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Some Fruit Characteristics of Cornelian Cherries (*Cornus mas* L.)

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Abstract

This study was carried out on 13 local cornelian cherry (*Cornus mas* L.) genotypes grown in Yusufeli (Artvin) in Northeast Anatolia in Turkey. Cornelian cherry fruits from these 13 genotypes were harvested and analyzed during the ripening period in 2010. Some physical and chemical characteristics of cultivars were determined. Fruit weight and fruit flesh ratio of these genotypes ranged from 2.72 to 4.11 g and 79.08 to 89.99%. Soluble solid content were determined the lowest as 13.7% and the highest as 18.6%. The genotypes had vitamin C between 31 to 70 mg/100 g with average of 50 mg/100 g. Total protein, cellulose, tannin and ash content of genotypes were determined between 0.75-2.18%; 0.36-1.08%; 0.57-1.28% and 0.51-1.13%. The genotypes were found to be free of pest and diseases. The present study showed that there were enough variability among cornelian cherry genotypes grown in same ecological conditions of a small area and these genotypes could be important both to improve nutritional value through germplasm enhancement programmes and to use them in organic production.

Keywords: chemical content, dogwood, food properties, fruit traits, principal coordinate analysis

Introduction

Plant genetic resources are any material of plant, containing functional units of heredity of actual and potential value. Genetic resources generally at the local, national and international levels, play a critical role in the life of the people of most of the countries. They are very important for agriculture (specifically for breeding) and for preservation of the environment (Day, 1997; Swanson, 1996). The people and the communities depend on these resources for their economic, social and cultural well-being (Hanemann, 1988). Destruction of biological diversity threatens the life-support system of all humans by undermining the ecological processes that provide the ingredients for our food, medicine, shelter and livelihoods (Duvick, 1991).

The Coruh valley contain a wide reserve of biodiversity of fruit tree species that, over a period of several centuries. The valley is accepted one of the 35 hotspots for plant biodiversity in the world (IUCN, 2009). More recently the diffusion of new cultivars belongs to different fruit species originating from genetic improvement programs and dam constructions on the rivers resulted high risk on these valuable genetic resources in the valley. However, public interest in the safeguarding of biodiversity and the development of a new interest in genetic resources and their scientific, economic and cultural importance, inspired some non governmental actions aimed at the valorisation and conservation of these valuable materials.

Cornelian cherries (*Cornus mas* L.) are abundant in Coruh valley located in Northeastern Anatolia and recent years increasing attention has been paid by consumers to this fruits which had unusual flavors and qualities, and they are rich with antioxidants and anthocyanins (Ersoy *et al*., 2011; Seeram *et al*., 2002; Yilmaz *et al*., 2009a).

There are about 65 species of cornelian cherry (*Cornus* spp.) distributed primarily throughout the temperate regions of the northern hemisphere (Eyde, 1988). Most species used as ornamentals and only a few species are grown for their fruits. Among species *Cornus mas* is the most widespread because of its better fruit characteristics (Seeram *et al*., 2002).

The cultivation of cornelian cherry (*Cornus mas* L.) in the Caucasus and Central Asia has occurred for centuries. Fruits of this species mainly used for food, medicine, ornamental and honey plant (Mamedov and Craker, 2004). In these areas, Turkey is an important centre of cornelian cherries (Ercisli *et al*., 2007), especially northern Anatolia (Yilmaz *et al*., 2009b).

In Turkey, the cornelian cherries is widely used on account of its antioxidant, antiallergenic, antimicrobial and antihistaminic properties. Approximately 15.000 tons of cornelian cherry fruit is produced yearly in the country. The fruit is either consumed directly or processed into various products such as fruit juice, jam, marmalade, pestil (a dried form of marmalade produced in the eastern part of Turkey), paste, and sherbet or is dried (Celik *et al*., 2006).

Turkey has a rich gene pool of cornelian cherry genotypes adapted to various local and regional conditions (Ercisli, 2004). In Turkey, the majority of cornelian cherry trees are propagated by seeds. In most regions, these are the smallest groups of trees (5-10) which are in reproductive state and still 'communicate' between themselves (pollinate each other). They are to be found in the forest margins. There are also numerous single or isolated cornelian cherry trees whose 'communication' is disturbed by mechanical obstructions (buildings, forest) or by too long distances. Such trees grow on farm yards, or can often be seen growing on the grasslands and nearby paths as solitary trees (Yilmaz *et al*., 2009b).

During the last two decades, the native and semi-wild cornelian cherry plants have been disappearing rapidly. This cornelian cherry genetic erosion is probably even faster that we could imagine previously. It is urgent to determine and conserve cornelian cherry genetic resources for future use before it is lost forever. Therefore the general aim of the study was to contribute to the exploration, collection and conservation of the germplasm of the cornelian cherry.

Materials and methods

The study was conducted in Yusufeli districts in Northeast part of Turkey. A total 13 seed propagated cornelian cherry (*Cornus mas* L.) genotypes were preselected in 2010 according to their better yield and fruit chracteristics in natural growing places and were assessed in this research. The pomological analyses encompassed 50 random mature fruits per genotypes. Fruit weight (g), flesh ratio (%), skin color (a/b ratio), soluble solid content (%), vitamin C (mg/100 g), titratable acidity (%), total protein (%), cellulose (%), tannin (%) and ash (%) content were assessed.

Fruit weight was measured by using a digital balance with a sensitivity of 0.001 g. Flesh ratio (%) was counted considering fruit and seed weight. Fruit skin color (as *a* and *b* value) was measured on the cheek area of 30 fruits (Minolta Chroma Meter CR-400, Minolta-Konica, Japan)

Flesh parts of fruit samples were used to assess the total soluble solids content (SSC), titratable acidity (TA), vitamin C, total protein, cellulose, tannin and ash. Soluble solid contents (SSC) were determined by extracting and mixing one drops of juice from the each fruit into a digital refractometer and displayed as %. Vitamin C and titratable acidity were determined with the reflectometer set of Merck Co (Merck RQflex). Total protein quantity was calculated by multiplying the nitrogen content using Kjeldahl method by the coefficient 6.25 (AOAC, 1995). Cellulose quantity was determined according to the method reported in AOAC (1995). Tannins and ash were also determined according to AOAC (1995) procedures.

The statistical analyses were carried out using SAS (SAS Inst., 2005). The pomological characteristics were subjected to principle component analysis (PCA) using the PRINCOMP procedure. The relationships were determined from a covariance matrix derived from standardized morphological and chemical characteristics means and the output data sets consisted of eigen-values, eigenvectors, and standardized principal component scores.

Results and discussion

In the present study, we found considerable variations in all traits searched among cornelian cherry genotypes at $p<0.01$ level. The average values of searched parameters were given in Tab. 1.

Fruit weight and fruit flesh ratio of cornelian cherry genotypes ranged from 2.72 g ('YU-5') to 4.11 g ('YU-8') and 79.08% ('YU-8') to 89.99% ('YU-3') with an average of 3.27 g and 83.53%, respectively (Tab. 1). Previous studies showed that fruit weight and fruit flesh ratio is one of the most variable characteristics of cornelian cherries grown in both Turkey and elsewhere. Fruit weight and fruit flesh ratio of cornelian cherry genotypes in Turkey were reported between 1.49-9.11 g (Demir and Kalyoncu, 2003; Karadeniz, 2002; Karadeniz *et al*., 2009; Yilmaz *et al*., 2009b) and 74-93% (Karadeniz, 2002; Karadeniz *et al*., 2009; Yilmaz *et al*., 2009b), respectively. These values were reported between 3.42 and 8.00 g and 79.32 and 88.55% in Serbia (Bijelic *et al*., 2011; Ognjanov *et al*., 2009), 0.5 and 3.4 g in Slovakia (Brindza *et al*., 2009) and 5.0 and 8.0 g and 89 and 92% in Ukraina (Klimenko, 2004).

The a/b color values of genotypes varied from 1.44 ('YU-11') and 2.70 ('YU-9'), respecitvely (Tab. 1). The a/b values could be important for cornelian cherries to estimate both harvest time and also anthocyanin content. The a/b values are effectively use in tomato to estimate harvest time. The increasing a/b value indicate the increase of red color (Batu, 2004). The increase of a/b values are also indicate higher anthocyanin content. Therefore we could say that the genotype 'YU-9' might have more red color and higher anthocyanin content than the others.

The SSC, vitamin C and titratable acidity values of cornelian cherry genotypes were found between 13.7% ('YU-2') and 18.6% ('YU-4'); 31 mg/100 g ('YU-2') and 70 mg/100 g ('YU-9') and 1.32% ('YU-4') and 2.08% ('YU-11') with an average values of 15.4%, 50 mg/100 g and 1.77% (Tab. 1). Previously SSC content of cornelian cherry genotypes was recorded as between 12.06 and 21.16% (Ercisli *et al*., 2006; Karadeniz, 1995; Karadeniz *et al*., 2009; Ognjanov *et al*., 2009). Titratable acidity in cornelian cherry was also reported between 1.34-4.56% (Karadeniz *et al*., 2001; Karadeniz, 2002; Yalcinkaya and Eti, 2000). Vitamin C content of cornelian cherries was

Tab. 1. Fruit characteristics of 13 pre selected cornelian cherry (*Cornus mas* L.) genotypes

Genotypes	Fruit weight (g)	Fruit flesh ratio (%)	Fruit skin color a/b	SSC (%)	Vit.C (%)	T.Acid. (%)	Protein (%)	Cellul. (%)	Tannins (%)	Ash (%)
'YU-1'	3.06cd	84.78cd	2.53a	14.8e	39f	1.51e	1.07d	0.36h	1.04bc	0.51g
'YU-2'	3.80b	79.10f	2.07bc	13.7f	31g	1.95b	0.75f	1.00b	0.76ef	0.64f
'YU-3'	2.91de	89.99a	1.75de	16.2c	52de	2.04ab	1.39c	0.62f	0.67g	0.86de
'YU-4'	4.03ab	85.95bc	1.77d	18.6a	68a	1.32f	1.63b	0.76de	0.58h	1.11ab
'YU-5'	2.72e	80.38ef	2.02b	15.5d	31g	1.53e	0.98de	0.30h	1.11b	1.13a
'YU-6'	3.24c	81.06e	1.95c	13.9f	46e	1.64cd	0.80f	0.52fg	1.28a	1.03bc
'YU-7'	2.92de	86.48b	1.52fg	14.6e	58bc	1.40f	1.61b	1.08a	1.03bc	0.89d
'YU-8'	4.11a	79.08f	1.98c	15.8d	48de	2.03ab	2.07a	0.83d	0.90d	0.85de
'YU-9'	3.16cd	80.79e	2.70a	16.3bc	70a	2.13a	1.79b	0.73e	1.03bc	0.80e
'YU-10'	2.73e	85.77bc	1.58efg	15.7d	59b	1.73c	2.18a	1.01b	0.69fg	1.11ab
'YU-11'	3.79b	89.79a	1.44g	16.6b	53cd	2.08a	1.39c	0.48fg	0.57h	0.85de
'YU-12'	3.16cd	83.29d	2.08bc	15.7d	46e	1.60de	2.04a	0.91c	0.79e	1.02c
'YU-13'	2.99cde	79.54ef	1.70def	13.9c	53cd	2.07a	0.87ef	0.82d	1.07bc	0.84de
Min.	2.72	79.08	1.44	13.7	31	1.32	0.75	0.36	0.57	0.51
Max.	4.11	89.99	2.70	18.6	70	2.08	2.18	1.08	1.28	1.13
Average	3.27	83.53	1.93	15.4	50	1.77	1.42	0.72	0.89	89

*Values in the same column with different lower-case letters are significantly different at P<0.01

previously found between 14.8-193 mg/100 g (Brindza *et al*., 2009; Ercisli *et al*., 2006; Klimenko, 2004; Ognjanov *et al*., 2009; Rop *et al*., 2010; Yilmaz *et al*., 2009a). Burmistrov (1994) stated that vitamin C in cornelian cherry populations increased towards northern region in Ukraina and he found high variability among genotypes (36-122 mg/100 g)

We found vitamin C content lower than Klimenko (2004) and higher than Rop *et al*. (2010). Our vitamin C results were consistent with data of the other authors. The significant differences described above, were not surprising due to the possible genotypic and/or environment effects (Ercisli and Esitken, 2004; Ercisli and Orhan, 2008).

The total protein, cellulose, tannin and ash content of cornelian cherry fruits were found between 0.75% ('YU-2') and 2.18% ('YU-10'); 0.36% ('YU-1') and 1.08% ('YU-7'), 0.57% ('YU-11') and 1.28% ('YU-6') and 0.51 % ('YU-1') and 1.13% ('YU-5'), respectively. Brindza *et al*. (2009) reported protein content between 0.34-0.50 % in cornelian cherry in Slovakia. We did not found any literature related to cellulose content of cornelian cherry. The all plant originated horticultural foods are sources of dietary fiber that refers to the cell wall components in plants: namely, pectin, beta-glucans, hemicellulose, cellulose, lignin, fructans, and gums. The fiber content and composition, however, varies depending on the plant part harvested for food, fruit or vegetable species, maturity, and the growing environment of the plant.

Tab. 2. Coefficients and eigenvalues for the first three principle components (PC) of PCA for cornelian cherry (*Cornus mas* L.) sampled from Turkey

Variable	PC1	PC2	PC3
Fruit weight	0,14	0,51	-0,17
Flesh ratio	0,35	-0,13	-0,39
a/b	-0,29	0,08	-0,12
SSC	0,44	-0,04	-0,33
Vitamin C	0,38	0,00	0,20
Titratable Acidity	-0,04	0,58	0,05
Proteins	0,40	0,02	0,29
Cellulose	0,20	0,20	0,70
Tannins	-0,42	-0,28	0,23
Ash	0,24	-0,52	0,17
Eigenvalue	3,38	1,62	1,35
Proportion	0,34	0,16	0,14
Cumulative	0,34	0,50	0,63

Cornelian cherry fruits are very rich sources of tannin compared to the most of fruits. Traditionally tannins from cornelian cherry has been using in ethnomedicinal purposes in cornelian cherry growing countries (Baytop, 2004). In Ukraina, wild grown cornelian cherry genotypes in natural populations were contained average 2400 mg/100 g tannin (Burmistrov, 1994).

The means of all traits were subjected to PCA (Fig. 1). The results indicated that the first three components showed 34%, 16% and 14% of the phenotypic variations, for a total of 64%. The most important traits positively correlated were fruit weight, flesh ratio, SSC, Vitamin C, protein, cellulose with PC1 and ash. a/b ratio, acidity, tannin and ash were negatively correlated with PC1 (Tab. 2).

The accessions were plotted on three dimensions based on their PCA results (Fig. 1). The genotypes were easily separated from each other with enough diversity. Continuous seed propagation in the region for centuries had resulted in a number of local genotypes differing in most of fruit characteristics in the valley. These genotypes are unknown origin and represent rich diversity.

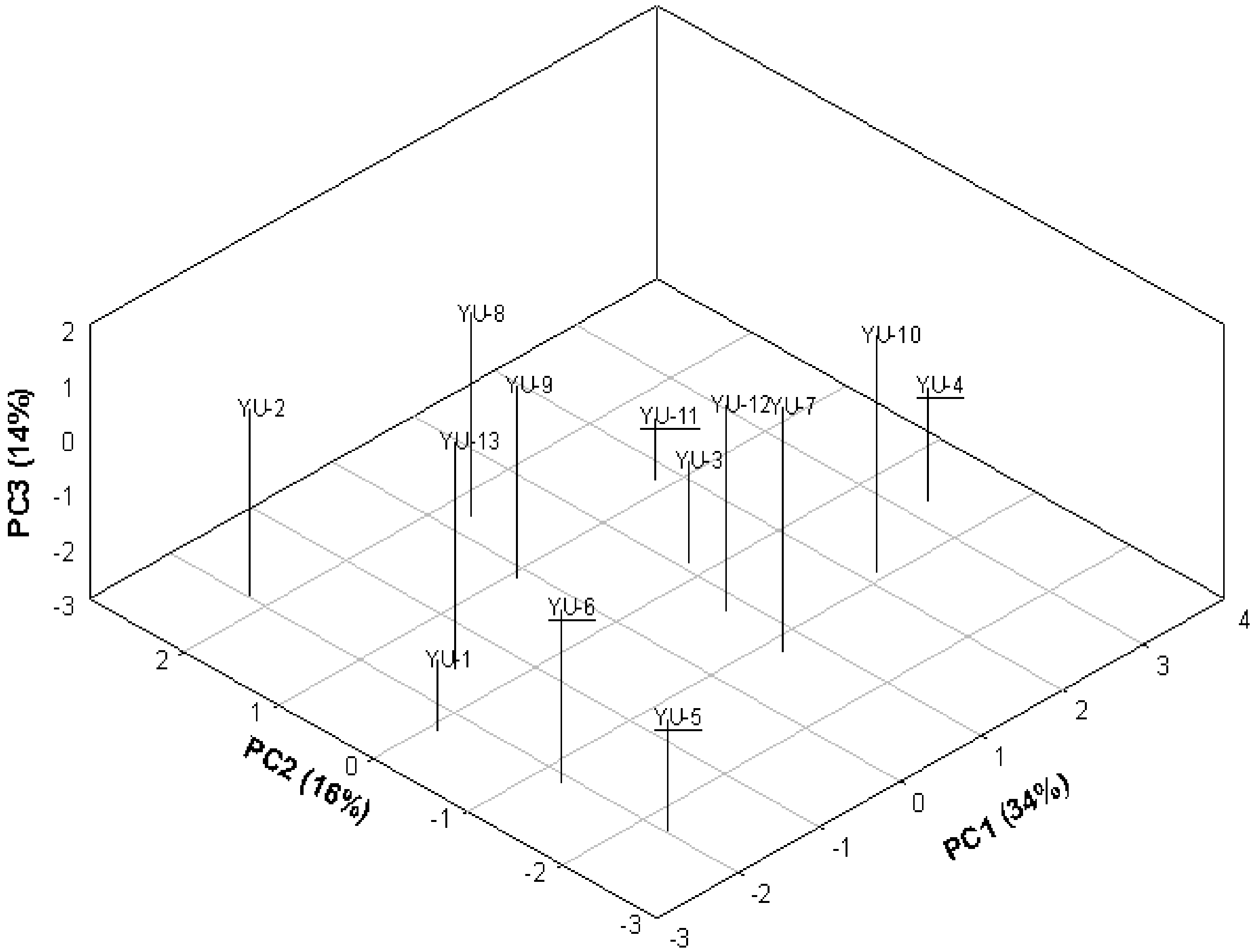

Fig. 1. PCA plot of the first three PCs depicting relationships among, *Cornus mas* genotypes sampled from Turkey

Conclusions

The research of cornelian cherry genetic resources even in a small area points to a great phenotypic diversity among the cornelian cherry genotypes that may have hidden important genes inside and they could be important for breeding better cornelian cherry cultivars by using them as parental material in future. This study also showed that cornelian cherry fruits are a rich source of nutrients for humans such as vitamins C, dietary fiber, tannin etc. Currently this plant is less known and this new source can be potential as a functional food or value added ingredients in future in our dietary system.

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