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NUTRITIONAL PROPERTIES AND ANTIOXIDANT ENZYME ACTIVITIES OF WILD PLANTS CONSUMED AS VEGETABLES WITH NATURAL DISTRIBUTION IN ARDAHAN

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Abstract

Today, chemical spraying, irrigation with sewage water and excessive fertilization on cultivated vegetables threaten human health, reduce or cause the plants to lose their natural flavor, and push people to seek safe food. In this context, people are interested in organic products and naturally grown vegetables. This study was carried out in 2019 to determine the nutritional contents of some edible wild plant species that grow in their natural habitats in Ardahan province/Turkey and its districts (Damal, Posof, Hanak, Çıldır, Göle) and are known by the local people. As a result of the current research, 23 wild vegetable species consumed in Ardahan province were determined. Among these species, it was determined that the Gelin Parmağı (*Cerastium armeniacum* Gren.) is an endemic species. Ash content, pH, vitamin C, protein, antioxidant enzyme activity (CAT, SOD and POD) and mineral substance (P, N, K, Ca, Mg, Ca, Fe, Na, Zn, Mn, B and Cu) contents were analyzed to determine the nutritional content of 23 different wild edible vegetables collected and to compare them with some cultivated vegetables. Protein content of 23 wild vegetable species was 17.66%-35.83%; Ca content ranged from 6577.3 mg kg^{-1} to 13862.7 mg kg^{-1} and Fe content ranged from 137.02 mg kg^{-1} to 293.26 mg kg^{-1}. It has been determined that the wild plant species examined have a richer content in terms of vitamin and nutrient content than some commonly consumed cultural vegetables (spinach, cabbage, lettuce, radish, and parsley). At the end of the research, *Capsella bursa-pastoris* L. whose local name is the Revan Özeği was determined as the wild plant species containing the highest nitrogen and protein. It was concluded that wild species show a great difference in terms of mineral element composition and other quality characteristics and they have a richer content than some cultivated species whose leaves are consumed. Findings from our study showed that the antioxidant activity of different species varies according to the species. We believe that our study results will pave the way for future breeding and cultivation studies, can contribute to the promotion of sustainable ecotourism and can be used to develop strategies for the sustainable use of wild edible plants.

Key words: Antioxidant enzyme, Ardahan, Edible wild vegetables, Mineral elements, Turkey.

Introduction

Living and non-living elements in the ecosystem are a source of life for people from ancient times to today's world. In the ongoing process of this cycle, plants serve as a touchstone for the continuity of human life. In this regard, people's approaches to plants and their evaluation studies differ in line with the needs.

In studies on the plant species in the world, it has been stated that there are approximately 1 000 000 plant species (Öztürk and Özçelik 1991). The number of plant species consumed as food and grown for nutritional purposes is around 3000. Moreover, the number of wild plant species used as food is more than 10000 (Kunkel 1984; Bayramoğlu *et al*., 2009). When these numbers are considered, Turkey takes its place among the richest countries in the world in terms of plant species. Turkey has 1251 genera belonging to 174 families and more than 12000 species and subspecies taxa (Davis 1988; Faydaoğlu & Sürücüoğlu, 2011). 234 of these taxa are of foreign origin and are cultivated plants. The remaining species are plants that spread naturally in Turkey (Ekim *et al*., 1989; Erik & Tarıkahya, 2004; Faydaoğlu & Sürücüoğlu, 2011). While the total number of endemic taxa in all European countries is approximately 2750, the number of endemic species in Turkey is 2891. When we include 497 subspecies and 390 varieties that are endemic to this number, the total number of endemic taxa is more than 3 750 (Güner *et al*., 2000; Faydaoğlu & Sürücüoğlu, 2011; Niksarlı-Inal 2013; Özer & Aksoy, 2019).

The deficiencies in providing adequate nutrition to the markedly increasing world population are widening day by day. In the world, especially in developing countries, health problems such as obesity due to inadequate and unbalanced nutrition are increasing. The lack of mineral substance intake caused by inadequate and unbalanced nutrition causes many chronic diseases in humans and has negative effects on their physical and mental development. Besides these reasons, people have become more interested in adding wild edible plant species and their products to their nutritional diets due to their medicinal importance and aromatic properties (Alam *et al*., 2020). Wild plant species provide the essential fatty acids, minerals, vitamins, and fiber that humans need (Cámara *et al*., 2016; Datta *et al*., 2019) and contribute to the aroma, flavor and color of food (Alam *et al*., 2020). They can be a source of fiber, micronutrients and energy and offer a wide range of phytochemicals such as tannins, phenols, terpenoids, steroids, polysaccharides, flavones, saponins, and alkaloids (Cámara *et al*., 2016; Bacchetta *et al*.,2016; León-Lobos *et*

al., 2022). Thus, wild edible plant species can increase the nutrient content of lean diets (Pereira *et al*., 2011; León-Lobos *et al*.,2022) and provide health benefits (Marrelli *et al*., 2020; Mateos-Maces *et al*., 2020). Because of these uses, wild edible plant species have potential as exploitable food sources (Bharucha & Pretty, 2010), functional foods, and products designed to meet special dietary needs.

Today, chemical spraying, irrigation with sewage water and excessive fertilization (Ataseven 2011) on cultivated vegetables threaten human health (Zurera *et al*., 1989; Çağlarırmak & Hepçimen, 2010) and push people to seek safe food. In this context, people are interested in organic products, naturally grown vegetables and fruits. Interest in the use of weeds as vegetables has recently increased rapidly (Doğan *et al*., 2004; Ceylan & Yücel, 2015; Tunçtürk & Özgökçe, 2015; Korkmaz & Karakurt, 2015; Doğan 2016; Alaca 2018). Conservation of wild plant diversity adapted to the obligatory living conditions in the natural environment provides the opportunity to obtain resistant varieties against the difficulties that may be encountered in plant breeding in the future (Şekeroğlu *et al*., 2005).

In this study, it was aimed to determine the edible wild plant species that grow naturally in Ardahan and are known by the local people, to evaluate the nutrient content of these plants and to evaluate their potential as cultivated plants. The nutritional and vitamin contents of wild plant species obtained from the study were compared with the nutritional and vitamin contents of cultured vegetables (spinach, lettuce, cabbage, parsley and radish) and their alternatives to each other were evaluated. In addition, it is aimed to contribute to breeding by forming the first step of the cultivation of wild plant species, to know these plants for future generations, and to introduce these species in the international arena through scientific classification.

Material and Methods

Study Area: In the study, edible wild plant species grown in natural habitats in Ardahan province and known by the local people were collected, with the possibility of being an alternative to the vegetables consumed in Turkey-Ardahan provinces and its districts (Damal, Posof, Hanak, Çıldır, Göle) between May and August 2019. The province of Ardahan, where this research is conducted, is located in the northeast of the Eastern Anatolia Region and the average altitude is approximately 1800 meters. Ardahan is one of the most mountainous and rugged lands in Eastern Anatolia. The total area of the province is 4842 km^2 (Anon., 2018a). The high plains in the central part of Ardahan province are the Ardahan Plateau and the altitude of the plateau varies between 1800-2000 m (Anon., 2019). Ardahan has a harsh continental climate and the winters are harsh, long and snowy. The characteristics of the (Eastern) Black Sea climate are seen mostly in the west and north of the province. Its annual average temperature is 3.9°C, the lowest annual average temperature is –39.8°C and the highest annual temperature is 35.0°C (Anonymous 2018b). The annual average precipitation is 552.8 mm.

Plant material: Specified characteristics of wild plant species detected during field trips were evaluated according to the answers we received in line with the questions asked to the local people. Photographs were taken, labeled, and samples to be used for herbarium and chemical analysis were taken. While the wild plants used as study material were collected, the people living in the visited village, who were considered vegetables, were identified with the knowledge and experience of the wild plants, and information was obtained from the areas where the plant grows, its collection methods, consumption patterns, and local names. The locations and altitudes of the plants collected in the field were determined using the GPS (Global Positioning System) device. Identification and identification of collected wild species were made by Yusuf Kaya, Department of Biology, Faculty of Science, Atatürk University.

Mineral analysis: Total nitrogen and protein analysis, dry matter amount, ash analysis, macro and micro elements (P, N, Mg, K, Ca, Fe, Na, Fe, Zn, Mn, B, Cu) analyzes, pH and vitamin C determinations were made. The used/consumed part of wild plants was ground after drying in an oven at 68°C for 48 hours. Total N (a Vapodest 10 Fast Kjeldahl Distillation Unit, Gerhardt, Konigswinter, Germany) was determined by the Kjeldahl method. Ca, P, Mg, K, Cu, Fe, B, Mn, Zn, Cl, and Cd were determined based on the method given by Mertens (2005).

Antioxidant Enzyme Analysis: For superoxide dismutase (SOD), catalase (CAT) and peroxidase (POD) enzyme analysis, 3 mL of 50 mM phosphate buffer, pH: 7, was added and approximately 500 mg (on a dry weight basis) samples were used for homogenization. POD, CAT and SOD activities were determined based on the method given by Sahin *et al*. (2018).

Evaluation of Data

All statistical analysis was performed using SPSS Statistics (v. 20 for Windows; IBM Corporation, Armonk, NY, USA). Multivariate analysis of variance (MANOVA) was used to detect significant differences between groups. The means were separated by Duncan's multiple range test ($p<0.05$).

Results

Wild plants used as vegetables in Ardahan Province, Turkey: As a result of the collection of wild plants that grow wild in nature and are considered vegetables by the people of Ardahan, Amaranthaceae (2), Asterceae (3), Brassicaceae (3), Crassulaceae (1), Caryophyllaceae (1), Hypericaceae (1), Fabaceae (1), Lamiaceae (3), Malvace (1), Plantaginaceae (1), Polygonaceae (3), Urticaceae (1), Umbelliferae (2). A total of 23 species belonging to families were found and examined. In terms of the consumption patterns of these species, it was determined that 9 species were consumed raw, 12 species were consumed by cooking and 2 species were consumed by pickling. The scientific and local names, places of collection and coordinates of wild plant species consumed as vegetables in the region are given in (Table 1).

Table 1. Classification of wild plants collected and consumed as vegetables within the scope of the study.

Scientific name	Local name	Collected place, altitude	Coordinates
Lathyrus latifolius L.	Kotan Gülü	Hanak- Sevimli Village (1815m)	41°10'44"N 42°59'35"E
Hypericum perforatum L.	Çay Çiçeği	Çıldır-Akkiraz Village (1421 m)	41°15'5"N 43°7'42"E
Mentha pulegium L.	Yarpuz	Çıldır-Öncül Village (1762 m)	41°14'22"N 43°9'45"E
Sinapis arvensis L.	Yabani Hardal	Merkez-Güzçimen Village (1881 m)	41°4'13"N 42°38'11"E
Plantago major L.	Bağa Yaprağı	Posof-Kır Village (1672 m)	41°28'39"N 42°42'48"E
Arctium lappa L.	Deve Tabanı	Merkez-Tepeler Village (1821 m)	41°4'5"N 42°35'28"E
Cerastium armeniacum Gren.	Gelin Parmağı	Çıldır-Doğankaya Village (1771 m)	41°9'37"N 42°58'6"E
Carum carvi L.	Kımı	Çıldır-Gölebakan Village (1999 m)	41°4'8"N 43°7'39"E
Thymus sp.	Kek Otu	Çıldır-Gölebakan Village (2194 m)	41°3'23"N 43°5'45"E
Rumex acetosella L.	Kuzukulağı	Çıldır-Doğankaya Village (1756 m)	41°9'29"N 42°58'6"E
Polygonum cognatum Meisn.	Madımak or Kuşekmeği	Çıldır-Doğankaya Village (1756 m)	41°9'29"N 42°58'6"E
Tragopogon porrifolius L.	Yemlik	Merkez- Yaylacık Village (1844 m)	41°5'46"N 42°42'32"E
Falcaria vulgaris BERNH.	Kazayağı	Çıldır-Gölbelen Village (1986 m)	41°4'59"N 43°7'52"E
Onopordum acanthium L.	Kangal or Galagan	Merkez-Alagöz Village (2199 m)	41°2'6"N 42°41'47"E
Rumex patientia L.	Evelik	Merkez-Alagöz Village (2119 m)	41°26'N 42°41'47"E
Urtica dioica L.	Isırgan Otu or Cincar	Posof-Merkez (1507 m)	41°30'21"N 42°43'40"E
Salvia verticillata L.	Öküz Pöçüğü	Merkez-Alagöz Village (2126 m)	41°22'6"N 42°43'25"E
Crassulaceae	Camış Kulağı	Merkez-Alagöz Village (2135 m)	41°1'11"N 42°42'16"E
Chenopodium album L.	Tel Pancarı or Unluca	Merkez-Kaptanpaşa Neighbourhood (1821 m)	41°6'12"N 42°42'24"E
Amaranthus retroflexus L.	Boz Pancar	Merkez-Kaptanpaşa Neighbourhood (1821 m)	41°6'12"N 42°42'24"E
Raphanus raphanistrum L.	Turp Otu or Su Didası	Merkez-Kaptanpaşa Neighbourhood (1833 m)	41°6'11"N 42°42'23"E
Malva sylvestris L.	Ebegümeci	Merkez-Kaptanpaşa Neighbourhood (1821 m)	41°6'11"N 42°42'23"E
Capsella bursa-pastoris L.	Ravan Özeği or Acıgıcı	Merkez-Kaptanpaşa Neighbourhood (1830 m)	41°6'12"N 42°42'24"E

Nutritional contents and antioxidant enzyme activities of wild plants used as vegetables in Ardahan Province, Turkey: The 'Species' factor ($p \leq 0.001$) was found to be statistically significant in terms of N, protein, K, P, Ca, Mg, Na, Zn, Mn, Fe, B and Cu determined in wild plant species. According to the N analysis results, the highest nitrogen content among wild plant species was determined in the Revan Özeği plant (5.74%). The lowest nitrogen content was determined in the samples of Deve Tabanı, Çay Çiçeği, Kotan Gülü and Boğa Yaprağı plant species at 2.83%, 2.89%, 2.90% and 2.92% respectively (Table 2). It was determined that the protein content of the species varied between 17.66% and 35.83%. The highest protein content was found in Revan Özeği (35.83%), unlike other species. The lowest protein content among the species was determined in the samples of DeveTabanı (17.66%) (Table 2). When the P content of wild plant species is examined, it is seen that it varies between 2861.3 mg kg^{-1} and 61640.0 mg kg^{-1}. Among its species, the highest P content was found in Revan Özeği and Ebegümeci plants. The lowest P content was found in Kotan Gülü and Çay Çiçeği plants (Table 2).

It has been determined that the K content varies between 29033.0 mg kg^{-1} and 63741.7 mg kg^{-1}. Unlike other species, the highest K value was determined in the Revan Özeği plant (63741.7 mg /kg^{-1}). The Çay Çiçeği plant, on the other hand, was determined as the species with the lowest content, unlike all other wild plant species, with a content of (29033 mg kg^{-1}). It was found that the species with the lowest K content after the Çay Çiçeği plant was the Kotan Gülü (30058.7 mg kg^{-1}) plant (Table 2).

When the species were compared in terms of Ca content, it was found that the highest contents were found in Revan Özeği and Ebegümeci species and 13862.7 mg kg^{-1} at 12983.0 mg kg^{-1} respectively (Table 2). The lowest Ca content was determined in the Kotan Gülü plant (6577.3 mg kg^{-1}).

Magnesium contents in wild plant species were found to vary between 2012.0 mg kg^{-1} and 3995.7 mg kg^{-1} (Table 2). The lowest Mg content was found in the Çay Çiçeği plant at 2012.0 mg kg^{-1}. In terms of Mg, Yarpuz, Yabani Hardal, Boğa Yaprağı species were statistically in the same group. The highest Mg content was determined in Revan Özeği (3995.7 mg kg^{-1}) and Ebegümeci (3944.7 mg kg^{-1}) plants. When wild plant species were examined in terms of Na content, it was determined that it ranged between 577.0 mg kg^{-1} and 1307.0 mg kg^{-1}. The lowest Na content was determined to change in the Boğa Yaprağı (577.0 mg kg^{-1}), while the highest Na content was found in the Revan Özeği (1307.0 mg kg^{-1}) plant (Table 2). As a result of the research, when wild plant species were examined, the highest Zn content was found in the Revan Özeği (75.76 mg kg^{-1}) plant. The lowest Zn content was found in Deve Tabanı, Kotan Gülü, Çay Çiçeği plants at 25.33 mg kg^{-1}, 25.69 mg kg^{-1}, 25.86 mg kg^{-1} respectively. In addition, Çamış kulağı and Tel pancarı species were found to have the same value (Table 2). When wild plant species evaluated as vegetables were ranked in terms of Fe content, it was determined that the highest content was 293.26 mg kg^{-1} in the Revan Özeği plant. As a result of the analysis, it was determined that the Deve Tabanı plant had the lowest Fe content with 131.69 mg kg^{-1} (Table 2). In the study, the Mn contents of wild plant species examined in the laboratory ranged from 112.24 mg kg^{-1} to 49.19 mg kg^{-1}. The lowest Mn content was found in the Deve Tabanı (49.19 mg kg^{-1}) plant. According to the results of the research, the highest Mn contents were determined in Revan özeği, Ebegümeci and Boz Pancar plants, respectively (Table 2).

When wild vegetable species were examined in terms of Cu content, the highest Cu content was found in 65.92 mg kg^{-1} Ebegümeci plant, 65.70 mg kg^{-1} Revan Özeği plant and 63.42 mg kg^{-1} Boz Pancar plant, respectively. The lowest Cu content was found in Çay Çiçeği (34.88 mg kg^{-1}) and Kotan Gülü (34.67 mg kg^{-1}) (Table 2). According to the B analysis results, it was determined that the B contents of the species varied between 40.03 mg kg^{-1} and 14.53 mg kg^{-1}. According to the analysis, the highest B content was determined in the Revan Özeği (40.03 mg kg^{-1}) plant (Table 2). In addition, the lowest B content was found in Kotan Gülü (14.53 mg kg^{-1}), Turp Otu (16.50 mg kg^{-1}), Isırgan (16.68 mg kg^{-1}), Yarpuz (16.95 mg kg^{-1}), and it was detected in Yemlik (17.18 mg kg^{-1}) plants.

Table 2. Protein and mineral contents in wild plant species.

Wild plant species	N (%)	Protein (%)	K (mg kg^{-1})	P (mg kg^{-1})	Ca (mg kg^{-1})	Mg (mg kg^{-1})	Na (mg kg^{-1})	Zn (mg kg^{-1})	Fe (mg kg^{-1})	Mn (mg kg^{-1})	Cu (mg kg^{-1})	B (mg kg^{-1})
Kotan Gülü	2.90 h**	18.13 jk **	30058.7 d**	2861.3 h**	6577.3 i**	2085.7 ef**	589.3 e**	25.69 g**	137.02 de **	53.01 def**	34.67 d**	14.53 g**
Çay Çiçeği	2.89 h	18.06 jk	29033.0 d	2900.0 h	6657.0 hi	2012.0 f	587.3 e	25.86 g	137.78 de	51.95 ef	34.88 d	15.52 fg
Yarpuz	3.00 gh	18.26 ijk	35832.3 bcd	3277.3 e-h	7283.3 f-i	2227.3 def	679.3 e	30.66 efg	157.81 cde	59.25 c-f	38.45 bcd	16.95 efg
Yabani Hardal	3.12 gh	19.50 h-k	37551.0 bcd	3943.7 c-g	7940.0 e-i	2259.7 def	653.7 e	34.18 c-g	167.14 cde	61.66 b-f	37.74 cd	21.77 d-g
Bağa Yaprağı	2.92 h	18.30 kji	36197.3 bcd	3454.3 d-h	6929.0 ghi	2159.3 def	577.0 e	31.48 d-g	159.46 cde	56.57 c-f	39.96 bcd	19.00 d-g
Deve Tabanı	2.83 h	17.66 k	31310.7 bcd	3062.3 gh	6570.7 i	2068.0 ef	621.3 e	25.33 g	131.69 e	49.19 f	39.87 bcd	16.44 efg
Gelin Parmağı	3.33 e-h	20.83 ghi	34711.0 bcd	4108.0 c-f	8569.7 c-f	2576.0 c-f	783.3 de	36.82 c-g	158.77 cde	66.30 b-f	38.04 cd	19.21 d-g
Kımı	3.79 c-f	23.66 def	38105.7 bcd	4367.3 cd	8724.0 c-f	2242.0 def	635.7 e	39.83 c-f	174.79 cde	64.47 b-f	43.62 bcd	24.22 d-g
Kek Otu	3.57 c-g	22.33 efg	37136.7 bcd	4252.7 cde	8307.7 d-g	2269.3 def	637.7 e	39.62 c-f	162.94 cde	63.93 b-f	40.95 bcd	25.32 def
Kuzu Kulağı	3.30 e-h	20.66 g-j	35002.0 bcd	3833.7 c-h	7754.0 e-i	2425.7 c-f	696.0 e	35.30 c-g	156.04 cde	64.85 b-f	36.88 cd	20.04 d-g
Kuş Ekmeği	3.20 fgh	20.00 g-k	33282.7 bcd	3082.0 gh	7309.3 f-i	2387.0 c-f	684.7 e	29.82 efg	154.37 cde	61.00 b-f	38.22 bcd	16.23 fg
Yemlik	3.24 e-h	20.26 g-k	33356.3 bcd	3090.3 gh	7557.0 f-i	2193.0 def	640.7 e	29.17 fg	155.05 cde	57.54 c-f	39.66 bcd	17.18 efg
Kaz Ayağı	3.37 d-h	21.06 gh	41436.3 bc	4011.3 c-g	8626.0 c-f	2631.7 c-f	791.7 de	37.65 c-f	181.10 cd	70.26 bcd	42.85 bcd	21.64 d-g
Kangal	3.61 c-g	22.50 efg	44278.0 b	4210.0 c-f	8673.0 c-f	2446.7 c-f	716.7 e	41.09 cde	195.86 c	68.64 b-e	44.85 bcd	24.11 d-g
Evelik	2.96 h	18.50 kji	35333.0 bcd	3232.0 fg	6924.3 ghi	2273.3 def	711.3 e	28.51 fg	152.26 cde	57.90 cdef	40.79 bcd	16.68 efg
Isırgan Otu	3.43 d-h	21.43 fgh	36724.7 bcd	3849.7 c-h	8124.3 d-h	2455.3 c-f	688.7 e	37.67 c-f	165.09 cde	60.28 b-f	47.82 bc	21.90 d-g
Öküz Pöcüğü	3.82 cde	23.86 def	39973.3 bcd	4538.7 c	9718.7 c	2828.3 cd	845.0 cde	42.68 cd	182.27 cd	71.58 bc	43.05 bcd	22.40 d-h
Camış Kulağı	4.12 c	25.80 dc	41885.0 bc	4686.7 bc	9500.0 cd	2527.3 c-f	732.7 e	44.73 c	190.59 c	72.50 bc	47.14 bc	27.87 bcd
Tel Pancarı	3.95 c	24.68 de	42896.7 b	4580.3 bc	9112.0 cde	2770.7 cde	760.7 de	44.66 c	181.00 cd	77.08 b	44.53 bcd	26.21 cde
Boz Pancar	4.81 b	30.10 c	63559.7 a	5457.3 ab	11631.0 b	3602.0 ab	990.3 bcd	61.53 b	278.91 ab	96.82 a	63.42 a	35.91 ab
Turp Otu	3.82 cde	23.80 def	41148.7 bc	3281.0 e-h	8664.3 c-f	3065.0 bc	1080.0 abc	32.77 d-g	168.07 cde	71.20 b-f	50.37 b	16.50 efg
Ebegümeci	5.20 b	32.53 b	54764.3 a	5735.0 a	12983.0 a	3944.7 a	1101.7 ab	63.97 b	246.31 b	98.18 a	65.92 a	34.16 abc
Ravan Özeği	5.74 a	35.83 a	63741.7 a	6164.0 a	13862.7 a	3995.7 a	1307.0 a	75.76 a	293.26 a	112.24 a	65.70 a	40.03 a

**Different letters in the same column indicate significant differences (P≤0.01) based on the Duncan's multiple range test. ns: Non-significant (at p>0.05)

Table 3. pH, vitamin C, ash and enzyme contents in wild plant species.

Genotype	pH	Vitamin C (mg $^{l-1}$)	Ash (%)	CAT (u/g TA)	SOD (u/g TA)	POD (u/g TA)
Kotan Gülü	4.80 ab**	447.33 a**	7.00 ij **	6.09 bc**	798.02 c**	111.29 a**
Çay Çiçeği	2.17 c	371.00 c	6.56 j	6.53 b	316.86 l	1.94 lm
Yarpuz	2.20 c	44.67 kl	11.00 e-h	0.43 mn	449.33 h	28.83 h
Yabani Hardal	5.00 a	239.33 g	7.00 ij	1.03 jkl	858.72 a	86.79 c
Bağa Yaprağı	4.60 ab	107.00 hi	15.00 bcd	4.62 e	14.93 p	7.66 k
Deve Tabanı	2.17c	43.93 kl	16.46 bc	0.06 n	253.20 m	27.42 h
Gelin Parmağı	5.00 a	113.00 h	14.16 cde	0.93 klm	538.27 f	24.81 i
Kımı	2.67c	22.20 m	16.53 bc	2.13 h	248.01 m	70.44 e
Kek Out	2.40 c	340.00 e	8.00 hij	0.08 n	671.45 d	38.98 g
Kuzu Kulağı	3.73 b	24.00 m	8.53 ghi	1.46 ij	681.83 d	1.79 lm
Kuş Ekmeği	5.00 a	83.00 j	10.16 f-i	3.45 f	830.17 a	105.31 b
Yemlik	2.17 c	31.60 lm	13.5 c-f	0.83 klm	420.92 i	15.47 j
Kaz Ayağı	2.20 c	447.67 a	13.53 c-f	2.02 h	528.56 f	81.68 d
Kangal	2.70 c	98.00 i	16.50 bc	0.76 lm	342.01 k	7.50 k
Evelik	4.40 ab	47.00 k	14.00 cde	0.45 mn	201.10 n	27.35 h
Isırgan Otu	2.00 c	26.00 m	18.00 b	6.20 b	640.99 e	47.70 f
Öküz Pöcüğü	1.80 c	447.67 a	11.00 e-h	14.12 a	436.61 hi	15.17 j
Camış Kulağı	5.00 a	360.00 cd	12.00 d-g	2.84 g	690.38 d	0.56 m
Tel Pancarı	5.00 a	257.00 f	22.00 a	5.64 cd	482.98 g	3.84 l
Boz Pancar	4.20 ab	245.00 fg	24.00 a	5.29 d	74.92 o	24.40 i
Turp Out	5.20 a	355.00 d	15.00 bcd	1.30 jk	375.38 j	22.37 i
Ebegümeci	5.00 a	422.67 b	16.00 bc	1.91 hi	438.82 hi	4.17 l
Ravan Özeği	5.00 a	245.00 fg	18.00 b	1.90 hi	530.86 f	23.82 i

** Different letters in the same column indicate significant differences ($p \leq 0.01$) based on the Duncan's multiple range test
ns: Non-significant (at $p > 0.05$)

The species factor ($p \leq 0.001$) was found to be statistically significant in terms of pH, vitamin C and ash determined in local vegetable species collected from the Ardahan region. As a result of the research, pH ratios vary between 1.80 and 5.2. The highest pH content was determined in the Turp Otu plant. Statistically, the lowest pH content was measured in the Öküz Pöçüğü plant (Table 3). The amount of vitamin C in the plant species included in the study was found to be between 22.20 mg 100 g^{-1} and 447.67 mg 100 g^{-1} (Table 3). It was determined that the highest levels of vitamin C were found in Öküz Pöçüğü (447.67 mg 100 g^{-1}) and Kotan Gülü (447.33 mg 100 g^{-1}), respectively. The lowest vitamin C content was determined in Kımı (22.20 mg 100 g^{-1}) plant. It was determined that the Boz Pancar plant (24%) had the highest ash content among the wild species considered vegetables. The lowest ash content was determined to be 6.56% in the Çay Çiçeği plant (Table 3).

The difference between the species in terms of antioxidant enzyme activities of Catalase (CAT), Superoxide dismutase (SOD) and Peroxidase (POD) was found to be statistically significant ($p \leq 0.001$) (Table 3). When Table 3 is examined, it is seen that plant materials vary between 0.06 (u/g TA) and 14.12 (u/g TA) as a result of CAT analysis. Among the species, it was determined that the highest CAT level was 14.12 (u/g TA) in the Öküz Pöçüğü plant. The lowest CAT level was found to be 0.06 in the Deve Tabanı plant. Among the wild species that are the research material, the plant with the highest SOD content is the Yabani Hardal plant with 858.72 (u/g TA). It was determined that the Boğa Yaprağı plant had the lowest SOD value among the species with 14.93 (u/g TA) (Table 3). According to the POD analysis results of wild species evaluated as vegetables, POD ratios were determined between 0.56 (u/g TA) and 111.29 (u/g TA). It was determined that the plant with the highest POD rate was the Kotan Gülü (111, 29 u/g TA). The lowest POD rate was determined to be in the Çamış Kulağı (0.56) plant (Table 3).

Discussion

Existing species are extremely important for the sustainability and conservation of biodiversity. In addition, the protection of plant resources, especially the identification and protection of wild plant forms or their wild relatives, has a remarkable quality. It is likely that wild species will be found and preserved so that new species can be discovered through breeding. This study is the first conducted in this style in the provinces and districts of Ardahan/Turkey (Posof, Damal, Çıldır, Hanka, Göle) and is an initial and inventory study. The main purpose of the study is to collect wild plant species considered vegetables in Ardahan province, determine their nutrient content and evaluate them in terms of breeding. In this direction, 23 plant species were collected in the evaluation made for the collection of plant species for the research. It was determined that Gelin Parmağı (*Cerastium armeniacum* Gren.) is an endemic species of these collected plants (Yüksel *et al*., 2018). For each wild plant, plant introduction information including characterization data, local names of the plant and phenological observation studies was prepared.

Considering the climatic conditions of the wild plants determined in the research, they were collected at the beginning of summer. In the face-to-face interviews with the local people, the plant parts (stem, flower and leaf) used were determined, and the public's knowledge was also consulted about the way of consumption. The types of consumption were determined as 9 types of raw, 12 types

of cooked and 2 types of pickles. Some of the plants mentioned have more than one local folk name. This can be explained by the use of different names for the same plant in different regions of Turkey. They can also be consumed in different ways in different regions (Civelek 2011; Miskoska-Milevska *et al*., 2020).

Among the wild plant species collected within the scope of the research and the nutrient content of which was analyzed, the highest nitrogen and protein content was determined in *Capsella bursa-pastoris* L., the local name of which is Revan Özeği. As a result of a study on wild plant species, it was reported that nitrogen contents ranged between 3.38% and 5.36% (Civelek 2011; Civelek and Balkaya 2013). As a result of another study, it was reported that the nitrogen content of wild plants with the potential to be vegetables varies between 0.25% and 5.16% (Ceylan and Yücel 2015). In terms of protein content, Civelek (2011) reported a change between 21.15-33.51%, Yücel *et al*., (2011) between 0.09-21.94% and Ceylan & Yücel (2015) between 1.59% and 32.26%. The nitrogenand protein values of our study are in line with the results of studies conducted on wild plant species by Civelek (2011), Yücel *et al*., (2011), Ceylan & Yücel (2015), and Özer & Aksoy (2019). Yucel *et al*., (2011) reported that the protein content of most wild plants is very high and can contribute significantly to meeting the daily protein requirement in cases of consumption. It has also been reported that there may be differences in protein content in wild plants consumed locally, and this content may vary depending on the region of the wild plant, the organs of the plant, and the type and variety of the product (Kaya *et al*., 2004; Özer & Aksoy, 2019).

The lowest phosphorus content of wild plant species was determined in *Lathyrus latifolius* L., which is locally called Kotan Gülü. It is known that 250 mg kg^{-1} of cultured vegetables, 630 mg kg^{-1} of celery and 280 mg kg^{-1} of spinach contain phosphorus (Turan *et al*., 2003). Considering these values, it has been determined that wild vegetable species in the Ardahan region have a richer phosphorus content than cultivated vegetables in terms of phosphorus content. Among the species, the plant with the highest value in terms of potassium and calcium is *Capsella bursa-pastoris* L., whose local name is Revan Özeği.

In our study, Tel Pancarı and Ebegümeci have potassium contents of 4289.7 mg kg^{-1} and 54764.3 mg kg^{-1}, respectively, while Akgünlü (2012) reported that they have potassium contents of 30233.0 mg kg^{-1} and 30712.0 mg kg^{-1}, respectively, in the same species. Akgünlü (2012) also determined that Kuzukulağı, another wild plant species, has a calcium content of 7659.0 mg kg^{-1}. In our study, the 7754.0 mg kg^{-1} calcium content of the Kuzukulağı plant was determined. Our study does not match Akgünlü (2012) in terms of potassium values in Tel Pancarı and Ebegümeci plants, but in terms of calcium content in Kuzukulağı plant, our study overlaps with Akgünlü (2012) study. In terms of magnesium content, *Hypericum perforatum* L., whose local name is Çay Çiçeği, is the lowest among the species; It was determined that the highest Ebegümeci and *Capsella bursa-pastoris* L., whose local name is Revan Özeği, are the highest. Civelek (2011) reported that Isırgan has 220.0 mg kg^{-1} magnesium content in his study. In our study, it was determined that the Isırgan plant has a magnesium content of 2455.3 mg kg^{-1}. Civelek (2011) does not coincide with his work on the Isırgan Otu plant. In terms of manganese analysis, zinc content and iron content, it was determined that the Revan Özeği plant had the highest value. Among the examined plant species, the richest copper content was determined in the Ebegümeci plant. The contents of minerals such as zinc, manganese, copper and iron were high when we compared them to cultured vegetables which are spinach, lettuce, radish, celery and broccoli (Turan *et al*., 2003).

When we examined the pH, vitamin C content and ash analysis of our study, it was determined that they had different values between species. The pH value in the study was found to be similar to studies conducted on different wild edible plants grown in Turkey (Özer & Aksoy, 2019). However, in the current study, the pH value of the *Chenopodium album* L. plant was found to be 5, and Yıldırım *et al*., (2001) reported the pH value of the *Chenopodium album* L. plant as 6.32. As a result of the analysis of the vitamin C determination made in the *Chenopodium album* L. plant, the vitamin C content was found to be 257.0 mg kg^{-1}, while Samancıoğlu (2016) reported that it had a content of 12.45 mg kg^{-1} in their study. The presence of different values in the same plant may be caused by ecological differences and mineral substances in the soil. Wild plants are typically known to have higher levels of vitamin C than cultivated ones (Simopoulos, 2004). The ash content of wild plants examined by Civelek (2011) in the Bafra plain was found to be between 3.84-24.73%. Doğan (2016) determined that the ash content of the wild plants he examined in the Gevaş district of Van province was between 8.39-18.96%. The ash content results in our research are similar to the results found by Civelek (2011) and Doğan (2016).

Main minerals have a very important place in human nutrition and health (Şekeroğlu *et al*., 2006; Özer and Aksoy 2019). As a result of the current research. It was concluded that wild species show a great difference in terms of mineral element composition and other quality characteristics and they have a richer content than some cultivated species whose leaves are consumed. As a result of two previous studies conducted by Şekeroğlu *et al*., (2006) and Doğan (2016), it has been determined that the plants studied are richer than cultured vegetables in terms of nutritional content and mineral matter. These literatures were determined in accordance with the results of the current study.

Antioxidants derived from wild plant species are preferred to synthetic ones in the development of new therapeutic drugs. It is stated that higher antioxidant intake is associated with a lowerincidence of human diseases (Ajayi *et al*., 2012). In addition, it has been reported that edible wild vegetables are an important source of natural antioxidants (Ozturk *et al*., 2022). The natural anthocyanin and antioxidant compounds found in these plants are available in previous research results and have a protective effect against many diseases (Ivanova *et al*., 2021; Sibiya *et al*., 2021). In our current study, the highest CAT amount of the species collected from the relevant regions was determined in the Öküz Pöçüğü plant (14.12 u/g TA). The

highest amount of SOD was measured in Yabani Hardal (858.72 u/g TA) (Table 3). The highest amount of POD was determined in the Kotan Gülü (111.29 u/g TA) plant. It is thought that the difference in enzyme activity among the species in the study is due to species differences. Findings from our study showed that the antioxidant activity of different species varies according to the species.

Conclusion

As a result, in recent studies, plant genetic materials have been protected in national gene banks, tissue cultures or botanical gardens. However, in our country, the protection of wild plants is not given as much importance as cultivated vegetables. As a result of the unconscious collection of wild plants by humans, many plants are in danger of extinction. As an example of this situation, in the face-to-face interviews with the people living in Doğankaya village, which is located in the study area, they stated that unconscious and excessive collection of the Gelin Parmağı plant, which used to be more common in the region, is less common in the region compared to previous years.

Today, food intake is important for the continuity of human life; the nutritional content of the products we consume is also very important. One of the species with rich nutritional content that nature offers us are wild plants. As a result of the study, although all plant species show superior characteristics, Revan Özeği, Tel Pancarı and Ebegümeci plants contain nutrients (protein, P, N, K, Ca, Mg, Na, Zn, Fe,Cu, B and Mn) were determined to be richer. Among the species, especially Öküz Pöçüğü and Kotan Gülü plants were found to be rich in ascorbic acid. It has been determined that the data obtained from wild plants has a high nutritional potential and their nutritional values are higher or the same as those of cultivated vegetables. For these reasons, studies should be carried out to transfer the superior characteristics of wild plant species related to their nutritional quality and resistance to physiological conditions, to suitable plants according to their degree of kinship, or to cultivate these species. For this reason, we believe that our study will pave the way for future breeding and cultivation studies. In addition, such a study can contribute to the promotion of sustainable ecotourism and be used to develop strategies for the sustainable use of wild edible plants as a natural resource.

References

Ajayi, A.F., R.E. Akhigbe, O.M. Adewumi, L.O. Okeleji, K.B. Mujaidu and S.B. Olaleye. 2012. Effect of ethanolic extract of *Cryptolepis sanguinolenta* stem on in vivo and in vitro glucose absorption and transport: mechanism of its antidiabetic activity. *Ind. J. Endocrinol. Metab.*, 16(Suppl1): 91-96.

Akgünlü, S. 2012. Mineral content and microbiological analysis of some wild edible vegetables consumed in Kilis and Gaziantep provinces, (Master's thesis). Kilis 7 Aralik University, Institute of Science and Technology, Kilis.

Alaca, K. 2018. Phenolic contents and antioxidant activities of some wild plants consumed as food in Van province. Master's thesis, Van Yüzüncü Yıl University, Institute of Science and Technology, Van, Turkey.

Alam, M.K., Z.H. Rana, S.N. Islam and M. Akhtaruzzaman. 2020. Comparative assessment of nutritional composition, polyphenol profile, antidiabetic and antioxidative properties of selected edible wild plant species of Bangladesh. *Food Chem.*, 320: 126646.

Anonymous. 2018a. www.diyadinnet.com/YararliBilgiler-615&Bilgi=ardahanın-coğrafi-yapısı. (Access date: 20/ 09/2018).

Anonymous. 2018b. Average meteorological values of Ardahan Province in 2018 Ministry of Agriculture and Forestry General Directorate of Meteorology Ardahan, (Access date: 26/09/2018).

Anonymous. 2019. https://www.google.com/search?rlz=ardahan+harita&oq. (Access date: 21/12/2019).

Ataseven, Y. 2011. Investigation of the effects of agricultural activities on drinking water basins: The case of ANKARA, 104 p.

Bacchetta, L., F. Visioli, G. Cappelli, E. Caruso, G. Martin, E. Nemeth, G. Bacchetta, G. Bedini, A. Wezel, T. van Asseldonk, L. van Raamsdonk and F. Mariani. 2016. A manifesto for the valorization of wild edible plants. *J. Ethnopharmacol.*, 191: 180-187.

Bayramoğlu, M.M., D. Toksoy and G. Şen. 2009. Medicinal plant trade in Turkey. II. Socio-Economic Problems in Forestry Congress, 19-21 February, Süleyman Demirel University, Isparta.

Bharucha, Z. and J. Pretty. 2010. The roles and values of wild foods in agricultural systems. *Philos. Trans. R. Soc. Lond., B, Biol. Sci.*, 365(1554): 2913-2926.

Çağlarırmak, N. and A. Z. Hepçimen. 2010. Effect of heavy metal soil pollution on food chain and human health. *Acad. Food*, 8(2): 31-35.

Cámara, M., V. Fernández-Ruiz and B.M. Ruiz-Rodríguez. 2016. Wild edible plants as sources of carotenoids, fibre, phenolics and other non-nutrient bioactive compounds. *Mediter. Wild Edible Plants*, 187-205.

Ceylan, F. and E. Yücel. 2015. Consumption patterns and nutritional value of wild plants consumed as food in Düzce and its surroundings. *Afyon Kocatepe University, J. Sci. Eng. Sci.*, 15: 1-7.

Civelek, C. and A. Balkaya. 2013. The nutrient content of some wild plant species used as vegetables in Bafra plain located in the Black sea region of Turkey. *Eur. J. Plant Sci. Biotechnol.*, 7(1): 62-65.

Civelek, C. 2011. Collection, determination of some nutritional values and evaluation for breeding of wild plant species used as vegetables in Bafra Plain (Master's thesis). Ondokuz Mayıs University, Institute of Science and Technology, Samsun, Turkey.

Datta, S., B.K. Sinha, S. Bhattacharjee and T. Seal. 2019. Nutritional composition, mineral content, antioxidant activity and quantitative estimation of water-soluble vitamins and phenolics by RP-HPLC in some lesser used wild edible plants. *Heliyon*, 5(3): e01431.

Davis, P.H. 1988. Mill, R.R., Tan, K., Flora of Turkey and The East Aegean Islands. Vol. 10, Edinburgh University Press. Edinburgh, North Britian.

Doğan, S. 2016. Determination of the nutritional values and some wild plants used as local fresh consumption in Gevaş (Van) district (Master's thesis). Yüzüncü Yıl University, Institute of Science and Technology, Van, Turkey.

Doğan, Y., S. Başlar, G. Ay and H.H. Mert. 2004. The use of wild edible plants in western and central Anatolia (Turkey). *Econ. Bot.*, 58(4): 684-90.

Ekim, T., M. Koyuncu, S. Erik and R. İlarslan. 1989. Endangered rare and endemic plants of Turkey. *Turkish Nature Conservation Association Publications, Turkey*, **p. 227.**

Erik, S. and B. Tarıkahya. 2004. On Flora of Turkey. Kebikeç Journal of Resource Studies for Human Sciences, *Alpine Printing House*, Ankara, Turkey, 17: 139-163.

Faydaoğlu, E. and M.S. Sürücüoğlu. 2011. History of the use of medical and aromatic plants and their economic importance. *Kastamonu Uni. J. Forest. Fac.*, 11(1): 52-67.

Güner, A., N. Özhatay, T. Ekim and K.H.C. Başer. 2000. Flora of Turkey, Volume 11, *Edinburgh University Press*. Edinburgh, North Britian.

Ivanova, T., Y. Bosseva, M. Chervenkov and D. Dimitrova. 2021. Enough to Feed Ourselves! Food plants in Bulgarian rural home gardens. *Plants*, 10(11): 2520.

Kaya, İ., N. İncekara and Y. Nemli. 2004. Ingredients of some weeds consumed as food in Aegean Region. *Y.Y.U. J. Agr. Sci.*, 14(1): 1-6.

Korkmaz, M. and E. Karakurt. 2015. Traditional uses of natural food plants in Kelkit (Gümüşhane) district. *Biyol. Bilim. Araşt. Derg.,* 8 (2): 31-39.

Kunkel, G. 1984. *Plants for human consumption*. Koeltz Scientific Books. **University of Minnesota, USA, p. 393.**

León-Lobos, P., J. Díaz-Forestier, R. Díaz, J.L. Celis-Diez, M. Diazgranados and T. Ulian. 2022. Patterns of traditional and modern uses of wild edible native plants of chile: Challenges and future perspectives. *Plants,* 11(6):744.

Marrelli, M., G. Statti and F. Conforti. 2020. A review of biologically active natural products from Mediterranean wild edible plants: benefits in the treatment of obesity and its related disorders. *Molecules*, 25(3): 649.

Mateos-Maces, L., J.L. Chávez-Servia, A.M. Vera-Guzmán, E.N. Aquino-Bolaños, J.E. Alba-Jiménez and B.B. Villagómez-González. 2020. Edible leafy plants from Mexico as sources of antioxidant compounds, and their nutritional, nutraceutical and antimicrobial potential: A review. *Antioxidants*, 9(6): 541.

Mertens D. 2005. AOAC Official Method 975.03. Metal in plants and pet foods official methods of analysis. In: 18th edn. (Eds.): Horwitz, W. and G.W. Latimer. Chapter 3, pp 3-4, AOAC-International Suite 500, 481. N F Avenue, Gaitherburg, Maryland 20877-2417, USA.

Miskoska-Milevska, E., A. Stamatoska and S. Jordanovska. 2020. Traditional uses of wild edible plants in the Republic of North Macedonia. *Phytol. Balc.*, 26: 155-162.

Niksarlı-İnal, F. 2013. Conservation of plant species existing in nature. *Aegean Agricultural Research Institute, Technical Brochure* No:2. http://arastirma.tarim. gov.tr/etae/Belgeler/ TeknikBrosur/BGK_do%C4%9Fal%20 bitkiler.pdf.

Özer, M.Ö. and M. Aksoy. 2019. Mineral composition and nutritional properties of *Trachystemon orientalis* (L.) G. Don populations in the Central Black Sea Region of Turkey. *Acta Sci. Pol-Hortoru.*, 8(4): 157-167.

Ozturk, H.I., H. Nas, M. Ekinci, M. Turan, S. Ercisli, H.K. Narmanlioglu, E. Yıldırım, A. Assouguem, R. Almeer, A. A. Sayed and I. Peluso. 2022. Antioxidant activity, phenolic composition, and hormone content of wild edible vegetables. *Horticulturae*, 8(5): 427.

Öztürk, M. and H. Özçelik. 1991. Useful Plants of East Anatolia (Turkish), *SİSKAV (Siirt, İlim, Spor, Kültür ve Araştırma Vakfı)*, Semih Ofset Matbaacılık Yayıncılık ve Ambalaj Sanayi Limited Şirketi, Ankara, Turkey.

Pereira, C., L. Barros, A.M. Carvalho and I.C. Ferreira. 2011. Nutritional composition and bioactive properties of commonly consumed wild greens: Potential sources for new trends in modern diets. *Food Res. Int.*, 44(9): 2634-2640.

Sahin, U., M. Ekinci, S. Ors, M. Turan, S. Yildiz and E. Yildirim. 2018. Effects of individual and combined effects of salinity and drought on physiological, nutritional and biochemical properties of cabbage (*Brassica oleracea* var. capitata). *Sci. Hort.*, 240: 196-204.

Samancıoğlu, A., I.G. Sat, E. Yıldırım, S. Ercişli, T. Jurikova and T. Mıcek. 2016.Total phenolic and vitamin C content and antiradical activity evaluation of traditionaly consumed wild edible vegetables from Turkey. *I.J.T.K.*, 15 (2): 208-213.

Şekeroğlu, N., F. Özkutlu, M. Deveci, Ö. Dede and N. Yılmaz. 2005. Investigation of some wild plants consumed as vegetables in Ordu and its region in terms of nutritional value. *Turkey VI. Field Crops Congress*, Antalya, Turkey.

Sibiya, N.P., E. Kayitesi and A.N. Moteetee. 2021. Proximate analyses and amino acid composition of selected wild indigenous fruits of Southern Africa. *Plants*, 10(4): 721.

Simopoulos, A.P. 2004. Omega-3 fatty acids and antioxidants in edible wild plants. *Biol. Res.*, 37(2): 263-277.

Tunçtürk, M. and F. Özgökçe. 2015. Chemical composition of some Apiaceae plants commonly used in herby cheese in Eastern Anatolia. *Turk. J. Agric. For.*, 39: 55-62.

Turan, M., S. Kordali, H. Zengin, A. Dursun and Y. Sezen. 2003. Macro and micro mineral content of some wild edible leaves consumed in Eastern Anatolia. *Acta Agric. Scand. - B Soil Plant Sci.*, 53 (3): 129-137.

Yıldırım, E., A. Dursun and M. Turan. 2001. Determination of the nutrition contents of the wild plants used as vegetables in upper Çoruh Valley. *Turk. J. Bot.*, 25: 367-371.

Yücel, E., A. Tapırdamaz, İ.Y. Şengün, G. Yılmaz and A. Ak. 2011. Determining the usage ways and nutrient contents of some wild plants around Kisecik Town (Karaman/Turkey). *Biodiv. Conserv*., 4 (3): 71-82.

Yüksel, E. and H.A. Beğen. 2018. The flora of Dereiçi village (Yusufeli, Artvin, Turkey) and its surroundings. *Turk. J. Biodiv.*, 1(1): 34-40.

Zurera, G., R. Moreno, J. Salmeron and R. Pozo. 1989. Heavy metal uptake from greenhouse border soils for edible vegetables. *J. Sci. Food Agric*., 49: 307-314.

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