

Selection of Table Cornelian Cherry (*Cornus mas L.*) Types in Çoruh Valley

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Abstract: The aim of this selection research was to determine the having large fruits and high yielded of cornelian cherries (*Cornus mas L.*) grown in Çoruh valley during 1994-1995. Forty types were chosen in terms of fruit size and productivity in the first year. Fifteen of these types which were found to be superior for consumption were selected using weighted rankit method in the first year, and the second year, the fruit characteristic of those types were evaluated. The fruit characteristics for the selected types were ranged 2.907-3.906 g for fruit weights, 5.950-10.707 for flesh/stone ratio, 11.5-16.8% for TSS, 43.78-76.75 mg vitamin C/100 g, 2.215-4.690% for total acidity (as malic acid), 3.042-7.168 for TSS/acid ratio, 4.220-9.960% for total sugar and 2.024-5.664% for reducing sugar, respectively.

Çoruh Vadisinde Yetişen Sofralık Kızılcık (*Cornus mas L.*) Tiplerinin Seleksiyonu

Özet: 1994-1995 yıllarında yapılan bu seleksiyon çalışmasında Çoruh vadisinde yetişen kızılcıklar arasından iri meyveli ve verimli olanların seçilmesi amaçlanmıştır. İlk yıl meyve iriliği ve verimliliğe göre 40 tip selekte edilmiştir. Tartılı derecelendirme metoduna göre bu tiplerden 15'i üstün sofralık özelliklere sahip olarak bulunmuş ve ikinci yıl bu tiplerde incelemelere devam edilmiştir. Bu tiplerde meyve ağırlığı 2.907-3.906 g, et/çekirdek oranı 5.950-10.707, SÇKM %11.5-16.8, vitamin C içeriği 43.78-76.75 mg/100 g, malik asit cinsinden toplam asitlik %2.215-4.690, SÇKM/asit oranı 3.042-7.168, toplam şeker %4.220-9.960 ve indirgen şeker %2.024-5.664 arasında bulunmuştur.

Introduction

Cornelian cherry is a widely grown fruit species in different regions of Turkey. Although, it is naturally grown in orchards or mountains, there are some exclusive orchards of this fruit in some regions. Cornelian cherry growing area in North-East Anatolia is generally located around the river valleys. Particularly, Çoruh river valley and its branches (Artvin and Erzurum provinces) have a wide cornelian cherry population. Currently, in Turkey there are 1.585.000 cornelian cherry trees, in which yield is approximately 14.000 tons per year. Also, 758 tons fruit were harvested from the 77.060 cornelian cherry trees located in Artvin and Erzurum regions where the present study was undertaken (1).

The cornelian cherry fruits contain a great amount of vitamin C having juicy, sour and sweetish taste. Fruits of this species is not only consumed fresh but also used to produce jam, jelly, stewed fruit, marmalade, pestil (a

locally dried fruit pulp product), syrup and several types of soft drinks. It is also used for medicinal purposes due to properties of leaves and fruits (2, 3). Despite of its wide usage in this country, there have been no standardization studies on this species as is the case for the other fruit species.

Since it is a cross pollinated fruit species (3), a number of cornelian cherry types have naturally occurred in different regions. Hence, Turkey has a wide genetic variation for this species in many regions due to the occurring cross-pollination for centuries. Standard cultivar production is a very significant process in the fruitculture. Therefore, it is necessary to select desired types for superior fruit characteristics and to develop standard cultivars from a wide variety of natural population. Provided that high yielding and high quality fruit types are propagated by vegetative methods and distributed to growers, cornelian cherry production could be increased considerably in the region.

There have been very limited studies related to selection of cornelian cherry in Turkey. Some of the selection studies on cornelian cherry conducted to determine some characteristics include studies by Eriş et al., (4) in Bursa and vicinity, Yağınkaya and Kaşka (5) in Malatya, Elaziğ, South and North Anatolia, Kalkışım and Odabaş (6) in Vezirköprü district of Samsun and Pırlak and Güteryüz (7) in Uzundere, Tortum and Oltu districts of Erzurum.

While there have not been enough selection studies on this fruit grown naturally in this country, selection studies were initiated for long time ago in other countries. For example, Rudkovsky (8) selected two type of cornelian cherry having large fruits, cold resistant and a rather fruitful type among the naturally grown population in Russia. In another study conducted in Yugoslavia, five different types of various their fruit size and shape were selected (9). Again, in Azerbaijan, Imamaliyev (10) determined 47 wild cornelian cherry types which had different morphological characteristics. Similar selection studies were also reported in some other countries such as Czechoslovakia and Australia (11, 12).

The objective of this research was to select fruitful and high quality cornelian cherry types grown naturally in Çoruh valley.

Material and Methods

This study was conducted on naturally grown cornelian cherry populations in Ardanuç, Şavşat and Yusufeli districts of Artvin and İspir district of Erzurum. Forty trees from these fruit types were selected as a research material in first year, 1994.

In order to chose the superior types, the selection criteria used in the first year study were yield, fruit size, flesh/stone ratio, taste and aroma. Then according to the Weighted Rankit (WR) results, fifteen types that had at least 700 score of were selected. This score was suggested as an acceptable limit for the WR score for cornelian cherries (13). Same studies were repeated on these cornelian cherry types in 1995. The detailed information for selected types were given in Table 1.

Yield of trees were observed according to their places of origin and compared around the other trees. The yield of trees were classified as very high, high, medium and low.

Average fruit weight and fruit size were determined on randomly choosen 25 individual samples, and flesh/stone ratio was calculated using [(fruit weight-stone weight/stone weight)] formula. Taste and aroma of fruits

were determined using sensory evaluation of a hedonic scale. Fruit taste was classified as slightly sourish, sourish, slightly sour and sour while aroma was evaluated as very good, good, medium and poor. TSS of the fruits was determined by an hand refractometer. Some pomological properties were also investigated. For example, adherence of the flesh to stone was determined by the panelists with visual observations and the fruits were classified as tightly bound, moderately bound and slightly bound. Vitamin C content, titrable acidity (as malic acid) and total and reducing sugars were determined by Anon., (14), Anon., (15), and Ertan (16), respectively.

Table 1. The places where the cornelian cherry types were found.

Type No*	Places of trees			Owner
	City	District	Village	
08-M-05	Artvin	Merkez	Varziya	Ahmet KARATAŞ
08-M-06	Artvin	Merkez	Sakalar	Enver PEKER
08-M-07	Artvin	Merkez	Sakalar	Enver PEKER
08-M-08	Artvin	Merkez	Hamamlı	İsmet TAŞAN
08-Ş-01	Artvin	Şavşat	Eskikale	Habib HÜNER
08-A-02	Artvin	Ardanuç	Tepedüzü	Cavit ZÜMRÜT
08-A-03	Artvin	Ardanuç	Harmanlı	Şükrek ZÜMRÜT
08-A-09	Artvin	Ardanuç	Kızılçık	Taştan KAYA
08-A-10	Artvin	Ardanuç	Kızılçık	Nazım KAYA
08-A-12	Artvin	Ardanuç	Kızılçık	Süleyman GÜNEY
08-A-15	Artvin	Ardanuç	Naldöken	Ali Rıza ATAK
08-Y-01	Artvin	Yusufeli	Kirazalan	Abdül İŞİK
08-Y-02	Artvin	Yusufeli	Çevreli	Hüseyin OCAK
08-Y-03	Artvin	Yusufeli	Çevreli	Hüseyin OCAK
08-Y-05	Artvin	Yusufeli	Çevreli	Servet ŞAHİN

(*) 08 stands for the code of city, capital letter for the district and last number for the types.

Evaluation of the Total Weighted Ranked Scores

The modified Weighted Rankit (WR) method was used to determine the fresh consumption cornelian cherry types (17, 18, 19, 20, 21, 22). The characteristics evaluated with the WR method and their relative scores were shown in Table 2. The relative scores were multiplied by the each characteristic scores and summed to obtain WR scores for each type of the cornelian cherries.

Table 2. Characteristics, relative scores, classes and scores of the characteristics for "Weighted-Rankit" method in cornelian cherry types.

Characteristics	Relative Scores	Classes and Scores of the Characteristics
YIELD	30	Verg High 10 High 7 Medium 4 Low 1
FRUIT SIZE	25	Average fruit weight (g) 3.524-3.906 10 3.142-3.523 7 2.760-3.141 4 2.377-2.759 1
FLESH/STONE RATIO	20	Fruit weight-Stone weight/ Stone weight 9.245-10.707 10 7.785- 9.244 7 6.325- 7.784 4 4.864- 6.324 1
TASTE	10	Panel Scores Slightly Sourish 10 Sourish 7 Slightly Sour 4 Sour 1
AROMA	10	Panel Scores Very Good 10 Good 7 Moderate 4 Poor 1
TOTAL SOLUBLE SOLIDS	5	Refractometric values (%) 17.0-19.0 10 14.9-16.9 7 12.8-14.8 4 10.6-12.7 2

Results

The characteristics evaluated with WR method for forty cornelian cherry types investigated in 1994 were presented in Table 3. The yield of these types ranged between medium and very high. Fruit weights of the forty types were between 2.377 (25-I-01) and 3.906 g (08-Y-01) while the flesh/stone ratio was the lowest in 08-A-06 (4.864) and the highest in 08-A-03 (10.707) types.

After the determination of the characteristics, their scores for each cornelian cherry type were evaluated and given in Figure 1. While the highest WR score (880) was recorded for 08-A-07 type, the lowest WR score was (460) for 08-M-09, 08-Y-06 and 08-Y-07 types. As a result, fifteen types that reached 700 or higher WR score were selected.

In 1995, all the evaluations and analysis were reported on 15 pre-selected types in the first year of the study. The characteristics evaluated with the WR method and the some other observations were given in Table 4. In the selected types, fruit weight ranged from 2.907 g (08-A-12) to 3.684 g (08-Y-01), flesh/stone ratio from 5.950 (08-Y-01) to 9.438 (08-A-03), and TSS from 11.50% (08-M-08) to 16.70 % (08-A-09).

Some other analysis as well as main selection criteria were also made on the selected types in 1994. For instance, fruit length and fruit width ranged between 1.950 cm and 2.516 cm and 1.442 cm and 1.630 cm, respectively. Also, 08-A-03 had the lowest stone weight

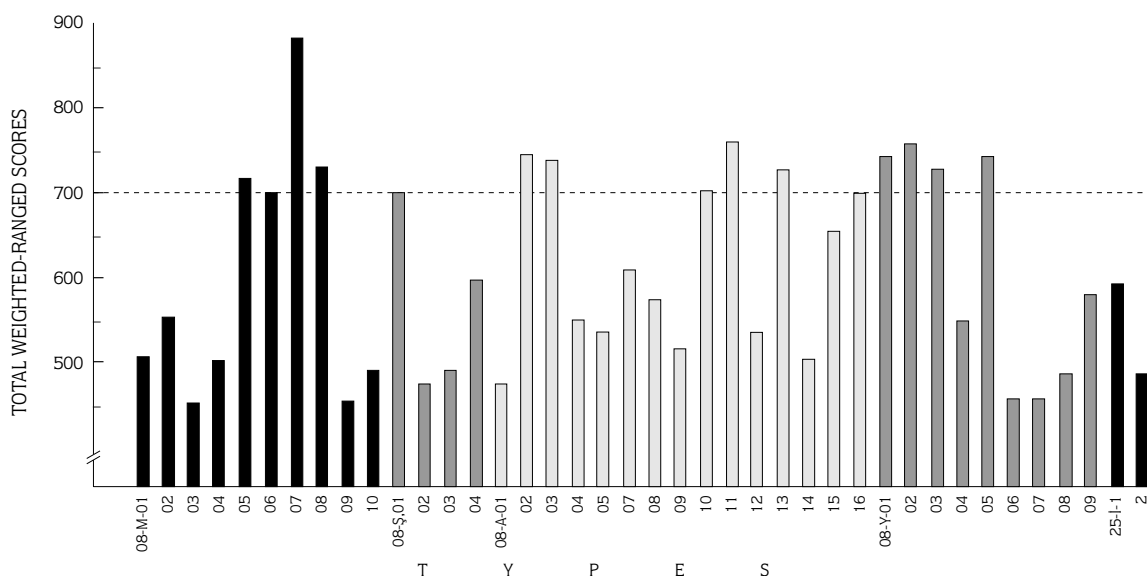


Figure 1. Total weighted rankit scores for the investigated types in 1994.

Table 3. Characteristics based for the weighted rankit for cornelian cherry types in 1994.

Type No	Yeld	Fruit Weight (g)	Flesh/Stone Ratio	Taste	Aroma	TSS (%)
08-M-01	H	2.547	8.129	Sh	M	14.0
08-M-02	M	3.331	6.369	SSh	G	12.5
08-M-03	H	2.622	5.364	SSh	G	16.8
08-M-04	H	2.530	8.370	Sh	M	13.0
08-M-05	VH	3.370	7.179	SSh	G	13.3
08-M-06	H	3.729	7.360	Sh	G	13.7
08-M-07	VH	3.530	7.847	SSh	G	13.3
08-M-08	VH	3.244	7.130	SSh	G	12.0
08-M-09	H	2.506	5.922	Sh	VG	15.0
08-M-10	H	2.644	6.447	SSh	M	15.1
08-Ş-01	H	3.438	7.509	SSh	VG	16.1
08-Ş-02	H	2.585	5.986	SSh	VG	13.7
08-Ş-03	M	2.945	7.002	SSh	G	12.9
08-Ş-04	H	3.332	5.970	SSh	G	13.0
08-A-01	H	2.916	5.877	SSr	G	15.7
08-A-02	VH	3.031	8.531	SSh	G	16.8
08-A-03	H	3.360	10.707	Sh	VG	12.5
08-A-04	VH	2.742	6.702	Sh	G	10.6
08-A-05	H	2.965	6.641	Sh	M	16.5
08-A-06	VH	2.774	4.864	SSh	G	13.6
08-A-07	VH	2.607	6.972	Sh	G	12.8
08-A-08	M	3.032	8.416	Sh	M	13.4
08-A-09	H	3.167	7.896	SSh	VG	13.3
08-A-10	H	3.142	10.063	Sh	G	15.6
08-A-11	M	3.118	8.593	Sh	G	15.8
08-A-12	VH	3.018	8.704	SSh	G	13.7
08-A-13	H	2.793	7.728	Sh	M	12.4
08-A-14	H	3.513	6.334	Sh	G	17.4
08-A-15	H	3.544	6.159	SSh	VG	13.9
08-Y-01	VH	3.906	6.114	Sh	G	15.6
08-Y-02	H	3.186	7.825	SSh	G	15.4
08-Y-03	H	3.515	8.225	SSh	VG	11.6
08-Y-04	H	2.847	5.590	SSh	G	17.6
08-Y-05	VH	3.510	9.086	SSr	G	12.8
08-Y-06	H	3.150	6.274	Sr	P	15.1
08-Y-07	M	3.066	7.354	SSh	P	19.0
08-Y-08	M	2.939	6.713	SSh	M	18.7
08-Y-09	M	3.197	6.611	SSh	G	14.9
25-I-01	H	2.377	8.358	SSh	G	18.6
25-I-02	M	3.065	8.149	Sh	M	14.0

VH : Very High
H : High
M : Medium

SSh : Slightly Sourish
Sh : Sourish
SSr : Slightly Sour
Sr : Sour

VG : Very Good
G : Good
M : Medium
P : Poor

Type No	Yield	Fruit Weight (g)	Flesh/Stone Ratio	Taste	Aroma	TSS (%)
08-M-05	VH	3.113	7.732	SSh	M	13.9
08-M-06	H	3.260	7.787	SSh	VG	13.2
08-M-07	VH	3.158	7.374	SSh	VG	13.2
08-M-08	VH	3.525	8.375	SSh	G	11.5
08-Ş-01	VH	2.957	7.123	SSh	VG	14.0
08-A-02	VH	2.937	8.294	SSh	G	15.2
08-A-03	H	3.215	9.438	SSh	VG	12.5
08-A-09	VH	3.484	7.442	Sh	G	16.7
08-A-10	H	3.143	8.163	SSh	VG	15.6
08-A-12	VH	2.907	8.170	SSh	G	15.0
08-A-15	VH	3.198	7.883	SSh	G	14.2
08-Y-01	VH	3.684	5.950	Sh	G	13.4
08-Y-02	VH	3.149	6.972	SSh	G	14.3
08-Y-03	VH	3.086	8.867	SSh	VG	12.4
08-Y-05	H	3.442	9.367	SSr	G	13.1

VH : Very High
H : High
M : Medium

SSh : Slightly Sourish
Sh : Sourish
SSr : Slightly Sour
Sr : Sour

VG : Very Good
G : Good
M : Medium
P : Poor

Table 4. Characteristics based for the weighted rankit method in selected cornelian cherry types in 1995.

(0.287) g) while 08-Y-01 had the highest stone weight (0.549 g). Stone length and width were between 1.297-1.704 cm and 0.553-0.711 cm, respectively. Fruit samples had 2.215-4.138% titrable acidity, 3.359-7.268 TSS/Acid, 4.220-9.960% total sugar and 2.055-4.892% reducing sugar. Type 08-A-15 type had the lowest vitamin C content (43.70 mg/100 g) while 08-A-03 type had the highest vitamin C content (76.75 mg/100 g) (Table 5, 6).

In 1995, fruit length and fruit width ranged from 1.697 cm to 2.485 cm and 1.335 cm to 1.541 cm, respectively. The 08-A-03 type had the lowest stone weight (0.308 g) while the 08-Y-01 type had the highest (0.530 g). The average stone length and width ranged from 1.240 to 1.680 cm, and 0.551 to 0.690 cm. The types of 08-M-07 (2.350%) and 08-A-15 (3.690%) had the lowest and the highest titrable acidity, respectively. On the other hand, vitamin C content was the lowest in 08-A-15 type (45.16 mg/100 g) and the highest in 08-A-03 type (67.40 mg/100 g). As indicated in Tables 5 and 6, the selected types had average 3.040-5.617 TSS/Acid, 4.276-9.960% total sugar and 2.024-5.664% reducing sugar.

Total weighted ranked scores for the types selected in 1995 were presented in Figure 2. The types, 08-M-08 and 08-A-03 had the highest WR score (790) while the type 08-Ş-01 had the lowest WR score (700).

Discussion

This study was carried out to select the best cornelian cherry types according to the evaluation criteria from the naturally grown populations in Çoruh valley. As a result, some differences were determined in yield, fruit size and the other quality criteria for the cornelian cherry population grown in this area. Average fruit weight was between 2.907-3.906 g in 15 selected types based on two years of the evaluation. However, the average fruit weight reported by some researchers was between 0.470-5.600 g in Turkey and in some other countries (4, 5, 6, 7, 9, 12, 23). When the fruit weights in this study were compared to previous studies, the results were within normal limits or even higher than those of the reported results. One of the significant breeding goal for cornelian cherry is to have larger and attractive fruit characteristics (24). Therefore, the selected types in this study could be used as breeding materials for future breeding programmes.

Average flesh/stone ratio was between 5.950-10.707 for the selected 15 cornelian cherry types in this research. However, Eriş et al., (4) reported that flesh/stone ratio was between 2.15-6.84 for the cornelian cherry types grown in Bursa while Kalkışım and Odabaşı (6) found 2.05-7.42 flesh/stone ratio in the same fruit species

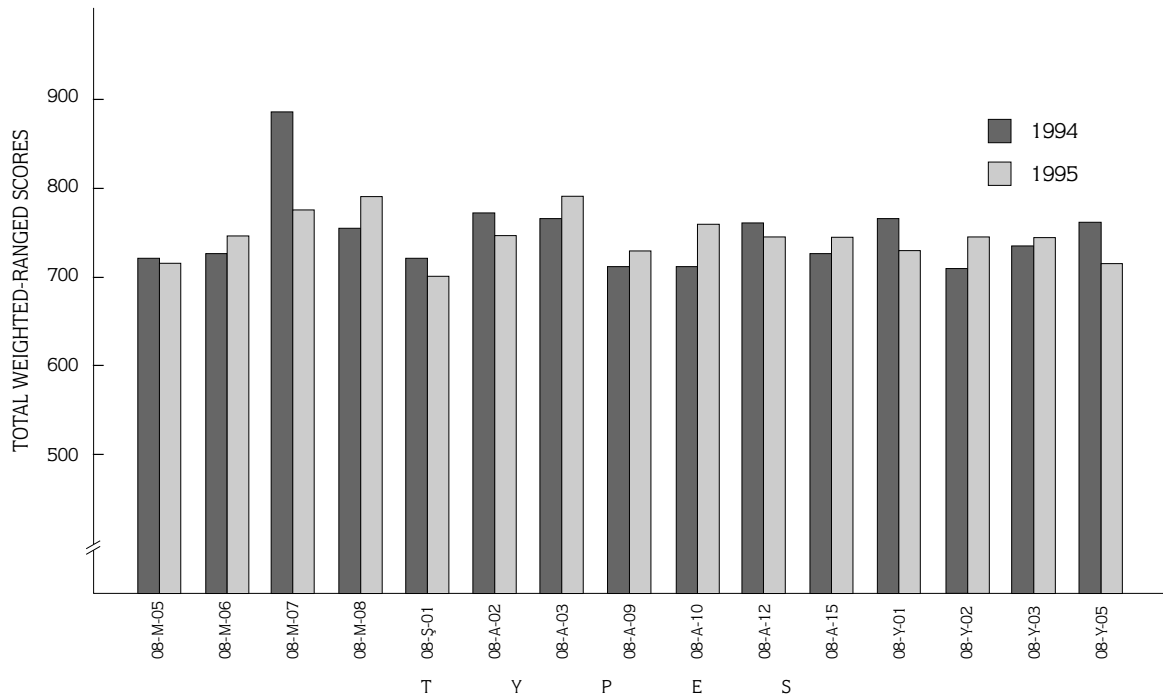


Figure 2. The total weighted rankit scores for the selected types in 1994 and 1995.

Type No	Fruit Length (cm)	Fruit Width (cm)	Fruit LW Ratio	Stone Weight (g)	Stone Length (cm)	Stone Width (cm)	Stone Separation
1994							
08-M-05	2.158	1.532	1.408	0.412	1.461	0.623	MB
08-M-06	2.303	1.615	1.426	0.446	1.537	0.675	TB
08-M-07	2.463	1.502	1.639	0.399	1.554	0.649	MB
08-M-08	2.031	1.541	1.317	0.399	1.429	0.640	TB
08-Ş-01	2.279	1.521	1.498	0.404	1.610	0.636	MB
08-A-02	2.154	1.486	1.449	0.318	1.408	0.588	SB
08-A-03	2.172	1.537	1.413	0.287	1.457	0.553	SB
08-A-09	2.137	1.442	1.481	0.396	1.523	0.657	SB
08-A-10	2.286	1.464	1.561	0.284	1.478	0.563	TB
08-A-12	2.197	1.498	1.466	0.311	1.346	0.618	MB
08-A-15	2.154	1.559	1.381	0.495	1.438	0.708	MB
08-Y-01	2.516	1.585	1.587	0.549	1.704	0.711	SB
08-Y-02	1.986	1.495	1.328	0.351	1.415	0.629	TB
08-Y-03	1.950	1.630	1.196	0.381	1.297	0.673	TB
08-Y-05	2.192	1.568	1.397	0.348	1.356	0.614	SB
1995							
08-M-05	1.973	1.541	1.282	0.402	1.376	0.665	MB
08-M-06	1.968	1.540	1.279	0.410	1.356	0.650	TB
08-M-07	2.172	1.415	1.536	0.358	1.570	0.618	MB
08-M-08	2.019	1.511	1.349	0.376	1.344	0.628	TB
08-Ş-01	1.906	1.369	1.450	0.364	1.476	0.666	MB
08-A-02	1.910	1.335	1.430	0.316	1.328	0.583	SB
08-A-03	2.215	1.524	1.453	0.308	1.468	0.562	SB
08-A-09	2.036	1.512	1.407	0.425	1.543	0.646	SB
08-A-10	1.850	1.376	1.375	0.308	1.306	0.551	TB
08-A-12	1.880	1.370	1.425	0.317	1.466	0.628	MB
08-A-15	1.956	1.495	1.308	0.527	1.409	0.683	MB
08-Y-01	2.485	1.510	1.645	0.530	1.680	0.690	SB
08-Y-02	2.021	1.400	1.461	0.375	1.500	0.644	TB
08-Y-03	1.697	1.473	1.152	0.363	1.240	0.645	TB
08-Y-05	2.046	1.532	1.335	0.332	1.350	0.599	SB

Table 5. Some physical characteristics of selected cornelian cherry types in 1994 and 1995.

TB : Tightly Bound
 MB : Moderately Bound
 SB : Slightly Bound

selected from Vezirköprü district of Samsun. When the results of the present study were compared to the reported studies conducted in Bursa and Samsun, the selected types in Çoruh valley had higher flesh/stone ratio than that of those types. Again, if flesh/stone ratio in the selection of cornelian cherry is considered as a main

Table 6. Some chemical characteristics of selected cornelian cherry types in 1994 and 1995.

Type No	Titriable Acidity (%)	TSS/ Acid	Vitamin C (mg/100 g)	Total Sugar (%)	Reducing Sugar (%)
1994					
08-M-05	2.662	4.996	54.70	8.659	4.892
08-M-06	3.244	4.223	55.13	9.440	4.970
08-M-07	2.338	5.668	65.51	8.940	4.176
08-M-08	3.222	3.724	63.78	5.064	2.334
08-Ş-01	2.215	7.268	58.37	5.282	4.384
08-A-02	3.132	5.363	64.43	8.408	5.400
08-A-03	3.266	3.827	76.75	6.595	3.985
08-A-09	3.054	4.354	65.18	9.960	4.646
08-A-10	3.506	4.449	67.02	6.516	4.008
08-A-12	3.946	3.471	71.35	4.276	2.192
08-A-15	4.138	3.359	43.78	4.220	2.113
08-Y-01	3.074	5.074	61.62	5.220	2.852
08-Y-02	2.931	5.254	60.86	5.001	2.930
08-Y-03	2.510	4.621	61.94	5.533	2.266
08-Y-05	2.628	4.870	71.67	4.689	2.055
1995					
08-M-05	2.995	4.641	47.90	7.672	4.416
08-M-06	2.450	3.826	46.51	8.856	4.792
08-M-07	2.350	5.617	57.67	7.468	4.176
08-M-08	3.260	4.575	59.53	4.704	2.024
08-Ş-01	3.060	3.527	58.13	5.820	4.176
08-A-02	3.490	4.355	60.48	8.506	5.664
08-A-03	3.185	3.924	67.40	6.290	3.772
08-A-09	3.760	4.441	57.67	9.960	4.656
08-A-10	3.960	3.939	54.88	6.516	4.008
08-A-12	4.390	3.416	65.11	4.276	2.192
08-A-15	4.690	3.040	45.26	4.860	2.328
08-Y-01	2.980	4.496	56.13	5.340	2.445
08-Y-02	3.750	3.813	58.13	5.144	3.140
08-Y-03	2.880	4.305	55.34	6.028	2.472
08-Y-05	2.744	4.774	59.45	4.993	2.144

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selection criteria (24), the selected types in this study appeared to be a good breeding material.

TSS value of the selected types ranged between 11.5 and 16.8% while this result was between 9.17-19.88% in other reports on this fruit species. The present results for this parameter is sometimes higher than that of the previous reports while it is lower in some cases (4, 6, 7, 8, 9, 12, 25). This could be natural result of different environmental conditions and genotype types since TSS is greatly influenced by those factors according to some reports (26).

The vitamin C content ranged between 43.78 and 76.75 mg/100 g in our selected types while in the some other similar studies vitamin C content was between 31.70-99.52 mg/100 g (6, 7, 12, 25, 27, 28, 29, 30). These results again are in line with the previous observations.

Titriable acidity in the selected types was between 2.215-4.690% while it was between 1.17-6.82% in other studies reported by some researchers (4, 6, 7, 9, 27).

TSS/Acid ratio ranged from 3.040 to 7.268 in the selected types grown in Çoruh valley, but Kalkışım ve Odabaşı (6) reported that TSS/Acid ratio was between 8.3-9.1 in their research material.

Total sugar was between 4.220-9.960% while reducing sugar was between 2.024-5.664%. Total sugar was reported to be 7.42% for cornelian cherry in a study conducted by Oblak (29) on the composition of some wild fruit species grown in Yugoslavia. In another selection study in Yugoslavia, total and reducing sugar contents were between 9.00-13.80% and 7.56-10.20%, respectively.

As a conclusion, 15 cornelian cherry types naturally grown in Çoruh valley were determined to be suitable for commercial fruit production for table type cornelian cherry production.

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