Ethnomedicinal potential of *Aconitum deinorrhizum* Stapf (Mohra): A threatened medicinal plant of North Western Himalayas: A comprehensive review

Dinesh Kumar Sharma, Ekta Bhardwaj

**ABSTRACT**

*Aconitum deinorrhizum* Stapf, commonly known as Mohra and Indian aconite, is one of the important Aconitum species in Western Himalayas. It is a flowering plant belonging to buttercup family (Ranunculaceae). Plants of this species are common in the sub-alpine and alpine zone of the Himalaya occurring at altitudes between 2400-4500 m. Air-dried roots of this species contain aconitine and pseudoaconitine as main alkaloids. Traditionally *Aconitum deinorrhizum* Stapf is used to treat neuralgia, paralysis and muscular rheumatism. *Aconitum deinorrhizum* is one of the endangered medicinal plants of Western Himalayas and its population reduction rate is 50-80 per cent. It has been put under critically endangered species, requiring high priority conservation. In this review we have tried to summaries all the phytochemical, pharmacological, toxicological properties and the current status of the *Aconitum deinorrhizum* Stapf.

**Keywords:** *Aconitum Deinorrhizum* Stapf, Aconitine, Pseudoaconitine, Phytochemical, Pharmacological, Toxicological, Conservation.

**INTRODUCTION**

From time immemorial the biodiversity in terms of natural sources is an integral part of human beings. It is essential for meeting not only primary needs but also important from health point of view. India is blessed with different climatic regions from snow bound mountains to plains. These climatic conditions have made it one of the richest biodiversity regions of the world. India is home to more than 17000 species of flowering plants which accounts for approximately 11% of the world floral species. Approximately 50% of these species are reported from Himalayas [1].

Aconitum spp. (family: Ranunculaceae) are endemic in Himalayan region. The plants of these spp. are found in different regions. World-wide there are more than 300 species of Aconitum out of which more than 24 species are in Indian part of Himalayas [2]. *Aconitum deinorrhizum* (A. deinorrhizum) Stapf, commonly known as Mohra and Indian aconite, is one of the important Aconitum species of North-Western Himalayas. *Aconitum deinorrhizum* (A. deinorrhizum) Stapf species were named after scientist Stapf. The species were discovered from Rampur Bushehr region of the state of Himachal Pradesh India [3]. The species are mainly existing in sub-alpine and alpine regions (2500-4000 m alms) of Himalayas [4,5].

In Ayurvedic system of medicine the Aconitum genus has been described by the name of “Atish” and has been described as an important genus with great medicinal properties. The main properties of the genus are in various disorders such as G.I. disorders, Neurological disorders and Endocrine disorders. Besides this the species are having anticancer, antiviral, antifungal, antihelminthic and carminative properties. Traditionally *A. deinorrhizum* Stapf is used to treat neuralgia, paralysis and muscular rheumatism [5]. The main Phytochemicals in *Aconitum* species are flavonoids and diterpene alkaloids. All the parts of the plant are effective but the main medicinal properties are of tuber which produce aconitine, a potent neurotoxin [7].

Now, a day’s people all over the world are inclining towards herbal medicine because of their less side effects, as a result of which the demand of the herbal drugs is increasing all over the world as well as in India [8]. It has resulted in over exploitation of the important herbal drugs. Due to the over exploitation many species of *Aconitum* have been put under threatened list by IUCN, of which *A. deinorrhizum* is one of them. In recent years considerable dwindling in the status of this species is seen because of its foreign trade and also because of its use in drug development [9,10].
A. deinorrhizum is one of the endangered medicinal plants of Western Himalayas and its population reduction rate is 50-80 per cent. It has been put under critically endangered species, requiring high priority conservation[1]. It is in the negative list of export. In this review we have tried to summaries all the phytochemical, pharmacological, toxicological properties and the current status of the A. deinorrhizum Stapf.

![Aconitum deinorrhizum Stapf](image1.png)

**Figure 1: Aconitum deinorrhizum Stapf**

**Taxonomy**

| Kingdom   | Plantae                      |
|-----------|------------------------------|
| Phylum    | Tracheophyta                 |
| Class     | Magnoliopsida                |
| Order     | Ranunculales                 |
| Family    | Ranunculaceae                |
| Genus     | Aconitum                     |
| Species   | Aconitum deinorrhizum Stapf  |

**Botanical description**

*A. deinorrhizum* Stapf is a tall herb. The stem is approximately 2-3 metre in height and is reddish in colour. Leaves are multiple, multilobed with 3-5 lobes and each lobe 7-8 cm long. Flowers are bluish in colour with inflorescence 50-60 cm. Roots are tuberous and elongated (6-8 cm in length). Seeds are having small numerous lamellae[12].

**Traditional use**

Traditionally in many parts of India *A. deinorrhizum* Stapf. is used to treat rheumatic fever and headache[13]. Along with mustard oil it is used as a massage to treat various neurological disorders such as paralysis and muscular rheumatism[5]. In Ayurveda, roots of *A. deinorrhizum* are used in toothache and body pain. The main preparations from the roots of this plant are unitunicate, laghuvaishgarbhataila, swalpakasturi-bhairovrasa, semianimate, mritunjayarsa, kaphketu-rama etc.[14]. It is also used in leprosy, cholera and in diarrheal conditions[15].

**Phytochemistry**

Diterpenoid Alkaloids, flavonoids and free fatty acids (FFA) are the main phytoconstituents of *Aconitum* [16,17]. Aconitine, meaconitine and hyo aconitine are the main alkaloids of *Aconitum* species [18]. *A. deinorrhizum* Stapf roots contain alkaloids, which are responsible for its poisonous properties. Air-dried roots contain up to 1.2 per cent of alkaloids chiefly aconitine and pseudo-aconitine. Pseudo-aconitine is about 1.5 times more toxic than aconitine. A sample of roots from Bushehr was reported to contain 0.9 per cent alkaloid of which pseudo-aconitine was 0.4 per cent[4]. Aconitine (16-ethyl-1,16,19-trimethoxy-4-(methoxymethyl)aconitane-3,8,10,11,18-pentol 8-acetate 10-benzoate)(Figure 2) is a C19-norditerpenoid toxic alkaloid. It is soluble in organic solvents and alcohol. It has affinity for both polar and lipophilic structures (such as cell membranes and receptors) making it permeable for Blood-Brain barrier[19]. Pseudoaconitine (Figure 3) is a diterpene alkaloid. It is soluble in water and more soluble in alcohol. It is a lipophilic substance. When heated it undergoes pyrolysis and forms pyropseudoaconitine[20].

![Aconitine](image2.png)

**Figure 2: Aconitine**

![Pseudoaconitine](image3.png)

**Figure 3: Pseudoaconitine**

**Biological and pharmacological properties**

The secondary metabolites are responsible for their pharmacological properties. The biological properties of *Aconitum* are due to the presence of alkaloids mainly diterpenoids. Aconitine has been reported to possess anticancer us activities[21]. In one of the studies conducted on mice gastric cells and S180 cells aconitine showed anticancer activity besides this it also inhibited metastasis of lung cancer cells[22].

**Toxicity Mechanism**

Aconitum at lower doses is medicinal but at higher doses it is toxic[23]. Diester diterpenoid alkaloids (DDAs) like aconitine, meaconitine, and Hy aconitine are mainly responsible for its toxic effects [23-24]. These compounds produce toxic effects by acting on voltage sensitive sodium channels present in the cell membranes of cardiac and skeletal muscles[24]. The opening of sodium cause depolarisation and generation of action potential. Pseudoaconitine causes inhibition of acetylcholinesterase enzyme resulting in increase in concentration of acetylcholine leading to.

Palpitation, biliousness, vertigo, hypotension and arrhythmia[25]. These alkaloids at higher toxic concentrations primarily target the heart and the central nervous system leading to cardiotoxicity and neurotoxicity[23,26].

**Safety evaluation**

Safety evaluation of *Aconitum* is of utmost importance before its use. It can be done by various standardization techniques. Proper processing techniques reduces toxicity potential of the tubers[27]. The acetyl group and benzoyl ester group of diester-diterpene alkaloids are mainly responsible for the toxicity of aconites[23,28]. Various procedures causing hydrolysis of these compounds to unesterified compounds and reduce its toxicity[29]. In ayurvedic system one of the techniques is Shodhana which reduces toxicity of aconites[30,31]. In
Chinese system of medicine Chinese traditional processing method called “Pauhui for detoxification has been developed” [32,33].

Herbal interactions with other medicinal herbs also reduce the toxicity of aconites [34]. The use of herbal preparations containing ginger and liquorice is in practice since ancient times for the treatment of cardiovascular diseases [35]. In ayurvedic and unami medicines heating and alkaline treatment is used for detoxification.

**Dwindling status**

Recently, the demand for aconite and Pseudaconitine has grown tremendously because of their medicinal uses. Tubers of *A. deinorrhizum Stapf* are rich source of these compounds. It has resulted in excessive exploitation of this species and has put it in endangered species list [36]. These species mainly grow in alpine and subalpine regions where land holding is very less. Moreover, germination percentage of the species is also very low. These are the main reasons behind the declining status of *A. deinorrhizum* [37]. Cultivation cycle of this species is very long ranging from 5-8 years [38]. Destruction of natural habitat is also responsible for its endangered status.

**CONCLUSION**

*A. deinorrhizum* Stapf is an important medicinal plant of Himalayas. There is a great demand of its tubers because of good concentration of Pseudoaconitine and aconitine compounds. In our review we found that a very little work has been done to pharmacologically validate its traditional uses. *A. deinorrhizum* Stapf status is declining because of its overexploitation. Modern techniques like use of cryopreserved gene banks, in vitro techniques of germplasm conservation and biotechnological tools could help in conservation of this precious species. The concerned organizations must come together to save this endangered species which will be highly beneficial in the interest of mankind in future yield of the extract was calculated and kept under refrigeration in an.

**Conflict of Interest**

None declared.

**Financial Support**

None declared.

**REFERENCES**

1. Nayar MP. Hot spots of endemic plants of India. Nepal and Bhutan, TBGRRI, Trivandrum. 1996:217.
2. Sharma E, Gaur AK. Aconitum balfourii Stapf: a rare medicinal herb from Himalayan Alpine. Journal of Medicinal Plants Research. 2012;6(22):3810-7.
3. Stapf O. Aconites of India; a monograph. Ann. R. Bot.Gdn. Calcutta 10(I):158-160.
4. Chopra RN. Glossary of Indian medicinal plants.1956.
5. Kirtikar KR, Basu BD. Indian medicinal plants 2nd edition. M/S Bishen Singh Pal Singh, Delhi. 1975:1465-72.
6. Jaiswal Y, Liang Z, Yong P, Chen H, Zhao Z. A comparative study on the traditional Indian Shodhana and Chinese processing methods for aconite roots by characterization and determination of the major components. Chemistry Central Journal. 2013;7(1):1-6.
7. Sharma M, Kumar S, Prashar A, Sharma A. An interesting case of suicidal poisoning. Online J Health Allied Scs. 2009;8(4):14.
8. Ved DK, Goraya GS. Demand and supply of medicinal plants in India. NMPB, New Delhi & FRLHT, Bangalore, India. 2007;18:510-52.
9. Sharma, S.K. Need for Conservation and Propagation of Medicinal Plants of Himalachal Pradesh, India. Indian J. Plant Sci. 2012;2(3):217-20.
10. Chakraborti L, Varshney V. Trading in contraband. Down to Earth New Delhi. 2001:27-41.
11. Bhardwaj M, Kandari LS, Negi T. Survey of major ethnomedical plants of District Kinnaur, Himachal Pradesh. Indian Journal of Plant Genetic Resources. 2020;33(1):43-51.
12. Kirtikar KR, Basu BD. Indian medicinal plants. SN Basu, Bhuwaneshwari Aśrama; 1918.
13. Pullaiah T. Encyclopaedia of world medicinal plants. Daya books; 2006;11-65.
14. Chauhan NS. Medicinal and aromatic plants of Himachal Pradesh. Indus publishing; 1999.
15. Manandhar NP. Some less known medicinal plants of Rasuwa district (Nepal). Quarterly Journal of Crude Drug Research. 1980 1(8):3:147-51.
16. Yin T, Zhou H, Cai L, Ding Z. Non-alkaloidal constituents from the genus Aconitum; a review. RSC advances. 2019;9(18):10184-94.
17. Khan H, Nabavi SM, Sureda A, Mehterov N, Gulei D, et al. Therapeutic potential of songorine, a diterpenoid alkaloid of the genus Aconitum. European journal of medicinal chemistry. 2018 10;153:29-33.
18. Sutan NA, Manolescu DS, Fierascu I, Neblea AM, Sutan C, Ducu C, Soare LC, et al. Phytosynthesis of gold and silver nanoparticles enhance in vitro antioxidative and mitostimulatory activity of *Aconitum toxicum* Reichenb. rhizomes alcohol extracts. Materials Science and Engineering: C. 2018 1;93:746-58.
19. Dewick PM. Medicinal natural products: a biosynthetic approach. John Wiley & Sons; 2002.
20. Tsuda Y, Marion L. The alkaloids of Eupatorium maculatum L. Canadian Journal of Chemistry. 1963.1:4(18):1919-23.
21. Du J, Lu X, Long Z, Zhang Z, Zhu X, Yang Y, Xu J, et al. In vitro and in vivo anticancer activity of aconitine on melanoma cell line B16. Molecules. 2013;18(1):757-67.
22. Zhou G, Tang L, Zhou X, Wang T, Kou Z, Wang Z, et al. A review on phytochemistry and pharmacological processes of the cultivated species of Aconitum carmichaelii Debeaux. Journal of Ethnopharmacology. 2015 3;160:173-93.
23. Singhuber J, Zhu M, Prinz S, Kopp B. Aconitum in traditional Chinese medicine—a valuable drug or an unpredictable risk?. Journal of ethnopharmacology. 2009;126(1):18-30.
24. Chen TY. Aconie poisoning. Clin toxicol. 2009;47(4):279-85.
25. Sun B, Wu S, Li L, Li H, Zhang Q, Chen H, Li F, et al. A metabolomic analysis of the toxicity of Aconitum sp. alkaloids in rats using gas chromatography/mass spectrometry. Rapid Communications in Mass Spectrometry: An International Journal Devoted to the Rapid Dissemination of Up-to-the-Minute Research in Mass Spectrometry, 2009 Apr 30(23(8)):1221-8.
26. Chan CP, Au CK. Three cases of aconite root poisoning due to Bikhama in a Hong Kong Nepalese family. Hong Kong Journal of Emergency Medicine. 2010;17(2):158-62.
27. Lu G, Dong Z, Wang Q, Qian G, Huang W, Jiang Z, Leung KS, et al. Toxicity assessment of nine types of decoction pieces from the daughter root of *Aconitum carmichaeli* (Fuzi) based on the chemical analysis of their diterpenoid alkaloids. Planta medica. 2010;76(8):825-30.
28. Lin CC, Phua DH, Deng JF, Yang CC. Aconitine intoxication mimicking acute myocardial infarction. Human & experimental toxicology. 2011;30(7):782-9.
29. Tong P, Wu C, Wang X, Hu H, Lin H, Li C, Zhu Y, et al. Development and assessment of a complete-detoxification strategy for Fuzi (lateral root of *Aconitum carmichaeli*) and its application in rheumatoid arthritis therapy. Journal of ethnopharmacology. 2013. 27;146(2):562-71.
30. Buha M, Sojitra N, Acharya R. Adverse effect due to inhalation of Vatsanabha (Aconitum ferox Wall.) root powder during its processing and its Ayurvedic management: A Case study. International Journal of AYUSH Case Reports. 2018 5;2(1):1-9.
31. Marray SK, Seth A, Lalloo D, Singh NK, Gatum DN, Singh AK, et al. Sodhana: An Ayurvedic process for detoxification and modification of therapeutic activities of poisonous medicinal plants. Ancient science of life. 2015 ;34(4):188.
32. Chen HC, Chen WC, Lin KH, Chen YH, Lo LC, Lee TC, Hsia TC, et al. Simulating studies of the diterpenoid alkaloid Songorine from *Aconitum ferox* Wall. root powder during its processing and its Ayurvedic management: A Case study. International Journal of AYUSH Case Reports. 2018 5;2(1):1-9.
33. Marray SK, Seth A, Lalloo D, Singh NK, Gatum DN, Singh AK, et al. Sodhana: An Ayurvedic process for detoxification and modification of therapeutic activities of poisonous medicinal plants. Ancient science of life. 2015 ;34(4):188.
36. Shah NC. Endangered medicinal and aromatic plants of U.P. Himalaya. In: An assessment of threatened plants of India. Jain, S.K. and R.R. Rao (Eds.). Botanical Survey of India.1983. Howrah, pp. 40-49.

37. Srivastava N, Sharma V, Kamal B, Jadon V. Aconitum: need for sustainable exploitation (with special reference to Uttarakhand). International Journal of Green Pharmacy. 2010;4(4):220.

38. Rawat GS, Pangtey YP. A contribution to the ethnobotany of alpine regions of Kumaun. Journal of Economic and Taxonomic Botany. 1987;11(1):139-48.

HOW TO CITE THIS ARTICLE
Sharma DK, Bhardwaj K. Ethnomedicinal potential of Aconitum deinorrhizum Stapf (Mohra): A threatened medicinal plant of North Western Himalayas: A comprehensive review. J Phytopharmacol 2022; 11(1):107-110. doi: 10.31254/phyto.2022.11210

Creative Commons (CC) License-
This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY 4.0) license. This license permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited. (http://creativecommons.org/licenses/by/4.0/).