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A Review: On Enhancement Of Digestion To Prevent Bloating By Using Herbs Like Matricaria Recutita And Cynara Scolymus

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ABSTRACT: The review explores the use of *Matricaria recutita* (Chamomile) and *Cynara scolymus* (Artichoke) in enhancing digestion and preventing bloating. It covers the mechanism of digestion, from ingestion to nutrient absorption, and the role of herbs in alleviating digestive discomfort. The review also addresses the causes and symptoms of bloating, highlighting the therapeutic properties of these herbs, including their antioxidant, anti-inflammatory, and gastroprotective effects. By focusing on natural remedies, it provides insight into managing bloating and improving overall digestive health.

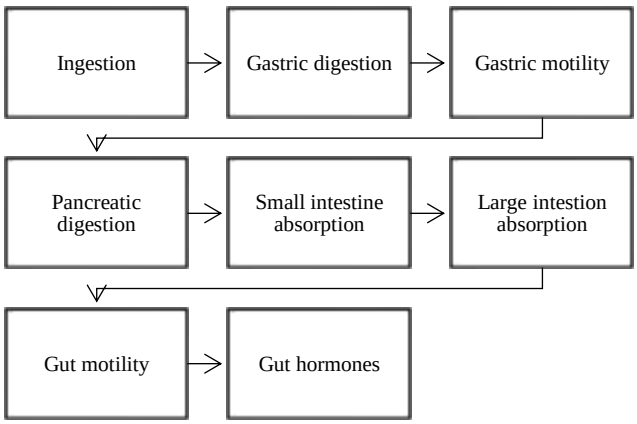
KEYWORDS: *Matricaria recutita, Cynara scolymus,* Bloating prevention, Digestion enhancement.

1. DIGESTION:

Digestion is the process by which the body breaks down food into smaller molecules that can be absorbed and utilized for energy, growth, and repair [2].
The human digestive system is examined in the context of main four-part process: oral processing to reduce particle size and produce a bolus; gastric processing to initiate chemical and enzymatic breakdown; small intestinal processing to break down macromolecules and absorb nutrients; and fermentation and water removal in the colon [1].

1.1 MECHANISM OF DIGESTION:

Here is a detailed explanation about digestion mechanism:



Ingestion: Food enters the mouth, where it is chewed and mixed with saliva containing enzymes like amylase and lipase [21].
Gastric digestion: Food enters the stomach, where it is mixed with gastric juices containing pepsin and hydrochloric acid, breaking down proteins and activating digestive enzymes.[2]
Gastric motility: The stomach muscles contract and relax, mixing food with gastric juices and breaking down larger particles.[19]
Pancreatic digestion: Pancreatic juices containing enzymes like amylase, lipase, and trypsin are released into the small intestine, further breaking down carbohydrates, fats, and proteins.[22]
Small intestine absorption: Nutrients are absorbed into the bloodstream through the walls of the small intestine via passive diffusion, facilitated diffusion, and active transport.[2]
Large intestine absorption: Water and electrolytes are absorbed in the large intestine, and the remaining waste is eliminated.[2]
Gut motility: The muscles in the small and large intestines contract and relax, moving food through the digestive system.[19]

Gut hormones: Hormones like gastrin, secretin, and cholecystokinin regulate digestion, gut motility, and pancreatic secretion.[20]

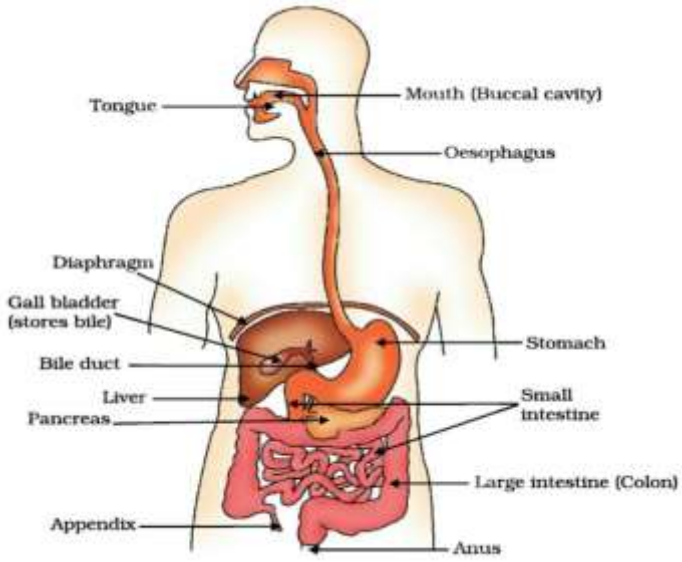


Figure .1. Human digestive system

2. EXPLANATION TO BLOATING:

Bloating is a common and uncomfortable symptom characterized by a subjective sensation of abdominal fullness or distension, often accompanied by objective abdominal distension [5]. It can manifest as a feeling of a bloated or distended abdomen, fullness in the belly, abdominal pressure or wall tension, or an abundance of gas [4]. Bloating is frequently associated with functional gastrointestinal problems and is typically not consistently reported over several months, varying in severity throughout the day [6]. It often worsens postprandially, peaking in severity towards the end of the day and improving at night, accompanied by an increase in abdominal circumference that can be objectively measured or subjectively felt [3,6].

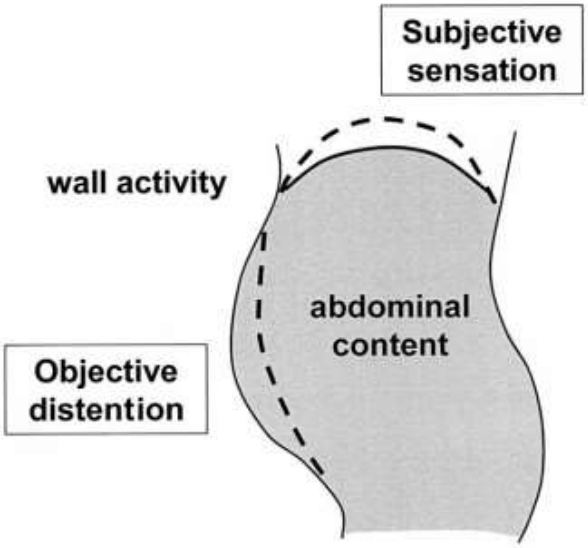


Figure 2: Bloating can be caused by subjective or objective factors such as abdominal distention, increased abdominal content, or intra-abdominal content redistribution. Changes in abdominal wall activity can induce a sensation of bloating or objective abdominal distention, even without a net increase in intra-abdominal volume [4].

2.1 SYMPTOMS OF BLOATING:

The symptoms of bloating can vary in severity and impact daily life. Here's a summary of the common symptoms:

a) **Abdominal distension:** Visible swelling of the abdomen, often accompanied by discomfort or pain.[7]
b) **Abdominal pain or cramping:** Pain or cramping in the abdominal region, which can be constant or intermittent.[8]

c) **Discomfort or tightness:** Feeling of discomfort, tightness, or heaviness in the abdominal region.[9]
d) **Gas and flatulence:** Passing gas, burping, or feeling like there is gas trapped in the abdomen.[10]
e) **Nausea and vomiting:** Feeling queasy or experiencing vomiting, especially after eating.[11]
f) **Changes in bowel movements:** Alterations in bowel habits, such as diarrhoea, constipation, or irregular bowel movements.[11]
g) **Feeling full quickly:** Feeling full or satisfied quickly, even after eating small amounts.[13]
h) **Weight gain or loss:** Unexplained weight gain or loss due to changes in eating habits or gut function.[14]
i) **Fatigue and lethargy:** Feeling tired, sluggish, or lacking energy due to discomfort or digestive issues.[15]
j) **Anxiety and depression:** Experiencing anxiety, depression, or mood swings due to the emotional impact of bloating symptoms.[16]

2.2 OCCURRENCE OF BLOATING:

Bloating is a frequent symptom that can arise from a variety of causes. Here is an overview of how bloating occurs: Bloating can be caused by various factors, including altered gut motility, such as slowed or accelerated transit, and small intestine bacterial overgrowth (SIBO), which can lead to excessive gas production [16]. Hormonal fluctuations during menstruation, menopause, or pregnancy can also contribute to bloating [11]. Additionally, age-related changes in gut function and motility can lead to bloating [17]. Dietary factors, such as consuming fermentable oligo-, di-, mono-saccharides, and polyols (FODMAPs), carbonated drinks, artificial sweeteners, lactose intolerance, fructose malabsorption, and gluten sensitivity, can also result in bloating [10]. Certain medical conditions, including irritable bowel syndrome (IBS), gastroparesis, and inflammatory bowel disease, can cause bloating, as can some medications like antidepressants, antihistamines, and painkillers [7,12,14]. Notably, bloating affects up to 30% of the general population, with higher rates in women and individuals with IBS, and can be exacerbated by stress and anxiety [13,15].

2.3 TYPES OF BLOATING:

Absolute Bloating:

Absolute bloating refers to a significant increase in abdominal girth, typically greater than 5 cm, measured at the umbilicus.[12]

These are some common causes of absolute bloating:[4]

- Severe gas production.
- Small intestine bacterial overgrowth (SIBO).
- Intestinal obstruction or pseudo-obstruction.
- Cyclic vomiting syndrome (CVS).
- Gut hypersensitivity.
- Hormonal Fluctuations

Chronic Bloating:

Chronic bloating is a persistent and recurring symptom characterized by a feeling of abdominal fullness, discomfort, and visible distension, lasting for more than 3 months. It affects approximately 15-30% of the general population and is more prevalent in women.[13]

Chronic abdominal bloating and distension are complex and often multifactorial conditions that are incompletely understood.[18]

These are the common causes of chronic bloating:[18]

- Small intestinal bacterial overgrowth.
- Lactose, fructose, and other carbohydrate intolerances.
- Celiac disease.
- Pancreatic insufficiency.
- Prior gastroesophageal surgery (e.g., fundoplication, bariatric surgery).
- Gastric outlet obstruction.
- Gastroparesis.
- Ascites.
- Gastrointestinal or gynaecologic malignancy.
- Hypothyroidism.
- Adiposity.
- Small intestine diverticulosis.
- Chronic intestinal pseudo-obstruction.

3. DETAILED PLANT STUDIES:

[3.1] *Cynara scolymus*:

[3.1.1] Taxonomical classification:[25]

Kingdom	Plantae
Phylum	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Asterales
Family	*Asteraceae*
Genes	*Cynara*
Species	Cynara cardunculus
Binominal Name	*Cynara scolymus*

[3.1.2] Vernacular names:

Sanskrit- Kantakaari, Sevtakanta, Suli.
Hindi- Kanta gobi, Hathicuk, Tiksnak.
English- Globe Artichoke, French Artichoke, Green Artichoke, Purple Artichoke.
Gujarati- Tikhado, Kanto gobi.

[3.1.3] Geographical Distributions:

Artichokes thrive in regions with specific climate and soil conditions. Adequate soil moisture is necessary for artichokes during their vegetative and reproductive growth phases [23]. The ideal temperature range for artichoke production includes cool winters with average temperatures between 32°F (0°C) and 50°F (10°C), and mild winters without extreme frosts or prolonged periods below 25°F (-4°C) [24]. Warm summers with average temperatures between 64°F (18°C) and 85°F (29°C) are also suitable [23]. Additionally, artichokes require high sunlight with at least 6 hours of direct sunlight per day, well-drained soil such as sandy loam or clay loam, and adequate water supply with an annual rainfall of at least 20 inches (500 mm) or supplemental irrigation. Regions that meet these conditions, such as the Mediterranean coastal areas, parts of California, and other similar climates, are well-suited for artichoke production. In India artichoke is found in the region of Himachal Pradesh and Kashmir [24].

Figure 3: *Cynara scolymus*

[3.1.4] Botanical Description:

The artichoke plant is a robust perennial that grows up to 3-4 feet (90-120 cm) tall and 2-3 feet (60-90 cm) wide [26]. It features a stout, fibrous stem with a woody base, supporting a rosette of large, prickly leaves [27]. These leaves are pinnately lobed, with a distinctive grey-green colour and a fuzzy texture [28]. As the plant matures, it produces large, showy flowers in shades of purple, pink, or white, which are actually immature fruits [29]. Upon closer inspection, the artichoke flower reveals itself to be a composite of hundreds of tiny florets, arranged in a spiral pattern [30]. The fruit is a modified flower head, comprising edible bracts (scales) that protect the tender inner florets, making it a unique and delicious culinary delight [31].

Bark: *Cynara scolymus*, the artichoke plant, is known for its thick and fibrous bark [26]. The cylindrical, greyish-brown, woody stem bark has a rough texture and a greyish-brown tint [26]. The bark of the plant matures, developing deep longitudinal ridges and furrows that are more angular and fractured [27]. A unique pattern of lenticels, which are tiny, elevated pores that permit gas exchange, is also visible in the bark [28]. Histologically speaking, the artichoke plant's bark is made up of three layers: cork cells on the outside, phelloderm cells in the middle, and phloem tissue on the outside [30]. The phloem tissue is in charge of delivering nutrients and sugars generated during photosynthesis to the other parts of the plant [32].

Leaves: The artichoke plant (*Cynara scolymus*) has enormous, beautiful, deeply lobed leaves that have a fuzzy feel and a distinctive grey-green hue [34]. At the base of the plant, they are grouped in a rosette pattern, with each leaf having a maximum length of two feet (60 cm) and a maximum width of one foot (30 cm) [26]. With three to five major lobes and many tiny lobules, the leaves are pinnately lobed, giving them a characteristic jagged look. The surface of the leaf has a woolly appearance due to the thin, white hairs covering it [27]. Additionally, the leaves have veins that are somewhat elevated above the leaf surface and a noticeable midrib [30]. The artichoke plant's leaves

have a thick cuticle, a layer of epidermal cells, and a mesophyll layer made up of palisade and spongy parenchyma cells [32]. The leaves also include microscopic, dispersed trichomes, which are considered to add to their fuzzy appearance [29].

Flower: The artichoke plant (*Cynara scolymus*) produces huge, spectacular blooms that are grouped in a composite flower head [33]. Each flower head is up to 7 inches (18 cm) in diameter and contains hundreds of tiny florets [26]. The outer florets, or bracts, are big and petal-like, with purple, pink, or white colours [27]. The inner florets, or disc florets, are tiny and tubular, with a yellow or purple tint [28]. The bracts form a compact, spherical shape by covering one another in a spiral fashion [30]. The bracts around the core cluster in which the disc florets are organized [32]. The bracts have no stamens and a modified corolla, but each disc floret has five stamens and a five-lobed corolla [29]. Because the blooms have both male and female reproductive organs, they are hermaphrodites [34]. The stigma is situated near the tip of the style, while the anthers are grouped at the base of the corolla [35].

Fruits: The artichoke plant's fruit is a modified flower head called a cypsela [33]. Each cypsela is a solitary fruit with one seed [26]. The flower head's bracts (modified leaves) enclose the cypselae, which are grouped in a tight, spherical arrangement [27]. Cypselae are tiny, cylindrical, and greyish-brown in colour, measuring around 1-2 cm long and 0.5-1 cm wide [28]. They have a smooth surface and a sharp tip [30]. The seed of the cypsela is tiny, white, and greasy [32].

Seeds: The seeds of the *Cynara scolymus* are tiny, white, and oily, measuring around 2-3 mm long and 1-2 mm wide [33]. They are enclosed within the artichoke plant's separate fruits, known as cypselae [26]. The seeds have a smooth surface and a pointed apex, with a little beak-like feature on the tip [27]. They are endospermic, which means that a huge endosperm surrounds the embryo [28]. The embryo is tiny, made up of two cotyledons and a radicle [30]. The cotyledons are leaf-like structures that feed nutrition to the developing seedling, whilst the radicle serves as the plant's major root [32]. The seeds are distributed by wind when the cypselae disarticulate from the receptacle and release the seeds [29].

[3.1.5] Phytochemical profile:

Phytochemicals are chemical compounds derived from plants. Phytochemicals (from Greek Phyto, meaning "plant") are compounds generated by plants during primary or secondary metabolism. Biologically active in plants, they aid in growth and protection against rivals, diseases, and predators.

Plant parts	Chemical constituents [36,37]
Leaves	Cynarin, Chlorogenic acid, Caffeic acid, Sesquiterpene lactones, Ferulic acid, Sesquiterpene lactones.
Flowers	Anthocyanins, α-Tocopherol, β-Carotene, Linalool, Pinene, Quercetin, Kaempferol, Apigenin, Luteolin.
Seeds	Oleic acid, Linoleic acid, Palmitic acid, β-Sitosterol, Stigmasterol.
Stem	Cynarinine, Scolimoside, Phenolic acids, Sesquiterpene lactones, Phytosterols.

[3.1.6] Pharmacological Profile of *Cynara scolymus*:

Antioxidant: Artichoke extracts have antioxidant properties, protecting against oxidative stress and cell damage. [38, 39]

Anti-inflammatory: Artichoke extracts have anti-inflammatory effects, inhibiting pro-inflammatory enzymes and cytokines. [40, 41]

Antimicrobial: Artichoke extracts have antimicrobial activity against various microorganisms, including bacteria, fungi, and viruses. [42, 43]

Hepatoprotective: Artichoke extracts have hepatoprotective effects, protecting against liver damage and toxicity. [44, 45]

Cardiovascular: Artichoke extracts have cardiovascular protective effects, improving lipid profiles and reducing blood pressure. [46, 47]

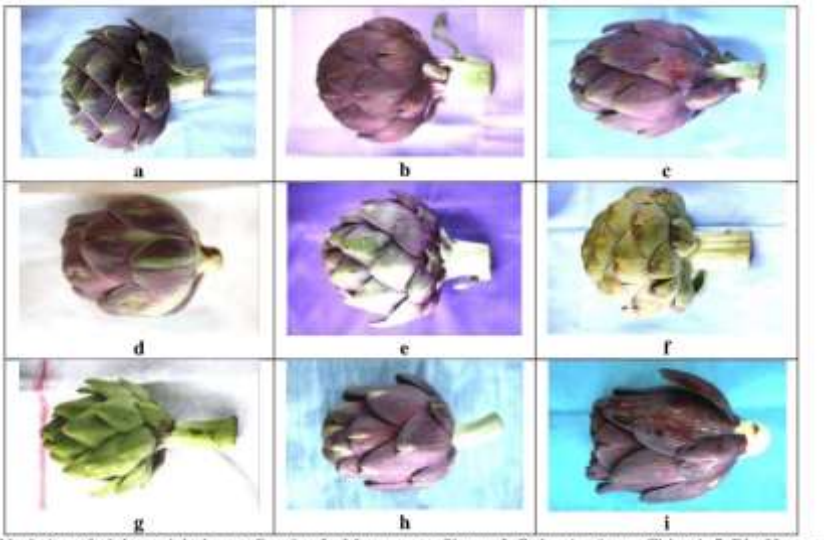
Antidiabetic: Artichoke extracts have antidiabetic effects, improving insulin sensitivity and glucose metabolism. [48, 49]

Neuroprotective: Artichoke extracts have neuroprotective effects, protecting against neurodegenerative diseases and cognitive impairment. [50, 51]

Anti-cancer: Artichoke extracts have anti-cancer properties, inhibiting cancer cell growth and inducing apoptosis. [52, 53]

Gastroprotective: Artichoke extracts have gastroprotective effects, protecting against gastric ulcers and inflammation. [54, 36]

Immunomodulatory: Artichoke extracts have immunomodulatory effects, modulating immune responses and cytokine production. [52, 54]



2. Varieties of globe artichoke: **a**. Omaha; **b**. Mercury; **c**. Siena; **d**. Baby Anzio; **e**. Chianti; **f**. Big Heart;

Figure 4: Varieties of globe artichoke

[3.2] ***Matricaria recutita:***

[3.2.1] Taxonomical classification:

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Asterales.
Family	*Asteraceae.*
Genes	*Matricaria*
Species	chamomilla
Binominal name	*Matricaria recutita*

[3.2.2] Vernacular names:

Sanskrit- Karpurapushpa**,** Kamalika.
Hindi- Babunabh, Kamal-phool.
English- German chamomile, Wild chamomile, Hungarian chamomile, Single chamomile, True chamomile.
Gujarati- Babuna.

[3.2.3] Geographical Distributions:

The genus Matricaria comprises five species, which are widely dispersed across various regions, including Europe, northern Africa, Macaronesia, western, southwestern, and central Asia, as well as western North America [55]. These species have adapted to diverse environments and are commonly found in disturbed areas, grasslands, roadsides, railroads, and vacant lots [55]. Notably, two species within the genus, M. aurea and M. chamomilla, have been recorded in India, showcasing the genus's extensive geographical reach and adaptability [55]. German chamomile, a versatile annual herb, has a vast global presence [56]. Furthermore, its cultivation has expanded to numerous regions, including Eastern Europe, Asia, and the Americas, highlighting its significance as a widely sought-after crop [56].

Figure 5: *Matricaria recutita*

[3.2.4] Botanical description:

German chamomile is an annual herb that typically grows to be 10-60 cm tall, with some specimens reaching up to 80 cm in height [55]. It has a slender taproot and upright, branching stems [55]. The leaves are arranged alternately and are made up of multiple leaflets [55]. The plant's flowers form a distinctive head, known as a capitulum, with

an outer ring of ray florets and an inner disc of florets, characteristic of the Asteraceae family [57]. Each head is solitary, terminal, and radiate, measuring 1-3 cm in diameter, and is supported by a 3-6 cm long peduncle [57]. A cup-shaped involucre surrounds the base of each head. The plant produces small, cylindrical fruits called achenes, which are 0.8-1 mm long, 0.5 mm wide, and feature 3 abaxial and 2 marginal thin ribs [55].

Stems: The stem of German chamomile is erect, branched, and smooth, with a slender and cylindrical shape that is slightly ribbed. It has a green or glabrous appearance, measuring 1-3 mm in diameter [57]. The internodes are 1-5 cm long, with a slightly woody base, while the nodes are swollen and have a slight pubescence [57].

Flower: The flower head of German chamomile is solitary, terminal, and daisy-like, measuring 10-30 mm in diameter [59,60]. It consists of 10-20 white ray florets, each 5-10 mm long, and numerous yellow disc florets, each 2-3 mm long [61]. The ray florets are ligulate and ovate-lanceolate in shape, with entire and slightly toothed margins [62]. The disc florets are tubular and 5-lobed, with sagittate anther bases [63]. The reproductive structures comprise an androecium with 5 syngenesious stamens, a 2-carpellate and syncarpous gynoecium, and a bifid style [64].

Figure 6: Botanical representation of *Matricaria recutita.*

Roots: The root system of German chamomile consists of a taproot with secondary roots [59]. The taproot is fusiform in shape, tapering towards the apex, and measures 5-20 cm in length and 0.5-2 cm in thickness [60,62]. It has a white or yellowish color and a fibrous, slightly woody texture [61,63]. The primary root is 5-15 cm long and 0.5-1.5 cm in diameter, with a surface covered in fine hairs [64,65]. The secondary roots are numerous, measuring 2-10 cm in length and 0.2-0.5 cm in diameter, and spread horizontally [66,67]. The root system also features fine, white, and soft root hairs, which play a crucial role in absorbing water and nutrients [68,59].

Fruits: The fruits of German chamomile are achenes, characterized by a cylindrical shape with a slight curvature [59,60]. They measure 1-2 mm in length and 0.5-1 mm in width, with a brown or grayish-brown color [61,62]. The surface is smooth and glabrous, and each achene is attached to the receptacle by a short stalk [63,64]. Numerous achenes are arranged in a dense cluster [65].

Seeds: The seeds of German chamomile are characterized by their ellipsoidal shape, slightly flattened, measuring 0.5-1 mm in length and 0.2-0.5 mm in width [59,60]. They have a white or cream-colored appearance, with a smooth and glabrous surface [61,62]. Each seed contains a small, straight embryo surrounded by endosperm, and features a thin, transparent Testa and a small, inconspicuous hilum [63,63,65,66].

[3.2.5] Phytochemical profile:

Phytochemicals are chemical compounds derived from plants. Phytochemicals (from Greek Phyto, meaning "plant") are compounds generated by plants during primary or secondary metabolism. Biologically active in plants, they aid in growth and protection against rivals, diseases, and predators.

Plant parts	Chemical constituents[69,70,71]
Stem	Apigenin, Luteolin, Quercetin, Kaempferol, Isorhapontigenin, Chamazulene, Bisabolol.
Flower	Bisabolol oxides, Quercetin, Patuletin, Umbelliferon, Scopoletin, Flavonoid glycosides, Coumarins
Root	Volatile oils, Phenolic acids, Sesquiterpenes, Glycosides, Coumarins, Terpenoids, Flavonoids.
Fruit	Hydroxycinnamic acid derivatives, Saponins, Terpenoids, Flavonoids, Sesquiterpenes, Glycosides, Coumarins.
Seeds	Polyacetylenes, linoleic acid, oleic acid, cinnamic acid, ferulic acid, chamomilline, Sesquiterpenes.

[3.2.6] Pharmacological Profile of *Matricaria recutita*:

Antifungal Properties: Chamomile plants part and its extract have been documented for the antifungal properties, indicating that they are highly effective against a wide range of fungal strains.[72]

Antidiabetic Activity: M. chamomilla extract, isolated apigenin, apigenin-7-O-glucoside, and cis and trans-2-hydroxy-4-methoxycinnamic acid glucosides were tested for their ability to inhibit beta-amylase and maltase.[73]
Anti-Tumour Activity: The anti-tumour effects of M. chamomilla extracts and essential oils on a variety of cancer cell lines have also been investigated. Evaluation which proves that chamomile EO have an anticancer activity on the human breast carcinoma cell line.[74]
Anti-inflammatory Activity: German chamomile has anti-inflammatory properties, which can be attributed to the presence of sesquiterpenes, such as chamazulene and Bisabolol [75]. These compounds inhibit the production of pro-inflammatory cytokines and enzymes, leading to a reduction in inflammation.[75]
Anxiolytic and Sedative Effects: German chamomile has been shown to possess anxiolytic and sedative effects, which can be attributed to the presence of apigenin, luteolin, and other flavonoids [76]. The flavonoids interact with the GABA receptor, leading to a calming effect on the nervous system [77].
Wound Healing and Skin Soothing Effects: German chamomile has wound healing and skin soothing effects, which can be attributed to the presence of sesquiterpenes, such as chamazulene and Bisabolol [78]. These compounds promote tissue regeneration and reduce inflammation, leading to faster wound healing [78] .
Gastroprotective and Anti-Ulcerogenic Effects: German chamomile has gastroprotective and anti-ulcerogenic effects, which can be attributed to the presence of flavonoids and sesquiterpenes [79]. These compounds reduce inflammation and promote tissue regeneration in the gastrointestinal tract, leading to a reduction in ulcers [80] .

3. CONCLUSION: In conclusion, the review highlights the potential of *Matricaria recutita* and *Cynara scolymus* in enhancing digestion and preventing bloating through their phytochemical properties. Both herbs exhibit significant pharmacological activities, such as anti-inflammatory, antioxidant, and gastroprotective effects, making them valuable for addressing common digestive issues. Their widespread traditional use, supported by scientific evidence, suggests they could offer effective natural remedies for bloating and related gastrointestinal symptoms.

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