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Mediterranean Region Studies of Mainstreaming Biodiversity Conservation and Sustainable Use for Improved Human Nutrition and Wellbeing Project

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ABSTRACT: *"Mainstreaming biodiversity conservation and sustainable use for improved human nutrition and wellbeing" project is being carried out in three pilot sites in Turkey. Mediterranean pilot site contains high mountain steps of Taurus Mountains and Central Anatolian steps where transition zone between Irano-Turanian and Mediterranean biogeographic regions exists. This site has highest endemism rate in Turkey. Mediterranean pilot site includes 4 cities as Antalya, Konya, İçel and Karaman include 17 districts and 31 villages. In the Mediterranean Region 20 taxa; 16 of them using for nutrition, 3 of them using as folk medicine 1 is local race (cultivated). People in the rural area use many plant for nutritional and medical purpose. These species have been selected and collected from nature and local bazaars. Plant materials have been sent to the Bursa Food and Forage Control Central Research Institute for content analysis, Proximities, dietary fiber, vitamins and minerals were assayed using standard methods and reference materials. Plants are analyzed to the Western Mediterranean Agricultural Research Institute, Medicinal and Aromatic Plants Central Research Institute for antioxidant properties. Antioxidant activity analysis (two method using) was completed for all priority species of the project. The antioxidant activity analyses were done according to the DPPH and TEAC methods.*

Keywords: *Wild edible plants, Mediterranean Region, medicinal food, biodiversity, traditional knowledge, socio-economic surveys.*

İnsan Beslenmesi ve Refahının İyileştirilmesi için Biyoçeşitliliğin Korunması ve Sürdürülebilir Kullanımının Yaygınlaştırılması Projesi Akdeniz Bölgesi Çalışmaları

ÖZ: *"İnsan Beslenmesi ve Refahı İçin Biyolojik Çeşitliliğin Korunması ve Sürdürülebilir Kullanımı" projesi Türkiye'de üç pilot bölgede yürütülmektedir. Akdeniz pilot bölgesi, İran-Turan ve Akdeniz biyocoğrafik bölgeleri arasındaki geçiş bölgesinde bulunduğu Toros Dağlarının yüksek dağ steplerini ve Orta Anadolu steplerini içerir. Bu bölge endemik olarak en yüksek orana sahiptir. Akdeniz'de pilot bölgesinde 4 il; Antalya, Konya, İçel ve Karaman'da 17 ilçe ve 31 köy çalışılmıştır. Akdeniz Bölgesi'nde bulunan 20 takson; Bunlardan 16'sı beslenme için, 3'ü halk hekimliği ve 1'i yerel tür (yetiştirilen) olarak kullanılıyor. Kırsal alanda yaşayan insanlar, beslenme ve tıbbi amaçla birçok bitki kullanıyorlar. Bu türler doğadan ve yerel pazarlardan seçilmiş ve toplanmıştır. Bitki materyalleri içerik analizi için Bursa Yem ve Yem Kontrol Merkezi Araştırma Enstitüsüne gönderildi. Beslenme değerleri, diyet lifi, vitaminler ve mineraller standart yöntemler ve referans malzemeler kullanılarak analiz edilmiştir. Bitkilerin, Batı Akdeniz Tarımsal Araştırma Enstitüsü, Tıbbi ve Aromatik Bitkiler Merkezi Araştırma Enstitüsü'nde antioksidan aktivite analizleri yapılmıştır. Projenin tüm öncelikli türleri için antioksidan aktivite analizi (iki yöntem kullanılarak) tamamlanmıştır. Antioksidan aktivite analizleri için DPPH ve TEAC yöntemleri kullanılmıştır.*

Anahtar Sözcükler: *Yabani yenilebilir bitkiler, Akdeniz Bölgesi, tıbbi gıda, biyoçeşitlilik, geleneksel bilgi, sosyo-ekonomik anketler.*

INTRODUCTION

It has been estimated that there are some 8.7 million eukaryotic species on earth of which some 25% (2.2 million) are marine, and most of them have yet to be discovered (Mora *et al*. 2011). Wild biodiversity has an important role in contributing to food production and security in many agroecosystems worldwide (Scoones *et al*., 1992; Johns and Maundu, 2006; Turner *et al*., 2011; Dogan, 2012; Mavengahama *et al*., 2013; Vinceti *et al*., 2013; Powell *et al*., 2014; Achigan-Dako *et al*., 2014; Vira *et al*., 2015).

There is an increasing public awareness that nutrition and dietary components have a very relevant contribution to personal well-being and health (Biesalski *et al*., 2011). In the case of non-cultivated traditional vegetables, despite its intermingled nutritional and medicinal role has been widely documented (Etkin, 1996; Carvalho and Morales, 2010; Guarrera, 2003; Heinrich *et al*., 2005; Pardo-de-Santayana *et al*., 2005).

A recent survey summarizing information from 36 studies in 22 countries highlights that wild biodiversity still plays an important role in local contexts with around 90–100 wild species per location and community group. Based on some estimates, the use of wild food reached up to 300-800 species, although actual consumption and dietary intakes were not studied (Bharucha and Pretty, 2010).

The Project Objective is to strengthen the conservation and sustainable management of agricultural biodiversity through mainstreaming into national and global nutrition, food and livelihood security strategies and programs.

Mediterranean pilot site includes 4 cities as Antalya, Konya, İçel and Karaman (Figure 1). This site contains high mountain steps of Taurus Mountains and Central Anatolian steps where transition zone between Irano-Turanian and Mediterranean biogeographic regions exists. Due to these variations, we have also shown the vegetation and agriculture of these regions to be as variable as the factors creating the climate, as well as how the hydrologic cycle and energy balance play a role in the climate of these regions.

In biogeography, the Mediterranean Basin (also known as the Mediterranean Region) is the region of lands around the Mediterranean Sea that have a Mediterranean climate, with mild, rainy winters and hot, dry summers which supports characteristic Mediterranean forests, woodlands and scrub vegetation.

This area is highest endemism rate in Turkey. Antalyahas got 2126 taxa, 572 is endemic, Mersin has got 1724 taxa, 399 is endemic, Karaman has got 331 taxa, 150 is endemic and Konya has got 1396 taxa 428 is endemic.

Figure 1. The study area of Mediterranean Region.
Şekil 1. Akdeniz Bölgesi çalışma alanları.

Mediterreanean Region is rich in biodiversity over 20 important plant areas. This selected 20 taxa; 16 of them using for nutrition, 3 of them using as folk medicine 1 is local race (cultivated).

Examples of our most important target species studied in the Mediterranean Region about the importance of the purpose and usage are given. Some of these; *Colocasia esculenta* (Taro) is an ancient food crop that was domesticated at least 9000 years ago, largely for its underground corm. All plant parts can be utilized. Its corms are baked, roasted or boiled; the leaves are frequently eaten as a vegetable and represent an important source of vitamins. The blades and petioles of leaves can be preserved or dried, and thereby become an important food in times of scarcity. Various plant parts are used for medicinal purposes (Rao *et al.,* 2010; Iosefa *et al.,* 2013). *Nasturtium officinale* R. Br. (watercress) is used to cure abdominal pain in Turkish folk medicine and is eaten as a vegetable and in salads in Turkey (Tuzlaci and Erol, 1999). *Chondrilla juncea* is used raw in salads. *Cichorium intybus* as vegetable is used raw and cooked and also medicinal uses as digestive disorders such as laxative, diuretic and invigorative, hypoglycemic, depurative, disinfectant of urinary tract, hepatoprotective, and in skin diseases (Morales, *et al.,* 2014). White lupine (*Lupinus albus* L.) crops were important to many Mediterranean civilizations and was domesticated in the Old and New World (Putnam *et al.,* 1993). The fiber-rich flour made from white lupine seeds are used by humans. The flour is a good source of macro- and micro-nutrients, protein, fat, carbohydrates, minerals, and vitamins (Yanez, 1996). It is used to enrich pastas, cake mixes, cereals, and other baked goods (Birk, 1993). Sweet white lupine flour is also added to emulsify meat products to increase its nutritional value, aroma and to modify texture (Erbas *et al*., 2005). Among them *Tragopogon porrifolius* L. known as white salsify is used as a vegetable in Europe as well as in Turkey (Formisano *et al.,* 2010; Baytop, 1999).

Table 1. Study area in the provinces of Antalya, Konya, Icel and Karaman.
Çizelge 1. Antalya, Konya, İçel and Karaman illerindeki çalışma alanları.

City (İl)	Antalya	Konya	Icel	Karaman
District (İlçe)	Gündoğmuş Akseki Korkuteli Elmalı Gazipaşa	Taşkent Beyşehir Derebucak Ereğli Halkapınar	Aslanköy (Erdemli) Mut Gülnar Tarsus Çamlıyayla	Ermenek Ayrancı
Species (Tür)	1. *Juniperus drupacea* Labill. (Andız, Pekmez ardıcı) 2. *Pyrus serikensis* Güner & H. Duman (Serik Armudu) 3. *Dioscorea communis* (L.) Caddick & Wilkin (Kuşkonmaz) 4. *Chondrilla juncea* L. (Gara gavruk) 5. *Colocasia esculenta* (L.) Schott (Gölevez)	6. *Eremurus spectabilis* M.Bieb. (Çiriş) 7. *Nasturtium officinale* R.Br., Aiton (Su teresi) 8. *Lupinus albus* L. (Termiye, Tirmis) 9. *Acorus calamus* L. (Eğir) 10. *Capparis spinosa* L. (Kebere, Kapari) 11. *Eriolobus trilobatus* (Labill. ex Poir.) At Elması 12. *Ferulago trachycarpa* Boiss. (Çakşır, çaşır) 13. *Berberis crataegina* DC. (Karamuk)	14. *Gundelia tournefortii* L. (Kenger)	15. *Ferula elaeochytris* Korovin (Çakşır) 16. *Scorzonera cana* (C.A.Mey.) Griseb (Dedem sakalı) 17. *Gypsophila arrosti subsp nebulosa (*Boiss. & Heldr.) Greuter & Burdet (Çöğen) 18. *Rhus corioria* L. (Sumak) 19. *Tragopogon porrifolius* subsp. *longirostris* (Sch.Bip.) Greuter (Yemlik) 20. *Cichorium intybus* L. (Güneyik, Karahindiba)

The roots and young shoots are used as vegetables (Zidorn *et al.,* 2010). Aerial parts of the *T. porrifolius* and also some of other *Tragopogon* species are known as Yemlik and Teke Sakalı in Anatolia and they are eaten freshly or after cooked (Turan *et al.,* 2003; Ugur *et al.,* 2009).The genera were also used as herbal medicine. *T. porrifolius*is used, in European folk medicine, for its antibilious, diuretic, laxative effects and in Lebanese folk medicine for treatment of cancer (Formisano *et al.,* 2010; Turner *et al.,* 2011). *E. spectabilis*, locally known as "Çiriş otu" is widely used in Turkey as a wild edible vegetable and has been traditionally used in folk medicine. Its tender shoots, buds and leaves have traditionally been used as vegetable in cooking in a wide variety of recipes. It is an important wild species for rural peoples both diets and livelihood. "Foxtail lilly" was selected as target species for the Mediterranean Region (Tugrul Ay *et al.,* 2017).

MATERIALS AND METHODS

Target species have been selected in the Mediterranean Region. Surveys to determine the baseline status of community biodiversity for food and nutrition, dietary diversity and traditional knowledge were completed.

Table 2.Sustainability indices of the species studied in Mediterranean Region.
Çizelge 2. Akdeniz Bölgesinde çalışlan türlerinin sürdürülebilirlik indeksleri.

Species Tür	English Name İngilizce adı	Economic sustainability Sürdürülebilirlik indeksi	Food and nutritional sustainability index Gıda ve Beslenmede sürdürülebilirlik indeksi	Environmental sustainability Çevresel sürdürülebirlik indeksi	Total sustainability Index Toplam sürdürülebilirlik indeksi
Eremurus spectabilis	Foxtail lily	3.21156	0.59666	3.75000	7.55822
Lupinus albus	White lupin	2.29029	0.22516	4.75000	7.26545
Nasturtium officinale	Watercress	3.02472	1.61955	3.00000	7.64427
Chondrilla juncea	Rush skeleton weed	1.00752	0.79003	2.00000	3.79755
Tragopogon porrifolius subsp. *longirostris*	Purple salsify	2.89138	1.61329	3.00000	7.50468
Cichorium intybus	Common chicory	1.84513	0.58130	3.25000	5.67643
Dioscorea communis	Black bryony	2.03036	0.73952	1.75000	4.51988
Scorzonera cana	N/A	2.58520	0.34298	3.25000	6.17818
Ferulago trachycarpa	N/A	1.64958	0.48755	1.75000	3.88712
Colocasia esculenta	Taro, Elephant ear	2.12922	0.06351	2.75000	4.94273
Gundelia tournefortii	Gundelia or Galgal, Tumbleweed	1.81846	0.22460	2.50000	4.54306
Rhus coriaria	Elm-leaved sumach	4.07692	1.79172	3.25000	9.11864
Capparis spinosa	Caper bush	2.11664	0.26996	5.00000	7.38660
Ferula elaeochytris	N/A	3.01317	2.13341	2.50000	7.64658
Gypsophila arrostii subsp. *nebulosa*	N/A	3.01678	2.30713	2.00000	7.32391
Pyrus serikensis	N/A	2.14113	0.71530	2.25000	5.10643
Eriolobus trilobatus	Crab apple	0.86411	0.25056	3.25000	4.36467
Juniperus drupacea	Syrian juniper	4.32255	0.11723	4.00000	8.43978
Acorus calamus	Calamus or Sweet flag	2.04037	1.96942	1.75000	5.75978
Gundelia tournefortii	Berberis	3.42933	1.97736	3.75000	9.15669

Ecological and socio-economical surveys to document information on wild edibles plants and underutilized species/ land races in the Mediterranean Region have been done.

Socio-economic data and traditional knowledge collected during the surveys and 2.334 questionnaires administered across the regions. During the surveys the information has been gathered to allow analyzing and concluding the baseline status of community biodiversity for food and nutrition from foraging to consume.

Surveys to determine the baseline status of community biodiversity for food and nutrition, dietary diversity and traditional knowledge were completed. The survey results allow us to analyze and conclude the duration from foraging to consume.

At the same time the gathered information results to evaluate the marketing opportunities and also to develop new policies as well as documenting the traditional knowledge of the priority species and other utilized species for food and nutrition.

Food consumption and anti-oxidant analysis were completed for all species. To ensure sample quality and prevent deterioration, samples were promptly sent to "The Central Research institute of Food and Feed Control in Bursa" where composite samples were produced by combining primary samples.

Table 3. Antioxidant activity analysis results of the species studied in Mediterranean Region.
Çizelge 3. Akdeniz Bölgesi'nde çalışılan türlerin antioksidant aktivite analiz sonuçları.

Sample English name Örnek İngilizce adı	Scientific name Bilimsel adı	Turkish name Türkçe adı	1/IC50* (DPPH)	STD	µM trolox equivalent t/g sample (Örnek) (TEAC)	STD
Syrian juniper	*Juniperus drupacea*	Andız	122.4	4.9	208.8	0.1
N/A	*Ferulago trachycarpa*	Kuzukemirdi	245.4	3.7	315.8	19.7
N/A	*Ferula elaeochytris*	Çağ	5.5	0.5	38.9	1.8
Foxtail lily	*Eremurus spectabilis*	Çiriş	170.0	2.5	168.9	5.1
N/A	*Gypsophila arrostii* subsp. *nebulosa*	Çöğen	4.0	0.1	31.2	0.5
N/A	*Scorzonera cana*	Tekesakalı	275.6	7.4	522.6	18.0
Calamus or Sweet flag	*Acorus calamus*	Eğir	21.0	0.1	117.9	0.1
Rush skeletonweed	*Chondrilla juncea*	Garakavruk	434.2	6.6	690.0	2.2
Crab apple	*Eriolobus trilobatus*	At e lması	4.4	0	38.3	1.5
Taro, Elephant ear	*Colocasia esculenta*	Göleviz	12.9	0.2	29.8	1.5
Caper bush	*Capparis spinosa*	Kapari	85.6	3.9	465.8	10.6
Common chicory	*Cichorium intybus*	Hindiba (Med.)	274.2	11.4	539.0	6.4
Berberis	*Berberis crataegina*	Karamuk	1380.6	14.2	2362.1	2.7
Gundelia or Galgal, Tumbleweed	*Gundelia tournefortii*	Kenger	145.1	11.0	284.1	4.1
Black bryony	*Dioscorea communis*	Dolambaç	47.0	0.7	303.5	11.6
N/A	*Pyrus serikensis*	Zingit (serikarmutu)	93.4	6.7	244.4	13.1
Elm-leaved sumach	*Rhus coriaria*	Sumak	1825.3	76.1	3055.6	20.4
Watercress	*Nasturtium officinale*	Suteresi	420.0	16.1	903.0	17.7
White lupin	*Lupinus albus*	Termiye	undetected	undetected	undetected	undetected
Purple salsify	*Tragopogon porrifolius* subsp. *longirostris*	Helevan (Yemlik)	192.6	11.9	220.7	7.5
		BHT**	2101.2	277.1	16651.9	59.0

*The reverse of the fresh plant value in terms of mg which inhibits 50% of the 1g DPPH radical.
**Butyrate hydroxyl toluene.

RESULTS AND DISCUSSION

The food composition analyses (Proximate composition of the edible parts of the samples; Moisture, Fat, Protein, Total available Carydrate, Ash, Fibre, Energy, Mineral element, vitamin B_1, B_2 and vitamin content of edible parts of the samples of Ca, Fe, Mg, P, Zn, K, Na, C, Vit C, Vit B_1, Vit B_2) results of all species have been evaluating for the assessments of nutritional value.

For the detail information to implement to the project component the case studies and best practices in the regions were planned.

Antioxidant activity analysis (two method using) was done for all priority species of the project. The antioxidant activity analyses were done according to the DPPH (1, 1-diphenyl-2-picrylhydrazyl) radical scavenging method and TEAC (Trolox Equivalent Antioxidant Capacity/ABTS Method). These methods were made by the Thermo Scientific™ Multiskan™ GO microplate reader supplied from the BFN Project. IC50 values were calculated from the concentration-effect linear regression curve (Cemeroglu, 2010; Ayas *et al.,* 2014, 2017). The analyses results and Standard deviation values of the 20 plants and 1 control (BHT) are given in the table below.

The radical scavenging effect values of *Rhus coriaria* (1825.3) and *Berberis crataegina* (1380.6) are the closest of BHT value (2101.2) according to the DPPH method, this shows that these plant species radical scavenging effect are higher than the others and they have natural antioxidant characteristic. The antioxidant capacity values (μM trolox equivalent/g sample) of *Rhus coriaria* (3055.6) and *Berberis crataegina* (2362.1) are the closest of BHT antioxidant value (16651.9) according to the TEAC method.

It is known that red-purple colored plant species which are rich in anthocyanins show antioxidant activity sweeping the DPPH and ABTS radicals, this case were seen in the analyses results. In addition, the greater the diversity of species you eat, the more likely you are to cover all your nutritional bases including complementarity effects.

All data collected from surveys and laboratory analysis were recorded in the relevant data based to link national portals and databases. Tools and guidelines for dissemination were prepared. The target species were determined for the further studies such as creating markets and value chain to use. The related regulations, programs, master plans were reviewed for the development of policy guidelines.

CONCLUSION

The ethno-botanic and socio-economic surveys were conducted at the Mediterranean Region in the villages, local markets, local restaurants as well as supermarkets. In order to obtain detailed socio-economic and traditional information on edible wild species and local varieties, preliminary surveys were conducted primarily in the region. The socio-economic studies were conducted for detail data with monograph technic. During surveys ethno-botanical information and the different type of dishes of wild edible pants were recorded. The data recorded from face to face questioners with 149 collector and 632 consumers for the conclusion of process from harvest to consumption. In the Mediterranean Region, the majority of consumers stated that they consumed wild species 1-2 times a week. Some species are usually collected for commercial purposes, some are only gathering for domestic consumption and there are no sales of these species in the local market.

In addition, awareness activities have been conducted to disseminate the results and promote our project studies. These activities are leaflets, brochures, posters were prepared and also information about the BFN project on various televisions is provided. The Mediterranean Region and also the target species of the project; 43 species of botanical drawing were made.

Rural areas in the Mediterranean Region (Turkey) wild edible foods are collected and used for home consumption or sold in local markets and medical purposes thus complementing people's diets and representing an additional income for many households

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