DOI: http://dx.doi.org/10.32571/ijct.1529920 **E-ISSN: 2602-277X**

International Journal of Chemistry and Technology

http://dergipark.org.tr/ijct

Research Article

A study on antioxidant and antimicrobial potential of Kahramanmaraş tarhana

Emre Cem Eraslan[1*]

[1]*Akdeniz University, Faculty of Science Department of Biology, Antalya, Turkey*

Received: 7 August 2024; Revised: 25 October 2024; Accepted: 4 November 2024

*****Corresponding author e-mail: emrecemeraslan@gmail.com

Citation: Eraslan E.C. *Int. J. Chem. Technol.* **2024**, 8 (2), 159-163.

ABSTRACT

Since ancient times, fermented foods have been produced for the purpose of long-term storage of foods and adding different flavors. Today, in addition to these properties, their use as functional products and the search for different tastes have directed people to fermented foods. In our study, the antioxidant and antimicrobial potential of Kahramanmaraş tarhana, a fermented food, was determined. The total antioxidant status and total oxidant status index were assessed utilizing Rel Assay TAS and TOS kits. The antimicrobial activity was evaluated against conventional bacterial and fungus strains utilizing the agar dilution method. The analyses revealed that the TAS value of tarhana is 7.612±0.151 mmol/L, the TOS value is 6.685±0.076 µmol/L, and the OSI value is 0.088±0.001. It demonstrated efficacy against bacterial strains at extract concentrations ranging from 100 to 400 µg/mL and against fungal strains at extract concentrations between 200 to 400 µg/mL. In this connection, it was established that tarhana, favored for its nutritional and fragrant attributes, possesses antioxidant and antibacterial effects.

Keywords: Antimicrobial, Antioxidant, Fermented foods, Functional foods, Tarhana.

1. INTRODUCTION

Fermented foods, enriched in terms of flavor due to the effect of microorganisms, have become an indispensable part of human civilization since ancient times with their extended shelf life and enhanced nutritional value. Various foods, from dairy products to vegetables, from grains to legumes, have been transformed into essential food sources through the fermentation process, which holds great significance worldwide. One of the most notable health benefits of fermentation is its ability to significantly increase the antioxidant properties of foods.[1] Fermentation is a microbial process carried out for the purpose of long-term storage of food products. In addition, this microbial process involves the production of new food products with different tastes and textures. Fermented foods have positive effects on human health because they contain different properties than normal foods. In addition, fermented products have high protective properties due to the increase in the antimicrobial properties of the food due to the fermentation process.[2-4] The antioxidant activity of foods is crucial for both their shelf life and the protection against oxidative damage in the human body. Increased oxidative stress plays a role in the development of most chronic diseases associated with aging and diet. As a result, antioxidant activity is regarded as a key nutritional property. Its effectiveness within the human body is influenced by the structure of the food matrix and the concentration of antioxidants in the food, both of which depend on processing conditions, ultimately affecting antioxidant bioavailability.[5] In our study, the total antioxidant status, total oxidant status and oxidative stress index of Kahramanmaraş tarhana were determined. In addition, its antimicrobial activity against test bacterial and fungal strains was tested.

Kahramanmaraş tarhana is distinguished from other tarhanas due to its features such as different processes applied in production technology and natural additives. Tarhana, one of the symbolic traditional products of Kahramanmaraş, consists of two basic raw materials, wheat flour and yogurt. The production stage of Kahramanmaraş tarhana is made at home with traditional methods. In addition, production is also common in large enterprises with modern techniques. It is made between May and October with traditional methods. Although it is produced with similar methods, it varies due to the equipment, materials and raw materials used, which vary according to preference.[6-9] In our study, Kahramanmaraş

DOI: http://dx.doi.org/10.32571/ijct.1529920 E-ISSN: 2602-277X

tarhana obtained after the home-type production stage was used.

2. MATERIALS AND METHODS

2.1. Materials

2.1.1. Tarhana production

The tarhana to be used in our study was produced using the traditional method. First, the threshing was sorted and ground. Then, it was washed with clean water. Then, it was added to boiled water and salt was added. Then, the threshing was boiled until it melted. Then, it was waited for a certain period for the cooked threshing to cool. The kneading process was carried out using thyme, black cumin and yogurt. Then, it was waited for approximately 12 hours for fermentation. Then, it was laid on special sticks called "çig" which are used only for laying tarhana. The drying process was carried out for an average of two days (Figure 1). After the drying process, the tarhana was turned into powder. 30 g of the powdered tarhana was weighed and the extraction process was carried out. For this, 30 g of tarhana was extracted with 250 mL of ethanol in a Soxhlet apparatus for approximately 6 hours. The solvent of the resulting extract was evaporated using a rotary evaporator and the crude extract was obtained.

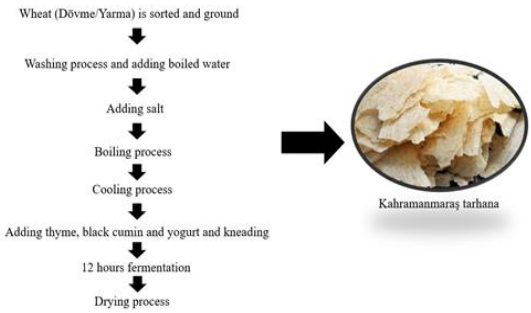

Figure 1. Tarhana production process

2.2. Methods

2.2.1. Total antioxidant and oxidant status

The TAS and TOS values of tarhana were assessed using Rel assay kits. The analyses were conducted according to the manufacturer's methodology. The antioxidant status was determined using the Rel Assay Diagnostics-TAS Assay Kit. The kit includes Reagent 1, which is a buffer solution, Reagent 2, which is a solution containing a colored ABTS radical, Standard 1, which has a concentration of 1.00 mmol Trolex equivalent per liter, and Standard 2, which also has a concentration of 1.00 mmol Trolex equivalent per liter. Reagent 1, in a volume of 200 µL, was introduced into the wells of the plate. Subsequently, a volume of 12 µL of tarhana extract was introduced. The initial absorbance was measured at a wavelength of 660 nm. Next, 30 microliters of Reagent 2 were introduced. The incubation process was carried out at a temperature of 37 degrees Celsius for a duration of 5 minutes. Next, the measurement of absorbance at a wavelength of 660 nm was conducted.[10]

The oxidant status test utilized the Rel Assay Diagnostics-TOS Assay Kit. The kit includes four components: Reagent 1 (Assay buffer), Reagent 2 (Prochromogen solution), Standard 1 (Blank solution: distilled water), and Standard 2 (stock stabilized standard solution (SSSS): 800mM H_2O_2 Equiv./L). Within this framework, standard 2 underwent a dilution process of 40-fold by means of distilled water. Next, a volume of 5 µL of standard 2 was transferred into an Eppendorf tube, followed by the addition of 1 mL of distilled water. It was subsequently subjected to vortex. A volume of 5 microliters of this solution was transferred into an Eppendorf tube, and then 1 milliliter of water was added. Within this framework, a solution of hydrogen peroxide (H_2O_2) was created with a concentration of 20 micromoles per liter. This solution was consistently produced anew each time. Initially, 200 µL of Reagent 1 was dispensed into the well on the plate, followed by the addition of 30 µL of tarhana extract. Subsequently, the initial absorbance measurement was taken at a wavelength of 530 nm. Next, 10 microliters of Reagent 2 were introduced, and the mixture was kept at a temperature of 37 degrees Celsius for a duration of 5 minutes. Next, the absorbance at 30 nm was measured.[11]

In order to determine the Oxidative Stress Index (OSI), the unit of measurement for the total oxidant value was standardized to be the same as the unit of measurement for the total antioxidant value. Next, the total amount of oxidants was divided by the total amount of antioxidants to calculate the percentage.[12]

2.2.2. Antimicrobial activity test

The antibacterial efficacy of tarhana extract was evaluated against typical bacterial and fungal strains. The modified agar dilution method was employed for the assay. Bacterial strains were pre-cultured in Hinton Broth medium. Fungal strains were pre-cultured in RPMI 1640 broth medium. The findings of our investigation indicated the minimal extract concentration that inhibited the growth of bacterial and fungal strains. Extracts were evaluated against bacterial and fungal strains at concentrations ranging from 12.5 to 800 µg/mL.[13-16]

Test bacteria: *Acinetobacter baumannii* ATCC 19606, *Staphylococcus aureus* ATCC 29213, *S. aureus* MRSA ATCC 43300, *Pseudomonas aeruginosa* ATCC 27853, *Enterococcus faecalis* ATCC 29212, and *Escherichia coli* ATCC 25922
Test fungi: *Candida krusei* ATCC 34135, *C. albicans* ATCC 10231, and *C. glabrata* ATCC 90030

DOI: http://dx.doi.org/10.32571/ijct.1529920 **E-ISSN: 2602-277X**

3. RESULTS AND DISCUSSION

3.1. Antioxidant Activity

Reactive oxygen species are molecules with high reactivity.[17] As the levels of these compounds increase, cellular damage may occur.[18] This damage is prevented by the antioxidant defense system. However, as the levels of reactive oxygen species increase, the antioxidant defense system may become insufficient.[19] In this case, oxidative stress occurs. As a result of oxidative stress, serious diseases such as cancer, cardiological disorders, diabetes, obesity, Parkinson's, and Alzheimer's can be seen in humans. Supplemental antioxidants can be used to prevent the formation of these diseases.[20-22] In this context, the total antioxidant status, total oxidant status, and oxidative stress index of Kahramanmaraş tarhana were determined in our study. The findings are shown in Table 1.

Table 1. TAS, TOS and OSI values of Kahramanmaraş tarhana

Solvent	TAS (mmol/L)	TOS (µmol/L)	OSI (TOS/(TASX10))
Tarhana	7.612±0.151	6.685±0.076	0.088±0.001

Values are given as mean ± standard deviation. (n=3)

No findings were identified in the literature addressing the TAS, TOS, and OSI values of tarhana. It was identified for the first time in our research. Nonetheless, it has been documented that tarhana possesses antioxidant potential through several methodologies.[23-27] The antioxidant capacity of Kahramanmaraş tarhana was assessed utilizing Rel assay kits in our study. Literature reports TAS, TOS, and OSI values for several mushroom and plant species utilizing Rel Assay kits. The TAS values for *Marrubium globosum, Alcea kurdica, Cantharellus cibarius, Clavariadelphus truncatus, Terfezia boudieri, Glycyrrhiza glabra,* and *Bovista nigrescens* were recorded as 7.677, 3.298, 5.268, 2.415, 2.332, 8.770, and 4.140 mmol/L, respectively. The TOS values were documented as 12.387, 8.312, 6.380, 3.367, 26.945, 14.590, and 8.860 µmol/L, respectively. OSI values were documented as 0.162, 0.252, 0.121, 0.140, 1.156, 0.167, and 0.215, respectively.[20,28-34] Compared to these studies, the TAS value of the tarhana extract used in our study was determined to be lower than *Marrubium globosum* and *Glycyrrhiza glabra* and higher than *Alcea kurdica*, *Cantharellus cibarius*, *Clavariadelphus truncatus*, *Terfezia boudieri* and *Bovista nigrescens*. The TAS number signifies the total antioxidant chemicals generated in a food product. In comparison to plants and fungi recognized for their antioxidant activities in the literature, the antioxidant potential of tarhana utilized in our study was shown to be significant. The TOS number indicates the total oxidant chemicals generated in food goods. The TOS value of the tarhana extract used in our study was determined to be lower than *Marrubium globosum*, *Alcea kurdica*, *Terfezia boudieri*, *Glycyrrhiza glabra* and *Bovista nigrescens*, and higher than *Cantharellus cibarius* and *Clavariadelphus truncatus*. In this context, it was observed that the oxidant compound levels of tarhana were at normal levels. The OSI value shows the percentage of endogenous antioxidants suppressing endogenous oxidant compounds.[35] The OSI value of tarhana used in our study was found to be lower than *Marrubium globosum*, *Alcea kurdica*, *Cantharellus cibarius*, *Clavariadelphus truncatus*, *Terfezia boudieri*, *Glycyrrhiza glabra* and *Bovista nigrescens*. In this context, it was found that tarhana had a better effect in suppressing oxidant compounds compared to the reported natural plant and fungal species. As a result, it was determined that Kahramanmaraş tarhana has a significant antioxidant potential.

3.2. Antimicrobial activity

Currently, the prevalence of microbial diseases is rising. The primary cause of this phenomenon is the rise in resistance microbes resulting from indiscriminate antibiotic usage.[36] The efficacy of contemporary antibacterial agents is inadequate. In light of the potential adverse effects of synthetic pharmaceuticals, researchers have shifted their focus towards the exploration of natural antibacterial agents.[37,38] In our study, the antimicrobial activity of Kahramanmaraş tarhana, a fermented product, was determined. The findings are shown in Table 2.

Table 2. Antimicrobial activity results of Kahramanmaraş tarhana

Bacterias	Tarhana *Extract*
S. aureus	200
***S. aureus* MRSA**	200
E. faecalis	200
E. coli	400
P. aeruginosa	100
A. baumannii	200
C. glabrata	200
C. albicans	200
C. krusei	400

*100, 200 and 400 µg/mL: extract concentration.

The efficacy of tarhana extract against typical bacterial and fungal strains was assessed in our investigation. The extract was found to be effective against bacteria at concentrations ranging from 100 to 400 µg/mL. The extract demonstrated efficacy against fungal strains at concentrations between 200-400 µg/mL. The extract had the most significant efficacy against *P. aeruginosa* at a dose of 100 µg/mL. It demonstrated efficacy against *S. aureus*, MRSA *S. aureus*, *E. faecalis*, *A. baumannii*, *C. glabrata*, and *C. albicans* at a dose of 200 µg/mL. It was established that it was effective against *E. coli* and *C. krusei* at a dose of 400 µg/mL. Literature indicates that tarhana exhibits antibacterial properties against *B. cereus* and *S. aureus*.[39] Our study assessed the efficacy of tarhana against six bacterial strains and three fungus types. Consequently, it was noted that it has antibacterial

DOI: http://dx.doi.org/10.32571/ijct.1529920 **E-ISSN: 2602-277X**

action against the bacterial and fungal strains employed in our study.

4. CONCLUSION

This study assessed the total antioxidant status, total oxidant status, and oxidative stress index of Kahramanmaraş tarhana. Furthermore, its antibacterial efficacy against typical bacterial and fungal strains was assessed. The studies indicated that tarhana possesses a significant antioxidant potential. Furthermore, it was noted that it had antibacterial efficacy against bacteria and fungal strains. Consequently, tarhana, a fermented food, demonstrates beneficial possibilities regarding health, in addition to its flavor and nutritional attributes.

Conflict of interest

I declare that there is no conflict of interest with any person, institute, company, etc.

REFERENCES

1. Seo, M.J. *Antioxidants*, **2024**, 13(9), 1120.
2. Nout, M.J.R. *Food Res Int*. **1994**, 27(3), 291-298.
3. Caplice, E.; Fitzgerald, GF. *Int J Food Microbiol*. **1999**, 50(1-2), 131-149.
4. Hasan, M.N.; Sultan, M.Z.; Mar-E-Um, M. *J. Sci. Res*. **2014**, 6(2), 373-386.
5. Fardet, A., & Rock, E. *Nutrition research reviews*, **2018**, *31*(1), 52-70.
6. Şimşekli, N.; Doğan, İ.S. *Iğdır Üniversitesi Fen Bilimleri Enstitüsü Dergisi*. **2015**, 5(4), 33-40.
7. Yörükoğlu, T.; Dayısoylu, K.S. *Atatürk Üniversitesi Ziraat Fakültesi Dergisi*. **2016**, 47(1), 53-63.
8. Çekal, N.; Aslan, B. *Güncel Turizm Araştırmaları Dergisi*, **2017**, (2), 124-135.
9. Gök, S.A.; Sezgin, A.C.; Yıldırım, F. *Aydın Gastronomy*. **2017**, 1(1), 61-70.
10. Erel, O. *Clinical Biochemistry*. **2004**, 37(4), 277-285.
11. Erel, O. *Clinical Biochemistry*. **2005**, 38(12), 1103-1111.
12. Sevindik, M. *Mantar Dergisi*. **2021,** 12(1), 29-32.
13. Bauer A.W.; Kirby W.M.; Sherris J.C.; Turck, M. *Am J Clin Pathol*. **1966,** 45: 493-96.
14. Hindler, J.; Hochstein, L.; Howell, A. *In H. D. Isenberg (ed) Clinical microbiology procedures handbook*, vol. 1. American Society for Microbiology, Washington, D.C. **1992,** p. 5.19.1-5.19.6.
15. Matuschek, E.; Brown, D.F.; Kahlmeter, G. *Clinical Microbiology and Infection*, **2014**, 20(4): 255-266.
16. Baba, H.; Sevindik, M.; Dogan, M.; Akgül, H. *Fresen Environ Bull*. **2020,** 29(09), 7840-7846.
17. Uysal, İ.; Mohammed, F.S.; Şabik, A.E.; Kına, E.; Sevindik, M. *Turkish Journal of Agriculture-Food Science and Technology*. **2021,** 9(10), 1902-1904.
18. Mushtaq, W.; Baba, H.; Akata, İ.; Sevindik, M. *Kahramanmaraş Sütçü İmam Üniversitesi Tarım ve Doğa Dergisi*. **2020,** 23(3), 592-595.
19. Eraslan, E.C.; Altuntas, D.; Baba, H.; Bal, C.; Akgül, H.; Akata, I.; Sevindik, M. *Sigma Journal of Engineering and Natural Sciences*. **2021,** 39(1), 24-28.
20. Bal, C.; Eraslan, E.C.; Sevindik, M. *Prospects in Pharmaceutical Sciences*. **2023,** 21(2), 37-41.
21. Mohammed, F.S.; Uysal, I.; Sevindik, M. *Prospects in Pharmaceutical Sciences*. **2023,** 21(2), 1-21.
22. Sevindik, M.; Mohammed, F.S.; Uysal, I. *Prospects in Pharmaceutical Sciences*. **2023,** 21(3), 38-48.
23. Yaz, H.H.; Uysal, İ.; Polat, A.O.; Mohammed, F.S.; Sevindik, M. *Lekovite sirovine*. **2023,** 43(1), e156.
24. Koca, A. *Asian J. Chem*. **2008,** 20(7), 5667-5672.
25. Kilci, A.; Gocmen, D. *Food Chem*. **2014,** 151, 547-553.
26. Değirmencioğlu, N.; Gürbüz, O.; Herken, E.N.; Yıldız, A.Y. *Food Chem*. **2016,** 194, 587-594.
27. Gurbuz, I. B.; Yildiz, E. *Environ. Sci. Pollut. R*. **2019,** 26, 25526-25537.
28. Ghafoor, K.; Al-Juhaimi, F.; Özcan, M.M.; Babiker, E.E.; Ahmed, I.A.M.; Alsawmahi, O.N. *Int. J. Food Sci. Tech*. **2021,** 56(7), 3600-3606.
29. Sevindik, M.; Pehlivan, M.; Dogan, M.; Selamoglu, Z. (2018). *Gazi University Journal of Science*. **2018,** 31(3), 707-711.
30. Sevindik, M. *Mantar Dergisi*. **2018,** 9(2), 165-168.
31. Sevindik, M. *Turkish Journal of Agriculture-Food Science and Technology*. **2019,** 7(9), 1377-1381.
32. Mohammed, F.S.; Korkmaz, N.; Doğan, M.; Şabik, A.E.; Sevindik, M. *Journal of Faculty of Pharmacy of Ankara University*. **2021,** 45(3), 524-534.
33. Pehlivan, M.; Mohammed, F.S., Şabik, A.E.; Kına, E.; Dogan, M.; Yumrutaş, Ö.; Sevindik, M. *Turkish Journal of Agriculture-Food Science and Technology*. **2021,** 9(6), 1129-1132.
34. Mohammed, F.S.; Sevindik, M.; Uysal, I.; Sevindik, E.; Akgül, H. *Biology Bull*. **2022,** 49(Suppl 2), S59-S66.
35. Sevindik, M.; Gürgen, A.; Khassanov, V.T.; Bal, C. (2024). *Foods*. **2024,** 13(10), 1560.

DOI: http://dx.doi.org/10.32571/ijct.1529920 **E-ISSN: 2602-277X**

36. Korkmaz, N.; Mohammed, F.S.; Uysal, İ.; Sevindik, M. *Prospects in Pharmaceutical Sciences*. **2023,** 21(4), 48-53.

37. Sevindik, M.; Akgül, H.; Günal, S.; Doğan, M. *Kastamonu University Journal of Forestry Faculty*. **2016,** 16(1), 153-156.

38. Karaltı, İ.; Eraslan, E.C.; Sarıdoğan, B.G.Ö.; Akata, I.; Sevindik, M. *Int. J. Med. Mushrooms*. **2022,** 24(12), 69-76.

39. Kaya, H.I.; Şimşek, Ö. *Microorganisms*. **2020**, 8(7), 1083.