

Phytoconstituents, Botanical Features, Therapeutic Applications and Pharmacological Activities of *Artemisia absinthium* L.: An Exhaustive Review with Special Reference to the Unani System of Medicine

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ABSTRACT

Artemisia absinthium L. (Wormwood), a medicinal herb of the family Asteraceae, has been extensively used in traditional systems of medicine, particularly the Unani system, for the management of a wide range of ailments. This review critically summarizes the botanical features, phytochemical profile, traditional applications, pharmacological activities, and safety aspects of *A. absinthium* based on classical Unani literature and contemporary scientific evidence. The plant contains a variety of bioactive constituents, including sesquiterpene lactones, essential oils, flavonoids, phenolic compounds, terpenoids, tannins, and organic acids, which are responsible for its diverse biological activities. Traditionally, *A. absinthium* has been employed as a digestive stimulant, stomachic, hepatoprotective, splenic tonic, antipyretic, anti-inflammatory, nervine, and general tonic. Experimental studies have substantiated many of these traditional claims by demonstrating significant digestive stimulant, anthelmintic, antibacterial, antifungal, hepatoprotective, anti-inflammatory, immunomodulatory, analgesic, cytotoxic, and limited antiprotozoal activities. Recent advances in nanotechnology-based formulations have further improved its bioavailability and therapeutic efficacy, particularly in hepatoprotection. Although therapeutic doses are generally well tolerated, excessive intake may cause thujone-associated neurotoxicity and gastrointestinal adverse effects, emphasizing the need for dose standardization. Overall, the available evidence highlights *A. absinthium* as a promising medicinal plant with substantial therapeutic potential. However, further well-designed preclinical and clinical studies are warranted to validate its efficacy, elucidate its mechanisms of action, and establish standardized, safe, and evidence-based therapeutic applications.

Keywords: Antifungal, Anti-inflammatory, Antimicrobial, Hepatoprotective, Phytochemistry, Thujone.

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INTRODUCTION

Artemisia absinthium L. (family Asteraceae), commonly known as wormwood, is a perennial aromatic herb widely recognized for its medicinal importance. The plant is characterized by its greenish, silky-pubescent appearance, intensely bitter taste, and highly dissected leaves. Its small, inconspicuous yellow flowers are arranged in numerous globular capitula (flower heads), which are borne in branched panicles.^[1-3] Owing to its distinctive morphological characteristics and rich phytochemical composition, *A. absinthium* has been extensively used in

traditional systems of medicine and has attracted considerable scientific interest for its diverse pharmacological properties which have been attributed to a chemically diverse group of secondary metabolites. Phytochemical investigations have identified volatile monoterpenes and sesquiterpenes, sesquiterpene lactones, flavonoids, phenolic compounds, and other constituents in different plant parts and extracts.^[1,2] Among the characteristic constituents of the species are bitter sesquiterpene lactones, including absinthin and related compounds, while the essential oil may contain monoterpenes such as thujone. The qualitative and quantitative composition of these constituents can vary considerably according to geographical origin, plant material, developmental stage, environmental conditions, and extraction or processing methods. Experimental studies have reported several biological activities for the plant extracts and isolated constituents, including antioxidant, antimicrobial, anti-inflammatory, gastrointestinal, hepatoprotective, and other pharmacological effects.^[4] Within the Unani system of



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medicine, *A. absinthium* (Afsanteen) has particular significance as a medicinal drug and is incorporated into numerous classical compound formulations (Murakkabat).^[5] A systematic evaluation of its phytochemical profile, reported pharmacological activities, safety considerations, and documented use in Unani formulations may therefore provide a more comprehensive understanding of its therapeutic potential. Such an assessment may also contribute to the scientific evaluation of traditional therapeutic claims and support the integration of ethnomedical knowledge with contemporary pharmacological evidence.^[6]

BOTANICAL DESCRIPTION

A. absinthium is a perennial, hoary, silky-pubescent herbaceous plant with an aromatic odour (Figure 1). The stem is erect, angular, ribbed, and typically attains a height of 0.3-0.9 m. The leaves are ovate, measuring approximately 2.5-5.0 cm in length, and are unequally bipinnatifid to tripinnatifid, with spreading linear or lanceolate obtuse segments. Both leaf surfaces are densely hoary, while the radical and lower cauline leaves gradually narrow into winged petioles.^[7] The inflorescences consist of numerous small, yellow, heterogamous capitula. The ray florets possess a dilated corolla, whereas the involucre bracts are oblong, hoary, and narrowly to broadly scarious.^[3] The receptacle bears long, straight hairs, and the anthers are acuminate but lack awns (non-aristate). The fruits are elliptic-oblong achenes, approximately 1 mm in length.^[8]

Taxonomic Classification

The taxonomic classification of *Artemisia absinthium* L. is presented below (Table 1).^[9]

Habitat

The plant is native to Europe and is widely distributed throughout the temperate regions of Europe and Asia. It occurs naturally in Northern Asia, Siberia, Afghanistan, North Africa, Eastern Canada, and the United States. In the Indian subcontinent, the species is found in the temperate Himalayan region, particularly in Kashmir up to an altitude of approximately 2,500 m above sea level, as well as in Nepal and other mountainous regions of northern India.^[1,3,7,10]

Vernacular Names

The vernacular names of *Artemisia absinthium* L. in different languages and regions are presented in Table 2.

PHYTOCHEMICAL CONSTITUENTS

Artemisia absinthium L. contains a diverse range of bioactive phytochemicals, including volatile (essential) oils, sesquiterpene lactones, phenolic compounds, flavonoids, terpenoids, tannins, resins, organic acids, glycosides, and carbohydrates. One of its principal bitter constituents is absinthin (Figure 2), a

sesquiterpene lactone responsible for the characteristic bitter taste of the herb.^[1,3,5,10] The essential oil is composed predominantly of monoterpenes and their oxygenated derivatives, including α -thujone, trans-thujone, β -thujone, artabsin, myrcene, α -pinene, γ -terpinene, terpinen-4-ol, p-cymene, 1-8 cineole, methylheptenone, β -phellandrene, camphene, camphor, linalool, bornyl acetate, trans-sabiny acetate, thujyl alcohol, thujyl acetate, cadinene, guaiazulene, and chamazulene. The plant also contains the flavonoid artemetin (artemisetin), along with resins, tannins, succinic acid, and potassium salts, including malates and nitrates.^[1,3,5,8,11-13] The inorganic (mineral) constituents include calcium, magnesium, potassium, sodium, iron, aluminium, and trace amounts of lead.^[5,10]

USES

Traditional uses

The plant has been widely used in the Unani system of medicine for the treatment of a broad spectrum of diseases and is regarded as an important medicinal herb due to its diverse therapeutic properties. It is traditionally prescribed as a stomachic (*Muqawwī-i-Mi'da*), appetizer (*Mushtahī*), general tonic (*Muqawwī*), and febrifuge (*Musakkin-i-Harārat*).^[3,5,10,16-19] The herb is commonly employed in the management of gastrointestinal disorders, including dyspepsia (*Sū'al-Haḍm*), gastric debility (*Ḍu'f al-Mi'da*), abdominal pain (*Al-Waja' fi'l-Baḥn*), abdominal distension due to gaseous accumulation (*Istisqā' Tablī*), haemorrhoids (*Bawāsīr*), and dropsy (*Istisqā'*).^[1,3,5,10,16-18] It is also extensively used in the treatment of hepatobiliary and splenic disorders, including hepatitis (*Waram al-Kabid*), liver diseases (*Amrād-i-Kabid*), hepatic obstruction (*Sudda-e-Jigar*), splenitis (*Waram-i-Tihāl*), splenic disorders (*Amrād-i-Tihāl*), splenic pain (*Waja'al-Tihāl*), and jaundice (*Yarqān*).^[5,8,15-19]

A. absinthium has also been recommended for the management of intermittent and chronic fevers, phlegmatic and compound fevers (*Hummā Balghamiyya* and *Hummayāt-i-Murakkaba*), epidemic fever associated with catarrh (*Nazla wa Hummā Wabā'ī*), and other febrile illnesses.^[1,3,5,8,12,16,17,19,20] In addition, it has been used in cardiovascular disorders such as pericarditis (*Waram-i-Ghishā'-i-Qalb*) and palpitations (*Khafaqān*).^[16,19]

The herb is considered beneficial for disorders of the nervous system and has traditionally been prescribed for brain concussion, nervous depression, hysteria (*Ikhtināq al-Raḥim*), loss of consciousness (*Sakta*), facial palsy (*Laqwa*), dizziness (*Sadr*), tetanus (*Kuzāz*), and neuromuscular weakness.^[1,5,7,8,17,18] Furthermore, it has been employed in the treatment of menstrual disorders (*Amrād-i-Hayḍ*),^[3,11] eye diseases (*Amrād-i-Ayn*),^[16-18] and ear disorders, including otorrhoea (*Sayalān al-Udhun*) and otalgia.^[15-18] Classical texts also describe its use in the management of arthralgia (*Waja'al-Mafāṣil*),^[8,15-17] skin diseases (*Amrād-i-Jild*),^[1,17,21] tissue indurations,^[15,16,18] dark circles under the eyes,^[15] and disorders attributed to morbid humours (*Fāsīd Bukhārāt*).^[16]



Figure 1: *Artemisia absinthium* L.

Collectively, these traditional applications indicate that *A. absinthium* has historically been regarded in Unani medicine as a valuable digestive stimulant, hepatoprotective, splenic tonic, antipyretic, nervine, anti-inflammatory, and general restorative agent, supporting its extensive therapeutic use in the management of gastrointestinal, hepatobiliary, splenic, neurological, musculoskeletal, dermatological, and febrile disorders.^[1,3,5,10-11,18-21]

Therapeutic Applications in Unani Formulations

A review of classical Unani literature indicates that the plant is incorporated into a diverse range of compound formulations (*Murakkabat*) traditionally prescribed for the management of various disorders. Formulations containing *A. absinthium* as a principal or constituent ingredient include *Sharbat-e-Afsanteen*, *Roghan-e-Afsanteen*, *Roghan-e-Kalan*, *Joshanda Afsanteen*, *Qurs-e-Afsanteen* and *Arq-e-Afsanteen*.^[19,22,23]

In addition to these formulations, the plant has been documented as a constituent of several other classical Unani compound preparations, including *Itrifal-e-Habbul-Qara*, *Qurs-e-Anisoon*, *Habb-e-Nuzul-ul-Ma*, *Habb-e-Qatil-e-Deedan*, *Arq Biranjasif*, *Habb-e-Mafasil*, *Arq Ma-ul-Laham Makoh Kasni Wala*, *Aujaia*, *Sadri*, and *Safoof Deedan*.^[24-26] The recurrent incorporation of *A. absinthium* across multiple classical Unani formulations and textual sources reflects its established therapeutic significance within the Unani system of medicine and indicates a broad spectrum of traditional medicinal applications.

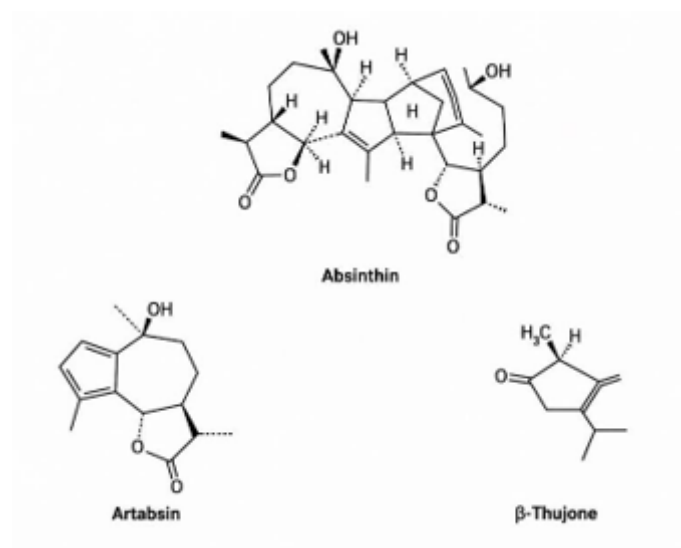


Figure 2: Structural representations of major constituents of *A. absinthium* L.^[2]

Side Effects

The adverse effects associated with the plant are primarily observed following overdose and are largely attributed to the toxic effects of thujone, a biologically active monoterpene ketone. Clinical manifestations of thujone toxicity include vomiting, gastrointestinal cramping, and urinary retention. Thujone content in *A. absinthium* can be significantly reduced through high-pressure supercritical carbon dioxide extraction, thereby potentially decreasing its toxicological risk.^[2] Its leaves

Table 1: The taxonomic classification of *Artemisia absinthium* L.

Taxonomic Rank	Classification
Kingdom	Plantae - Plants
Sub-kingdom	Tracheobionta - Vascular plants
Super-division	Spermatophyta - Seed plants
Division	Magnoliophyta - Angiosperms/Flowering plants
Class	Magnoliopsida - Dicotyledons
Sub-class	Asteridae
Order	Asterales
Family	Asteraceae - Aster family
Genus	<i>Artemisia</i> L.
Species	<i>Artemisia absinthium</i> L.

Table 2: The vernacular names of *Artemisia absinthium* L.

Language	Common Name(s)
English	Wormwood, Mugwort, Absinth, Ajenjo
Arabic	Khattrak
Latin	Absinthium
Unani	Afsanteen, Khatraq
Persian	Afsantin
Farsi	Mardah, Mavi Bakusha, Murdah
Sanskrit	Indhana, Nagadamani, Damara, Aphasantin
Bengali	Mastaru
Urdu	Vilayati Afsantin, Afsanteen
Balochi	Tarkh
Hindi	Majri, Sitara, Karmala, Vilayati Afsantin
Tamil	Machipattri
Telugu	Tartiha, Machipati
Malayalam	Nilampla, Shulabandha
German	Wermutkraut, Bitterer Beifuß, Wurmkraut
French	Herbe d'Absinthe
Kannada	Vruvalu, Urittige, Uruvalu
Gujarati	Mastaru

have traditionally been used as stomachic agents to promote gastric function.^[8,14] However, other parts of the plant may produce adverse gastrointestinal effects, indicating that the pharmacological and toxicological properties vary among different plant tissues.^[14]

PHARMACOLOGICAL PROPERTIES

Digestive Stimulant

A. absinthium L. has traditionally been used as a digestive tonic due to its high content of bitter sesquiterpene lactones and essential oils. The bitter constituents stimulate digestion through several physiological mechanisms. Activation of bitter taste (gustatory)

receptors elicits a cephalic reflex that enhances gastric juice secretion, while stimulation of hepatic and pancreatic secretory pathways promotes the release of bile and pancreatic enzymes. In addition, these compounds exert a direct stimulatory effect on the gastric mucosa, resulting in increased gastric motility, enhanced mucosal blood flow, and improved digestive secretions. Essential oil constituents further contribute to these effects by promoting gastrointestinal perfusion and secretory activity.^[13,27]

The digestive-stimulant effects of *Absinthii herba* are generally limited in healthy individuals but become more pronounced in subjects with impaired digestive function. Experimental studies have demonstrated that *A. absinthium* preparations modulate postprandial haemodynamics by altering peripheral vascular resistance and sympathetic nervous system activity, thereby increasing gastrointestinal blood flow, facilitating the gastric phase of digestion, and improving overall digestive function.^[28]

Anthelmintic Activity

The plant possesses significant anthelmintic activity against a variety of gastrointestinal helminths.^[12] In which nematicidal activity against second stage juvenile of *Meloidogyne incognita* chitwood at 50 and 100% concentration after exposure of 24-48 hr.^[8] Experimental studies have shown that extracts of *A. absinthium* induce paralysis and mortality in *Haemonchus contortus*, accompanied by a significant reduction in faecal egg counts in infected hosts, indicating effective suppression of parasitic burden.^[7,29] Furthermore, its ethanolic extract has shown marked ovicidal activity against the eggs of *Ascaris suum* (porcine roundworm) and larvicidal activity against *Trichostrongylus colubriformis* (rabbit gastrointestinal nematode), suggesting broad-spectrum efficacy against gastrointestinal nematodes.^[30]

Antiprotozoal activity

The plant has been investigated for its antiprotozoal potential against several clinically important protozoan pathogens, including *Trypanosoma brucei*, *Trypanosoma cruzi*, *Leishmania infantum*, and *Plasmodium falciparum*, which are responsible for African trypanosomiasis, Chagas disease, leishmaniasis, and malaria, respectively.^[13,29] Evaluation of different concentrations of *A. absinthium* extracts demonstrated generally low antiprotozoal activity, with measurable inhibitory effects observed only against *T. brucei*.^[31] It contains several bioactive constituents, including the sesquiterpene lactones absinthin, anabsinthin, and anabsin, as well as the monoterpene thujene some of which possess endoperoxide structures or recognized antimalarial properties.^[12] The antiprotozoal activity of its ethanolic and aqueous extracts, which contain sesquiterpene lactone fractions, was evaluated against *Naegleria fowleri*, the causative agent of primary amoebic meningoencephalitis. Both extracts exhibited concentration-dependent inhibitory activity, achieving complete growth inhibition of *N. fowleri* at higher concentrations.^[32] Furthermore, leaf extracts exhibited schizontocidal activity in

4-day suppressive test against a chloroquine-sensitive strain of *Plasmodium berghei* in mice.^[8] A clinical study involving 25 patients with intestinal amoebiasis evaluated the therapeutic efficacy and safety of *A. absinthium*. The drug was administered orally as 500 mg capsules, with three capsules given every 6 hr for 15 days. Treatment was associated with marked clinical improvement in symptoms across patients with varying stages of intestinal amoebiasis. Parasitological evaluation demonstrated complete eradication of *Entamoeba histolytica* in 70% of the patients. No treatment-related adverse events were reported during the study period, suggesting that the drug was effective and well tolerated under the prescribed dosing regimen. However, the relatively small sample size warrants further validation through larger, well-designed randomized controlled clinical trials.^[8]

Antibacterial activity

A. absinthium exhibits broad-spectrum antibacterial activity against both Gram-positive and Gram-negative bacterial pathogens. In a rat model of *Staphylococcus aureus*-infected postoperative wounds, topical application of its hydroalcoholic extract significantly reduced the bacterial burden to 3×10^5 CFU/wound, compared with 7×10^6 CFU/wound in untreated controls. This bactericidal effect was attributed primarily to bioactive constituents present in the plant's essential oil.^[33] The essential oil has also demonstrated potent growth-inhibitory and bactericidal activities against a wide range of pathogenic bacteria, including *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Shigella sonnei*, *Staphylococcus aureus*, *Clostridium perfringens*, *Listeria monocytogenes*, *Enterobacter aerogenes*, *Klebsiella oxytoca*, and *Proteus mirabilis*.^[34] Methanolic extracts of the plant have further demonstrated broad-spectrum antibacterial and antifungal activities, highlighting their potential as alternatives or adjuncts to conventional antimicrobial agents. Phytochemical profiling by UPLC-QTOF-MS identified 90 metabolites, including 69 compounds reported for the first time in this species and a novel class of caffeoyl methyl glucaric acids, with quinic acid derivatives and flavonoids representing the predominant constituents. Among the identified phytochemicals, salicylic acid, caffeic acid, casticin, and 3,4-dicaffeoylquinic acid exhibited notable antimicrobial activity. Furthermore, acute toxicity studies revealed no mortality or observable adverse effects at an oral dose of 5000 mg/kg, indicating a favorable safety profile and supporting the therapeutic potential of *A. absinthium* as a promising source of antimicrobial agents for combating antimicrobial resistance.^[35]

Antifungal activity

The antifungal activity of the plant has been evaluated against several phytopathogenic fungi, including *Fusarium moniliforme*, *Fusarium oxysporum* F. sp. *Lycopersici*, and *Fusarium solani*, using the agar dilution method in the presence of 0.05 mg/mL methyltetrazolium salt. Essential oils obtained from cultivated, wild, and commercial sources exhibited varying degrees of

antifungal activity, with the commercial oil and one cultivated population demonstrating the greatest efficacy. Among the fifteen essential oils evaluated, seven inhibited *F. oxysporum*, six inhibited *F. solani*, and only two were active against *F. moniliforme* with ED₅₀ values below 1 µg/mL. Notably, the strongest antifungal activity was observed in thujone-free cultivated plants, suggesting that constituents other than thujone contribute significantly to the antifungal potential of *A. absinthium*.^[36] The antifungal potential of plant extracts obtained from different plant organs has also been investigated using various extraction techniques. Among the extracts tested, the ethyl acetate root extract contained the highest concentration of thiophenes and exhibited the most potent antifungal activity, while supercritical fluid extraction proved to be the most efficient method for recovering these bioactive constituents. Several isolated thiophenes, including two newly identified compounds, demonstrated pronounced antifungal activity against soil-borne fungal pathogens, highlighting *A. absinthium* roots as a promising source of natural antifungal agents.^[37]

Hepatoprotective activity

The hepatoprotective potential has been investigated using a hydromethanolic extract in rat models of acetaminophen- and carbon tetrachloride-induced liver injury. Prophylactic administration of the extract (500 mg/kg body weight) for two consecutive days significantly reduced serum aspartate Aminotransferase (AST) and alanine Aminotransferase (ALT) levels and decreased acetaminophen-induced mortality by approximately 20%. Therapeutic administration of the extract also attenuated acetaminophen-induced hepatotoxicity but did not confer protection against carbon tetrachloride-induced liver damage. Additional investigations suggested that the hepatoprotective effects may involve central nervous system-mediated mechanisms, as evidenced by alterations in pentobarbital-induced sleep duration and strychnine-induced mortality following extract administration.^[38]

Recent advances have focused on improving the oral bioavailability and therapeutic efficacy of *A. absinthium* through nanotechnology-based formulations. A nanosuspension prepared using the antisolvent precipitation technique exhibited a mean particle size of approximately 254 nm, a low polydispersity index, and an appropriate zeta potential, indicating good physicochemical stability. Compared with the coarse extract, the nanosuspension demonstrated enhanced dissolution, a 1.13-fold increase in oral bioavailability, and greater antioxidant activity as determined by the DPPH radical scavenging assay.^[27,39] In a carbon tetrachloride-induced hepatotoxicity rat model, oral administration of the nanosuspension (100 mg/kg) significantly reduced serum AST, ALT, Alkaline Phosphatase (ALP), and bilirubin levels, while restoring serum albumin, total protein, and hepatic antioxidant enzyme activities, including Superoxide Dismutase (SOD), Catalase (CAT), and Glutathione

Peroxidase (GPx). Importantly, the hepatoprotective efficacy of the nanosuspension at a lower dose was comparable to that of a higher dose of the coarse extract, indicating improved therapeutic efficiency attributable to enhanced bioavailability of polyphenolic constituents, particularly quercetin.^[39]

Anti-inflammatory activity

The plant also possesses significant anti-inflammatory activity, as demonstrated in a carrageenan-induced paw oedema model in mice. In this study, prophylactic administration of the essential oil (2, 4, and 8 mg/kg) or aqueous extract (50, 100, and 200 mg/kg) significantly reduced paw oedema in a dose-dependent manner, with the essential oil at doses of 4 and 8 mg/kg exhibiting pronounced anti-inflammatory effects comparable to the reference drug acetylsalicylic acid.^[40] The anti-inflammatory activity of *A. absinthium* has also been attributed to cardamonin, a bioactive flavonoid isolated from the plant. Cardamonin suppresses activation of the Nuclear Factor-Kappa B (NF-κB) signaling pathway through direct inhibition of NF-κB DNA-binding activity, thereby reducing the production of Nitric Oxide (NO) and other pro-inflammatory mediators.^[41]

Immunomodulatory activity

Extracts of the plant have demonstrated significant immunomodulatory potential through modulation of both innate and adaptive immune responses. In one study, murine dendritic cells treated with an ethanolic extract of *A. absinthium* for 18 hr exhibited enhanced cellular maturation, as evidenced by increased surface expression of the co-stimulatory molecule CD40, a key regulator of cytokine production and T-cell activation. Furthermore, mixed lymphocyte reaction assays demonstrated that treatment with the extract (100 µg/mL) inhibited allogeneic T-lymphocyte proliferation by 78.2% compared with untreated controls, while significantly increasing the secretion of the anti-inflammatory cytokine Interleukin-10 (IL-10). These findings indicate that *A. absinthium* exerts immunomodulatory effects by promoting dendritic cell maturation while suppressing excessive T-cell activation, thereby supporting its traditional use in the regulation of immune responses.^[42]

Cytotoxic activity

The extracts and essential oils of the plant demonstrate significant cytotoxic and antiproliferative properties against a wide range of human malignancies, including liver, breast, colorectal, oral, lung (A549, NCI-H292), and Melanoma (SK-MEL-5) carcinomas.^[27,43] These anticancer effects are primarily mediated by cell cycle arrest, intracellular ROS accumulation, and apoptosis via mitochondrial and endoplasmic reticulum stress pathways.^[27] The essential oil and its fractions exhibit selective, dose-dependent toxicity-most effectively targeting SK-MEL-5 and HCT116 lines while sparing non-malignant HS5 bone marrow stromal cells-a property

largely driven by high concentrations of (E)-caryophyllene and germacrene D.^[43]

Anti-tumour activity

Artemisia species possess significant antitumor potential driven by both isolated bioactive compounds and crude plant fractions. For instance, the isolated flavonoid artemisetin exhibits marked cytotoxicity against B16 melanoma.^[8] While crude methanolic extracts from five *Artemisia* species demonstrate strong, dose-dependent growth inhibition against Hep2 and HepG2 carcinomas. Combined, these findings highlight the genus *Artemisia* from pure flavonoids to whole extracts as a promising source of natural antitumor agents.^[13]

Analgesic activity

The analgesic potential of *A. absinthium* has been demonstrated in murine models of nociception. Administration of the essential oil or aqueous extract significantly reduced the number of writhing episodes in the acetic acid-induced writhing test and markedly prolonged the latency to nociceptive response in the hot-plate test. These findings indicate that the plant possesses both peripheral and central analgesic activities, supporting its traditional use in the management of pain.^[40]

Antidepressant activity

The antidepressant activity of the plant has been investigated in mice using The Forced Swim Test (FST) and Tail Suspension Test (TST), two well-established experimental models for evaluating antidepressant activity. Intraperitoneal administration of the methanolic extract (125-1000 mg/kg body weight) significantly reduced immobility time in both models in a dose-dependent manner. In the FST, the highest tested dose (1000 mg/kg) produced an antidepressant-like effect comparable to that of imipramine (5 mg/kg), whereas in the TST, a dose of 500 mg/kg exhibited efficacy similar to the reference drug. These findings suggest that *A. absinthium* have significant antidepressant-like activity, indicating its potential as a source of bioactive compounds acting on the central nervous system.^[44]

Neuroprotective activity

The neuroprotective effects have been evaluated in a rat model of ischemic stroke induced by transient Middle Cerebral Artery Occlusion (MCAO). Prophylactic oral administration of the methanolic extract (100-200 mg/kg) significantly attenuated oxidative stress, reduced lipid peroxidation and cerebral infarct volume, and partially restored glutathione levels and endogenous antioxidant enzyme activities. In addition, treated animals exhibited significant improvements in locomotor coordination and short-term memory compared with untreated controls. These findings suggest that *A. absinthium* exerts neuroprotective effects against cerebral ischemia-induced neuronal injury, primarily through its antioxidant and free radical-scavenging properties.^[45]

Antioxidant activity

The antioxidant activity of the plant has been extensively investigated using both *in vitro* and *in vivo* experimental models. *In vitro* studies demonstrated that the plant extracts possess strong free radical-scavenging activity against superoxide anions, hydrogen peroxide, hydroxyl radicals, and nitric oxide, in addition to exhibiting significant reducing power. In an *in vivo* model, mice were orally administered a methanolic extract of the plant prior to bilateral carotid artery occlusion followed by reperfusion. Evaluation of oxidative stress biomarkers revealed that treatment with the extract (100 and 200 mg/kg) significantly attenuated oxidative damage within the central nervous system. Specifically, lipid peroxidation, as indicated by Thiobarbituric Acid-Reactive Substances (TBARS), was markedly reduced, whereas the activities of endogenous antioxidant enzymes, including Superoxide Dismutase (SOD) and Glutathione Peroxidase (GPx), together with Glutathione (GSH) levels, were significantly increased. These findings show the potent antioxidant capacity of plant and support its potential therapeutic application in the management of oxidative stress-related disorders.^[13,46] The antioxidant activity of *A. absinthium* has been largely attributed to its abundance of phenolic and flavonoid constituents. Accordingly, the methanolic extract prepared from the aerial parts of the plant collected during the flowering stage was evaluated using five complementary antioxidant assay systems, further confirming its strong free radical-scavenging and reducing capacities.^[47]

CONCLUSION

Artemisia absinthium L. is a medicinally important plant with a long-standing history of use in the Unani system of medicine and other traditional healthcare systems. The present review highlights its rich ethnomedicinal heritage, botanical characteristics, phytochemical diversity, and broad spectrum of pharmacological activities. The plant contains numerous bioactive constituents, including sesquiterpene lactones, essential oils, flavonoids, phenolic compounds, terpenoids, and tannins, which collectively contribute to its therapeutic potential. Traditional Unani literature describes the plant as a stomachic, digestive stimulant, hepatoprotective, splenic tonic, antipyretic, nervine, anti-inflammatory, and general restorative, and many of these claims have been substantiated by modern pharmacological investigations.

Experimental studies have exhibited significant digestive stimulant, anthelmintic, antibacterial, antifungal, antiprotozoal, hepatoprotective, anti-inflammatory, immunomodulatory, antioxidant, neuroprotective, antidepressant, analgesic, and cytotoxic activities, supporting its potential in the management of infectious, inflammatory, hepatic, neurological, and oxidative stress-related disorders. Recent advances in phytochemical characterization and nanotechnology-based formulations have further improved the bioavailability and therapeutic efficacy of

A. absinthium, particularly in hepatoprotective applications, indicating promising prospects for its development into novel phytopharmaceuticals.

Despite these encouraging findings, the majority of available evidence is derived from *in vitro* and experimental animal studies, whereas high-quality clinical trials remain limited. In addition, the presence of thujone, a potentially neurotoxic constituent, necessitates careful dose standardization, quality control, and comprehensive toxicological evaluation to ensure safe therapeutic use. Overall, *Artemisia absinthium* represents a valuable medicinal plant that bridges traditional Unani knowledge with modern scientific evidence and holds considerable promise for the development of safe, effective, and evidence-based herbal therapeutics.

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ABBREVIATIONS

AST: Aspartate Aminotransferase; **ALT:** Alanine Aminotransferase; **ALP:** Alkaline Phosphatase; **SOD:** Superoxide Dismutase; **CAT:** Catalase; **GPx:** Glutathione Peroxidase; **GSH:** Glutathione; **NF-κB:** Nuclear Factor-Kappa B; **NO:** Nitric Oxide; **IL-10:** Interleukin-10; **CD40:** Cluster of Differentiation 40; **FST:** Forced Swim Test; **TST:** Tail Suspension Test; **MCAO:** Middle cerebral Artery Occlusion; **TBARS:** Thiobarbituric Acid-Reactive Substances; **DPPH:** 2,2-Diphenyl-1-picrylhydrazyl; **CFU:** Colony-Forming Unit.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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