The European Journal of Plant Science and Biotechnology ©2013 Global Science Books

The Nutrient Content of Some Wild Plant Species Used as Vegetables in Bafra Plain Located in the Black Sea Region of Turkey

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ABSTRACT

Some wild plant species have been used as vegetables in several parts of the world. These species are also used with respect of their aromatic and medicinal properties. Furthermore, these plants are evaluated as alternative food sources in periods where crop vegetables were not available. In this study, nineteen wild plant species, which are used as vegetable by local people in Bafra Plain, were collected and identified systematically. Dry matter, ash, protein, phosphorus, potassium, magnesium, calcium, iron, manganese and zinc contents were analyzed in order to determine the nutritional values of consumed parts of these wild species. Significant differences were found between species regarding their nutritional values. In fresh plant samples; the highest dry matter content was determined in *Trachystemon orientale* (14.73 g/100 g) and the highest ash content in *Chenopodium album* L. (24.73 g/100 g-dry sample). Within the species the highest protein content was observed from *Taraxacum officinale* Weber (32.03 g/100 g-dry sample) and *Coronopus squamatus* Forssk. Aschers. (31.73 g/100 g). Species displaying the highest phosphorus, potassium, magnesium, calcium, iron, manganese and zinc contents were respectively *Chenopodium album* L. (0.49 g/100 g), *Trachystemon orientale* L. (2.90 g/100 g), *Chenopodium album* L. and *Rumex acetocella* L. (0.47 g/100 g), *Malva silvestris* L. (1.54 g/100 g), *Coronopus squamatus* Forssk. Asch. (583.40 mg/kg), *Ocimum basilicum* L. (39.86 mg/kg) and *Asparagus acutifolius* L. (44.13 mg/kg). The results of this study showed that most of these examined nutritional values of these species are higher than cultivated vegetables such as spinach, lettuce and parsley.

Keywords: biodiversity, breeding, indigenous plants, nutritional ingredient

INTRODUCTION

Plant genetic resources are decreasing day by day for reasons such as unconsciously use to meet the needs of people, natural disasters, urbanization and industrialization, etc. (Balkaya and Yanmaz 2001; Özgen *et al*. 2004). Genetic diversity provides breeders and farmers through various breeding methods to breed and produce new varieties which are resistant to pests and diseases, can adapt to different environmental conditions and displaying high nutritive quality (Rao 2004). The wild plants have an important role in plant breeding because of their superior characteristics and their relationship with cultivated species.

Turkey, one of the richest countries in the world in terms of plant diversity is also the gene center of many plant species. There are 12.476 plant taxa in Turkey and 4.080 of them are endemic (Karagöz *et al*. 2010). Plants are directly or indirectly sources of all food products and nearly 3.000 of plant species are under cultivation. Furthermore, it is reported that about 10.000 wild plant species have been used as a food source (Baytop 1984; Duzenli 1988).

Today vegetables are essential foods regarding nutrition and health. Chemical analyses showed that vegetables are rich sources in terms of some minerals and vitamins. On the other hand many researchers have reported that wild plants have been used as vegetables in many regions of the world and also Turkey (Siyamoğlu 1984; Pemberton and Lee 1996; Ladio 2001; Dogan *et al*. 2004; Ertug 2004; Rajasab and Isaq 2004; Dovie *et al*. 2007; Abak 2010; Pereira *et al*. 2011; Ashok and Reddy 2012).

In this study, wild plants used as vegetables by the local people in Bafra Plain and their nutritional contents were determined. Also the kind of using these species as vegetables and their local names were recorded. This study was carried out as a part of a master's thesis entitled "Collection, determination of some nutritional values and evaluation for breeding of wild plant species used as vegetables in Bafra Plain".

MATERIALS AND METHODS

Bafra Plain is located in Black Sea region of Turkey and has typical Black Sea region climate. It is located in between 41° 13′ 26″ N 41° 44′ 6″ N latitude and 35° 29′ 50″ E 36° 01′ 01″ E longitude. The current land area is approximately 175,000 ha. The district has an average altitude of 15-20 m. Bafra Plain is a delta plain formed by Kızılırmak River and 20 km from the Black Sea. The average annual relative humidity is above 70%. Average annual rainfall is 750-1000 mm. Generally, Bafra has a mild climate and may be considered as a microclimate. The region has a rich potential respect plant species.

Collection of wild plants used as vegetables in Bafra Plain

Surveys and field studies for determination and collection of wild plants used as vegetables by the folk in the area was carried out in local markets, city center and villages of Bafra district built on Bafra Plain between 2009 and 2010. For this purpose, primarily local markets were visited and wild plants sold in these markets were identified. After, basing on interviews in the form of questionnaire with local people, the other wild plants used as vegetables were determined and collected from their natural habitats. During collection, assistance was taken by the local people who have knowledge and experience on this subject. Then taxonomic identifications of these wild species were performed by Prof. Dr.

Received: 13 October, 2011. Accepted: 20 April, 2012.

Research Note

Table 1 Botanical and local names, common names, consumed part and consumption methods of wild species.

Botanical name	Local name	Common name	Consumed part	Consumption method
Arum maculatum L.	Hünük	Yılan yastığı	leaf	boiled-soup
Asparagus acutifolius L.	Tilki kuyruğu	Kuşkonmaz	young shoot	roasted
Malva sylvestris L.	Ebegümeci	Ebegümeci	leaf	boiled-roasted
Aegopodium podagraria L.	Mendek	Keçiayağı otu	leaf	boiled-roasted
Coronopus squamatus L.	Yol eğrisi	-	whole plant	roasted
Chenopodium album L.	Sirken	Ak pazı	leaf	roasted
Geranium molle ssp. *molle* L.	İğnelik	Turnagagası	leaf	roasted
Oenanthe pimpinelloides L.	Kazayağı	Alan maydanozu	leaf	roasted
Ocimum basilicum L.	Reyhan	Reyhan, fesleğen	leaf	raw as salad
Rumex acetocella L.	Ekşimek	Kuzukulağı	whole plant	raw-roasted
Stachys byzantina C. Koch	Kuzu kulağı	Karabaş otu	leaf	roasted
Stellaria media ssp. *media* L.	Kuş yüreği	Kuşotu	leaf+stem	roasted-pie
Nasturtium officinale R. Br.	Su teresi	Su teresi	leaf	raw as salad
Trachystemon orientale L.	Kaldirik	Kaldırak, ispit	leaf	roasted
Rumex patientia L.	Efelik	Labada	whole plant	raw-roasted
Smilax excelsa L.	Kırçan	Saparna	young shoot	pickle-roasted
Taraxacum officinale Weber	Haldar	Hindiba, radika	whole plant	roasted-pie
Urtica dioica L.	Isırgan	Isırganotu	leaf	dried-soup-pie
Polygonum cognatum Meissn.	Madımak	Madımak, çobanekmeği	leaf+stem	boiled-roasted-pie

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Preparation of samples for analyses

In order to identify nutritional values of wild plant species evaluated as vegetables in Bafra Plain, some macro and microelements (P, K, Ca, Mg, Fe, Mn, Zn) which are important in human nutrition, protein, dry matter and ash contents were determined. After harvesting, the plant samples collected from their natural habitats were purified and their edible parts were separated. Fresh plant samples were weighed and then dried to constant weight at 80°C. Dried samples were grinded (size of mesh 1 mm) and samples were subjected to wet decomposition process with nitric acid: perchloric acid (4: 1) for analyses (Kacar and İnal 2008). For wet decomposition treatment, from dried and grinded samples for each species 1 g were weighed and placed in 100-ml Erlenmeyer flasks in triplicate. Later, 10 ml nitric-perchloric stock acid solution was added on each sample and were shaken carefully for mixing samples and stock acid solution and flasks were placed by putting on them glass funnels on a hot plate placed in a laminar cabinet. The process started and adjusted temperature at least 200°C gradually. Wet decomposition process was finished after 30 min when perchloric acids white dense fumes covered the flasks inside. When the samples temperature reached to suitable temperature, samples transferred to 50 ml volumetric flasks and filled the flasks until measurement line with distilled water. After waiting for six hours, samples were decanted to glass tubes by filtering with Whatman paper. Spectrofotometric analyses were made in these samples.

Determination of some nutritional values of wild plant species used as vegetables in Bafra Plain

Dry matter contents were observed by comparing fresh and dry weights. Fe, Mn, Zn, Ca and Mg contents were determined using an atomic absorption spectrophotometer (Perkin Elmer–22080) in dried and grinded samples prepared by the method of wet decomposition with nitric-perchloric acid. Potassium contents also in samples prepared with the same method were determined by using a flame photometer (BWB–1). To determine the ash contents of plant samples, 2 g from each dried and grinded sample was placed porcelain crucibles kept in a desiccator and weighed with a precision balance. After, samples were burned in an oven at 550°C. Burning finished when the samples colors were gray or close to gray. The samples were cooled in desiccator and weighed again and then ash contents were calculated according to differences in weight. Total protein and phosphorus were observed by using Near Infrared Reflectance Spectroscopy (NIRS Foss 6500) with software package program 'IC-0904FE'.

Sampling, experimental design and statistical analyses

Locations where the species have rich populations and intensive consumption were selected and plant samples were collected from these regions. All analyzes were conducted in three replicates for all contents and species. In order to reveal differences among the species in terms of nutritional values, analysis of variance (ANOVA) was made with SPSS 9®.

RESULTS AND DISCUSSION

Wild plants used as vegetables in Bafra Plain

19 wild plant species used as vegetables by the local people were collected (**Table 1**). These species are as follows: lords and ladies (*Arum maculatum* L.), wild asparagus (*Asparagus acutifolius* L.), mallow (*Malva silvestris* L.), ground elder (*Aegopodium podagraria* L.), creeping watercress (*Coronopus squamatus* Forssk. Aschers.), goosefoot (*Chenopodium album* L.), dovefoot (*Geranium molle* ssp. *molle* L.), water dropwort (*Oenanthe pimpinelloides* L.), sweet basil (*Ocimum basilicum* L.), sorrel (*Rumex acetocella* L.), lamb's ear (*Stachys byzantina* K. Koch.), chickweed (*Stellaria media* ssp. *media* L.), watercress (*Nasturtium officinale* R. Br.), borage (*Trachystemon orientale* L.), patience dock (*Rumex patientia* L.), rough bindweed (*Smilax excelsa* L.), dandelion (*Taraxacum officinale* Weber), stinging nettle (*Urtica dioica* L.) and knotweed (*Polygonum cognatum* Meissn.). Different parts of these wild species such as leaves, young shoots, whole plant, etc. have been used as vegetables in different ways such as raw, dried, boiled, etc. (**Table 1**). These plants have been evaluated as vegetables in diverse ways and known as different local names in different regions of Turkey, also. For example, *Arum maculatum* L. species called as "hünük" in the study area although the same species called as "tirşik otu" in the Aegean Region of Turkey (Tan and Taşkın 2009). Local names and common names of species studied in this study were given in **Table 1**.

Nutritional contents of wild plants used as vegetables in Bafra Plain

All nutritional contents of plant samples which were analyzed varied depend on species. Dry matter in edible parts of plant samples ranged from 10.40% (*Arum maculatum* L.) to 14.73% (*Trachystemon orientale* L.). Sekeroglu *et al.* (2006) reported for *Urtica dioica* L. 12.40% dry matter. In this study also found a similar result (11.57%) for the same species. The highest ash content was determined in *Cheno-*

Table 2 Dry matter (%), ash and protein (g/100 g) contents of species.

Species	Nutritional content			Species	Nutritional content		
	Dry matter	Ash	Protein		Dry matter	Ash	Protein
Arum maculatum L.	10.40	9.51	23.50	*Stachys byzantina* C. Koch	12.29	16.14	27.59
Asparagus acutifolius L.	13.51	7.94	30.46	*Stellaria media* ssp. *media* L.	10.46	13.71	21.31
Malva sylvestris L.	13.29	17.14	28.38	*Nasturtium officinale* R. Br.	13.65	16.68	21.15
Aegopodium podagraria L.	11.81	16.14	27.39	*Trachystemon orientale* L.	14.73	15.53	22.58
Coronopus squamatus L.	11.55	14.64	31.73	*Rumex patientia* L.	11.87	11.11	29.67
Chenopodium album L.	12.31	24.73	29.38	*Smilax excelsa* L.	12.22	6.77	24.30
Geranium molle ssp. *molle* L.	12.91	10.36	22.21	*Taraxacum officinale* Weber	13.25	14.40	32.03
Oenanthe pimpinelloides L.	10.71	15.88	24.86	*Urtica dioica* L.	11.57	12.83	30.47
Ocimum basilicum L.	12.07	7.07	25.69	*Polygonum cognatum* Meissn.	12.23	11.38	25.85
Rumex acetocella L.	12.09	13.23	21.72				

Table 3 Phosphorus, potassium, magnesium and calcium contents of species (g/100 g).

Species	Nutritional content				Species	Nutritional content			
	P	K	Mg	Ca		P	K	Mg	Ca
Arum maculatum L.	0.45	1.25	0.21	1.17	*Stachys byzantina* C. Koch	0.46	1.62	0.24	0.86
Asparagus acutifolius L.	0.48	1.70	0.15	0.53	*Stellaria media* ssp. *media* L.	0.44	1.92	0.22	0.77
Malva sylvestris L.	0.45	1.49	0.21	1.54	*Nasturtium officinale* R. Br.	0.44	1.98	0.29	1.00
Aegopodium podagraria L.	0.45	1.82	0.16	1.10	*Trachystemon orientale* L.	0.38	2.90	0.16	0.90
Coronopus squamatus L.	0.47	1.25	0.23	1.25	*Rumex patientia* L.	0.47	1.19	0.21	0.82
Chenopodium album L.	0.49	1.32	0.47	1.20	*Smilax excelsa* L.	0.45	1.45	0.20	0.76
Geranium molle ssp. *molle* L.	0.47	1.73	0.22	1.24	*Taraxacum officinale* Weber	0.47	1.19	0.21	0.92
Oenanthe pimpinelloides L.	0.44	1.45	0.20	1.17	*Urtica dioica* L.	0.47	1.32	0.22	1.15
Ocimum basilicum L.	0.45	1.42	0.36	1.10	*Polygonum cognatum* Meissn.	0.42	1.59	0.23	0.77
Rumex acetocella L.	0.44	2.13	0.47	0.98					

Table 4 Iron, manganese and zinc contents of species (mg/kg).

Species	Nutritional content			Species	Nutritional content		
	Fe	Mn	Zn		Fe	Mn	Zn
Arum maculatum L.	117.92	3.03	38.38	*Stachys byzantina* C. Koch	114.93	8.07	28.13
Asparagus acutifolius L.	60.23	4.54	44.13	*Stellaria media* ssp. *media* L.	112.94	17.15	24.88
Malva sylvestris L.	613.24	37.84	26.38	*Nasturtium officinale* R. Br.	204.42	12.78	31.65
Aegopodium podagraria L.	131.84	13.12	23.63	*Trachystemon orientale* L.	251.20	5.05	28.25
Coronopus squamatus L.	583.40	8.58	22.63	*Rumex patientia* L.	104.99	4.54	26.00
Chenopodium album L.	370.55	16.65	31.88	*Smilax excelsa* L.	103.00	2.52	41.50
Geranium molle ssp. *molle* L.	110.95	8.58	20.63	*Taraxacum officinale* Weber	84.10	6.05	35.25
Oenanthe pimpinelloides L.	133.83	21.19	34.13	*Urtica dioica* L.	182.57	29.26	33.38
Ocimum basilicum L.	510.80	39.86	18.13	*Polygonum cognatum* Meissn.	246.22	22.20	29.13
Rumex acetocella L.	283.03	11.60	24.88				

podium album L. (24.73 g/100 g) and the lowest ash content was determined in *Smilax excelsa* L. (6.77 g/100 g). Sekeroglu *et al*. (2006) reported 7.10 g/100 g ash content in *Smilax excelsa* L. This result is similar to our result for the same species. Plant species varied in protein contents. The highest protein content was determined in *Taraxacum officinale* Weber (32.03 g/100 g) and the lowest content was determined in *Nasturtium officinale* R. Br. (21.15 g/100 g) (**Table 2**). Some authors reported that around 15% protein for *Taraxacum officinale* Weber (Escudero *et al.* 2003; Choi *et al.* 2010). These differences may be due to ecological factors and collection time. Ozbucak *et al.* (2007) and Adedapo *et al*. (2011) reported for *Chenopodium album* L. 26.42 and 26.44 g/100 g protein, respectively. These results are consistent with our result (29.38 g/100 g) for the same species but Yıldırım *et al*. (2001) and Bhargava *et al*. (2008) reported very low protein values in the same species (3.69 and 4.51 g/100 g). The reason for these differences could be differences in method (e.g. making analyses in fresh samples or in different parts of plants) and time of collection as well as ecology. Phosphorus contents in dried and grinded samples of the species studied ranged from 0.38 g/100 g (*Trachystemon orientale* L.) to 0.49 g/100 g (*Chenopodium album* L.). The highest K, Mg and Ca contents of wild species were determined in *Trachystemon orientale* L. (2.90 g/100 g), *Chenopodium album* L. and *Rumex acetocella* L. (0.47 g/100 g) and *Malva silvestris* L. (1.54 g/100 g). The lowest K, Mg and Ca contents were determined in *Rumex patientia* L. and *Taraxacum officinale* Weber (1.19 g/100 g), *Asparagus acutifolius* L. (0.15 g/100 g) and also *Asparagus acutifolius* L. (0.53 g/100 g), respectively (**Table 3**). A partially different Mg content (0.37 mg/kg) from our result reported by Borah *et al*. (2009) for *Chenopodium album* L. Analyses showed that there were wide ranges of variations among the species regard iron concentrations of the wild species (**Table 4**). The highest value of Fe was determined in *Malva silvestris* L. (613.24 mg/kg) and the lowest value was determined in *Asparagus acutifolius* L. (60.23 mg/kg). Mn and Zn contents varied between 39.86 mg/kg (*Ocimum basilicum* L.) - 2.52 mg/kg (*Smilax excelsa* L.) and 44.13 mg/kg (*Asparagus acutifolius* L.) - 18.13 mg/kg (*Ocimum basilicum* L.), respectively (**Table 4**). Özcan (2004) and Krejpcio *et al.* (2007) reported for *Ocimum basilicum* L. 13.70 and 20.07 mg/kg Zn content, respectively. These results are similar to result we found in the same species in this study.

These results showed that wild species studied have higher contents respect almost all nutrients examined in this study than cultivated leafy vegetables reported by various researchers (**Table 5**). Vainio-Mattila (2000) indicated on the basis of many researchers that wild plants as food sources have high amounts of nutrients. Guil-Guerrero *et al*. (2003) reported based on some contemporary authors, that wild species of vegetables are fit for human nutrition. Ezer and Arısan (2006), Kültür (2007), Ugurlu and Secmen (2008) and Jain and Tiwari (2012) determined in their ethnobotanical studies, that many of wild plant species, including wild edible species, are used traditionally for medicinal purposes in different ways such as decoction, latex or poultice while Esiyok *et al.* (2004), Serteser *et al.* (2009)

Table 5 Nutritional contents of some leafy vegetables reported by various researchers.

Vegetable species	Nutritional content (g/100 g)			
	Dry matter	Ash	Protein	
Parsley (Siyamoğlu 1984)	16.10	2.40	3.70	
Cabbage (Mosha and Gaga 1999)	6.20	6.90	18.50	
	P	K	Mg	Ca
Lettuce (Turan *et al*. 2003)	0.03	0.22	0.01	0.03
Spinach (Gupta and Wagle 1988)	0.74	1.17	0.77	0.87
	Fe	Mn	Zn	
Spinach (Turan *et al*. 2003)	16.00	5.00	5.00	
Mint (Singh *et al*. 2001)	5.06	0.52	0.40	

and Barros *et al*. (2011) reported that these wild plant species contain compounds which have antioxidant properties.

CONCLUSIONS

This study showed that these wild plants contain high amounts of nutritional contents which are important in terms of human health. The study also showed that some species are facing extinction due to excessive and unconscious gathering from the nature. Therefore, these species should be protected. In addition, knowledge on these plants disappearing day by day due to lack of interest from the younger consumers. This is a cultural heritage and, it is important that the information and experience on these wild plants should be recorded and transferred from generation to generation, for ensuring the diversity of food and consciously use of these plants. Also, it should be noted that these plants may show toxic effects (Guil *et al.* 1997). For this reason, unless wild plants well recognized they should not be consumed.

These wild plant species are potentially respectable sources for gain new species to culture and human diet. Therefore, these species with their genetic potential should be protected and more studies related to cultivation of these wild species should be carried out.

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