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A Traditional Underutilized Crop of Turkey: Cowpea [Vigna Unguiculata (L.) Walp.] Landraces

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ABSTRACT: *Many diverse cowpea [**Vigna unguiculata** (L.) Walp.] landraces are still maintained on-farm in Turkey. Two of the ssp. grown in Turkey: **Vigna unguiculata** subsp. **sesquipedalis** (L.) Verdcourt and **Vigna unguiculata** subsp. **unguiculata**. Cowpea is a popular and important leguminous crop especially in Aegean, Mediterrenean and South Marmara Regions which is known as "börülce" and has different local names like "acebek", "loğlaz", "lolaz", "lübye", "kocafasulye", "karnıkara", "sarı gelin" in Turkey. These landraces are maintained on-farm for various reasons, including better quality than commercial varieties, better performance in terms of yieldor persistence under harsh agro-environmental conditions, traditional uses such as particular traits appreciated by the farm family. They are not necessarily maintained under 'traditional farming systems', but are 'maintained because of tradition', especially related to food. It is already marketed as niche. However, most of them, especially garden and neglected crops, are highly threatened because they are cultivated primarily by aging farmers. It is better adapted to drought, high temperatures and biotic stresses than other legume species. Green pods, fresh seeds and dry grains are consumed as different dishes and it plays an important role in the nutrition of the local people in Turkey.To assess the diversity of cowpea landraces in Turkey, cowpea populations were surveyed, collected, conserved ex-situ at the National Seed Gene Bank of the Aegean Agricultural Research Institute and also evaluated agro-morphologically. A total of 253 landrace accessions mainly from the Aegean, Mediterranean, and South Marmara Regions of Turkey were used to evaluate 41 qualitative and quantitative agro-morphological characteristics of the landrace samples. All landraces showed high variation of observed characters. As priority underutilized species of Biodiversity for Food and Nutrition Project of Turkey various studies were conducted on cowpea landraces. During surveys ethno-botanical information and traditional farming systems were recorded. The socio-economic studies were conducted for detail data with monography technic. The data recorded from face to face questioners with 23 producers/farmers and 67 consumers. Surveys for the conclusion of process from harvest to consumption were conducted to generate the idea on marketing opportunity, to assist to obtain the information for the development of policy to upload the relevant information about the traditional knowledge. During surveys ethno-botanical information, the different type of dishes of fresh pods and cowpea dry grains and traditional farming systems applied to cowpea production were recorded. Generally, the average age of responders is 53 and 76% have primary school degrees. The vast majority of consumers use the cowpeas 1-2 times a week in their diet. Cowpea consumption per household is 21.9 kg. year^{-1}and consumption per capita is 6.3 kg. year^{-1}. Consumption percentage has found as 76.1% and 61.7% of harvested amount are marketed. The food composition of dry grain and fresh pods collected from Aegean Region was also determined to evaluate nutritional value of cowpea landraces. The proximate composition and mineral content of cowpea samples were analyzed using standard methods and reference materials. The study shows that dry grains contain a rich source of protein, dietary fiber, zinc, potassium and iron. Dry grains of cowpea can be a good solution to digestion problems by regulating intestinal function with high dietary fiber content. Fresh pods also have high dietary fiber, potassium and zinc content. Cowpea meals are good sources of nutrients and can be used as ingredients in healthy diets.*

Keywords: *Cowpea, **Vigna unguiculata** (L.) Walp., landraces, genetic diversity, agricultural biodiversity, socio-economic study, traditional knowledge, food composition.*

Türkiye'de Yeterince Tüketilmeyen Geleneksel Ürün: Börülce [Vigna Unguiculata (L.) Walp.] Yerel Çeşitleri

ÖZ: *Birçok farklı börülce [**Vigna unguiculata** (L.) Walp.] yerel çeşitleri halen Türkiye'de tarlalarda yetiştirilerek üretici şartlarında muhafaza edilmektedir. Börülcenin iki ssp.'i Türkiye'de yetiştirilmektedir. Bunlar: **Vigna unguiculata** subsp. **sesquipedalis** (L.) Verdcourt ve **Vigna unguiculata** subsp. **unguiculata**. Börülce, "börülce" olarak bilinen ve "acebek", "loğlaz", "lolaz", "lübye", "koca fasulye", "karnıkara", "sarı gelin" gibi farklı yerel isimlere sahip olup, Ege, Akdeniz ve Güney Marmara Bölgelerinde popüler ve önemli bir baklagil türüdür. Bu arazi koşulları, ticari çeşitlere kıyasla daha kaliteli, kötü tarımsal-çevre koşullarında verim veya dayanıklılığın daha iyi olması, çiftlik ailesi tarafından takdir edilen belirli özellikler gibi geleneksel kullanımlar da dahil olmak üzere çeşitli nedenlerle küçük aile çiftliklerinde yetiştirilmektedir. Yerel çeşitler gıda ile ilgili olduğundan, 'geleneksel tarım sistemleri' altında muhafaza edilmekle kalmaz, özellikle 'gelenek nedeniyle' muhafaza edilir. Börülce de dahil olmak üzere yerel çeşitler ülkemizde halen "niş pazar"larda (dar bir tüketici grubunun istek ve gereksinmelerini karşılayan pazarlar) pazarlanmaktadır. Bununla birlikte, çoğu bahçe bitkileri ve ihmal edilmiş bitkiler, esas olarak yetiştiren çiftçilerin yaşlanmakta olması nedeni ile büyük tehdit altındadır. Börülce diğer baklagillere göre kuraklık, yüksek sıcaklıklar ve biyotik streslere daha iyi adaptasyon göstermektedir. Börülce, taze taneleri ve baklası yanında kuru taneleri ile de farklı yemekler olarak tüketilmekte ve Türkiye'de yöre halkının beslenmesinde önemli bir rol oynamaktadır. Türkiye'deki börülce yerel çeşitlerine ait populasyonlar Ege Tarımsal Araştırma Enstitüsünün Ulusal Tohum Gen Bankası'nda survey, toplama, ex-situ olarak korumaya tabi tutulmuş ve agro-morfolojik olarak da değerlendirilmiştir. Başta Ege, Akdeniz ve Güney Marmara Bölgelerinden olmak üzere toplam 253 yerel çeşit örneklerinin 41 kalitatif ve kantitatif özellikleri agro-morfolojik olarak belirlenmiştir. Tüm yerel çeşitler, gözlemlenen karakterler açısından yüksek oranda farklılık göstermiştir.Gıda ve Beslenme Projesi için Biyoçeşitlilik projesi önceliği Türkiye'nin yeterince kullanılmamış türler arasında olan börülce yerel çeşitleri üzerinde çeşitli çalışmalar yürütmek olmuştur. Survey sırasında etno-botanik ve geleneksel tarım sistemlerine aitbilgiler kaydedilmiştir. Sosyo-ekonomik çalışmalar, monografi tekniği ile ayrıntılı veriler edinmek için yürütülmüştür. Veriler, yüz yüze görüşmelerle 23 üretici / çiftçi ve 67 tüketiciyle yapılarak kaydedilmiştir. Hasattan tüketime sürecin tamamlanması için yapılan araştırmalar, geleneksel bilgi ile ilgili bilgileri yüklemek, politikanın geliştirilmesi ve bilgi edinmeye yardımcı olmak için pazarlama fırsatı fikrini oluşturmak üzere yürütülmüştür. Anketler süresince etno-botanik bilgi, taze ve kuru börülce yemekleri ile börülce üretiminde uygulanan geleneksel çiftçilik yöntemleri kaydedilmiştir.Anketin uygulandığı kitlenin yaş ortalaması genel olarak 53'tür ve % 76'sı ilkokul diplomasına sahiptir.Tüketicilerin büyük çoğunluğu börülceyi haftada 1-2 kez diyetlerinde kullanmaktadırlar.Hanehalkı börülce tüketimi yıllık 21,9 kg ve kişi başına düşen tüketim yıllık 6,3 kg'dır. Tüketim % 76,1 oranında olup, hasat edilen tutarın % 61,7'si pazarlanmaktadır. Ege Bölgesi'nden toplanan taze ve kuru börülce yerel çeşitleri baklasına ait gıda bileşimleri, besin değerlerini değerlendirmek için de belirlenmiştir. Börülce örneklerinin bazı besin ve mineral içerikleri standart yöntemler ve referans değerler kullanılarak analiz edilmiştir.Çalışma; kuru börülce tanelerin protein, diyet lifi, çinko, potasyum ve demir içerdiğini ve zengin bir kaynağı olduğunu göstermektedir. Kuru börülce tanesi, yüksek diyet lifi içeriğiyle bağırsak fonksiyonunu düzenleyerek sindirim problemlerine iyi bir çözüm olabilir. Taze taneler de yüksek diyet lifi, potasyum ve çinko içermektedir. Börülce yemekleri iyi besin kaynaklarıdır ve sağlıklı diyet için katkı sağlar.*

Anahtar Sözcükler: *Börülce, **Vigna unguiculata** (L.) Walp., Agro-morfolojik karakterler, yerel çeşit, genetik çeşitlilik, varyasyon, tarımsal biyoçeşitlilik, sosyo-ekonomik çalışma, geleneksel bilgi, gıda bileşimi.*

INTRODUCTION

Turkey is the one of the most significant countries for plant genetic resources and plant diversity in the world. Many agricultural crop species are part of the native Anatolian flora and domesticated 3000-7000 years ago, or they have gradually been introduced through cultural exchanges held with other civilizations in ancient times (Tan, 2010).

Cowpea, *Vigna unguiculata* (L.) Walp. (2n=22), is one of the most ancient human food sources. Although native country of cowpea is uncertain and it has believed to be originated in Africa (Anonymous, 2017), it is one of the most important indigenous legumes of the tropics and sub tropics (Joel, 2010). After it was introduced into Anatolia, its cultivation spread throughout most of the country. With its widespread distribution, natural and artificial selection by farmers has resulted in a great diversity of landraces. In many regions of Turkey, diverse cowpea landraces have gradually been developed over time (Tan, 2010).

Given the diversity of cowpea landraces in Turkey, populations of cowpea were collected, regenerated, conserved in cold storage conditions according to *ex-situ* conservation methods at the National Gene Bank (NGB) of the Aegean Agricultural Research Institute (AARI) and were also evaluated agro-

morphologically. A total of 253 landrace accessions mainly from the Aegean and Mediterranean regions of Turkey were used to evaluate 41 qualitative and quantitative agro-morphological characteristics in the landrace samples (Kir *et al.*, 2015).

The purpose of this study was to evaluate socioeconomic and nutritional value of cowpea landraces as priority underutilized species of Biodiversity for Food and Nutrition Project of Turkey.

MATERIALS AND METHODS

Survey and collection of landraces of cowpea were carried out from different parts of Turkey, especially Aegean, Mediterranean, South Marmara and South East Regions. Agro-Morphologically Characterization of plant genetic resources (PGR) has been performed. Morphological observations were performed according to characters of descriptors chosen among the International Board for Plant Genetic Resources Institute (IBPGRI) and International Union for the Protection of New Varieties of Plants (UPOV) of plant feature criteria. Multivariate relationships among accessions were revealed through the Principal Component Analysis (PCA) (Clifford and Stephenson, 1975).

Questionnaire survey study was conducted in Aydın provinces of Aegean Region. Questionnaire surveys were carried out for collecting ethnobotanic and socio-economic data by using face-to-face interviews with cowpea landraces producers and consumers. Monographic research technique was used in the study. Total of 23 cowpea farmers and 67 consumers were interviewed in 2014. In the study the number of interviewed farmers and consumers that represent population were determined by judgment sampling.

Dry grain and fresh pods of cowpea landraces samples were taken from local markets of Aydın and Muğla for food composition analysis. Proximate composition (protein, dietary fibre and carbohydrate) of samples were analyzed according to reference AOAC procedures. Minerals were determined by ICP MS after microwave digestion using NMKL 186 method. The procedure described by Gokmen *et al.*, 2000 was used for vitamin C analysis. Thiamin and riboflavin were analyzed by HPLC (Agilent 1260, Agilent Technologies, Santa Clara, CA) with fluorescence detection and Lahely *et al.* (1999) procedure was modified for the determination of niacin.

RESULT AND DISCUSSION

Observation data of samples were included in the research and assessed with the Principle Component Analysis (ABA). At the end of the analysis, Eigen values of 3 main components were found between 8.326 and 3.761. These components accounted for 36.2% of the total variance.

Group A and two sub-groups were formed in the second main components, which were evaluated as 17.71% of the total variance and 10.48% of the total variance. In the formation of the first major component, the number of first flowering days is 0.241, days to first mature pods are 0.232, the terminal leaflet shape is 0.231, the mature pod curvate is 0.221, the mature pod length is 0.260, the number of flowering days is 0.239, the number of days of holding 50% pods was mainly affected by the values of 0.241 and fresh pod length of 0.271. This main group formed of accessions which have short pod length and thin pod. In the first of the two subgroups, earliness of populations related to days to first flowering and days to first mature poding were affected by consisted group. But, high length plants and landraces which have medium-earliness (days to flowering and days to mature podding) consisted second sub-group.

Agro-Morphologically Characterization results of this study showed in agreement with the agronomic and morphological results of many studies of cowpea local varieties. In our country, studies of cowpea were carried out in the departments of Horticulture and Field Crops of Agriculture Faculties of various universities and a very wide variation of cowpea local populations, (Unlu *et al.*, 2006; Peksen *et al.*, 2005) yield

performance of cowpeas, (Peksen *et al.*, 2002; Unlu, 2004; Peksen, 2007; Geren *et al.*, 2007) and the salinity tolerance of a cowpea local variety (Dasgan *et al*., 2006) have been reported.

Cowpea (*V. unguiculata* L.) landrace accessions were surveyed and collected, regenerated, morphologically characterized and conserved by means of the several project studies (Kir *et al.*, 2010; Kir and Tan, 2012; Kir *et al.*, 2015). At the end of the activities;

- Within local varieties representing Turkish geographical area, material with high and low relative resistance to arid conditions has been identified.
- These local varieties have been the source material for new projects.
- The material under custody of cowpea genetic resources has been expanded.
- Genetic resources of cowpea have been transferred to the National Genetic Bank in sufficient quantities and agro-morphological definitions.
- This material has been presented for the information and use of the identified material, the country and the world scientists / breeders.
- The size of the current genetic variation has been determined.
- The passport information of the material will be transferred to the data base program in AARI National Gene Bank in electronic environment and the information of our cowpea collection has been opened to the use of breeders.

During surveys for the conclusion of process from harvest to consumption were conducted to generate the idea on marketing opportunity, to assist to obtain the information for the development of policy to upload the relevant information about the traditional knowledge.

It was observed that cowpea is a popular and important leguminous crop especially in Aegean, Mediterranean and South Marmara Regions. It is widely known as “börülce” but it has different local names like “acebek”, “loğlaz”, “lolaz”, “lübye”, “kocafasulye”, “karnıkara”, “sarı gelin” throughout of Turkey. These landraces are maintained on-farm for various reasons, including better quality than commercial varieties, better performance in terms of yield or reistance under harsh agro-environmental conditions, traditional uses such as particular traits appreciated by the farm family. They are not necessarily maintained under ‘traditional farming systems’, but are ‘maintained because of tradition’, especially related to food. It is already marketed as niche. However, most of them, especially garden and neglected crops, are highly threatened because they are cultivated primarily by aging farmers.

Generally, the average age of responders determined as 53 and 76% of them having primary school degrees. The vast majority of consumers use the cowpeas 1-2 times a week in their diet. Cowpea consumption per household is 21.9 kg. year^{-1} and consumption per capita is 6.3 kg. year^{-1} (Table 1). The vast majority of consumers (76.1 %) use the cowpeas 1-2 times a week in their diet (Table 2).

Total production of local cowpea is determined as about 8 tons. 61.7% of harvested amount are marketed and 18% of them used as household consumption (Table 3).

While all cowpea producers sell dried cowpea grains directly to consumers at local market, 68 % of them sell fresh pods to consumers and 33% of them sell fresh pods to trader at local market. 41% of producers sells fresh pods to traders at markets (Table 4).

During surveys different type of dishes prepared by using cowpea green pods and dried grains were recorded. Green pods, fresh and dried grains of cowpea are used in salads and meals which are prepared with olive oil. Dried grains also are used in ‘Tarhana’ soup especially in Mugla Province of Aegean Region in Turkey.

The food composition of dried grain and fresh pods collected from Aegean Region was also determined to evaluate nutritional value of cowpea landraces. The data presented in Table 5 showed

proximate composition of dried grain and green pods of cowpea samples. Mineral composition and vitamin content of cowpea mg/100g is given in Table 6 and 7 respectively.

Table 1. Cowpea amount per household and annual consumption amounts per capita in Aegean Region.
Çizelge 1. Ege Bölgesinde hanehalkı ve kişi başına düşen yıllık börülce tüketim miktarı.

Species Tür	Consumption Per Household (Kg / year) Hanehalkı Başına Tüketim (kg/yıl)	Consumption Per Capita (Kg / year) Kişi Başına Tüketim (kg/yıl)
Cowpea Börülce	21.9	6.3

Table 2. Consumption frequency of cowpea of Aegean Region (%).
Çizelge 2. Ege Bölgesinde börülcenin tüketim sıklığı (%).

Species Tür	Everyday Hergün	3-4 times per week Haftada 3-4 kez	1-2 times per week Haftada 1-2 kez	1 in 15 days 15 15 Günde 1 kez	1 per month Ayda 1 kez
Cowpea Börülce	3.0	11.9	76.1	4.5	4.5

Table 3. Distribution of harvested amounts of Aegean cowpea by using pattern.
Çizelge 3. Ege Bölgesi hasat edilen börülcenin tasarruf şekline göre dağılımı.

Species Tür	Household consumption (%) Ev tüketimi (%)	Distributed to neighbours/ relatives (%) Komşu-akrabaya dağıtılan (%)	Used for animal feeding (%) Hayvan beslemede kullanılan (%)	Marketed (%) Pazarlanan (%)	Amount harvested (Kg) Hasat miktarı (kg)
Cowpea Börülce	18.3	4.7	15.3	61.7	7996

Table 4. The cowpea marketing status of producers in Aegean Region.
Çizelge 4. Ege Bölgesindeki üreticilerin börülce pazarlama şekilleri.

Species Tür	Average distance to market (km) Pazara ortalama uzaklık (km)	Proportion of Selling to Consumers at Local Market (%) Yerel pazarda tüketiciye satış yapanların oranı (%)	Proportion of Selling to Trader at Local Market (%) Yerel pazarda tüccara satış yapanların oranı (%)	Proportion of Selling to Trader at Village (%) Köyde tüccara satış yapanların oranı (%)
Cowpea (dry) Kuru Börülce	14	100.0	-	-
Cowpea (fresh) Taze Börülce	14	66.7	33.3	-

Table 5. Proximate composition of cowpea.
Çizelge 5. Börülcenin yaklaşık besin bileşimi.

Species Türler	Moisture Nem (g/100g)	Fat Yağ (g/100g)	Protein Protein (g/100g)	Carbohydrate Karbonhidrat (g/100g)	Ash Kül (g/100g)	Dietary fiber Diyet lifi (g/100g)	Energy Enerji (kcal/100g)
Dried Cowpea Kuru Börülce	9.3±0.2	1,36±0.04	21.68±0.18	30.75±0.22	3.44±0.05	33.50±0.03	288.9±1.0
Fresh Cowpea Taze Börülce	88.6±0.3	0.47±0.02	3.23±0.11	3.69±0.40	0.66±0.02	3.31±0.01	38.8±1.0

Table 6. Mineral contents of cowpea (mg/100g)
Çizelge 6. Börülcenin mineral içeriği (mg/100g)

Species Türler	Ca	Fe	Mg	P	Zn	K	Na	Cu
Dried Cowpea Kuru Börülce	107.5±2.7	5.6±0.1	166.7±2.6	283.8±3.8	3.34±0.01	1148±13	8.4±0.1	1.06±0.1
Fresh Cowpea Taze Börülce	64.6±0.5	1.05±0.02	61±1.9	67.5±1.1	0.68±0.02	299±4	2.6±0.1	0.25±0.01

Table 7. Vitamin content of cowpea.
Çizelge 7. Börülcenin vitamin içeriği.

Species Türler	Vit C (mg/100g)	Thiamin (mg/100g)	Riboflavin (mg/100g)	Niacin (mg/100g)	Beta-Carotene (µg/100g)	Alpha-tocopherol (mg/100g)
Dried Cowpea Kuru Börülce	nd	0.53±0.01	0.086±0.003	1.83±0.34	nd	0.20±0.01
Fresh Cowpea Taze Börülce	9.9±1.2	0.23±0.04	0.079±0.004	1.30±0.10	429±56	4.64±0.47

nd: not detected.

Protein and fat content was 21.68 and 1.36 mg/100g, respectively in dried grain samples and these values are very close to data obtained by Antova *et al.*, 2014. The result of this study showed that dried grain of cowpea contains a rich source of protein, dietary fiber, zinc, potassium and iron. Dried grain of cowpea can be a good solution to digestion problems by regulating intestinal function with high dietary fiber content. Fresh pods also have high dietary fiber, potassium and zinc content. Cowpea meals are good sources of nutrients and can be used as ingredients in healthy diets.

CONCLUSION

Although Anatolia is not centre of origin for *Vigna* spp. studies apparently showed that Turkey is centre of diversity of cowpea cultivars. So, multivariate relationships among accessions were highly variable and qualitative and quantitative characteristics of cowpea local varieties have shown a wide variation.

Although cowpea landraces are maintained on-farm by aging farmers, the consumption amount and frequency is high in Aegean Region. Nutritional and mineral composition results of this study support its consumption as a nutritive legume crop for local people. In addition, when we consider cowpea is better adapted to drought, high temperatures and biotic stresses than other legume species, there are needed to encourage young farmers for its production.

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