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PHARMACOLOGICAL POTENTIALS OF *MIKANIA MICRANTHA*: A COMPREHENSIVE REVIEW

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Abstract

Since ancient times, people have used medicinal plants to treat a wide range of ailments. Mikania micrantha (M. micrantha) is a tropical plant of the asteraceae family. It is also known by the names climbing hemp vine, bitter vine, and American rope. It's also known as the mile-a-minute vine. Many plants have long been used in folk medicine to treat a wide range of ailments; it deals with plant extracts and their active components. This plant is found in the eastern foothills of the Andes, which stretch from Bolivia to Colombia, as well as in America, Argentina, Mexico, southeast Brazil, and other nations. Folk medicine has historically utilised this plant to treat a wide range of illnesses. It has been used historically for many purposes, such as antibacterial, anti-inflammatory, and wound healing. The physical traits, distribution, phytochemistry, and pharmacological qualities of M. micrantha are all thoroughly examined in this paper.

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1. Introduction

Humanity has been using medicinal plants to heal a variety of illnesses since prehistoric times. 80% of the world's population receives their primary care from traditional medicine, according to the World Health Organisation. It deals with plant extracts and their active ingredients; many plants have long been utilised in folk medicine to treat a wide range of illnesses [1]. M. micrantha, sometimes referred to as climbing hemp vine, bitter vine, or American rope, is a tropical plant that belongs to the Asteraceae family. Another name for it is mile-a-minute vine [2]. This plant found in America, Argentina, Mexico, southeast Brazil, eastern Andes foothills, which extend from Bolivia to Colombia and other countries [3]. This plant has long been used in folk medicine to treat a variety of ailments. Traditionally, it has been used for a variety of reasons, including wound healing, anti-inflammatory, anti bacterial etc [4, 5]. This review offers a comprehensive analysis of

the morphological characteristics, distribution, phytochemistry, and pharmacological properties of M. micrantha.

2. Morphology

The M. micrantha plant (Fig.1) features clusters of 4.5–6.0 millimeter white flowers and ribbed stems that can reach a maximum length of 6 meters. The leaves are 4–13 centimeters long, with a heart-shaped base and a pointy apex [6].

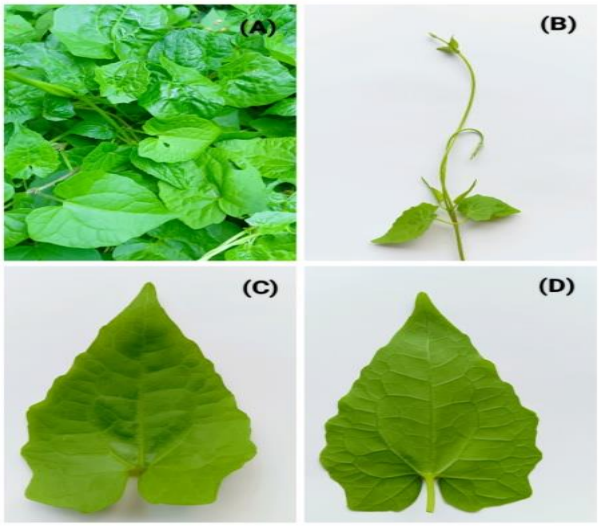

Fig. 1. M. micrantha plant (A), stem (B), upper leaf surface (C), lower leaf surface (D).

3. Distribution

M. micrantha is a herbaceous perennial climber belonging to the Asteraceae family that originated in subtropical and tropical America [7]. M. micrantha's natural range includes many Caribbean nations as well as northern Argentina and Mexico. The two main areas of diversity for M. micrantha are thought to be the highlands of southeast Brazil and the eastern Andes foothills, which extend from Bolivia to Colombia. M. micrantha is found between 30° N and 30° S latitudes in its introduced range. It is found all over Asia, including Nepal, the Philippines, and Indonesia, and stretches from Pakistan to Taiwan. In the Indian Ocean, it can also be found in the islands of Sri Lanka, Christmas, La Réunion, and Mauritius [8].

4. Phytochemistry

Various secondary metabolites have been isolated and identified from M. micrantha. Matawali. A et al. performed the phytochemical test like alkaloids by Wagner's test; flavonoids by Wilstatter-Sianidin, Batesmith and Metcalf test; tannins by Gelatin test; polyphenols by Ferric chloride test; saponins by Frothing test; terpenoids by Salkowski test. They found that leaves and aerial parts of M. micrantha contain alkaloid, tannin, polyphenol, saponin, triterpenoids [9]. Ujjwal Kanti Dev et al. another phytochemical study conducted of petroleum ether, chloroform, methanol and aqueous extract of M. micrantha. They found that Petroleum ether extracts contain saponin; Chloroform extract contain alkaloid and saponins; Methanol extract contain Alkaloid, Reducing sugar, Flavonoids, Saponins, Phenolic compound, tannins, Amino acids, proteins; and aqueous extract contain Saponins, Phenolic compound, tannins, Amino acids and proteins [10].

5. Pharmacological activities

5.1. Antioxidant

Molecules with unpaired electrons, termed as free radicals, are highly reactive. Free radicals are capable of damaging cells, proteins, and DNA when they react with other molecules in the body. This can result in a number of health problems and hasten the ageing process. They are stabilised and prevented from causing damage by antioxidants. Sustaining health requires a balance between antioxidants and free radicals [11, 12]. There have been numerous reports of substances produced from plants having the ability to scavenge free radicals [13]. Significant antioxidant activity was demonstrated by the methanolic extract of M. micrantha leaves in three different in vitro assays, i.e., ferric-reducing antioxidant potential (FRAP) assay, 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay and ABTS radical cation ($ABTS^{*+}$) scavenging assay, where L-ascorbic acid was taken as a reference [14]. Lallianchhunga MC et.al observed in the FRAP assay, the Ferric iron (Fe3+) gets reduced to ferrous iron (Fe2+) by the antioxidant phytochemical [15]. Additionally, the phytochemical's reported ferric reduction antioxidant strength (FRAP) was possibly identical as or even greater in comparison to of the reference molecule. According to Dev UK et. al, it has been observed that the methanolic extract has more potent DPPH scavenging activity where IC50 value was found to be 41.8 µg/ml where the reference value of ascorbic acid was 129.9 µg/ml. The study found that methanolic extract had significant antioxidant activity; this extract's high level of antiradical activity may be related to the phenolic chemicals that predominate in it [10]. In case of the ABTS radical cation scavenging activity, Dong LM et.al found that SC50 values for different aerial parts of M. micrantha are ranging from 0.31 to 4.86 µM, indicating more significant antioxidative property than ascorbic acid having SC50 value of 10.48 µM [14]. According to these outcomes, it can be suggested that the plant extract has specific phytochemical components that can give a free radical hydrogen in order to scavenge any potential damage.

5.2. Anti bacterial

Among the numerous biological activities that phytochemicals demonstrate are bacteriostatic effects, which refer to the ability of a substance to prevent the development and reproduction of bacteria in lieu of entirely killing them. According to Hao et al. (2007) and Zhuang et al. (2010), M. micrantha showed the widest variety of antimicrobial activity against some plant pathogens [16, 17]. Potential antibacterial activities against multidrug-resistant pathogenic bacteria, such as *Staphylococcus aureus, Pseudomonas aeruginosa, E. Coli,Salmonella typhii, Staphylococcus epidermidis* and *Bacillus subtilis* were demonstrated by several extracts of M. micrantha that contained tannins, flavonoids, and polyphenols [9, 18, 19]. According to a study, a 200 mg/ml concentration of M. micrantha methanolic extract had antibacterial activity against *Bacillus cereus* that was comparable to ciprofloxacin, and it may be able to suppress the growth of six bacterial strains [20]. Additionally, extracts from leaves and flowers demonstrated a moderate level of inhibition against the growth of *E. coli, B. cereus, Shigella sonnii,* and *Streptococcus* pyogenes [9, 21, 22]. To develop new products based on the findings of this study, additional research will be required to assess the antibacterial activity against various plant ailments indicating M. micrantha as an appropriate replacement as a novel antibacterial phytochemical.

5.3. Antifungal

The bioactive substances found in plants have strong antifungal effects. These characteristics are beneficial in both the prevention and treatment of fungal infections in a range of instances, such as medicine, agriculture, and food preservation. Phytochemicals have antifungal properties through various pathways targeting different aspects of fungal cell structure and function. It has been observed that, compared to the stem extracts, the leaf extracts showed considerably more fungistasis action. The greatest fungi stasis activity was seen in the chloroform extracts [23]. According to research, the antifungal action against *S. rolfsii, F. proliferatum, F. eridiforme* and *F. moniliforme*is triggered by the presence of glycosides and quinones in *M. micrantha,* where

the mechanism involves the inhibition of the synthesis of proteins and the activity of cells by quinones by targeting membrane-bound enzymes and cell-wall polypeptides [24, 25]. Another study reveals that, several fungal species, including *C. lagenarium, E.turcicum, B. cinerea* and *P.cubensis* undergo inhibition against germination of the spores by *M. micrantha* leaf extracts [5]. Ongoing research aims to discover and characterize different species of the plant with potent antifungal activities.

5.4. Anti parasitie

Natural derivatives have been utilized to treat parasite infections for generations. The antiparasitic attributes of alkaloids, tannins and lactones derived from herbs have been demonstrated by both in vitro and in vivo tests [26]. The methanolic extract of M. micrantha contains alkaloids, flavonoids, saponins, and phenolic compounds that have a slight antihelmintic property that paralyzes and destroys the adult earthworm *P.posthuma* in a dose-dependent manner [10]. According to Laura et al., the main factors influencing the antiprotozoal activity of the sesquiterpene lactones are the α and β-unsaturated lactone groups. In an investigation, it has been found that sesquiterpene lactones of M. micrantha significantly inhibit *L. braziliensis* and *T.cruzi* [27]. In order to effectively utilize the therapeutic effects of M. micrantha against parasitic infections, extensive scientific investigation and validation are necessary.

5.5. Wound healing

Medicinal plants have been shown to improve wound healing by increasing blood clotting and reducing infection, with few adverse effects [28]. Herbal medicine was traditionally utilised in India and China to treat wounds and sores due to its powerful healing properties. Collagen protein works as an organizing principle in connective tissue, which causes higher forces at the wound site. Furthermore, an ointment containing M. micrantha demonstrated modest wound healing rates [29].

5.6. Anti diabetic

The International Diabetes Federation (IDF) estimates that diabetes affects around 285 million people worldwide. Some typical side effects of oral and injectable anti diabetic medications include nausea, vomiting, diarrhoea, and cardiovascular issues [30]. Natural derivatives with fewer side effects and higher efficacy can serve as an alternative antidiabetic medication. Several plants from the asteraceae family have been shown to have anti-diabetic properties. M. micrantha has been shown to lower blood sugar levels [31].

5.7. Anti cancer

An estimated 13% of deaths worldwide are caused by cancer, making it the second most common disease worldwide. Most cancer treatments available today use chemotherapeutics, which have a long list of adverse effects. As a result, less harmful natural derivatives might be a preferable option than those manufactured medications. It has been discovered that certain asteraceae plants are cytotoxic to cancer cells [32]. Sesquiterpene lactones (SLs), among other phytochemicals, are recognized to have potent antiproliferative properties. Because of their unique structural characteristics, nine SLs that were isolated from the aerial sections of M. micrantha showed cytotoxic effects on three cancer cell lines. These anatomical characteristics could specifically harm the tumour cells' oncogenic markers. These investigations suggested that M. micrantha might include phytochemicals with strong anticancer properties [33]. To determine their potential in clinical practice, additional research into their mode of action is necessary.

5.8. Antihelmentic

The anthelmintic action was tested on the adult earthworm, Pheritima posthuma. It is morphologically and physiologically similar to the intestinal roundworm parasite in humans. Studying the extract from M. micrantha leaves when the worms failed to resurrect in regular saline, it was claimed that paralysis had occurred. When the worms lost their ability to move and their body colours faded, it was believed that they were dead. M. micrantha have been investigated for anthelmintic activity [10].

5.9. Anti stress

Stress is the culmination of all the body's responses that upset regular physiological condition changes brought on by stress are often adaptive, self-limiting, and compensating. However, in higher animals, alterations become quite irreversible when stress events of any kind (physical, chemical, biological, and emotional) exceed certain "threshold" limitations. Stress-induced illness and maladjustment are pathologic manifestations of disturbed homeostasis and exhaustion. Drug therapy in the present day does not address disorders linked to stress. Numerous methods exist for enhancing endurance performance, such as physical training focused on endurance exercises, yoga and meditation routines, nutraceuticals supplementation, and adaptogen intervention. Present study will provide a scientific base for experimental research on Indian herb for stress related diseases [34]. M. micrantha is found in the tropics of America and Asia and is commonly known as guaco. The plant is branching and scrambling. Twining, slender-stemmed vine. Mikania has over 300 recognized species, but only 20 have been examined. It's used to treat fever, rheumatism, influenza, and respiratory illnesses, adaptogenic activity [35].

6. Conclusion

The current study summarises the phytochemistry, pharmacological, and toxicological aspects of M. micrantha and critically evaluates the results that have been published. Current research indicates that M. micrantha had significant therapeutic advantages. The majority of published research has focused on the wide range of pharmacological activities of crude plant extracts. This plant's phytochemicals have a variety of properties, such as antibacterial, antioxidant, and anticancer properties. Therefore, the focus of future studies should be on the biological and pharmacological effects of plant extracts as well as analyses of the bioactive compounds that underlie the activity. Future dosages for treating a range of ailments could be created using these findings. Recent pharmacological research indicates that M. micrantha possesses a wide range of pharmacological qualities, such as anti-stress, anti-cancer, anti-helmentic, antibacterial, antifungal, antiparasite, wound-healing, and anti-diabetic effects. To further explore its possible practical applications, more in vivo pharmacological activity and toxicity research of M. micrantha and their chemical constituents are recommended.

Reference

1. Zhang, L., et al., *M. micrantha HBK in China–an overview.* Weed Research, 2004. **44**(1): p. 42-49.
2. Robinson, B.L., *Mikania scandens and its near relatives.* Contributions from the Gray Herbarium of Harvard University, 1934: p. 55-71.
3. Rameshprabu, N. and P. Swamy, *Prediction of environmental suitability for invasion of M. micrantha in India by species distribution modelling.* Journal of Environmental Biology, 2015. **36**(3): p. 565.
4. Das, G., et al., *M. micrantha extract enhances cutaneous wound healing activity through the activation of FAK/Akt/mTOR cell signaling pathway.* Injury, 2023. **54**(8): p. 110856.

5. Li, Y., et al., *Antimicrobial constituents of the leaves of M. micrantha HB K.* Plos one, 2013. **8**(10): p. e76725.
6. Almeida, V.P.d., et al., *Comparative morphoanatomical analysis of Mikania species.* Revista Brasileira de Farmacognosia, 2017. **27**(1): p. 9-19.
7. Willis, M., S. Zerbe, and Y.-L. Kuo, *Distribution and ecological range of the alien plant species M. micrantha Kunth (Asteraceae) in Taiwan.* Journal of Ecology and Environment, 2008. **31**(4): p. 277-290.
8. Day, M.D., et al., *Biology and impacts of Pacific Islands invasive species. 13. M. micrantha Kunth (Asteraceae) 1.* Pacific Science, 2016. **70**(3): p. 257-285.
9. Matawali, A., et al., *Antibacterial and phytochemical investigations of M. micrantha HBK (Asteraceae) from Sabah, Malaysia.* Transactions on Science and Technology, 2016. **3**(1-2): p. 244-250.
10. Dev, U.K., M.T. Hossain, and M.Z. Islam, *Phytochemical investigation, antioxidant activity and anthelmintic activity of M. micrantha leaves.* World Journal of Pharmaceutical Research, 2015. **4**(5): p. 121-133.
11. Krishnaiah, D., R. Sarbatly, and R. Nithyanandam, *A review of the antioxidant potential of medicinal plant species.* Food and bioproducts processing, 2011. **89**(3): p. 217-233.
12. Sharma, P., et al., *Reactive oxygen species, oxidative damage, and antioxidative defense mechanism in plants under stressful conditions.* Journal of botany, 2012. **2012**(1): p. 217037.
13. Gupta, V.K. and S.K. Sharma, *Plants as natural antioxidants.* 2006.
14. Dong, L.-M., et al., *Phenolics from M. micrantha and their antioxidant activity.* Molecules, 2017. **22**(7): p. 1140.
15. Lallianchhunga, M., et al., *Antioxidant activity of methanolic extract of M. micrantha leaves.* World Journal of Pharmaceutical Research, 2016. **5**(4): p. 879-886.
16. Hao CaiQin, H.C., et al., *Chemical constitutents and fungicidal activity of essential oil from M. micrantha.* 2007.
17. Zhuang ShiHong, Z.S., et al., *Active antifungal components of M. micrantha HBK.* 2010.
18. Harahap, N.I., M. Nainggolan, and U. Harahap, *Formulation and evaluation of herbal antibacterial gel containing ethanolic extract of M. micrantha kunth leaves.* Asian J Pharm Clin Res, 2018. **11**(3): p. 429-431.
19. Mc, P.-A., et al., *Phytochemical and pharmacological studies on M. micrantha HBK (Asteraceae).* Phyton, 2010. **79**: p. 77.
20. Borkataky, M., B. Bhusan, and L. Saikia, *Antimicrobial activity and phytochemical screening of some common weeds of Asteraceae family.* Int J Pharm Sci Rev Res, 2013. **23**(1): p. 116-120.
21. Jyothilakshmi, M., M. Jyothis, and M. Sankunni Latha, *M. micrantha–a Natural Remedy to Skin Infections.* Int J Curr Microbiol Appl Sci, 2016. **5**(2): p. 742-5.
22. Rafeza Khatun, R.K., et al., *Comparative antimicrobial evaluation of available Mikania species in Bangladesh.* 2017.
23. Sheam, M., Z. Haque, and Z. Nain, *Towards the antimicrobial, therapeutic and invasive properties of M. micrantha Knuth: a brief overview.* J. Adv. Biotechnol. Exp. Ther, 2020. **3**(2): p. 92-101.
24. Baral, B., N. Bhattarai, and G.S. Vaidya, *Pharmacological and antagonistic potentials of M. micrantha.* Nepal Journal of Science and Technology, 2011. **12**: p. 75-84.
25. Omojate Godstime, C., et al., *Mechanisms of antimicrobial actions of phytochemicals against enteric pathogens–a review.* J Pharm Chem Biol Sci, 2014. **2**(2): p. 77-85.
26. Nain, Z., M.A. Islam, and M. Minnatul Karim, *Antibiotic resistance profiling and molecular phylogeny of biofilm forming bacteria from clinical and non-clinical environment in southern part of Bangladesh.* Int J Enteric Pathog, 2019. **7**(2): p. 37-43.

27. Laurella, L.C., et al., *Assessment of sesquiterpene lactones isolated from Mikania plants species for their potential efficacy against Trypanosoma cruzi and Leishmania sp.* PLoS Neglected Tropical Diseases, 2017. **11**(9): p. e0005929.
28. Raina, R., et al., *Medicinal plants and their role in wound healing.* Online Veterinary J, 2008. **3**(1): p. 21.
29. Rangaraj, A., K. Harding, and D. Leaper, *Role of collagen in wound management.* Wounds uk, 2011. **7**(2): p. 54-63.
30. Marín-Peñalver, J.J., et al., *Update on the treatment of type 2 diabetes mellitus.* World journal of diabetes, 2016. **7**(17): p. 354.
31. Sidhu, M. and T.S. Tanu Sharma, *A database of antidiabetic plant species of family Asteraceae, Euphorbiaceae, Fabaceae, Lamiaceae and Moraceae.* 2013.
32. Uzun, K., et al. *Cytotoxic Potentials of Some Asteraceae Plants from Turkey on HeLa Cell Line*. in *Proceedings*. 2017. MDPI.
33. Ríos, E., et al., *Sesquiterpene lactones from M. micrantha and Mikania cordifolia and their cytotoxic and anti-inflammatory evaluation.* Fitoterapia, 2014. **94**: p. 155-163.
34. Sharma, R.K. and R. Arora, *Herbal drugs: a twenty first century perspective.* 2006.
35. Ittiyavirah, S.P. and K. Sajid, *Anti stress activity of M. micrantha Kunth roots in Wistar albino rats.* J Sci Innov Res, 2013. **2**(6): p. 999-1005.

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