Pharmedico Publishers
International Journal of Pharmaceutical Science and Medicine
Volume 2, Issue 3 (2024): 89-93
DOI: 10.70199/IJPSM.2.3.89-93

REVIEW ARTICLE

ISSN: 2584-1610 (Online)

UNLOCKING THE HEALING POWER OF *GLOCHIDION VELUTINUM* - AN IN-DEPTH REVIEW OF ITS MEDICINAL BENEFITS AND USES

Sheshna Srivastava*, G. Pavan Kumar, Gyan Singh

Research Scholar, Institute of Pharmacy, PK University, Thanra - 473665, Madhya Pradesh, India.

Article History
Received: 14 July 2024
Revised: 25 August 2024
Accepted: 02 September 2024
Published: 25 September 2024

Correspondence should be addressed to
Sheshna Srivastava,
Research Scholar, Institute of Pharmacy, PK University, Thanra - 473665, Madhya Pradesh, India.

Email- sheshnasrivastva@gmail.com

ABSTRACT: The traditional medical substance *Glochidion velutinum*, seldom discussed, has actually been used for centuries in various cultures across the world. This comprehensive review describes the phytochemical composition of the plant, its pharmacological activities, and potential applications in modern medicine. This well-shaghout lead contains bioactive compounds with a wide range of health effects: Besides anti-inflammatory and anti-oxidative properties it also has anti-microbial properties. Moreover, it is effective against cancer. Bioassay experiments in recent years could be taken as evidence that traditional Chinese medicinal materials such as *Glochidion velutinum* can be a therapeutic source for developing new drugs. Traditional uses of the plant are being confirmed by clinical studies. Its promising therapeutic prospects deserve further study. Today, through a search of the literature the authors have compiled this review article in the hope of revealing all aspects of medicinal properties contained in *Glochidion velutinum* together with prospects for future pharmacological or pharmaceutical research.

Key Words: *Glochidion velutinum*, Medicinal plant, Therapeutic properties, Pharmacological activities, Bioactive compounds

1. INTRODUCTION

Since ancient times, medicinal plants have played an essential role in human health and well-being. The raw material of traditional healing and modern pharmaceuticals alike, these species consist of a rich array of bioactive compounds, which offer a wide variety of medical benefits. These can range from treating an everyday cough or headache to curing some very complex diseases indeed. The more people want natural and sustainable health solutions for a global audience, the more scientific research we are seeing into the medicinal properties each of these plants has. Proliferation of medicinal plants has a double role: to lead people into experimenting with new drugs and to conationalise and inherit the traditional knowledge of Chinese medicine [1]. *Glochidion velutinum*, from the family Phyllanthaceae, is one relatively unknown plant in the world of natural medicine. In different parts of Asia, it has been utilized medicinally by people for time immemorial; all cultures that meet the plant know how valuable it is in treating various ills [2]. But as a medicinal herb, little work has been done at all to systematically study it. The plant contains many different kinds of phytochemicals, and these are thought to be responsible for its curative effects. However, there is scarcely any thorough scientific analysis done until now that could provide a solid basis or understanding of what kind of health benefits it might bestow upon humanity in future [3].

In this review, we aim to give a comprehensive analysis of the medical uses which are expected from *Glochidion velutinum* [4]. By compiling and analyzing literature, this paper tries to reveal the plant's phytochemical composition, pharmacology effects, and traditional use [5]. In addition, it will explore recent scientific research supporting *Glochidion velutinum* traditional use as well as potential directions of future medicinal development for this material through reviewing those studies [6]. Through this comprehensive review we aim to show that *Glochidion velutinum* is of great significance in today's medicine and further research is needed on its therapeutic properties [7].

2. PHYTOCHEMICAL COMPOSITION

Overview of Phytochemical Constituents

Glochidion velutinum harbors diverse chemical compounds. These phytochemicals contribute most directly to its medicinal properties. Included among these are flavonoids, tannins, alkaloids and other phenolic compounds [8]. Each type of phytochemical makes a specialty contribution to the therapeutic potential of this plant [9]. Thus, flavonoids are famous for their antioxidant as well as anti-inflammatory effects. Tannings additionally have antimicrobial and anti-cancer capabilities. And as a third significant class, the alkaloids show analgesic and antimalarial powers too [10]. The interaction of these active components is thought to make *Glochidion velutinum* not only capable cumulatively of addressing a range of common afflictions but also more effective than a single component alone [11].

Methods of Phytochemical Analysis

Several phytochemical constituents from *Glochidion velutinum* are identified followed by quantification by available analytical techniques. Common methods include:

- **Chromatography:** This is a method in which the chemicals are separated with the help of suitable solvents so that these phytochemicals can be identified separately with the help of HPLC (High-Performance Liquid Chromatography) or GC-MS (Gas Chromatography-Mass Spectrometry) [12].
- **Spectroscopy:** Nuclear Magnetic Resonance spectroscopy and Infrared spectroscopy give an insight on the molecular structure of the compounds [13].
- **Mass Spectrometry:** This method is used to find out molecular weight and structure of the phytochemicals [14].
- **Qualitative Tests:** These include preliminary phytochemicals by the use of certain specific reagents for different groups of compounds [15].

Table 1: Key Phytochemicals Identified in *Glochidion velutinum* [16]

Phytochemical	*Class*	*Reported Activities*
Flavonoids	Phenolic compounds	Antioxidant, anti-inflammatory
Tannins	Polyphenols	Antimicrobial, anticancer
Alkaloids	Nitrogenous compounds	Analgesic, antimalarial
Saponins	Glycosides	Antimicrobial, anti-inflammatory, cholesterol-lowering
Terpenoids	Isoprenoids	Antiviral, anticancer, anti-inflammatory
Phenolic acids	Phenolic compounds	Antioxidant, anti-inflammatory, antimicrobial
Glycosides	Sugars combined with other compounds	Cardiotonic, anti-inflammatory
Steroids	Lipid compounds	Anti-inflammatory, hormone regulation
Coumarins	Phenolic compounds	Anticoagulant, antimicrobial, anticancer

3. PHARMACOLOGICAL ACTIVITIES

Anti-inflammatory Properties

It is well known for its anti-inflammatory nature which is attributed to bioactive compounds such as flavonoids and terpenoids present in the plant [17]. They work by "blocking" major pro-inflammatory enzymes like COX-2 and LOX, which are involved in inflammation. To add onto that, they decrease the production of inflammatory cytokines like TNF-α, IL-1β, and IL-6, thus decreasing systemic inflammation. These pathways modulation indicates the possibility of *Glochidion velutinum* to work on inflammatory conditions [18].

Antioxidant Activities

Glochidion velutinum exhibit high antioxidant properties attributed to its rich flavonoids, phenolic acids, and tannins. Such compounds are useful to counteract those free radicals that causes damage to the cells (oxidative damages) that lead to chronic diseases [19, 20]. The antioxidant potency of this plant is equal to, or even more than, examples of well-known antioxidants like Vitamin C and E, showing that *G. velutinum* L. extract could be a fantastic source of natural antioxidants for the development and establishment of drugs [21].

Antimicrobial Properties

It has also been reported that the antimicrobial compounds extracted from *Glochidion velutinum* have a wide antimicrobial activity to Gram-positive and -negative bacteria, as well as fungi, and even viruses [22]. Bioactive compounds including tannins and saponins in the plant can be responsible for this as they interact with microbial cell walls and metabolic processes [23]. *Glochidion velutinum* exhibit broad-spectrum anti-microbial activity, suggesting that antimicrobial compounds from this plant and its associated endophytes could be potential sources of new antibiotic, which could be utilized against the rising antibiotic resistance. This could inspire new treatments for antibiotic-resistant bacterial strains [24].

Anticancer Activities

Many biological investigation were performed on this plant which exhibits a significant anticancer activities as its cytotoxic effects was found against human breast, liver and colon cancer cell lines [25]. The alkaloids and coumarins work to induce apoptosis and counter cell proliferation. The anticancer effects include the induction of both intrinsic and extrinsic apoptotic pathways [26]. The plant *Glochidion velutinum* inhibits nitric oxide production and, therefore, decreases inflammatory signaling that leads to cellular proliferation, an early hallmark of cancer development, while some of its compounds are also capable of increasing the expression of pro-apoptotic proteins (e.g., Bax) and reduce anti-apoptotic proteins (*e.g.,* Bcl-2), tipping the balance toward programmed cell death [27-30]. The present findings provide the first proof-of-concept in support of *Glochidion velutinum*, which may be utilized as a potent preventive lead thermotherapy to devise future anticancer treatments [31].

4. TRADITIONAL USES AND ETHNOPHARMACOLOGY

Historical Use in Traditional Medicine

Collected from the wild parts of the plant, *Glochidion velutinum* has long been produced and studied for its biological activity that enables it to be effectively used as medicine in many different cultures [32]. It is, therefore, used in many working methods of traditional healers and herbalists who have traditionally used various parts of the plant to treat a variety of diseases from everyday health problems to serious diseases. This efficacy of the plant in traditional healing has ensured its continued use and recognition by local medicinal systems [33-35].

Ethnobotanical Studies and Surveys

Different surveys and ethnobotanical studies were done during the past years to record the traditional knowledge and practices regarding *G. velutinum*. While researching these studies, they will acquire data on the well-known utilizations and planning strategies from nearby networks and Indigenous healers.

Recording these practices, will help exploring the ethnic importance of *Glochidion velutinum* in healing potential in different part of the country by the researchers [36-40].

Table 2: Traditional Medicinal Applications of *Glochidion velutinum* [41]

Application	Traditional Preparation	Reported Effectiveness
Wound healing	Leaf paste	Effective
Fever reduction	Decoction	Effective
Digestive aid	Infusion	Moderate
Pain relief	Poultice	Effective
Respiratory ailments	Inhalation of vapor	Moderate
Skin disorders	Topical application	Effective
Diarrhea	Decoction of bark or leaves	Effective
Anti-inflammatory	Leaf decoction	Moderate

5. MODERN APPLICATIONS AND FUTURE PROSPECTS

Current Research Trends and Developments

The pharmacological studies on *G. velutinum* are an emerging field in the recent days owing to the modern scientific research methodologies and remarkable need of natural health care solutions all over the world [42]. Research focus is particularly on mechanisms of action of the bioactive constituents of *Glochidion velutinum* as well as identification of some potential areas where these could find application in modern medicine. Research is ongoing to determine its effectiveness in multiple disease models and identify new therapeutic targets [43-44].

Potential for Drug Development

This review explored the pharmacological properties of the bioactive molecules exhibited in *Glochidion velutinum* which appear to be a very efficient source of drug development. These are interesting molecules showing anti-inflammatory, antioxidant, antimicrobial and anticancer activities, making them attractive to develop new drugs. Such a broad range of indie molecules in the chemical profile of a single plant can lead to the discovery of potent and selective drug candidates that are able to fill untended medical niches, including inflammation, infectious diseases and cancer [45-46].

Challenges and Limitations in Current Research

Although *Glochidion velutinum* has promising therapeutic potential, there are many challenges and barriers in the current research work [47]. The major barrier is the lack of consistent empirical knowledge of its pharmacological properties and potential adverse events, especially its safety profile [48]. In order to increase the appropriateness, the quality and the standardization of the extraction methods as well as the of methods which may serve as control measures has to be followed to put reliability and reproducibility to the foreground when conducting the research [49]. Moreover, such studies require that proof-of-concept findings be translated to the clinical setting, a transition that would require overcoming substantial logistical and regulatory hurdles [50].

CONCLUSION

Consequently, the integrative and holistic dissection of medicinal attributes broadens the horizon to exploit the therapeutic capabilities residing from *Glochidion velutinum*. This is mainly due to its various pharmacological properties arisen from its complex chemical composition, which contains flavonoids, tannins, alkaloids and other bioactive compounds, which can explain its anti-inflammatory, antioxidant, anti-microbial, and anticancer effects. In this present review the ethanopharmacological uses as well its traditional uses are discussed and supported by bibliography, as well as studies from modern pharmacological research showing high potential as a medicinal plant for a wide range of pathogies. The plant has been shown to be equally effective from wound healing, fever reduction to pain relief, and anti-cancer.

These findings emphasize the necessity for investigations of the therapeutic potential of *Glochidion velutinum*. The molecular mechanisms of action of bioactive components of Safed musli, need to be uncovered with further research, the effectiveness and safety of these compounds have to be assessed with well-controlled preclinical and clinical trials as well as new formulations for the pharmacological actions. Also collaborating traditional healers with researchers and indigenous communities can overcome the gap between ancient knowledge and modern science and can bring home actual drugs from natural sources.

It is hoped that the new awareness of natural and plant-based medications will also lead to follow-up of *Glochidion velutinum* as an attractive candidate for further drug development. The fact that it has been traditionally in several cultures and new scientific evidences that reinforce the therapeutic properties of this compound, make it an important molecule to be explored in the finding of new therapeutic agents. Further investigation and research of *Glochidion velutinum* would offer quite tremendous medical health contributions to the recent medical science apparently being safe and effective, leading to a sustainable world free health challenges.

ACKNOWLEDGEMENT: Nil

CONFLICT OF INTEREST: Nil

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How to Cite this article:
Srivastava S, Kumar GP, Singh G. Unlocking the healing power of *Glochidion velutinum* - an in-depth review of its medicinal benefits and uses. International Journal of Pharmaceutical Science and Medicine 2024; 2(3): 89-93.