JAP&T
TPA-Timişoara

Available online at http://journal-of-agroalimentary.ro

Journal of Agroalimentary Processes and Technologies 2023, 29 (2), 78-81

Journal of Agroalimentary Processes and Technologies

Effect of drying method and solvent on antioxidant activity of *Prunus armeniaca* and *Prunus avium* leaves

Hülya Şen Arslan

Department of Food Engineering, Karamanoğlu Mehmetbey University, 70100 Karaman, Turkey

Abstract

In this study, the effect of ethanolic and methanolic extracts of microwave and air-dried cherry leaves on antioxidant activity were investigated. *Prunus armeniaca* and *Prunus avium* leaves were cleaned and dried with microwave (Mw) and air (A) separately. Then, by taking methanol (MeT) and ethanol (ET) extractions, an experimental design was made with two extraction methods as AMeT (Air-Methanol), AET (Air-Ethanol), MwMeT (Microwave-Methanol) and MwET (Microwave-Ethanol) and two drying methods. AMET *Prunus armeniaca* extracts have the highest antioxidant activity (39.63 mg TEAC/g). MwMET *Prunus avium* extracts have the lowest antioxidant activity (18.08 mg TEAC/g). When the results are examined in terms of EC_{50}; MwMeT *Prunus armeniaca* extracts have the highest activity (4.56 g sample/g DPPH). MwMeT *Prunus avium* extracts have the lowest activity (28.52 g sample/g DPPH). In addition, it was found that leaves also affected antioxidant activity and there was a statistically significant ($p<0.05$) difference between them.

Keywords: air; apricot; cherry; microwave

1. Introduction

In recent years, the amount of food waste has been increasing around the world due to production and consumption. It is observed that organic wastes such as leaves, which are formed as a result of physical processes such as sorting, are especially high in fruit and vegetable production facilities.

Drying, which is a dehydration technique in its most general definition, is the removal of moisture from the product area by heat and mass transfer. With this method, the formation of microbial activities is prevented by decreasing the water activity value, and chemical degradation is prevented by decreasing the enzyme activity [1]. Convection drying technique is a widely applied technique although drying times are long, it is economical in the food industry. However, this method also has some disadvantages such as long drying time and loss of quality properties of the product [2]. Microwave drying technique is the process of drying the product by absorbing microwave energy and converting the energy into heat. The difference of the microwave drying method from the traditional methods is that the heat is generated directly in the product and evaporates the water a short time [3]. In this drying method, heat generation and transmission are faster in the product, thus the drying time is shortened [4].

Fruits and vegetables had high antioxidant activity. In addition, these fruit leaves also show antioxidant properties because they contain phenolic compounds. The first step in obtaining phytochemicals from plant materials is the extraction process [5]. The solubility of phenolics varies depending on the type of solvent used, the degree of polymerization of phenolics and the formation of insoluble complexes with other components, extraction time and temperature, sample, solvent ratio. Water, methanol, ethanol, ethyl acetate, acetone and their combinations at different rates are widely used in phenolic component extraction. Choosing the appropriate solvent affects the amount of extracted phenolic compounds and thus also affects the antioxidant

* Corresponding author: *hsenarslan@kmu.edu.tr*

properties [6]. In this study, the effect of ethanolic and methanolic extracts of microwave and air-dried apricot and cherry leaves on antioxidant activity was investigated.

2. Materials and Method

2.1. Materials

Apricot (*Prunus armeniaca*) and cherry (*Prunus avium*) leaves were collected from Karaman in June 2022. In the microwave (Mw) drying process, 50 g of leaves were dried at 13 W/g (650 W) microwave power densities for 210-270 s. In the air drying process (A), leaves were dried on a clean surface at room temperature for one week. The dried leaves were ground with a commercial blender and stored at -18 °C until extraction [7].

2.2. Leaves extracts

Methanol (MeT) and ethanol (ET) extracts of leaves were prepared using the method of Özpınar et al. (2013) [8]. In MeT extraction, 100 mL of methanol was added to 20 g of ground leaves. In ET extraction, 100 mL of ethanol was added to 20 g of ground leaves. It was kept in a shaking water bath set at 25 °C and 150 RPM for 24 hours. The extracts were centrifuged at 4000 RPM for 10 minutes and the filtrate was obtained by passing the upper part through Whatman 1. The obtained filtrates were stored at -18 °C until the analysis period.

2.3. Radical scavenging activity by DPPH

DPPH assay was determined according to method of Singh et al. (2002) [9]. Briefly, a 0.1 mL of diluted extract solution was mixed with 3.9 mL of a 25 mg/L methanolic solution of DPPH and this mixture was vortexed for 10 s. After 30 min of incubation at room temperature, absorbance was measured at 515 nm using UV-Vis spectrophotometer (Agilent 8453, USA) versus prepared blank (methanol). The results were expressed as EC_{50} value which is defined as amount of sample necessary to decrease initial DPPH concentration by 50%. EC_{50} was expressed as gram of sample to gram of DPPH.

2.4. Antioxidant capacity by ABTS

The antioxidant capacity was determined by another radical called ABTS [10]. The solutions of ABTS (2.45mM) and $K_2S_2O_8$ (12.25 mM) were mixed and incubated in darkness for 16 h to obtain stock solution of ABTS radical. The absorbance of the ABTS solution was adjusted to 0.700 ± 0.005 at 734 nm just before the application of the assay. Extracts (20 µL) and ABTS solution (2 mL) were mixed and incubated in a darkness for 6 min. Trolox standards (40-200 mg/L) were prepared and reacted with ABTS as stated above in order to generate a linear regression equation. The absorbances were measured by a spectrophotometer at 734 nm. The results were given as mg trolox equivalent per 100 g sample.

2.5. Statistical analysis

The results were analyzed statistically using SPSS 22 (IBM Corp., Armonk, New York, USA) program. Sample means were compared using Two Way ANOVA and were evaluated with Tukey test from Post Hoc Test.

3. Results and Discussion

ABTS and DPPH antioxidant activity differ from each other in mechanism. A high ABTS value indicates that the antioxidant activity is high, but it can be said that the antiradical activity increases as the EC_{50} value decreases. The effect of leaf type, drying method and solvent difference on antioxidant activity showed Table 1. According to Table 1, *Prunus armeniaca* has higher antioxidant activity than *Prunus avium*. Air-dried leaves and extracts taken with methanol have higher antioxidant activity. In addition, it can be concluded that different fruit leaves, using different solvents and drying the leaves with different methods have different effects on antioxidant activity and the difference between them is statistically significant ($p<0.05$).

Drying method and solvent interaction on antioxidant activity is showed in Table 2. It was determined that the extract of the air-dried *Prunus armeniaca* leaves with methanol had the highest antioxidant activity (39.63 mg TEAC/g). The lowest antioxidant activity was the extract of the microwave dried *Prunus avium* leaves with methanol (18.08 mg TEAC/g). When the results are examined in terms of EC_{50}, MwMeT *Prunus armeniaca* extracts have the highest activity (4.56 g sample/g DPPH). The lowest activity was the extract of the microwave dried *Prunus avium* leaves with methanol (28.52 g sample/g DPPH). It has been determined that the effects of fruit leaf type, drying method and solvent difference interactions

Table 1. The effect of leaf type, drying method and solvent difference on antioxidant activity

Factor	Treatments	ABTS* (mg TEAC/g)	DPPH* EC_{50} (g sample/g DPPH)
Solvent	Ethanol	23.41^{b} ±1.18	10.45^{b} ±0.96
	Methanol	27.87^{a} ±1.71	11.63^{a} ±0.73
Drying	Air	28.08^{a} ±1.74	8.587^{b} ±0.01
	Microwave	23.21^{b} ±1.55	13.486^{a} ±0.05
Leaves	*Prunus armeniaca*	26.47^{a} ±1.98	6.66^{b} ±1.89
	Prunus avium	24.82^{b} ±1.99	15.41^{a} ±1.01

* Comparison of the means of 6-replicate data with Tukey multiple comparison tests shows that there is a significant difference between the letters on the means; $p < 0.05$

Table 2. The effect of leaf type. drying method and solvent interaction on antioxidant activity

Drying	Solvent	Leaves	ABTS* (mg TEAC/g)	DPPH* EC_{50} (g sample/g DPPH)
Air	Methanol	*Prunus avium*	31.65^{b} ±1.37	7.92^{e} ±0.01
Air	Methanol	*Prunus armeniaca*	39.63^{a} ±1.51	5.52^{g} ±0.01
Air	Ethanol	*Prunus avium*	20.84^{cde} ±1.19	13.78^{b} ±0.02
Air	Ethanol	*Prunus armeniaca*	20.21^{de} ±0.88	7.13^{f} ±0.01
Microwave	Methanol	*Prunus avium*	18.08^{e} ±1.45	28.51^{a} ±0.01
Microwave	Methanol	*Prunus armeniaca*	22.13^{cd} ±1.40	4.56^{h} ±0.03
Microwave	Ethanol	*Prunus avium*	28.70^{b} ±1.68	11.44^{c} ±0.01
Microwave	Ethanol	*Prunus armeniaca*	23.91^{c} ±1.67	9.44^{d} ±0.05

* Comparison of the means of 6-replicate data with Tukey multiple comparison tests shows that there is a significant difference between the letters on the means; $p < 0.05$

on antioxidant activity gave statistically significant results (Table 2). The results of this study indicate that phenolic compounds extracted from *Prunus avium* and *Prunus armeniaca* leaves as a natural food preservative may be used to reduce oxidative degradation.

The DPPH reducing activities of the extracts taken from walnut leaves with different solvents were found to be ethyl acetate (91.57%), methanol (39.37%) and water (8.01%). ABTS+ scavenging activities were found to be ethyl acetate (73.25%), water (46.77%) and methanol (37.24%) [11]. There are studies investigating the antioxidant activities of different extracts. Kobya et al. (2019) found that between 48.26-90.20% ethanol extract of olive leaves antioxidant activities , Amessis-Ouchemoukh et al. (2014) determined that ethanol extracts of gum tree (97.33%), myrtle tree (96.95) and blackberry (52.04) leaves have antioxidant activities [12,13].

4. Conclusions

In this study, the effects of air-microwave drying and ethanolic-methanolic extracts on the antioxidant activity of *Prunus armeniaca* and *Prunus avium* leaves were investigated. It was observed that the drying method difference and the solvent type affected the antioxidant activity of the fruit leaves. In terms of antioxidant activity, fruit leaf varieties differed. *Prunus armeniaca* has higher antioxidant activity than *Prunus avium*. Methanolic extracts have higher activity. Drying method differed according to ABTS and DPPH methods.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest (if any exists, this must be indicated) and all procedures involving human and/or animal subjects (if exists) respect the specific regulations and standards. Authors declare that they present their own literature survey and results/discussion/conclusion in the article.

References

1. Polat, A.; Kurtulmuş, F.; İzli, N., Sürekli ve kesikli mikrodalga yöntemleriyle kurutulan elmanın renk değişim analizi, *Bursa Uludağ Üniversitesi Ziraat Fakültesi Dergisi* **2020**, *34*(1), 149-165.
2. Karam, M.C.; Peti, J.; Zimmer, D.; Djantou, E.B.; Scher, J., Effects of drying and grinding ın production of fruit and vegetable powders: A Review, *Journal of Food Engineering* **2016**, *188*, 32-49.

3. Yılmaz, M.S., Brokolinin mikrodalga kurutma karakteristiklerinin belirlenmesi ve modellenmesi, Yüksek Lisans Tezi, Ankara Üniversitesi, Fen Bilimleri Enstitüsü, Ankara, **2015**.
4. Arda, S.O., Mikrodalga ve güneş enerjisi kombinasyonlu kurutucu kullanılarak kurutma davranışının deneysel olarak incelenmesi, Yüksek Lisans Tezi, Namık Kemal Üniversitesi, Fen Bilimleri Enstitüsü, Tekirdağ, **2017**.
5. Dai, J.; Mumper, R.J., Plant phenolics: extraction. analysis and their antioxidant and anticancer properties, *Molecules* **2010**, *15*(10), 7313-7352.
6. Xu, B.J.; Chang, S.K.C., A comparative study on phenolic profiles and antioxidant activities of legumes as affected by extraction solvents, *Journal of Food Science* **2007**, *72*(2), S159-S166.
7. Şen Arslan, H.; Cabi, A.; Yerlikaya, S.; Sarıçoban, C., Antibacterial and antioxidant activity of peach leaf extract prepared by air and microwave drying, *Journal of Food Processing and Preservation* **2021**, *45*, 15847.
8. Özpınar, H.; Dağ, Ş.; Yiğit, E., Şeftali (*Persica vulgaris* Miller) yaprak ekstraktının antibakteriyel etkisi, Cumhuriyet Tıp Dergisi, **2013**, *35*(2), 172–178.
9. Singh, R.P.; Murthy, K.N.C.; Jayaprakasha, G.K., Studies on the antioxidant activity of pomegranate (*Punica granatum*) peel and seed extracts using in vitro models, *Journal of Agricultural and Food Chemistry* **2002**, *50*, 81-86.
10. Re, R.; Pellegrini, N.; Protrggente, A.; Pannala, A.; Yang, M.; Rice-Evans, C., Antioxidant activity applying an improved ABTS radical cation decolorization assay, *Free Radical Biology and Medicine* **1999**, *26*, 1231-1237.
11. Yapıcı, S.; Kıvanç, M., Ceviz yaprak ekstrelerinin antioksidan, antimikrobiyel ve antibiyofilm aktivitesi, *Gıda* **2023**, *48*(2), 405-421.
12. Kobya, O.; Çağlak, E.; Kara, B., Balıkesir-Ayvalık ve Trabzon-Çarşıbaşı 'ndan toplanan zeytin yapraklarının (*Olea europaea* L.) farklı yöntemlerle kurutulması ile elde edilen ekstraktların antioksidan ve antimikrobiyal etkilerinin karşılaştırılması, *Journal of Anatolian Environmental and Animal Sciences* **2019**, *4*(2), 257262.
13. Amessis-Ouchemoukh, N.; Madani, K.; Falé, P.L.; Serralheiro, M.L.; Araújo, M.E.M., Antioxidant capacity and phenolic contents of some Mediterranean medicinal plants and their potential role in the inhibition of cyclooxygenase1 and acetylcholinesterase activities, *Industrial Crops and Products* **2014**, *53*, 6-15.