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Phenolic Profile, Organic Acids and Melatonin Contents of Purslane (*Portulaca oleracea L.*) Selected from Mediterranean Region

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ABSTRACT

Purslane contains some chemical compounds that play a role in the prevention of diseases such as cancer, cardiovascular diseases, diabetes, high blood pressure and ulcers and give it functional properties. In this study, it was aimed to determine the phenolic profile, organic acids and melatonin amounts in purslane samples grown naturally in two different provinces of the Mediterranean Region and to compare them with each other. Gallic acid, rutin and quercetin contents were found to be higher in purslane samples from Mersin. While succinic acid content was 518.68 µg/g in purslane from Antalya, it was 374.45 µg/g in purslane from Mersin. The melatonin content of purslane from Mersin (58.45 ng/g) was also higher than that of purslane from Antalya (46.73 ng/g).

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INTRODUCTION

Purslane is an annual vegetable that belongs to the genus Portulaca oleracea L. of the family Portulacaceae (1). Purslane is over 90% water-containing, up to 30 cm in height, lying flat on the ground, has glabrous stems and stalkless dark green clusters (2,3). Purslane has been used as a vegetable, animal feed and medicinal plant in many cultures, particularly in the Mediterranean region, from ancient times to the present day (4). The stems, leaves and buds of purslane are edible. It can be used as dried or fresh, in various salads, soups, dishes and even pickles. However, since it has a characteristic, pungent and slightly sour taste, it is used mainly raw in mixed salads (5,6). Purslane pickles are a less common but also an interesting garnish (7). It has been reported that 100 g of fresh purslane leaves contain 23 kcal energy, 93 g moisture, 3 g protein, 2.65 g carbohydrate, 300-400 mg omega-3, 1.21 g fiber, 27 mg vitamin C, 12 mg vitamin E, 12.2 mg α-tocophenol acid, 26.6 mg ascorbic acid, 1.9 mg beta-carotene and 14.8 mg glutathione. It was found that 373.23 mg potassium, 29 mg calcium, 5.36 mg phosphorus, 24.12 mg sulfur, 59.32 mg sodium, 0.13 mg manganese, 1.11 mg iron, 0.011 mg copper, 30.37 mg magnesium, 0.29 mg zinc in 100 g dry purslane leaves (8). Although some chemical compounds contained of purslane do not have nutritional value, it can play an important role in the prevention of some diseases such as cancer, cardiovascular diseases, diabetes, high blood pressure and ulcers. These compounds can include flavanoids, phenolic acids, thiols, indoles, lignans, stilbenes, glucosinolates and organic sulfur compounds (9,10). It is reported that the aqueous extract of purslane has high phenolic, flavonoid, anthocyanin and antioxidant effects. Thus, it has functional properties with the potential to be an easily accessible natural antioxidant source (11). Purslane is an important plant that is used for the treatment of pain and edema. Purslane is high in β-carotene, vitamin C, vitamin E and omega-3, which have regenerative effects at the cellular level. These compounds which are powerful antioxidants, are preventive of future signs of aging by reducing skin and even UV-induced damage. In addition, it also contains components such as urea, calcium, iron, phosphorus, manganese, copper and fatty acids. According to research, it is an important source of omega-3 fatty acid, an important fatty acid in preventing heart attack and regulating the immune

system. Purslane is an important source of α-linolenic acid, an omega-3 fatty acid not synthesized in the human body, which is important in disease prevention and human growth and development (12).

Natural and cultivated species of plants are influenced such factors as soil, climatic conditions, altitude and therefore their composition changes. In Türkiye, studies have been carried out on purslane grown especially in the Aegean, Eastern and South Eastern Anatolia regions, but no study including melatonin content of the Mediterranean region has been found. The aim of this study was to determine and compare the phenolic profile, organic acid and melatonin content of purslane samples grown naturally in the Mediterranean region and thus to reveal the functional properties of this important product of the region.

METHODS

Materials

Purslane samples purchased from Antalya and Mersin provinces during the 2018 harvest period were used in this study. The samples were dried using a lyophilizer, placed in airtight glass containers and stored at -18 °C until analysis.

Determination of phenolic profile

4 g of sample was weighed and 40 mL methanol + 40 µL HCl was added and homogenized for 1 min with the help of Ultraturrax. Samples which were kept in an ultrasonic water bath for 15 min and then centrifuged at 6000 rpm for 15 min were filtered through Whatman no:42, the filtrate was passed through a 0.45 µm filter and given to the HPLC device. The methanolic lemon peel extract solution (1 g/mL) was filtered through a 0.22 µm membrane filter (Millex HV13, Millipore) and then placed into 1.5 mL HPLC vials (Agilent, screw tab 5,182-0176) (13).

Determination of organic acids

Following 4 g of purslane samples were weighed and 40 mL methanol + 40 µL HCl was added. It was homogenized with the help of Ultraturrax for 1 min. It was kept in an ultrasonic water bath for 15 minutes and centrifuged at 6000 rpm for 15 minutes. The filtrate was then filtered through Whatman no:42 and the filtrate were filtered through a 0.45 µm filter and given to the HPLC device. Diode-array detection (DAD) was performed using an Agilent 1260 series High performance liquid chromatography (HPLC) system equipped with an ACE GENERIX 5 C18 column (5 µm, 4.6 mm × 250 mm). HPLC elution was performed at 30°C using 98% Na2HP4 (pH 2.4 adjusted with H3PO4) and the mobile phase flow rate was 1 ml min-1 (14).

Determination of the melatonin content

1 g sample was dissolved in 10 mL acetonitrile (ACN)/water (45/55). After 1 h in ultrasonic water bath, it was centrifuged at 6000 rpm for 10 min. Then, 1 mL of the filtrate was filtered through a 0.45 µm filter and the solvent was evaporated with nitrogen (N2) gas. The remaining 0.1 mL of the extract was dissolved in ACN and given to the HPLC device (15).

Statistical analysis

Statistical analysis was carried out by using SPSS 25.0 package program. The significance of the difference between the samples was determined by independent sample T-test ($P<0.05$).

RESULTS AND DISCUSSION

Purslane samples are given in Table 1 for phenolic substances, organic acids and melatonin values. Gallic acid, catechin, rutin and quercetin were determined in purslane samples from both Antalya and Mersin regions. Rutin was the highest phenolic compound with 20.14 µg/g and Gallic acid was the lowest with 1.52 µg/g. Gallic acid content of Mersin sample (1.89 µg /g) was higher than Antalya sample (1.52 µg/g) ($p<0.002$). Gallic acid is a powerful antioxidant. This means that it can help fight oxidative stress, which can damage our cells and can lead to numerous chronic diseases. Research suggests that the antioxidant power of gallic acid may be behind its predicted anticancer benefits and neuroprotective effects, which refers to its ability to protect brain structure and function. While no catechins were detected in the Mersin sample, 7.14 µg/g was determined in the Antalya sample. Catechins are natural polyphenolic compounds belonging to the flavonoid family. Catechins inhibit tumor formation, the spread of bacteria and viruses, cell growth, and are multifunctional bioactive molecules responsible for anti-inflammatory and antioxidative effects. There was significant difference in rutin content between Mersin and Antalya samples ($p<0.000$). Rutin content of purslane sample from Mersin (20.14 µg/g) was higher than that of purslane sample from Antalya (11.06 µg/g). Rutin is a phenolic antioxidant, has been found to scavenge superoxide radicals and can chelate with metal ions such as iron cations. The in vivo antioxidant activity of rutin is due to its metabolite and aglycan quersetin, which is formed during the advanced digestion process. Gallic acid, which is a powerful polyphenol, has been determined to inhibit carcinogenesis. Gallic acid has been known to inhibit the growth of cancer cells. Gallic acid has also shown cytotoxic effect against tumor cells. Gallic acid has been reported to have strong antioxidant, anti-inflammatory, antimutagenic and anticancer properties. The pro-oxidant property of gallic acid is known as an apoptosis inducer in cancer cells (16). Rutin has been shown to have antimicrobial, anti-arthritic, anti-allergic, anti-oxidant, anticancer, anti-inflammatory, anti-diabetic and wound healing effects (17). It has been determined that catechin inhibits glucose absorption by affecting α-amylase and α-glycosidase activity. In addition, catechins are known to have anti-diabetes, anti-inflammatory and anti-carcinogenic effects (18). Quercetin has been reported to have antioxidant and anticarcinogenic effects (19). While quercetin was not detected in Antalya sample, it was determined as 7.38 µg/g in Mersin sample. In one study, flavonoids such as quercetin, rutin and myricetin and phenolic acids such as chlorogenic, rosmarinic and vanillic acid

were detected in purslane samples (20). These results indicate that purslane and its extracts are an important source of antioxidants.

Both purslane samples were determined succinic and fumaric acids as organic acids. The succinic acid content of the Antalya sample (518.68 µg/g) was higher than the Mersin sample (374.15 µg/g). The fumaric acid content of the purslane sample from Antalya (1.36 µg/g) was higher than that of the purslane sample from Mersin (0.48 µg/g). Succinic acid is a four-carbon dicarboxylic acid, a chemical compound added to various foods, beverages and pharmaceutical products (21). Melatonin content of purslane sample from Mersin (58.45 µg/g) was higher than that of purslane sample from Mersin (46.73 µg/g). According to a study, approximately 19000 pg/g melatonin was determined in the leaves of fresh purslane samples (20,22). It is thought that the reason why melatonin levels were higher in our samples compared to the literature may be due to the fact that purslane extracts were given as dry extracts.

Table 1. The independent sample T-test results of purslane from Antalya and Mersin against different analyses.

Analyzes	Examples	N	Mean	SD	t	p*
Phenolic profile						
Gallic acid (µg/g)	A	3	1.52	0.05	-12.768	0.002
	M	3	1.89	0.02		
Catechin (µg/g)	A	3	7.14	0.13	96.921	0.000
	M	3	nd	0.00		
Rutin (µg/g)	A	3	11.06	0.11	-37.909	0.000
	M	3	20.14	0.40		
Quercetin (µg/g)	A	3	nd	0.00	-182.609	0.000
	M	3	7.38	0.07		
Organic acid profile						
Succinic acid (µg/g)	A	3	518.68	5.19	27.493	0.000
	M	3	374.15	7.48		
Fumaric acid (µg/g)	A	3	1.36	0.05	33.782	0.001
	M	3	0.48	0.01		
Melatonin content						
Melatonin (ng/g)	A	3	46.73	1.05	-16.055	0.000
	M	3	58.45	0.71		

SD: Standard deviation, A: Antalya, M: Mersin.

CONCLUSION

Increasing the demand for natural food products is considered very important for rural development. In this study, phenolic profile, organic acid and melatonin contents of purslane, which has economic importance for Antalya and Mersin provinces, were investigated. It was determined that both purslane samples are good sources of phenolic compounds, organic acids and melatonin and should be included in the daily diet for healthy nutrition. Purslane samples from Antalya and Mersin regions are thought to contribute to the regulation of circadian rhythm with the melatonin they contain. Therefore, it can be beneficial to consume this vegetable for those who cannot provide enough melatonin hormone, which is essential for the human body, for different reasons. As a result, it is important for both producers and consumers to encourage the consumption of purslane, which is natural, rich in phenolic compounds and contains melatonin, by highlighting it more in our country.

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Data Availability

All data are available for publication

Conflict of Interest

Data are available on request to the authors.

Data Availability Statements

Ethical Statement

The full text or part of the paper has not been submitted or published elsewhere. The paper will not be submitted to other places until the editorial department of the journal is completed. This paper does not involve animal and human experiments.

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