

Review of Ativisha (*Aconitum Heterophyllum*) – And Its Therapeutic Potential

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ABSTRACT

India's medical history dates back thousands of years, with the Rigveda being the oldest recorded reference of medicinal usage. Ayurveda, an Upveda, includes about 6000 species of medicinal plants. Ativisha, a tall herb made from dried, tuberous roots of the perennial herb *Aconitum heterophyllum* Wall. Ex. Royle is highly recommended for preventing debility following a fever and has various pharmacological characteristics and therapeutic indications. Ativisha is mentioned in every ancient compendium, including the Vedas and the Ayurvedic Chikitsa Grantha. Phytochemistry of *Aconitum heterophyllum* includes a diverse array of bioactive chemicals, especially alkaloids, contributing to its traditional uses and medicinal qualities. The plant has a long history of traditional applications in medical systems, including Ayurveda and Traditional Chinese Medicine (TCM). It has been used to treat digestive disorders, respiratory disorders; anti-inflammatory and analgesic properties, diarrhea and dysentery, gastrointestinal disorders, antispasmodic agents, malaria, and febrile diseases. Pharmacological effects of *Aconitum heterophyllum* include strong anti-inflammatory and analgesic effects, as well as antipyretic properties. Its extracts and alkaloids have shown inhibitory actions against specific disease-causing microbes, making it a potential candidate for the development of antimicrobial drugs.

Keywords: *Ativisha, Aconitum Heterophyllum, Anti-Inflammatory, Analgesic Effect*

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1. INTRODUCTION

India's medical history dates back thousands of years. One of the oldest texts, the Rigveda, contains the first recorded reference of the medical usage of these plants. The Rigveda cited 67 medicinal herbs. 81 and 89 plant species with therapeutic properties were described in the Yajurveda and Atharvaveda, respectively(1). The specific qualities of medications and their applications are then described in depth in Ayurveda, which is regarded as an Upveda. In India, include about 6000 species of medicinal plants. An extremely useful medicinal plant for preventing debility following a fever is Ativisha. This tall herb has follicles that contain blackish pyramidal seeds, racemes with blue flowers, paired white tuberous roots, and varied leaves (upper amplexicaul, lower long petiole). Ativisha is made from dried, tuberous roots of the perennial herb *Aconitum heterophyllum* Wall. Ex. Royle (Family: Ranunculaceae), which is indigenous to the western Himalayas and grows between 2,500 and 4,000 meters above sea level in Garhwal, Kumaon, and Kashmir. Benzoyl heteratisine, aldine, histisine, helisine, helidine, heterophylline, heterophyllisine, isoatisine, dihydroatisine, hetisinone, and atisine (0.4%) are the primary constituents of the 0.79% diterpenoid alkaloids that are produced by roots(2).

The roots have astringent, aphrodisiac, tonic, analgesic, anti-inflammatory, stomachic, digestive, thermogenic, expectorant, bitter, and anti-periodic properties. The dried root is tonic and febrifuge. In cases of diarrhea, dysentery, helminthiasis, vomiting, diarrhea, hemorrhoids, hemorrhages, and overall weakness, they can be helpful. They are highly recommended for children's illnesses, but this priceless medicinal plant has numerous other uses that are listed in important Ayurvedic texts but have not yet been the subject of experimental or clinical research. The scope of this plant's other pharmacological effects must thus be investigated in the ancient Ayurvedic literature(3). This significant medication is mentioned in every ancient compendium, including the Vedas and the Ayurvedic Chikitsa Grantha. In the Vedas, Ativisha is referred to as

"Ativishwa." "Ativishwa" suggests that this medication can treat any illness in the globe (Vishwa). Vidhi Richa mentions Ativisha, which is regarded as the finest remedy for delirium (Raap or Pralapa). Ativisha decoction can be used to treat delirium. Numerous clinical and experimental investigations have also demonstrated the effectiveness of *Aconitum heterophyllum* Wall ex. Royle(4). The pharmacological characteristics of Ativisha and its various therapeutic indications as described in key Ayurvedic textbooks and Lexicons will be highlighted in this article. In order to examine various Ativisha single and compound formulations and their indications in various diseases, a thorough analysis of several Ayurvedic textbooks and Lexicons has been conducted.

2. CLASSIFICATION OF ATIVISHA

While Sushruta made reference to Ativisha in Pippalyadi Gana, Vachadi Gana, Mustadi Gana, and Shirovirechana Dravya, Charak included it in Lekhaniya Mahakashaya, Arshoghna Mahakashaya, and Tikta Skanda1. In Ashtang Hridaya, the medication Ativisha is referred to as Tikta skandha dravya in Vatsakadi gana, Ghunapriya (A.H.Su.15/33), Vachaharidradi gana (A.H.Su.15/35), and Mustadi gana (A.H.Su.15/40).

3. SYNONYMS

The heterophyllum *Aconitum* Wall ex. Royle is referred to as Ativisha, which lessens the effects of poisons while being a member of the genus of poisonous plants. Shuklakanda (the tuber's official part is white), Ghunavallabha (it is susceptible to pest damage), Aruna (its rhizome is reddish-brown), and Shringi (the rhizome has a projection that resembles a horn), Bhangura (the rhizome is fragile and breaks quickly), Shishubhaishajya (it is a common medicine for children's diseases), Mahaushadha (it is beneficial for a variety of disorders), and Vishwa (it assimilates to every region of the body due to its Sukshma guna). In Sanskrit, Prativisha (which is an antidote for many poisons), Kashmira (which grows at high elevations like Kashmir), Atisaraghni (which is helpful for diarrhea), and Shofapaha (which reduces swelling or oedema)(5)

Ativisha's physical characteristics according to Lexicons (Nighantu)

With the exception of Light (Laghu) in Madanpala and Kaiyedeve Nighantus property (guna), the majority of Nighantus have not discussed the properties (guna) of Ativisha. Nearly all Nighantus state that Ativisha has a pungent (Katu) and bitter (Tikta) flavor (Rasa), whereas Sodhala, Madhava Dravyaguna, and Madanpala Nighantu have only described the bitter (Tikta) taste. According to all of the Nighantus, Ativisha is powerful (Veerya) and hot (Ushna).

Ativisha's therapeutic use according to Lexicons

Nearly all Nighantus, with the exception of Sodhala, Madhava Dravyaguna, and Madanpala Nighantu, recommend Ativisha for the treatment of cough and diarrhea; Dhanvantri, Sodhala, and Priya Nighantu for pediatric complaints; Dhanvantri, Raja, and Priya Nighantu for fever; and Dhanvantri Nighantu, Kaiyedeve, Bhav Prakash, and Raja Nighantu for poisoning. Ativisha's rejuvenating and appetizing qualities have also been described in Lexicons.

According to Acharya Charaka, Acharya Sushruta, and Acharya Vagbhata, Ativisha's therapeutic Ayurvedic yoga the usage of the root of Ativisha for Shirovirechana is recorded in the Charak Samhita (C.S. Vi. 8/151)(6). Ativisha is included as the best Deepana, Pachana, Sangrahaka, and Sarvadoshahara dravya in the list of best drugs (Agya Dravyas) (C.S.Su.25/39). Ativisha is used as a component in powerful alkali preparations (Pakya or Teekshna kshara), according to Acharya Sushruta.

4. CHEMISTRY

Recently, Gopinath reviewed the chemistry of Atis (Ativisha, Ataicha). Pelletier, Stern, and Parthasarathy have written more reviews on the topic. A good source of diterpene alkaloids (0.7%) is *Aconitum heterophyllum*. Whalley, Leete, Weissner, and Wenkert have discussed the biogenesis of the bitter diterpene alkaloid atisine (I) (0.4% in the roots) and atidine (II)(7). According to the hypothetical pathway proposed by Whalley and Leete, these compounds may originate from VI & VIII by condensation with -amino ethanol. In the light mentioned above, the biogenesis of the remaining members is equally understandable(8).

It is evident that at common reference points, all of these compounds exhibit the same absolute stereochemistry. The fundamental elements of *A. heterophyllum* roots have been divided into three major fractions by Gopinath et al.:

- Weak Base Fraction
- Strong Base Fraction
- Extremely Strong Base Fraction

It is known that atisine (I) makes up the majority of the strong-base fraction that contains the bulk of the alkaloids. The six new alkaloids that are left Heterophyllisine, heterophylline, and heterophyllisine were obtained from the weak base fraction(9). These substances are structurally linked to heteratisine and are lactone alkaloids. In addition to atisine, the strong base fraction produced two new alkaloids: atidine and F-dihydroatisine. Similarly, the very strong base fraction

produced hetidine and the alkaloids known as hetidine and hetisinone. Tannic acid, starch, fat, a combination of fatty acids and their glycerides, carbs, etc. are among the additional components found in the plant(10).

5. PHARMACOLOGY

The species is frequently considered non-poisonous since atisine (I) is far less toxic than aconitine and pseudoaconitine. The root's whole aqueous extract caused noticeable hypertension, presumably via acting on the sympathetic nervous system, even though the alkaloid atisine causes hypotension. It has now been established that the alkaloid atisine is a key component of *A. heterophyllum*, acting as an antiperiodic aphrodisiac and tonic(11). Due to the presence of benzyl ester and OH-groups in the molecular structure of this system, which is present in the polyesters of *Celastrus paniculatus*, aconitine has an action similar to that of aconitine in the CNS, CVS, and respiratory system(12).

6. IDENTIFICATION

According to reports, the aconite in question has undergone significant adulteration. Pharmacognostic methods are frequently employed to identify crude pharmaceuticals, although they are ineffective for evaluating Ayurvedic preparation. It is crucial that an Ayurvedic herb be correctly identified from the perspective of its chemistry when it is purchased from a vendor at an Ayurvedic pharmacy(13). Large pharmaceutical companies may afford HPLC systems, but tiny Ayurvedic shops must use cautious analysis techniques. Some chromatographic study results have been replicated for the benefit of these units. Khorana and Murthy used Whatman to perform paper chromatography on the crude drug extract. The No. 1 filter strips have two solvent systems: water, acetic acid, and n-butanol (4:1:5 and 12:3:5). The strips were allowed to develop at room temperature, and Munier's suggested modified Dragendorff's reagent was sprayed on the strips to identify the spots. The A alkaloids' RF values with two solvent systems that produced distinct and well-defined spots are (a) 0.47, 0.53, and 0.70 and (b) 0.50, 0.53, and 0.80. Mehta conducted a similar investigation, and the thin layer chromatogram fig II has been replicated for accurate identification of the crude substance in question.

7. PHYTOCHEMISTRY

A diverse array of bioactive chemicals, especially alkaloids, describe the phytochemistry of *Aconitum heterophyllum*, sometimes referred to as Ativisha or Indian Atees, and contribute to its traditional uses and medicinal qualities(14). Numerous investigations have concentrated on identifying and describing the chemical components found in the plant's various parts, especially the roots, which are the part most frequently utilized medicinally(15). Some of the main phytochemicals present in *Aconitum* are listed below.

8. HETEROPHYLLUM

C20-Diterpenoid Alkaloids: Many of the pharmacological properties of *Aconitum heterophyllum* are attributed to its abundance of C20-diterpenoid alkaloids. This plant contains the following main alkaloids:

- **Aconitine:** Aconitine is a biologically active, very poisonous alkaloid with analgesic and anti-inflammatory qualities. However, aconitine needs to be treated very carefully because of its toxicity(16).
- **Heteratisine:** Well-known for its anti-inflammatory and analgesic properties.
- **Atisine:** Another significant alkaloid with anti-inflammatory and analgesic effects is atisine(17).
- **Heterophyllin:** A substance with possible antibacterial properties.

A class of polyphenolic chemicals called flavonoids is present in a variety of plants, including *Aconitum heterophyllum*. These substances support the plant's anti-inflammatory and antioxidant qualities(18). *Aconitum heterophyllum* has been found to contain flavonoids such as kaempferol, quercetin, and its derivatives.

Secondary metabolites with a broad variety of biological activity are called phenolic compounds. *Aconitum heterophyllum* antioxidant and antibacterial qualities are attributed to a variety of phenolic substances, including catechins and derivatives of gallic acid(19).

- **Terpenoids:** *Aconitum heterophyllum* contains a number of Terpenoids, a broad class of molecules that are present in plants. Although their precise functions are still being investigated, these chemicals might be involved in the pharmacological actions of the plant(20).

9. OTHER MOLECULES

Glycosides, steroids, and carbohydrates are a few minor molecules that may also be present in *Aconitum heterophyllum* and may add to its overall therapeutic effects.

Importantly, poisonous alkaloids, particularly aconitine, which can be dangerous if consumed in excess, are present in

Aconitum heterophyllum(21). To lessen the plant's toxicity and make it safer for use in traditional medicine, traditional preparation techniques including boiling and purifying have been used. To prevent negative effects, proper processing and dosage management are essential. All things considered, *Aconitum heterophyllum* phytochemistry shows promise as a source of bioactive substances with a range of therapeutic uses(22). Any possible therapeutic usage needs to be handled carefully and should include thorough safety reviews because of the presence of hazardous ingredients.

Aconitum heterophyllum, also referred to as Ativisha or Indian Atees, has a lengthy history of traditional applications in a variety of medical systems, most notably Ayurveda and Traditional Chinese Medicine (TCM)(23). Numerous medical diseases are treated with various plant parts, particularly the roots. Some of the traditional applications of *Aconitum heterophyllum* are listed below.

The antipyretic and fever-reducing properties of *Aconitum heterophyllum* are among its main traditional uses. It is frequently used to control feverish situations and lower fever. Traditional medicine has recognized the plant's capacity to reduce body temperature in order to treat a variety of inflammatory and viral illnesses(23).

- **Digestive Disorders:** Traditional medicine uses *Aconitum heterophyllum* to treat digestive issues like gas, indigestion, and stomach pain. It is thought to contain carminative qualities that support a healthy digestive system and reduce flatulence(24).
- **Respiratory disorders:** Asthma, bronchitis, and coughs are among the respiratory conditions that *Aconitum heterophyllum* is traditionally used to treat. Its expectorant qualities are thought to aid in respiratory symptom relief and airway clearance(25).
- **Anti-inflammatory and Analgesic:** *Aconitum heterophyllum* has long been used as an analgesic to reduce inflammation and discomfort brought on by a number of illnesses, including rheumatism and arthritis. It is regarded as a crucial treatment for pain and discomfort management(26).
- **Diarrhea and Dysentery:** Because of its astringent and anti-diarrheal qualities, *Aconitum heterophyllum* has been used to treat diarrhea and dysentery. It is thought to lessen the frequency of bowel movements and assist regulate loose stools(27).
- **Gastrointestinal disorders:** *Aconitum heterophyllum* is used by traditional healers to treat a number of gastrointestinal conditions, such as nausea, stomach pains, and colic. It is thought that the herb has calming properties for the digestive system(28).
- **Antispasmodic:** Traditionally, *Aconitum heterophyllum* has been used as an antispasmodic agent to assist the body relaxes during cramps and muscle spasms. It is used to relieve the pain and discomfort that muscle spasms create. *Aconitum heterophyllum* is used as a moderate sedative in certain traditional systems to encourage tranquility and relaxation. It is thought to lessen tension and anxiety(29).
- **Malaria and Febrile diseases:** *Aconitum heterophyllum* has long been used to treat febrile diseases, including malaria. It is thought to help manage these illnesses because of its antipyretic and anti-inflammatory qualities(30). Although *Aconitum heterophyllum* has been used traditionally for a long time, it also contains poisonous alkaloids, especially aconitine, which can be dangerous if not taken correctly. Boiling and filtration are examples of ancient preparation techniques that have been used to lessen toxicity and make it safer for use in conventional medicine(31).
- **Pharmacological effects:** The presence of several bioactive chemicals, especially alkaloids, is responsible for the wide spectrum of pharmacological effects exhibited by *Aconitum heterophyllum*, commonly referred to as Ativisha or Indian Atees. This plant has long been used for its therapeutic qualities in traditional medical systems like Ayurveda and Traditional Chinese Medicine (TCM)(32). Its pharmacological effects have also been studied by contemporary scientists. Some of *Aconitum heterophyllum* noteworthy pharmacological actions are listed below:
 - **Analgesic and Anti-Inflammatory:** *Aconitum heterophyllum* has strong anti-inflammatory and analgesic effects. It has been demonstrated that the plant's alkaloids, including atisine, heteratisine, and aconitine, have analgesic properties through their interactions with central nervous system pain receptors(33). Furthermore, the plant's capacity to block inflammatory mediators is thought to be responsible for its anti-inflammatory properties, which lower pain and inflammation.
 - **Antipyretic:** *Aconitum heterophyllum* has long been recognized for its antipyretic qualities, and recent studies have shown that it can lower fever and body temperature. It is thought to help lower fever by acting on the hypothalamus, which controls body temperature(34).
 - **Antibacterial:** The plant exhibits strong antibacterial properties against a range of diseases, such as bacteria, fungus, and some viruses. It is a possible option for the creation of antimicrobial drugs because its extracts and alkaloids have demonstrated inhibitory actions against specific disease-causing microbes(35).
 - **Immunomodulatory:** It is thought that *Aconitum heterophyllum* can alter the immune response because of its Immunomodulatory properties. This characteristic might help the body fight off infections and illnesses by bolstering the immune system(36).

- **Antioxidant:** Flavonoids and other phenolic chemicals give the plant its antioxidant properties. By assisting in the body's defense against dangerous free radicals, antioxidants lessen oxidative stress and shield cells from harm(37).
- **Cardiovascular Effects:** According to certain research, alkaloids and extracts from *Aconitum heterophyllum* may have cardiovascular effects. Their vasodilatory qualities have been shown to help enlarge blood vessels and possibly lower blood pressure. To completely comprehend its effect on cardiovascular health, more research is necessary in this field(38).
- **Potential Anticancer Effects:** *Aconitum heterophyllum* may have anticancer effects, according to some research. Its alkaloids may have anticancer properties because they have demonstrated cytotoxic effects against a variety of cancer cell types. However, more investigation is required to assess its safety and effectiveness in treating cancer(39). It is crucial to remember that although *Aconitum heterophyllum* has a number of advantageous pharmacological properties; it also includes harmful alkaloids, most notably aconitine. If consumed in excess or not properly processed, these hazardous ingredients may be dangerous(40).
- **Safety Issues:** The main safety issues with using *Aconitum heterophyllum*, also referred to as Ativisha or Indian Atees are related to the presence of poisonous alkaloids, specifically aconitine. These toxic substances can be dangerous if consumed in excess or if the plant is not well prepared before use(41). They are found in many areas of the plant, particularly the roots.
- **Aconitine Toxicity:** *Aconitum heterophyllum* contains the extremely poisonous alkaloid aconitine. When taken in excess, it can have major negative consequences and affect the nervous system. Nausea, vomiting, diarrhea, abdominal pain, lightheadedness, weakness, cardiac arrhythmias, respiratory paralysis, and in extreme situations, death, are all signs of aconitine overdose(41). *Aconitum heterophyllum* must be handled extremely carefully due to aconitine toxicity.
- **Appropriate Processing:** To lessen its toxicity and make it safer for use as medicine, *Aconitum heterophyllum* is put through particular processing techniques in traditional medical systems like Ayurveda and Traditional Chinese Medicine (TCM)(42). The plant material is often boiled several times, washed with water, and then dried completely in these processing techniques. The risk of toxicity is decreased and poisonous alkaloids' levels are decreased with proper processing.

10. CONCLUSION

India's medical history spans thousands of years, with the Rigveda being the oldest recorded reference. Ayurveda, an Upveda, includes 6000 medicinal plants. Ativisha, a tall herb made from *Aconitum heterophyllum* roots, is highly recommended for fever prevention and has various pharmacological properties. *Aconitum heterophyllum* has anti-inflammatory, analgesic, and antipyretic properties, making it a potential candidate for antimicrobial drug development.

REFERENCES

- [1] Jaiswal YS, Williams LL. A glimpse of Ayurveda - The forgotten history and principles of Indian traditional medicine. *J Tradit Complement Med.* 2017 Jan;7(1):50–3.
- [2] Kour G, Chaubey S, Singh D, Mishra R. ATIVISA (*ACONITUM HETEROPHYLLUM* WALL EX. ROYLE): A COMPREHENSIVE REVIEW ON PROPAGATION, TRADITIONAL USES AND PHARMACOLOGY. *AYUSHDHARA.* 2021 May 16;3168–77.
- [3] Swami DV, Anitha M, Rao MC, Sharangi A. Medicinal Plants: Perspectives and Retrospectives. In 2022. p. 1–28.
- [4] Nagarajan M, Kuruvilla GR, Kumar KS, Venkatasubramanian P. Pharmacology of Ativisha, Musta and their substitutes. *J Ayurveda Integr Med.* 2015 Jun;6(2):121–33.
- [5] Paramanick D, Panday R, Shukla SS, Sharma V. Primary Pharmacological and Other Important Findings on the Medicinal Plant “*Aconitum Heterophyllum*” (Aruna). *J Pharmacopuncture.* 2017 Jun;20(2):89–92.
- [6] Gohil S, Banne S. Exploring the pharmacological efficacy of Ativisha (*Aconitum heterophyllum*) in traditional and modern medicine. 2025 Jan 1;40:583–92.
- [7] Buddhadev S, Buddhadev S. A COMPLETE REVIEW ON ATIVISHA –*ACONITUM HETEROPHYLLUM*. *Pharma Sci Monit.* 2017 Apr 7;8:111–4.
- [8] Mesnard F, Ratcliffe R. NMR analysis of plant nitrogen metabolism. *Photosynth Res.* 2005 Feb 1;83:163–80.
- [9] Pelletier SW, Aneja R, Gopinath KW. The alkaloids of *Aconitum heterophyllum* Wall.: Isolation and characterization. *Phytochemistry.* 1968;7(4):625–35.
- [10] Wani T, Kaloo Z, Dangroo N. *Aconitum heterophyllum* Wall. ex Royle: A critically endangered medicinal herb with rich potential for use in medicine. *J Integr Med.* 2021 Dec 1;20.
- [11] Malhotra N, Kumar V, Sood H, Singh TR, Chauhan RS. Multiple genes of mevalonate and non-mevalonate pathways contribute to high aconites content in an endangered medicinal herb, *Aconitum heterophyllum* Wall. *Phytochemistry.* 2014 Dec 1;108:26–34.

- [12] Buddhadev S, Buddhadev S. A COMPLETE REVIEW ON ATIVISHA –ACONITUM HETEROPHYLLUM. *Pharma Sci Monit.* 2017 Apr 7;8:111–4.
- [13] Agarwal P, Goyal A. A COMPREHENSIVE REVIEW ON ADULTERATION AND SUBSTITUTION OF CRUDE DRUGS. *Asian J Pharm Clin Res.* 2021 Apr 6;33–8.
- [14] Paramanick D, Panday R, Shukla SS, Sharma V. Primary Pharmacological and Other Important Findings on the Medicinal Plant “*Aconitum Heterophyllum*” (Aruna). *J Pharmacopuncture.* 2017 Jun;20(2):89–92.
- [15] Rabizadeh F, Mirian MS, Doosti R, Kiani-Anbouhi R, Eftekhari E. Phytochemical Classification of Medicinal Plants Used in the Treatment of Kidney Disease Based on Traditional Persian Medicine. *Evid-Based Complement Altern Med ECAM.* 2022;2022:8022599.
- [16] MI L, LI YC, SUN MR, ZHANG PL, LI Y, YANG H. A systematic review of pharmacological activities, toxicological mechanisms and pharmacokinetic studies on *Aconitum* alkaloids. *Chin J Nat Med.* 2021 Jul 1;19(7):505–20.
- [17] Ye X, Wang Y, Chen Q, Feng Q, Liu T, Feng W, et al. Anti-inflammatory diterpenoid alkaloids from *Aconitum tanguticum* (Maxim.) Stapf. *Phytochemistry.* 2023;206:113524.
- [18] Roy A, Khan A, Ahmad I, Alghamdi S, Rajab BS, Babalghith AO, et al. Flavonoids a Bioactive Compound from Medicinal Plants and Its Therapeutic Applications. *BioMed Res Int.* 2022;2022:5445291.
- [19] Sun W, Shahrajabian MH. Therapeutic Potential of Phenolic Compounds in Medicinal Plants-Natural Health Products for Human Health. *Mol Basel Switz.* 2023 Feb 15;28(4).
- [20] Wani T, Kaloo Z, Dangroo N. *Aconitum heterophyllum* Wall. ex Royle: A critically endangered medicinal herb with rich potential for use in medicine. *J Integr Med.* 2021 Dec 1;20.
- [21] Talreja S, Tiwari S. A comprehensive review of *Aconitum heterophyllum*. *J Ayurveda Integr Med Sci.* 2023;8(10):195–201.
- [22] Singh IP, Tanwar AK, Chatterjee D, Lal UR. Medicinal chemistry and detoxification of poisonous plants in traditional medicine: A comprehensive review. *Toxicol Off J Int Soc Toxicology.* 2025 Apr;258:108307.
- [23] Talreja S, Tiwari D. A comprehensive review of *Aconitum heterophyllum*. *J Ayurveda Integr Med Sci.* 2023 Dec 9;8:195–201.
- [24] Prasad SK, Jain D, Patel DK, Sahu AN, Hemalatha S. Antisecretory and antimotility activity of *Aconitum heterophyllum* and its significance in treatment of diarrhea. *Indian J Pharmacol.* 2014 Feb;46(1):82–7.
- [25] Gururani R, Patel S, Bisht A, Jain S, Kumari K, Paliwal S, et al. Airways Relaxant and Antiasthmatic Activity of *Aconitum heterophyllum* Wall ex Royle. Roots: A Mechanistic Insight. *Cell Biochem Biophys.* 2024 Sep;82(3):2607–24.
- [26] Choudhary M, Kumar V, Malhotra H, Singh S. Medicinal plants with potential anti-arthritis activity. *J Intercult Ethnopharmacol.* 2015 Jun;4(2):147–79.
- [27] Prasad SK, Jain D, Patel DK, Sahu AN, Hemalatha S. Antisecretory and antimotility activity of *Aconitum heterophyllum* and its significance in treatment of diarrhea. *Indian J Pharmacol.* 2014 Feb;46(1):82–7.
- [28] Sharma V, Sharma R, Gautam DS, Kuca K, Nepovimova E, Martins N. Role of Vacha (*Acorus calamus* Linn.) in Neurological and Metabolic Disorders: Evidence from Ethnopharmacology, Phytochemistry, Pharmacology and Clinical Study. *J Clin Med.* 2020 Apr 19;9(4).
- [29] Martínez-Pérez EF, Juárez ZN, Hernández LR, Bach H. Natural Antispasmodics: Source, Stereochemical Configuration, and Biological Activity. *BioMed Res Int.* 2018;2018:3819714.
- [30] Meremikwu MM, Odiwe CC, Akudo Nwagbara B, Udoh EE. Antipyretic measures for treating fever in malaria. *Cochrane Database Syst Rev.* 2012 Sep 12;2012(9):CD002151.
- [31] Chan TYK. Aconite poisoning. *Clin Toxicol Phila Pa.* 2009 Apr;47(4):279–85.
- [32] Paramanick D, Panday R, Shukla SS, Sharma V. Primary Pharmacological and Other Important Findings on the Medicinal Plant “*Aconitum Heterophyllum*” (Aruna). *J Pharmacopuncture.* 2017 Jun;20(2):89–92.
- [33] Tiwari S, Acharya P, Solanki B, Sharma AK, Rawat S. A review on efforts for improvement in medicinally important chemical constituents in *Aconitum* through biotechnological interventions. *3 Biotech.* 2023 Jun;13(6):190.
- [34] Aronoff DM, Neilson EG. Antipyretics: mechanisms of action and clinical use in fever suppression. *Am J Med.* 2001 Sep;111(4):304–15.
- [35] Vaou N, Stavropoulou E, Voidarou C, Tsigalou C, Bezirtzoglou E. Towards Advances in Medicinal Plant Antimicrobial Activity: A Review Study on Challenges and Future Perspectives. *Microorganisms.* 2021 Sep 27;9(10).
- [36] Alhazmi HA, Najmi A, Javed SA, Sultana S, Al Bratty M, Makeen HA, et al. Medicinal Plants and Isolated Molecules Demonstrating Immunomodulation Activity as Potential Alternative Therapies for Viral Diseases Including COVID-19. *Front Immunol.* 2021;12:637553.
- [37] Zahra M, Abrahamse H, George BP. Flavonoids: Antioxidant Powerhouses and Their Role in Nanomedicine. *Antioxid Basel Switz.* 2024 Jul 29;13(8).
- [38] Talreja S, Tiwari D. A comprehensive review of *Aconitum heterophyllum*. *J Ayurveda Integr Med Sci.* 2023 Dec 9;8:195–201.

- [39] Saravanan S, Hari R, Sekar K. Anti-proliferative potentials of *Aconitum heterophyllum* Root Extract in Human Breast cancer (MDA-MB-231) cell lines-Genetic and Antioxidant enzyme approach. *Avicenna J Med Biotechnol.* 2023 Sep;15(3):188–95.
 - [40] Ameri A. The effects of *Aconitum* alkaloids on the central nervous system. *Prog Neurobiol.* 1998 Oct;56(2):211–35.
 - [41] Chan TYK. *Aconitum* alkaloid poisoning related to the culinary uses of aconite roots. *Toxins.* 2014 Sep 2;6(9):2605–11.
 - [42] Singhuber J, Zhu M, Prinz S, Kopp B. *Aconitum* in Traditional Chinese Medicine-A valuable drug or an unpredictable risk? *J Ethnopharmacol.* 2009 Aug 1;126:18–30.
-