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Review Article

Chemical composition, biological activities, and nutritional application of *Asteraceae* family herbs: A systematic review

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ABSTRACT

Medicinal herbs, including the Asteraceae family (AF), have different antimicrobial and therapeutic effects. Therefore, they can be used as health factors in the food and medicinal industries. In this systematic review, the essential information was collected from the relevant databases, *e.g.*, PubMed, Science Direct, and Google Scholar based on medicinal herbs, AF, essential oil, antimicrobial, antioxidant, therapeutic effect, and COVID-19 keywords. AF can be used as safe preservatives and food additives with a specific amount of consumption in the food industry thanks to their good flavor, antioxidant and antimicrobial effect. Due to their therapeutic effects, they can improve the health role of food. AF herbs contain important bioactive compounds, but not all of them can be used as medicine and food supplements since yarrow, chamomile, and artichoke exhibit toxic effects in high dosage, therefore, the consumption of these herbs should be considered to not endanger the health of the consumer.

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1. Introduction

Today, the production and consumption of vegetables and fruits are rising due to consumer demand to eat healthy foods. Among vegetables, herbs are considered healthy food due to the presence of effective therapeutic and nutritional compounds. The edible parts of medicinal herbs contain a variety of bioactive compounds such as vitamins, minerals, fiber, inulin, and polyphenols, which all are liable to increase the quality of food. All of these reasons lead to the use of medicinal herbs as a source of healthy products for the improvement of functional foods (Frutos et al., 2019). Within the past few decades, a large number of medicinal and herbal drugs have attracted popularity from the scientific community regarding their broad valuable pharmaceutical, therapeutic features, etc. (Mohammadhosseini et al., 2021; Vignesh et al., 2021). Thus, to create a healthy diet, one should look for natural antimicrobial and antioxidant compounds in plants such as the Asteraceae family. The growth and multiplication of microbial food spoilage reduce the maintainability and quality of food products and also endangers consumers' health. To deal with this situation, various types of chemical food preservatives and antibiotics are used in the food industry, which has caused antimicrobial resistance that causes microbial food spoilage. On the other hand, the negative effects of long-term usage of chemical preservatives on the human gastrointestinal tract are not hidden from anyone. Traditional herbs have been used in the treatment of disease because of their useful properties. All of these factors have led humans to use medicinal herbs as natural preservatives with many therapeutic effects in medicine and food. Extensive research has proven medicinal herbs' antimicrobial, antiviral, and antioxidant properties (Pesewu et al., 2008; Nasirpour et al., 2014). Also, more than half (80%) of the world's society in developing regions

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often uses herbs for main health care (Khushtar et al., 2018). A lot of comprehensive research has shown the antimicrobial, antiviral, and antioxidant effects of herbs (Aali et al., 2017; Kazeminia et al., 2017; Mahmoudi et al., 2017a, 2017b; Ghara et al., 2018; Mehrabi et al., 2021). The Asteraceae family is one of the most common groups of herbs used in traditional medicine and food. The species *Achillea millefolium* L., *Chamaemelum nobile* L., *Arctium lappa* L., *Bellis perennis* L., *Artemisia annua* L., *Calendula officinalis* L., *Arnica montana* L., *Artemisia aucheri* L., *Artemisia persica* L., *Eupatorium cannabinum* L., *Matricaria chamomilla* L., *Cichorium intybus* L., *Taraxacum officinale* L., *Polygonum bistorta* L., *Helichrysum stoechas* L., and *Cynara scolymus* L. have grown in different parts of the world (Garcia-Oliveira et al., 2021). The use of medicinal herbs in the human diet is due to nutritional and therapeutic effects that originate from antimicrobial, antioxidant, and other beneficial effects on human health. Asteraceae family herbs are among the medicinal herbs with these properties that are greatly used in the medicinal and food industries with their various effective compounds (Azizi et al., 2010). Also, the urgent human need to use economical, available, effective, and safe preservatives have led to the use of Asteraceae family herbs that contain valuable, available, and economical compounds (Karimipour Saryazdi et al., 2020). On the other hand, the use of medicinal herbs as a food additive is being forgotten and this science must be protected so we can use it in the future (Mir et al., 2021). As a result, in the current study, our aim was to demonstrate the significance of using selected herbs of the Asteraceae family in the medicinal and food industries. This article distinguishes their current uses and suitability for the development of functional food industrial applications. The essential oils, phenolic compounds, and sesquiterpene lactones are some of the major constituents related to various bioactivities. Thus, they could be interested in the development of new functional foods.

2. Experimental

2.1. General instrumentation

There are several species of herbs in the Asteraceae family. Thus, species were selected for a more detailed study that their application in food and traditional medicine has been published in prestigious journals. In particular, this review has focused on the following species: *Achillea millefolium* L., *Arctium lappa* L., *Artemisia annua* L., *Artemisia aucheri* L., *Artemisia persica* L., *Cichorium intybus* L., *Cynara scolymus* L., *Matricaria chamomilla* L., and *Polygonum bistorta* L. In this systematic review, we examined the benefits of using selected herbs of the Asteraceae family as a safe functional compound in the food industry and pharmacology. Findings of the research were obtained by reviewing other studies in the world that have been published in reputable journals about Asteraceae family herbs. The keywords including medicinal herbs, Asteraceae family, essential oil, antimicrobial, antioxidant, therapeutic effect, and COVID-19 were searched in the PubMed, Science Direct, and Google Scholar databases from 2000 to 2021. Inclusion and exclusion standards of the studied articles: Articles that examined the therapeutic, antimicrobial, antioxidant effects, and effective compounds in Asteraceae family herbs were included in this study. Articles that were outside our goal, and also to avoid duplicating related articles that had an older publication year were excluded.

2.2. Findings

Based on the data in Fig. 1, out of 1049 articles were found by searching scientific databases, including Science Direct, Google Scholar, and PubMed. 670 related articles were found, and 454 research pieces were identified and selected according to the purpose of the study. The reason for deleting the rest of the articles was non-compliance with the purpose of the research. Finally, 297 articles were included in the study due to the removal of old and similar articles. Then, Asteraceae family herbs were classified according to their therapeutic effect, antimicrobial effect, major habitats, effective compounds, and how they work. Each herb of this family has its ideal and unique specialties. In this section, scientific studies evaluating the beneficial attributes of the selected herbs will be described. *Achillea millefolium* L.: There are 110 to 140 herbaceous species (Azizi et al., 2010). It is hairy, green, compact and the height of the stem is 20 to 90 cm (Rehuš and Neugebauerová 2011). *Achillea millefolium* usage in the nutrition science and food industry: Due to its antibacterial and aromatic effect, it can be used as a natural seasoning (Baggio et al., 2002; Cavalcanti et al., 2006) and preservative in the food industry as well as storage pest control (Darnahal et al., 2020). *Arctium lappa* L. or burdock: A biennial herbaceous herb with a thick, snake-like branching stem covered with coarse hairs. The leaves are large and broad, drooping on the stem and the root is long and spindly (Zargari 1991). *Arctium lappa* or burdock usage in the nutrition science and food industry: In Chinese societies, its consumption is recommended as a healthy and nutritious food (Chan et al., 2011). Eating its root at night helps maintain a healthy gut microflora. As a prebiotic, the inulin in it stimulates the growth of bifid bacteria and lactobacilli (Zargari 1991; Milani et al., 2012; Rasouli et al., 2017). New pectin, abbreviated to ALP-2, consisting of galacturonic acid, glucuronic acid, rhamnose, galactose, glucose, arabinose, and xylose was extracted from it, which can be used as an active component in a functional food or as a therapeutic agent in relieving constipation. The pectin in *Arctium lappa* reduces the contact of lipids with lipase by increasing the viscosity of the contents of the gastrointestinal tract, thus preventing lipolysis, and as a prebiotic by regulating the gut microbial, is effective in maintaining the health of the gastrointestinal tract (Li et al., 2019). Another pectin, abbreviated to ASALP, consisting of rhamnose, arabinose, xylose, glucose, and galactose, was obtained from *Arctium lappa*, which has a beneficial effect on the gut microbial flora (Zhang al., 2020a). *Artemisia annua* L. or sweet wormwood: A yellow

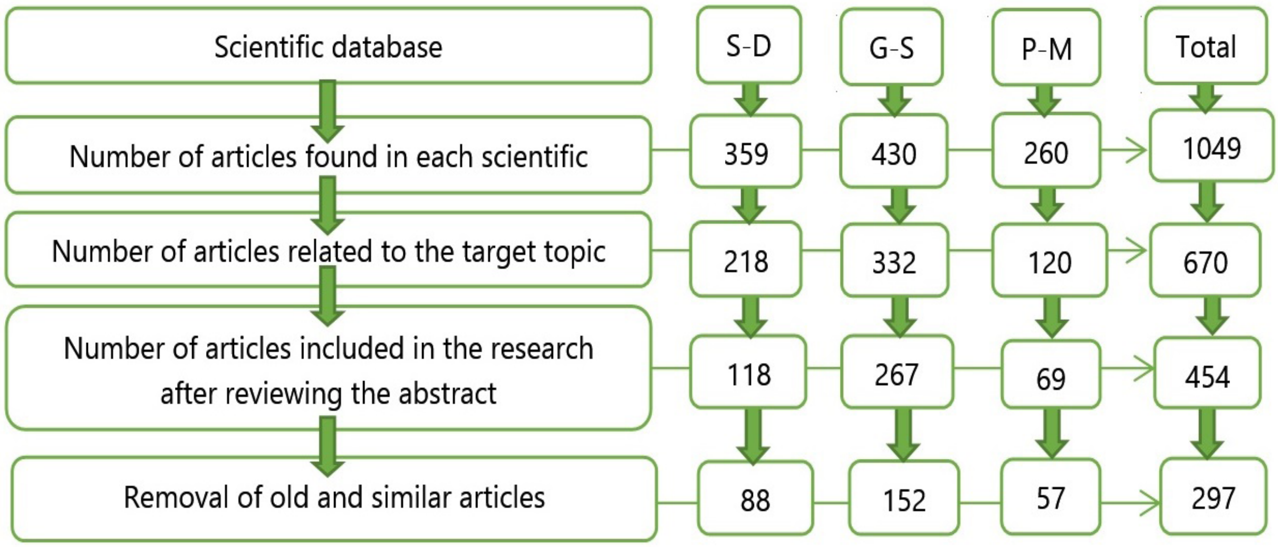


Fig. 1. Steps for selecting and entering studies into research by searching science databases including Science Direct (S-D), Google Scholar (G-S), and PubMed (P-M).

herbaceous herb with a camphor-like odor that is spread all over the world (Zheng 1994). *Artemisia annua* usage in the nutrition science and food industry: It is traditionally used in the form of herbal tea (Lang et al., 2019). It is used as a seasoning along with some spicy aromatic vegetables such as coriander (Fu et al., 2020). It has antioxidant (Juteau et al., 2002), antifungal (Firouzbakhsh et al., 2014), and anti-insect effects (Tripathi et al., 2000; Zhang et al., 2008 ;Hosseinpour et al., 2011), so it can be considered as a preservative in edible coatings and a harmless compound for the environment to control grain storage pests (Oftadeh et al., 2020). *Artemisia aucheri* L.: It is a shrub herb with a height of 25 to 50 cm that grows where annual rainfall is more than 300 mm, which is why it forms the predominant vegetation of steppe and semi-steppe areas. Studies on this herb have shown the existence of flavonoids, saponins, lipids, and bitter compounds in different sections of the herb (Jafari Dinani et al., 2010). *Artemisia aucheri* usage in the nutrition science and food industry: The repellent effect of *Artemisia aucheri* on grain storage pests has been confirmed and due to its antioxidant effects, it can be used as a preservative in the food industry. Contains effective compounds to inhibit the expression of genes involved in biofilm formation in methicillin-resistant *Staphylococcus aureus* (MRSA) (Ramak and Sefidkon 2008). *Artemisia persica* L.: A herbaceous, perennial, and self-seeding herb with compressed leaves, stems with a wooden base covered with fibers, and 90 to 120 cm high (Choi et al., 2013). *Artemisia persica* usage in the nutrition science and food industry: It is used in aromatizing all kinds of food and beverages. It is anti-fungal and anti-bacterial. Its phenolic compounds, such as flavonoids and proanthocyanidins, have antioxidant functions that make *Artemisia* a natural preservative (Choi et al., 2002; Mehani et al., 2018). The antibacterial effect of *Artemisia persica* is due to the combination of sesquiterpene and lactone, and its anti-insect effect is due to the combination of 1-8-cineol and α-thujone (Höld et al., 2000; Aggarwal et al., 2001). Using *Artemisia persica* is recommended to control grain storage pests and antifungal coatings in aquaculture (Sonker et al., 2015). *Cichorium intybus* L. or chicory: has a relatively thick and vertical root, the stem carries a large number of blue flowers and the lower leaves are cut and the upper leaves are simple and alternate and can grow annually, biennially, and perennially (Mozaffarian 1996). *Cichorium intybus* usage in the nutrition science and food industry: *Cichorium intybus* seed extract has more antioxidant effect than other organs (roots and leaves) because it has the highest number of polyphenolic compounds (Milala et al., 2009). Inulin in *Cichorium intybus* as a prebiotic in symbiotic foods (probiotics along with prebiotics) increases the growth and resistance of probiotic microbes in the acidic environment of the gastrointestinal tract and is also effective in improving gastrointestinal diseases and protecting polyphenols (Michalska et al., 2019). Chicory contains vitamin C and malic acid. The green leaves of chicory are a basic compound in salads and favorite addition to sandwiches. The roots are used as a substitute for decaffeinated coffee. Chicory extract is added to beverages to improve the taste (Sánchez-Mata et al., 2012; Nwafor et al., 2017; Jafarinia and Jafarinia 2019). *Cynara scolymus* L. or artichoke: Roots and aerial parts of artichoke can be used (Ahmadi Mahmoodabadi et al., 2006). It is cultivated in most regions of the world due to its useful nutritional and pharmaceutical effects (Gebhardt 1997). *Cynara scolymus* usage in the nutrition science and food industry: artichoke is full of minerals, phenolic compounds, fiber, and inulin, so it has found wide usage in the nutrition science and food industry (Ruiz-Cano et al., 2015). The stem of this herb has daily food intake and medicinal uses in different regions of Iran (Jamshidzadeh et al., 2005; Coruh et al., 2007).

In the past decades, its use in the food industry was limited to the manufacture of coffee-like beverages due to its bitter taste (Abbasi and Farzanmehr 2009), but today inulin is used as a substitute for dietary fat and sugar (Kaur and Gupta 2002). Adding artichoke to yogurt also helps the growth of probiotics such as *Lactobacillus acidophilus* and *Bifidobacterium lactis* (Ehsani et al., 2018). Artichoke extract can be used alone or in combination with other herbs to make herbal tea. The polyphenolic compounds in it exhibit potential antioxidant properties (Ben Salem et al., 2017). Artichoke flour has nutritional and functional effects. Adding 6% of artichoke flour to wheat flour improves the sensory and physicochemical properties of bread, but in higher amounts leads to hardening of the texture and chewing, and has a negative effect on color, taste, and overall appearance (Frutos et al., 2008). Artichoke, as a suitable alternative to common hops in the beverage industry, has physicochemical properties and satisfactory sensory acceptance (Schuina et al., 2019).

Chamomile (*Matricaria chamomilla* L. or *German chamomile* L.): Chamomile species are somewhat similar in appearance and have more or fewer differences, including Shirazi chamomile, aromatic chamomile, wild chamomile (*Tripleurospermum disciforme* L.), Roman chamomile (*Anthemis nobilis* L.) and feverfew (*Tanacetum parthenium* L.) (Zahra et al., 2013).

Chamomile usage in the nutrition science and food industry: It is the most widely used herbal tea in the world. The reason for this widespread acceptance is its antioxidant, analgesic, and anti-cancer effects (Sotiropoulou et al., 2020). Its flavonoid compounds play an important role in creating antioxidant activity which is used as a preservative in the food industry (Asgary et al., 2002; McKay and Blumberg 2006). It is also recommended as a preservative in pasteurized milk with useful properties of functional food (Ahmadi et al., 2020). Chamomile can be used to increase the maintainability of dairy products, particularly fermented products (Caleja et al., 2015). Fermentation of chamomile by *Lactobacillus plantarum* can help develop its antioxidant and anti-cancer function (Park et al., 2017).

Polygonum bistorta L.: A perennial herb with 300 species with a height of one meter. But its height is variable and, in some cases, it becomes very short and reaches up to 20 cm (Özbay and Alim 2009). This herb is called Snakeroot in English, Bijband in Hindi, and Anjbar in Urdu (Khushtar et al., 2018).

Polygonum bistorta usage in the nutrition science and food industry: *Polygonum bistorta* root is used as a powder in soup and bread production (Grieve and Herbal 1984). The antimicrobial effect of *Polygonum bistorta* is related to gallic acid and benzenoid which inhibits the growth of pathogenic microbes such as MRSA (Lone et al., 2015; Rajput and Agnihotri 2020). Due to its widespread antioxidant and antimicrobial effects, it is recommended to use it as a safe preservative in food (Demiray et al., 2009).

Asteraceae family herbs were classified based on their therapeutic effect, antimicrobial effect, major compounds, and major distribution in Table 1, adverse effects in Table 2, and the impact of effective compounds in Table 3 and Fig. 2. The Asteraceae family contains several bioactive compounds that are responsible for their biological attributes and their use in traditional medicine. These herbs are presently used in various products, but understanding their mechanism of action and the ingredients involved in bioactive attributes can lead to the development of new industrial applications. Thus, in the Fig. 3. the chemical structure of the main components of the Asteraceae family is listed.

According to the information obtained from Table 1, all Asteraceae family herbs have antimicrobial, antioxidant, anti-cancer, remedy effects, and improve digestive disorders. Thus, herbs from the Asteraceae family can be used in traditional and modern medicine. Tea prepared from *Matricaria chamomilla* L. and *Artemisia persica* L. is recommended for pain relief. To reduce the volume of body mass, the use of *Artemisia aucheri*, *Arctium lappa*, *Polygonum bistorta*, *Artemisia annua*, and *Cynara scolymus* is recommended. In the treatment of diabetes, *Cichorium intybus*, chamomile, the use of *Arctium lappa*, *Polygonum bistorta*, *Artemisia annua*, and *Cynara scolymus* are effective. To improves inflammation, the use of *Achillea millefolium* L., *Arctium lappa* L., *Artemisia annua* L., *Artemisia aucheri* L., *Artemisia persica* L., *Matricaria chamomilla* L., and *Polygonum bistorta* L. are effective. To treatment of gastric ulcer, the use of *Polygonum bistorta* L. and *Arctium lappa* L. are effective. To improve asthma, the use of *Artemisia annua* L. and *Artemisia persica* L. are effective. To prevent flatulence, the use of *Matricaria chamomilla* L., *Artemisia persica* L., and *Achillea millefolium* L. are effective. To heal the wound, the use of *Polygonum bistorta* L., *Matricaria chamomilla* L., *Artemisia annua* L., *Arctium lappa* L., and *Achillea millefolium* L. are effective. To treatment of atherosclerosis, the use of *Cynara scolymus* L., *Artemisia persica* L., and *Arctium lappa* L. are effective. Improve kidney function, the use of *Polygonum bistorta* L., *Cynara scolymus* L., and *Cichorium intybus* L. are effective. To hair growth stimulation and anti-dandruff, the use of *Achillea millefolium* L. and *Arctium lappa* L. are effective. To relaxation, the use of *Artemisia persica* L., *Artemisia aucheri* L., *Cichorium intybus* L., chamomile, and *Artemisia annua* L. are effective. *Cichorium intybus* L., chamomile, *Arctium lappa* L., *Polygonum bistorta* L., and *Artemisia annua* L. have antiviral activity, which *Artemisia annua* L. has an inhibitory effect on a wider range of viruses.

3. Results and Discussion

The Asteraceae family is widely distributed worldwide in a variety of ecological habitats, except Antarctica. They are found inwoodland habitats and highland pastures, but they are much less common in tropical regions. The shape of the leaves is very different: while most of them are large, some are small and prickly, and some are nonexistent, and their function is taken over by the green stem. Most leaves are covered with hairs of any length and color. Most of them have a flat bunch of small flowers of different colors (Bohm and Stuessy 2001). A wide range of phenolic compounds are found, including kaempferol, chicoric acid, and its derivatives, luteolin and its derivatives, quercetin, and

Table 1
Therapeutic and antimicrobial effects of *Asteraceae* family herbs.

Herb	Application/Compounds/ Distribution	Effect/Ingredients/Location
Achillea millefolium L.	Therapeutic effect	Contraception (Innocenti et al., 2005), facilitates labor, reduces cervical adhesion, controls uterine infection (Zakeri et al., 2019), reduces the premenstrual syndrome (Kalhor et al., 2019), treatment of infectious diseases, treatment of liver disease, accelerates blood clotting, wounds healing, relieves muscle cramps during menstruation, treatment of colds (Rehuš and Neugebauerová 2011), antioxidants (Mazaraie and Fahmideh 2020), inhibition of cancer cell production (Soltani and Darbemamieh 2020; Khosravi et al., 2021), improvement of gallbladder function (Bozin et al., 2008), anti-inflammatory, antipyretic (Hegazy et al., 2008; Saeidnia et al., 2011), antiparasitic (Sozangar et al., 2012), protection of red and white blood cells against free radicals (Karaalp et al., 2009), treatment of respiratory problems, treatment of oily hair, anti-dandruff, hair growth stimulation, local healing of the skin (Van Wyk and Wink 2018), anti-flatulence, improvement of digestive disorders (Baggio et al., 2002; Cavalcanti et al., 2006), and use as a mouthwash due to its effect killing of opportunistic bacteria in the mouth (Atai et al., 2006).
	Antimicrobial effect	*Bacillus* (*subtilis, cereus,* and *licheniformis*), *Staphylococcus* (*saprophyticus*, *aureus*, and *epidermidis*), *Streptococcus* (*pyogenes*, *agalactiae*, *pneumoniae*, *sanguinis*, and *salivarius*), *Salmonella* (*typhimurium* and *typhi*), *Proteus* (*vulgaris* and *mirabilis*), *Pseudomonas aeruginosa*, *Serratia marcescens*, *Klebsiella pneumoniae*, *Actinomyces viscosus*, *Enterobacter cloacae*, *Escherichia coli*, *Aspergillus niger*, and *Candida albicans* (Zafar and Ali 1998; Aljančić et al., 1999; Atai et al., 2006; Mohammadi Sichani et al., 2011; Ghaderi et al., 2012; Saeedach et al., 2014).
	Major compounds	3-*O*-caffeoylquinic acid (**1**)*, caffeic acid (**2**), and chamazulene (**3**) (Dias et al., 2013).
	Other compounds	Sabinene, α-terpineol, cineole, chamazulene, borneol, caryophyllene, y-terpinene, and terpinene-4-ol (Vasconcelos et al., 2020). Chamazulene, 1,8-cineole, camphor, and α-eudesmol (Farhadi et al., 2020). Guaiol, germacrene D, caryophyllene oxide, and spathulenol (Fathi et al., 2019).
	Major distribution	Europe, Asia and North America (Kiumarsi et al., 2009).
Arctium lappa L.	Therapeutic effect	Improves calcium absorption (de Moreno de LeBlanc et al., 2011), reduces the risk of osteoporosis (Alhusaini et al., 2019), anti-obesity (Ha et al., 2021), suppresses the growth of pathogenic bacteria (Donohoe et al., 2011), antiviral (Chan et al., 2011), antioxidant, diuretic, prevents dandruff and hair loss, treatment of gastric ulcer (Skowrońska et al., 2021), remedy of skin diseases such as laryngitis, ulcers, pimples, eczema, and pneumonia (Zargari 1991), blood purification (Ferracane et al., 2010), treatment of gout, hepatitis, and liver disease (Naeini et al., 2010; Abdolahzade et al., 2011), blood pressure control (Eftekhar-Sadat et al., 2016), prevention from atherosclerosis (Kim et al., 2008), treatment of heart disease (Wu et al., 2021), treatment of influenza, Alzheimer's, and cancer (Gao et al., 2018), improvement of cachexia (severe weight loss) due to cancer (Han et al., 2020), treatment of cerebral ischemia (complication due to lack of oxygen to the brain) (Yang et al., 2021), treatment of tuberculosis, anti-constipation (Watanabe et al., 2020), wound healing (Yari 2016), lowering of blood sugar, increase of tolerance to carbohydrates, treatment of diabetes (Annunziata et al., 2019), anti-allergy (Yang et al., 2016), anti-inflammatory, and treatment of bacterial infections (Hashemi et al., 2019).

Table 1 Continued

Herb	Application/Compounds/ Distribution	Effect/Ingredients/Location
Arctium lappa L.	Antimicrobial effect	*Brucellae* (*melitensis* and *abortus*), *Shigella* (*flexneri* and *sonnei*), *Bacillus subtilis*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Enterococcus faecalis*, *Aeromonas hydrophila*, *Escherichia coli, Micrococcus luteus, Helicobacter pylori*, and *Candida albicans* (Srinivasan et al., 2001; Pereira et al., 2005; Chan et al., 2011; Nassiri-Semnani et al., 2016; Gao et al., 2018; Hashemi et al., 2019; Liu et al., 2021).
	Major compounds	*p*-Coumaric acid/4-hydroxybenzoic acid (**4**), isoniazid (**5**), and rifampicin (**6**) (Zhao et al., 2014).
	Other compounds	Quercetin-3-rutinoside hydrate, 3,4,5-trihydroxybenzoic acid, 5-*O*-caffeoylquinic acid, and 3,4-dihydroxybenzoic acid (de Souza et al., 2019). Butanal, 2,3-pentanedione, 3-methylbutanal, β-selinene, α-selinene, 2-methylbutanal, methylene chloride, γ-curcumene, hexanal, and furfural (Xia et al., 2021).
	Major distribution	Around the World (Kemper 1999).
Artemisia annua L.	Therapeutic effect	Wound healing, analgesic, anti-asthma, anti-osteoporosis, anti-obesity (Feng et al., 2020), improve immune function (Gholamrezaie et al., 2013), anti-viral bovine diarrhea, anti-hepatitis B virus, anti-Epstein-Barr virus, anti-coronavirus (Haq et al., 2020; Law et al., 2020; Nair et al., 2021), antioxidant, anti-diabetic (Hashem-Sirjani et al., 2020), anti-inflammatory (Abate et al., 2021), treatment of hemorrhoids (Bilia et al., 2006; Azadbakht and Azadbakht 2008), treatment of tuberculosis (Martini et al., 2020), antiparasitic (Sen et al., 2007), treatment of schistosomiasis or snail fever (a disease caused by parasitic worms) (Munyangi et al., 2018), anti-malarial (Shen et al., 2018), antidepressant (Perazzo et al., 2003), anti-tumor (Yan et al., 2019), and inhibition of cancer cell production (Lang et al., 2019).
	Antimicrobial effect	*Staphylococci* (*aureus* and *epidermis*), *Bacillus* (*subtilis*, *cereus*, *licheniformis*, and *thuringiensis*), *Enterococci faecalis*, *Mycobacterium* (*tuberculosis* and *intracellulare*), *Pseudomonas aeruginosa*, *Yersinia enterocolitica*, *Enterobacter aerogenes*, *Salmonella typhi*, *Shigella flexneri*, *Escherichia coli*, *Proteus vulgaris*, *Enterococcus hirae*, *Erwinia carotovora*, *Xanthomonas campestris*, *Aspergillus niger*, *Candida* (*krusei* and *albicans*), *Fusarium* (*solani* and *oxysporum*), and *Saccharomyces cerevisiae* (Juteau et al., 2002; Rasooli et al., 2003; Slade et al., 2009; Verdian-rizi 2009; Ahameethunisa and Hopper 2010; Ćavar et al., 2012; Massiha et al., 2013; Appalasamy et al., 2014; Aghajanyan et al., 2020; Martini et al., 2020; Mirbehbahani et al., 2020).
	Major compounds	Ethyl-2-methylbutanoate (**7**), hexadecanoic acid (**8**), and 1-hexanol (**9**) (Ćavar et al., 2012).
	Other compounds	Kaempferol, quercetin, luteolin, stigmasterol, isorhamnetin, sitosterol, eupatin, tamarixetin, patuletin, [(2*S*)-2-[[(2*S*)-2-(benzoyl amino)-3-phenylpropanoyl]amino]-3-phenylpropyl] acetate, artemetin, areapillin, cirsiliol, skrofulein, vitexin_qt, DMQT, 6,8-di-c-glucosylapigenin_qt, deoxyartemisinin, and artemisinin (Zhang et al., 2020b). Camphor, artemisia alcohol, 1,8-cineole, β-myrcene, artemisia ketone, *cis*-3-hexenyl 2-methyl butanoate, β-caryophyllene, santolina triene, and (*E*)-β-farnesene (Vidic et al., 2018). Benzyl pentanoate, β-selinene, alloaromadendrene epoxide, aromandendrene, phytone, cuminaldehyde, α-acoradiene, and 4-cadinen-7-ol (Son et al., 2021).
	Major distribution	Around the World (Zheng 1994).

Table 1 Continued

Herb	Application/Compounds/ Distribution	Effect/Ingredients/Location(s)
Artemisia aucheri L.	Therapeutic effect	Analgesic, anti-inflammatory (Tadayoni et al., 2018), anti-amoeba (Pazoki et al., 2019), anti-constipation, anti-parasite (Azadbakht et al., 2003), anti-leishmania major, anti-skin leishmaniasis (Karimipour Saryazdi et al., 2020), anti-toxoplasma (Ghaffarifar et al., 2020), inhibit cancer cell production (Ali et al., 2021), anti-breast cancer, anti-ovarian cancer (Abbaspour et al., 2019), antioxidants, lowering cholesterol, and increasing blood HDL levels (Ramak and Sefidkon 2008).
	Antimicrobial effect	*Staphylococcus* (*aureus*, *saprophyticus* and *epidermidis*), *Bacillus* (*cereus* and *subtilis*), *Streptococcus* (*faecalis*, *faecium*, *agalactiae*, *pneumoniae*, *sanguinis*, *salivarius* and *mutans*), *Shigella* (*flexneri* and *dysenteriae*), *Proteus vulgaris*, *Escherichia coli*, *Enterococcus faecalis*, *Listeria monocytogenes*, *Salmonella typhimurium*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Enterobacter aerogenes*, *Serratia marcescens*, and *Aspergillus* (*niger* and *flavus*) (Tayefeh et al., 2012; Badrabadi et al., 2015; Baghini et al., 2018).
	Major compounds	Chrysanthenone (**10**), camphor (**11**), and 1,8-cineole (**12**) (Negahban et al., 2007).
	Other compounds	Verbenone, α-pinene, camphene, and β-myrcene (Boghozian et al., 2014; Taherkhani 2017). Thymol, linalool, davana ether, geraniol, and *cis*-davanone (Asl et al., 2018).
	Major distribution	Iran, Caucasus, Siberia, Turkmenistan, Afghanistan, Pakistan, Central Asia, Armenia, Iraq, Himalayas, Tibet and Europe (Podlech et al., 1986).
Artemisia persica L.	Therapeutic effect	Anti-flatulence, appetizer, anti-parasite, fever-relieving, nervous and gastrointestinal pain relief, facilitating childbirth, fortifying (El-Massry et al., 2002; Kazemi et al., 2011; Masoudi et al., 2012; Habibi et al., 2013), anti-allergy, anti-inflammatory in insect bites, effective in treating asthma (Nematollahi et al., 2006), anti-cancer of the stomach (Sofalian et al., 2020), and prevent the progression of atherosclerosis (Ahmadvand et al., 2013; El-Tantawy and nutrition 2015; Mehani et al., 2018).
	Antimicrobial effect	Staphylococci (aureus and epidermidis), Clostridium perfringens, Bacteroides fragilis, Bacillus lentus, Escherichia coli, Enterococcus faecalis, and Saccharomyces cerevisiae (Moellering and Robert 1998; Talei et al., 2004; Asl et al., 2018).
	Major compounds	β-Thujone (**13**), 4-terpineol (**14**), and cuminic aldehyde (**15**) (Nikbakht et al., 2014).
	Other compounds	Pinocarvone, *trans*-Pinocarveol, α-Pinene, artedouglasia oxide C, laciniata, and furanone E (Dehghani Bidgoli 2021). (Z)-sabinene hydrate, laciniata furanone *E*, *p*-cymene, myrtenal, artedouglasia oxide C, (*E*)-Pinocarveol, and 1,8-cineole (Siadat and Direkvand-Moghadam 2018). Borneol, camphor, and camphene (Moghtader et al., 2018).
	Major distribution	Iran, Caucasus, Siberia, Turkmenistan, Afghanistan, Pakistan, Central Asia, Armenia, Iraq, Himalayas, Tibet and Europe (Podlech et al., 1986).

Table 1 Continued

Herb	Application/Compounds/ Distribution	Effect/Ingredients/Location(s)
Cichorium intybus L.	Therapeutic effect	Antiviral (Zafar and Ali 1998), laxative, diuretic, analgesic, antipyretic, prevention of migraine attacks (Bahmani et al., 2015), treatment of infectious, hepatic, ocular, gastrointestinal diseases, and intoxications (Madani et al., 2006), anti-malarial (Bischoff et al., 2004), treatment of diabetes (Shahverdi et al., 2020), treatment of patients with non-alcoholic fatty liver (Elmieh et al., 2019), liver protection, blood purifier (Jamshidzadeh et al., 2006), improvement of cholestasis (a liver disease) (Ahmed 2009; Mulabagal et al., 2009), lowering bilirubin (Khedmat et al., 2021), kidney protection (Zaman et al., 2019), reduction of blood histamine (Al-Snafi and Esmail 2016), protective impact against the destructive effects of alcohol in the stomach (Gürbüz et al., 2002), inhibition of cancer cell production (Shahani et al., 2015), and treatment of stomatitis caused by chemotherapy (Wagih Abd ElFattah and El 2014).
	Antimicrobial effect	*Bacillus* (*cereus* and *subtilis*), *Pseudomonas* (*aeruginosa* and *fluorescence*), *Staphylococcus aureus*, *Micrococcus luteus*, *Agrobacterium radiobacter*, *Erwinia carotovora*, and *Escherichia coli* (Aqil and Ahmad 2003; Petrovic et al., 2004; Nishimura and Satoh 2006; Nandagopal and Kumari 2007; Shah et al., 2018; Rashed and Butnariu 2021).
	Major compounds	Caftaric acid (**16**), 5-*O*-caffeoylquinic acid (**17**), and chicoric acid (**18**) (Petropoulos et al., 2017).
	Other compounds	Coumaric acid, luteolin-7-*O*-glucoside, quercetin-di-glucoside, *p*-hydroxybenzoic acid, 4-*O*-caffeoylquinic acid, 3-*O*-caffeoylquinic acid, quinic acid, caffeoyl hexose, 3,4-di-*O*-caffeoylquinic acid, kaempferol-3-*O*-glucoside, quercetin-3-feruloyl-sophoroside, quercetin-3-*O*-rutinoside, 4-feruloyl quinic acid, quercetin-3-glucoside, and kaempferol-3-sophoroside (Zeb et al., 2019). Benzofuran derivative, β-hydroxytaraxasterol, usnic acid, β-sitosterol, sitoindoside, glyceryl-1,3-dioleate, β-sitosterol-3-*O*-glucoside, and β-13-dihydrolactucin (Satmbekova et al., 2018). Lactucin-15-oxalate, 8-deoxylactucin-15-oxalate, and lactucopicrin-15-oxalate (Bogdanović et al., 2020).
	Major distribution	Areas in Europe and Asia (Street et al., 2013).

Table 1 Continued

Herb	Application/Compounds/ Distribution	Effect/Ingredients/Location(s)
Cynara scolymus L.	Therapeutic effect	Reduction of blood fats (total cholesterol, triglycerides, and LDL-cholesterol) (Mejri et al., 2020), anti-obesity (Ben Salem et al., 2019), contraception and moderation (Kirchhoff et al., 1994), antioxidants (Kostić et al., 2021), anti-HIV virus (Nateghi et al., 2013), treatment of hepatitis (Zhu et al., 2004), anti-breast cancer (Erdogan et al., 2019; Rajapriya et al., 2020), anti-lung cancer (Abdel-Moneim et al., 2021), treatment of gastrointestinal disorders (Ziai et al., 2005), treatment of diabetes (Turkiewicz et al., 2019), prevention of atherosclerosis (Rossoni et al., 2005), protective effect on the kidney (Sümer et al., 2020), repair of pancreatic cells and protective effect on the liver (Li et al., 2004), treatment of non-alcoholic fatty liver disease, and prevention of diabetes (Narenjkar et al., 2010; Heidarian et al., 2011).
	Antimicrobial effect	*Bacillus* (*subtilis* and *cereus*), *Staphylococcus aureus*, *Streptococcus agalactiae*, *Micrococcus luteus*, *Agrobacterium tumefaciens*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Listeria monocytogenes*, *Salmonella typhimurium*, *Helicobacter pylori*, *Candida albicans*, *Saccharomyces cerevisiae*, *Aspergillus niger*, and *Penicillium oxalicum* (Zhu et al., 2004; Arbabian et al., 2009; Nariman et al., 2009; Ergezer et al., 2018; Maghsoudi and Saeidi 2020; Mousavi et al., 2021; Qodrat et al., 2021).
	Major compounds	Kaempferol (**19**), salicylic acid-*O*-hexoside (**20**), and apigenin-7-*O*-glucoside (**21**) (Ben Salem et al., 2019).
	Other compounds	1,3-di-*O*-Caffeoylquinic acid, 5-*O*-caffeoylquinic acid, and salicylic acid (Farhan et al., 2018). Apigenin-7-glucoside chlorogenic acid, luteolin-7-O-rutinoside, quercetin-*O*-pentoside, dihydroxy propiophend-hexoside, 3-mono-*O*-cafeoylquinic acid, kampferol 3-*O*-rutinoside, and caffeic acid (Ben Salem et al., 2019). Quercetin, (−)-epigallocatechin, chlorogenic acid, (+)-catechin, and caffeic acid (Demir and Ağaoğlu 2021). Ferulic acid, apigenin-7-*O*-glucoside, kaempferol, isoquercetin, aesculetin, kaempferol-3-*O*-glucoside, and rutin (Kostić et al., 2021).
	Major distribution	Areas in Asia, Southern Europe, the Mediterranean and North Africa (Zhu et al., 2004).

Table 1 Continued

Herb	Application/Compounds/ Distribution	Effect / Ingredients / Location(s)
Matricaria chamomilla L.	Therapeutic effect	Treatment of diabetes (Heidarianpour et al., 2021), anti-flatulence (Srivastava et al., 2010), anti-inflammatory, lowering blood lipids (Mirazi et al., 2019), regulating blood pressure (Bas et al., 2021), anti-viral (Rezatofighi et al., 2014), antioxidant activity and inhibiting tissue damage (Soltani et al., 2018), improving sleep quality (Abdullahzadeh and Naji 2014), sedative and anti-anxiety (Ghanavati et al., 2010; Ionita et al., 2018), analgesic (Pardakhty et al., 2021), anticonvulsant (Rostampour et al., 2014), reduction of breast pain (periodic mastalgia) (Saghafi et al., 2018), reduction of menstrual pain (Shabani and Zareian 2020), reduction of bleeding intensity in menstruation (Modarres et al., 2011), prevention of facial flushing in postmenopausal women (Kupfersztain et al., 2003), facilitating childbirth (Rahnavardi et al., 2018), diminish the symptoms of vomiting and nausea during gestation (Modares et al., 2012), treatment of autoimmune disease (Abdanipour et al., 2015), treatment of shortness of breath (Rahimi et al., 2018), burn treatment (Ebrahimi et al., 2020), wound healing (Nejati et al., 2019), inhibition of cancer cell production (Shwaikh et al., 2021), and use as mouthwash (Sabzehkar et al., 2021).
	Antimicrobial effect	*Bacillus* (*subtilis* and *cereus*), *Staphylococcus* (*aureus* and *epidermidis*), *Streptococcus* (*sanguinis*, *salivarius*, and *sobrinus*), *Shigella flexneri*, *Escherichia coli*, *Actinomyces viscosus*, *Klebsiella pneumoniae*, *Listeria monocytogenes*, *Salmonella typhimurium*, *Fusarium culmorum*, and *Candida* (*krusei* and *albicans*) (Wang et al., 2005; Saharkhiz et al., 2008; Izadi et al., 2013; Azmodeh et al., 2016; EL-Hefny et al., 2019; Azizi Alidoust et al., 2020).
	Major compounds	Quercetin (**22**), luteolin (**23**), and (*E*)-β-farnesene (**24**) (Stanojevic et al., 2016).
	Other compounds	Quercetin, apigenin, luteolin, isorhamnetin, and kaempferol (Qureshi et al., 2019). Chamazulene, α-bisabolol oxide A, spathulenol, β-farnesene, α-bisabolol oxide B, *trans*-β-farnesene, β-cubebene, (*E*)-spiroether, α-bisabolol, and (*Z*)-γ-bisabolene (Piri et al., 2019). 6β-hydroxystigmast-4-en-3- one, 7,22-diene-3,5,6-trihydroxyergosterol, 7,22-diene-3,5,6-trihydroxyergosterol, 5α-stigmasta-3,6-dione, 3β-hydroxy-5α,8α-epidioxyergosta-6,22-diene, stigmast-22-ene-3,6-dione, 7α-hydroxystigmasterol, 3β-hydroxy-(22E,24R)-ergosta-5,8,22-trien-7-one, 7α-hydroxysitosterol, 6β-hydroxystigmasta-4,22-dien-3-one, and 7β-hydroxystigmasterol (Zhao et al., 2020). Galangin, 6-methoxykaempferol, eupafolin, 3-methylquercetin, scopoletin, ermanin, bracteoside, isochlorogenic acid B, 7-O-(β-D-glucopyranosyl)-galactin, 4-hydroxybenzoic acid, isochlorogenic acid C, hispidulin, 5,7,4'-trihydroxy-3,6-dimethoxyflavonone, and 5-pentadecylbenzene-1,3-diol (Zhao et al., 2018).
	Major distribution	Widely distributed in West Asia, North America, and Africa (Safaei et al., 2011).

Table 1 Continued

Herb	Application/Compounds/ Distribution	Effect / Ingredients / Location(s)
Polygonum bistorta L.	Therapeutic effect	Anti-obesity (Kim et al., 2013), anti-HIV virus (Lin et al., 2010), anti-diarrhea, treatment of plague, anti-inflammatory (Harborne 1998), treatment of kidney stones, anti-diabetes, anti-tumor (Smolarz et al., 2008), treatment of bronchitis, pulmonary disorders, purulent skin lesions (Ogwuru and Adamczeski 2000), prevention of urinary tract irritation and abortion (Chen et al., 2006), soothing, stimulant, blood clotting (Grieve and Herbal 1984), wound healing (Mirbehbahani et al., 2020), treatment of bladder inflammation, irritable bowel syndrome, ulcerative colitis and excessive menstruation (Van Wyk and Wink 2018), treatment of gastric ulcer (Khushtar et al., 2018), treatment of breast cancer (Habibi et al., 2011), and inhibition of cancer cell production (Shali et al., 2019; Abdossalami et al., 2020).
	Antimicrobial effect	*Bacillus subtilis*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Escherichia coli* (Datta et al., 2007; Ghelich et al., 2014; Lone et al., 2015; Rajput and Agnihotri 2020).
	Major compounds	4-Methyl catechol (**25**), *p*-hydroxy benzoic acid (**26**), and protocatechuic acid (**27**) (Intisar et al., 2012).
	Other compounds	Arborinone, adianenone, 3β-acetoxy-dammara-20, arborinol, 24-diene, and isoarborinol (Mazid et al., 2011). 24(E)-ethylidenecycloartan-3α-ol and 24(*E*)-ethylidenecycloartanone (Manoharan et al., 2005). 3,7,3-Trihydroxy-5,6-dimethoxyflavone, kaempferol, quercetin, baicalin, 3-methyl quercetin, myricetin, and isoquercetin (Shen et al., 2018).
	Major distribution	Around the World (Hasan et al., 2008).

Table 2
Adverse effects of *Asteraceae* family herbs.

Herb name	Adverse effects
Achillea millefolium L.	Dermatitis, headache, and dizziness (Hausbn et al., 1991; Cavalcanti et al., 2006).
Matricaria chamomilla L.	Symptoms of an allergy to chamomile include swelling of the tongue, obstruction of the trachea, and angioedema of the lips and eyes, which can cause breathing problems and bronchitis (Subiza et al., 1990). Its allergenic reactions are attributed to compounds such as anticoagulants (Van Ketel 1987). Due to the effects of chamomile on the development of human embryos, chamomile consumption during pregnancy should be done with more caution (Pourmahdirad and Kesmati 2009).
Cynara scolymus L.	High consumption of artichoke extract has a toxic effect on the liver (Jamshidzadeh et al., 2005).

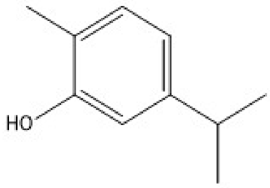
apigenin and its derivatives. They are also found in theunderground parts of herbs; *e.g.*, *Cichorium intybus* L. root is a source of many acids such as chlorogenic acid, caffeic acid, and isovanillic acid. Phenolic compounds in *Asteraceae* family herbs have potent antioxidant and anti-inflammatory properties (Karimi et al., 2014; Eruygur et al., 2019; Hueza et al., 2019). The *Asteraceae* family herbs are rich resources of chlorogenic acid, a hydroxycinnamic acid derivative formed by the reaction between quinic acid and a specific *trans*-cinnamic acid, such as ferulic, caffeic or *p*-coumaric acid. Chlorogenic acids have been found to possess anti-inflammatory antiviral, antimutagenic, and antioxidant activities (Jaiswal et al., 2011). Herbs are like the spine of the traditional health care system because they are used by most people all over the world. Medicinal herbs are used not only in developing countries but also in developed countries due to their low side effects and economic conditions; however, due to urbanization, the use of medicinal herbs as a food additive is declining; therefore, there is an urgent need to stop the disappearance of this tradition (Khushtar et al., 2018). Preservatives and chemical medicine are expensive **Fig. 2.** Structures of effective compounds of *Asteraceae* family herbs.

Table 3
List of characterized natural compounds of *Asteraceae* family herbs in the previously published reports.

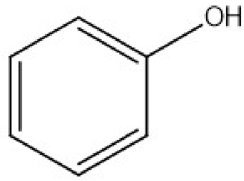
Effective compound	How does it work?
Carvacrol*	Leading to proton flux and ATP depletion, so the measurement of intracellular and extracellular ATP levels shows that intracellular ATP levels decrease and increase unstoppably outside the cell after the presence of carvacrol in the environment (Burt 2004).
Phenol	Exerting remarkable antioxidant effect by inhibiting free radicals (Bozin et al., 2008).
Chamazulene	Stimulating leukotriene synthesis in neutrophilic granulocytes and reduces inflammation. Chamazulene also prevents inflammation by preventing the synthesis of prostaglandins and reducing the production of tumor necrosis factor-alpha and interleukins 6 and 8 (Wang et al., 2005). It prevents the formation of leukotriene B-4 in healthy cells, and its anti-inflammatory activity may be related to the prevention of leukotriene production as well as its antioxidant activity (Carl and Emrich 1991).
Terpineol	Inducing the process of programmed cell death and also plays a role in causing allergies and dermatitis (Murakami et al., 2002).
Chlorogenic acid	Reducing the repletion of fatty acids in the liver (Romualdo et al., 2020) and control diabetes by lowering blood sugar (Shimoda et al., 2003).
Scopolin	Playing an important role in cooling, antipyretic, anti-inflammatory, and anti-allergic activities (Thabet et al., 2018).
Cynarine	By inhibiting cholesterol biosynthesis and increasing its biliary excretion in the liver, it lowers blood cholesterol levels and LDL levels. By increasing the number of liver cells and the concentration of intracellular RNA, it has a significant protective effect on the liver (Englisch et al., 2000).
Catechin	Having a restorative effect on beta cells against damage induced by alloxan monohydrate (Andrade-Cetto and Wiedenfeld 2001).
Betalain	Having an antioxidant effect and prevents atherosclerosis, cardiovascular and liver diseases by inhibiting free radicals (Xiang et al., 2005).
Chicoric acid	Significantly contributing to the antioxidant function of Asteraceae family herbs or foods containing them (Didier et al., 2011).

*The molecular structure of the characterized compounds of *Asteraceae* family herbs is shown in the Fig. 2.

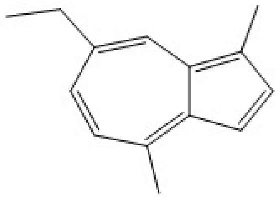
expensive due to the complex production process, but medicinal herbs are a good choice for use as food additives due to their natural growth, availability, and low side effects. If a specific effective material is recognized in herbs, it may lead to the manufacture of the medicine or active preservative compounds that also help reduce the use of expensive chemical compounds (Haq et al., 2020). The multiple attributes of the selected herbs of the *Asteraceae* family are listed in Table 1. As shown in Table 1, various studies have been developed to reveal the chemical profile of many selected herbs of the *Asteraceae* family and relate their composition and biological attributes with their potential applications. Few species of the *Asteraceae* family have been used as natural components in medicinal and food products. In fact, some of these species are sold in various forms, such as herbal teas, spices, powders, capsules, etc., which are considered to be "primitive shelf-care products" (Garcia-Oliveira et al., 2021). The use of herbs in the form of food additives also reduces the risk of resistance and drug residues (Fu et al., 2020). On the other hand, lifestyle changes, increasing body mass, and the incidence of diabetes are the problem of the new century that is associated with various diseases. Due to the anti-obesity and anti-diabetes effects of some *Asteraceae* family herbs, promoting their use of them in the daily diet can help deal with this emerging problem (Ha et al., 2021). herbs of the *Asteraceae* family can be used in the production of herbal shampoos due to their positive effect on hair growth (Skowrońska et al., 2021). Also, with a protective effect on the mouth and control of its microbial flora, they can be used in the production of herbal mouthwashes (Atai et al., 2006; Sabzehkar et al., 2021). Its therapeutic effect on cardiovascular, gastrointestinal, liver, kidney, lung, and skin diseases has been well-documented in various studies (Xiang et al., 2005; Ziai et al., 2005; Van Wyk and Wink 2018; Elmieh et al., 2019; Sümer et al., 2020; Abdel-Moneim et al., 2021). Herbs produce a variety of by-product metabolites under various physiological and environmental conditions. These by-product metabolites are liable to the biological activity observed under various pathophysiological conditions. As a result, it justifies the presence of different effective compounds in the same herb species in different places (Abate et al., 2021). Also, the conditions of preparation, storage, and drying have a significant effect on the quality and the presence of effective compounds (Zhang et al., 2020c).



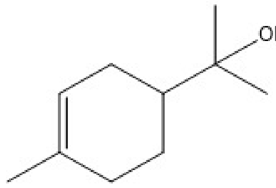
2-Methyl-5-(propan-2-yl)phenol (Carvacrol)



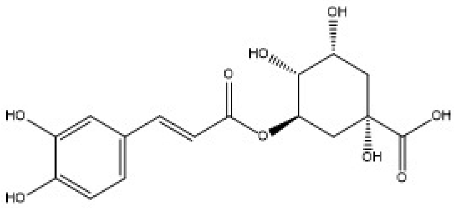
Hydroxybenzene (Phenol)



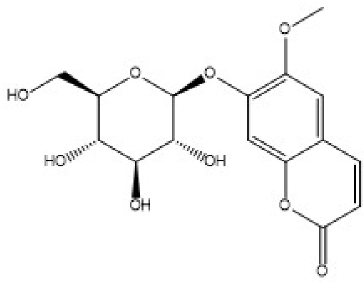
7-Ethyl-1,4-dimethylazulene (Chamazulene)



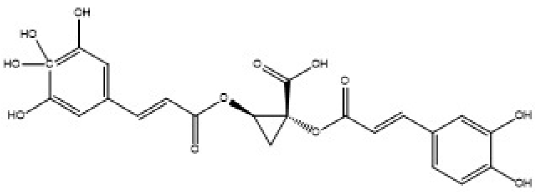
2-(4-Methylcyclohex-3-en-1-yl)propan-2-ol (Terpineol)



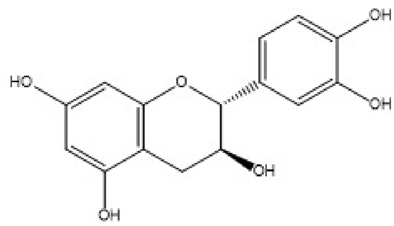
(1*S*,3*R*,4*R*,5*R*)-3-{[(2*E*)-3-(3,4-Dihydroxyphenyl)prop-2-enoyl]oxy}-1,4,5-trihydroxycyclohexane-1-carboxylic acid (Chlorogenic acid)



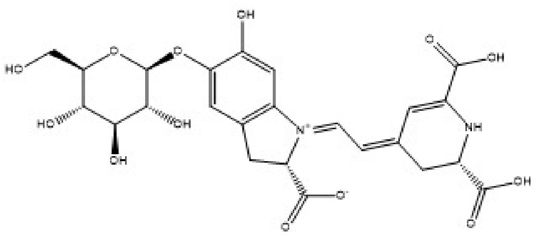
7-(β-D-Glucopyranosyloxy)-6-methoxy-2H-1-benzopyran-2-one (Scopolin)



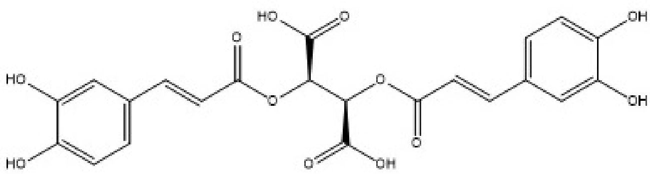
(1*R*,3*R*,4*S*,5*R*)-1,3-Bis{[(2*E*)-3-(3,4-dihydroxyphenyl)prop-2-enoyl]oxy}-4,5-dihydroxycyclopropane-1-carboxylic acid (Cynarine)



(2*R*,3*S*)-2-(3,4-Dihydroxyphenyl)-3,4-dihydro-2H-chromene-3,5,7-triol (Catechin)

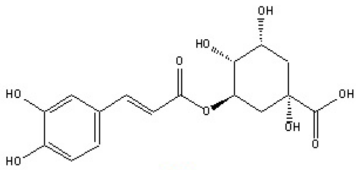


(2*S*)-1-{2-[(2*S*)-2,6-dicarboxy-2,3-dihydropyridin-4(1H)-ylidene]ethylidene}-5-(β-d-glucopyranosyloxy)-6-hydroxy-2,3-dihydro-1H-indol-1-ium-2-carboxylate (Betalain)



(2*R*,3*R*)-2,3-Bis{[(2*E*)-3-(3,4-dihydroxyphenyl)prop-2-enoyl]oxy}butanedioic acid (Chicoric acid)

Fig. 2. Structures of effective compounds of *Asteraceae* family herbs.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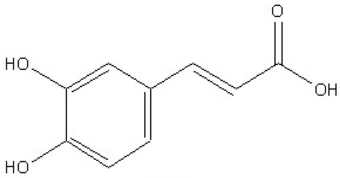
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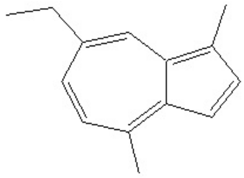
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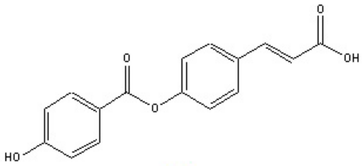
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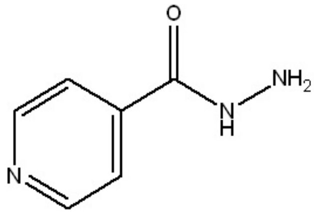
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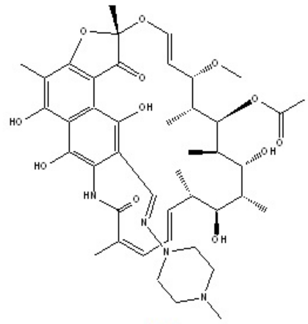
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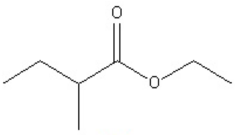
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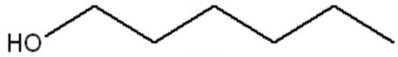
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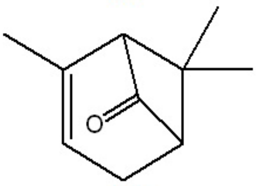
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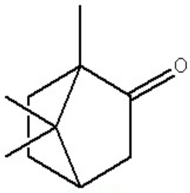
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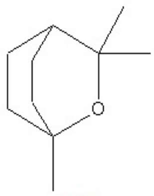
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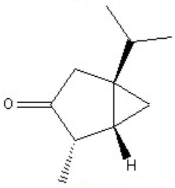
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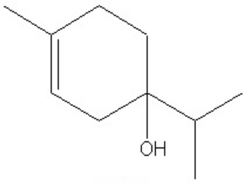
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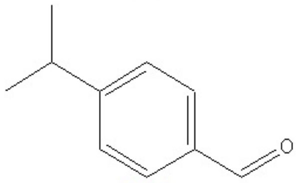
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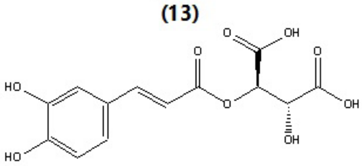
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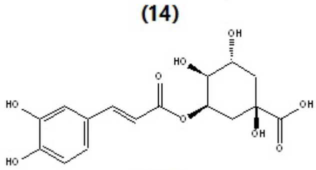
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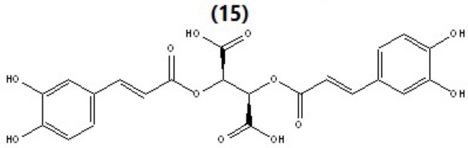
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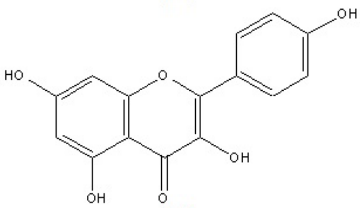
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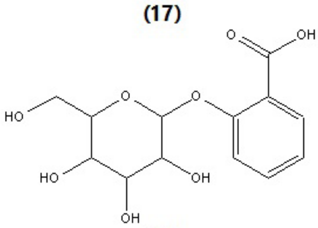
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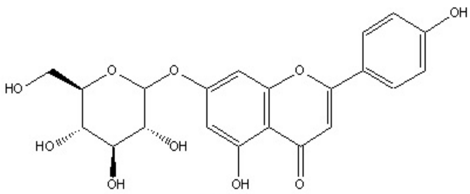
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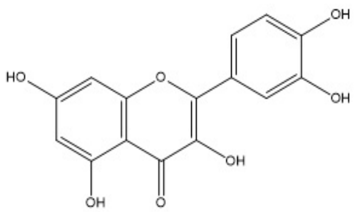

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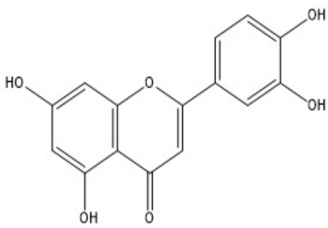

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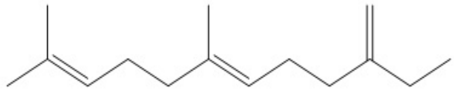

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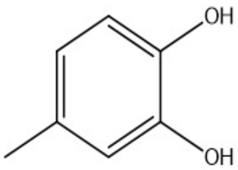

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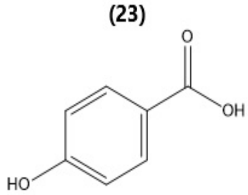

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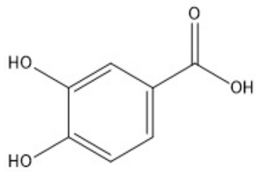

(27)

Fig. 3. Structures of chemical ingredients isolated from herb species of the *Asteraceae* family.

4. Concluding remarks

Asteraceae family herbs can be used as a safe and natural seasoning and preservative in a variety of foods due to their antimicrobial, antioxidant, and flavor effects and the presence of different effective compounds in their structure such as 1-8-cineol, α-pinene, β-pinene, camphor, sabinene, and kaempferol are used in the remedy of different illnesses, but it should be noted that herbs such as yarrow, chamomile, and artichoke in high doses have toxic effects on consumer health, and we must be careful when using these plants. The presence of growth-promoting compounds (Phytohormones) of probiotics in *Asteraceae* family herbs makes their use in symbiotic foods practical. Due to the emergence of the COVID-19 disease in recent years and the antiviral performance of *Asteraceae* family herbs such as chicory, chamomile, *Polygonum bistorta*, and sweet wormwood, it is recommended that the antiviral performance of these herbs against coronavirus be evaluated in future studies. Also, with its antimicrobial, antifungal, and antioxidant effects, there is a need for further study on how they work in food models. The results of this systematic review study demonstrate that plants of the *Asteraceae* family can be widely used in the food industry and medical.

Conflict of interest

The authors declare that there is no conflict of interest.

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