

Some Physico-Chemical Characteristics in Fruits of Rose Hip (*Rosa* spp.) Genotypes from Bolu Province in Western Part of Turkey

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Abstract

More recently, functional foods or food supplements which can protect humans from oxidative stress and several diseases have attracted worldwide interest. Among functional foods, fruits were given special attention, particularly wild edible fruits (neglected or underutilized fruits). There are various neglected and underutilized fruit tree species grown in Turkey solely. They could be exploited directly as foods, or used to obtain valuable natural compounds and derivatives. Rose hip (*Rosa* spp.) is one of them. The aim of the study is to determine some fruit characteristics of promising rose hip selections from Bolu province in the western part of Turkey. In the selection study, around 100 wild growing rose hip plants were investigated and among them 9 promising genotypes were selected based on rose hip selection criteria. The fruit mass, fruit flesh ratio, soluble solid content, titratable acidity, total dry matter and vitamin C content of these selected nine genotypes ranged from 1.40-2.77 g, 64.92-82.83%, 24.10-30.50%, 0.04-1.55%, 32.44-56.94% and 332.42-1603.52 mg/100 g respectively. Among the 9 promising genotypes, two genotypes had high, two genotypes had medium and five genotypes had low level of thorn.

Key words: *Rosa* spp., fruit weight, chemical content

Introduction

Rose hip (*Rosa spp.*) belongs to the *Rosa* genus in the Rosales order in the sub family of Rosoideae in the Rosaceae family. Nearly 70-100 rose hip species are grown world wide and 25% (27 species) of them are cultivated in Turkey (Kutbay and Kılınç, 1996; Türkben, 2003; Ercişli 2004; Ercişli 2005, Ercişli and Güleriyüz, 2005).

Rose hip is a plant that could be as tall as 0.5-4.0 m dependent on species, straight or downward shape formed, thorny main stem and shoots to some extent, bush formed and leaves dropping in winter season. Thorns are mostly curved or straight to a lesser extent. Smooth leaves contain 5-11 leaflets, and each leaflet is 2-4 cm long and egg or ellipse shaped, the margins of leaves are simple or folded with serrated margins and bluish green in color. The flowers are hermaphrodite and contain many anthers and pistils. Receptacle swells to form hip which is round, egg-shaped or ellipse, bright in fruit flesh but it changes from green before maturation towards tile red-red when it is ripe. The exocarp could be woolly or smooth, and endocarp could also be woolly more or less and contains many seeds and generally keeps on the plant during winter (Gökmen, 1973; Göbelez, 1981; Tanrıverdi, 1987; Gönüllü et al., 1990; İlisulu, 1992; Türkben, 2003).

Rose hip (*Rosa spp.*) has recently attracted consumers' attention due to its natural antioxidant contents beneficial for humans (Su et al., 2005), along with minerals, carotenoids, tocopherol, bioflavanoids, fruit acid, tannine, pectin, amino acid and essential fats (Çınar and Çolakoğlu, 2005). This plant is reported to have been used by folk medicines for diabetes, stomach diseases, kidney disorders and gingival bleeding successfully (User, 1967; Kühn, 1992; Kostic, 1994). Moreover, rose hip is effective in refreshing the blood and beneficial for intestines, as well as for inflammatory diseases and common cold due to its high ascorbic acid content (Şen and Güneş, 1996).

This fruit has a long history in Turkey. There are different rose hip genotypes adapted to local conditions and, thus a large gene pool could be pronounced. Many genotypes having different productivity, fruit size, shape, color, taste and nutrient content grow natively in this country. Our country is one of the most important gene sources (Ercişli and Güleriyüz, 2005). Superior genotypes should be selected from these rich resources and cultivated. It is not only important for the economy, but also to gain the time for the selection process. This work, which considers the selection criteria, conducted in the villages of Bolu (the geographical position is between 30° 32'-32° 36 'minutes east longitude and 40° 06' 41° 01 'north latitude) by selecting the naturally-grown plants primarily aimed at searching the plants and fruit properties, to reveal the superior genotypes that could serve as reference for further studies.

Material and Methods

This work was conducted in the centre villages of Bolu in which rose hip is naturally grown intensely. Bolu's climate is a transition area between the Black Sea climate and the land (steppe) climate of inner Anatolia. The temperature is between + 39.4 °C and -31.5 °C in summer and winter. The annual rainfall is between 535-1084 mm (Anonymous, 2016).

In May and June of 2011, 100 rose hip plants were selected for a survey and at least 30 fruits per plant were harvested in September-October and were under a research. In order to determine the rose hip type character, the selection criteria used were productivity, fruit size, flesh rate, vitamin C, thorn status, soluble solid content and total dry matter. Regarding the selection criteria, 9 genotypes were detected with over 700 points according to weight-ranked-method (Bolat and Güleriyüz, 1992) (Table 1).

Tab. 1. Main selection criteria for weight-ranked-method and its importance degree
Главни селекциони критеријуми за weight-ranked-method и његов степен важности

Weight-ranked-method criteria <i>Weight-ranked-method критеријуми</i>	Value scores <i>Вриједност резултата</i>	Relative scores <i>Релативни резултати</i>
Productivity <i>Продуктивност</i>	10-8-2	20
Fruit size (g) <i>Величина плода (g)</i>	10-8-6-4-2	20
Flesh rate (%) <i>Удио меса плода (%)</i>	10-8-6-4-2	15
Vitamin C (mg/100g) <i>Витамин C (mg/100g)</i>	10-8-6-4-2	15
Thorn status <i>Удио трња</i>	10-7-3	10
Soluble solid content (SSC) (%) <i>Садржај растворљиве суве материје</i>	10-8-6-4-2	10
Total dry matter (TSS) (%) <i>Укупна сува материја</i>	10-8-6-4-2	10

After selecting the genotypes, fruit weight (fruit weight was measured with a scale which is sensitive to 0.01 g), fruit length [fruit lengths were measured with digital calipers (Mitutoyo, Kanawaga, Japan, accuracy \pm 0.01 mm)], fruit diameter [fruit diameters were measured with digital calipers (Mitutoyo, Kanawaga, Japan, accuracy \pm 0.01 mm)], fruit shape index (ratio of maximum height to width, H / W), fruit flesh ratio (flesh/seed ratio) and thorn formation (the degree of thorniness on the shrubs was evaluated as high, medium, low, and thornless by comparing the shrubs with one other on the location where they grow) were determined according to Ercişli (1996), vitamin C (2,6-dichlorophenolindophenol (dye) solution, based on the principle of calculating the amount of ascorbic acid present) according to TSE (1989), total dry matter (fruits were dried by heating to a constant weight at a temperature of 105 °C and total acidity ratio (acidity (expressed as % citric acid) was determined by titrating with 0.1 N NaOH to an end point of pH 8.10) according to Yamankaradeniz (1982), and soluble solids (by reading a drop of fruit juice on a refractometer) were determined to Cemeroğlu (1992).

Results and Discussion

Table 2 and 3 give mean values of chemical and physical properties of rose hip genotypes taken in 2011. The fruit weight ranged from 1.40–2.77 g and changing the fruit weight and other parameters are pointed out by many researchers depending on the ecological conditions. A selection study conducted in Czech Republic found fruit weight 3.61 g (Nitransky, 1976), 3.90 g in Sweden (Uggla, 1991) and 1.90-7.60 g in Lithuania (Kiseleva, 1978).

The fruit weight of selected genotypes in Turkey varied among 0.61-4.95 g in Erzurum (Yamankaradeniz, 1982), 3.07 g in Tokat (Kara and Gerçekçioğlu, 1992), 1.6-6.0 g in Gümüşhane (Ercişli, 1996), 1.81- 3.99 g in Gevaş and Ahlat (Balta and Çam, 1996), 1.51-7.77 g in Van (Kazankaya et al., 1999), 0.88-2.22 g in Bursa (Türkben et al., 1999), 0.91-3.40 g in Adilcevaz (Kazankaya et al., 2001), 1.00-1.93 g in Gevaş and Edremit (Kazankaya et al., 2002), 0.41-2.40 g in Tatvan (Türkoğlu and Muradoğlu, 2003), 2.04- 6.10 g in Bitlis, Hakkari and Van (Kazankaya et al., 2005).

The fruit length changed from 18.92 to 24.13 mm among the selected genotypes and from 11.80 to 15.88 mm for fruit diameter. Fruit flesh ratio fluctuated from 64.92 to 82.83 %. Similar studies were conducted during the first and the second year round and the fruit diameter was 10.80-17.06 mm, fruit length was 17.86-29.50 mm, fruit flesh ratio was 42.61-78.88 %; the second year results were as follows: 9.14-18.48 mm, 15.41-27.76 mm and 32.29-79.00 % respectively (Kazankaya et al., 2001).

Tab. 2. Fruit characteristics of rose hip selections from Bolu region
Особине плода селекционисаног шипка из покрајине Болу

Genotypes <i>Генотипови</i>	Fruit weight (g) <i>Тежина плода</i>	Fruit length (mm) <i>Дужина плода</i>	Fruit diameter (mm) <i>Пречник плода</i>	Fruit shape index <i>Индекс облика плода</i>	Flesh ratio (%) <i>Омјер меса плода</i>	Pubescence of fruit exterior <i>Длакавост спољног омотача плода</i>	Seed weight (g) <i>Тежина сјемена</i>	Seed number per fruit <i>Бр. сјеменки по плоду</i>
14 BL 2	2.20	23.99	13.34	1.81	66.86	Absent / <i>нема</i>	0.74	25.00
14 BL 4	2.21	21.93	14.15	1.56	76.46	Absent / <i>нема</i>	0.48	23.40
14 BL 10	2.38	19.38	15.88	1.23	71.70	Absent / <i>нема</i>	0.79	39.10
14 BL 12	2.77	22.03	15.49	1.43	74.40	Absent / <i>нема</i>	0.71	31.70
14 BL 36	2.56	24.13	14.04	1.72	82.83	Absent / <i>нема</i>	0.44	20.70
14 BL 42	1.75	19.43	12.68	1.54	65.65	Absent / <i>нема</i>	0.60	29.00
14 BL 48	1.50	18.92	12.74	1.49	76.72	Present / <i>има</i>	0.35	19.50
14 BL 51	1.40	19.12	11.80	1.62	64.92	Absent / <i>нема</i>	0.49	28.10
14 BL 91	1.81	20.91	12.64	1.66	68.01	Absent / <i>нема</i>	0.58	30.90

Tab. 3. Some morphological and chemical characteristics of rose hip selections from Bolu region
Неке морфолошке и хемијске особине селекционисаног шипка из покрајине Болу

Genotypes <i>Генотипови</i>	Plant height (m) <i>Висина биљке</i>	Plant width (m) <i>Ширина крошње</i>	Thorn status <i>Присуство трнова</i>	Leaf length (mm) <i>Дужина листа</i>	Leaf width (mm) <i>Ширина листа</i>	Leaflet number per leaf <i>Бр. лиски по листу</i>	SSC (%)	TSS (%)	Titrateable acidity (%) <i>Титрациона киселост</i>	Vitamin C (mg/100 g) <i>Витамин С</i>
14 BL 2	1.9	1.5	low / <i>ниска</i>	54.35	46.48	7.00	30.50	50.24	1.19	332.47
14 BL 4	1.4	0.7	low / <i>ниска</i>	44.10	37.93	5.33	30.00	40.10	1.34	948.98
14 BL 10	2	1.1	normal/ <i>нормална</i>	49.50	43.80	6.67	24.50	40.07	1.46	1460.76
14 BL 12	1.9	0.9	low / <i>ниска</i>	43.30	39.10	5.67	25.10	32.44	1.04	442.13
14 BL 36	1.5	1.2	high / <i>висока</i>	50.77	50.77	5.33	25.70	36.72	1.36	926.25
14 BL 42	1.5	1.2	low / <i>ниска</i>	52.39	52.39	6.00	25.80	47.06	1.55	615.03
14 BL 48	1.5	0.8	low / <i>ниска</i>	56.31	56.31	7.00	25.90	44.80	1.15	884.76
14 BL 51	1.8	2.2	normal/ <i>нормална</i>	49.27	49.27	5.67	29.10	56.94	1.46	1603.53
14 BL 91	1.9	1.4	high / <i>висока</i>	52.55	52.55	7.00	28.10	54.49	1.39	452.51

A study was conducted in Siirt and the results were 10.08- 15.63 mm, 15.00-24.55 mm and 58-79 % in the first year; and 10.12-15.36 mm, 17.40-25.29 mm 51-74 % in the second year, respectively during the above study (Yörük, 2006). Comparing the results with the former studies, we realized that the results of this study were in the normal range, and some genotypes had higher or lower fruit weights. The fluctuations might be related to ecological conditions, variety, cultivar as well as genotypic circumstances. Rose hip generally grows well in the infertile conditions in which other fruits could not flourish.

To our analyses, shape index varied among 1.23-1.81, and 5 of the genotypes were less thorny, 2 of them were medium thorny and 2 of them were observed as the most thorny. The seed weight was in the range of 0.35-0.74 g, the number of seeds were fixed as 19.50-39.10 per/fruit. Vitamin C content was also determined and this was regarded as a selection. Rose hip is considered as the highest vitamin C containing fruit among the cultivated fruits in the world (Ağaoğlu et al., 1987). In our study carried out in Bolu in 2011, vitamin C content of the rose hip genotypes was found in the range of 332.47-1603.53 mg/100g. Rose hip could be used not only for marmalade and fruit juice, but also as additive material to enrich the vitamin C content of fruit juice (Yamankaradeniz, 1983). Former studies indicated vitamin C as 234-650 mg/100g (User, 1967), 378 mg/100 g (Nizharadze, 1971), 145-520 mg/100 g (Oblak, 1980), 700-1500 mg/100 g (Sojak and Hricovsky, 1986), 132-1273 mg/100 g (Ercişli, 1996), 106-1703.04 mg/100 g (Güneş, 1997), 107-1094 mg/100g (Kazankaya et al., 2001), 301-1183 mg/100 g (Kazankaya et al., 2005). Our results are in agreement with the former studies. Chemical constituents of rose hip especially for vitamin C might change depending on the climate, altitude, variety, cultivar and the region (Nizharadze, 1971; Halasova and Jicinska, 1988).

Total soluble solid content of the samples ranged between 32.44-56.94 %, soluble solids were between 24.50-30.50 % and acidity between 1.04-1.55 %. Plant heights were 1.4-1.9 m, plant diameter 0.7-2.2 m. Full bloom of rose hip genotypes occurred between May 20 and June 7. Leaves length ranged from 43.30 to 56.31 mm, leaves diameter from 43.30 to 54.35 mm, leaflet number from 5.33 to 7.00. Our study was conducted in Bolu in 2011, the wool formation in the fruit was smaller in 11 genotypes, higher in 7 and none in 81 genotypes.

Regarding the former studies, fruit flesh ratio was reported as 61 % (Nizharadze, 1971), 67 % (Nitransky, 1976), 56-80 % (Yamankaradeniz, 1982), 44 % (Kara and Gerçekçioğlu, 1992), 63-71 % (Kocamaz and Karakoç, 1994), 54- 91 % (Ercişli, 1996), 41-81 % (Güneş, 1997), 52-79 % (Balta and Çam, 1996), 32-79 % (Kazankaya et al., 2001), 46-79 % (Kazankaya et al., 2005).

When comparing our results with other studies, fruit flesh ratio of selected genotypes was found to be in a normal range, 61.69-82.83 %. Our selected rose hip genotypes had superior properties in terms of fruit flesh ratio.

Total soluble solids in fruits are directly related to taste. Soluble solids consist mostly of sugars (Karaçalı, 1990; Cemeroglu, 1992). Soluble solids contents reported to be 28-48 % (Nizharadze, 1971), 24 % (Smatana et al., 1988), 20-27 % (Yamankaradeniz, 1982), 21 % (Kara and Gerçekçioğlu, 1992), 22-28 % (Kocamaz and Karakoç, 1994), 20-36 % (Ercişli, 1996) 12-41 % (Güneş, 1997), 16-24 % (Balta and Çam 1996), 15-45 % (Kazankaya et al., 2001), 12- 32 % (Kazankaya et al., 2002), 14-36 % (Kazankaya et al., 2005) in the former studies. Our results were in the normal range of 16.90-31.40 %. The differences between the results could be attributed to the ecological conditions, altitude and species (Özbek, 1977).

Conclusions

Selected genotypes resulted in the normal range in terms of fruit flesh ratio, soluble solids, and vitamin C contents; however, some gave higher or lower results when compared to either domestic or international studies.

We have observed that investigated rose hip varieties showed differences among genotypes in terms of the fruit and plant properties. When checking these, fruit thickness appeared to give higher results in our study even though they were grown under infertile and improper conditions. If the selected genotypes had been grown under the optimal conditions, they would have given better results. Regarding soluble solids, differences could be related to temperature, rain, humidity and altitude. A dry matter content in a genotype is considered to be better in the rainy region in contrast to arid ones. Rose hip generally adapted well to barren land conditions in which other fruits cannot grow properly. These values are expected to rise in suitable conditions.

As accepted for the other fruits, the main aim of breeding is to get big and spectacular fruit. In addition to fruit thickness, productivity, suitability for machine-harvested, easy-grown and thornless are also the important breeding criteria for rose hips (Ugglä, 1991; Kocamaz and Karakoç, 1994). Results of this study indicate that the level of variation among rose hip genotypes is appreciably high and these genotypes can be used for breeding programs and the information generated in this study is of much use in the improvement of rose hip through breeding.

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Неке физичко-хемијске особине плодова шипка (*Rosa* spp.) за генотипове из покрајине Болу у западној Турској

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Сажетак

У посљедње вријеме, значајну пажњу широм свијета привлаче здрава храна и додаци исхрани који могу заштитити човјека од оксидативног стреса и већег броја болести. Од здравих производа, посебну пажњу привлачи воће, а посебно дивље, јестиво воће (занемарене и недовољно искориштене врсте). Значајан број ових врста у Турској има ендемичан карактер. Ове врсте могу се искористити директно у исхрани или за производњу вриједних природних једињења и деривата. Једна од ових врста је и шипак (*Rosa* spp.). Циљ овог истраживања је одређивање најважнијих особина плодова економски најважнијих генотипова шипка из покрајине Болу у западној Турској. У поступку селекције, истражено је око 100 биљака дивљег шипка, од чега је, на основу критеријума селекције, одабрано девет генотипова који су показали најбоље особине. Маса плода, удио меса плода, титрирајућа киселост, укупна сува материја и садржај витамина С девет изабраних генотипова кретали су се од 1,40-2,77 g, 64,92-82,83%, 24,10-30,50%, 0,04-1,55%, 32,44-56,94% и 332,42-1603,52 mg/100, тим редом. Од девет изабраних генотипова, два генотипа су имали високу, два средњу а пет малу количину трња.

Кључне ријечи: *Rosa* spp., маса плода, хемијски састав

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