Journal of Food Science and Technology (Iran)

Homepage:www.fsct.modares.ir

Scientific Research

Evaluation of antioxidant activity, total phenol and flavonoid and antibacterial activity of German chamomile

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ARTICLE INFO

Article History:
Received:2024/4/9
Accepted:2024/5/21

Keywords:

German chamomile,

Essential oil,

Antimicrobial,

Antioxidant,

Phenolic compounds.

DOI: 10.22034/FSCT.21.154.139.

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ABSTRACT

German chamomile (*Matricaria chamomilla* L.) is a well-known medicinal plant that is distributed worldwide and is widely used in traditional medicine for the treatment of various diseases. In this study, the essential oil of *M. chamomilla* was extracted by water distillation method and its total phenol content, total flavonoid content, antioxidant activity, and antimicrobial effect were investigated. The total phenol content of the essential oil was 39.70 mg GAE/g and its total flavonoid content was 18.80 mg QE/g. The antioxidant activity of the essential oil was evaluated based on two methods of inhibiting free radicals DPPH and ABTS; the essential oil was able to inhibit free radicals DPPH (58.60 %) and ABTS (61.60 %). The antimicrobial effect of the essential oil against *Bacillus cereus*, *Streptococcus pyogenes*, *Staphylococcus aureus*, *Shigella dysenteriae*, *Enterobacter aerogenes*, and *Salmonella typhimurium* was investigated by disk diffusion agar, well diffusion agar, minimum inhibitory concentration, and minimum bactericidal concentration. The findings of the antimicrobial activity of the essential oil by the disk diffusion agar and well diffusion agar, showed that *S. pyogenes* and *E. aerogenes* were the most sensitive and resistant microbial strains to *M. chamomilla* essential oil, respectively. The results of this study showed that the essential oil of *M. chamomilla* has shown strong antioxidant and antimicrobial activity, which can be a potential candidate for the preparation of antioxidant and antimicrobial drugs.

1. Introduction

Despite the use of various preservation methods, food poisoning remains a concern for both consumers and the food industry. Due to the resistance that pathogens create against antibiotics, there is an increasing interest in using natural antibacterial products for food preservation, such as plant and spice extracts and essential oils. In fact, raw natural extracts and essential oils and biologically active compounds of plant species used in traditional medicine may be valuable sources for such new preservatives [1-40].

In addition, in food processing, lipid oxidation not only reduces the nutritional and taste quality of foods, but also produces oxidized products such as free radicals, leading to various undesirable chemical reactions [13]. To prevent or delay this process, common synthetic antioxidants such as Butylated Hydroxyanisole (BHA), Butylated Hydroxytoluene (BHT), Propyl Gallate (PG), and Tert-Butylhydroquinone (TBHQ) have been used for over five decades. However, these synthetic antioxidants are suspected of having negative health effects [41]. Therefore, there is an increasing interest in studies of natural additives as potential antioxidants. Many sources of plant-based antioxidants have been studied in recent years. Among them, the antioxidant properties of many aromatic and medicinal plants have been effective in delaying the process of lipid peroxidation in oils and fatty foods and have attracted the attention of many research groups. Therefore, the demand for these plants in industrial and non-industrial countries is increasing, leading to an increase in their prices [2, 8, 14].

German chamomile (*Matricaria chamomilla* L.) is one of the important medicinal plants native to southern and eastern Europe. It also grows in Germany, Hungary, France, Russia, Yugoslavia, and Brazil. These plants can be found in North Africa, Asia, North and South America, Australia, and New Zealand. Hungary is the main producer of plant biomass and it grows abundantly in poor soils and is a source of income for the poor residents of these areas. The flower of this plant is mainly exported to Germany for essential oil extraction. Chamomile has been used in herbal medicines for thousands of years and is known in ancient Egypt, Greece, and Rome. This plant was considered by the Anglo-Saxons as one of the nine sacred plants given by God to humans. The flowers of German chamomile contain 0.2 to 1.9 % essential oil, which has various applications. Chamomile is mainly used as an anti-inflammatory, antiseptic, and also antispasmodic. German chamomile is a natural source of blue oil (essential oil). The flowers and flower heads are the main parts of essential oil production. The flower oil of chamomile is mainly composed of sesquiterpene derivatives (75 to 90 %). The main components of the essential oil extracted from the flowers are beta-farnesene, farnesol, alpha-bisabolol, chamazulene. The color of the essential oil determines its quality. The blue color of the essential oil is due to sesquiterpene [42].

Marino and colleagues (2001) tested the essential oils of marigold, mint, hyssop, chamomile, and mountain mint for inhibitory effects against 9 Gram-negative bacterial strains and six strains of Gram-positive bacteria. The essential oils of marigold, mint, hyssop, and chamomile also had bacteriostatic activity. It seems

that the essential oil of mountain mint is bactericidal at concentrations higher than 400 ppm, probably due to their high content in phenolic compounds. Bacteriostatic activity was more effective against Gram-positive bacteria. On the other hand, bactericidal activity was higher against Gram-negative bacteria [43].

Given the above, this study was conducted with the aim of extracting the essential oil of German chamomile and determining the amount of its phenolic and flavonoid compounds, as well as investigating the antioxidant and antimicrobial activity of the essential oil of this medicinal plant.

2. Materials and methods

2.1. Essential oil extraction

The German chamomile plant was collected from Fars province. The Clevenger apparatus was used for 4 hours to extract the essential oil from the German chamomile flower. The extraction was carried out in 500 mL of water and the resulting essential oil was stored at a temperature of 4 ◦C until use [44].

2.2. Total phenol and flavonoid contents

The total phenol and flavonoid content of the essential oil was evaluated using the method presented by Alizadeh Behbahani and colleagues [10]. To determine the total phenol content, 10 µL of the essential oil was mixed with 50 µL of Folin-Ciocalteu reagent and stirred for 3 min. Then, 300 µL of sodium bicarbonate was added and the solution was shaken for 2 h. The absorbance of the solution at a wavelength of 765 nm was obtained. Gallic acid solution (0-200 mg/L) was used as a standard. By comparing the absorbance obtained from the essential oil with the calibration curve of the gallic acid solution, the total phenol content was obtained in terms of milligrams equivalent to gallic acid per gram of essential oil (mg GAE/g). On the other hand, the flavonoid content was calculated using the aluminum chloride method and the response was measured as milligrams equivalent to quercetin mg QE/g essential oil.

2.3. Antioxidant effect

The antioxidant activity of the essential oil was determined using the methods of inhibiting free radicals DPPH and ABTS and according to the methods presented by Adewusi and colleagues [45] with the necessary modifications. To evaluate the ability of the essential oil to inhibit the DPPH radical, a mixture of 185 µL of 0.135 mM DPPH solution in methanol and 15 µL of essential oil was prepared. The mixture was kept in the dark at room temperature for 30 min. Then, the absorbance of the mixture at a wavelength of 570 nm was measured. The ability of the essential oil to inhibit the DPPH radical was determined using the following formula:

Inhibition (%) = [(A control – A sample)/A control] × 100

To determine the ABTS inhibition capacity of the essential oil, a stock solution was prepared by mixing equal volumes of 7 mM ABTS salt and 2.4 millimolar potassium persulfate. After incubating it in the dark for 16 hours at room temperature, the solution was diluted with methanol until its absorbance reached 0.706 at a wavelength of 734 nm. Then, the essential oil was mixed with 2 mL of the ABTS solution and the absorbance at a wavelength of 734 nm was recorded. The ABTS inhibition

capacity of the essential oil was calculated using the following formula:

Inhibition (%) = [(A control – A sample)/A control] × 100

2.4. Antimicrobial effect

The antimicrobial effect of German chamomile essential oil against Bacillus cereus, *Streptococcus pyogenes*, *Staphylococcus aureus*, *Shigella dysenteriae*, *Enterobacter aerogenes*, and *Salmonella typhimurium* was evaluated according to the methods of disk diffusion agar, well diffusion agar, minimum inhibitory concentration (MIC), and minimum bactericidal concentration (MBC) [10, 11, 40].

In the disk diffusion agar test, the essential oil was sterilized using a 0.22 micrometer syringe filter. Then, blank disks were soaked in the essential oil for 15 min. In the inoculation stage, the above bacteria were used at an inoculation rate equivalent to the 0.5 McFarland standard. The microbial plates were rotated at a 60-degree angle to ensure that the microorganisms covered the entire surface of the medium. The disks that had been soaked in the essential oil were then placed on the surface of the medium. The culture medium was incubated at a temperature of 37 ◦C for 24 h and the diameter of the non-growth halo around the disks was measured.

In the well diffusion agar test, Mueller Hinton agar culture medium was prepared and poured into a Petri dish. Using an L-shaped spreader, some microbial suspension was spread on the culture medium. Then, several wells with a diameter of 6 mm were created on the surface of the culture medium. Next, 20 µL of essential oil was poured into the wells. The culture medium was kept at a temperature of 37 ◦C for 24 h and finally, the diameter of the non-growth halo around the wells was measured.

To measure the minimum inhibitory concentration, 125 µL of microbial suspension (equivalent to 0.5 McFarland) was added to each well of a 96-well plate and then the essential oil (concentrations of 2, 4, 8, 16, 32, 64, 128, 256, and 512 mg/mL) was added. Incubation was carried out for 24 h at a temperature of 37 ◦C. Then, 25 µL of triphenyl tetrazolium chloride solution (5 mg/mL) was added to each well. A dark red color appeared in the wells where the microbe had grown. The lowest concentration at which no microbial growth and color change were observed was considered as the minimum inhibitory concentration.

To determine the minimum bactericidal concentration, 100 µL of medium from each well (no red color in the plate) was cultured on Mueller Hinton agar medium and incubated at a temperature of 37 ◦C for 24 hours. The minimum concentration that prevented colony formation was considered as the minimum bactericidal concentration.

2.5. Statistical analysis

The data were analyzed using Minitab software (version 21). Tukey's test was used at a 95% confidence level to determine the difference between the mean data. It should be noted that the experiments were repeated three times.

3. Results and discussion

The total phenol and flavonoid content of *M. chamomilla* essential oil were respectively equal to 39.70 mg GAE/g and 18.80 mg QE/g (Fig. 1). In addition, the antioxidant activity of M. chamomilla

essential oil based on DPPH and ABTS radical inhibition methods was respectively equal to 58.60% and 61.60% (Fig. 2).

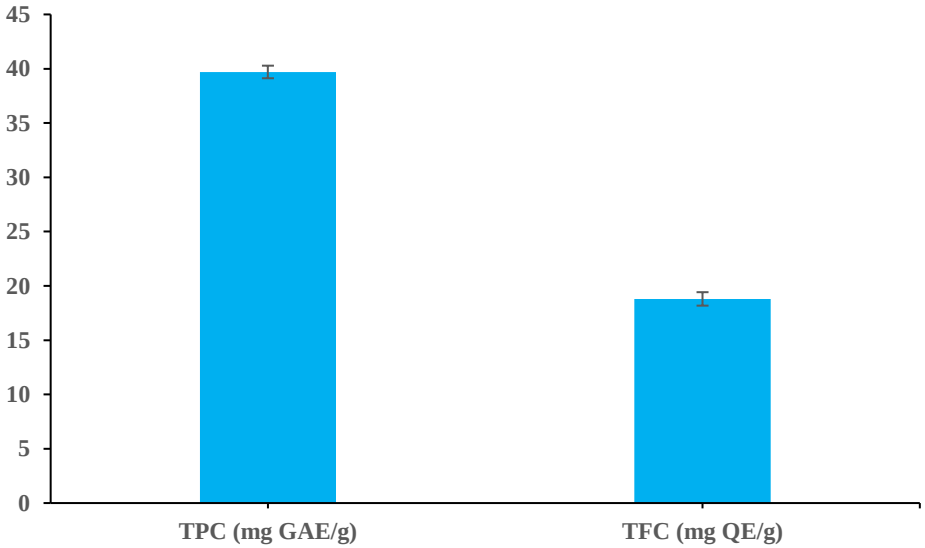

Figure 1. Total phenol content (TPC) and total flavonoid content (TFC) of *Matricaria chamomilla* essential oil. GAE = Gallic acid equivalent; QE = Quercetin equivalent.

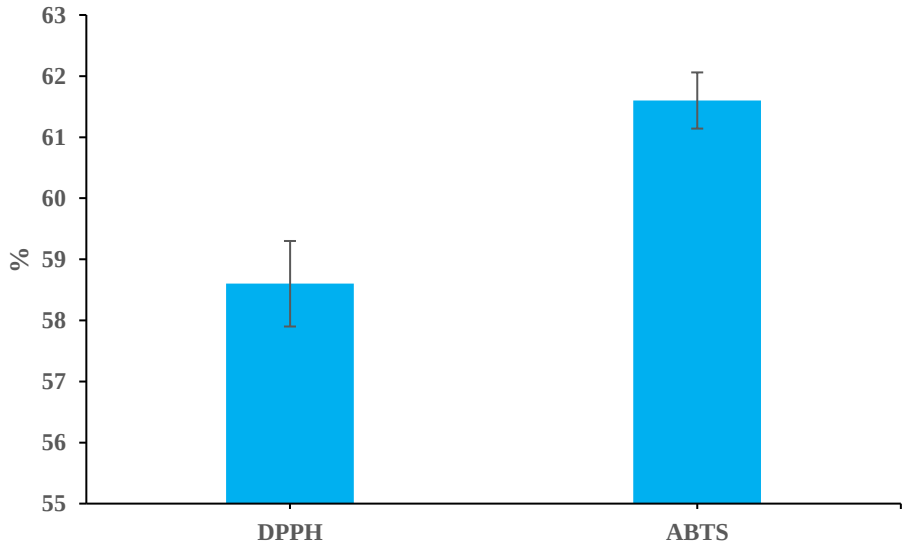

Figure 2. Antioxidant effect of *Matricaria chamomilla* essential oil based on DPPH and ABTS radical scavenging methods.

Fig. 3 shows the results of the antimicrobial effect of *M. chamomilla* essential oil based on the disk diffusion agar method. The average diameter of the non-growth halo varied from 11.30 mm to 20.10 mm. *S. pyogenes* and *E. aerogenes* bacteria were respectively the most sensitive and resistant strains to *M. chamomilla* essential oil ($p < 0.05$). In general, Gram-positive bacteria

(*B. cereus*, *S. pyogenes*, and *S. aureus*) were more sensitive to the essential oil compared to Gram-negative types (*Sh. dysenteriae*, *E. aerogenes*, and *S. typhimurium*).

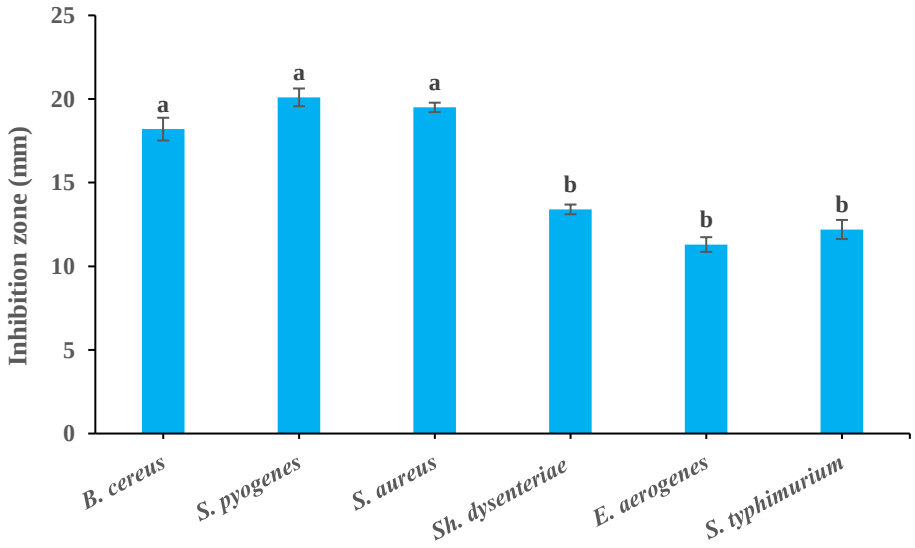

Figure 3. Antibacterial effect of *Matricaria chamomilla* essential oil based on disc diffusion agar method.

According to the results of the well diffusion agar test (Fig. 4), the average diameter of the non-growth halo for *B. cereus*, *S. pyogenes*, *S. aureus*, *Sh. dysenteriae*, *E. aerogenes*, and *S. typhimurium* bacteria was respectively equal to 20, 21.70, 20.60, 15.10, 12.90, and 13.30 mm. In this regard, *S. pyogenes* and *E. aerogenes* bacteria were respectively the most sensitive and resistant strains to the essential oil, which is in line with the findings of the disk diffusion agar test.

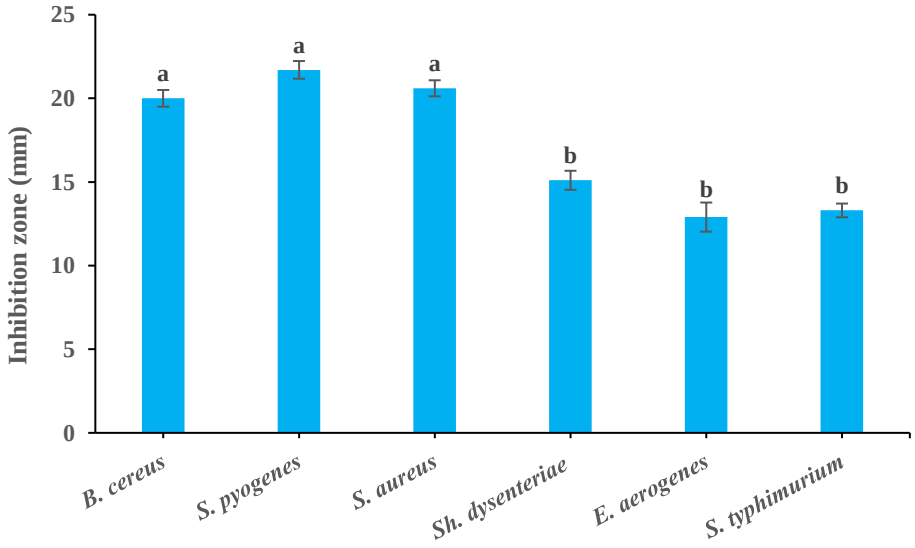

Figure 4. Antibacterial effect of *Matricaria chamomilla* essential oil based on well diffusion agar method.

The results of the antimicrobial tests, minimum inhibitory concentration, and minimum bactericidal concentration of the essential oil are presented in Table 1.

According to the results, Gram-positive bacteria had a lower minimum inhibitory concentration and minimum bactericidal concentration compared to Gram-negative bacteria, indicating their higher sensitivity to *M. chamomilla* essential oil.

Table 1. Antibacterial effect of *Matricaria chamomilla* essential oil based on minimum inhibitory concentration and minimum bactericidal concentration methods.

Bacterial type	Minimum inhibitory concentration (mg/mL)	Minimum bactericidal concentration (mg/mL)
B. cereus	4	64
S. pyogenes	4	64
S. aureus	4	128
Sh. dysenteriae	32	> 512
E. aerogenes	64	> 512
S. typhimurium	64	> 512

The antioxidant and antimicrobial activity of *M. chamomilla* essential oil and extracts have been demonstrated in various studies. The antioxidant and antimicrobial activity of *M. chamomilla* essential oil in terms of their potential use as natural antioxidants and antimicrobial agents were investigated by Stanojevic and colleagues (2016). The results obtained confirmed the presence of 52 components, with the highest content of β-farnesene (29.8%), α-farnesene (9.3%), α-bisabolol and its oxide (15.7%), chamazulene (6.4%), germacrene D (6.2%), and spiroether (5.6%). The antioxidant activity was investigated using the DPPH method and this amount was equal to 2.07 mg/mL. The antimicrobial activity of chamomile essential oil was tested using the agar diffusion method, where the essential oil showed a significant antibacterial effect with a non-growth halo diameter from 13.33 mm (in *Listeria monocytogenes*) to 40 mm (on *S. aureus*), and chamomile essential oil had no antimicrobial activity on *Pseudomonas aeruginosa* [46]. In addition, it has been reported that *M. chamomilla* essential oil, compared to the standards used BHT and α-tocopherol, shows less antioxidant activity [47]. In another study on German chamomile, the essential oil and methanolic extract showed significant antioxidant activity using DPPH sensing and reducing power. This activity varied depending on environmental factors and chemical composition. In fact, the highest activity was achieved by essential oils rich in oxygenated compounds and extract with high phenolic content [48].

The antibacterial effect of *M. chamomilla* essential oil and extract was investigated in several studies. In general, the agar diffusion method, using disks or wells, has the most use for screening the antibacterial activity of essential oils and extracts. Using this technique, Stanojevic and colleagues (2016) reported the antibacterial activity of *M. chamomilla* essential oil. The most sensitive strain was *S. aureus* and the most resistant strain was *P. aeruginosa* [46]. Similarly, Owlia and colleagues [49] did not report any activity using the disk diffusion method against *P. aeruginosa*. However, the essential oil was able to reduce biofilm formation and alginate production and demonstrated its effectiveness in controlling biofilm-

producing bacteria. On the other hand, the results showed that *Bacillus subtilis* was the most sensitive bacteria to *M. chamomilla* essential oil grown in Morocco [50]. In the present study, Gram-positive bacteria showed the lowest minimum inhibitory concentrations. These results can be explained by the difference in cell wall structure as Gram-negative bacteria have a complex and rigid membrane rich in lipopolysaccharide that limits the access of antimicrobial molecules [13, 40].

4. Conclusions

In this research, the antioxidant properties and antimicrobial activity of *M. chamomilla* essential oil were investigated. The antioxidant activity of the essential oil was significant and therefore *M. chamomilla* essential oil can help prevent and treat diseases. The antimicrobial activity of the essential oil was evaluated using the disk diffusion agar method, well diffusion agar, minimum inhibitory concentration, and minimum bactericidal concentration. *S. pyogenes* and *E. aerogenes* were respectively the most sensitive and resistant strains to the essential oil. Therefore, the essential oil under investigation can be recommended as a source of necessary medicinal materials for the preparation of new antimicrobial drugs. However, it is suggested that the effective compounds of the essential oil be identified using the method of gas chromatography coupled to mass spectrometry to provide a better understanding of the antimicrobial and antioxidant activity of the essential oil.

5. Acknowledgements

The authors would like to express their sincere gratitude to the Vice-chancellor for Research and Technology of Agricultural Sciences and Natural Resources University of Khuzestan for supporting this study as a project number 1402.52.

6.References

[1] Alghooneh, A., Alizadeh Behbahani, B., Noorbakhsh, H., & Tabatabaei Yazdi, F. (2015). Application of intelligent modeling to predict the population dynamics of Pseudomonas aeruginosa in Frankfurter sausage containing Satureja bachtiarica extracts. *Microbial Pathogenesis*, *85*, 58-65.

[2] Alizadeh Behbahani, B., Falah, F., Lavi Arab, F., Vasiee, M., & Tabatabaee Yazdi, F. (2020). Chemical Composition and Antioxidant, Antimicrobial, and Antiproliferative Activities of Cinnamomum zeylanicum Bark Essential Oil. *Evidence-Based Complementary and Alternative Medicine*, *2020*, 5190603.

[3] Alizadeh Behbahani, B., Falah, F., Vasiee, A., & Tabatabaee Yazdi, F. (2021). Control of microbial growth and lipid oxidation in beef using a Lepidium perfoliatum seed mucilage edible coating incorporated with chicory essential oil. *Food Science & Nutrition*, *9*(5), 2458-2467 .

[4] Alizadeh Behbahani, B., & Imani Fooladi, A. A. (2018b). Shirazi balangu (Lallemantia royleana) seed mucilage: Chemical composition, molecular weight, biological activity and its evaluation as edible coating on beefs. *International Journal of Biological Macromolecules*, *114*, 882-889.

[5] Alizadeh Behbahani, B., & Imani Fooladi, A. A .(2018a). Development of a novel edible coating made by Balangu seed mucilage and Feverfew essential oil and investigation of its effect on the shelf life of beef slices during refrigerated storage through intelligent modeling. *Journal of Food Safety*, *38*(3), e12443.

[6] Alizadeh Behbahani, B., Noshad, M., & Falah, F. (2020). The combined effect of the combined Fennel and Clove essential oils on Staphylococcus epidermidis, Bacillus cereus, Salmonella typhi and Enterobacter aerogenes using Checkerboard assay (fractional inhibitory

[7] concentration index). *Journal of Food Science and Technology*, *17*(106), 75-83.

[8] Alizadeh Behbahani, B., Noshad, M., & Jooyandeh, H. (2020). Improving oxidative and microbial stability of beef using Shahri Balangu seed mucilage loaded with Cumin essential oil as a bioactive edible coating. *Biocatalysis and Agricultural Biotechnology*, *24*, 101563.

[9] Alizadeh Behbahani, B., & Shahidi, F. (2019). Melissa officinalis Essential Oil: Chemical Compositions, Antioxidant Potential, Total Phenolic Content and Antimicrobial Activity. *Nutrition and Food Sciences Research*, *6*(1), 17-25.

[10] Alizadeh Behbahani, B., Shahidi, F., Yazdi, F. T., Mortazavi, S. A., & Mohebbi, M. (2017). Use of Plantago major seed mucilage as a novel edible coating incorporated with Anethum graveolens essential oil on shelf life extension of beef in refrigerated storage. *International Journal of Biological Macromolecules*, *94*, 515-526.

[11] Alizadeh Behbahani, B., Shahidi, F., Yazdi, F. T., Mortazavi, S. A., & Mohebbi, M. (2017). Antioxidant activity and antimicrobial effect of tarragon (Artemisia dracunculus) extract and chemical composition of its essential oil. *Journal of Food Measurement and Characterization*, *11*, 847-863 .

[12] Alizadeh Behbahani, B., Yazdi, F. T., Mortazavi, A., Gholian, M. M., Zendeboodi, F., & Vasiee, A. (2014). Antimicrobial effect of Carboxy Methyl Cellulose (CMC) containing aqueous and ethanolic Eucalyptus camaldulensis L. leaves extract against Streptococcus pyogenes, Pseudomonas aeruginosa and Staphylococcus epidermidis. *Archives of Advances in Biosciences*, *5*(2), 59-69 .

[13] Barzegar, H., Alizadeh Behbahani, B., & Falah, F. (2021). Safety, probiotic properties, antimicrobial activity, and technological performance of Lactobacillus strains isolated from Iranian raw milk cheeses. *Food Science & Nutrition*, *9*(8), 4094-4107.

[14] Barzegar, H., Alizadeh Behbahani, B., & Mehrnia, M. A. (2020). Quality retention and shelf life extension of fresh beef using Lepidium sativum seed mucilage-based edible coating containing Heracleum lasiopetalum essential oil: an experimental and modeling study. *Food Science and Biotechnology*, *29*(5), 717-728.

[15] Behbahani, B. A., Noshad, M., & Falah, F. (2019). Cumin essential oil: Phytochemical analysis, antimicrobial activity and investigation of its mechanism of action through scanning electron microscopy. *Microbial Pathogenesis*, *136*, 103716 .

[16] Behbahani, B. A., Shahidi, F., Yazdi, F. T., & Mohebbi, M. (2013). Antifungal effect of aqueous and ethanolic mangrove plant extract on pathogenic fungus" in vitro". *International Journal of Agronomy and Plant Production*, *4*(7), 1652-1658 .

[17] Behbahani, B. A., Yazdi, F. T., Vasiee, A., & Mortazavi, S. A. (2018). Oliveria decumbens essential oil: Chemical compositions and antimicrobial activity against the growth of some clinical and standard strains causing infection. *Microbial Pathogenesis*, *114*, 449-452 .

[18] Falah, F., Shirani, K., Vasiee, A., Yazdi, F. T., & Behbahani, B. A. (2021). In vitro screening of phytochemicals, antioxidant, antimicrobial, and cytotoxic activity of Echinops setifer extract. *Biocatalysis and Agricultural Biotechnology*, *35*, 102102 .

[19] Falah, F., Vasiee, A., Behbahani, B. A., Yazdi, F. T., Moradi, S., Mortazavi, S. A., & Roshanak, S. (2019). Evaluation of adherence and anti−infective properties of probiotic Lactobacillus fermentum strain 4-17 against Escherichia coli causing urinary tract infection in humans. *Microbial Pathogenesis*, *131*, 246-253.

[20] Falah, F., Zareie, Z., Vasiee, A., Tabatabaee Yazdi, F., Mortazavi, S. A., & Alizadeh Behbahani, B. (2021). Production of synbiotic ice-creams with Lactobacillus brevis PML1 and inulin: functional characteristics, probiotic viability, and sensory properties. *Journal of Food Measurement and Characterization*, *15*(6), 5537-5546.

[21] Heydari, S., Jooyandeh, H., Alizadeh Behbahani, B., & Noshad, M. (2020). The impact of Qodume Shirazi seed mucilage-based edible coating containing lavender essential oil on the quality enhancement and shelf life improvement of fresh ostrich meat: An

experimental and modeling study. *Food Science & Nutrition*, *8*(12), 6497-6512.

[22] Hojjati, M., Behabahani, B. A., & Falah, F. (2020). Aggregation, adherence, anti-adhesion and antagonistic activity properties relating to surface charge of probiotic Lactobacillus brevis gp104 against Staphylococcus aureus. *Microbial Pathogenesis*, *147*, 104420.

[23] Jalil Sarghaleh, S., Alizadeh Behbahani, B., Hojjati, M., Vasiee, A., & Noshad, M. (2023). Evaluation of the constituent compounds, antioxidant, anticancer, and antimicrobial potential of Prangos ferulacea plant extract and its effect on Listeria monocytogenes virulence gene expression. *Frontiers in Microbiology*, *14*.

[24] Jooyandeh, H., Ebrahimi Hemmati Kaykha, M., Alizadeh Behbahani, B., & Noshad, M. (2022). Evaluating the quality of mutton meat coated with Cordia myxa fruit mucilage containing Rosmarinus officinalis essential oil during cold storage. *Journal of Food Measurement and Characterization*, *17*(3), 2062-2074.

[25] Noshad, M., Alizadeh Behbahani, B., Jooyandeh, H., Rahmati-Joneidabad, M., Hemmati Kaykha, M. E., & Ghodsi Sheikhjan, M. (2021). Utilization of Plantago major seed mucilage containing Citrus limon essential oil as an edible coating to improve shelf-life of buffalo meat under refrigeration conditions. *Food Science & Nutrition*, *9*(3), 1625-1639.

[26] Noshad, M., Behbahani, B. A., Nikfarjam, Z ,. &Zargari, F. (2023). Antimicrobial activity between Coriandrum sativum seed and Cuminum cyminum essential oils against foodborne pathogens: A multi-ligand molecular docking simulation. *LWT*, *185*, 115217.

[27] Noshad, M., Hojjati, M., & Behbahani, B. A. (2018). Black Zira essential oil: Chemical compositions and antimicrobial activity against the growth of some pathogenic strain causing infection. *Microbial Pathogenesis*, *116*, 153-157 .

[28] Rahmati- Joneidabad, M., & Alizadeh Behbahani, B. (2021). Identification of chemical compounds, antioxidant potential, and antifungal activity of (Thymus daenensis) essential oil against spoilage fungi causing apple rot. *Iranian Food Science and Technology Research Journal*, *17*(5), 691-700.

[29] Rahmati-Joneidabad, M., Alizadeh Behbahani, B., & Noshad, M. (2021). Antifungal effect of Satureja khuzestanica essential oil on Aspergillus niger, Botrytis cinerea, and Rhizopus stolonifer causing strawberry's rot and mold. *Journal of food science and technology (Iran)*, *18*(115), 171-180 .

[30] Saboktakin-Rizi, M., Alizadeh Behbahani, B., Hojjati, M., & Noshad, M. (2021). Identification of Lactobacillus plantarum TW29-1 isolated from Iranian fermented cereal-dairy product (Yellow Zabol Kashk): probiotic characteristics, antimicrobial activity and safety evaluation. *Journal of Food Measurement and Characterization*, *15*(3), 2615-2624.

[31] Saffari Samani, E ,Jooyandeh, H., & Alizadeh Behbahani, B. (2023). The impact of Zedo gum based edible coating containing Zataria multiflora Boiss essential oil on the quality enhancement and shelf life improvement of fresh buffalo meat. *Journal of Food Measurement and Characterization*, 17, 2663–2675.

[32] Shirani, K., Falah, F., Vasiee, A., Yazdi, F. T., Behbahani, B. A., & Zanganeh, H. (2022). Effects of incorporation of Echinops setifer extract on quality, functionality, and viability of strains in probiotic yogurt. *Journal of Food Measurement and Characterization*, *16*(4), 2899-2907.

[33] Sureshjani, M. H., Yazdi, F. T., Mortazavi, S. A., Behbahani, B. A., & Shahidi, F. (2014). Antimicrobial effects of Kelussia odoratissima extracts against food borne and food spoilage bacteria" in vitro. *Journal of Paramedical Sciences*, *5*(2), 115-120 .

[34] Tabatabaei Yazdi, F., Alizadeh Behbahani, B., Vasiee, A., Mortazavi, S. A., & Yazdi, F. T. (2015). An investigation on the effect of alcoholic and aqueous extracts of Dorema aucheri (Bilhar) on some pathogenic bacteria in vitro. *Archives of Advances in Biosciences*, *6*(1), 58-64 .

[35] Tabatabaei Yazdi, F., Falah, F., Alizadeh Behbahani, B., Vasiee, A., & Mortazavi, A. (20 .(١٩Antimicrobial effect of Citrus aurantium essential oil on some food-borne pathogens and its determination of chemical compounds, total phenol content, total flavonoids content and antioxidant potential. *Journal of Food Science and Technology*, *16*(87), 291-304.

[36] Tabatabaei Yazdi, F., Nooshkam, M., Shahidi, F., Asadi, F., & Alizadeh-Behbahani, B. (2018). Evaluation of antimicrobial activity and antioxidant potential of chitosan Maillard-based conjugates in vitro. *Applied Microbiology In Food Industries*, *4*(3), 1-15.

[37] Tanavar, H., Barzegar, H., Alizadeh Behbahani, B., & Mehrnia, M. A. (2021). Investigation of the chemical properties of Mentha pulegium essential oil and its application in Ocimum basilicum seed mucilage edible coating for extending the quality and shelf life of veal stored in refrigerator (4°C). *Food Science & Nutrition*, *9*(10), 5600-5615.

[38] Yazdi, F. T., & Behbahani, B. A. (2013). Antimicrobial effect of the aqueous and ethanolic Teucrium polium L. extracts on gram positive and gram negative bacteria "in vitro". *Archives of Advances in Biosciences*, *4*(4), 56-62 .

[39] Yazdi, F. T., Falah, F., Behbahani, B. A., Vasiee, A., & Mortazavi, S. A. (2019). Identification of Chemical Compounds, Antioxidant Potential, Phenolic Content and Evaluation of Inhibitory and Bactericidal/Fungicidal Effects of Ginger Essential Oil on Some Pathogenic Microorganisms in Vitro. *Qom University of Medical Sciences Journal 13*(3), 50-62 .

[40] Yazdi, F. T., Tanhaeian, A., Azghandi, M., Vasiee, A., Alizadeh Behbahani, B., Mortazavi, S. A., & Roshanak, S. (2019). Heterologous expression of Thrombocidin-1 in Pichia pastoris: Evaluation of its antibacterial and antioxidant activity. *Microbial Pathogenesis*, *127*, 91-96.

[41] Zanganeh, H., Mortazavi, S. A., Shahidi ,F., & Alizadeh Behbahani, B. (2021). Evaluation of the chemical and antibacterial properties of Citrus paradise essential oil and its application in Lallemantia iberica seed mucilage edible coating to improve the physicochemical, microbiological and sensory properties of lamb during refrigerated storage. *Journal of Food Measurement and Characterization*, *15*(6), 5556-5571.

[42] Kulisic, T., Radonic, A., Katalinic, V., & Milos, M. (2004). Use of different methods for testing antioxidative activity of oregano essential oil. *Food Chemistry*, *85*(4), 633-640.

[43] Singh, O., Khanam, Z., Misra, N., & Srivastava, M. K. (2011). Chamomile (Matricaria chamomilla L.): An overview. *Pharmacogn Rev*, *5*(9), 82-95.

[44] Marino, M., Bersani, C., & Comi, G. (2001). Impedance measurements to study the antimicrobial activity of essential oils from Lamiaceae and Compositae. *International Journal of Food Microbiology*, *67*(3), 187-195.

[45] Tolouee, M., Alinezhad, S., Saberi, R., Eslamifar, A., Zad, S. J., Jaimand, K., Taeb, J., Rezaee, M.-B ,.Kawachi, M., Shams-Ghahfarokhi, M., & Razzaghi-Abyaneh, M. (2010). Effect of Matricaria chamomilla L. flower essential oil on the growth and ultrastructure of Aspergillus niger van Tieghem. *International Journal of Food Microbiology*, *139*(3), 127-133.

[46] Adewusi, E. A., Moodley, N., & Steenkamp, V. (2011). Antioxidant and acetylcholinesterase inhibitory activity of selected southern African medicinal plants. *South African Journal of Botany*, *77*(3), 638-644.

[47] Stanojevic, L. P., Marjanovic-Balaban, Z. R., Kalaba, V. D., Stanojevic, J. S., & Cvetkovic, D. J. (2016). Chemical Composition, Antioxidant and Antimicrobial Activity of Chamomile Flowers Essential Oil (Matricaria chamomilla L.). *Journal of Essential Oil Bearing Plants*, *19*(8), 2017-2028.

[48] Mahdavi, B., Ghorat, F., Nasrollahzadeh, M. S., Hosseyni-Tabar, M., & Rezaei-Seresht, H. (2020). Chemical composition, antioxidant, antibacterial, cytotoxicity, and hemolyses activity of essential oils from flower of Matricaria chamomilla var. chamomilla. *Anti-Infective Agents*, *18*(3), 224-232 .

[49] Formisano, C., Delfine, S., Oliviero, F., Tenore, G. C., Rigano, D., & Senatore, F. (2015). Correlation among environmental factors, chemical composition and antioxidative properties of essential oil and extracts of chamomile (Matricaria chamomilla L.) collected in Molise (South-central Italy). *Industrial Crops and Products*, *63*, 256-263 .

[50] Owlia, P., Rasooli, I., Saderi, H., & Aliahmadi, M. (2007). Retardation of biofilm formation with reduced productivity of alginate as a result of Pseudomonas aeruginosa exposure to Matricaria chamomilla essential oil. *Pharmacognosy Magazine*, *3*(10), 83-89 .

[51] El-Assri, E.-M., Eloutassi, N., El Barnossi, A., Bakkari, F., Hmamou, A., & Bouia, A. (2021). Wild chamomile (Matricaria recutita L) from the Taounate province, Morocco: extraction and valorisation of the antibacterial activity of its essential oils. *Tropical Journal of Natural Product Research*, *5*(5), 883-888 .

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مقاله علمی–پژوهشی

ارزیابی فعالیت آنتی اکسیدانی، فنول و فلاونوئید کل و فعالیت ضدباکتریایی بابونه آلمانی

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اطلاعات مقاله

تاریخ های مقاله :

تاریخ دریافت: ۱٤۰۳/۱/۲۱

تاریخ پذیرش: ۱٤۰۳/۳/۱

کلمات کلیدی:

بابونه آلمانی،

اسانس،

ضد میکروب،

آنتی‌اکسیدان،

ترکیبات فنولی

DOI:10.22034/FSCT.21.154.139.

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چکیده

بابونه آلمانی (*Matricaria chamomilla* L.) یک گیاه دارویی شناخته شده است که در سراسر جهان توزیع می‌شود و در طب سنتی برای درمان انواع بیماری‌ها کاربرد فراوانی دارد. در این پژوهش، اسانس بابونه آلمانی توسط روش تقطیر با آب استخراج گردید و محتوای فنول کل، فلاونوئید کل، فعالیت آنتی‌اکسیدانی و اثر ضدمیکروبی آن بررسی شد. میزان فنول کل اسانس برابر با ۳۹/۷۰ mg GAE/g و فلاونوئید کل آن برابر با ۱۸/۸۰ mg QE/g بود. فعالیت آنتی‌اکسیدانی اسانس بر پایه دو روش مهار رادیکال‌های آزاد DPPH و ABTS مورد ارزیابی قرار گرفت؛ اسانس قادر به مهار رادیکال‌های آزاد DPPH (۵۸/۶۰ درصد) و ABTS (۶۱/۶۰ درصد) بود. اثر ضد میکروبی اسانس بر علیه *باسیلوس سرئوس*، *استرپتوکوکوس پیوژنز*، *استافیلوکوکوس اورئوس*، *شیگلا دیسانتری*، *انتروباکتر ائروژنز* و *سالمونلا تیفی‌موریوم* توسط دیسک دیفیوژن آگار، چاهک آگار، حداقل غلظت مهارکنندگی و حداقل غلظت کشندگی مورد بررسی قرار گرفت. یافته‌های فعالیت ضد میکروبی اسانس به روش دیسک دیفیوژن آگار و چاهک آگار نشان داد که *استرپتوکوکوس پیوژنز* و *انتروباکتر ائروژنز* به ترتیب حساس‌ترین و مقاوم‌ترین سویه‌های میکروبی نسبت به اسانس بابونه آلمانی بودند. نتایج این پژوهش نشان داد که اسانس بابونه آلمانی فعالیت آنتی‌اکسیدانی و ضد میکروبی قوی نشان داده است که می‌تواند کاندیدای بالقوه برای تهیه داروهای آنتی‌اکسیدان و ضد میکروب باشد.