

Charming Chamomile: Unveiling The Wonders & Uses of this Tranquil Herb

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ABSTRACT

Chamomile, a member of the daisy family, has been used in traditional and alternative medicine for thousands of years. Its popularity can be attributed to its slow and minimal side effects. Chamomile, derived from the Greek word for "ground apple," was first used by the Ancient Egyptians in the 13th century to treat acute fever. It is also used in magic spells and has been used in Ayurveda. Chamomile is a significant restorative spice native to southern and eastern Europe, with dried blossoms found in various countries. It is also used in traditional home-grown restorative products, such as natural teas and herbal remedies. Chamomile oil is prepared in traditional Persian medicine by boiling watery chamomile in sesame oil, and is used in spice brewing and beer production.

In Europe, chamomile is considered a "fix all" and is often used as a tea or tonic. It is also used in beauty care products and perfumery businesses, such as Ormenis multicaulis Braun-Blanq. and Moroccan chamomile. In Germany, it is known as "alleszutraut," meaning it is suitable for anything. Chamomile is generally considered safe for use and is part of some customary, Unani, and homeopathic therapeutic arrangements.

Chamomile, a yearly plant, is known for its terpenoids, including α pinene, which are known for their corrosive properties. These terpenoids, along with other essential compounds like α pinene, are essential for the plant's growth and can be used to treat various ailments, including skin irritation and narcotic use.

KEYWORDS: Chamomile, German Chamomile, Matricaria Chamomile L.

INTRODUCTION

Chamomile is a well-known herb with a history of use in traditional medicine dating back to Ancient Egypt in the 13th century. Its name comes from the Greek word for "ground apple," reflecting its apple-like scent. Chamomile belongs to the Asteraceae family and includes two main species: Matricaria chamomilla (German chamomile) and Chamaemelum Nobile (Roman chamomile).

This herb is celebrated for its calming and anti-inflammatory properties, making it effective for treating conditions such as anxiety, digestive issues, skin irritations, and even more serious ailments like cancer and cardiovascular problems. The dried flowers are commonly brewed into herbal teas, while chamomile oil is used in traditional medicine and cosmetics.

Chamomile contains over 120 bioactive compounds, including terpenoids and flavonoids, which contribute to its therapeutic effects. It is generally considered safe for consumption and is widely used in

various traditional and homeopathic remedies for its soothing properties.

HISTORY

Chamomile is one of the oldest known medicinal herbs, historically used by the Egyptians for treating fevers and dedicated to their gods. The name "chamomile" derives from the Greek "kamai-melon," meaning "ground apple," due to the flower's apple-like scent. The plant spread from the Middle East to Spain, with notable figures like Hippocrates and Dioscorides recommending it for various ailments, including digestive issues and menstrual pain.

There are two main species of chamomile: *Roman chamomile* (*Chamaemelum Nobile*) and *German chamomile* (*Matricaria recutita*). Roman chamomile is native to parts of Europe and the Mediterranean, while German chamomile is widely distributed across Europe. Both species are used in traditional herbal medicine, but German chamomile is more commonly preferred for therapeutic purposes.

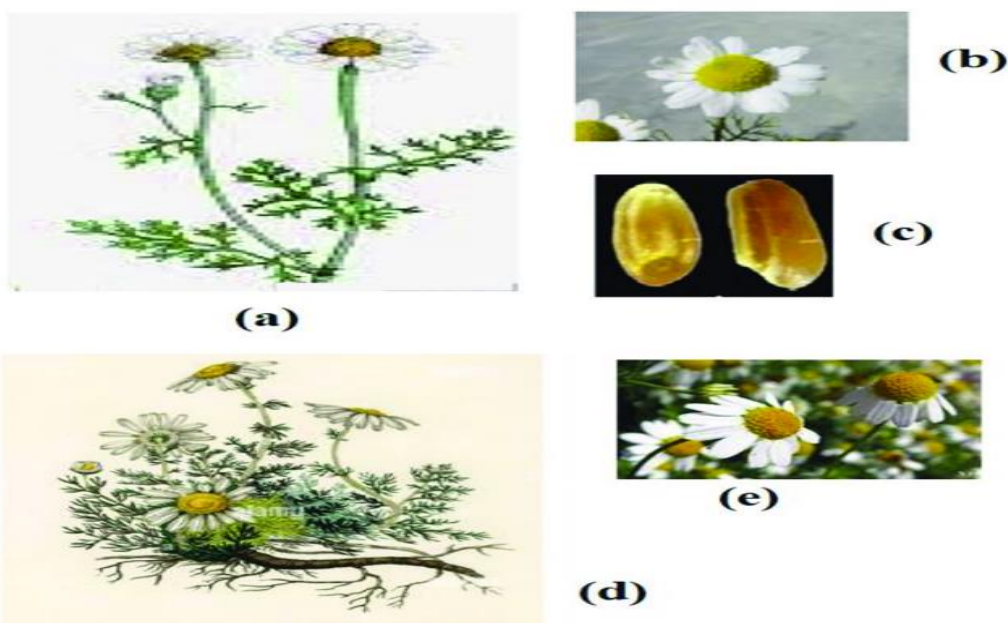
Chamomile is utilized in various forms, including tea, oil, and poultices, for treating conditions such as anxiety, insomnia, digestive disorders, and skin irritations. Its historical significance spans multiple cultures, with uses ranging from flavouring sherry in Spain to brewing beer in medieval England. The plant is also known for its pest-repelling properties, benefiting nearby plants when grown together.

Overall, chamomile's rich history and diverse applications highlight its importance in herbal medicine and cultural practices across the globe.

MORPHOLOGY

Chamomile is an annual plant with slender roots and an erect, branched stem that grows 10-80 cm tall. Its leaves are long and bi- to tripinnate. The flower heads are solitary, 10-30 mm in diameter, featuring yellow central florets and white surrounding florets. The fruit is a tubular achene, 0.8-1 mm long.

Roman chamomile (*Chamaemelum Nobile*) is a perennial variety, growing up to 30 cm tall, with fragrant foliage and larger, daisy-like white flowers. True chamomile is often confused with similar-looking plants from the genus *Anthemis*.



TAXANOMY

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Order	Asterales
Family	Asteraceae
Genus	Matricaria
Species	chamomilla
Synonyms	<i>Matricaria recutita</i> L.;
	<i>Chamomilla vulgaris</i> Gray
	<i>Chamaemelum chamomilla</i> (L.) E.H.L.Krause
	<i>Chrysanthemum chamomilla</i> (L.) Bernh

GEOGRAPHICAL DISTRIBUTION

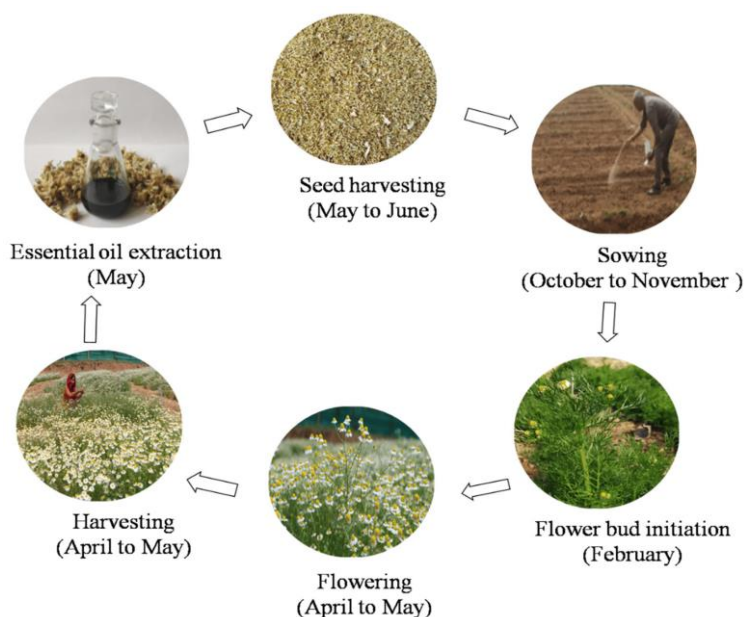
Chamomile (*Matricaria chamomilla* L.) is an important medicinal herb primarily found in southern and eastern Europe, with significant cultivation in Germany, Hungary, France, Russia, Yugoslavia, and Brazil. It was introduced to India during the Mughal era, particularly in regions like Punjab, Uttar Pradesh, Maharashtra, and Jammu and Kashmir. The plant is also grown in North Africa, Asia, North and South America, Australia, and New Zealand.

Hungary is the leading producer of chamomile biomass, thriving even in poor soils, which provides a source of income for local residents. The flowers are exported to Germany for essential oil extraction. Globally, chamomile is commercially cultivated in various regions, including the former USSR, North Africa, and parts of Asia and the Americas.

Estimates of global production vary, but in 1995, it was around 500 tons of dried flowers annually, increasing to approximately 1,000 tons of essential oil by 1998. In India, chamomile has been cultivated in Lucknow for about 200 years and was introduced to Jammu in 1957. The plant was first documented in Lucknow in the mid-1960s

CULTIVATION & COLLECTION:

Chamomile requires cool, mild conditions to develop well, and temperatures of 7 to 26 °C. It needs long summer days, full sun and tall warm units to create ideal oil yields. It can be developed on a wide extend of soil sorts, but lean towards a well-drained, sandy or sandy-loam soil with a pH of 4,8 to 8,3



PROPAGATION: German chamomile is propagated by direct seeding, while Roman chamomile can be grown from seeds or by dividing older plants. Each Roman chamomile plant produces 12 to 14 runners. It's important to select high-quality plants for propagation. The 2-month growing season of German chamomile allows for interplanting with other herbs or for early/late cropping.

SOIL Arrangement: Homegrown and essential oil crops thrive in healthy soils, producing high-quality products in global demand. Soil analysis is recommended to identify nutrient deficiencies and guide improvements.

PLANTING: German chamomile is sown annually at a rate of 500 to 1,000 g/ha, with seeds mixed at 5 g per 4 liters of fine sand. For Roman chamomile, seeds should be dispersed to achieve quick ground cover and suppress weeds, with a planting distance of 30 x 30 cm. Late-sown plants yield fewer flowers and less growth. Roman chamomile, being perennial, involves dividing older plants in early spring for transplanting. It's very small seeds should be sown shallowly.

FERTILISATION: German chamomile does not require huge amounts of manures, but depending on soil tests, little amounts of nitrogen, phosphorus, and potassium should be connected some time recently planting. It incorporates a tall sodium take-up, subsequently recovering the soil.

IRRIGATION: Sprinkler water system ought to be utilized. The soil must be wet, particularly amid seedling foundation, but not overwhelmed.

WEED CONTROL: Steady weeding is fundamental until the chamomile 'mat' takes over. Keep the plants clean amid the summer by hand-weeding, as hoeing may annihilate little plants.

COLLECTION

Harvesting German chamomile is optimal at 22 to 25 °C, using hand rakes, clipping, or specialized tools. For the best quality, flower heads should be harvested at intervals. This labour-intensive method allows for multiple harvests, as chamomile blooms continuously. The first harvest removes the initial open flowers, with follow-up harvests for later blooms.



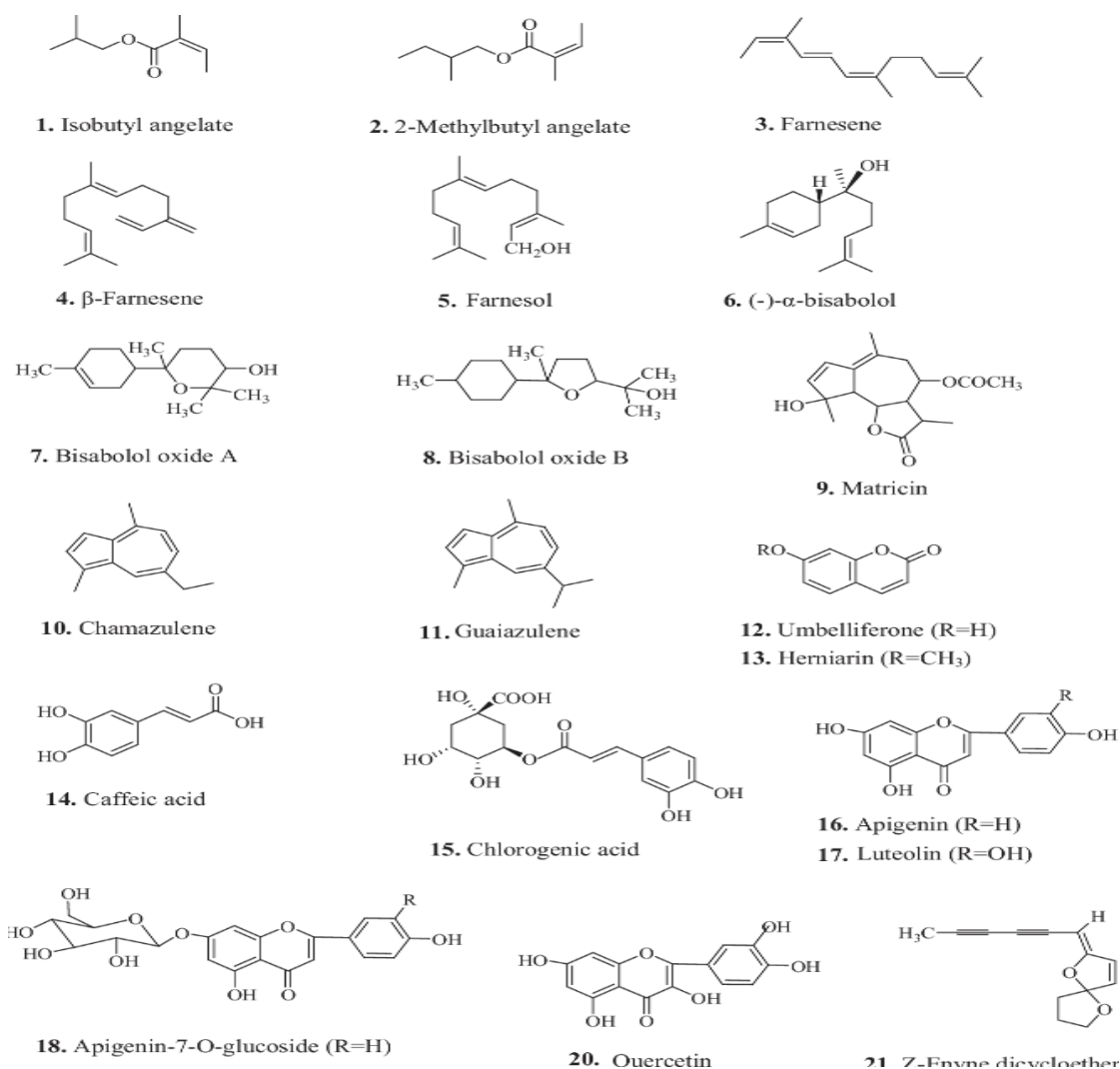
To preserve the beneficial properties of chamomile, it is essential to dry the flowers immediately after harvesting in a dry, dark room at temperatures between 21 to 27 °C, which takes about two weeks. For faster drying, a low oven temperature of around 30 °C is recommended, as higher temperatures can degrade the medicinal compounds. If using an oven, keep the door slightly open with a wooden spoon to allow moisture to escape. Properly dried chamomile flowers can be stored in an airtight container for up to a year without losing potency.

PHYTOCHEMICALS

Chamomile flowers include several phenolic compounds, primarily the flavonoids apigenin, quercetin, patuletin, luteolin and their glucosides. Coumarins and Dicycloethers also occur in the flowers. The principal components of the essential oil extracted from the flowers are the terpenoids α -bisabolol and its oxides and azulenes, including chamazulene. Bioactive phenolic composition coumarins: herniarin, umbelliferon; phenylpropanoids: chlorogenic acid, caffeic acid; flavones: apigenin, apigenin-7-O-glucoside. Luteolin, luteolin-7-O-glucoside; flavonols: quercetin, rutin and flavanone: naringenin are also present in chamomile extract. Chamomile oil includes chamazulene, (1-15 %) chamazulene carboxylic acid and pyrazolines. The essential oil from chamomile showed specific inhibition toward aflatoxin G production, and (E) - and (Z)-spiroethers were isolated as the active compounds from the oil. The largest group of medically important compounds forming the essential oils are primarily bisabololoxides, bisabolonoxide A, trans- β -farnesene, α -farnesene, spathulenol and the cis/trans-en-in-dicycloethers. Flavonoids, coumarins, mucilages, mono and oligosaccharides also have pharmacological effects. Chamazulene carboxylic acid is a natural proven with antiinflammatory activity and degradation product of proazulenic sesquiterpene lactones and matricin. Chamomile is one of the richest dietary sources of apigenin 840 mg/100 gm of chamomile.

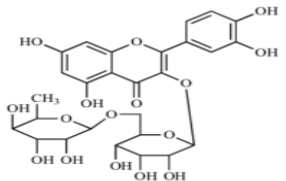
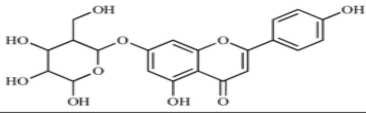
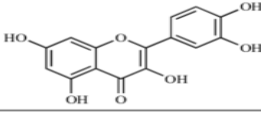
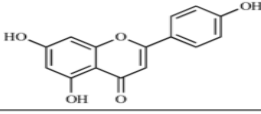
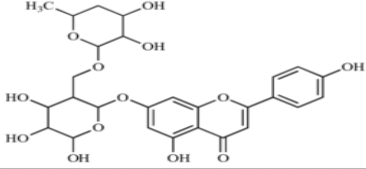
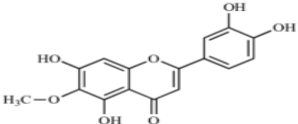
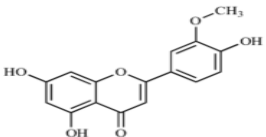
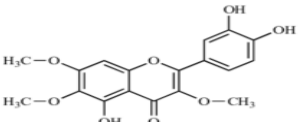
1. ORGANIC ACIDS

Organic acids contain carboxylic acid, and sulfonic acid functional groups. A total of 26 organic acids have been isolated from chamomile, among which four acids are primary metabolites and are essential compounds for the growth and development of living organisms. The compounds also have great potential in the treatment of cardiovascular diseases, immune system diseases and cancer. In addition, the remaining 22 acids are secondary metabolites.



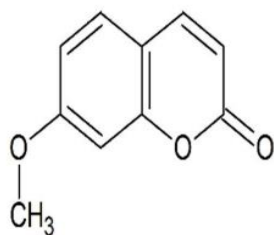
2. Flavonoids

In general, flavonoids have a core structure of 2-phenyl chromone. A total of fifty flavonoids have been isolated from Chamomile and are its main active components. They include quercetin, apigenin, luteolin, and rutin. These compounds exhibit antibacterial, antioxidant, anticancer, and other pharmacological effects. Yang et al. reported the presence of apigenin-7-O- β -D-glucoside and luteolin-7-O- β -D-glucose glycosides in an alcohol extract, and these are assumed to be the main bioactive flavonoids of chamomile. Mire Ayi et al. evaluated the inhibitory effect of a total flavonoid extract on pancreatic lipase using 4-methylumbelliferone oleate (4-MUO) as a substrate. Therefore, chamomile could be an alternative medicine to prevent and treat obesity. According to reports, apigenin has anti-inflammatory properties. Apigenin reduces inflammation in lipopolysaccharide (LPS)-stimulated BV2 microglia via the Glycogen Synthase Kinase 3 β /Nuclear factor E2 related factor 2 (GSK-3 β /Nrf2) signaling pathway. In addition, it affects the levels of interferon- γ and interleukin-10 in lymphocytes

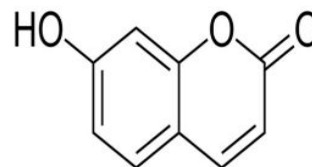
#	Name	Structure	MW	log P	TPSA
01	Rutin		$C_{28}H_{10}O_{16}$ 610.57	0.68	265.52
02	Apigenin-7-O-glucoside		$C_{21}H_{20}O_{10}$ 432.41	-0.01	166.14
03	Quercetin		$C_{15}H_{10}O_7$ 302.25	1.75	127.45
04	Apigenin		$C_{15}H_{10}O_5$ 270.25	2.79	86.99
05	Apigenin-7-O-neohesperidosid		$C_{27}H_{30}O_{13}$ 562.57	0.68	204.83
06	Axillarin		$C_{16}H_{12}O_7$ 316.28	2.49	116.45
07	Chrysoeriol		$C_{16}H_{12}O_6$ 300.28	2.71	96.22
08	Chrysoplenol		$C_{18}H_{16}O_8$ 360.34	2.53	114.68

3. Coumarins

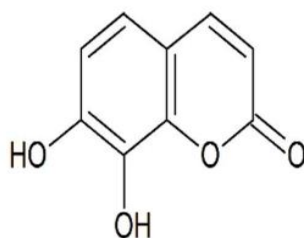
The parent nucleus of coumarin is benzopyrone. A total of 10 coumarins, including coumarin, 7-methoxycoumarin, esculetin, skimmin, daphnin, daphnetin, umbelliferone, scopoletin, isoscapoletin, and 3,4-Dihydrocoumarin, have been identified from Chamomile. Li et al. established a method of simultaneous quantitative analysis for multi-components by single marker (QAMS) to determine the content of 7- methoxycoumarin, which uses an external standard method to determine apigenin, and uses a relative correction factor to determine 7-methoxycoumarin and other components.



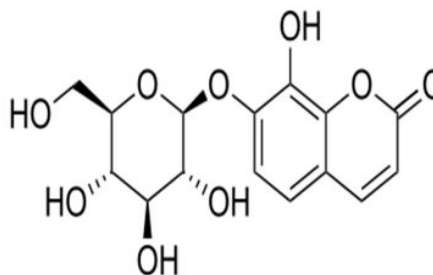
Herniarin



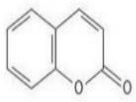
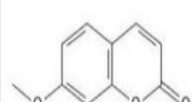
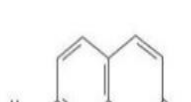
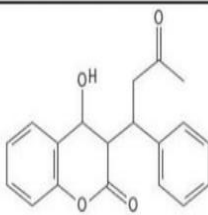
Umbelliferone



Daphnetin



Daphnin

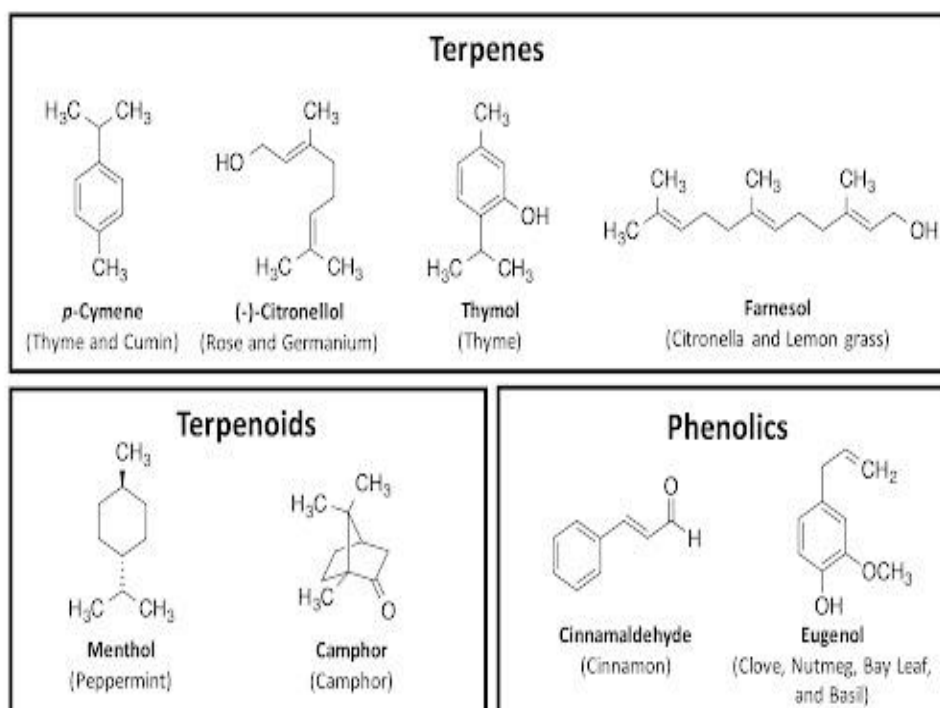
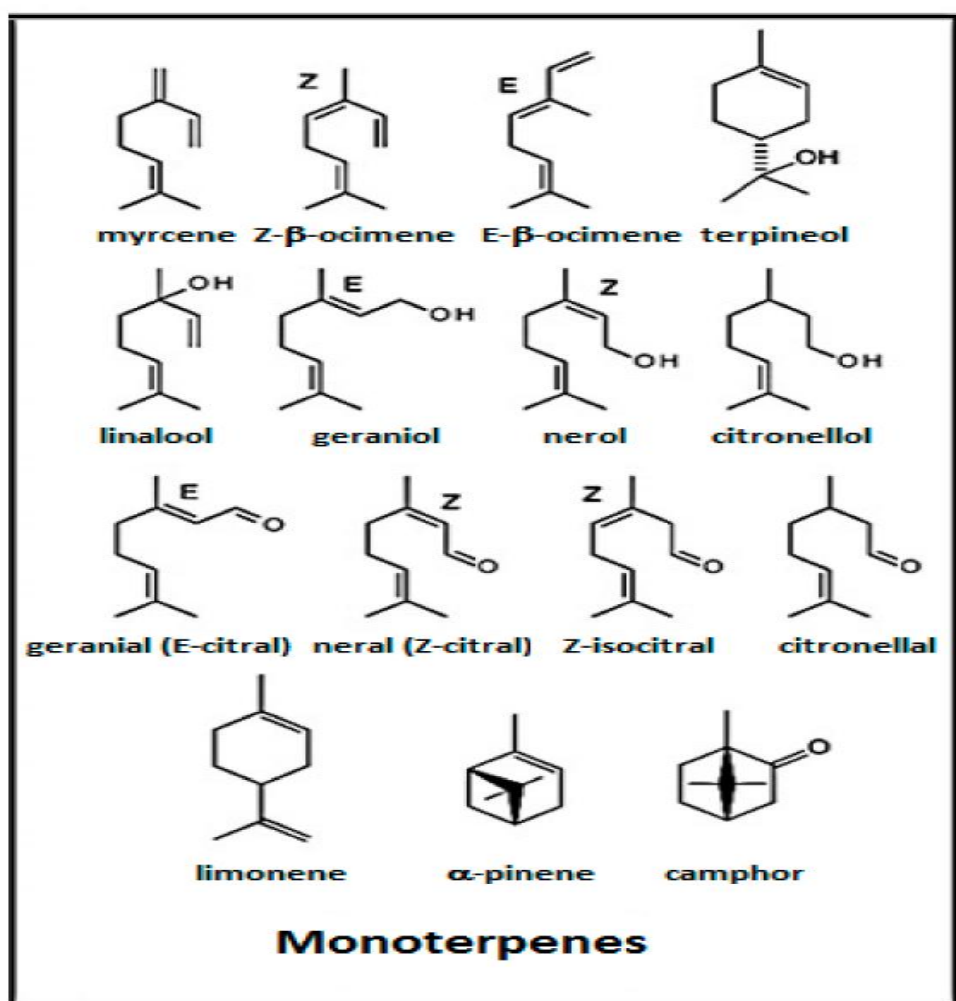
Example Coumarins in Chamomile			
			
Coumarin	Herniarin	Umbelliferone	Warfarin

4. Volatile Oil

The volatile oil of Chamomile has been prepared using a water distillation method, and its components have been identified using gas chromatography-mass spectrometry (GC-MS). A total of 102 components are reported in the volatile oil. Volatile components, such as isopentyl isobutyrate, isobutyl isobutyrate, and others, have been reported to exhibit sedative and calming effect.

5. Diterpenes and Triterpenes

Diterpenes contain four isoprene units, whereas triterpenes contain six isoprene units. Up to now, two diterpenes (alcohol and phytanetriol) and three triterpenes (oleic acid, taraxanol, and taraxasterol) have been reported in chamomile.



USES**1 Anticancer activity**

Studies on chamomile, especially its compound apigenin, suggest it may inhibit tumour growth in various cancers. Chamomile extracts reduce cancer cell viability while sparing normal cells. TBS-101, a blend of botanical extracts including chamomile, shows a strong safety profile and significant anticancer effects against prostate cancer PC-3 cells in vitro and in vivo.

2. Cardiovascular conditions

Frequent flavonoid consumption may lower coronary heart disease risk in elderly men, as shown in a study of 805 men. Another study found that chamomile tea slightly increased brachial artery pressure in heart disease patients, with many experiencing deep sleep afterward. Further research is needed to assess chamomile's cardiac health benefits.

3. Osteoporosis

Osteoporosis is a condition characterized by reduced bone mass and increased fracture risk due to excessive bone resorption. Chamomile extract has been studied for its potential to enhance the development and mineralization of osteoblastic cells, which are essential for bone formation. It appears to have an anti-estrogenic effect, suggesting a mechanism related to oestrogen receptors. However, more research is needed before chamomile can be recommended for osteoporosis treatment.

4. Sleep Aid/Sedation

Chamomile is widely used in teas and essential oils for its calming effects, often helping with insomnia. The flavonoid apigenin is believed to bind to benzodiazepine receptors in the brain, promoting sedation. Preclinical studies have shown anticonvulsant and central nervous system depressive effects. Some cardiac patients reported deep sleep after consuming chamomile tea. However, more clinical trials are needed to confirm these effects.

5. Diabetes

Chamomile may help manage diabetes by lowering blood sugar levels, increasing liver glycogen storage, and inhibiting sorbitol in red blood cells. Its effects appear to be independent of insulin secretion, and it may protect pancreatic beta cells from oxidative stress related to hyperglycaemia. Further studies are necessary to evaluate its effectiveness in diabetes management.

6. Sore Throat/Hoarseness

A study involving patients undergoing intubation found that chamomile spray did not significantly reduce postoperative sore throat or hoarseness. This suggests limited effectiveness in this context, indicating that more research is needed to explore its potential benefits.

7. Vaginitis

Chamomile may help alleviate symptoms of vaginal inflammation, such as itching and discomfort, particularly in postmenopausal women. While it has few side effects, more research is needed to establish its efficacy for this condition.

8. Wound Healing

Chamomile has shown promise in improving wound healing, particularly in a clinical trial involving patients who underwent keratoplasty. The extract was effective in promoting wound drying and epithelialization, and it exhibited antimicrobial activity. The test group showed a significant reduction in wound area and faster healing compared to controls.

9. Quality of Life in Cancer Patients

Aromatherapy using chamomile essential oils has been explored for its effects on anxiety and self-esteem in cancer patients. While some studies show positive outcomes, such as reduced anxiety in elderly women receiving aromatherapy massage, more rigorous clinical trials are needed to validate these findings.

10. Gastrointestinal Conditions

Chamomile has traditionally been used to treat various gastrointestinal issues, including gas, colic, and ulcers. A commercial preparation containing chamomile has demonstrated anti-ulcer effects, reduced acid output and increasing mucin secretion, which may help protect against gastric ulcers.

11. Haemorrhoids

Chamomile ointment and tinctures may help alleviate symptoms associated with haemorrhoids, such as inflammation and discomfort. More research is needed to confirm its effectiveness in this area.

12. Inflammatory Conditions

Chamomile may help reduce inflammation linked to gastrointestinal diseases and has been suggested to suppress *Helicobacter pylori*, a bacterium associated with stomach ulcers. Its effectiveness in treating minor skin irritations is noted, but more evidence-based research is required.

13. Mucositis

A clinical trial found no significant benefit of chamomile mouthwash in reducing stomatitis induced by chemotherapy. This indicates that its effectiveness in this context remains unclear and requires further investigation.

14. Eczema

Chamomile topical applications have shown effectiveness in treating atopic dermatitis, with some studies indicating it is more effective than placebo in reducing eczema symptoms.

15. Colic/Diarrhea Conditions

Chamomile may help reduce colic symptoms in infants and shorten the duration of diarrhea in children. Studies have shown that chamomile tea can effectively alleviate colic in newborns, providing a safe treatment option.

16. Common Cold

Inhaling steam infused with chamomile may help alleviate symptoms of the common cold, although further research is needed to confirm these benefits.

17. Anxiety and Seizure

Chamomile has been reported to have mild anxiolytic effects and may reduce seizure activity in preclinical studies. However, results have been inconsistent, and more research is needed to clarify its role in anxiety and seizure management.

18. Antihypertensive Activity

Chamomile extract has shown potential antihypertensive effects in hypertensive animal models, suggesting it may help lower blood pressure without affecting normal levels.

19. Hypolipidemic Activity

Chamomile has been found to lower blood lipid levels in hypolipidemic models, improving cholesterol profiles by reducing total cholesterol and increasing HDL levels.

20. Antiallergy Activity

Chamomile has demonstrated potential antiallergic effects, with studies indicating it may inhibit allergic responses. However, more research is needed to confirm its efficacy.

21. Antidepressant Activity

Chamomile may alleviate depressive symptoms, particularly in postpartum women. Some studies suggest it

has antidepressant properties, but further research is necessary to establish its effectiveness.

22. Organoprotective Effect

Chamomile exhibits protective effects on various organs, including the liver and kidneys, potentially safeguarding against oxidative damage and improving overall organ function.

23. Hepatoprotective and Pulmoprotective Effect

Chamomile flavonoids may protect against liver and lung damage from toxins, improving biochemical markers of injury and enhancing antioxidant defences.

24. Nephroprotective Effect

Chamomile has shown potential in protecting against kidney damage, particularly in models of nephrotoxicity, by reducing oxidative stress and improving renal function.

25. Gastroprotective Effect

Chamomile has antiulcer and antioxidant properties, protecting against gastric mucosal injury and promoting healing of the gastric lining, which may be beneficial for individuals with gastritis or peptic ulcers.

26. Genitoprotective Effect

Chamomile extract may improve reproductive health in PCOS models by reducing insulin resistance and regulating hormones. It also protects testicular tissue from damage and oxidative stress.

27. Neuroprotective Effect

Chamomile shows neuroprotective properties, enhancing BDNF levels and reducing oxidative stress in the hippocampus. It may improve memory deficits and has potential benefits against neurodegenerative diseases.

28. Analgesic Activity

Chamomile has historical use as an analgesic for pain relief, including migraines and menstrual cramps. It exhibits spasmolytic effects on smooth muscle, suggesting benefits for gastrointestinal issues.

29. Insomnia

Chamomile extract has been shown to improve sleep quality in elderly patients, but studies in younger adults have shown mixed results. Guidelines recommend caution in using chamomile for chronic insomnia.

30. Estrogenic Activity

Chamomile is commonly used for morning sickness and menopause. It exhibits weak estrogenic activity in vitro and anti-estrogenic effects on breast tissue, indicating a complex hormonal role.

31. Radiation Dermatitis

Chamomile cream showed no significant benefit over almond cream for acute radiation dermatitis, leading to recommendations against its use for this condition.

32. Ulcerative Colitis

A study found no significant difference in outcomes between chamomile extract and mesalazine in ulcerative colitis patients, suggesting chamomile may not be superior but could be explored as an alternative treatment.

FUTURE PROSPECTS

The audit emphasizes the diverse chemical components in chamomile that exhibit various natural activities, suggesting its potential as a therapeutic herb. While numerous in vitro studies have detailed its medicinal applications, there is a lack of substantial clinical evidence supporting its effectiveness in vivo. Many researchers have noted that, despite chamomile's promising properties, clinical studies do not yield

the same positive results as laboratory experiments.

Several factors may contribute to this discrepancy. For instance, chamomile's essential oils contain lipophilic components that are prone to oxidation, leading to degradation into less effective compounds. Although alcoholic and aqueous extracts of chamomile can be used, they often demonstrate poor tissue permeability and low solubility, resulting in low bioavailability. Additionally, when used topically or in inhalation therapies, chamomile essential oil can irritate mucosal tissues. To enhance the safety and efficacy of chamomile, it is crucial to explore innovative delivery systems that can improve its bioavailability and therapeutic potential.

References:

1. Sah, A., Naseef, P. P., Kuruniyan, M. S., Jain, G. K., Zakir, F., & Aggarwal, G. (2022). A Comprehensive Study of Therapeutic Applications of Chamomile. *Pharmaceuticals* (Basel, Switzerland), 15(10), 1284.
2. Dai, Y. L., Li, Y., Wang, Q., Niu, F. J., Li, K. W., Wang, Y. Y., Wang, J., Zhou, C. Z., & Gao, L. N. (2022). Chamomile: A Review of Its Traditional Uses, Chemical Constituents, Pharmacological Activities and Quality Control Studies. *Molecules* (Basel, Switzerland), 28(1), 133.
3. Ebrahimi, H., Mardani, A., Basirinezhad, M. H., Hamidzadeh, A., & Eskandari, F. (2022). The effects of Lavender and Chamomile essential oil inhalation aromatherapy on depression, anxiety and stress in older community-dwelling people: A randomized controlled trial. *Explore* (New York, N.Y.), 18(3), 272–278.
4. Hieu, T. H., Dibas, M., Surya Dila, K. A., Sherif, N. A., Hashmi, M. U., Mahmoud, M., Trang, N. T. T., Abdullah, L., Nghia, T. L. B., Y, M. N., Hirayama, K., & Huy, N. T. (2019). Therapeutic efficacy and safety of chamomile for state anxiety, generalized anxiety disorder, insomnia, and sleep quality: A systematic review and meta-analysis of randomized trials and quasi-randomized trials. *Phytotherapy research : PTR*, 33(6), 1604–1615.
5. Jia, Y., Zou, J., Wang, Y., Zhang, X., Shi, Y., Liang, Y., Guo, D., & Yang, M. (2021). Action mechanism of Roman chamomile in the treatment of anxiety disorder based on network pharmacology. *Journal of food biochemistry*, 45(1), e13547.
6. Singh, O., Khanam, Z., Misra, N., & Srivastava, M. K. (2011). Chamomile (*Matricaria chamomilla* L.): An overview. *Pharmacognosy reviews*, 5(9), 82–95.
7. Miraj, S., & Alesaeidi, S. (2016). A systematic review study of therapeutic effects of *Matricaria recutita* chamomile (chamomile). *Electronic physician*, 8(9), 3024–3031.
8. Petrič, D., Mravčáková, D., Kucková, K., Čobanová, K., Kišidayová, S., Cieslak, A., Ślusarczyk, S., & Váradyová, Z. (2020). Effect of dry medicinal plants (wormwood, chamomile, fumitory and mallow) on in vitro ruminal antioxidant capacity and fermentation patterns of sheep. *Journal of animal physiology and animal nutrition*, 104(5), 1219–1232.
9. Mailänder, L. K., Lorenz, P., Bitterling, H., Stintzing, F. C., Daniels, R., & Kammerer, D. R. (2022). Phytochemical Characterization of Chamomile (*Matricaria recutita* L.) Roots and Evaluation of Their Antioxidant and Antibacterial Potential. *Molecules* (Basel, Switzerland), 27(23), 8508.
10. Imb, M., Véghelyi, Z., Maurer, M., & Kühnel, H. (2024). Exploring Senolytic and Senomorphic Properties of Medicinal Plants for Anti-Aging Therapies. *International journal of molecular sciences*, 25(19), 10419.
11. Yang, J., Zhang, X., Hua, Z., Jia, H., Li, K., & Ling, C. (2024). High-Quality Assembly and Analysis

- of the Complete Mitogenomes of German Chamomile (*Matricaria recutita*) and Roman Chamomile (*Chamaemelum nobile*). *Genes*, 15(3), 301.
12. Nemati, S., Yousefbeyk, F., Ebrahimi, S. M., FaghihHabibi, A. F., Shakiba, M., & Ramezani, H. (2021). Effects of chamomile extract nasal drop on chronic rhinosinusitis treatment: A randomized double-blind study. *American journal of otolaryngology*, 42(1), 102743.
13. Rashad, M. G., Arafa, M. M., El-Zanaty, A. E. I., El-Saeed, M., El-Ashram, S. A., Al-Olayan, E. M., Hegazy, M. M., & Farouk, M. H. (2024). Dietary chamomile flowers extract improved performance and mitigated aflatoxin B1 toxicity in rabbits. *Journal of animal physiology and animal nutrition*, 10.1111/jpn.13974. Advance online publication
14. Ahmad, A., Tahir Ul Qamar, M., Shoukat, A., Aslam, M. M., Tariq, M., Hakimian, M., & Joyia, F. A. (2021). The effects of genotypes and media composition on callogenesis, regeneration and cell suspension culture of chamomile (*Matricaria chamomilla* L.). *PeerJ*, 9, e11464.
15. Ling, C., Zheng, L., Yu, X., Wang, H., Wang, C., Wu, H., Zhang, J., Yao, P., Tai, Y., & Yuan, Y. (2020). Cloning and functional analysis of three aphid alarm pheromone genes from German chamomile (*Matricaria chamomilla* L.). *Plant science : an international journal of experimental plant biology*, 294, 110463.
16. Viapiana, A., Struck-Lewicka, W., Konieczynski, P., Wesolowski, M., & Kaliszan, R. (2016). An Approach Based on HPLC-Fingerprint and Chemometrics to Quality Consistency Evaluation of *Matricaria chamomilla* L. Commercial Samples. *Frontiers in plant science*, 7, 1561.
17. Biltekin, S. N., Karadağ, A. E., Demirci, F., & Demirci, B. (2023). In Vitro Anti-Inflammatory and Anticancer Evaluation of *Mentha spicata* L. and *Matricaria chamomilla* L. Essential Oils. *ACS omega*, 8(19), 17143–17150.
18. Nikvarz, N., Sedighi, B., Ansari, M., Shahdizade, S., Shojaei, R., & Sharififar, F. (2024). Medicinal plants used in multiple sclerosis patients, prevalence and associated factors: a descriptive cross-sectional study. *BMC complementary medicine and therapies*, 24(1), 278.
19. Kazemian, H., Ghafourian, S., Sadeghifard, N., Houshmandfar, R., Badakhsh, B., Taji, A., Shavalipour, A., Mohebi, R., Ebrahim-Saraie, H. S., Houri, H., & Heidari, H. (2018). In vivo Antibacterial and Wound Healing Activities of Roman Chamomile (*Chamaemelum nobile*). *Infectious disorders drug targets*, 18(1), 41–45.
20. Yousefbeyk, F., Hemmati, G., Gholipour, Z., Ghasemi, S., Evazalipour, M., Schubert, C., Koohi, D. E., & Böhm, V. (2022). Phytochemical analysis, antioxidant, cytotoxic, and antimicrobial activities of golden chamomile (*Matricaria aurea* (Loefl.) Schultz Bip). *Zeitschrift fur Naturforschung. C, Journal of biosciences*, 77(7-8), 331–342.
21. Shakir, N., Anwaar, S., Jabeen, N., Anwar, T., Qureshi, H., Munazir, M., Zaman, W., & Soufan, W. (2024). Impact of NaCl stress on phytoconstituents and bioactivity of *Matricaria chamomilla*: a multi-analytical approach. *Scientific reports*, 14(1), 19717.
22. Hajaji, S., Alimi, D., Jabri, M. A., Abuseir, S., Gharbi, M., & Akkari, H. (2018). Anthelmintic activity of Tunisian chamomile (*Matricaria recutita* L.) against *Haemonchus contortus*. *Journal of helminthology*, 92(2), 168–177.
24. Bosak, Z., Irvani, M., Moghimipour, E., Haghighizadeh, M. H., Jelodarian, P., & Khazdair, M. R. (2020). Evaluation of the influence of chamomile vaginal gel on dyspareunia and sexual satisfaction in postmenopausal women: A randomized, double-blind, controlled clinical trial. *Avicenna journal of phytomedicine*, 10(5), 481–491.