

THE CHAMOMILE AS A COMPLEMENTARY MEDICINE: THE CURRENT STATE OF KNOWLEDGE

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Abstract

The historic use of chamomile as medicine dates back many years. Roman chamomile, or *Chamaemelum nobile* L., and German chamomile, or *Matricaria chamomilla* L., are the two types of chamomile that are most frequently used and have medicinal uses. The plant is made up of numerous parts, including its therapeutic qualities are caused by flavonoids, terpenoids, and coumarins. The study covers current advancements that support the drug's significance as a therapeutic agent in several fields, including hepatoprotection, anti-inflammatory, antioxidant, analgesic, antibacterial, anti-allergic, anticancer, and anti-hypertensive. Cancer, metabolic disorders, microbial infections, neurological and cardiovascular diseases, and other ailments claim the lives of millions of people globally. The evaluation of herbal plants' potential as complementary medicines has been a major focus of recent research. One of these species is the chamomile (*Matricaria chamomilla*), which belongs to the Asteraceae family. It elicits protective properties against a variety of ailments, including neuropathies, cancer, ulcers, bacterial and fungal infections, inflammation, and oxidative stress. The many medicinal and ethnomedical uses of chamomile are the focus of this review. We also discuss the underlying mechanism and therapeutic effects of the constituents of chamomile.

Keywords: CTS, TDS, ts, Relay, Adaptive, CTR.

INTRODUCTION

One of the oldest recognized therapeutic herbs for humans is chamomile. It belongs to the family Asteraceae/Compositae and is symbolized by two common Roman (*Chamaemelum nobile*) and German (*Chamomilla recutita*) chamomile variants [1]. The therapeutic benefits of chamomile are attributed to the abundance of terpenoids and flavonoids present in its dried flowers. Many human problems, including hay fever, inflammation, muscular spasms, menstrual disorders, sleeplessness, ulcers, wounds, gastrointestinal disorders, rheumatic pain, and hemorrhoids, are frequently treated with chamomile products. Chamomile essential oils are widely utilized in aromatherapy and cosmetics. There are several ways to prepare chamomile, but the most well-liked one is in the form of herbal tea, which is drunk more than a million cups daily [2].

General description

A plant that only grows evenly in the soil, true chamomile is an annual with slender, spindle-shaped roots. Ten to eighty centimeters is the maximum height of the erect, strongly ramified branching stem. There are two to three veins in the long, narrow leaves. With a diameter ranging from 10 to 30 mm, the flower heads are heterogamous and pedunculate, and they are arranged individually [2]. A glandulous tube always terminates the 1.5–2.5 mm long golden yellow tubular florets, each of which has five teeth. The 6–11 mm long, 3.5 mm wide, and concentrically placed white plant blossoms are numbered 11–27 [1]. The container measures 6 to 8 mm in width. It is flat initially but eventually becomes conical and cone-shaped, hollow, and devoid of paleae a crucial feature that sets *Matricaria* apart. A yellow-brown achene is the fruit [3].

Classification

Table 1. Biological classification

Name	Chamomile
Kingdom	Plantae
Subdivision	Spermatophyta
Division	Magnoliophyta
Order	Asterales
Family	Asteraceae

Various species of chamomile

• *Chamaemelum nobile*

Roman chamomile is another name for this perennial. Given that it only grows 4 to 12 inches tall, it can be utilized as a ground cover. The white, daisy-like flowers, with their petals tipped downward, complement the feathery, apple-scented foliage. The smooth, branching, apple-pineapple-scented annual German chamomile grows two to three feet tall [3]. The flower head measures one inch in diameter and features a hollow, conical core filled with little yellow florets encircled by florets that range in color from silver-white to cream. It features finely split leaves and erect branches [4].

• *Matricaria chamomilla*

German chamomile is another name for the yearly variety of chamomile. Like its relative, it features feathery foliage and daisy-like blossoms, growing up to 20 inches in length. While the foliage is not fragrant, the blossoms are. The fragrant creeping perennial Roman chamomile grows to a height of only one foot [2]. With a large conical disk covered in yellow florets encircled by white florets, the flower heads are an inch in diameter. Its beautifully split leaves and several freely branched hairy stems [3]

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The bioactive components found in chamomile

The plant contains 0.24-1.9% Volatile oil, composed of a variety of separate oils. When exposed to steam distillation, the oil ranges in color from brilliant blue to deep green when fresh, but turns to dark yellow after storage. Despite fading, the oil does not lose its potency. Approximately 120 secondary metabolites have been identified in chamomile [5] including 28 terpenoids and 36 flavonoids. Thirty-three different compounds were analyzed while twenty-two were detected belonging to different classes: flavonoids, flavonoid glucosides, and phenolic acids. With a yield of 1345 mg/kg, achieved at 45 bars [6]. Apigenin was found to be the dominant compound. The principal components of the essential oil extracted from the German chamomile flowers are the terpenoids α -bisabolol and its oxide azulenes, including chamazulene and acetylene derivatives. Chamazulene and bisabolol are very unstable and are best preserved in an alcoholic tincture. The essential oil of Roman chamomile contains less chamazulene and is mainly constituted from esters of angelic and tiglic acid. It also contains farnesene and α -pinene. Roman chamomile contains up to 0.6% of sesquiterpene lactones of the germacra-nolide type, mainly nobilin and 3-epirubicin. Both α -bisabolol and bisabolol oxides A and B, as well as chamazulene or azulenes, farnesene, and spiro-ether sesquiterpene lactones, glycosides, hydroxy coumarins, flavonoids (apigenin, luteolin, patuletin, and quercetin), coumarins (herniarin and umbelliferone), terpenoids and mucilage are considered to be the major bioactive ingredients [7].

Table 2. Biochemical constituents and their effects

Chemical constituent	Molecular weight	Therapeutic use
Bisabolol	222.37	Anticancer, antinociceptive, neuroprotective, cardioprotective antimicrobial.
Germacrene D	204.35	Anti-cancer Anti-ulcer Anticonvulsant
Geraniol	154.25	Antitumor Antimicrobial
Apigenin	270.24	Diabetes Alzheimer disease Insomnia
Herniarin	176.17	Antioxidant
Umbelliferone	162.14	Antioxidant
Caffeine acid	180.16	Anti-inflammatory Antimicrobial Antiviral Anxiolytic
Rutin	610.5	Anti-inflammatory Antimicrobial Antiviral Antidepressant
Chlorogenic acid	354.31	Antimicrobial Anti-inflammatory Antiviral Anxiolytic

Therapeutic effect of chamomile

Antioxidant activity

The antioxidant properties of α -bisabolol have been ascertained in both cellular culture and non-cellular systems. Bisabolol has been shown to strongly prevent the production of reactive oxygen species (ROS) and activate antioxidant mechanisms [8]. In vitro DPPH tests, β -farnesene has

demonstrated antioxidant-free radical scavenging action [9]. Germacrene D, a significant component in the extracted oil, was identified by GC-MS analysis and demonstrated suppression when compared to ascorbic acid and BHA in terms of antioxidant activity [10]. It is believed that geraniol's anti-inflammatory properties stem from its inhibition of COX-2 and activation of IL-10 [11]. Herniarin reduces IL-1 and TNF- α and inhibits oxidative stress and inflammation in the middle cerebral artery occlusion (MCAO) ischemia model of rats [12]. Because of its maximum antioxidant effects, aqueous extraction of *Matricaria chamomilla* at 80°C is a reasonable health-promoting agent; however, its usage should be regulated to ensure safe consumption. [13] Additional in vitro and in vivo research has validated *Matricaria chamomilla*'s antioxidant characteristics. Excerpt. For instance, chamomile promotes cell proliferation and development while lowering oxidative stress in adherent cells. [14] It is also known to stop oxidative damage in lung injuries brought on by paraquat. [15] Moreover, *Matricaria chamomilla* glycoconjugates are promoted as cutting-edge natural medicines and dietary supplements for the prophylaxis and management of disorders associated with oxidative stress. [16] *Matricaria chamomilla* extract reduces tissue oxidative stress and damage brought on by poisoning from carbon tetrachloride in mice. Additionally, it might have positive effects on antioxidant enzymes (SOD, liver enzymes, such as aspartate aminotransferase (AST) and alanine aminotransferase (ALT), as well as glutathione synthetase and glutathione peroxidase. [17] Fraxidin, matriisobenzofuran, apigenin, scopoletin, palmatoside A, apigenin 7-O-b-glucopyranoside, and p-hydroxyacetophenone are examples of *Matricaria chamomilla*'s active ingredients that have been shown to control glutathione S-transferase (GST) activity and thereby contribute to redox-associated GSH signaling. [18] In conclusion, it has been demonstrated that a variety of *Matricaria chamomilla* extracts may successfully scavenge the 2,2-diphenyl-1-picrylhydrylhydrate (DPPH) radical; its methanolic extract is the most effective in this regard [19].

Anti Bacterial

Matricaria species are widely used in Europe, Latin America, Asia, Nepal, and Africa to treat the indications and symptoms of bacterial infections caused by *Bacillus cereus*, *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Candida albicans*, and *Aspergillus niger*. In [20] While topical applications are used to treat skin infections, inhalational and oral therapies are utilized to treat respiratory infections. The species is most frequently utilized to treat gastrointestinal disorders, even though the genus offers a wide variety of therapeutic applications. It is noteworthy that *Matricaria chamomilla* extracts possess antibacterial activities, as evidenced by their minimal inhibitory concentration (MIC) being among the lowest for formulations derived from plants.

Neuroprotective

Matricaria chamomilla extract shields hippocampus neuronal morpho-functional properties from oxidative damage caused by scopolamine. [21] Passive avoidance experiments and the Morris water maze have shown that Supplementing with *Matricaria chamomilla* ethanolic extract has been shown to have memory-enhancing and free radical-scavenging properties, suggesting that it may be a viable therapy option against the pathophysiology of AD. [22] It's interesting to note

that *Matricaria chamomilla* has been suggested to have strong anxiolytic and antidepressant effects in individuals with concurrent depression and generalized anxiety properties. [23] Postmenopausal women who take chamomile supplements report less erratic sleep patterns. This may be because the herb contains a lot of apigenin, which has calming and sleep-promoting properties. [24] It has also been demonstrated that *Matricaria chamomilla* extract significantly reduces the neuropathic pain brought on by chemotherapy drugs like vincristine and cisplatin. [25] *Matricaria chamomilla* and morphine exhibit synergistic analgesic effects in a mouse model of peripheral neuropathy produced by vincristine. [26] Chamomile likely extract treatment acts as an anxiolytic and depressive agent in a scopolamine-induced toxicity model in rats, presumably through its cholinergic stimulatory relaxations. [27] Bovine animals have been treated with a medicinal formulation based on *Matricaria chamomilla* (CH12) to reduce stress, inhibit the production of cortisol, and promote relaxation. [28] Finally, *Matricaria chamomilla* has been implicated in neuromuscular circuit stimulation.

Anticancer Activity

The presence of anti-cancer properties in chamomile extracts was initially noted by Srivastava et al. [29]. These authors examined its impact on prostate cancer cells in humans. The dose-dependent decrease in cell viability observed in both aqueous and methanolic extracts ranged between 6 and 37%, even though methanolic extracts elicited higher responses. Methanolic extracts were also shown to display three-fold enhanced apoptosis upon further investigation of the mechanism of action. In a study on the anti-proliferative action, IC₅₀ values for aqueous and methanolic extracts were found to be 1650–4000 µg/mL and 165–300 µg/mL, respectively [30]. Another author examined the ethanolic extract's anti-proliferative properties against a human hepatoma cancer cell line. It was discovered that there is 2,2-diphenyl-1-picryl-hydrazyl-hydrate (DPPH) and that the IC₅₀ value is 300 µg/mL. Another author examined the ethanolic extract's anti-proliferative properties against a human hepatoma cancer cell line. It was discovered that the 2,2-diphenyl-1-picryl-hydrazyl-hydrate (DPPH) scavenging activity was 94% by 1.5 mg/mL, and the IC₅₀ value was 300 µg/mL. High concentrations of flavonoids and polyphenols were found once the chemical components were determined. The anti-cancer properties of chamomile have been studied using a wide range of clinical cancer models. Results have indicated anti-cancer activity against several cancer types, including lung cancer, breast cancer, skin cancer caused by ultraviolet B rays (UV-B), oral carcinogenesis, and colon cancer. A thorough investigation revealed that the primary agent causing anti-cancer activity via apoptosis and anti-proliferation is apigenin.

Anti-allergic activity

Allergy-related illnesses have grown more prevalent globally. Most organs and tissues have mast cells, which when activated, release proinflammatory cytokines, histamine, and inflammatory mediators such as prostaglandins, leukotrienes, and proteases. Cytokines. In a study by Chandrashekar et al. [31], allergy was brought on by treatments with the mast cell stimulant chemical 48/80. The conventional medication, disodium cromoglycate (control), and a methanolic chamomile extract were also used to treat the allergy. At 300 mg/kg,

chamomile extracts inhibited mast cell degranulation by 73.3%, while disodium cromoglycate only inhibited it by 67.75%. In addition, there was a significant decrease in histamine levels between the treated and control groups. When NO levels in peritoneal, bronchoalveolar, and serum fluids were also measured, a roughly three-fold decrease was seen with NO levels also measured in serum, peritoneal, and bronchoalveolar fluids. Standard treatments resulted in a reduction of roughly three times, while chamomile extracts at a dose of 300 mg/kg indicated a maximum reduction of five times [32]. The effectiveness of topical chamomile oil on 2,4-dinitrochlorobenzene-induced allergic dermatitis was investigated by another author. Following 4 weeks of application for chamomile oil and 2 weeks for IgG1 and serum IgE, respectively, histamine levels were dramatically lowered [33].

Antimicrobial activity

To strengthen the antibacterial properties of synthetic medications, plant ingredients can also be employed in concert with them. To find the MIC values of chamomile extracts and essential oils, a study was carried out. Against *Staphylococcus aureus*, *Escherichia coli*, and *Candida albicans* in hexane, diethyl ether, and dichloromethane. The results were compared with antibiotics including ampicillin, cefuroxime, tetracycline, fluconazole, and nystatin. Although the extracts' MICs were higher than those of conventional antibiotics, their combined use showed a synergistic or additive impact. With tetracycline, the effect was most noticeable; against both Gram-positive and Gram-negative bacteria, a four-fold reduction in minimum inhibitory concentration (MIC) and a fraction inhibitory concentration index of 0.26–0.37 were noted. Since the study employed various chamomile extract fractions, numerous components may interact and demonstrate antibacterial characteristics [34]. An epithelial cell line and human keratinocytes were used in a different investigation to assess the cytotoxic effects of chamomile oil [35]. The following chamomile oil quantities were tested: 16 µg/mL, 32 µg/mL, 125 µg/mL, and 250 µg/mL. Only at the greatest dosage did the oil exhibit toxicity, it was discovered. Additionally, the author examined the antibacterial properties of *P. aeruginosa*, *Klebsiella pneumoniae*, *Enterobacter*, and *E. coli* against Gram-negative organisms.

Treatment of Diabetes Mellitus

Matricaria chamomilla ethanolic extract exhibits strong antihyperglycemic properties, suggesting that it can be a potent blood glucose regulator. [36] The concurrent antihyperglycemic and antioxidant properties of *Matricaria chamomilla* have also been documented in a rodent model of diabetes produced by streptozotocin. [37] *Matricaria chamomilla* has demonstrated a significant hypoglycemic effect in diabetic rats, reducing blood levels of urea, creatinine, uric acid, AST, and ALT, among other metabolites. [38] Similarly, by lowering oxidative stress, blood glucose, and lipid peroxidation, *Matricaria chamomilla* has been shown to markedly alleviate diabetes-related cardiac problems.

1. Use during lactation and pregnancy Although many pregnant women use chamomile as a beverage to relieve morning sickness, there have been no studies on the safety of chamomile for pregnant or nursing women [32].

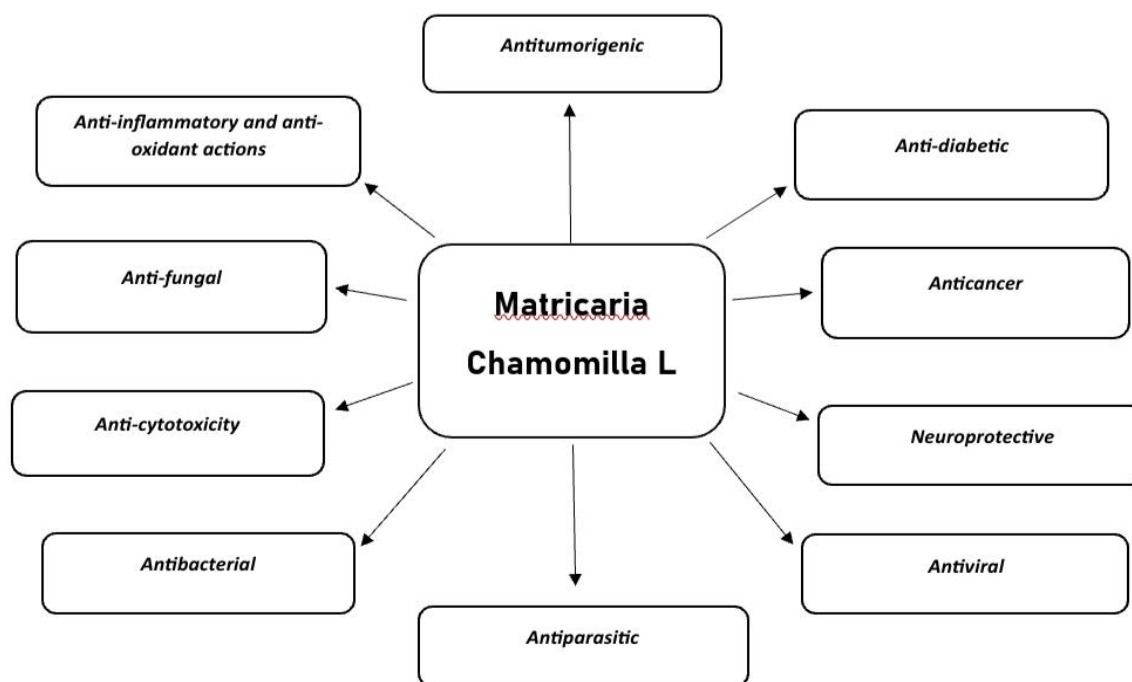


Fig. 2. Therapeutical effect of Chamomile Medicinal uses of chamomilla

2. Since ancient times, chamomile has been utilized as a mildly astringent, antioxidant, anti-inflammatory, and therapeutic herb[34].
3. Is used to treat rheumatic pain, hemorrhoids, neuralgia, sciatica, burns, eczema, gout, wounds, ulcers, and skin irritations. Mastitis and other illnesses[39].
4. Antiulcer activity: In rats, stomach ulcers brought on by stressful stimuli were prevented by bisabolol and chamomile flowers[40].
5. Anxiolytic and sedative effects: Chamomile extracts dramatically decreased the rats' ability to move about[17].
6. Anti-inflammatory and antiallergic activity: Animal studies have shown that chamomile has anti-inflammatory properties. Bisabolol was anti-inflammatory.[40]

Various pharmaceutical products

Table 3. Various pharmaceutical products available in the market

Name of product	Brand	Category
Organic Chamomile flower powder	One herb	Health supplement
Pure chamomile infusion	Twinnings	Muscle relaxant
Chamomile herbal tea bags	Vadham	Immunity booster
Chamomile talc-free baby powder	The Moms Co.	Moisturizer
Pure chamomile essential oil	Indus valley	Muscle relaxant
Roman essential oil	GYA labs	Aromatherapy
Pure and natural chamomile essential oil	Brooklyn Botany	Skin therapy
Chamomile vit-E soothing and moisturizing lotion	Aroma treasure	Moisturizer

Conclusion

Since it contains a variety of beneficial properties, chamomile has been used as an herbal remedy since ancient times. It is still widely used today and is likely to be used in the future. Bioactive compounds with medicinal properties. Improved cardiovascular health, immune system stimulation, and possible cancer prevention are among the benefits of chamomile. More investigation and the production of scientific evidence are necessary to determine whether or not patients benefit from chamomile's medicinal effects.

Sustained efforts are required to concentrate on pre-clinical studies utilizing animal models of many diseases and chamomile. After that, these findings might be confirmed in human clinical studies to establish chamomile as a potentially useful medicinal substance. It is still unclear, in the absence of such proof, if these are unverified and untested is still uncertain whether these experimental and unproven medical therapies are indeed helpful in the absence of such proof. We can infer that using chamomile products sparingly and appropriately is safe and beneficial; using them carelessly or indiscriminately, on the other hand, may be dangerous.

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