Rungia pectinata (Linn.) Nees: A Review of Phytochemical Analysis and Pharmacological Activities

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Abstract

Rungia pectinata L. is an herbaceous weed traditionally used for many years for various disease conditions. Nevertheless, these indigenous medical practices are frequently regarded as self-limiting, necessitating a thorough examination of their purported benefits. This review aims to consolidate existing scientific insights and identify domains requiring additional research. The literature was searched using the keyword "Rungia pectinata" OR "Comb Rungia" in well-known scientific databases, including PubMed, Web of Science, and Scopus, and relevant papers were selected for this review. The leaf juice is used as a cooling agent and to treat smallpox in children, reducing pain and swelling. A paste made from the fresh leaves blended with castor oil can heal tinea capitis, a scaly fungoid scalp infection. This plant has a rich tradition of use in treating different disease conditions, such as hepatitis, acute conjunctivitis, children's dyspepsia, dysentery, and lymphoid tuberculosis. Additionally, it exhibits diverse pharmacological activities like antipyretic, anti-inflammatory, diuretic, analgesic, antifungal, and antibacterial effects. This study found that it has secondary metabolites, such as amino acids, glycosides, phenolics, terpenes, phytosterols, tannins, flavonoids, and carbohydrates. Additionally, a total of 38 isolated compounds were identified in essential oils, with the dominant compounds being trans-phytol, hexahydrofarnesyl acetone, and isophytol. However, the phytochemical compositions varied depending on the type of extraction process. R. pectinata presents a promising avenue for medicinal exploration, deeply rooted in traditional practices. This review underscores the need for a more thorough investigation into its diverse therapeutic applications and encourages further research to unlock the plant's full potential.

Keywords*: anti-inflammatory, Rungia pectinata, traditional medicine, medicinal plant, phytochemical analysis, therapeutic potential*

INTRODUCTION

Rungia pectinata (L.) Nees is a widespread herbaceous weed belonging to the Acanthaceae family. It has been traditionally used for various health conditions over many years, including the treatment of smallpox in children, alleviating painful inflammations and swellings, managing cuts and wounds, addressing measles and gastrointestinal disorders, and serving as a cooling agent (Nadkarni, 2002; Pandey and Sharma, 2022). It is commonly known as the "Mushroom Plant" or "Comb Rungia" (Kainsa & Bhoria et al., 2012). This is also known as Pindi or Birlongo park, Punaka pundu, Krebuchi (Marma) in Bangladesh (Rahman et al., 2018; Rahman, 2013) and Pindi or Pindi Konda, Punakapundu, Tavashu murunghie in India (Jaiswal et al., 2017; Padal et al., 2017), Ukuchi jhar in Nepal (Pandey and Sharma, 2022), San phra (สันพร้า) in Thailand (Rueangsawang et al., 2020). This plant is distributed across India, Sri Lanka, Myanmar, China, Laos, Cambodia, Vietnam, Peninsular Malaysia, and Indonesia. It thrives in various habitat types, including evergreen forests along rivers and slopes with large limestone outcrops, deciduous forests mixed with bamboo, dry ground in light shade, and mixed montane forests, typically found at altitudes ranging from 20 to 1,000 meters (Rueangsawang et al., 2020).

The medicinal uses of *R. pectinata* are well-known among traditional practitioners, particularly in traditional Chinese medicine. This plant leaf juice is considered a cooling agent and is traditionally used to cure smallpox in children (Saha et al., 2016). The leaf paste is externally applied to relieve painful inflammations and swellings (Zhang et al.,

2016, Shekhawat MS et al., 2016; Swain et al., 2008). The combination of leaves and castor oil paste is reported to cure tinea capitis, a scaly fungal infection on the scalp (Shekhawat MS et al., 2016). In India, the roots are used as a febrifuge by the tribal population (Sarker et al., 2017). There are also reports that it is used as a diuretic and vermifuge (Shekhawat MS et al., 2016; Swain et al., 2008). In South China, *R. pectinata* treats hepatitis, acute conjunctivitis, children's dyspepsia, dysentery, lymphoid tuberculosis (Zhao et al., 2008). As this plant is used to treat infantile indigestion, it is also known as "infant's herb" in China (Lin et al., 2019). Several studies reported that *R. pectinata* has different pharmacological activities, such as antipyretic, anti-inflammatory, diuretic, analgesic, antifungal, and antibacterial effects (Singh et al., 2022; Swain et al., 2008; Shekhawat et al., 2016).

This plant, *R. pectinata*, renowned for its multifaceted health benefits, remains curiously underexplored in the scientific domain, particularly in terms of phytochemical analysis and pharmacological activities. Despite its traditional applications and the prevalence of its consumption as a leafy vegetable in specific regions, a comprehensive synthesis of its intricate phytochemical composition and pharmacological potential is notably absent. Our extensive data mining from reputable scientific databases, including Scopus, PubMed, and Web of Science, underscored the scarcity of in-depth reports across various dimensions (Figure 1). In scientific exploration, this lacuna prompts the need for a dedicated review to unravel the full spectrum of phytochemical constituents and pharmacological activities associated with *R. pectinata*. Therefore, this study aims to fill the existing knowledge gap surrounding *R. pectinata* by conducting a comprehensive review focused on its phytochemical analysis and pharmacological activities. Our objective is to provide a thorough understanding of the plant's medicinal potential through an exhaustive synthesis of current scientific insights. This review not only highlights the importance of *R. pectinata* in traditional medicine and its culinary use but also lays the groundwork for future research initiatives, emphasizing potential applications in developing novel therapeutic interventions.

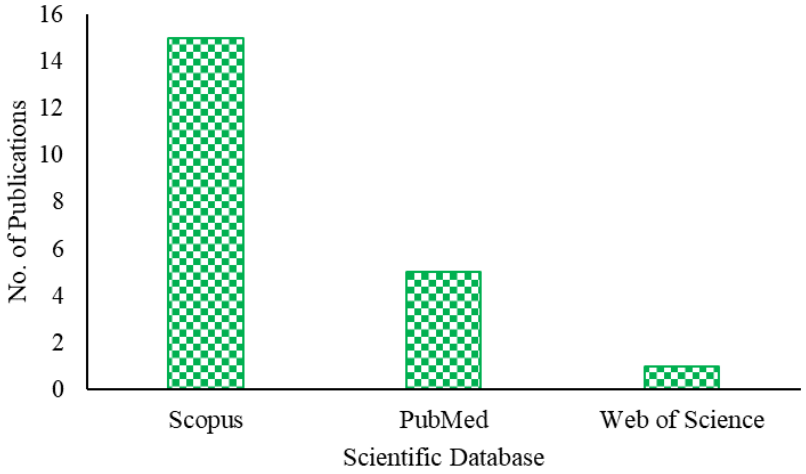

Figure 1. Publications report on *Rungia pectinata* (L.) Nees in scientific databases- Scopus, PubMed and Web of Science. The data presented is as of 23 December 2023

RESEARCH METHODOLOGY

This study initiated a comprehensive literature search employing the keywords "*Rungia pectinata*" OR "Comb Rungia" across reputable scientific databases, namely Scopus (https://www.scopus.com/), PubMed (https://pubmed.ncbi.nlm.nih.gov/), and Web of Science (https://www.webofscience.com/). The search aimed to identify pertinent studies and articles related to the phytochemical analysis and pharmacological activities of *R. pectinata* (L.) Nees. The systematic exploration of these databases ensured the inclusion of diverse perspectives and scholarly contributions to enhance the robustness of our review.

RESULT AND DISCUSSION

Botanical Description

R. pectinata is a small annual and perennial herbaceous weedy plant that grows abundantly on mountainsides. The species name pectinata means comb-like, most likely due to the resemblance of the flower-spike to a comb. This plant, recognized for its oval-shaped leaves and spikes bearing purple or blue flowers (Rueangsawang et al., 2020), manifests as a procumbent or semierect herb with oppositely arranged leaves measuring 1-3 cm, oblong-lanceolate, and sharply tipped (Figure 2). The flowers, approximately 3-4 mm in size, are tiny, violet-blue, and form spikes at the axils [www.flowersofindia.net]. This herb has cylindrical weak stems (10-20 cm) that bloom from November to December (Shekhawat MS et al., 2016).

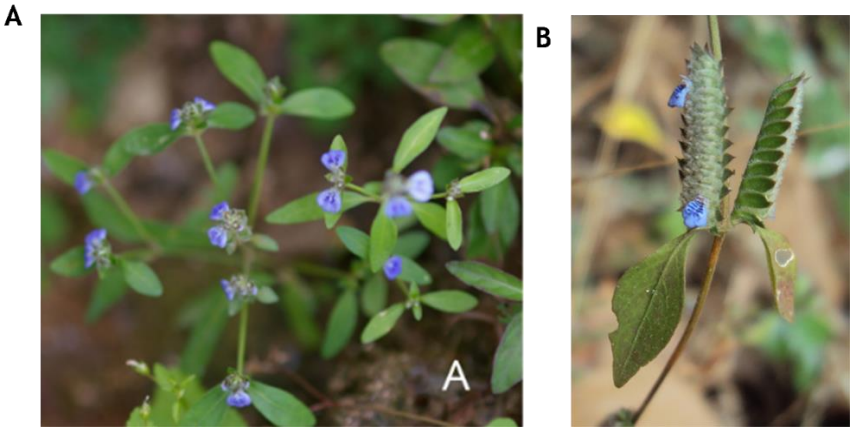

Figure 2. *Rungia pectinata* (L.) Nees: A. Habit and inflorescence, B. Inflorescence; photos by C. Suwanphakdee [Figure reproduced from Rueangsawang et al., 2020]

Phytochemical Analysis

The phytochemical analysis of *R. pectinata* was done using air-dried leaves, aerial parts, or whole plants. Secondary metabolites, such as phytosterols, terpenes, tannins, flavonoids, and carbohydrates, were reported in the leaves of *R. pectinate* (hydroethanolic extract, 50:50) (Swain et al., 2008b). The aerial parts of *R. pectinata* were evaluated for their Total Phenolic Content (TPC), Total Flavonoid Content (TFC) and other secondary metabolites (Pandey and Sharma, 2022). TPC and TFC were expressed in mg GAE/g of dry extract and mg QE/g of dry extract, respectively. The hot extract of aerial parts of *R. pectinata* showed 111.52 ± 1.57 mg GAE/g TPC and 47.87 ± 2.57 mg QE/g TFC. The major secondary metabolites present in the plant extracts were alkaloids, polyphenols, glycosides, coumarins, tannins, flavonoids, and reducing sugar. Zhang et al. (2016) conducted an essential oil extraction of *R. pectinata* utilizing hydrodistillation. The resultant light yellowish oil, obtained from the hydrodistillation of the dried plant, exhibited an average yield of 0.15% (w/w). Through GC-MS analysis, 38 compounds were identified from this essential oil, constituting

94.51% of the total oil composition. The primary components of *R. pectinata* oil were determined to be trans-Phytol (35.77%), Hexahydrofarnesyl acetone (18.72%), and Isophytol (3.79%). Notably, the oil comprised monoterpenoids (2.45%), sesquiterpenoids (26.64%), and diterpenoids (45.52%) (Review Zhang et al., 2016 for details).

Pharmacological Activities

Plants having a long history of use in ethnomedicine can be an important resource of compounds for the treatment of numerous conditions and infectious diseases. The reported pharmacological activity of *Rungia Pectinata* has been review and discussed (Table 1).

Table 1. Overview of pharmacological activities of *Rungia pectinata*

Pharmacological effect	Tested substance	Plant part	Remark	Ref
Anti-inflammatory activity	Ethanol extract	leaves	Moderate anti-inflammatory activity	(Swain et al., 2008)
Anti-inflammatory activity	Ethanol extract	whole grass	*Rungia pectinata* (Linn.) Nees has a considerable inhibitory impact on the production of pro-inflammatory factors, but only a little effect on the enhancement of anti-inflammatory factors	(Zhao et al., 2008)
Diuretic effect	Ethanol extract	whole grass	Significantly improved the diuretic effect	(Swain et al., 2008)
Antimicrobial Activities	Ethanol extract Acetone extract Petroleum ether extract Benzene extract Chloroform extract	whole grass	Showed significant activity against *Trichophyton mentagrophytes*	(Swain et al., 2008)

Anti-inflammatory Activity

The hydroalcoholic leaves extract of *R. pectinata in vivo* study showed anti-inflammatory activity at a dose of 200 mg/kg, 400 mg/kg, and 800 mg/kg, respectively, by using Swiss albino mice. Also, compared to the standard aspirin, it indicates that *Rungia pectinata* can significantly reduce inflammation (Swain et al., 2008). In other research, it has been reported that the ethanol extract of *R. pectinata* was able to block the activation of NF-B, which led to a significant reduction in the production of pro-inflammatory cytokines and mediators, as well as slightly promote the release of an anti-inflammatory mediator called HO-1 and suppress the production of IL-10. On the other hand, it has been reported that compared to Dexamethasone, *R. pectinata* has milder effects on boosting the secretion of anti-inflammatory mediators and similar effects on inhibiting pro-inflammatory mediators and cytokines (Zhao et al., 2008).

Diuretic effects

The ethanolic leaf extract of R. pectinate was found to have diuretic effects in Wistar rats. The findings were compared to the standard medication frusemide. By increasing the excretion of Na+, K+, and Cl- ions, *R. pectinata* has a diuretic effect (Swain et al., 2008). Many diuretics cause K+ loss, which can lead to hypokalemia. Diuretic activity is caused by active phytoprinciples such as flavonoids and terpenoids (Zhao et al., 2008).

Antimicrobial activities

Various extracts of *R. pectinata*, including ethanol, acetone, petroleum ether, benzene, and chloroform extracts, exhibited antimicrobial activity against tested bacteria and fungi. Study reported that the antibacterial activity of various extracts of *R. pectinate* revealed substantial activity against all the tested bacteria and fungus, where the disc diffusion method was used (Swain et al., 2008). The ethanol extract, at 30 to 60 µg/disc, demonstrated antibacterial and antifungal effects against the bacteria *Escherichia coli*, *Staphylococcus pyogenes*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, and *Bacillus cereus*, as well as the fungus *Aspergillus niger*, *Aspergillus flavus*, *Candida albicans*, *Fusarium oxyporum*, and *Fusarium solani*. The acetone extract showed considerable activity against *Candida albicans* but mild effects on other bacteria. Ethanol extract, overall, displayed significant antimicrobial activity (Swain et al., 2008).

Toxicological Assessment

R. pectinata has been reported as non-toxic. Acute and subchronic toxicity tests on albino mice and rats, using hydroalcoholic leaf extract, revealed no adverse effects. Test groups receiving doses of 1000, 2000, and 4000 mg/kg orally showed no significant changes in food and fluid intake, body weight, absolute and relative organ weights, or hematological markers. The fatal dose (LD_{50}) was determined to be greater than 4000 mg/kg (p.o.), signifying the plant's safety for human use (Swain et al., 2008).

CONCLUSIONS

In conclusion, *R. pectinata* demonstrates significant potential as a medicinal resource, particularly in the realm of drug discovery. However, despite its promising attributes, a comprehensive exploration of its pharmacological activities and the isolation of pure compounds remains an unexplored frontier. With approximately 70,000 species scrutinized for medicinal utility, the rich repository of secondary metabolites in plants like *R. pectinata* holds promise for addressing diverse diseases. Traditional uses and pharmacological studies underscore the multifaceted benefits of *R. pectinata*, spanning antipyretic, anti-inflammatory, diuretic, analgesic, antifungal, and antibacterial effects. Despite these promising aspects, limited research has been dedicated to this medicinal plant. Consequently, there is a pressing need for further investigations into the medicinal value and activity of *R. pectinata* through both *in vitro* and *in vivo* studies. This endeavor is essential to unlock the full potential of *R. pectinata* and contribute valuable insights to the field of natural medicine.

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