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

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### 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 pseudo-aconitine 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 subalpine 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, anthelmintic 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<sup>[1]</sup>. 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.



Figure 1: *Aconitum deinorrhizum* Stapf

### Taxonomy

Kingdom	Plantae
Phylum	Tracheophyte
Class	Magnoliopsida
Order	Ranunculales
Family	Ranunculaceae
Genus	Aconitum
Species	<i>Aconitum deinorrhizum</i> 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<sup>[10-12]</sup>, 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<sup>[12]</sup>.

### Traditional use

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

### Phytochemistry

Diterpenoid Alkaloids, flavonoids and free fatty acids (FFA) are the main phytoconstituents of *Aconitum*<sup>[16,17]</sup>. Aconitine, me aconitine and hypo aconitine are the main alkaloids of *Aconitum* species<sup>[18]</sup>. *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<sup>[4]</sup>. Aconitine (16-ethyl-1,16,19-trimethoxy-4-(methoxymethyl)aconitan-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<sup>[19]</sup>. Pseudo-aconitine (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<sup>[20]</sup>.

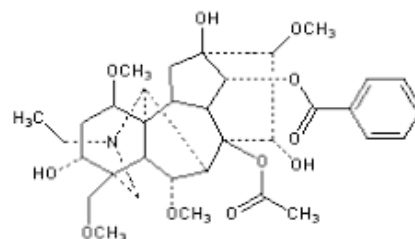


Figure 2: Aconitine

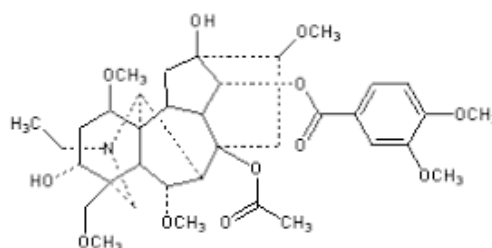


Figure 3: Pseudo aconitine

### 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<sup>[21]</sup>. 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<sup>[22]</sup>.

### Toxicity Mechanism

Aconitum at lower doses is medicinal but at higher doses it is toxic<sup>[23]</sup>. Diester diterpenoid alkaloids (DDAs) like aconitine, me aconitine, and Hy aconitine are mainly responsible for its toxic effects<sup>[23,24]</sup>. These compounds produce toxic effects by acting on voltage sensitive sodium channels present in the cell membranes of cardiac and skeletal muscles<sup>[24]</sup>. 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<sup>[25]</sup>. These alkaloids at higher toxic concentrations primarily target the heart and the central nervous system leading to cardiotoxicity and neurotoxicity<sup>[25, 26]</sup>.

### 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<sup>[27]</sup>. The acetyl group and benzoyl ester group of diester-diterpene alkaloids are mainly responsible for the toxicity of aconites<sup>[24,28]</sup>. Various procedures causing hydrolysis of these compounds to unesterified compounds and reduce its toxicity<sup>[29]</sup>. In ayurvedic system one of the techniques is *Shodhana* which reduces toxicity of aconites<sup>[30,31]</sup>. In

Chinese system of medicine Chinese traditional processing method called “Pauahi for detoxication 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 umami medicines heating and alkaline treatment is used for detoxification.

### Dwindling status

Recently, the demand for aconitine and Pseudoaconitine 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

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