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Review Article

Traditional therapeutic uses and pharmacological uses of *Aristolochia indica* L. (Aristolochiaceae)

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Abstract: *Aristolochia indica* is a well-known medicinal plant extensively used in traditional systems of medicine across India. The plant has long been employed for the treatment of snakebites, skin diseases, gastrointestinal disorders, inflammation and reproductive ailments. In parallel, modern pharmacological investigations have revealed a broad spectrum of biological activities. Several bioactive compounds have been isolated from different plant parts and are believed to be responsible for these activities. However, the presence of aristolochic acids has raised serious toxicological concerns, limiting the safe therapeutic use of the plant. The present study critically compiles and analyzes published literature on the traditional therapeutic uses, pharmacological properties and bioactive constituents of *A. indica*. Emphasis is placed on correlating ethnomedicinal claims with experimental evidence, identifying safety concerns and highlighting research gaps for future investigations. The study aims to provide a consolidated scientific basis for the rational use and further research of *A. indica*.

Keywords: Aristolochic acid, bioactive compounds, ethnomedicine, pharmacological activity, toxicity

Introduction

Medicinal plants have played a pivotal role in the healthcare systems of human societies since antiquity (El-Saadony et al., 2025). Traditional knowledge, transmitted orally across generations, has served as the foundation for many modern drugs (Alum, 2024). India, being one of the world's richest reservoirs of medicinal plant diversity, has contributed significantly to ethnopharmacology through systems such as Ayurveda, Siddha, Unani and folk medicine (Pandey et al., 2013). Among the diverse medicinal flora, the genus *Aristolochia* occupies a unique position due to its extensive traditional use and its controversial toxicological profile (Lerma-Herrera et al., 2022). *Aristolochia indica*, commonly known as Indian birthwort, is a perennial climber belonging to the family Aristolochiaceae (Agrawal and Laddha, 2016).

Figure 1: Habitat(a), flowers (b) and fruits (c) of *A. indica*

It is widely distributed in tropical and subtropical regions of India, Sri Lanka and Southeast Asia (Sreelakshmi et al., 2024). Traditionally, various parts of the plant, especially roots and the whole plant, have been used to treat snakebites, skin diseases, inflammation, ulcers and reproductive disorders (Dey and De, 2011). Despite its widespread traditional use, the genus *Aristolochia* has attracted global attention due to the presence of aristolochic acids, compounds associated with nephrotoxicity and carcinogenicity (Xu et al., 2021). In recent decades, scientific investigations have attempted to validate the traditional claims associated with *A. indica* through pharmacological and phytochemical studies (Borah et al., 2021). Several studies have reported promising biological activities, including anti-inflammatory, antitumor, antiviral and anti-diarrhoeal effects (Lerma-Herrera et al., 2022). Concurrently, toxicological studies have raised concerns regarding genotoxicity and renal damage (Han et al., 2019). Therefore, a balanced and critical evaluation of both therapeutic potential and safety is essential. The present study aims to compile available information on the traditional therapeutic uses, pharmacological activities and bioactive compounds of *Aristolochia indica*. Through correlating ethnomedicinal knowledge with experimental evidence, the study seeks to identify research gaps and provide directions for future studies.

Methodology

A comprehensive literature survey was conducted to collect information on the traditional uses, pharmacological activities and phytochemical constituents of *Aristolochia indica*. Scientific databases, including PubMed, ScienceDirect, Google Scholar, Scopus and Web of Science, were searched for relevant articles published till 2023. Keywords such as "*Aristolochia indica*", "ethnomedicinal uses", "pharmacological activity", "aristolochic acid" and "bioactive compounds" were used individually and in combination. Peer-reviewed research articles, review papers, ethnobotanical surveys and pharmacological studies were considered. Data were screened for relevance and only studies providing clear information on plant parts used, experimental models and outcomes were included. Traditional uses were compiled primarily from ethnobotanical and ethnopharmacological reports, while pharmacological and phytochemical data were obtained from experimental studies. The collected information was systematically organized and discussed critically (Kumar, 2025).

Results and discussion

Aristolochia indica Linn. is a slender, perennial, twining climber characterized by cordate leaves and distinctive tubular flowers with a curved perianth. The roots are woody and aromatic, which are commonly used for medicinal purposes. The plant grows abundantly in forests, hedges and scrublands of tropical India (Figure 1).

Traditional therapeutic uses: Traditional medicine systems have extensively utilized *A. indica* for a variety of ailments (Table 1). The roots are the most frequently used part, particularly in the treatment of snakebites. Ethnic communities have long considered the root as a potent antidote, often administered as a paste or decoction. Bhattacharjee and Bhattacharyya, (2013) scientifically evaluated this traditional claim and reported anti-phospholipase activity, supporting its role in neutralizing snake venom enzymes. The abortifacient property of the roots has been documented by Pakrashi and Shaha, (1978), indicating its influence on female fertility. Such usage highlights the potent bioactivity of the plant but also highlights the risk associated with unsupervised consumption. The whole plant has been traditionally used to treat skin diseases, suggesting antimicrobial and anti-inflammatory properties. The traditional uses of *A. indica* reflect a broad therapeutic spectrum, largely centred on inflammation, envenomation and skin disorders. However, traditional knowledge often lacks standardized dosage and safety evaluation, necessitating scientific validation.

Table 1: Traditional therapeutic uses of *A. indica*

Plant parts	Uses	Source
Roots	Useful in the treatment of snakebites.	Mathew et al., (2011)
Roots	Used as an abortifacient.	Pakrashi and Shaha, (1978)

Roots	Use as an antidote for snake bites.	Bhattacharjee and Bhattacharyya, (2013).
Whole plants	Used for the treatment of skin diseases.	Mathew et al., (2011)

Table 2: Pharmacological values of *A. indica*

Plant parts	Uses	Source
Roots	Used for anti-inflammatory, antipruritic and mast cell stabilizing activity.	Mathew et al., (2011)
Roots	Used to inhibit carcinogenesis.	Nagasawa et al., (1997)
Roots	Used for antibacterial, anti- inflammatory, anti-adenocarcinoma and antineoplastic activities.	Garodia et al., (2007)
Roots	Used for anti-phospholipase activity and genotoxicity study.	Dey et al., (2021)
Roots	Used for anti-diarrhoeal activity.	Dharmalingam et al., (2014)
Whole plant	Used for antitumor activities.	Achari et al., (1981)
Whole plant	Used for antiviral activity.	Mathew et al., (2011)
Whole plant	Used for antipruritic activities.	Mathew et al., (2011)

Table 3: Bioactive compounds of *A. indica*

Plant parts	Bioactive compounds	Source
Apical parts	Aristolactam I	Lerma-Herrera et al., (2022)
Apical parts	β-caryophyllene and α-humulene	Lerma-Herrera et al., (2022)
Leaves	Flavonoids, tannins, glycosides, phenol, saponins, terpenoids and amino acids	Lerma-Herrera et al., (2022)
Roots	Aristolochine	Mathew et al., (2011)
Roots	Aristolochic acid	Mathew et al., (2011)
Roots	Aristololactam-I *N-β-D*-glucoside	Lerma-Herrera et al., (2022)
Roots	*β*-sitosterol	Lerma-Herrera et al., (2022)

Anti-inflammatory and antipruritic activities: Several studies have demonstrated the anti-inflammatory and antipruritic activities of *A. indica* root extracts (Table 2). Mathew et al., (2011) reported significant inhibition of inflammatory mediators and mast cell stabilization, supporting its traditional use in inflammatory conditions and skin disorders.

Anticancer and antitumor activities: Pharmacological studies have revealed the potential of *A. indica* in cancer prevention and treatment (Table 2). Nagasawa et al., (1997) demonstrated that aristoloside inhibited carcinogenesis in experimental models. Similarly, whole-plant extracts exhibited antitumor activity (Achari et al., 1981). Despite these promising results, the carcinogenic risk associated with aristolochic acids presents a paradox that must be carefully addressed.

Antimicrobial and antiviral activities: Root extracts of *A. indica* have shown antibacterial activity against various pathogens (Garodia et al., 2007). Additionally, antiviral activity of the whole plant has been reported, further validating its ethnomedicinal use in infectious diseases (Table 2).

Anti-diarrhoeal activity: Dharmalingam et al., (2014) reported significant antidiarrhoeal activity of *A. indica* root extracts in mice, possibly due to inhibition of intestinal motility and secretion. This supports its traditional use in gastrointestinal disorders (Table 2).

Anti-phospholipase and genotoxicity studies: Dey et al., (2021) investigated the anti-phospholipase activity of *A. indica* in relation to snakebite treatment. While the extract showed promising enzyme inhibition, genotoxicity studies revealed potential DNA damage, raising safety concerns (Table 2).

Bioactive compounds: Phytochemical investigations have identified numerous bioactive compounds in *A. indica* (Table 3). Aristolochic acid and aristolactams are among the most studied compounds, responsible for both therapeutic and toxic effects. Other constituents such as β-sitosterol, flavonoids, tannins, saponins and terpenoids contribute to the pharmacological activities of the plant. The presence of volatile compounds like β-caryophyllene and α-humulene in apical parts suggests anti-inflammatory and antimicrobial potential. However, aristolochic acids remain the major concern due to their established nephrotoxic and carcinogenic effects.

Research gaps

Despite extensive traditional use and growing scientific interest, several research gaps remain:

1. Lack of standardized extracts and dosage guidelines.
2. Insufficient clinical studies validating efficacy and safety.
3. Limited research on detoxification or removal of aristolochic acids.
4. Inadequate exploration of safer analogues or derivatives.
5. Poor understanding of synergistic effects among bioactive compounds.

Addressing these gaps is crucial for the safe and effective utilization of *A. indica*.

Conclusion

Aristolochia indica is a medicinal plant of significant ethnopharmacological importance, with a long history of use in traditional medicine. Scientific studies have validated several of its traditional claims, particularly anti-inflammatory, antitumor, antimicrobial and anti-diarrhoeal activities. The plant is rich in diverse bioactive compounds that contribute to its pharmacological potential. However, the presence of aristolochic acids poses serious safety concerns, limiting its therapeutic application. Future research should focus on isolating safer compounds, developing standardized formulations and conducting rigorous toxicological and clinical evaluations. A balanced approach integrating traditional knowledge with modern scientific validation is essential to harness the therapeutic potential of *A. indica* while ensuring patient safety.

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