjanadevi N, Abirami P, Sharmila M. IN VITRO PROPAGATION OF AN ENDANGERED MEDICINAL PLANT BRYONIA LACINIOSA L. THROUGH LEAF EXPLANT. 2017; 2(1):33-36.
- Panda H. Handbook on herbal medicines. Asia Pacific Business Press Inc.; 2004.
- Rai MK, Ojha GC. Ethnomedicinal studies of Chhindwara district (MP) Plants used in stomach disorders. Indian Medicine. 1989; 1(2):1-5.
- Supe U. Direct Rhizogenesis, Phytochemical Analysis and Antimicrobial Activity of Bryonia laciniosa. 2018; 6(1):2321-8991.
- Mosaddik MA, Haque ME. Cytotoxicity and antimicrobial activity of goniotalamin isolated from Bryonopsis laciniosa. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2003 Dec; 17(10):1155-7. <https://doi.org/10.1002/ptr.1303>
- Singh V, Malviya T, Tripathi DN, Naraian U. An Escherichia coli antimicrobial effect of arabinoglucomannan from fruit of

- Bryonia laciniosa. Carbohydrate polymers. 2009 Feb 11; 75(3):534-7. <https://doi.org/10.1016/j.carbpol.2008.08.025>
9. Gupta M, Mazumdar UK, Sivakumar T, Vamsi ML, Karki SS, Sambathkumar R, Manikandan L. Evaluation of anti-inflammatory activity of chloroform extract of Bryonia laciniosa in experimental animal models. Biological and Pharmaceutical Bulletin. 2003; 26(9):1342-4. <https://doi.org/10.1248/bpb.26.1342>
 10. Sivakumar T, Perumal P, Sambath Kumar R, Vamsi ML, Gomathi P, Mazumder UK, Gupta M. Evaluation of analgesic, antipyretic activity and toxicity study of Bryonia laciniosa in mice and rats. The American journal of Chinese medicine. 2004; 32(04):531-9. <https://doi.org/10.1142/S0192415X0400217X>
 11. Reddy J, Gnanasekaran D, Vijay D, Ranganathan TV. In vitro studies on anti-asthmatic, analgesic and anti convulsant activities of the medicinal plant Bryonia laciniosa. Linn. International Journal of drug discovery. 2010; 2(2):01-10. <https://doi.org/10.9735/0975-4423.2.2.1-10>
 12. Gabrielian SE, Gevorgovich A. Bryonia, as novel plant adoptogen, for prevention and treatment of stress induced disorders. Promising Res Abstr. 1997; 5003:1-8.
 13. Singh V, Malviya T. A non-ionic glucomannan from the seeds of an indigenous medicinal plant: Bryonia laciniosa. Carbohydrate polymers. 2006 May 30; 64(3):481-3. <https://doi.org/10.1016/j.carbpol.2005.12.021>
 14. Paul V, Hem Raj KK. Chemical investigation of Bryonopsis laciniosa fruit oil. Proceedings of the National Academy of Sciences of the USA. 1960; 29(Pt 3):218-21.
 15. Chauhan NS, Dixit VK. Effects of Bryonia laciniosa seeds on sexual behaviour of male rats. International Journal of Impotence Research. 2010 May; 22(3):190-5. <https://doi.org/10.1038/ijir.2009.62>
 16. Patel, S.B., Santani, D., Patel, V., et al.: 'Anti-diabetic effects of ethanol extract of Bryonia laciniosa seeds and its saponins rich fraction in neonatally streptozotocin-induced diabetic rats', Pharmacognosy Res., 2015; 7:92-99 <https://doi.org/10.4103/0974-8490.147217>
 17. Sharma PV. Dravyaguna Vijnana Vol. 2. Varanasi: Chaukhamba Bharti Academy. 1999:168-9.
 18. Gabrielian SE, Gevorgovich A. Bryonia, as novel plant adoptogen, for prevention and treatment of stress induced disorders. Promising Res Abstr. 1997; 5003:1-8.
 19. Acharya D. Shivlingi: A common but important twine in Patalkot. Am Chron. 2007.
 20. Chauhan S, Chauhan SV. Worship and trees in India. Siberian Journal of Forest Science. 2019; 4:36-48.
 21. Organización Mundial de la Salud, World Health Organization, Światowa Organizacja Zdrowia. WHO guidelines on good agricultural and collection practices [GACP] for medicinal plants. World Health Organization; 2003 Dec 16.
 22. Sunil, C., Duraipandiyar, V., Agastian, P., & Ignacimuthu, S. Antidiabetic effect of plumbagin isolated from Plumbago zeylanica L. root and its effect on GLUT4 translocation in streptozotocin-induced diabetic rats. Food and chemical toxicology, 2012; 50(12):4356-4363. <https://doi.org/10.1016/j.fct.2012.08.046>
 23. Sheeja, E., Joshi, S. B., & Jain, D. C. Bioassay-guided isolation of anti-inflammatory and antinociceptive compound from Plumbago zeylanica leaf. Pharmaceutical biology, 2010; 48(4):381-387. <https://doi.org/10.3109/13880200903156424>
 24. Dang, G. K., Parekar, R. R., Kamat, S. K., Scindia, A. M., & Rege, N. N. Antiinflammatory activity of Phyllanthus emblica, Plumbago zeylanica and Cyperus rotundus in acute models of inflammation. Phytotherapy Research, 2011; 25(6):904-908. <https://doi.org/10.1002/ptr.3345>
 25. Ved DK, Kinhal GA, Ravikumar K, Sankar RV, Haridasan K. Conservation Assessment and Management Prioritisation (CAMP) for wild medicinal plants of North-East India. Medicinal Plant Conservation. 2005; 11:40-4.
 26. Ehsan B, Vital A, Bipinraj N. Antimicrobial activity of the ethanolic extract of Bryonopsis laciniosa leaf, stem, fruit and seed. African Journal of Biotechnology. 2009; 8(15):3565-3565.
 27. Colston MJ, Cox RA. Mycobacteria, molecular biology and virulence. Mycobacterial Growth Dormancy. 1999; 1:198-219. <https://doi.org/10.1002/9781444311433.ch11>
 28. Reddy J, Gnanasekaran D, Vijay D, Ranganathan TV. In vitro studies on anti asthmatic, analgesic and anti convulsant activities of the medicinal plant Bryonia laciniosa. Linn. International Journal of drug discovery. 2010; 2(2):01-10. <https://doi.org/10.9735/0975-4423.2.2.1-10>
 29. Sud K, Sud S. A Scientific Review on Shivlingi Beej (Bryonia Laciniosa): A Mystical Ethno-Medicine for Infertility. European Journal of Biomedical. 2017; 4(8):1098-102.
 30. Patel SB, Santani D, Patel V, Shah M. Anti-diabetic effects of ethanol extract of Bryonia laciniosa seeds and its saponins rich fraction in neonatally streptozotocin-induced diabetic rats. Pharmacognosy Research. 2015 Jan; 7(1):92-99. <https://doi.org/10.4103/0974-8490.147217>
 31. Sanjeevkumar CB, Londonkar RL, Kattagouda UM, Tukappa NA. Screening of in vitro antioxidant activity of chloroform extracts of Bryonopsis laciniosa fruits. International Journal of Current Microbiology and Applied Sciences. 2016; 5(3):590-7. <https://doi.org/10.20546/ijcmas.2016.503.068>
 32. de Oliveira-Júnior RG, Ferraz CA, Souza GR, Guimarães AL, de Oliveira AP, Lima-Saraiva SR, Rolim LA, Rolim-Neto PJ, da Silva Almeida JR. Phytochemical analysis and evaluation of antioxidant and photoprotective activities of extracts from flowers of Bromelia laciniosa (Bromeliaceae). Biotechnology & Biotechnological Equipment. 2017 May 4; 31(3):600-5. <https://doi.org/10.1080/13102818.2017.1288073>
 33. Aseena R, Zaidi SZ, Rasheed N, Mohammad AS. Anti-Asthmatic, Analgesic and Anti-Convulsant activities of the medicinal plant Bryonia laciniosa. Linn. Contributors. Asian Journal of Pharmaceutical Research. 2017 Dec 1; 7(4). <https://doi.org/10.5958/2231-5691.2017.00040.5>
 34. Sivakumar T, Kumar RS, Perumal P, Vamsi ML, Sivakumar P, Kanagasabai R, Baskaran MV, Karki SS, Mazumder UK, Gupta M. Antitumor and antioxidant activities of Bryonia laciniosa against Ehrlich's Ascites Carcinoma bearing Swiss albino mice. Oriental Pharmacy and Experimental Medicine. 2005; 5(4):322-30. <https://doi.org/10.3742/OPEM.2005.5.4.322>
 35. Sanjeevkumar CB, Londonkar RL, Kattagouda UM. In vitro antioxidant anti-inflammatory and cytotoxicity activities from Hexane extract of Bryonopsis laciniosa fruits. International Journal of Phytomedicine. 2018; 10(1):23-9. <https://doi.org/10.5138/09750185.1835>