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Antioxidant Activities of *Glycyrrhiza glabra L.* and *Momordica charantia L.* Collected From *Kahramanmaraş, Türkiye*

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ABSTRACT

Objective: Türkiye is one of the countries that are rich in plant biodiversity. This geographical structure and climatic conditions of Kahramanmaraş allow various plant species to coexist. The usefulness of bioactive molecules as a source of novel antioxidant chemicals may be revealed by studies aimed at determining the antioxidant activity of plant species. The antioxidant capacity of the crude products from two Kahramanmaraş plants, licorice (*Glycyrrhiza glabra*) and bitter melon (*Momordica charantia L.*), was examined.

Methods: This study systematically investigates, for the first time, various combinations of temperature, stirring rpm and time, and solvent to optimally extract the bioactive properties from these plants. Using ferric ion antioxidant potential (FRAP) reduction and DPPH (1,1-diphenyl-2-picrylhydrazyl free radical) scavenging tests, the antioxidant capabilities of plant extracts were investigated. Additionally, measurements were made of their total polyphenol levels (TPC), copper (II) ion reducing antioxidant capacity (CUPRAC), and iron (II) chelation activity (FIC).

Results: The results of the FRAP assay and the DPPH assay showed a good connection, suggesting that the extracts included chemicals that could reduce ferric ions and scavenge free radicals. A strong association between TPC and other findings indicated that the extracts' polyphenols contributed to some of the antioxidant activity.

Conclusion: The investigation indicates that consuming these plants would have a lot of advantageous effects due to the antioxidant properties they possess.

Keywords: Antioxidants, *Glycyrrhiza glabra L. Momordica charantia L.*, plant extracts

INTRODUCTION

Free radicals are atoms or molecules with one or more unpaired electrons in its outermost shell and are highly reactive. Radicals can be negatively, positively, or neutrally charged in terms of electrical charge. These reactive chemicals become stable by capturing electrons from other molecules around them. Thus, they convert the molecule from which they have taken its electron into a free radical, making it unstable or reactive. This situation leads to undesirable reactions in the human body. According to a study, it has been stated that a human cell is exposed to radical attacks approximately 10^5 times a day.[1,2] Also, studies have shown that free radicals can cause DNA damage, cell death, protein and lipid modifications, aging, cardiovascular diseases and even cancer stress.[3-6]

The human body employs its defense mechanism, the antioxidant defense system, to cope with the unwanted and damaging effects of such free radicals. Antioxidants present in the body neutralize free radicals. Factors such as improper and unhealthy diet, radiation, air pollution, infections and alcohol consumption contribute to the increase in free radicals solvents.[7]

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If an excess of free radicals is formed and the body's mechanism to deal with these radicals is disrupted, a phenomenon which is oxidative stress emerges. As a solution to this problem, consuming fruits and vegetables which are rich in polyphenols and flavonoids contributes positively to this defense mechanism, thereby inhibiting this effect.[8] The effect of antioxidants on free radicals stems from their ability to readily donate an H^+ atom and thereby convert radicals into low-density, less reactive forms, reducing oxidative stress in this manner.[9]

Glycyrrhiza glabra L., commonly known as licorice, is a flowering plant in the Fabaceae family that can reach up to one and a half meters in height. Due to the sweet aroma of its root, it is used to flavor food, beverages, toothpaste and tobacco products. Originally from the Mediterranean, Asia Minor to Iran, central to southern Russia, licorice species are perennial herbs that are now widely grown in Europe, the Middle East, and Asia. With the development of modern pharmacology, many important pharmacological activities of licorice root have been discovered, and with the help of these developments, natural compounds such as triterpenoids and flavonoids have been isolated from licorice root.[10]

Momordica charantia L. also known as bitter melon or bitter gourd is a tropical vine belonging to the gourd family and is grown as a one-year plant in warm climate conditions, particularly during the summer months. The origin of this plant is in China, although it is also cultivated in Africa and Asia[11] The fruit of this plant contains beneficial chemicals such as polypeptide-p, amino acids like threonine and alanine, and additionally, compounds like picolinic acid and luteolin, which make it highly nutritious. [12] It has been explained by scientists that the seeds contain rich antioxidant compounds such as phenolic acid, gallic acid, catechin, and chlorogenic acid.[13] Turkey holds an important position in terms of genetic diversity in the Cucurbitaceae family[14] Both of these plants are consumed in Turkey especially, Kahramanmaraş.

The active ingredients isolated from plants have been shown in numerous studies in recent years to have antitumor, antimicrobial, antiviral, anti-inflammatory, immunoregulatory, and several other properties that support the preservation and repair of the neurological, gastrointestinal, respiratory, endocrine, and cardiovascular systems.[15–18] In Kahramanmaraş, consumption of licorice is quite widespread, often consumed in the form of licorice sherbet. This sherbet is a refreshing beverage particularly favored during the summer months and the Ramadan period.

Licorice sherbet is frequently consumed due to its health benefits such as being beneficial for the kidneys, stomach, and strengthening the immune system. Bitter melon, on the other hand, is a medicinal plant consumed in various forms in Kahramanmaraş and generally throughout Turkey. Prevalent consumption methods include eating the fruit, consuming it as a paste, or mixing it with olive oil.

Antioxidant activity refers to the reaction occurring between a single antioxidant substance and free radicals. Antioxidant capacity signifies the reaction of a mixture of compounds possessing antioxidant properties with free radicals. Direct or indirect measurements can be used to determine a compound's antioxidant capability.[19] Antioxidant activity analyses, which measure the oxidative stress of antioxidants, are generally divided into two reaction mechanisms. First method based on hydrogen atom transfer (HAT) and the second one is based on singlet electron transfer (SET). In the first method, antioxidants interact with free radicals capturing the reactive hydrogen atoms they possess; it is monitored by color change. In the second method, antioxidants stabilize radicals by donating electrons to them. It can also be defined as a method based on the reduction of structures containing metals or carbonyl groups.[20]

In the first step of this article, extraction of dried bitter melon, and licorice plants will be compared using different solvent systems. To enhance the interaction between the bioactive compounds in the plant and the solvent, a magnetic stirrer was used at room temperature for specific minutes. More effective and efficient extraction of these components were facilitated in this way. After the filtration and drying process, the plant extracts were subjected to different instrumental analysis for the determination of their compositions and stored in the refrigerator at +4 °C to for further studies. After determining the extract yield, incubation time, and solvent polarity conditions with the highest efficiency, total antioxidant capacity determinations of these compositions were conducted by 5 different methods in the continuation of this study.

METHODS

Materials and Preparation of Extracts

An experiment was initiated to compare the extraction efficiency of dried bitter melon and licorice roots obtained from Kahramanmaraş, and to determine the most effective extraction conditions using different solvents of varying polarity and mixing times. First, 0.1 grams of the plant material was taken and 10 mL of pure water was added.

The mixture was then stirred with a magnetic stirrer for 5 minutes. Afterward, the resulting solution was filtered through ordinary filter paper. Subsequently, 2 mL of the filtrate was drawn using a micropipette and transferred to a pre-weighed watch glass. This process was repeated three times. The watch glasses were placed in an oven set to 120 °C for 2 hours. Each watch glass was weighed again, and the values were recorded. The same procedures were conducted for 0.1 grams of both power bitter melon and licorice roots, with 5, 10, 20, 30, 40, and 60 minutes of mixing times. During these processes, shown in Figure 1 different solvent systems such as pure water, ethanol, n-hexane, and boiling pure water were used.

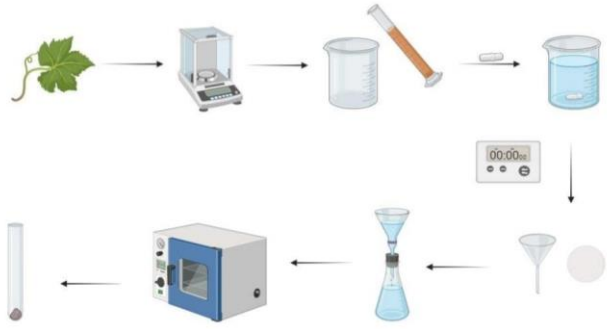

Figure 1: Plant extraction stages

Antioxidant Activity Methods

DPPH Radical Scavenging Activity Assay

DPPH, one of the most commonly used methods for scavenging free radicals, is a chemical compound with the chemical name 2,2-diphenyl-1-picrylhydrazyl. This structure, which is a nitrogen radical reacts with substances with high antioxidant content, causing the purple color of DPPH to disappear, and this process is examined spectrophotometrically at 515 nm.[21]

Firstly, a 10^{-4} M DPPH solution was prepared. Then, a 2000 µg/µL plant stock solution was prepared. From this prepared stock solution, 100, 200, and 1000 µL were taken and diluted with water to a total volume of 1000 µL. In contrast, a control group consisting of 100 µg/µL ascorbic acid stock solution was used to prepare ascorbic acid solutions at five different concentrations by taking 50, 100, 250, 500, and 1000 µL.1 mL of each prepared solution was transferred to Falcon tubes, 2 mL of DPPH was added to it. After vortexing each tube for 30 seconds, they were kept in a dark place for 30 minutes. 1 mL of solvent was used as a blank solution. Absorbance values were read at 517 nm using a UV-Vis spectrophotometer, and the values were recorded. These steps were repeated three times. Then, the percentage of free radical scavenging activity was determined using the formula:

$$\% \text{ Free Radical Scavenging Activity} = (A_c - A_s) \times 100/A_c$$

Where A_c is the absorbance of the blank and A_s is the absorbance of the sample. The antioxidant activity of the plant extract was expressed as IC_{50}, defined as the extract concentration (in µg/mL) required to inhibit the formation of DPPH radicals by 50%. The results were compared with ascorbic acid.

Total Phenolic Content (TPC) Determination Method

This method is based on the measurement of the absorbance of the colored product observed at 745 nm, resulting from the oxidation of phenolic compounds in the antioxidant extract with the Folin-Ciocalteu (FC) reagent. The obtained results are evaluated based on a reference standard of gallic acid to measure antioxidant activity [22].

Plant extracts with a concentration of 1 mg/mL were mixed with 5 mL of Folin reagent in a 1:10 ratio. A 7.5% (w/v) Na_2CO_3 solution was prepared with water. A stock solution of 1000 µg/mL gallic acid was prepared and diluted to concentrations of 20, 40, 60, 80, and 100 µg/mL. After preparing all solutions, 0.4 mL of plant extract and other standard solutions were transferred to Falcon tubes. Then, 2 mL of Folin reagent was added to it and vortexed. After 5 minutes, 1.6 mL of 7.5% Na_2CO_3 solution was added to the mixtures and vortexed again. Falcon tubes were left at room temperature for 1 hour, and absorbances were read at 765 nm against the blank containing 0.4 mL of water.

Iron Reducing Power Assay (FRAP) Method

This antioxidant determination method relies on the reduction of Fe (III) to Fe (II) chelate by the reaction of the Fe(III) tripyridyl triazine (TPTZ) complex with substances rich in antioxidants. This reduction reaction produces a dark blue color, and the measurement is determined spectrophotometrically at 595 nm.[23]

Firstly, 40 mM HCl aqueous solution is prepared. Then, a 10 mM TPTZ (2,4,6-tripyridyl-s-triazine) solution is prepared using a 40 mM HCl. Then, 20 mM $FeCl_3.6H_2O$ solution is prepared. Subsequently, a 0.3 M acetate buffer aqueous solution is prepared. After preparing all solutions, 30 mL of 0.3 M pH 3.6 acetate buffer, 3 mL of 20 mM $FeCl_3.6H_2O$, and 3 mL of 10 mM TPTZ solutions (in a ratio of 10:1:1) are mixed and incubated at 37°C for 10 minutes.1 mM $FeSO_4.7H_2O$ solution is prepared using ethanol as the solvent. The calibration curve is prepared by diluting this stock solution to concentrations of 100, 200, 300, 400, and 500 µM. Additionally, a 1000 µg/mL ascorbic acid solution is prepared. The plant extract solution is also diluted to a concentration of 1 mg/mL.

After preparing all solutions, 200 µL is taken from each and mixed with 1.8 mL of the prepared FRAP solution, followed by vortexing. The reaction mixtures are then incubated at 37°C in a water bath for 30 minutes. After reaching room temperature, absorbances are read at 593 nm against a blank solution. The difference between the sample absorbance and the blank absorbance is calculated to determine the FRAP value. The results are compared against the standard. All measurements are repeated three times.

Iron (II) Chelation Activity (FIC) Method

Ferrozine (3-(2-Pyridyl)-5,6-diphenyl-1,2,4-triazine p,p'-disulfonic acid) is a compound that can form complexes with free ferrous ions (Fe(II)) and contains a chromophore that causes strong absorption. Antioxidant components capable of chelating Fe(II) reduce the concentration of free Fe(II) in the solution, thereby decreasing the concentration of the Ferrozine-Fe(II) complex, leading to absorption loss at 562 nm. Antioxidants that chelate with Fe(II) reduce the formation of the Ferrozine-Fe(II) chelate, resulting in less color formation.

Antioxidant activity is measured based on this process.[24] Different concentrations of plant extracts, ranging from 1 to 10 mg/mL, were prepared from the 1000 µg/mL plant extract solution. Then, 0.25 mM $FeSO_4.7H_2O$ solution was prepared using water.

After preparing all solutions, 0.2 mL of sample solutions at various dilutions and a solution were transferred to falcon tubes. Then, 0.2 mL of 0.1 mM $FeSO_4.7H_2O$ and 0.4 mL of 0.25 mM ferrozine solution were added to each tube. After vortexing the solutions, they were incubated in the dark place at room temperature for 10 minutes, and absorbances were measured at 562 nm. Na_2EDTA was used as a reference. The process was repeated three times. The chelation effect of a sample on ferrous ions was calculated as follows:

$$\text{Chelation effect (\%)} = (A_{Control} - A_{Sample}) \times 100 / A_{Control}$$

Copper(II) Ion Reducing Antioxidant Capacity (CUPRAC) Determination

This method bears similarities to the FRAP method mentioned in 2.2.3. The only difference is that it is based on the reduction of the Cu(II)-neocuproine (Nc) complex to Cu(I) chelate by the antioxidant substance instead of Fe metals.[25] Plant stock solutions with a concentration of 5 mg/mL were diluted to a final concentration of 1 mg/mL. Then, an ascorbic acid solution with a concentration of 1 mM was prepared using water.

From the stock solution, the required amounts were taken to prepare solutions with concentrations of 100, 200, 400, 600, 800, and 1000 µM, and the total volume was adjusted to 1 mL with water. 10 mM $CuCl_2$ solution was prepared. Ammonium acetate (NH_4Ac) was used as a buffer solution to maintain a pH of 7.

Finally, 7.5 mM Neocuproine solution was prepared using ethanol as the solvent. After preparing all solutions, a reaction mixture was prepared in a separate beaker by mixing 20 mL of $CuCl_2$, Neocuproine, and NH_4Ac in a 1:1:1 ratio. To prepare the blank solution, 0.5 mL of plant solution and 3 mL of reaction mixture without $CuCl_2$ were added. From the extract and standard solutions, 0.5 mL was transferred to Falcon tubes, and 3 mL of the reaction mixture was added to it.

After vortexing, the tubes were left for incubation at room temperature for 30 minutes. Absorbance values were read at 450 nm, and the values were recorded. All procedures were repeated three times, and the results were expressed as mM ascorbic acid equivalent per extract.

RESULTS

Impact of Extraction Method and Solvent on Extract Yields

The data presented in Table 1 and Table 2 show the results of extraction obtained using different solvents and durations for bitter melon and licorice plants.

As indicated in Table 1, it is observed that the highest yield of the bitter melon plant is achieved by treating 0.1g of dried plant powder with 10 mL of distilled water for 30 minutes using a magnetic stirrer. According to Table 2, soaking 0.1g of dried plant powder in 10 mL of distilled water for 10 minutes with a magnetic stirrer yields the maximum yield of the licorice plant.

Antioxidant Activity

The research of plant species' antioxidant activity has increased dramatically in recent years due to the fact that many of them are used as sources of phytotherapeutic substances.[26–29] Since phenols feature an aromatic ring that permits the stability and relocation of unpaired electrons within their structure, they are the primary chemicals in plants that exhibit antioxidant action. This property facilitates the transfer of hydrogen atoms and electrons from the hydroxyl groups of their structure.[30,31] The species, tissue, stage of development, and environmental elements—such as temperature, stresses caused by water, and light conditions—all affect the total phenol content of plants.[32,3]

Table 1. Extraction data of bitter melon

Solvents	5 min		10 min		20 min		30 min		40 min		60 min	
	Ext. (mg)	Avg. (mg)	Ext. (mg)	Avg. (mg)	Ext. (mg)	Avg. (mg)	Ext. (mg)	Avg. (mg)	Ext. (mg)	Avg. (mg)	Ext. (mg)	Avg. (mg)
Water (10 mL)	9.30		7.50		9.70		10.20		10.20		10.70	
	11.30	**10.53**	6.60	**7.53**	9.10	**9.33**	10.80	**10.57**	10.30	**10.23**	10.60	**10.17**
	11.00		8.50		9.20		10.70		10.20		9.20	
Ethanol (10 mL)	0.70		0.50		0.60		1.10		0.70		1.20	
	0.60	**0.47**	1.50	**0.80**	0.30	**0.43**	1.00	**0.87**	1.40	**1.03**	1.10	**0.97**
	0.10		0.40		0.40		0.50		1.00		0.60	
N-hexane (10 mL)	0.30		0.10		0.20		0.10		0.10		0.10	
	0.10	**0.18**	0.20	**0.27**	0.10	**0.17**	0.08	**0.09**	0.20	**0.13**	0.10	**0.10**
	0.15		0.50		0.20		0.10		0.10		0.10	
Boiling water (10 mL)	9.70		11.30		8.30		10.20		11.90		11.10	
	9.80	**9.80**	11.00	**11.33**	7.80	**8.40**	10.40	**10.03**	12.00	**12.20**	11.40	**11.47**
	9.90		11.70		9.10		9.50		12.70		11.90	
Water (50 mL)	8.90		10.00		10.10		12.00		11.20		9.20	
	9.30	**9.23**	9.30	**9.47**	9.40	**10.00**	11.50	**11.47**	11.60	**11.43**	10.10	**9.87**
	9.50		9.10		10.50		10.90		11.50		10.30	

Table 2. Extraction data of licorice

Solvents	5 min		10 min		20 min		30 min		40 min		60 min	
	Ext. (mg)	Avg. (mg)	Ext. (mg)	Avg. (mg)	Ext. (mg)	Avg. (mg)	Ext. (mg)	Avg. (mg)	Ext. (mg)	Avg. (mg)	Ext. (mg)	Avg. (mg)
Water (10 mL)	5.90		8.50		6.20		7.10		7.00		4.50	
	5.90	**6.50**	8.40	**8.53**	6.90	**6.87**	7.40	**7.10**	6.30	**6.87**	4.70	**4.67**
	7.70		8.70		7.50		6.80		7.30		4.80	
Ethanol (10 mL)	0.40		0.40		0.60		0.30		0.40		0.40	
	0.30	**0.33**	0.10	**0.47**	0.10	**0.37**	0.40	**0.37**	0.20	**0.33**	0.30	**0.40**
	0.30		0.90		0.40		0.40		0.40		0.50	
N-hexane (10 mL)	2.20		2.50		0.10		0.10		0.30		0.30	
	2.60	**2.63**	2.90	**2.73**	0.10	**0.23**	0.10	**0.10**	0.50	**0.43**	0.90	**0.57**
	3.10		2.80		0.50		0.10		0.50		0.50	
Boiling water (10 mL)	3.90		4.20		2.00		4.30		4.10		4.10	
	3.60	**3.90**	3.40	**3.73**	3.20	**2.70**	4.00	**4.23**	4.50	**4.37**	4.00	**3.67**
	4.20		3.60		2.90		4.40		4.50		2.90	

Table 3: Antioxidant activity data of two plants (where GAE refers to Gallic Acid Equivalent and AAE; Ascorbic Acid Equivalent)

Antioxidant activity methods	*Momordica charantia L.*	*Glycyrrhiza glabra*
DPPH, IC50 (µg/mL)	1212 ± 19.46	1169.39 ± 25.23
TPC (mg GAE/g)	6.59 ± 0.16	25.41 ± 0.25
FRAP (mM Fe(II)/g)	1174.8 ± 30.25	1800 ± 12.58
CUPRAC (mM AAE/g)	267.77 ± 7.63	523.54 ± 10.92
FIC (mg EDTAE/g)	10.81 ± 2.39	37.33 ± 3.64

* Each value is the mean of three experiments.

Antioxidant molecules usually take part in electron transfer activities, which prevent the oxidation of other chemicals that are vulnerable to it when associated with them. Organic compounds were often evaluated for their antioxidant properties, and several of these compounds were employed as protective agents.[34,35]It is possible to assess the antioxidant properties of plant extracts using a variety of techniques; in fact, using at least two separate techniques is advised.[36]

The antioxidant potential of the two chosen species was demonstrated in our investigation using five different techniques to measure their antioxidant activity (Table 3). Additionally, there was a strong link between all of the approaches. With its apparent introduction about half a century ago, the DPPH technique is frequently employed to assess a compound's antioxidant properties as well as its potential to operate as a hydrogen donor or free radical scavenger. A 50% reduction in DPPH activity (color) is the substrate concentration known as the IC50 parameter, which is utilized to interpret DPPH method findings. In comparison to ascorbic acid, the plant extracts were shown to have higher IC50 values. Momordica charantia was shown to have a lower antioxidant capacity than Glycyrrhiza glabra due to the negative relationship between the IC50 concentration and antioxidant capacity.

The Folin–Ciocalteu reagent was used to quantitatively determine the total phenolic content. The TPC was determined as mg GAE/g dry extract weight using a calibration line (y = 0.0087x - 0.0297, R2 = 0.9948) of standard gallic acid. It has been discovered that licorice contains more phenolics.

When comparing the plant extracts' ferric ion-reducing activity to their DPPH scavenging activity, there was little variation seen. Licorice had modest ferric ion reduction activities, which were consistent with the outcomes of radical scavenging experiments. One of the most important ways to assess antioxidant activity is to see whether a molecule can chelate metal ions. This test demonstrates how the molecule interacts with specific ions that are physiologically active. Licorice showed better chelating ability with both iron and copper, according to the results.

Experimental studies have demonstrated that licorice has a higher antioxidant content compared to bitter melon. Also, when considering the frequency of consumption among the public, licorice consumption is more widespread and deeply rooted in Kahramanmaraş. Bitter melon, on the other hand, is consumed among individuals with a health-conscious mindset, particularly for specific health issues however it does not form as prevalent a consumption habit as licorice.

Statistical Analysis

Antioxidant activity was found to be highly significant ($P < .0001$) with DPPH and FRAP techniques for both plants when compared with ascorbic acid (Figure 2A). When compared to disodium EDTA, the FIC method was significant ($P < .01$) for *Momordica charantia L.* and highly significant ($P < 0.0001$) for *Glycyrrhiza glabra L.* There is a significant correlation between five methods of antioxidant activity for *Glycyrrhiza glabra L*. at $p < 0.001$ (Figure 2C). For *Momordica charantia L*., except FRAP other four methods were found to provide strong significance of antioxidant potential (Figure 2B).

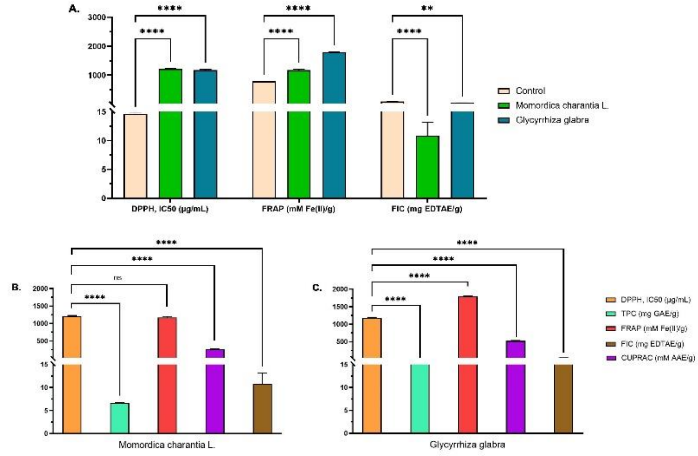

Figure 2. Comparison of antioxidant activity among *Momordica charantia L.* and *Glycyrrhiza glabra*. The antioxidant potential of the two chosen species compared with ascorbic acid using three different techniques (A), data are represented as ± SE, $N = 3$. Statistical analysis is two-way ANOVA $^{**}P < .01$; $^{****}P < .0001$. Comparison of antioxidant potential of *Momordica charantia L.*(B) and *Glycyrrhiza glabra L*. (C) using five different techniques, data are represented as ± SE, $N = 3$. Statistical analysis is one-way ANOVA $^{****}P < .0001$.

DISCUSSION

The research of plant species' antioxidant activity has increased dramatically in recent years due to the fact that many of them are used as sources of phytotherapeutic substances.[26-29] Since phenols feature an aromatic ring that permits the stability and relocation of unpaired electrons within their structure, they are the primary chemicals in plants that exhibit antioxidant action. This property facilitates the transfer of hydrogen atoms and electrons from the hydroxyl groups of their structure.[30,31] The species, tissue, stage of development, and environmental elements—such as temperature, stresses caused by water, and light conditions—all affect the total phenol content of plants.[32,33]

Antioxidant molecules usually take part in electron transfer activities, which prevent the oxidation of other chemicals that are vulnerable to it when associated with them. Organic compounds were often evaluated for their antioxidant properties, and several of these compounds were employed as protective agents.[34,35]

It is possible to assess the antioxidant properties of plant extracts using a variety of techniques; in fact, using at least two separate techniques is advised.[36] The antioxidant potential of the two chosen species was demonstrated in our investigation using five different techniques to measure their antioxidant activity (Table 3). Additionally, there was a strong link between all of the approaches. With its apparent introduction about half a century ago, the DPPH technique is frequently employed to assess a compound's antioxidant properties as well as its potential to operate as a hydrogen donor or free radical scavenger. A 50% reduction in DPPH activity (color) is the substrate concentration known as the IC_{50} parameter, which is utilized to interpret DPPH method findings. In comparison to ascorbic acid, the plant extracts were shown to have higher IC_{50} values. *Momordica charantia* was shown to have a lower antioxidant capacity than *Glycyrrhiza glabra* due to the negative relationship between the IC_{50} concentration and antioxidant capacity.

The Folin–Ciocalteu reagent was used to quantitatively determine the total phenolic content. The TPC was determined as mg GAE/g dry extract weight using a calibration line ($y = 0.0087x - 0.0297$, $R^2 = 0.9948$) of standard gallic acid. It has been discovered that licorice contains more phenolics. When comparing the plant extracts' ferric ion-reducing activity to their DPPH scavenging activity, there was little variation seen. Licorice had modest ferric ion reduction activities, which were consistent with the outcomes of radical scavenging experiments. One of the most important ways to assess antioxidant activity is to see whether a molecule can chelate metal ions. This test demonstrates how the molecule interacts with specific ions that are physiologically active. Licorice showed better chelating ability with both iron and copper, according to the results.

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In conclusion, this study reveals the antioxidant potential of two plants which are consumed commonly in Kahramanmaraş, Turkey, could protect against free radical damage.

The information and data obtained from this study are considered beneficial for the development of food products and additives with appropriate antioxidant properties. The identification of natural antioxidant sources and their appropriate consumption in the daily diet or the use of isolated compounds in clinical practices would be beneficial for a healthy life. From a broader perspective, the data obtained from this study will be crucial for individuals who rely herbal treatment methods based on natural sources, enabling them to make more informed consumption decisions. However, it is essential to remember that the effectiveness of herbal treatments depends on using the right plant, for the right person, in the right way, and at the correct dosage.

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