

Araştırma Makalesi/Research Article (Original Paper)

Biochemical and Pomological Characteristics of Hawthorn (*Crataegus spp.*) Fruits Grown in Şemdinli, Hakkari

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Abstract: The present study was conducted in Şemdinli town of Hakkari province in 2013-2014. The pomological and chemical characteristics of hawthorn (*Crataegus spp.*) fruits with different colors were investigated. Fruit samples were taken from 39 hawthorn trees selected from the villages of Şemdinli. In pomological analyses, fruit weight, fruit height, fruit width, number of seeds, seed weight and flesh ratio were determined. In chemical analyses, soluble solids content, pH, titratable acidity and sugar contents were determined. The evaluated accessions had average fruit weights of between 2.16-4.89g and flesh ratios of between 77.86-85.99%. Of the investigated genotypes, 16 were identified as promising genotypes. The greatest fruit weight was observed in yellow A-4 genotype with 4.89 g and the least fruit weight was observed in red L-9 genotype with 2.16 g. While glucose and sucrose were the dominant sugars in yellow hawthorn fruits, glucose and fructose were dominant in black and red hawthorn fruits. Of 16 promising hawthorn accessions, 7 had “yellow” skin color, 5 had “red”, 3 had “black” and 1 had “white” skin color. Current findings provide quite significant outcomes for further breeding studies.

Keywords: Breeding, Fruit, Hawthorn, Şemdinli

Hakkâri İli Şemdinli Yöresi Alıç (*Crataegus spp.*) Meyvelerinin Biyokimyasal ve Pomolojik Özellikleri

Özet: Bu araştırma 2013- 2014 yılları arasında Hakkâri İlinin Şemdinli İlçesinde yürütülmüştür. Bu çalışmada, farklı renklerdeki alıçların pomolojik ve kimyasal özellikleri araştırılmıştır. Çalışmanın yapıldığı Şemdinli (Hakkâri) İlçesine bağlı köylerde bir ön eleme ile belirlenen 39 alıç ağacı üzerinde iki yıl numune alınarak çalışma yapılmıştır. Bu genotiplerin meyvelerinde pomolojik analiz olarak meyve ağırlığı, meyve büyüklüğü, çekirdek sayısı, çekirdek ağırlığı ve meyve eti oranı gibi değerler incelenmiştir. Bununla birlikte kimyasal analizler olan pH, ŞÇKM, TA ve şeker içerikleri belirlenmiştir. Yapılan analizler sonucunda meyve ağırlığı 2.16- 4.89g aralığında, meyve eti oranı %77.86- %85.99 aralığında tespit edilmiştir. Netice olarak incelenen tiplerden 16 genotipin ümitvar olduğu kanaatine varılmıştır. En yüksek meyve ağırlığı Sarı renkli A-4 genotipinde 4.89 g, en düşük meyve ağırlığı ise kırmızı renkli L-9 genotipinde 2.16 g olarak ölçülmüştür. Sarı renkli alıç meyvelerinde glikoz ve sakaroz hakim şeker iken siyah ve kırmızı alıç meyvelerinde glikoz ve früktoz hakim şeker olarak tespit edilmiştir. Ümitvar olarak tespit edilen 16 genotipin 7 tanesi “sarı”, 5 tanesi “kırmızı”, 3 tanesi “siyah” ve 1 tanesi “beyaz” kabuk rengine sahiptir. Bu araştırma alıç meyvesi üzerinde yapılacak çalışmalara basamak oluşturacak sonuç ve değerlendirmeleri içermektedir.

Anahtar kelimeler: Alıç, Islah, Meyve, Şemdinli

Introduction

Turkey has a great potential in fruit culture and quite rich also in naturally growing wild species. Several wild fruits naturally grow in briefly mention the regions of Turkey. These wild fruit species are used for various purposes. Hawthorn is a naturally growing wild species and has several areas of utilization.

Hawthorn systematically belongs to the *Crataegus* subgroup of Rosacea family (Ağaoğlu vd. 1995). It has 200 different kinds all over the world, 50 of them being in north hemisphere and Turkey has 17 types of

Hawthorn. Hawthorn (*Crataegus* spp) is a deciduous tree. It is a thorny tree and grows in a form of bush. The leaves are either simple or lobed and fruits can be yellow, red, purple or black (Seçmen vd. 1989). When cultivation is taken into account, it seems that hawthorn has a potential to be used as rootstock for pome fruit; however, insufficient information is available about possible use of hawthorn trees as a rootstock (Ercişli 2004). Hawthorn trees usually grow in unprotected areas and they are exposed to different harsh conditions, diseases and pests. Therefore, fruits are most of the time do not have sufficient or desired quality attributes. Selecting the qualified accessions among these plants and reproducing or cultivating them will result in higher quality and more yielding hawthorn trees (Gazioğlu 2000). Hawthorn fruits contain several minerals. They are rich in Ca, P, Mg and Fe. Moreover, fruits are also quite rich in carbohydrate and sugars (Özcan vd. 2005).

Recently, there have been much studies conducted in several countries on hawthorn fruits. Researchers mostly collected fruits from the nature and analyzed their chemical and pomological characteristics. Researches have also been conducted in pharmaceutical industry about the impacts of substances obtained from hawthorn fruits on various health issues. Such health effects directed the industry to healthy natural products and brought about a need for commercial production of these wild fruit species. In present study, pomological and chemical characteristics of hawthorn fruits naturally growing in Şemdinli town of Hakkari province were investigated.

Materials and Methods

This study was conducted between the years of 2013 and 2014 in the villages of Semdinli town of Hakkari province (Günyazı, Altınsu, Akbal, Çatalca, Öveç, Karaağaç and Bozyamaç).

Fruit samples were collected from these villages. A total of 39 hawthorn accessions were collected in 2 years and fruit samples were subjected to fruit weight, fruit height, fruit width, number of seeds and seed weight analyses. Fruit heights and widths were measured over randomly selected 10 fruits in 3 replications with a digital caliper (± 0.01 mm) and average of measurements was taken. Fruit weights were measured with a digital scale (± 0.01 g). Seeds were counted and seed weight was measured again with a digital scale (± 0.01 g).

Besides pomological characteristics, chemical characteristics (soluble solids content, pH, titratable acidity, sugar contents) were also analyzed. For soluble solids content, fruit juices of randomly selected 10 fruits were mixed and measurement was performed with a portable refractometer. Titration method was used to determine titratable acidity. A bench-type pH-meter was used to measure the pH of fruit juice samples. The method recommended by Melgarejo vd., (2000) was modified and used for sugar analyses. Fructose, glucose, sucrose and maltose standards were employed in analyses. About 5 g samples were taken from hawthorn fruits and supplemented with 10 ml acetonitrile. Samples were then centrifuged at 12000 rpm for 2 minutes and passed through SEP-PAK C₁₈ cartridge. Resultant extract was preserved at -20 °C until the analyses. Sugars were analyzed in an HPLC device with a reactive index detector by using µbondapak-NH₂ column with the aid of 85% acetonitrile liquid phase. Concentrations were calculated based on externally supplied standards.

Expected Features of the Accessions

The expected attributes include but not limited to; ample and regular yield, a respectable amount of vegetative improvement, adequate rate of florescence, high level of fruit set, a short period of florescence process, adaptable periods of fruit maturing to local climate, large fruits, high level of fruit flesh, aroma, few seeds and resistance to diseases. The samples taken from 39 hawthorn trees were analyzed in laboratories of Horticulture Department of Yüzüncü Yıl University Agricultural Faculty. Of the analyzed species, 16 were identified as promising genotypes and results for them were presented.

Results

Pomological Characteristics

As a result of two-year study, 16 accessions were determined as promising. Some pomological characteristics such as fruit weight, fruit height, fruit width, number of seeds and seed weight are provided in Table 1.

Table 1. Pomological characteristics of promising accessions

Genotype	Fruit Weight (g)	Fruit Height (mm)	Fruit Width (mm)	Number of Seeds	Seed Weight (g)	Flesh Ratio (%)
G-1	3.16±0.30	16.30±0.78	19.38±0.98	2.00±0.29	0.70±0.16	77.84
G-2	3.71±0.60	16.70±0.85	20.82±2.25	2.05±0.20	0.77±0.15	79.24
G-3	4.32±0.48	17.52±0.78	22.05±1.09	2.10±0.47	0.86±0.15	80.00
G-4	3.30±0.21	16.08±0.78	18.81±2.23	2.30±0.49	0.66±0.11	79.92
I-5	2.64±0.72	15.69±1.43	17.09±2.08	2.30±0.49	0.54±0.14	79.35
L-9	2.16±0.34	14.72±1.25	15.15±1.54	1.95±0.57	0.39±0.09	81.78
Ç-1	3.84±0.73	17.66±0.89	20.32±1.71	2.20±0.50	0.60±0.09	84.33
Ç-2	3.82±0.80	17.49±1.34	20.67±1.86	2.50±0.58	0.59±0.11	84.51
A-4	4.89±0.92	18.75±1.17	23.20±2.17	2.15±0.37	0.68±1.17	85.99
A-5	4.87±1.94	18.19±2.23	21.30±4.33	2.10±0.28	0.73±0.11	85.01
D-1	3.48±0.74	17.52±1.60	19.14±2.63	2.30±0.50	0.61±0.13	82.41
B-2	3.46±0.87	17.02±1.74	20.11±1.87	3.47±0.75	0.59±0.13	82.98
B-4	2.43±0.18	15.08±0.52	16.18±0.58	2.10±0.33	0.49±0.05	79.86
B-6	3.66±0.45	18.20±1.34	20.14±0.88	3.30±0.63	0.56±0.10	84.59
B-7	4.80±0.98	19.81±1.48	22.53±2.11	2.95±0.50	0.77±0.16	83.80
B-10	3.22±0.85	16.63±1.97	19.61±2.08	3.25±0.54	0.52±0.14	83.81

Data is presented in mean±standard error

While the heaviest fruit weight was observed in yellow A-4 genotype with 4.89 g, the lightest fruit weight was observed in black L-9 genotype with 2.16 g. The red B-7 genotype had the widest average fruit width with 19.81 mm and the black L-9 genotype had the narrowest average fruit with 14.72 mm. The flesh ratio was the highest in yellow A-4 genotype with 85.99% and the lowest in yellow G-1 genotype with 77.86%.

Chemical Analyses

The chemical characteristics such as pH, soluble solids (SS) and titratable acidity (TA) are presented in Table 2 and sugar profile of the accessions are depicted in Table 3.

Table 2. Chemical characteristics (pH, TA, SS)

Genotype	pH	TA	SS
G-1	3.48±0.81	2.54±0.37	18.33±0.75
G-2	4.06±0.54	1.08±0.46	21.91±0.15
G-3	3.39±1.84	1.49±0.76	25.08±0.45
G-4	3.31±1.75	1.66±0.67	25.56±0.65
I-5	4.02±0.94	0.53±0.76	16.04±0.78
L-9	3.62±0.52	0.78±0.78	25.56±0.94
Ç-1	3.26±0.67	1.18±0.27	23.84±0.75
Ç-2	3.31±0.87	1.20±0.87	22.36±0.53
A-4	3.58±0.82	0.96±0.12	20.74±0.57
A-5	3.41±0.75	1.05±0.53	16.57±0.59
D-1	3.46±0.86	2.39±0.76	23.66±0.67
B-2	3.13±0.45	1.41±0.45	22.08±0.78
B-4	3.59±0.74	1.09±0.87	23.02±0.94
B-6	3.08±0.13	1.74±0.98	16.25±0.53
B-9	3.04±0.12	2.76±0.78	21.83±0.48
B-10	3.06±0.97	1.93±0.57	17.49±0.37
Average	3.42±0.79	1.48±0.62	21.27±0.62

The pH values of promising accessions varied between 3.04-4.06, titratable acidity values varied between 0.53 - 2.76% and soluble solids content values ranged between 16.04 - 25.56%.

Table 3. Sugar profile of selected accessions

Genotype	Fructose (g/100g)	Glucose (g/100g)	Saccharose (g/100g)	Maltose (g/100g)
D-4	9.29±0.87	4.27±0.72	6.00±0.58	0.010±0.078
Ç-1	13.57±0.65	14.74±0.68	4.09±0.75	0.059±0.024
D-3	9.28±0.75	8.77±0.85	13.86±0.56	0.040±0.025
İ-4	9.27±0.67	10.19±0.76	12.21±0.95	0.001±0.014
İ-2	9.22±0.95	9.43±0.79	7.37±0.84	0.009±0.094
D-2	11.08±0.87	8.33±0.92	11.90±0.37	0.164±0.084
B-6	6.51±0.65	7.21±0.95	5.72±0.49	0.026±0.074
D-1	8.84±0.76	7.74±0.56	7.97±0.48	0.308±0.042
G-2	11.28±0.68	8.90±0.78	8.09±0.72	0.052±0.025
G-3	15.92±0.73	9.41±0.58	6.37±0.65	0.073±0.024
Average	10.43±0.75	8.20±0.75	6.35±0.63	0.074±0.048

As seen from Table 3, fructose contents of the selected accessions varied between 6.51 - 15.92 (g/100g), glucose contents between 4.27 - 14.74 (g/100g), sucrose contents between 4.08 - 11.90 (g/100g) and maltose contents between 0.001 - 0.308 (g/100g).

Discussions

From the selection studies on naturally growing Hawthorn species in different regions of Turkey, it was deduced that there were different kinds of Hawthorn. In the present study, chemical and pomological analyses were carried out on promising accessions of Şemdinli town of Hakkari.

As a result of the research done between 2013 and 2014, 16 promising accessions were determined as high quality Hawthorn accessions. Among these accessions, yellow A-4 had the heaviest fruit weight with 4.89 g, whereas the black L-9 had the lightest fruit weight with 2.169 g. In a similar study carried out in Edremit town of Van province, Karadeniz and Kalkışım (1996) evaluated 14 accessions and reported the heaviest fruit weight as 2.14 g which was quite lighter compared with the current results.

Number of seeds and seed weight usually have significant effects on fruit flesh ratios. In the present study, average seed weight was round as 0.63 g. While the heaviest seed weight was observed in yellow G-3 genotype with 0.86 g, the lightest seed weight was observed in black L-9 genotype with 0.39g. The present results are consistent with the results of Asma and Birhanlı (2003), in Hekimhan and Yazihan towns of Malatya province. Sorgun vd. (2012) investigated two yellow, one red and five black promising hawthorn genotypes of Hakkari and surroundings and reported average number of seeds as 2.2 (varying between 1.6 – 3.0) and seed weight per fruit as 0.59 (varying between 0.31 – 0.83 g). In photochemical studies carried out with 27 different hawthorn genotypes in Europe, Asia and America, 36 different flavonoids, 6 different sugars and 17 different organic acids were reported (Edwards vd. 2012).

Gundogdu vd. (2014) investigated some pomological characteristics of eleven different hawthorn species and reported fruit weights (0.58 – 3.48 g), fruits heights (1.29 – 15.72 mm), fruit widths (1.44 – 17.68 mm), pH values (4.22 – 5.22), and SSC values (3.05 – 20.00%) respectively. The current results on pomological characteristics were in agreement with those earlier results. Turkoglu vd. (2005) investigated the pomological characteristics of Hawthorn species of Van region (31 from Gevaş and 18 from Edremit) and reported some ranges for average fruit heights (12.45 – 12.89 mm), average fruit widths (13.44 – 14.48 mm), average fruit weights (1.33 – 1.53 g), average seed weights (0.134 – 0.141 g), number of seeds (2.07 – 2.20), SSC values (18.24 – 19.10%), pH values between 3.30 – 3.82. Majority of those earlier findings comply with the present results. Liu vd. (2010) investigated acids, sugars and sugar alcohols of Chinese hawthorn species and reported fructose contents of different species (5.5 – 18.4 g/100g) DM and glucose contents (5.3 – 16.6 g/100g DM). Current values on sugar profiles of hawthorn species also well complies with those previous values.

Fruit flesh ratio is a significant criterion in terms of consumption. The average fruit flesh ratio was observed as 82.21% with the greatest ratio (85.99%) in yellow A-4 genotype and the least ratio (77.86%) in yellow G-1. Similarly, Karadeniz and Kalkışım (1996) carried out a research with hawthorns collected

from Edremit and Gevaş towns of Van province and reported flesh ratios of the fruits as between 70.27 - 82.82%. The earlier results supported the current results.

Before the present study, there haven't been any researches carried out on hawthorn species of the region. With this study, the promising hawthorn species with regard to quality and chemical parameters were identified. The results were also compared with the results of earlier studies carried out in different sections of Turkey.

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