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Vicoa indica: unveiling the therapeutic properties and phytochemical profiling of a lesser-known medicinal plant

Review Article

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Abstract:

Vicoa indica (L.) DC., a member of the Asteraceae (Compositae) family, is a well-known traditional medicinal plant widely available in tropical regions, including India. Various parts of this plant have been evaluated for their pharmacological properties. Traditionally, tribes in northern India have used *V. indica* as a contraceptive. The plant's biological activity is attributed to its diverse phytochemical composition, including sesquiterpenoid lactones, triterpenoids, and flavonoids. Several studies have reported its anti-inflammatory, contraceptive, antioxidant, and antimicrobial properties. This review compiles the existing scientific literature on the traditional medicinal uses of *V. indica*. However, limited research has been conducted on this species, highlighting the need for further studies to explore its therapeutic potential comprehensively.

Key words:
antioxidant, anti-inflammatory, antimicrobial, Asteraceae, Banjauri, contraceptive, sesquiterpenoid lactones, *Vicoa indica*, vicolides

Apstrakt:

***Vicoa indica*: otkrivanje terapeutskih svojstava i fitohemijski profil manje poznate lekovite biljke**

Vicoa indica (L.) DC., pripadnik porodice Asteraceae (Compositae), je dobro poznata tradicionalna lekovita biljka široko rasprostranjena u tropskim područjima, uključujući i Indiju. Različiti delovi ove biljke su proučavani zbog svojih farmakoloških svojstava. Tradicionalno, plemena severne Indije su koristila *V. indica* kao kontraceptiv. Biološka aktivnost biljke pripisuje se njenom raznovrsnom fitohemijskom sastavu, koji uključuje seskviterpenoidne laktone, triterpenoide i flavonoide. Nekoliko istraživanja je izveštavalo o njenim protivupalnim, kontraceptivnim, antioksidativnim i antimikrobnim svojstvima. Ovaj pregled objedinjuje postojeću naučnu literaturu o tradicionalnoj upotrebi *V. indica* kao lekovite biljke. Ipak, sprovedena su ograničena istraživanja na ovoj vrsti, što naglašava potrebu za daljim proučavanjima kako bi se u potpunosti ispitali njeni terapeutski potencijali.

Ključne reči:
oksidansi, antiinflamatorno, antiseptičko, Asteraceae, Banjauri, kontraceptiv, seskviterpenoidni laktoni, *Vicoa indica*, vikolidi

Introduction

The field of traditional medicine continues to play a significant role in global healthcare, with increasing interest in their integration into modern medicine. The growing interest in these practices, combined with ongoing research and regulatory efforts, is shaping the future of traditional medicine (Rizvi et al., 2022). There is increasing public interest in natural and holistic approaches to health, leading to greater acceptance and use of traditional medicines (Wyk et al., 2020). A desire for alternative treatments and a growing awareness of the potential benefits of traditional practices drives this interest. Many organizations promote research, develop regulatory frameworks, and integrate traditional medicine into broader health strategies.

Ethno-pharmacological research on *Vicoa indica* has predominantly focused on Asian countries, where the plant is primarily used in traditional medicine (Misra et al., 2011). The plant, belonging to the family Asteraceae, is a perennial herb distributed throughout central Asia and northeast tropical Africa (Tiwari et. al., 2018). So far, only limited research has been conducted on this plant, which is summarized below.

Botanical description and distribution

The plant is found in West tropical Africa, India, Pakistan, Myanmar, China, Sri Lanka, and Thailand. In India, it occurs in the Himalayas and the Western Ghats (Misra et al., 2011). This annual herb is widely cultivated in India, especially in the states of Kerala, Tamil Nadu, Andhra Pradesh, Karnataka, and Odisha. *Vicoa indica*, commonly known as Golden Daisy, is an erect annual herb reaching a height of 1–3 feet. The upper portion bears lush, cylindrical branches along the stems. The sessile leaves are oblong-lanceolate, acute, entire or serrulate, coarse or scabrid, with short appressed hairs on both sides. They vary in size, are dilated, and have rounded auricles at the base, typically measuring 3 to 8 cm in length. Yellow flower heads, 1–2 cm wide, appear singly on thin stems. The ray flowers number 12–24, each with three teeth at the apex; they are thin and accompanied by yellow disc florets. The flowers are bright yellow. Flowering and fruiting occur from September to March (Pullaiah et al., 2009; Tiwari et al., 2018). It is considered a weed of cultivation and a colonizer, commonly growing in plains and paddy fields up to 1300 m altitude.

Phytochemistry

Qualitative tests on various parts of *Vicoa indica* have been conducted to detect secondary metabolites. The plant is rich in phytocompounds such as flavonoids, sesquiterpene lactones, alkaloids, phenolic compounds, triterpenes, and others. Several sesquiterpenoid lactones were isolated from different extracts of *V. indica* and named Vicolides A, B, C, D, and E (Purushothaman et al., 1981; Vasanth et al., 1995). The structures of these compounds were elucidated using X-ray crystallography, chemical, and spectroscopic methods. Studies also revealed the presence of other phytochemicals, including triacontanol, campesterol, a rare flavonoid—3′,5,6-trihydroxy-4′,7-dimethoxyflavone—and β-sitosterol (Purushothaman et al., 1986). Sixteen n-alkanes and nine n-alkanoic acid ethers were isolated from aerial parts using the urea adduct method (Balakrishna et al., 1993). Chloroform and methanolic extracts contained compounds such as vicogenin and viscose B (Vasanth et al., 1992). Extracts of the aerial parts also showed the presence of germacranolide (Sawaikar et al., 1998). Additionally, Mossa et al. (1997) reported four new sesquiterpene lactones: 10α-hydroxy-14H-inuviscolide, 4α,5α-epoxy-10α,11β,13H,14H-1-epi-inuviscolide 3-β-d-glucoside, 2α-O-acetyl-3β-hydroxyalantolactone, and 2α,3α-dihydroxyalloalantolactone, along with several known compounds and thymol esters. Despite the isolation of many bioactive compounds, their pharmacokinetic profiles, bioavailability, and specific mechanisms of action remain largely unexplored. Most research has been conducted *in vitro*, with limited *in vivo* validation.

Uses in folk and traditional medicine

Traditionally, women use a decoction of *V. indica* to induce sterility. The plant is well known in northern Indian states as Banjauri, meaning a female infertility agent (Dhall et al., 1988; Basak et al., 2016). Banjauri is believed to prevent pregnancy for five to seven years, and sometimes it is also taken during menstrual cycles, although the results are not consistently reliable. In an ethnopharmacological study of the “Baiga” tribe in Madhya Pradesh, an aqueous decoction of *Vicoa indica* was used to treat rheumatism and arthritis (Tiwari et al., 2018). Tribes in the Nandurbar district of Maharashtra used an infusion of the whole plant as an abortifacient agent (Tayade et al., 2005). Additionally, the roots of the plant are traditionally used to treat cough and jaundice (Oudhia et al., 2001–2003). Despite its widespread use in traditional medicine, *V. indica* has not been extensively studied in clinical settings. This reliance on traditional knowledge underscores the need for controlled pharmacological studies to validate its safety and efficacy.

Biological activities
Antibacterial activity

Several reports suggest the antibacterial potential of *Vicoa indica*. The methanol extract of leaves proved effective against bacterial strains such as *Vibrio parahaemolyticus*, *Klebsiella pneumoniae*, and *Escherichia coli*, indicating the plant's potential for treating numerous infectious illnesses (Kesavan et al., 2007). However, aqueous and ethanolic extracts of *Vicoa indica* leaves did not show promising antibacterial activity when tested against *K. pneumoniae* and *Pseudomonas aeruginosa* (Harish et al., 2010). Gold nanoparticles (AuNPs) synthesized from the leaf extract demonstrated significant inhibitory ability against human pathogenic bacteria (HPB) (Deivanathan et al., 2023). Gopalakrishnan et al. (2013) compared extracts of various parts of different plants for antibacterial activity. Chloroform and acetone extracts of roots, flowers, leaves, and stem parts of *V. indica* showed inhibitory activity against *E. coli*. Among the various parts investigated, the leaf extract showed the maximum inhibition against the bacterial strain (Gopalakrishnan et al., 2013). Gopal et al. (1992) isolated vicolides A, B, C, and D, previously reported from the chloroform extract of the whole plant and subjected them to antibacterial studies against six strains. All vicolides showed moderate activity against *Bacillus subtilis*. Vicolide B also

showed reasonable efficacy against *Staphylococcus aureus*, while vicolide D was active against *Staphylococcus citreus* (Gopal et al., 1992).

Antifertility activity

In India, many plants have traditionally been used for birth control by tribal communities, and *Vicoa indica* is one such plant, commonly known as Banjauri. Ancient people widely used it as an abortifacient agent and to induce infertility in females. Female albino rats treated with *V. indica* demonstrated the antifertility activity of vicolide B (Vasanth et al., 1990), which was identified as a natural antiestrogenic compound. It also exhibited abortifacient effects despite neither being progestational nor antiprogestational. Animal studies on bonnet monkeys (*Macaca radiata*) further validated its contraceptive potential (Rao et al., 1996). In this study, female monkeys were treated on days 1–14 and 9–14 of their menstrual cycle or 2–5 days postpartum, and fertility was assessed in the subsequent cycle. The results showed that treatment from day 1 to day 14 of the cycle protected the monkeys from pregnancy; however, contraception failed during the postpartum period. Treated animals did not conceive even after 13 ovulatory cycles with fertile males, while all vehicle-fed monkeys became pregnant within just three cycles. The safety and contraceptive efficacy of *V. indica* (Banjauri) have also been evaluated in female human subjects using modern clinical trial methods. When administered at a dose of 15 g once daily for 3 days across three cycles, the drug was found to be free from side effects and exhibited dose-related antifertility activity, which could potentially be enhanced by modifying the drug delivery system (Dall et al., 1988).

Antiviral activity

The antiviral properties of the plant extracts were screened for their inhibitory activity against herpes simplex virus (HSV) replication using *in vitro* methods. The study revealed that the aqueous root extract showed maximum inhibition against HSV-1 replication, comparable to the standard drug acyclovir (Rani et al., 2013). Epilupeol, an antiviral compound, was isolated from the plant's hexane extract. Its antiviral activity was demonstrated using a chicken embryo model, establishing the plant's effectiveness in treating Ranikhet disease virus (RDV) (Chowdhury et al., 1990).

Anti-inflammatory and analgesic activity

The flavone isolated from the aerial parts of *Vicoa indica* was evaluated for analgesic and anti-inflammatory properties using *in vivo* models (Krishnaveni et al., 1997). The isolate was found to effectively inhibit responses in both anti-inflammatory and analgesic models. The analgesic effect is attributed to its action on opioid receptors. Additionally, the compound showed consistent anti-edema effects across three experimental models: carrageenan-, histamine-, and turpentine-induced edema. Sesquiterpene lactones, namely vicolides A, B, C, and D, exhibited anti-inflammatory effects on cotton pellet granulomas in rats treated with 10 mg/kg body weight via the subcutaneous route. Vicolides C and D reduced serum and liver protein levels, as well as the activities of SGOT, SGPT, and acid and alkaline phosphatases. The potent anti-inflammatory properties of vicolide C, which contains an ester moiety and a 3,4-epoxy group, and vicolide D, characterized by an epoxy angeloyl group, are linked to their molecular structures. The antipyretic action of vicolide D was observed at a dosage of 250 mg/kg of body weight (Alam et al., 1992).

Antioxidant activity

Natural antioxidants play an important role in maintaining and protecting human health, often preferred over synthetic antioxidants. Gold nanoparticles synthesized from the leaf extract demonstrated free radical scavenging activity (Deivanathan et al., 2023). The total phenolic content in the plant extract was measured at 135 GAE per microgram (Chethan et al., 2013).

Hepatoprotective activity

Methanolic extracts of *V. indica* leaves demonstrated hepatoprotective effects in CCl_4-induced hepatic toxicity rat models (Prasanth et al., 2020). However, the underlying mechanisms of hepatoprotection—such as CYP450 modulation and antioxidant pathways—remain speculative. Further research should incorporate targeted proteomic and metabolomic analyses, along with long-term toxicity assessments.

Conclusion

In summary, *Vicoa indica* emerges as a plant of significant therapeutic potential, highlighted by its diverse phytochemical composition and a wide range of pharmacological activities, including antibacterial, analgesic, anti-inflammatory, antioxidant, antifertility, and hepatoprotective effects. The comprehensive data presented here provide compelling evidence supporting its potential applications in various therapeutic contexts. To fully harness the medicinal value of *V. indica*, further clinical and pharmacological studies are needed to explore its extracts and isolated compounds.

Such investigations could pave the way for the development of novel pharmaceutical agents, establishing *V. indica* as a valuable resource in modern drug discovery and development.

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