

Artemisia Vulgaris: A Multifunctional Medicinal Herb

Vikas Sharma¹, Dr. Abhishek Soni², Mrs. Akanksha Sharma³, Mr. Vineet Kapoor⁴, Pooja⁵
Corresponding Author¹

M.Pharm, PhD in Pharmaceutics, (Dean School of Pharmacy)²

M.Pharm in Pharmacognosy, Assistant Professor^{3,4}

2nd author⁵

School of Pharmacy, Abhilashi University, Mandi, HP, India

9vik0000@gmail.com¹, abhisoni.phd@gmail.com², akshusharma026@gmail.com³

vineetkapoor47@gmail.com⁴, pooja5359e6@gmail.com⁵

Abstract: *In this study, a novel multifunctional copolymer was synthesized via a controlled polycondensation reaction involving 8-hydroxyquinoline-5-sulphonic acid, acrylamide, and formaldehyde. Structural characterization was carried out using Fourier-transform infrared (FTIR) spectroscopy, UV-Visible spectroscopy, and proton nuclear magnetic resonance (1H NMR), all of which confirmed the successful incorporation of functional groups into the polymer backbone. Molecular weight parameters, including the number-average (Mn) and weight-average (Mw) molecular weights, were determined by gel permeation chromatography (GPC), revealing relatively high molecular weights with a low polydispersity index, indicative of structural uniformity and compatibility with thermally stable polymer frameworks. X-ray diffraction (XRD) analysis showed a semi crystalline pattern, while scanning electron microscopy (SEM) revealed a uniform and porous surface morphology. Thermal behavior was systematically examined through thermogravimetric analysis (TGA), and kinetic parameters such as activation energy (Ea) were calculated using the Freeman-Carroll and Sharp-Wentworth models. These consistent results highlighted the copolymer's remarkable thermal stability. Collectively, the material demonstrates excellent thermal resilience, well-defined structural features, and favorable morphological characteristics, positioning it as a promising candidate for advanced high-temperature applications and demanding materials engineering environments.*

Keywords: Artemisia vulgaris, Mugwort, pharmacological activities, green synthesis, silver nanoparticles, medicinal plant.

I. INTRODUCTION

Medicinal plants have long been trusted as safe and natural remedies for maintaining health. People's use of these plants has always been influenced by culture, local traditions, the places where the plants grow, and their natural properties. Long before modern medicine came into practice, communities relied on age-old knowledge shared through stories, teachings, and written records to guide how these plants were used for healing¹. Artemisia vulgaris, more commonly known as *Mugwort*, is a plant that people across the world have recognized by many names *Nagadouna* in Hindi, *Mashibattiri* in Tamil, *Moxa* in Japan, *Nagadamani* in Ayurveda, and many more. It includes over 500 species, this hardy perennial weed grows freely across Europe, Asia, and North America. The name *Artemisia* is linked to Artemis, the Greek goddess associated with women's health, reflecting its long-standing use in traditional healing, especially for women's ailments. Over time, communities have given it hundreds of different names, showing just how widely known and culturally significant this plant has been throughout history². The plant is found in hilly areas upto 2400 m height.



II. BOTANICAL CLASSIFICATION
Classification of the Artemisia vulgaris species

• Category	• Details
• Kingdom	• Plantae
• Clade	• Angiosperms
• Order	• Asterales
• Family	• Asteraceae (Compositae)
• Genus	• Artemisia
• Species	• Artemisia vulgaris L.

Table 1: **Morphological Characteristics of Artemisia vulgaris**

Artemisia vulgaris is a perennial shrub with broad leaves, typically growing between 70 and 150 cm, though it can occasionally reach up to 2 meters. The stems are highly branched and produce numerous aerial shoots, accompanied by creeping rhizomes, while the plant lacks rosettes or runners. Its leaves are pinnately divided or bipinnately divided, with lance-shaped to oblong segments measuring 5–20 cm in length. They are sessile, with a dark green upper surface and a white-silver, densely hairy underside. The rhizomes are light brown, cylindrical, about 1 cm thick, and penetrate 7–18 cm into the soil. The roots have a pungent and sweet taste, whereas the aerial parts are aromatic and bitter. The flowers are small, ovoid, and glabrous, measuring roughly 3–4 mm in length and 2 mm in width, and are arranged in racemes or panicles. Each flower is hermaphroditic, with a tubular corolla that has five fringed lobes. The fruit is cylindrical or slightly flattened, usually smooth but occasionally hairy, lacking a pappus, and with an indistinct margin. Traditionally, various parts of the plant including aerial stems, leaves, and roots have been used in medicinal formulations.

III. GEOGRAPHICAL DISTRIBUTION

Artemisia vulgaris is widely distributed across the world. In **Canada**, it is most commonly found in the eastern regions, particularly abundant in **Ontario** and **Québec**, with populations also occurring in **Newfoundland, Prince Edward Island, Nova Scotia, New Brunswick, Manitoba, Saskatchewan, and British Columbia**. In the **United States**, it is widely spread, especially in the eastern parts. Globally, this species is considered a troublesome weed, affecting **25 crops in 56 countries**. The heaviest infestations occur in **Europe**, which is thought to be its region of origin, but it is also found in **Southeastern Asia, Australia, and South America**. Across all these regions, populations show a high degree of **morphological variability**.

Geographical Distribution



Figure -1



Anatomical characteristics

The root of *A. vulgaris*, when viewed in cross section, reveals a neat circular shape, and you can see a special region called the phelloderm, made up of soft, living parenchyma cells formed by the activity of the cork cambium. Looking at the stem, its cross section also appears mostly circular but with gentle, less pronounced ribs around the edge. At the center, there's a spongy area known as lacunose parenchyma, which has noticeable air spaces.

When examining the leaf in cross section, it shows a small bump close to the main central vein, or midrib. Within this area, there are three big vascular bundles in the middle and two smaller ones on the sides, all surrounded by the main parenchyma tissue. At the ends of the larger vascular bundles, you'll spot small patches of tougher sclerenchyma, and just beneath both the upper and lower skins (epidermises) near the midrib, there are additional layers of strengthening collenchyma tissue.

The leaf blade itself is built symmetrically, with a diverse arrangement of cells, and there's a single row of tightly packed palisade cells sitting right under both the top and bottom epidermis. The cells of the upper epidermis are noticeably bigger and have thicker outer walls than those on the lower side. The lower surface is also protected by many tiny, hair-like structures called trichomes, which are multicellular, T-shaped, and occur more frequently there, helping shield the plant⁴.



Figure-2(*Artemisia vulgaris*)

Chemical constituents in *Artemisia Vulgaris*

In the study, both the quantitative and qualitative composition of *Artemisia vulgaris* essential oils was analyzed using chromatographic techniques (GC-MS and GC-FID). A total of 60 different compounds were identified, demonstrating the plant's rich chemical diversity. Among these, 28 compounds were found in significant concentrations (above 3% in at least one sample). These findings highlight the complex nature of *A. vulgaris* essential oil and provide valuable insight into its potential pharmacological and therapeutic properties⁵. The essential oils of *Artemisia vulgaris* showed a strong fumigant and repellent effect against *Musca domestica* (the common housefly). This suggests that the oil possesses natural insecticidal properties and could serve as an effective, eco-friendly alternative to synthetic chemical repellents.

Classes of different compounds present in plant parts

Flavonoids: Apigenin, Chrysoeriol, Diosmetin, Eriodictyol, Eupafolin, Homoeriodictyol, Isoquercitrin, Isorhamnetin, Jaceosidine, Kaempferol and its glycosides, Luteolin and its glycosides, Chrysosplenetin, Artemetin, Quercetin and its methylated and glycosylated derivatives, Rutin, Tricine, Vitexin.

Phenolic Acids and Organic Acids: Various dicaffeoylquinic acids (e.g., 1, 3-O-dicaffeoylquinic acid), gallic acid, protocatechuic acid glucoside, malic acid, quinic acid, trihydroxy-octadecenoic acid, tuberonic acid glucoside.



Sesquiterpenes and Sesquiterpenic Acids: Artemisinin, eudesmane dialcohol, new sesquiterpenes, oxoedesma derivatives, vulgarin, yomogin, artemisinic acid glucosides.

Sesquiterpene Glucosides and Lactones, Lignan Glucoside, Monoterpene: Tracheloside, dehydrovomifoliol.

Monoamine Neurotransmitter: 5-HT (5-hydroxytryptamine).

These compounds have been isolated from different parts such as leaf, aerial parts, whole plant, flowering tops, stem, and root. Flavonoids and phenolic acids are mostly found in leaves and aerial parts. Sesquiterpenes and related acids are found throughout aerial parts and whole plants. Some specific compounds like artemisinin and analogs appear in leaves and aerial parts. Studies and reports span multiple references from different research groups, highlighting a broad interest in the phytochemistry of *Artemisia vulgaris*.

Pharmacological activities

1. Effect of *Artemisia vulgaris* Extract on Hypolipidemic Activity (Rats)

Feeding the rats a high-fat diet (HFD) caused their total cholesterol, triglycerides, LDL-C, VLDL-C, and atherogenic index to rise sharply, while their HDL-C the “good” cholesterol dropped compared to the control group. However, when these high-fat-fed rats were treated with **Artemisia vulgaris** extract, their cholesterol and triglyceride levels improved significantly. The extract lowered the bad fats (TC, TG, LDL-C, VLDL-C) and increased the good HDL-C, much like the effect seen with atorvastatin. This shows that **A. vulgaris** has strong cholesterol-lowering properties and may help by improving how the body handles fats and by boosting its antioxidant defenses.

2. Effect of *Artemisia Vulgaris* Extract on Premenstrual activity

Mugwort has long been used in traditional medicine across various cultures, mainly for managing menstrual-related issues such as premenstrual syndrome (PMS) and menstrual cramps (dysmenorrhea). It is also believed to influence reproductive health smaller doses are thought to help prevent miscarriage, while higher doses may be used to induce abortion, often in combination with other medicinal herbs. Further scientific studies are needed to evaluate the effectiveness of mugwort in treating menopausal symptoms and conditions like attention deficit hyperactivity disorder (ADHD). It's reported calming, anti-anxiety, and dream-enhancing effects also warrant clinical investigation, as the role of dreaming in healing is often underestimated in modern medicine.

3. Effect of *Artemisia Vulgaris* Extract on Antioxidant activity

This study was carried out to explore the antioxidant potential of *Artemisia vulgaris*. The plant's extract was tested both **in vitro** (in the lab) and **in vivo** (in rats) using several methods. In the lab, its ability to neutralize free radicals, scavenge nitric oxide, and act as a reducing agent was examined. In live rats, antioxidant activity was measured through the levels of serum ascorbic acid, blood glutathione, and superoxide dismutase after treatment with the extract. The study also measured the amount of phenolic and flavonoid compounds in the extract, which are known to contribute to antioxidant effects. Overall, the findings showed that *A. vulgaris* has strong antioxidant properties. Among the different tests used, the DPPH method proved to be a quick and reliable way to assess antioxidant activity. The extract displayed strong DPPH radical scavenging ability, which is likely due to its capacity to donate hydrogen atoms a key factor in neutralizing harmful free radicals.

4. Effect of *Artemisia Vulgaris* Extract on Antimicrobial activity

The antimicrobial study of *Artemisia vulgaris* essential oil against 616 microbial strains showed that it inhibited the growth of about 20.9% of them. However, its effectiveness varied depending on the type of microorganism. The oil demonstrated stronger activity against yeasts, molds, and *Bacillus* species, while it was less effective against common pathogenic bacteria such as *Staphylococcus aureus*, *Streptococcus* spp., *E. coli*, *Salmonella*, *Klebsiella pneumoniae*, *A. hydrophila*, and *E. tarda*. These results suggest that essential oil has selective antimicrobial potential, particularly against certain fungal and spore-forming bacterial strains.



5. Effect of Artemisia Vulgaris Extract on Hepatoprotective activity

The study showed that giving mice D-Galactosamine (D-GalN) and lipopolysaccharide (LPS) caused significant liver damage. This was seen through high ALT and AST levels and visible liver tissue damage. However, when the mice were pre-treated with *Artemisia vulgaris* extract (Av.Cr), the liver injury was noticeably reduced in a dose-dependent manner. The extract helped restore normal liver structure, reduced swelling and cell death, and prevented necrosis. These protective effects may be linked to the extract's ability to reduce inflammation and improve blood flow during liver stress. Importantly, the extract was also found to be safe even at high doses, suggesting that *Artemisia vulgaris* could be a promising natural remedy for protecting the liver against chemical or toxin-induced damage.

6. Effect of Artemisia Vulgaris Extract on Analgesic activity

The methanolic extract of *Artemisia vulgaris* showed a strong pain-relieving effect in experimental studies. In both the hot plate and tail flick tests, animals treated with the extract displayed a significant increase in pain tolerance, and this effect became stronger with higher doses (200, 400, and 800 mg/ml). This clearly indicates that the extract's analgesic activity is dose-dependent. The presence of natural compounds such as flavonoids, saponins, phenols, oils, tannins, and sesquiterpenoids likely contributes to this effect. Overall, the results suggest that *A. vulgaris* has promising natural analgesic properties and could be a useful source for developing safe and effective pain-relief remedies.

7. Effect of Artemisia Vulgaris Extract on Cytotoxic activity

In conclusion, the study reveals that the methanolic extract of *Artemisia vulgaris* exhibits significant biological potential. The extract demonstrated mutagenic as well as strong protective and pro-apoptotic activity when tested with mitomycin C (MMC). Although *A. vulgaris* alone did not show cytotoxic effects, its combination with MMC resulted in pronounced cytotoxicity after prolonged exposure. These findings suggest that constituents of *A. vulgaris* may contribute to anticancer activity, especially in enhancing the effects of chemotherapeutic agents. The high levels of chlorogenic acid and quercetin-3-O-glucopyranoside present in *A. vulgaris* are likely responsible for its genotoxic, pro-apoptotic, and cytotoxic properties, making it a promising candidate for further exploration in cancer therapy research.

Green Synthesis and Biomedical Potential of Artemisia vulgaris Silver Nanoparticles

The study highlights a simple and eco-friendly method for synthesizing silver nanoparticles using *Artemisia vulgaris* leaf extract. The formation of these nanoparticles was confirmed by UV-Vis spectroscopy (showing a peak at 420 nm) and supported by SEM, EDX, TEM, and AFM analyses, which revealed their uniform spherical shape. The biosynthesized nanoparticles exhibited strong antibacterial activity, notable antioxidant potential, and significant cytotoxic effects against HeLa and MCF-7 cancer cell lines. Given its abundance, low cost, and biocompatibility, *A. vulgaris* extract presents a promising natural resource for developing green nano materials with broad pharmaceutical and biomedical applications.

IV. CONCLUSION

This review emphasizes *Artemisia vulgaris* as a valuable medicinal plant with broad therapeutic potential. Its rich phytochemical composition—particularly flavonoids, phenolic acids, and terpenoids forms the basis of its diverse pharmacological actions, including lipid-lowering, hepatoprotective, antioxidant, antimicrobial, analgesic, and cytotoxic effects. The plant's role in the green synthesis of silver nanoparticles further highlights its importance in advancing modern biomedical and nanotechnology research. Overall, *A. vulgaris* emerges as a promising, natural, and cost-effective source for the development of new pharmaceutical and therapeutic formulations. Nonetheless, more detailed clinical and molecular investigations are essential to isolate its active compounds, clarify their mechanisms of action, and confirm their safety and efficacy in humans.



REFERENCES

1. Abiri R, Silva ALM, de Mesquita LSS, de Mesquita JWC, Atabaki N, de Almeida EB, et al. Towards a better understanding of *Artemisia vulgaris*: Botany, phytochemistry, pharmacological and biotechnological potential. Vol. 109, Food Research International. Elsevier Ltd; 2018. p. 403–15.
2. Siwan D, Nandave D, Nandave M. *Artemisia vulgaris* Linn: an updated review on its multiple biological activities. Futur J Pharm Sci. 2022 Nov 18;8(1).
3. Govindaraj S, Kumari BDR, Cioni PL, Flamini G. Mass propagation and essential oil analysis of *Artemisia vulgaris*. J Biosci Bioeng. 2008 Mar;105(3):176–83.
4. Barney JN, Ditommaso A. The biology of Canadian weeds. 118. *Artemisia vulgaris* L.
5. Judzentiene A, Garjonyte R. Compositional Variability and Toxic Activity of Mugwort (*Artemisia vulgaris*) Essential Oils.
6. Judzentiene A. Chemical composition of essential oils of *Artemisia vulgaris* L. (mugwort) from North Lithuania [Internet]. Available from: <https://www.researchgate.net/publication/291160304>
7. Wang J, Zhu F, Zhou XM, Niu CY, Lei CL. Repellent and fumigant activity of essential oil from *Artemisia vulgaris* to *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae). J Stored Prod Res. 2006;42(3):339–47.
8. A pharmacotherapeutic screening of *Artemisia vulgaris* whole plant: A brief review Sumbe RB, Dhalgade MS, Palve KN, Kale SS, Waghe VL, Autade KA, and Dr. Kothawade SN. Available from: <https://www.phytojournal.com>
9. Lee SJ, Chung HY, Maier CGA, Wood AR, Dixon RA, Mabry TJ. Estrogenic Flavonoids from *Artemisia vulgaris* L. J Agric Food Chem. 1998;46(8):3325–9.
10. Anwar F, Ahmad N, Alkharfy KM, Gilani A ul H. Mugwort (*Artemisia vulgaris*) Oils. In: Essential Oils in Food Preservation, Flavor and Safety. Elsevier; 2015. p. 573–9.
11. Liu T, Chen X, Hu Y, Li M, Wu Y, Dai M, et al. Sesquiterpenoids and triterpenoids with anti-inflammatory effects from *Artemisia vulgaris* L. Phytochemistry. 2022 Dec 1;204.
12. Hamdy Elltantawy W. Biochemical effects, hypolipidemic and antiinflammatory activities of *Artemisia vulgaris* extract in hypercholesterolemic rats. J Clin Biochem Nutr. 2015;57(1):33–8.
13. Khan Kayamkani A, Abedulla Khan K, Abedulla Khan Associate Professor K. A preclinical antihyperlipidemic evaluation of *Artemisia vulgaris* root in diet induced hyperlipidemic animal model. 2015;5:110. Available from: www.ss-journals.com
14. Adams JD, Garcia C, Garg G. Mugwort (<i>Artemisia vulgaris</i>, <i>Artemisia douglasiana</i>, <i>Artemisia argyi</i>) in the Treatment of Menopause, Premenstrual Syndrome, Dysmenorrhea and Attention Deficit Hyperactivity Disorder. Chin Med. 2012;03(03):116–23.
15. Ashok PK, Upadhyaya K. Evaluation of Analgesic and Anti-inflammatory Activities of Aerial Parts of *Artemisia vulgaris* L. in Experimental Animal Models. Journal of Biologically Active Products from Nature. 2013 Feb 1;3(1):101–5.
16. Temraz A, Pharm Sci PJ, El-tantawy WH. Characterization of antioxidant activity of extract from *Artemisia vulgaris* [Internet]. Vol. 21, Article in Pakistan Journal of Pharmaceutical Sciences. 2008. Available from: <https://www.researchgate.net/publication/23394456>
17. Matvieieva N, Drobot K, Duplij V, Ratushniak Y, Shakhovskiy A, Kyrpa-Nesmiian T, et al. Flavonoid content and antioxidant activity of *Artemisia vulgaris* L. “hairy” roots. Prep Biochem Biotechnol. 2019 Jan 2;49(1):82–7.
18. Raj Singh B, Singh V, Karan Singh R, Toppo S, Haque N, Ebibeni N. Antimicrobial effect of *Artemisia vulgaris* essential oil Full Paper ICAR Research Complex for NEH Region, Jharnapani, Nagaland (INDIA) 2 NRC on Mithun, Jharnapani, Nagaland (INDIA) 3 ICAR Research Complex for NEH Region, Sikkim Centre, Tadong, Gangtok, (INDIA).



19. Singh NB, Devi ML, Biona T, Sharma N, Das S, Chakravorty J, et al. Phytochemical Composition and Antimicrobial Activity of Essential Oil from the Leaves of *Artemisia vulgaris* L. *Molecules*. 2023 Mar 1;28(5).
20. Hamad A, Arfan M, Khan SA, Fatima N, Abbasi AM, Mannan A. Evaluation of antioxidant, antimicrobial and cytotoxic potential in *Artemisia vulgaris* L. *Rev Rom Med Lab*. 2018 Oct 1;26(4):431–42.
21. Gilani AH, Yaeesh S, Jamal Q, Ghayur MN. Hepatoprotective activity of aqueous-methanol extract of *Artemisia vulgaris*. *Phytotherapy Research*. 2005 Feb;19(2):170–2.
22. Al-Yassen AM, Kadhum HH, Shubbar M. Hepatoprotective activity of *Artemisia vulgaris* L. against Cisplatin induce hepatotoxicity in mice. *J Pharm Negat Results*. 2022;13(3):302–7.
23. Ivanescu B, Corciova A, Vlase L, Gheldiu AM, Miron A, Ababei DC, et al. Analgesic and anti-inflammatory activity of *Artemisia* extracts on animal models of nociception. *Balneo and PRM Research Journal*. 2021 Mar 1;12(1):34–9.
24. Jakovljević MR, Grujičić D, Vukajlović JT, Marković A, Milutinović M, Stanković M, et al. In vitro study of genotoxic and cytotoxic activities of methanol extracts of *Artemisia vulgaris* L. and *Artemisia alba* Turra. *South African Journal of Botany*. 2020 Aug 1;132:117–26.
25. Rasheed T, Bilal M, Iqbal HMN, Li C. Green biosynthesis of silver nanoparticles using leaves extract of *Artemisia vulgaris* and their potential biomedical applications. *Colloids Surf B Biointerfaces*. 2017 Oct 1;158:408–15.

