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ANTIRADICAL ACTIVITY OF BASIL AND CHAMOMILE IN DIFFERENT RATIOS

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Annotation

This study evaluated the antiradical activity of mixed chamomile and basil extracts prepared at different plant ratios and using different solvents. Chamomile-to-basil ratios of 1:1, 3:1, and 1:3 were extracted with water and ethanol. Antiradical activity was assessed using absorbance, antiradical activity (ARA, %), and ascorbic acid equivalent (AAE). The results showed that the antiradical activity of the extracts increased as absorbance decreased. The highest activity was observed for the 1:1 chamomile–basil sample prepared with ethanol: absorbance was 0.188, ARA was 83.0935%, and AAE was 483.65 mg/100 g. Among the aqueous extracts, the best result was obtained at a 1:3 chamomile-to-basil ratio, with an ARA of 81.295% and an AAE of 473.02 mg/100 g. The findings demonstrate that antiradical activity is directly dependent on both the plant ratio and the solvent. Ethanol extracted certain phenolic and flavonoid compounds more efficiently, whereas increasing the proportion of basil enhanced antiradical capacity in the aqueous medium. These findings support the potential use of chamomile–basil mixtures as a natural source of antioxidants.

How to Cite

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Introduction. Phytochemical compounds isolated from food sources have substantial potential as therapeutic and chemopreventive agents for the prevention and treatment of various chronic diseases. In particular, phenolic compounds found in spices, fruits, and vegetables are characterized by pronounced antioxidant activity.

Basil (Ocimum basilicum L.), a member of the Lamiaceae family, has been extensively studied as a bioactive plant of both nutritional and medicinal value. Its therapeutic properties are primarily associated with its rich chemical composition, which includes a balanced complex of macro- and microelements, flavonoids, phenolic compounds, and vitamins. The major nutritional constituents of basil include carbohydrates, proteins, and small amounts of lipids. Because dehydration reduces the water content, dried basil contains nutrients in a more concentrated form and therefore has a higher nutrient density [1]. Accordingly, dried basil is regarded as a concentrated raw material rich in minerals and phytochemicals. In terms of mineral composition, basil is particularly notable for its high potassium (K) and calcium (Ca) contents. These elements play important roles in supporting cardiovascular function, maintaining bone strength, and ensuring electrolyte balance. Basil also contains magnesium (Mg), sodium (Na), and other essential trace elements involved in metabolic processes and enzymatic reactions [1, 2]. The biological activity of basil is further attributable to its abundance of flavonoids and phenolic compounds. These

substances possess strong antioxidant properties, help reduce oxidative stress, and protect cells against free-radical damage. Vitamins, particularly ascorbic acid and carotenoids, also contribute immunomodulatory and anti-inflammatory effects. The chemical composition of Ocimum basilicum, which is rich in macro- and microelements, flavonoids, and vitamins, underlies its medicinal properties and supports its value as a functional food and phytotherapeutic agent.

Chamomile (Matricaria chamomilla) has long been used for medicinal purposes and remains the subject of extensive pharmacological research. In traditional medicine, it is used for various conditions, particularly respiratory infections, inflammatory processes, and infectious disorders. Its therapeutic efficacy is primarily attributed to the potent antioxidant and anti-inflammatory properties of its flavonoids, terpenoids, and other polyphenolic compounds. Chemically, Matricaria chamomilla contains a complex array of bioactive constituents, including essential oils, sterols, triterpenes, flavonoids, coumarins, saponins, tannins, alkaloids, amino acids, and various minerals [3–6]. The major flavonoids include apigenin, luteolin, quercetin, rutin, and kaempferol. These compounds play important roles in protecting cells against free radicals, reducing inflammatory mediators, and modulating immune responses. Phenolic acids in chamomile, including caffeic, chlorogenic, and rosmarinic acids and their derivatives, constitute a major bioactive fraction [7–9]. These compounds exhibit antioxidant, antimicrobial, and antispasmodic properties and enhance the overall therapeutic effects of the plant. Thus, the rich phytochemical composition of Matricaria chamomilla provides a scientific basis for its use as a natural anti-inflammatory and calming agent and as an adjunct in respiratory disorders. The biological importance of Matricaria chamomilla L. is particularly associated with its strong antiradical and antioxidant properties, which are attributed to highly active polyphenol–polysaccharide conjugates and other phenolic compounds. Studies have shown that these complex constituents effectively scavenge free radicals in DPPH and ABTS assay systems, thereby substantially reducing oxidative stress [2, 10]. Extracts obtained from chamomile flowers and roots have also demonstrated considerable antioxidant potential. In particular, they exhibit high activity against DPPH radicals and superoxide anion radicals and may protect cellular structures from oxidative damage [9, 11]. These findings confirm that Matricaria chamomilla is a natural source capable of strengthening antioxidant defense mechanisms and provide a scientific rationale for its use as an adjunct phytotherapeutic agent in disorders associated with oxidative stress.

Experimental section. The discoloration of the purple 2,2-diphenyl-1-picrylhydrazyl (DPPH) solution indicates the presence of antioxidant compounds capable of donating a hydrogen atom or an electron. The stable DPPH• radical is a reagent widely used in spectrophotometric assays [12]. In this study, the method proposed by Blois [13] for evaluating DPPH• free-radical inhibition was applied with minor modifications [14].

Preparation of the DPPH• working solution. A 7.92 mM DPPH• solution was prepared in ethanol in a 100 mL volumetric flask. The flask was wrapped in aluminum foil and kept in the dark at room temperature for 30 min.

Preparation of sample extracts. Basil and chamomile samples were combined at the specified ratios to obtain a total mass of 1 g. Each sample was extracted with 25 mL of solvent (water or 96% ethanol) in an ultrasonic bath at 60 °C for 20 min. The resulting extract was passed through a 0.45 μm syringe filter and used for analysis [15].

Determination of antiradical activity. Three milliliters of DPPH solution and 100 μL of solvent (blank) were placed in a 4 mL quartz cuvette. The mixture was kept in the dark, transferred to the spectrophotometer, and its absorbance (D_1) was measured at 517 nm after 30 min using a YOKE K7000 spectrophotometer (China). To assess the antiradical activity of the sample, 100 μL of extract was mixed with 3 mL of DPPH solution, and absorbance (D_2) was measured at 517 nm under the same conditions. Solvent was added as required to bring the total volume in the cuvette to 3.1 mL.

The antiradical activity of the sample extracts was calculated using the following equation:

$$\text{ARA}\ (\%) = (D_1 - D_2) / D_1 \times 100$$

The results are presented in Table 1.

Table 1. Measured absorbance and calculated antiradical activity values for the blank and test samples added to the DPPH solution

No.	Sample	Ratio	Solvent	Abs	ARA, %	AAE, mg/100 g
1	Chamomile–basil	1:1	Water	0.234	78.9568	459.201
2	Chamomile–basil	3:1	Water	0.466	58.0935	335.896
3	Chamomile–basil	1:3	**Water**	**0.208**	**81.295**	**473.02**
4	Chamomile–basil	1:1	**Ethanol**	**0.188**	**83.0935**	**483.65**
5	Chamomile–basil	3:1	Ethanol	0.262	76.4388	444.319
6	Chamomile–basil	1:3	Ethanol	0.271	75.6295	439.536

Results and discussion. The antiradical activity of mixed chamomile and basil extracts was evaluated across different plant ratios and solvents. The results showed that antiradical activity, expressed as ARA (%), increased as absorbance decreased. This relationship reflects the effective neutralization of the DPPH radical by bioactive antioxidant compounds present in the extracts. According to the table, the highest antiradical activity was recorded for the 1:1 chamomile–basil sample prepared with ethanol: Abs = 0.188, ARA = 83.0935%, and AAE = 483.65 mg/100 g. This finding suggests that, at the balanced 1:1 ratio, phenolic compounds, flavonoids, and other reducing constituents from the two plant materials may exert a synergistic effect.

Among the aqueous extracts, the highest activity was observed at a 1:3 chamomile-to-basil ratio. In this sample, absorbance decreased to 0.208, while ARA reached 81.295% and AAE reached 473.02 mg/100 g. This result indicates that increasing the proportion of basil enhances the antiradical capacity of the extract in an aqueous medium. Water-extractable polyphenols and hydrophilic antioxidant components of basil may participate more actively in free-radical scavenging. Conversely, in the aqueous extract with a higher proportion of chamomile (3:1), ARA decreased to 58.0935% and AAE to 335.896 mg/100 g. Under these conditions, an excessive proportion of chamomile may not increase antioxidant efficacy and may instead shift the ratio of active constituents away from its optimum.

Overall antiradical activity in the ethanolic extracts was more stable and generally higher than that of the aqueous extracts. At the 1:1 ratio, ethanol increased ARA from 78.9568% to 83.0935% relative to water, while AAE increased from 459.201 to 483.65 mg/100 g. Ethanol also showed a marked advantage at the 3:1 ratio: ARA was 58.0935% in the aqueous extract and 76.4388% in the ethanolic extract. This difference may be associated with the greater efficiency of ethanol in extracting moderately polar phenolic and flavonoid compounds. At the 1:3 ratio, however, the aqueous extract outperformed the ethanolic extract: ARA was 81.295% in water and 75.6295% in ethanol. Therefore, when basil predominates in the mixture, water may be relatively more effective in extracting certain hydrophilic antioxidants.

In descending order, the overall antiradical activity was: ethanolic 1:1 > aqueous 1:3 > aqueous 1:1 > ethanolic 3:1 > ethanolic 1:3 > aqueous 3:1. This sequence demonstrates that antiradical activity is directly influenced not only by the plant ratio, but also by solvent polarity and the chemical nature of the extracted bioactive compounds. The optimal result obtained for the 1:1 ethanolic extract indicates the formation of a balanced antioxidant profile between chamomile and basil constituents. At the same time, the increased activity observed with a higher proportion of basil in aqueous extracts confirms the important contribution of hydrophilic antioxidant components of basil.

The antiradical activity of chamomile–basil mixtures is characterized by solvent-dependent selectivity and ratio-dependent synergism. The highest antiradical efficacy was observed for the 1:1 ethanolic extract, which had the lowest absorbance and the highest AAE value. For aqueous extracts, the 1:3 ratio was optimal, and increasing the proportion of basil enhanced antiradical capacity. These findings show that both the mixture ratio and the choice of solvent are decisive when evaluating chamomile–basil combinations as a natural source of antioxidants.

Conclusion. The antiradical activity of mixed chamomile and basil extracts depends on both the ratio of the plant materials and the solvent used. The highest antiradical activity was found in the 1:1 chamomile–basil sample prepared with ethanol. This sample was characterized by the lowest absorbance and the highest AAE value, suggesting a beneficial interaction between the bioactive constituents of the two plants when present in a balanced ratio. Among the aqueous extracts, the 1:3 chamomile-to-basil ratio was the most effective; increasing the proportion of basil enhanced antiradical activity in the aqueous medium. Overall, the chamomile–basil combination is a promising natural antioxidant source. The 1:1 ethanolic extract may be regarded as the overall optimum, whereas the 1:3 aqueous extract is the preferred option for water-based extraction.

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