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# German and Roman Chamomile

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**ABSTRACT**

*Matricaria recutita* L. (syn. *M. chamomilla* L., *Chamomilla recutita* L. Rauschert) is known as true chamomile or German chamomile and *Chamaemelum nobile* (L.) All. (syn. *Anthemis nobilis* L.) is known as Roman chamomile. The biological activity of chamomile is mainly due to the flavonoids apigenin, luteolin, quercetin, patuletin and essential oil constituents such as α-bisabolol and its oxides and azulenes. There are several chamomile chemocultivars. Chamomile has anti-inflammatory, deodorant, bacteriostatic, antimicrobial, carminative, sedative, antiseptic, anticatarrhal and spasmolytic properties. It is used to treat sleep problems. Researchers indicated that the pharmacological effect of German chamomile is mainly connected with its essential oils. Environmental conditions and stresses can alter active substances of chamomile. This review focuses on characteristics, secondary metabolites and utilization of German and Roman chamomile.

**Keywords:** *Matricaria recutita*, *Anthemis nobilis*, active substances, essential oils, secondary metabolites.

## INTRODUCTION

The Compositae family contains very useful medicinal genera such as *Matricaria*, *Achillea*, *Artemisia*, *Tussilago*, *Calendula*, *Silybum* and *Taraxacum*. The chemical composition is very different, many compounds being identified in all species (like triterpenic saponosides, alantolactones, terpenoids), but some of them being specific. These compounds are mainly responsible for the therapeutic properties of extracts from Compositae family plants (anti-inflammatory, antiseptic, antihemorrhagic, antispastic, hepatoprotective properties) (Hadaruga *et al*., 2009). There are numerous kinds of chamomile. Two most popular are Roman chamomile and German chamomile, both are from the Compositae family. German chamomile is more widely cultivated than Roman chamomile (Newall *et al.*, 1996; Blumenthal, 1998). The biological activity of chamomile is mainly due to the phenolic compounds, primarily the flavonoids apigenin, quercetin, patuletin, luteolin and their glucosides, but also to the principal components of the essential oil extracted from the flowers like α-bisabolol and its oxides and azulenes, including camazulene (Hadaruga *et al.*, 2009). Chamomile is widely used throughout the world. Its primary uses are as a sedative, anxiolytic and antispasmodic, and as a treatment for mild skin irritation and inflammation. It has widespread use as a home remedy. Animal trials suggest efficacy as a sedative, anxiolytic and antispasmodic, but clinical studies in humans are needed. Chamomile is generally safe for consumption, although patients with hypersensitivity to ragweed and other members of the Compositae family should use caution (Gardiner, 1999). Worldwide production figures are difficult to isolate owing to the small scale of the farming operation and the fact that statistics generally do not quote the figures of essential oil crops or herbs separately. In 1995, the world production was estimated to be approximately 500 tons of dried flowers per annum, from

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large-scale farming. In 1998, the world production of chamomile blue essential oil was estimated to be 1000 tons of dried flowers per annum from large-scale farming (Alberts, 2009).

## PLANT CHARACTERISTICS

*Matricaria recutita* L. (syn. *M. chamomilla* L., *Chamomilla recutita* L. Rauschert) is known as true chamomile or German chamomile. German chamomile does not have scale-like palets between the flowers of the capitulum. Capitulum is bottom cone-shaped long and hollow. This plant has white ligulate flowers, smells pleasantly of chamomile (typical chamomile smell) and is annual, grows 10 to 80 cm high. The plant has thin spindle-shaped roots. The stem is in an upright position, mostly heavily ramified, bare, round, and filled with marrow. The leaves are alternate, double to triple pinnatipartite, with narrow-linear prickly pointed sections being hardly 0.5 mm wide. The golden yellow tubular florets with five teeth are 1.5 to 2.5 mm long, ending always in a glandulous tube. The white ligulate flowers are 6 to 11 mm long and 3.5 mm wide (Franke, 2005). The name of this plant is derived from Greek word CHAMOS which means 'ground', and MELOS which means 'apple'. These words refer to slowness of growing and apple odor of fresh flowers of the chamomile (Sharrif moghaddasi, 2011).The Latin name of *recutitus* refers to the petals, meaning truncated, trimmed (Franke, 2005).

The chamomile has varieties of diploid 2n=18 and tetraploid 2n=36. The varieties of diploid have shorter growth and less brushwood height than the varieties of tetraploid (Sharrif moghaddasi, 2011).

*Chamaemelum nobile* (L.) All. (syn. *Anthemis nobilis* L.) is known as Roman chamomile. Roman chamomile has, at least in the middle part of the flower capitulum, small setiform paleae between the flowers of the flower heads. Palets blunt, with dry tips. Plant smells pleasantly, perennial and many-headed rootstock (Franke, 2005).

The glandular hairs of *M. chamomilla* are multicellular and biseriate with two basal cells, two peduncle cells and a secretory head composed of six cells. The histochemical tests show that the glands are positive for lipids, essential oils, sesquiterpene lactones and pectic like substances (Andreucci *et al*., 2008).

German chamomile requires cool, temperate conditions to grow well, and temperatures of 7 to 26 °C are required. German chamomile can survive cold winter nights as low as -12 °C. To be able to grow well vegetatively and produce an abundance of flowers, chamomile needs long summer days, full sun and high heat units to produce optimum oil yields (Alberts, 2009).

The German chamomile should be harvested when most of flowers have been grown. Early or late harvest would reduce the quality of effective materials. The flowers have maximum amounts of essential oils when ray florets are in mood; afterwards, the amount of the essential oils decreases. In mechanized harvest 400-800 Kg /ha flowering stem would be collected to produce the essential oils. Weather determines the plant would flower once or twice; that is why, the amount of the product is really variable, as it is usual in other plants. After main product harvest, the flower's shoots appear from underneath of the plant; this provides the third harvest possibility (Sharrif moghaddasi, 2011).

## ACTIVE SUBSTANCES

Active principles of German chamomile are terpenoids: α-bisabolol, α-bisabolol oxide A and B, chamazulene, sesquiterpenes; coumarins: umbelliferone; flavonoids: luteolin, apigenin, quercetin; spiroethers: en-yn dicycloether and other components such as tannins, anthemic acid, choline, polysaccharides and phytoestrogens (Newall *et al*., 1996; Bagchi *et al*., 2001; McKay and Blumberg, 2006; Karbalay-Doust *et al*., 2010).

Active substances of Roman chamomile are terpenoids: chamazulene, bisabolol; flavonoids: quercetin, apigenin, luteolin; coumarins: scopoletin-7-glucoside and other components like angelic and tiglic acid esters, anthemic acid, fatty acids and choline (Newall *et al*., 1996).

The essential oil of both German and Roman chamomile has a light blue color due to the terpenoid chamazulene. Chamazulene is about 5% of the essential oil. Bisabolol comprises 50% of German chamomile's essential oil and is a spasmolytic for intestinal smooth muscle. The flavonoids apigenin and luteolin possess anti-inflammatory, carminative, and antispasmodic properties. Apigenin binds to GABA receptors and has a mild sedative effect. The spiroethers cis- and trans-en-yn-dicycloether occur in German chamomile. They are spasmolytic, antifungal and anti-inflammatory. The coumarin umbelliferone is reported to be antispasmodic, antibacterial, and antifungal (Achterrath-Tuckermann *et al*., 1980; Forster *et al*., 1980; Gardiner, 1999).

There are several chamomile chemocultivars. Depending on the active principles, the cultivars could, for example, be specified as *M. recutita* L. cv. "rich in bisabolol" or as *M. recutita* L. cv. "rich in bisabololoxide" (Franke, 2005).

A paper revealed active substances in the aerial parts of *A. nobilis* L. These substances were isobutyl isobutanoate (4.4%), 2-methylbutyl isobutanoate (4.3%), isobutyl angelate (24.5%), 2 butenyl angelate (7.3%), 2-methylbutyl angelate (17.4%), trans-pinocarveol (4.5%), isoamyl angelate (7.6%) and estragol (5.0%) (Radulovi *et al*., 2009).

The antioxidant and antimicrobial properties of essential oils were investigated in *A. nobilis* from Italy. The results indicated that the volatile oils from Roman chamomile possessed the highest antioxidant activity (Piccaglia *et al*., 1993).

Another study revealed the main sesquiterpenes in the chamomile essential oil. Camazulene (19.9%), α-bisabolol (20.9%), A and B bisabolol-oxides (21.6% and 1.2% respectively) and β-farnesen (3.1%) were the major components. In lower concentrations were identified α- and β-caryophyllene, caryophyllene-oxide and spathulenol, and also some monoterpenes like β-phellandrene (0.8%), limonene (0.8%), β-ocymene (0.4%) and γ-terpinen (0.2%) (Costescu *et al*., 2008).

An Iranian experiment studied four cultivars of German chamomile, Bodegold (tetraploid), Germania (diploid), Bona (diploid) and Goral (tetraploid). The results showed that plant height of Goral and Bodegold were significantly higher than Germania and Bona. Goral produced the highest anthodia yield. The lowest dry anthodia yield was produced by Bona. The highest essential oils content (0.627% w/w) extracted from Bona in the first harvest but Germania produced the lowest essential oils (0.627 %w/w) at third harvest. Chamazolene content of the cultivars ranged between 9.6-14% (Azizi, 2006).

The essential oils of *M. recutita* L. cultivated in Estonia were isolated and thirty-seven components were identified. The main components were bisabolol oxide A (20–33%) and B (8–12%), bisabolon oxide A (7–14%), (E)-farnesene (4–13%), α-bisabolol (8–14%), chamazulene (5–7%), and en-yn-dicycloether (17–22%) (Orav *et al*., 2001).

Another investigation in Estonia indicated that the main constituents of the essential oils were as follows: bisabolol oxide A (39.4%), bisabolone oxide A (13.9%), (*Z*)-en-yne-dicycloether (11.5%), bisabolol oxide B (9.9%), α-bisabolol (5.6%), and chamazulene (4.7%) (Raal *et al*., 2011).

Researchers indicated that the pharmacological effect of German chamomile is mainly connected with its essential oil for its spasmolytic, antimicrobial, and disinfective properties and the constituents contain α-bisabolol, bisabolol oxides, chamazulene, and enyn-dicycloethers (Arak, 1981; Arak *et al*., 1981; Brunke *et al*., 1992; Koppel *et al*., 1993; Grgesina *et al*., 1995).

A study regarding the responses of young plants of diploid and tetraploid *M. chamomilla* cultivars to abiotic stress (within an interval from 6 h before to 54 h after spraying the leaf rosettes with aqueous CuCl2 solution) revealed that the content of herniarin in the treated plants rose approximately 3 times. The highest amounts of umbelliferone in stressed plants exceeded 9 times and 20 times those observed in control plants of the tetraploid and diploid cultivar, respectively. Due to stress the concentration of ene-yne-dicycloether in leaves decreased by more than 40% (Eliasova *et al*., 2004). An Iranian study in Isfahan indicated essential oil components of German chamomile isolated by hydrodistillation of the aerial parts of the plant. Sixty-three components were characterized, representing 86.21% of the total oil components detected. α-Bisabolol oxide A (25.01%) and α - bisabolol oxide B (9.43%) were the major constituents of the oil (Shams-Ardakani *et al*., 2006).

## UTILIZATION

Chamomile has anti-inflammatory, deodorant, bacteriostatic, antimicrobial, carminative, sedative, antiseptic, anticatarrhal and spasmolytic properties. Roman chamomile is believed to possess carminative, antiemetic, antispasmodic, and sedative properties (Newall *et al*., 1996; Blumenthal, 1998).

Advanced periodontitis is an opportunistic infection caused by various endogenous bacteria such as *Porphyromonas gingivalis*. An investigation showed the antimicrobial effects of extract and essential oil of Roman chamomile flower head against *P. gingivalis*. The antimicrobial effects were evaluated by disk diffusion method. The results indicated that the means of inhibition zone for chamomile extract and essential oil were 13.33±3.4 and 20.5±0.5 respectively (Saderi *et al*., 2005). Chamomile is used for wounds, gout, skin irritations, eczema, neuralgia, rheumatic pain, hemorrhoidsand leg ulcers, cracked nipples, chicken pox, and as a hair tint (Newall *et al*., 1996; Blumenthal, 1998).

An investigation indicated the efficacy of a topical chamomile extract on patients with weeping dermabrasions from tattoo applications. Chamomile caused a significant decrease in the weeping wound area and was effective in wound healing (Glowania *et al*., 1987).

One of the most important properties of the chamomile is to cure the peptic ulcer and gastritis easily. The chamomile reinforces the nerves and sexual powers and desires. This plant enhances the milk secretion of mothers who foster children. Using the chamomile would crush and remove the bladder rock. In order to cure eye disease, pour the chamomile in vinegar and fumigate it. The chamomile tea can alleviate the pain of a child who is teething. The chamomile is used to remove the stomach and the bowel worm (Sharrif moghaddasi, 2011).

It is used as a digestive aid to treat gastrointestinal disturbances including flatulence, motion sickness, indigestion, nausea, and vomiting. It is thought to act as a liver stimulant (Mann and Staba, 1986). After 3-4 weeks of using the chamomile cream (Kamillosan), it was found to be as effective as hydrocortisone for eczema (Aertgeerts *et al*., 1985). The essential oil of chamomile is a treatment for malaria and parasitic worm infections, colds, and flu (Nemecz, 1998). It is used to treat hysteria, nightmares, and other sleep problems (Martens, 1995). Deep sleep after 10 minutes of drinking the chamomile tea (two cups) is an effect of this plant (Gould *et al*., 1973). Active substances of German chamomile can be efficient for infant colic (Weizman *et al*., 1993).

An experiment was conducted to evaluate the effect of chamomile essential oils on four human cytochrome P450 enzymes. Crude essential oil demonstrated inhibition of all enzymes, and camazulene, cis-spiroether, and trans-spiroether showed to be potent inhibitors of these enzymes (especially CYP 1A2). Other enzymes were inhibited by α-bisabolol (Ganzera *et al*., 2006). An investigation showed the inhibitory of chamomile essential oils on the sister chromatid exchanges produced by some drugs in mouse marrow cells. Bisabolol and its oxides, camazulene, farnesene, germacrene, and other sesquiterpenes have these kinds of activities (Hernandez-Ceruelos *et al*., 2002).

*M. chamomilla* L. ethanolic extract exhibited significant antihyperglycemic effect and protected β-cells in streptozotocin-diabetic rats, in a dose-dependent manner, and diminished the hyperglycemia-related oxidative stress (Cemek *et al*., 2008). Dried flowers from Roman and German chamomile are used for herbal teas and blends with other teas. The dried flowers of Roman chamomile are used for blond dyeing (Alberts, 2009). Oral administration of *M. chamomilla* extract at 400 mg/kg can be effective in preventing gastric ulceration in mice and does not produce toxic effects in doses up to 5000 mg/kg (Karbalay-Doust and Noorafshan, 2009). Antistreptococcal and antioxidant activity of essential oil from *M. chamomilla* have been reported (Owlia, 2007).

The essential oil and methanol extract of *M. Chamomilla* L. were used to evaluate the antioxidant activity by two assays, 2,2-Diphenykpicrylhydrazyl (DPPH) free radical scavenging and β-carotene-linoleic acid. In the DPPH assay, the $IC_{50}$ value of essential oil and methanol extract were respectively 4.18 and 1.83 μg/ml. In the β-carotene linoleic acid system, oxidation was effectively inhibited by *M. Chamomilla*, the oil and methanol extract were nearly the same value. The essential oil and methanol extract were tested against bacterial and fungal strains using a broth microdilution method. The results suggest that *M. Chamomilla*, oil and methanol extract have significant antimicrobial activity (Abdoul-Latif *et al.*, 2011).

The U. S. Food and Drug Administration (FDA) have classified the oil and extract of German and Roman chamomiles as substances which named Generally Regarded As Safe (GRAS).

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