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Comparison of the Effect of Process Temperature on Some Biochemical Properties of Nectar from Fresh and Dried Rosehip

Taze ve Kurutulmuş Kuşburnundan Üretilen Nektarın Bazı Biyokimyasal Özellikleri Üzerine İşlem Sıcaklığının Etkisinin Karşılaştırılması

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Abstract

Rosehip is a widespread wild plant that has been used in food products such as tea, jams, marmalades, nectar. It plays crucial role in traditional medicine because of valuable bioactive compounds including mainly phenolic compounds and ascorbic acid. The present study deals with biochemical and sensory properties of rosehip nectar produced from fresh and sun-dried rosehip. The fresh and dried rosehips were pulped at different temperature conditions as 65, 90, 100 ºC and then nectared. Total acidity, total soluble solid contents, pH, total phenolic, ascorbic acid content and sensory properties of produced nectars were examined. Process temperatures showed statistically significant effect ($p < 0.05$) on ascorbic acid and total phenolic content. No differences were found in the acidity and pH between nectar samples. All nectar samples treated at 65 ºC exhibited the highest ascorbic acid (56-90 g/100 mL) and total phenolic contents (654.2-894.4 mg GAE/100 mL). Colour and appearance scores of samples obtained at 65 ºC were found higher according to sensory analysis.

Keywords: Rosehip, Nectar, Biochemical Properties, Sensory Properties, Ascorbic Acid, Phenolic Compounds.

Özet

Kuşburnu, çay, reçel, marmelat, nektar gibi çeşitli gıda ürünlerine işlenmekte olan doğada yaygın olarak yetişen yabani bir bitkidir. Askorbik asit ve fenolik bileşikler başta olmak üzere içerdiği değerli biyoaktif bileşenler nedeniyle geleneksel tıpta önemli bir yere sahiptir. Bu çalışmada, taze ve güneşte kurutulmuş kuşburnu meyvelerinden elde edilen kuşburnu nektarlarının biyokimyasal ve duyusal özellikleri ele alınmıştır. Taze ve kurutulmuş kuşburnu örnekleri, 65, 90, 100 ºC olmak üzere farklı sıcaklık koşullarında pulpa ve daha sonra nektara işlenmiştir. Üretilen nektarların toplam asitlik, suda çözünür kuru madde içeriği, pH, toplam fenolik ve askorbik asit içeriği ile duyusal özellikleri belirlenmiştir. İşlem sıcaklıklarının, askorbik asit ve toplam fenolik içeriği üzerinde istatistiksel olarak önemli etkisi olduğu belirlenmiştir ($p<0.05$). Örneklerin asitlik ve pH değerlerinde önemli bir farklılık bulunmamıştır. 65ºC'de işlenen nektar örneklerinin en yüksek askorbik asit (56-90 g/100 mL) ve toplam fenolik içeriğine (654.2-894.4 mg GAE/100 mL) sahip olduğu belirlenmiştir. Duyusal analiz sonuçlarına göre 65 ºC'de elde edilen nektarların renk ve görünüş puanları daha yüksek bulunmuştur.

Anahtar Kelimeler: Kuşburnu, Nektar, Biyokimyasal Özellikler, Duyusal Özellikler, Askorbik Asit, Fenolik Bileşikler.

Abbreviations: TPC, Total phenolic content; GAE, gallic acid equivalent; TSS, Total soluble solid contents; HMF, 5-hydroxymethylfurfural.

1. INTRODUCTION

Rosehips are the congeries fruits of shrubs belonging to the *Rosa* genus of the *Rosaceae* family that are widely used by both food and pharmaceutical industries (Bhave, Schulzova, Chmelarova, Mrnka & Hajslova, 2017). The genus *Rosa* contains more than 100 species that are widely distributed among Europe, Asia, North America and the Middle East (Elmastas, Demir, Genc, Dolek & Gunes, 2017). Anatolia has rich genetic diversity areas of rosehip species (Demir, Yildiz, Alpaslan & Hayaloglu, 2014) in which Gumushane and its neighboring vicinities are one of the important natural growing areas for rosehip. The most investigated *Rosa* species is *R. canina* L. which is why quite a lot is known about its phytochemical profile as well as its biological activity (Jimenez et al., 2017). It consists significant amounts of biologically active compounds from phenolics, sugars, vitamins, minerals, carotenoids to flavonols.

Rosehip is not only consumed fresh, but also in the form of processed products such as pulp, marmalade, nectar, wine, traditional tea, fruit juice, food supplement, infant formula.

According to Codex Alimentarius Comission (2005) fruit nectar is the unfermented but fermentable product obtained by adding water with or without the addition of sugars, honey and/or syrups and/or food additive sweeteners or to a mixture of those products. Rosehip pulp is produced using by mechanical crushing (Ozdemir, Aksu & Nas, 1997). Following adjustment of acidity and sugar ratio of rosehip pulp, homogenization, deaeration, and pasteurization steps are applied. In practice, fruit juices (pH 3-4), nectars and pulps are heated at 85-95 °C for 8-40 seconds (Bake, 1984).

There have been current studies on phenolic composition and antioxidant activity (Bhave et al., 2017; Demir, Yildiz, Alpaslan & Hayaloglu, 2014; Ouerghemmi et al., 2016), vitamin C (Adamczak, Buchwald, Zieliński & Mielcarek, 2012; Jimenez et al., 2017), carotenoids (Al-Yafeai, Malarski, & Bohm, 2018; Zhong et al., 2016), flavonoid and phenolic acid (Elmastas et al., 2017) of rosehip fruits. Nectar from rosehip has also been investigated by Kadakal, Duman and Ekinci (2017) and Duru, Karadeniz and Erge (2012) terms of vitamin degradation and HMF formation, respectively. To our knowledge, until now no research is available about the effects of processing temperatures (65, 90, 100°C) on chemical and sensory properties of nectar produced from fresh and dried rosehip samples. Therefore, it is attempted to determine chemical (pH, total acidity, total phenolic and ascorbic acid contents) and physical characteristics of rosehip fruits and the effects of process temperature on chemical and sensory characteristics of rosehip nectar.

2. MATERIALS AND METHODS

2.1. Materials

Rosehip fruits collected from Gumushane (RG) and neighboring vicinities (RN) at the end of August and beginning of the September in 2016 were used in this study. Samples were stored at 0-2 °C until processing. The first part of the fruit was processed as fresh (RG and RN) and the other part was as dried (DG and DN) into pulp then nectar at Gumussu Food Co. in Gumushane, Turkey conditions using nearly 28.000 kg fruits. Sugar (beet sugar) and citric acid were supplied from local company in Gumushane, Turkey. Production was performed by 5 °fH (French degree of hardness) water.

2.2. Chemicals and Reagents

Ascorbic acid, gallic acid (GA), phenolphthalein, Folin-Ciocalteu phenol reagent, sodium hydroxide and other basic chemicals were purchased from Sigma Chemical Co. (Steinheim, Germany). All chemicals used were of analytical grade.

2.3. Pulp and Nectar Processing of Rosehip Fruits

2.3.1. Pretreatments

Mature and fresh rosehips (RG and RN) were put into plastic strongbox (40 x 60 x 6.5 cm) and dried under direct sunlight. When moisture content of fruits was attained to 15%, samples were filled into polyethylene (PE) bags. Fresh and dried fruits were processed into pulp and nectar according to following stages.

After seperation of damaged and diseased ones, fruits were washed in a washing pool (UWM, Kurtsan Stainless Steel Industry, Bursa, Turkey). Samples were transferred into a carving unit

(Turbo crusher, Kurtsan Stainless Steel Industry, Bursa, Turkey) and supplied with water nearly 1-1.5 times fruit weight to facilitate the crushing process.

2.3.2. Pulp And Nectar Production

Crushed fruit pieces (6-7 mm) were taken into boiler (Boiler, Kurtsan Stainless Steel Industry, Turkey) and heated to different temperatures 65, 90, 100 °C for 120 min. The boiled fruits were transferred to double stage pulper (Turboextractor, Kurtsan Stainless Steel Industry, Turkey) working at 800 rpm. Mesh size of first stage was 2 mm and those of second stage were 1.1, 0.7 and 0.4 mm. The mix was separated (Soza type seperator, Kyfhauser Hutte, Arten, Germany) and then homogenized (Homogenizator 101-04, Knollenberg Co., Germany) at a pressure of 100-150 kg/cm^2 and 35-40 °C. The product was deaerated (Deaerator, TMCI, Padovan, Italy) by removing dissolved oxygen at a pressure of 500 mmHg and 35 °C. A double jacket bull evaporator (Buller, Danisman, Turkey) was used to reach 12 °Brix under vacuum.

Produced pulp was processed to nectar by addition of sugar, citric acid and water up to 12-13 °Brix with minimum 40% puree and maximum 10% sugar content. After homogenization step, the pulp was sterilized with high temperature small time (HTST) method at 121 °C, 15 seconds (Tubular type sterilizer, TMCI, Padovan, Italy) and filled in opaque bottles.

2.4. Physical and Chemical Analysis

Rosehip fruit size and average seed number were determined by compass and counting seed. The mass of fruit was calculated on 100 randomly selected fruits, and then converted to a thousand fruit mass (Akinci, Ozdemir, Topuz, Kabas & Canakci, 2004). The amount of fruit flesh and its ratio was determined by separating and weighing flesh part of fruit. Total soluble solid contents (TSS) were measured according to Tanner and Brunner (1979), pH, total acidity (%), dry matter (%), ash (%), protein (%) were analyzed according to AOAC (2000). The spectrophotometric method for ascorbic acid content determination was based on that used by Farajzadeh and Nagizadeh (2003).

2.5. Estimation of Total Phenolic Content (TPC)

Total phenolic content was determined by Folin-Ciocalteu method and expressed as gallic acid equivalent (GAE) (Slinkard and Singleton 1977; Meda, Lamien, Romito, Millogo, & Nacoulma, 2005). The nectar samples and standard gallic acid were diluted to 2-20 µg in 2.0 mL distilled water and 2.0 mL of Folin-Ciocalteu reagent was added into test tubes. The tubes were mixed well and kept for 5 min at room temperature followed by addition of 2.0 mL of 10% aqueous sodium carbonate and incubated for 1 h at room temperature in the dark. Absorbance of the developed blue color was read at 760 nm (Shimadzu UV-2450, Shimadzu Corporation, Kyoto, Japan) against a reagent blank.

2.6. Sensory Analysis

Sensory evaluation of nectar samples were conducted by six panelists (three male and three female) who were familiar with the taste of rosehip nectar. The panelists assessed each sample for color, appearance, odor and taste according to Turkish Standards Institution, the standard of sour cherry juice (Anonymous, 2012), the standard of rosehip (Anonymous, 2014) and Yildiz, Alpaslan and Kara (2007) with slight modifications. The tests were held in a standard room (UNE 1979) equipped with a table for joint sessions and six individual taste booths. For the evaluation, fruit nectars were served at room temperature (18 ºC) in transparent glass with three digit numbers under lighting (Anonymous, 2012; Laboissière et al. 2007). The nectar samples were rated for color and appearance (1-4 scale), odor (1-5 scale), taste (1-6 scale). Lower scores mean less desirable attributes, while the highest scores represent the most desirable attributes.

2.7. Statistical Analysis

All tests were performed in triplicates and the results were expressed as mean ± standard deviation (SD). Obtained results were analyzed by using SPSS version 9.0 software for Windows (SPSS Inc., Chicago, IL, USA). All data were carried out using One-way analysis of variance (ANOVA) test with respect to temperature and location and the significant differences between means were compared by Duncan's multiple range test (DMRT). The significance level was set at $p<0.05$.

3. RESULTS AND DISCUSSION

3.1. Physical and Biochemical Properties of Rosehip Fruits

The physical and biochemical properties of rosehip fruits namely pH, TSS, total phenolic composition and ascorbic acid are shown in Table 1.

No statistically significant differences were found between length and width of fresh and processed rosehip fruits. As it was expected, dried fruit weight per 1000 g was found less than fresh rosehip. Average seed number of NF was higher than GF. However, this parameter had no significant effect on fruit flesh ratio.

While pH, total soluble dry matter, and total dry matter content of fruits from Gumushane and neighboring vicinities were found similar, acidity, total phenolic content, and ascorbic acid content were considerably different. Drying process had substantial effect on all biochemical parameters except ash and protein content ($p<0.05$).

TPC of fruits were ranged from 8265 to 9564 mg GAE/100 g on dry basis. TPC of rosehip was found as 96 mg/g and 31.08 mg/g of dry weight by Ercisli (2007) and Demir et al. (2014).

Nadpal et al. (2016) reported that TPC of rosehip samples collected from Republic of Serbia was 74.6 mg/g (water extract), 50.9 mg/g (methanol extract) of dry weight.

It was similar to those of found by those authors. It can be said that our results are in accordance with previously published articles regarding TPC of rosehip. Statistical analysis of the data revealed that TPC was significantly affected by drying process. TPC loss was observed at 3 and 14% by drying of rosehip fruits from Gumushane and neighboring vicinities. It is reported that drying process can cause loss in bioactive compounds such as vitamins, phenolic compounds, anthocyanins, carotenoids and flavonoids (Mrkic, Cocci, Dalla Rosa, & Sacchetti, 2006; Rawson et al., 2011). On the contrary, some of the drying processes may enhance the extractability of phenolic compounds. Koca, Ustun and Koyuncu (2009) investigated the effect of drying on TPC of rosehip. The authors dried fresh rosehip samples under different air temperatures and air flow rates. They reported a TPC loss at 32.86% and 47.21% for 50 °C-1.5 m/s air flow and 70 °C-1.0 m/s air flow, respectively.

Table 1. Technological and chemical properties of rose hip fruits*

Properties	RG	RN	DG	DN
Length of fruit (mm)	24.8±6.3^{a}	21.5±5.2^{a}	22.1±1.3^{a}	18.7±1.1^{a}
Width of fruit (mm)	16.0±3.3^{a}	16.3±3.1^{a}	13.1±0.9^{a}	13.5±0.7^{a}
Weight of 1000 fruits(g)	1989.3±201.5^{b}	1940.0±134.8^{b}	1190.0±9.1^{a}	1139.0±80.2^{a}
Fruit flesh ratio %	71.8±18.2^{b}	70.9±14.2^{b}	34.2±2.0^{a}	36.0±2.3^{a}
Average seed number (piece/fruit)	36.7±1.6^{a}	42.2±1.9^{b}	37.3±2.5^{a}	40.6±2.7^{ab}
TSS (°Brix)	25.6±2.2^{a}	27.6±2.5^{a}	42.6±2.7^{b}	41.1±2.6^{b}
pH	3.9±0.1^{c}	4.2±0.2^{c}	3.0±0.2^{b}	2.5±0.3^{a}
Acidity (Malic acid) %	1.4±0.1 ^{c}	1.2±0.1^{b}	0.6±0.03^{a}	0.6±0.02^{a}
Total dry matter %	26.5±6.5^{a}	26.2±1.4^{a}	85.8±1.4^{b}	84.2±1.9^{b}
Ash %	4.4±0.5^{b}	3.7±0.2^{a}	4.1±0.11^{ab}	3.6±0.2^{a}
Protein %	7.6±0.4^{a}	8.6±0.5^{b}	7.1±0.2^{a}	7.5±0.1^{a}
Total phenolic composition (mg GAE/100 g)	8654±42^{d}	9564±50^{c}	8390±59^{b}	8265±32^{a}
Ascorbic acid (mg/100g)	605.1±12.5^{b}	791.2±34.8^{c}	297.0±5.3 ^{a}	280.0±10.1 ^{a}

* All data represent mean of three determination and ±SD (standard deviation); Means followed by the same letter are not statistically different ($p<0.05$). Small letters indicate regional differences. Ash and protein are given on dry basis.
GF: Gumushane Fresh fruits; GD: Gumushane Dried fruits; NF: Neighboring Vicinities Fresh fruits; ND: Neighboring Vicinities Dried fruits; TSS: Total soluble solid contents, GAE: Gallic acid equivalent.

As for another bioactive compound, vitamin C, decreased by drying both NF and GF. No statistically significant differences were found between vitamin C values of dried fruits. Vitamin C reduction was 51% and 65% for dried rosehip fruits from Gumushane and neighboring vicinities, respectively. It is well known that vitamin C is an easily oxidized compound. Thermal methods including drying may cause vitamin C loss (Aramwit, Bang & Srichana, 2010; Vieira, Teixeira & Silva, 2000). In present study, higher vitamin C loss in dried neighboring vicinities may be due to handling from distant city and in parallel with this easily oxidation situation.

3.2. Pulp Yield of Rose Fruits

Table 2 shows the amount of 12 ºBrix pulp obtained from 100 kg of fresh and dried rosehip fruits. Taking into consideration the effect of temperatures on pulp quantity, there were significant differences between obtained pulp quantities at each process temperature. All rose fruits gave the highest amount of pulp at 90 ºC.

Table 2. Pulp yield of rosa fruits

	Open boiler		Vacuum boiler
Tempe -rature	**90 ºC**	**100 ºC**	**65 ºC**
RG	$134.5{\pm}1.7^{b,A}$	$115.3{\pm}3.9^{b,B}$	$123.5{\pm}5.7^{b,AB}$
RN	$131.0{\pm}4.3^{ab,A}$	$124.1{\pm}2.2^{ab,B}$	$125.8{\pm}6.6^{ab,AB}$
DG	$134.0{\pm}5.2^{ab,A}$	$129.3{\pm}4.4^{ab,B}$	$131.3{\pm}6.9^{ab,AB}$
DN	$140.0{\pm}5.5^{a,A}$	$127.6{\pm}3.9^{a,B}$	$135.0{\pm}6.9^{a,AB}$

* All data represent mean of three determination and ±SD (standard deviation); Means followed by the same letter are not statistically different ($p<0.05$). Small letters indicate regional differences, big letters indicate process differences.
** 320 kg of fresh rosehip yields about 100 kg of dried fruit.
RG: Gumushane Fresh fruits; DG: Gumushane Dried fruits; RN: Neighboring Vicinities Fresh fruits; DN: Neighboring Vicinities Dried fruits.

The amounts of pulp determined in our study showed similarity to those of found by Didin, Kizilaslan, Ozer and Fenercioglu (1996). The pulp yield from dried fruits was found lower than obtained from fresh ones. This may relate to the differences between total soluble solid contents of the pulps. Dry matter content and pulp yield result of current study suggest that production of the pulp from fresh rose fruits will be profitable. In the case of obtainment from dried rose fruits, yield increases with temperature. However, this may cause loss in final product quality.

3.3. Chemical Properties of Fruit Nectars

Biochemical properties including total acidity, vitamin C, total soluble solid, pH and total phenolic content are shown in Table 3. Obtained acidity results have revealed that there were statistically significant differences between the samples. While DN nectars had the highest total acidity, RG nectars had the lowest. Acidity contents of RN and DG nectar were between RG and DG. Thermal treatment did not cause substantial change in acidity and pH of all studied nectars. Vitamin C and total phenolic content did not differ in nectars processed at 90 and 100 ºC. As seen in Table 3, the nectars produced from fresh and dried rose fruits processed at 65 ºC had the highest ascorbic acid and total phenolic content. As the temperature increased to 90 or 100 ºC, both total phenolic content and vitamin C content decreased at each group fruit nectars. The decrease was noticeable at each group ($p<0.05$). Lower values observed at 90 and 100 ºC processing temperature may be attributed to temperature's damaging effect on bioactive compounds.

Duman (2014) evaluated the effects of different pasteurization temperatures (70, 80, 90, and 95 ºC) with the heating periods of 5, 10, 15, 20, 25 and 30 minutes on phenolic and vitamin C content of rosehip. Studied nectar samples were boiled at 70 °C for 30 min. TPC and vitamin C of produced nectar samples were given as 229.40 mg/L and 1643.5 mg/L by that author. In the course of our study, TPC of rosehip nectars produced from RG, RN, DG and DN and boiled at 65 °C for 120 min were found as 735.3, 799.4, 894.4 and 654.2 mg/100 mL, respectively. Vitamin C content was 71.0, 84.0, 90.0 and 56.0 mg/100 mL for the same temperature and same sample order as that just given. While TPC was higher than those reported by Duman (2014) ascorbic acid was lower. Those findings may be explained in terms of raw material differences, as the raw material composition varies depending on the geographical area, climate conditions, seasons, maturity level (Skrovankova, Sumczynski, Mlcek, Jurikova & Sochor, 2015).

Duman (2014) also reported significant losses in vitamin C and total phenolic content by raising the pasteurization temperature. Our study differs from theirs because of focusing on the evaluation of the effects of different boiling temperatures on rosehip nectars. However, degradation of phenolic compounds and vitamin C due to higher temperatures is commonly found in both studies.

Table 3. Chemical properties of nectars

Sample	ºC	Total acidity (g/L)	Vitamin C (mg/100 mL)	TSS %	pH	Total phenolic content (mg GAE/100 mL)
RG	65	7.7±0.2[b]	71.0±6.5[A]	14.0±1.6	3.5±0.0[a]	735.3±3.4[A]
	90	8.3±0.1[b]	39.0±3.2[B]	13.0±1.4	3.6±0.1[a]	605.5±3.9[B]
	100	7.6±0.2[b]	36.0±2.9[B]	14.0±1.5	3.5±0.0[a]	525.4±5.5[B]
RN	65	7.4±0.1[ab]	84.0±6.8[A]	13.4±1.5	3.1±0.1[b]	799.4±5.4[A]
	90	8.5±0.3[ab]	30.0±2.3[B]	12.6±1.6	3.1±0.1[b]	619.3±3.4[B]
	100	8.2±0.2[ab]	33.0±2.4[B]	13.0±1.7	3.3±0.0[b]	465.7±3.4[B]
DG	65	8.3±0.2[ab]	90.0±7.9[A]	13.0±1.7	3.6±0.1[a]	894.4±3.3[A]
	90	7.9±0.2[ab]	30.0±2.3[B]	13.0±1.6	3.8±0.1[a]	434.3±3.1[B]
	100	8.1 ±0.3[ab]	20.8±1.3[B]	14.0±1.6	3.6±0.0[a]	409.3±2.3[B]
DN	65	8.4±0.2[a]	56.0±4.8[A]	14.0±1.3	3.5±0.1[a]	654.2±4.6[A]
	90	8.2±0.2[a]	31.0±2.3[B]	14.0±1.6	3.6±0.0[a]	494.4±3.6[B]
	100	8.6±0.3[a]	22.5±1.6[B]	13.4±1.7	3.6±0.1[a]	404.7±4.9[B]

* All data represent mean of three determination and ±SD (standard deviation); Means followed by the same letter are not statistically different ($p<0.05$). Small letters indicate region differences, big letters indicate process differences.
RG: Gumushane Fresh fruits; DG: Gumushane Dried fruits; RN: Neighboring Vicinities Fresh fruits; DN: Neighboring Vicinities Dried fruits.
GAE: Gallic Acid Equivalent

3.4. Sensory Properties of Nectars

With respect to the sensory evaluation of the rosehip nectar, the color and appearance, odor and taste are shown in Table 4.

Table 4. Sensory properties of nectars

Sample	ºC	Color and appearance	Odour	Taste
RG	65	4.1±0.1[A]	5.2±0.0[a]	5.1±1.4[a]
	90	3.6±0.7[AB]	4.2±0.7[a]	5.6±0.0[a]
	100	3.1±0.7[B]	5.2±0.0[a]	5.5±0.1[a]
RN	65	4.1±0.0[A]	5.0±0.4[a]	5.4±0.4[ba]
	90	3.9±0.4[AB]	4.9±0.1[a]	5.2±0.4[ba]
	100	3.8±0.2[B]	4.2±1.4[a]	5.1±1.4[ba]
DG	65	3.6±0.6[A]	4.2±0.0[a]	5.2±2.8[ba]
	90	3.1±1.3[AB]	2.1±0.7[b]	4.4±1.6[cb]
	100	2.6±0.0[B]	3.1±0.0[b]	4.2±1.4[cb]
DN	65	3.8±0.3[A]	4.1±1.1[a]	5.1±1.4[ba]
	90	3.2±1.5[AB]	3.0±0.1[b]	4.3±0.8[c]
	100	3.1±0.1[B]	1.6±0.1[b]	4.0±0.9[c]

* All data represent mean of three determination and ±SD (standard deviation). Means followed by the same letter are not statistically different ($p<0.05$). Small letters indicate region differences, big letters indicate process differences. RG: Gumushane Fresh fruits; DG: Gumushane Dried fruits; NF: Neighboring Vicinities Fresh fruits; ND: Neighboring Vicinities Dried fruits.

There is no significant differences ($p<0.05$) between nectars obtained from fresh and dried rosehip for the color and appearance parameters at the same process temperature in spite of regional differences. Rosehip nectars processed at 65 ºC had the highest color and appearance scores because of rich color and crisp appearance. The darker nectar color may be due to Maillard reaction between reducing sugars and proteins with the increase process temperature. Maillard reaction products may partly be responsible for the taste, color or appearance of foods (Maillard and Gautier 1912; Tomruk et al., 2016).

Temperature differences had no statistically significant effect on odor, taste and total scores of RG and RN. However, those properties of DG and DN were the highest at 65 ºC so values of DG, DN nectars at 90 ºC and 100 ºC were not appropriate for reference criteria. Therefore, dried fruits should be processed 65 °C or lower temperatures.

Many studies on sensory characterization of passion fruit, mango nectar, orange nectar, carrot nectar have been reported in the literatüre (Charan et al., 2017; Hamid, El-Kholany & Nahla, 2014; Lakhanpal and Vaidya, 2015) but to our knowledge, until now no research is available about properties of rosehip nectar especially in large scale.

4. CONCLUSION

The present study deals with the effects of different process temperatures on the biochemical and sensory characteristics of nectars produced from fresh and dried rosehips. The physical and biochemical properties of the rosehips were also investigated. Significant differences especially in vitamin C and total phenolic content were found between the fresh and dried rosehip samples. Obtained results have also shown that fresh rosehip fruits are preferable to the corresponding dried fruits as raw material for pulp and nectar production. Optimum boiling temperature for rosehip nectar production was found as 65 °C. Because of the low quality of nectars produced from dried rosehip fruits, using dried fruits would be more sensible to produce marmalade.

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