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IMPORTANCE OF ADHATODA VASICA NEES IN TRADITIONAL SYSTEM OF MEDICINES: A REVIEW

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ABSTRACT: *Adhatoda vasica Nees*, belonging to the Acanthaceae family and commonly referred to as vasa or vasaka, is a prominent herbal remedy within Ayurvedic, Unani, and Homeopathic medicine systems. Vasaka is widely distributed across India and tropical regions in Southeastern Asia. This plant is recognized for its rich reservoir of phytoconstituents, notably vitamin C and various alkaloids. Alkaloids such as adhatodine, vasicine, vasicinol, vasicinone, vasicinolone, vasicine, and vasicinone, vasicine and vasicine both are found abundantly in the leaves and roots of *A. vasica*. Other constituents which are found in plant are triterpenes, flavonoids, alkanes, steroids, daucosterol, and β-sitosterol. The pharmacological efficacy of *A. vasica* primarily stems from vasicine, vasicinol, and vasicinone, known for their robust bronchodilator properties. Extensive research has explored the diverse medicinal attributes of this plant, including its antiasthmatic, antitussive, antioxidant, hepatoprotective, antiulcer, uterotonic, and abortifacient activities.

INTRODUCTION: *Adhatoda vasica* Nees, commonly referred to as vasa or vasaka, holds a prominent place as an herbal remedy in the Ayurvedic and Unani medicinal systems (Claeson *et al*., 2000). This drug encompasses the fresh dried leaves and roots of *Adhatoda vasica* Nees from the Acanthaceae family **Fig. 1**. The plant is widely distributed across the tropical regions of Southeast Asia, particularly in the plains of India [1]. Known by various names in different languages-Vasa (Sanskrit), atarusaka (Hindi), vasaka (Bengali), vasaka or malabar nut (English), vachaka (Assam), adulsa (Marathi), arusa (Punj)- this plant is a rich source of vitamin C and is extensively utilized for its medicinal properties. These encompass antispasmodic, antipyretic, antitussive, anti-inflammatory, anti-bleeding, bronchodilator, anti-diabetic, anti-jaundice, and oxytocic properties [2]. Additionally, it exhibits astringent, diuretic, antiperiodic, purgative, and expectorant qualities.

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In the realm of homeopathy, this plant finds application in treating colds, coughs, pneumonia, fever, jaundice, whooping cough, and asthma due to its primary actions as an expectorant and antispasmodic [3]. Furthermore, its significance in the treatment of respiratory disorders is underscored by an ancient Indian saying: "No man suffering from phthisis need despair as long as the vasaka plant exists" [4]. Branded herbal formulations

like Bisolven and vasavleha, incorporating vasaka as a primary ingredient, are employed to alleviate airway obstructions by reducing mucus secretions and facilitating the opening of air passages.

General Description: This evergreen shrub typically reaches a height of 2.2 to 3.5 meters and is characterized by its numerous branches, woody structure, and opposite ascending branches bearing white, pink, or purple flowers. The shrub's growth pattern involves high branching, with a normal root system featuring secondary and tertiary rootlets. Its large lance-shaped leaves are arranged oppositely and lack stipules. The flowers form in spikes or panicles within the axils of the leaves, densely packed and supported by short peduncles, while the bracts are broadly ovate and leaf-like. The fruit of the plant takes the form of a capsule containing four seeds [4].

Justicia adhatoda (L.) Nees, which is synonymous with *Adhatoda vasica* Nees and *Adhatoda zeylanica* Nees, belongs to the Acanthaceae family and holds significance as a well-known medicinal plant in both Ayurvedic and Unani medicine. This shrub is prevalent across the tropical regions of Southeast Asia [5]. The names *Justicia adhatoda* (L.) Nees and *Adhatoda zeylanica* Nees are used interchangeably. Additionally, there are other species within the *Justicia genus*, such as Justicia acuminate (Nees) Lindau, *Justicia acutangula* H.S. LO and D. Fangl, *Justicia acutifolia* Herden, *Justica adhaerens* Wassh and J.R.I Wood, and *Justicia gendarussa* Burm F., found in various parts of the world, each with its own distinct characteristics and uses.

The primary alkaloids found in this plant comprise Vasicine at 0.85% and vasicinone at 0.027%, both present in the leaves and roots. Additionally, the leaves contain several other alkaloid components like Vascinone, Vascinol, Adhatodine, Adhatonine, Adhavasinone, Anisotine, and Hydroxypeganine. Moreover, there are trace amounts of essential oil, crystalline acid, betaine, steroids, and alkanes in this plant. Flower of this plant contain triterpenes like alpha-amyrin, flavonoids such as Astragalin, Kaempferol, Quercetin, Vitexin, Apigenin, 4-dihydrochalcone-4-glucoside, and alkanes among its constituents. In the root section, Vitamin C comprises 5.2%, alongside fats at 2.5%. Daucosterol, a steroid, carbohydrates, alkanes, and various alkaloids like vascine (7.5%), vasicinal, vasicinolone, vasicinone (3.5%), fiber (5.2%), and adhatonine are also present.

FIG. 1: SHOWING PICTURE OF *ADHATODA VASICA NEES*

Ethnomedicinal uses: The historical and widespread use of all parts of *A. vasica* in traditional medicine is quite fascinating. Vasaka, highly valued in Indian traditional medicine, has been employed to address an array of health issues including asthma, joint and lumber pain, sprains, colds, coughs, eczema, malaria, rheumatism, swelling, and venereal diseases. European medical practitioners also recognized its medicinal properties. In England, fluid extracts and tinctures were utilized as antispasmodics, expectorants, and febrifuges, proving beneficial for conditions like intermittent fever, typhus, and diphtheria. Similarly, Germany and Sweden utilized the leaves for their expectorant and spasmolytic actions [6, 7, 8].

In Sri Lanka, Vasaka is used to treat excessive phlegm and menorrhagia, while in Southeast Asia, root pastes, powders, and decoctions are employed to combat tuberculosis, diphtheria, malarial fever, leucorrhoea, and eye diseases [9, 10]. Additionally, the root decoction is applied for gonorrhea [11].

Specific uses have been noted, such as the utilization of yellow leaves for coughs and employing the ash of leaves for asthma relief [12].

In various regions of India, different applications prevail, including the use of leaves to control postpartum hemorrhage and urinary issues, with reports of pregnant women in Lucknow using them to induce abortion. Additionally, the Neterh people in Bihar use leaf decoctions to stimulate and heal before and after delivery [13].

In Uttar Pradesh's Sitapur district, a paste made from roots mixed with sugar treats acute nightfall, while macerated roots are applied vaginally to aid parturition. The leaf powder boiled in sesame oil finds application in stopping bleeding, treating earaches, pus discharge from ears, and addressing jaundice.

Reported Phytochemistry: The chemical composition of *A. vasica* is quite diverse and intriguing, with vasicine being the most extensively studied bitter quinazoline alkaloid present in its leaves, roots, and flowers. Alongside vasicine, the leaves also contain adhatodine, adhatonine, adhavasinone, anisotine, vasakine, vasicinol, deoxyand N-oxide vasicine, vasicinone, vasicinolone, vasicol, and 6-hydroxy preganine. Furthermore, betaine, the steroid β-sitosterol, and alkanes are among the additional components found in the leaves [14, 15, 16]. Vasicine undergoes metabolism to yield vasicinone. Studies utilizing X-ray analysis of alkaloid hydrobromides have confirmed the absolute stereochemistry of (-)-vasicine, (-)- vasicinone, vasicinol, and vascinolone, all exhibiting a 3S configuration [17].

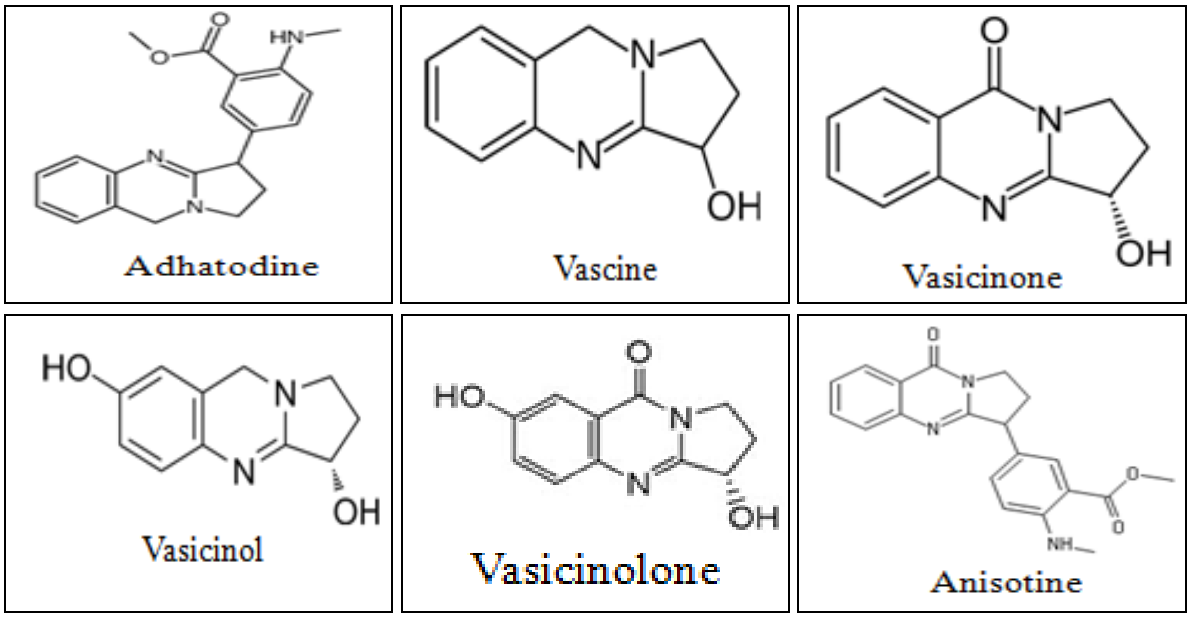

FIG. 2: SHOWING CHEMICAL STRUCTURE OF SOME PHYTOCHEMICAL OBTAINED FROM *ADHATODA VASICA NEES*

Moreover, a novel alkaloid characterized as 1, 2, 3, 9-tetrahydro-5-methoxypyrrol [2, 1-b] quinazolin-3-ol has been isolated from leaves [18]. Roots are also rich in alkaloids like adhatodine, vasicine, vasicinol, vasicinone, vasicinolone and deoxyvasicinone, along with the steroid daucosterol, carbohydrates, and alkanes [19]. In the flowers of *A. vasica*, alkaloids such as vasicine and vasicinine, triterpenes like α-amyrin, flavonoids including apigenin, astragalin, kaempferol, quercetin, vitexin, along with alkanes, steroids, daucosterol, and β-sitosterol have been identified. This diverse array of chemical constituents contributes to the plant's medicinal properties and potential therapeutic applications.

Reported Biological Activities: Absolutely, the pharmacological properties of *A. vasica* primarily stem from vasicine, vasicinol, and other active compounds within this medicinal plant. Vasicine, an optically active molecule, tends to undergo racemization during the extraction process. This compound has paved the way for the development of various derivatives such as bisolvon/bromhexine

and ambroxol, which are commonly found in marketed cough formulations, serving as expectorants. Ambroxol, derived from vasicine, is widely used as a secretolytic agent. It works by inhibiting IgE-mediated histamine release from mast cells, which contributes to its effectiveness in managing respiratory conditions [20].

Anti-inflammatory Activity: The anti-inflammatory properties of *Adhatoda vasica* Nees have been investigated using a carrageenan-induced rat paw edema model. Both aqueous and alcoholic extracts of the plant demonstrated significant anti-inflammatory effects in rats. The efficacy of these extracts was found to be comparable to that of diclofenac sodium, a commonly used anti-inflammatory medication [21, 22]. This suggests that the extracts from *Adhatoda vasica* Nees possess potent anti-inflammatory properties, as evidenced by their ability to reduce edema in the rat paw model. The comparative efficacy to diclofenac sodium, a well-known anti-inflammatory drug, highlights the potential of these extracts as natural alternatives for managing inflammatory conditions.

Antioxidant Activity: The oral administration of *A. vasica* leaves extract at a dosage of 800 mg/kg demonstrated a capacity to regulate hematological parameters back to normal levels in post-irradiated animals. Specifically, it helped in restoring levels of glutathione (GSH) and lipid peroxidation (LPO) to their standard ranges. Additionally, pretreatment with *A. vasica* Nees at doses of 100 and 200 mg/kg significantly enhanced levels of superoxide dismutase (SOD), catalase, and GSH in animals with CCl4-induced hepatotoxicity [23, 24]. These findings highlight the potential therapeutic effects of *A. vasica* in mitigating the detrimental impact of irradiation on hematological parameters and in alleviating hepatotoxicity induced by CCl_4. The plant extract demonstrated a capacity to restore antioxidant levels and minimize oxidative stress, indicating its potential as a protective agent against oxidative damage in these experimental conditions.

Hepatoprotective Activity: In a CCl_4-induced hepatotoxicity model in rats, the ethanolic extract of *A. vasica* Nees demonstrated notable effects. The extract showed a significant reduction in liver enzymes like serum glutamic oxaloacetic transaminase (SGOT), serum glutamic pyruvic transaminase (SGPT), and alkaline phosphatase (ALP). Additionally, the extract offered protection to hepatocytes against damage caused by the toxin [24-27]. This indicates the potential hepatoprotective properties of the ethanolic extract from *A. vasica* Nees. Its ability to decrease elevated liver enzymes and shield hepatocytes against toxin-induced damage suggests its promise as a therapeutic agent for managing hepatotoxicity.

Wound Healing Activity: The topical application of alcoholic and $CHCl_3$ (chloroform) extracts derived from *A. vasica* leaves on wounds in buffalo calves yielded promising results. There was a significant acceleration observed in the rate of wound healing, along with improvements in parameters like tensile strength, energy absorption, and extensibility. Additionally, this treatment led to increased levels of collagen, elastin, hydroxyproline, and zinc compared to the control group, starting from the third day of treatment [26, 27, 28].

These findings suggest that the application of these specific extracts from *A. vasica* leaves could expedite wound healing and enhance the quality of the healed tissue by promoting the production of essential components like collagen, elastin, hydroxyproline, and zinc. This highlights the potential of *A. vasica* extracts as an effective topical treatment for wound healing in animal models.

Uterotonic and Abortifacient Activity: The abortifacient effects of vasicine were observed to be dose-dependent and varied according to the stage of pregnancy in experimental animal models including rats, guinea pigs, and rabbits. Specifically, an aqueous solution of *A. vasica* leaves administered at a dosage of 175 mg/kg induced abortifacient activity in guinea pigs [29]. These findings indicate that vasicine, a component present in *A. vasica* leaves, demonstrated abortifacient properties, showing a capacity to induce abortion in a dose-related manner. The study highlights the potential risks associated with the use of *A. vasica* preparations during pregnancy and underscores the importance of caution and further investigation into its effects on gestation. Petroleum ether, alcoholic and aqueous extract of

leaves did not show any antifertility activity in rats and mice, however, 50% ethanolic extract of leaves showed 66.6% anti-implantation activity in rats. Antitussive activity Intravenous administration of the extract exhibited1/20–1/40 as active as codeine on mechanically and electrically induced cough in rabbits and guinea pigs [29-30]. Petroleum ether extract of *A. vasica* caused stimulation of respiratory tract fluid more than ammonium chloride and eucalyptol in atropinised rats. Respiratory secretions were reduced by 78.5%, 47% and 36%, respectively. In *in-vitro* studies, vasicinone produced tracheal relaxation comparable to theophylline incarbachol and histamine inducedconstriction. It showed inhibitory effects on histamine release and showed anti-anaphylactic activity in both *in-vitro* and *in-vivo* studies in rats.

Anti Microbial Activity: The antimicrobial potential of *A. vasica* extracts was evident in studies. Ethanolic and petroleum ether extracts of *A. vasica* exhibited antibacterial activity against a range of bacteria including *S. epidermidis, S. aureus, B. subtilis, E. faecalis, E. coli, P. aeruginosa, P. vulgaris, K. pneumoniae*, and also against the fungus *C. albicans* [29, 30]. Moreover, in an in vitro study, both aqueous and ethanolic extracts showed ovicidal and larvicidal effects against gastrointestinal nematodes found in sheep at concentrations of 25-50 mg/ml [30, 31]. These findings underscore the potential of *A. vasica* extracts as effective agents against various bacterial strains, fungi, as well as gastrointestinal nematodes, suggesting their possible utility in addressing microbial infections and parasitic infestations.

The aqueous extract derived from *A. vasica* leaves demonstrated an inhibitory effect on fungal growth by impeding the germination of fungal spores. This highlights its potential as a substance capable of reducing fungal proliferation [30, 31].

Anthelmintic Activity: Additionally, the anthelmintic activity of *A. vasica* was observed in a study where a 10% aqueous extract of its leaves exhibited a mortality rate of 73% on Meloidogyne incognita chit wood, a type of nematode. This suggests the extract's potential effectiveness as an anthelmintic agent against this particular nematode species [32, 33]. These findings indicate the diverse potential of *A. vasica* extracts in inhibiting fungal growth and combating certain types of nematodes. The administration of methanolic, chloroform, and diethyl ether extracts from the leaves of the Indian medicinal plant *Adhatoda vasica*, at a dosage of 400 mg/kg, led to a notable increase in the percentage of neutrophil adhesion to nylon fibers in adult male Wistar rats. This observed increase in neutrophil adhesion could indicate a potential effect on the immune system or inflammation response. Neutrophils are a type of white blood cell that plays a crucial role in the body's defense against infections and in the inflammatory process. An increase in their adhesion might suggest an enhancement in the immune response in the experimental setting studied [34].

CONCLUSION: Different research indicates that *Adhatoda vasica* plays a significant role in traditional herbal medicine, having been utilized in Ayurveda and Unani practices for centuries. The current study briefly explores the traditional and Ayurvedic perspectives regarding this plant. Extensive examination has focused on its chemical composition and therapeutic properties.

Adhatoda vasica is known for its richness in Vitamin C, Vasicine, Vasicinone, and various alkaloids. Numerous scientific investigations have validated its diverse pharmacological effects through experimental studies, demonstrating its efficacy in areas such as antifungal, antitussive, antiulcer, abortifacient, hypoglycemic, anti-tubercular, anti-inflammatory, radio modulatory, antiviral, and hepatoprotective properties. Formulations derived from this plant have shown promise for human use, particularly in treating respiratory ailments, as indicated by scientific studies.

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CONFLICT OF INTEREST: Nil

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