

Review Article

Leh-Ladakh: A New Potential Habitat for Aruna (*Aconitum Heterophyllum*)

Shardulya Shukla, Ankita Sharma*, Nitish Kumar, Bhupendar Kaur, Santosh Kumar,
Manoj Kumar Patel and Shweta Saxena

Department of Medicinal Plant, Defence Institute of High Altitude Research C/o 56 APO, India

*Corresponding author

ABSTRACT

Aconitum heterophyllum is a perennial herb native to the Western Himalayas and has been found distributed in Kashmir, Uttarakhand, Sikkim and Nepal. Roots of this plant have been found to show antidiarrheal, hepatoprotective, antipyretic antioxidant and carminative properties. Aconitine and atisine (alkaloids) are the marker compounds of *A. heterophyllum* which are used in commercial preparations. But increased consumption of this plant for medicinal preparation has led it towards extinction. Therefore, it has become essential to carry out extensive studies on trend of population, reproductive biology and alternative propagation techniques to support its conservation programmes. Plant tissue culture of this plant can act as effective approach for large scale cultivation without destroying the natural resources for extraction of phytochemicals. Leh-Ladakh is the northern most of country with the adverse environmental conditions which are responsible for accumulation of secondary metabolites.

Keywords

Aconitum heterophyllum,
Micropropagation,
Leh-Ladakh

Introduction

Dawn of medicines on their planet earth has been found to synchronize with the dawn of life. It can be seen as saga of human's struggle against diseases to survive on this planet. Ayurveda is the oldest system of medicine which is being followed in modern era too, to cure a number of diseases [1]. Basic rules of this system have been found essentially true for all times and have been observed without change from ages to ages. Ayurveda is based on intrinsic causes rather than extrinsic factors [1]. In India, Atharvaveda has been believed to be the

chronic reservoir of traditional knowledge about medicinal usage of plants which has been written from 4500 - 1600 B.C. [2]. There are a number of plants which has been archived in Ayurveda and Unani system of medicines for the treatment of many diseases in India [3].

A survey conducted by World Health Organization has revealed that about 65- 80% of the world's population, especially in tribal and rural areas still dependent upon herbal medicines for their daily healthcare requirements such as for the treatment of diseases and to maintain good health

conditions[4]. The reasons behind the acceptance of medicinal plant are their cultural acceptability, better compatibility and adaptability with fewer side effects. From records, it has been found that most of the drugs which are used currently to cure diseases are based either on medicinal plant extracts or on compound isolated from medicinal plant [5]. *Aconitum heterophyllum* is one of the medicinal plant of Ranunculaceae family, and division Magnoliophyta[6,7].

Different name has been given in various languages and regions of our country for example Indian English it is called as “Atees” and “Atis root”, in Sanskrit, as “Ativisha”, “Shuklakanda”, “Aruna” and “Vishada”, in Urdu, as “Atees”, in Hindi, as “Atis” and “Atvika”, in Bengali, as “Ataish”, in Telugu, as “Ati vasa”, in Gujarati, as “Ativakhani”, in Marathi as “Ativish”, in Kannada, as “Ativishsa”, in Malayalam, as “Ati-vidayam”, and in Panjabi, as “Atis” [8]. It is an important constituent of ‘Swasabhairava Rasa,’ ‘Mahamrutyunjaya Rasa’ and ‘SankhVati’ which are used for curing and treating diseases like asthma, constipation, fever, hyperacidity, ulcer, piles, fistula and hemorrhoids [8].

Physiology of plant

It is a perennial herb indigenous to Western Himalayas and has been found distributed in Kashmir, Uttarakhand, Sikkim and Nepal at altitudes lying between 2,500 - 4,000 m [8,9]. Roots of this plants are biennial, tuberous; whitish to grey in colour. Stem is erect, branched, varied in lengths from 15-20 cm, glabrous below and finely crispo-pubescent in the upper part. Leaves are glabrous, heteromorphous, with the orbicular-cordate or ovate-cordate blades having narrow sinus (1-1.5 cm deep); 5-lobed to the middle and amplexicaul. Flowers are arranged in either raceme Inflorescence;

Sepals are bluish or violet and rarely whitish in colour. Carpels are elliptic-oblong with contagious follicles. Seeds of this plant are pyramidal in shape with blackish brown colour [8,10].

Medicinal uses

Aconitum heterophyllum has been used from last century for the treatment and cure of many diseases both externally and internally. Juice of its roots has been used as expectorant along with milk of leaves. Further seeds and roots of this plant help in developing strong digestive system and in treatment of tonsillitis. Seeds have also been found to show diuretic properties resulting in enhancement in the intensity of urine [11,12]. Powdered roots of Ativihsa with honey are prescribed for cough irritations and bronchitis. Additionally, roots of this plant have been found to show antidiarrheal, hepatoprotective, antipyretic and analgesic, antioxidant, alexipharmic, anodyne, anti-atrabilious, anti-flatulent, anti-periodic, anti-phlegmatic, and carminative properties; furthermore, it can be used to treat patients with reproductive disorders[8,13].

It is anti-hermitic in action and is effective against guinea-worms. It is also effective in reducing blood pressure[4]. Ativihsa has been used in combination with other components to cure many diseases for example fine powder of roots is used with dry ginger, Bael fruits (Bellpetra in India), Nutmeg (Jaiphalin India) in equal quantity and take two pinches of this mixture is prescribed with water three times a day to treat diarrhea condition [11].

Respiratory system

The juice of this plant is given with milk due to its expectorant properties where as oral administration of its root powder is helpful in cervical lymphadenitis condition of patients [15].

Reproductive system

The root of *Aconitum heterophyllum* is used in treatment of spermatorrhoea, and also helpful in treatment of burning of vagina [14].

Secondary metabolites- key drivers of medicinal properties

Therapeutic properties of medicinal plants are determined largely by their phytochemical constituents. A good apprehension of chemical constituents of plants helps in better understanding of curative properties of the plants. There are two categories of phytochemicals viz., primary and secondary. Primary metabolites are responsible for performing basic life functions such as respiration, photosynthesis, cell division and growth, storage and reproduction. These primary metabolites are similar in all types of living cells [15,16]. On the other hand, secondary metabolites are chemical compounds which are produced by the plants through primary metabolic pathways. Albrecht Kossel, a noble laureate coined the term 'secondary metabolite' in 1891 for the compounds which provide scientific base for the use of herbs in traditional medicinal system [15]. These secondary metabolites have been found to play accessory role in plants like UV- absorbing compounds leads to protection from sun light, different chemical compounds help the plant to survive various abiotic and biotic stresses. Secondary metabolites have been classified into different classes based on their chemical structure viz., phenolics, alkaloids, saponins, terpenes, lipids, carbohydrates etc [17]. In *Aconitum heterophyllum*, non-poisonous tuberous roots have been found as the main component responsible for its medicinal properties. Roots of this plant have been found to contain many alkaloids viz., benzoyecaconine, mesaconitine, aconitine, hyaconitine, heteratisine, atidine, isotisine,

hetidine and hetsinone [18]. Aconitine and atisine (alkaloids) are the marker components of *A. heterophyllum* which are used in commercial preparations. Other species of *Aconitum* have been reported to contain many alkaloids, however most of the species of *Aconitum* are poisonous. For example, *Aconitum ferox*, also known as Indian Aconite, locally named as "Bikh" and "Bish" in Sikkim, is a rhizomatous poisonous herb, but has great medicinal properties when used after vigorous purification in right amounts with certain constituents [19].

Cultivation of *A. heterophyllum*

In natural conditions, *A. heterophyllum* has been found to grow at high altitude (2500-4000 msl) condition in sub-alpine and alpine region of the Himalayas. Outside of its natural habitat, seeds and root tubers are used to grow this plant. Seeds start germination in the month of March to April (spring). One to two daughter tubers are produced by the end of the growing season which is collected in autumn during the onset of winters. An average rain fall of 664.2 to 1485.7 mm is required for the cultivation of natural and transplanted populations of *A. heterophyllum* [8,9].

Need of the conservation of *A. heterophyllum*

Continuous illegal harvesting of this plant species for marketing from its natural habitats and reduced potential of regeneration of this medicinal plant outside of its natural habitat has led this plant species on the verge of extinction and requires immediate attention in terms of managing its habitat and sustainable collection practice. It has been included in IUCN list of endangered species [20]. All *Aconitum* species are prohibited for export in India if the plants have been collected from the wild with reference to Indian export-

import policy 2002-07 which permits prohibition of export of plants, plant portions, their derivatives and extracts of this species (<http://www.forests.tn.nic.in/EximPolicy.htm>; accessed on 22.10.2006). However, cultivated portions can be exported from India. This species has been proposed for inclusion in the Convention of International Trade in Endangered Species (CITES) appendices but is yet to be included. The trade name of the plants of this species is "Ativisa" [21].

Plant tissue culture technique- A new perspective in conservation and propagation of *A. heterophyllum*

There is a necessity to carry out extensive studies on trend of population, reproductive biology and alternative propagation techniques to support conservation programmes of this species. Further, poor germination of seeds and survival of seedlings leads to the production of reduced number of propagules by natural methods.

Thus making them insufficient for large scale plantation in either wild or cultivated field conditions [22]. Plant tissue culture technique which involves the clonal multiplication of plant under artificial conditions can found potential as alternative method for rapid multiplication of this plant species to provide large number of propagules in less interval of time for mass scale cultivation of this plant species.

These propagules can be reintroduced into their natural habitats. Further, large scale cultivation in vitro conditions can provide large amount of biomass for extraction of active phytochemicals. This biomass can be made available throughout the year without putting pressure on natural resources. A few reports have been published on *in vitro* propagation of *A. heterophyllum* using MS basal medium supplemented with different

combinations of auxins and cytokinins. Giri *et al.*, (1993) reported callus induction followed by somatic embryogenesis using MS medium supplemented with either 2,4-dichlorophenoxy acetic acid (2,4-D 1 mg/l) and kinetin (KN 0.5 mg/l) with coconut water (CW 10% v/v) or naphthalene acetic acid (NAA 5 mg/l) and benzylaminopurine (BAP 1 mg/l) [24].

Further, Jabeen *et al.*, (2006) has reported the callus induction followed by shoot proliferation in MS medium supplemented with NAA (0.5 mg/l) and BAP (0.25 mg/l) for callus induction and (0.25 mg/l) and BAP (0.5 mg/l) for shoot proliferation respectively [23]. However, less work on commercial propagation of this plant species through plant tissue culture has been reported.

'Aruna' also known as *A. heterophyllum* is a plant species with profound medicinal potential. However, increased demand of this plant has left this plant on the verge of extinction. Plant tissue culture of this plant can act as effective approach for large scale cultivation of this plant without destroying the natural resources for extraction of phytochemicals.

Further, Leh-Ladakh also known as 'land of lamas' has been found as natural reservoir of large number of medicinal plants. These plants have been found to accumulate a number of various secondary metabolites of medicinal value to survive harsh environmental conditions of this region.

However, no reports of presence of *A. heterophyllum* have been recorded in this region till now. Therefore, introduction of this species either by *in situ* propagation or by micropropagation will be helpful for obtaining biomass with large quantity of phytochemicals of interest with lesser expenditure of materials.

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