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Functional sirkencubin syrup with purple basil; bioactive properties, organoleptic acceptability, and possible effects on blood pressure

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Abstract

Sirkencubin syrup is a health-friendly alternative drink consisting of a mixture of honey, vinegar and water. In this study, purple basil sirkencubin syrup and the changes in sirkencubin syrup during two months storage period (1, 10, 20, 30 & 60 days) were investigated. Physicochemical properties, bioactive properties, organoleptic properties, general microbiology, and possible effects on blood pressure in healthy individuals during storage were evaluated. At the end of storage, no significant changes were detected in the physicochemical value of the samples. At the end of the storage period, total phenolic content (mg GAE/L) value of purple basil sirkencubin syrup sample was determined as 17.64% more than the sirkencubin syrup samples. Total antioxidants in purple basil sirkencubin syrup samples were higher than sirkencubin syrup samples. Ascorbic acid contents of the samples decreased during storage. In terms of organoleptic properties, purple basil sirkencubin syrup was more favored by the panelists. In our study, sirkencubin syrup and purple basil sirkencubin syrup had no acute effect on blood pressure. At the end of the study, purple basil sirkencubin syrup was found to be more successful than sirkencubin syrup.

Keywords: antioxidant; ascorbic acid; blood pressure; purple basil; sirkencubin syrup.

Pratical Application: The possible effects of functional sirkencubin syrup with purple basil on bioactive properties, organoleptic acceptability and blood pressure were investigated.

1 Introduction

One of the important plants of the Lamiaceae family, basil (*Ocimum basilicum L.*) is widely used as a sweetener in the food industry as well as in the traditional medicine and nutrition fields. Because of its polyphenols and aromatic compounds, basil has a lot of positive effects in terms of antioxidant, anticancer, antimicrobial, antiseptic, antiallergic, antispasmodic, antiinflammatory, analgesic, stimulant, sedative activities, etc. (Aguiar et al., 2019; Złotek et al., 2016).

Syrup made from fruit, honey or sugar was the most important source of income in the Seljuk period (Şahin, 2008). Sirkencubin, formed by the combination of two words with Persian origin, 'serke' (vinegar) and 'enerbin' (honey), is one of the drinks which is prepared by mixing honey and sugar. Syrup, jams and compotes were among the most popular drinks in the Mevlevi cuisine. Sirkencubin, which has a special importance in the period of Mevlana, is an appetizer when it is drunk before meals, and it is also an aid that helps digestion when it is consumed after meals (Özdengül, 2010; Sarıoğlan & Cevizkaya, 2016).

Hypertension is a chronic disease that can be controlled, though it has negative effects on heart, kidney, brain, and eyes. It is important to preserve heart health and keep blood pressure within normal limits in healthy young individuals. The risk of hypertension increases with age (Campbell et al., 2014). There are studies reporting positive and negative effects of supplementary food on blood pressure (Biçen et al., 2012; Efe et al., 2012). However, there are no studies investigating the effects of sirkencubin syrup on blood pressure in the literature.

Functional foods are foods and food components that provide additional benefits for human physiology and metabolic functions beyond the basic nutrient requirements of the body, thus effective in achieving a healthier life due to disease prevention. The term functional food was first used in Japan in the early 1980s. The interest in functional foods in Japan raised awareness of the need for these products in the United States and Europe. Since the 1990s, the use of the term functional food has become widespread all over the world and the market for functional food products has developed rapidly. Examples of functional food include enriched products, value-added products, replacement of existing components, and supported products (Aguiar et al., 2019; Bech-Larsen & Scholderer, 2007; Pastrana et al., 2017). Due to increasing interest in functional foods and health benefits, sirkencubin syrup containing honey and vinegar, and purple basil sirkencubin syrup with increased functional content were preferred.

In this study, determination of bioactive properties, sensory properties, general microbiology and changes in storage conditions of functional sirkencubin syrup and purple basil sirkencubin syrup, which is lacking in the literature, were investigated. The effects of these functional beverages on possible blood pressure were also evaluated.

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2 Materials and methods

2.1 Preparation of Sirkencubin syrup

Honey (pine honey) and vinegar (apple cider vinegar) were obtained from commercial companies. Due to its high bioactivity properties, pine honey was selected (Alpat, 2018). For the slurry mixture, honey (14 g) + vinegar (6 mL) + sterile water (0.2 L) was homogenized in the homogenizer for 2 minutes. The prepared sample was coded as sirkencubin syrup (SS). Commercially produced purple basil tea was used for preparation of purple basil sirkencubin syrup. Honey (14 g) + vinegar (6 mL) + purple basil tea (0.2 l (7.5 g purple basil/L)) was mixed with a 2 minute homogenization process and the mixture was coded as (PBSS). Prepared samples were stored at - 18 °C until analysis.

2.2 pH, Brix, titratable acidity

Soluble solids were measured using a refractometer (ATAGO brand RX-7000α model, Japan), and pH was measured using a potentiometer (Hanna Instruments HI 2002 pH/ORP, Romania). The titration acidity was potentiometrically determined by titration of the samples with 0.1 N NaOH solution to pH 8.1. A sample of 5 ml was weighed and 50 ml of distilled water was added with 10 ml of sample taken from the filtrate. The volume of NaOH was converted to g citric acid per 100 mL of syrup (Association of Official Analytical Chemists, 2000).

2.3. Determination of total polyphenols, total flavonoids, antioxidant activity, total sugar, ascorbic acid, and Hydroxymethyl Furfural (HMF)

The total phenolic content of Sirkencubin syrups was determined according to Folin-Ciocalteu method (Singleton & Rossi, 1965). The total phenolic content corresponding to the absorbance of the samples was determined by the standard graph plotted using gallic acid (R2 = 0.9979), given as gallic acid equivalent (GAE) mg GAE/L. The total amount of flavonoid in the samples was measured with aluminum chloride ($AlCl_3.6H_2O$) in colorimetric form according to Zhishen et al. (Zhishen et al., 1999). The results obtained by the method is expressed as mg CE (Catechin Equivalent)/100 mL.

Calculation of the ascorbic acid content of the samples was carried out with AOAC 961.27 vitamin preparation and ascorbic acid 2,6 dichlorophenol indophenol-titrimetric method in fruit juices (Association of Official Analytical Chemists, 2000). The results obtained were expressed as milligrams of ascorbic acid per 100 mL sample, and the calculation was done as stated below:

Ascorbic acid mg/100 mL = (titer x dye factor x concentration x 100)/ (extract aliquot used for estimation x volume of sample use for estimation).

The total antioxidant capacity of sirkencubin syrup was determined by the DPPH (1,1-diphenyl-2-picrylhydrazyl) method (Kumaran & Joel Karunakaran, 2006). Briefly, 2 mL of 0.1 mM DPPH solution was added to 100 tal of the sample and mixed with a vortex for 2 minutes and left at room temperature in darkness for 30 minutes. At the end of the period, the absorbance values of the samples at 517 nm were measured. The total antioxidant capacity of the samples was expressed in the form of 100 mL-1 mM trolox equivalent. The total sugar determination of the samples was carried out by the phenol sulfuric acid method (Nielsen, 2010; Taylor, 1995). With the colorimetric method using HMF with barbituric acid and p-toluene measured versus water at 550 nm with a SP-UV / VIS-300SRB spectrophotometer (LeBlanc et al., 2009).

2.4. Color analysis

Color analysis of the samples was completed using the Color Measuring Device PCE-CSM 5 (Germany) and the liquid container. Color L, a, and b color parameters are expressed. Before measurements, the device was calibrated with a calibration plate (Varela-Santos et al., 2012). Chroma (C) and hue angle (h) were expressed according to the following Equations 1, 2 (Ordóñez-Santos et al., 2017).

$$Chroma,\ C = (a2 + b2)^{1/2} \quad (1)$$

$$h\ (hue\ angle) = tan^{-1}(b/a) \quad (2)$$

2.5 Microbiological analysis

PCA (Plate Count Agar- Merck, Germany) was used for total aerobic plate count. Samples were incubated at 30 °C for 48 h. For yeast and mold count, PDA (Potato Dextrose Agar- Merck, Germany) was used. Samples were incubated at 24 °C for 3-5 days. Total *Enterobacteriaceae* count was determined in VRBG (Violet Red Bile Glucose Agar- Merck, Germany) incubated at 37 °C for 24 h. The pink-red ring and red precipitation colonies were evaluated. Results are given as log colony forming units (CFU) per milliliter of sirkencubin syrup and purple basil sirkencubin syrup (Cruz et al., 2007).

2.6 Organoleptic analysis

The hedonic test was used for sensory evaluation of the samples of sirkencubin. Panelists were selected as 32 people (18 female, 14 male) from among Nutrition and Dietetics students in Tekirdag Namık Kemal University between the ages of 18-25. Sensory properties were determined with a 9 point hedonic scale (0-9). Scale scores were excellent, 9; very good 8; good, 7; and acceptable. Sirkencubin samples were chilled (4-6 °C), randomly selected and coded with 3-digit numbers and presented to the panelists. Warm water was used to neutralize the mouth for the next test after each sample was tested (Choi et al., 2014).

2.7 Anthropometric measurements and blood pressure

This study was conducted with 10 volunteer adults (6 females, 4 males) aged 19-25 years without any health problems. The anthropometric measurements of the participants were made with Tanita MC 780 MA body analyzer of Tartı Medical Company. Blood pressure measurement of the students who participated in the study was performed after resting for at least 15 minutes with a pre-calibrated air manometer and in the sitting position, taking into account the blood pressure measurement technique (Özpancar, 2016). Blood pressure measurement was performed in two stages. In the first stage, blood pressure measurements were made 2 hours after the morning breakfast of the students. Then blood pressure measurements were performed again 30 minutes

after drinking 400 ml sirkencubin syrup. In the second stage, in the same way, blood pressure measurements were made 2 hours after the morning breakfast of the students. Then blood pressure measurements were performed again 30 minutes after drinking 400 ml purple basil sirkencubin syrup.

2.8 Statistical analysis

Significant differences between mean values of sirkencubin syrup samples were determined by an analysis of variance (one-way ANOVA) using Tukey's HSD (honestly significant difference) test at a significance level of $p < 0.05$. Blood pressure measurements were evaluated with the paired samples test. Statistical analysis was conducted using SPSS 22.0 software (SPSS Inc., Chicago, IL, United States). Pearson correlation coefficients were obtained using OriginPro version 2017 (OriginLab, Northampton, Massachusetts, USA.). All values were obtained in triplicate and expressed as mean ± standard deviation (SD).

3 Results and discussion

3.1 pH, total soluble solids (°Brix) and titratable acidity

Table 1 shows the change in pH, TSS (Brix) and TA value of sirkencubin syrup and sirkencubin syrup samples during storage. The differences between °Brix and TA values of sirkencubin and basil sirkencubin syrups during the storage period were not statistically significant ($p>0.05$). At the end of the 60th day, for the PBSS sample TA was determined as 0.15 g citric acid/100 mL. Statistically significant differences were detected in the pH values of samples during storage ($p<0.05$). The pH of the PBSS sample was determined as 4.02 at the end of storage. Similar studies have shown that there are decreases in pH values during storage of liquid foods. In another study of ultrasound applied to sirkencubin syrup, it was reported as pH (3.81), °Brix (5.10) and TA (0.16 g citric acid/100 mL) in the control sample (Yıkmış, 2019). The findings obtained in our study are compatible with these values. It is suggested that minimal changes in pH and TA value during storage in PBSS samples may result from activities of probiotic bacteria in the vinegar content of the syrup.

3.2 Total polyphenols, total flavonoids, antioxidant activity, total sugar, ascorbic acid, and Hydroxymethyl Furfural (HMF)

The changes in TPC, TFC, DPPH, CUPRAC, TS, and HMF values of sirkencubin and purple basil sirkencubin syrup samples during storage are shown in Table 2. The differences between the TPC (mg GAE/L) values during the storage period of SS and PBSS samples were found to be statistically significant ($p<0.05$). The differences between the first and tenth days for the SS and PBSS samples were not statistically significant ($p>0.05$). At the

Table 1. pH, Total soluble solids (°Brix) and titratable acidity analysis results of samples.

Analyses	Samples	Storage Period (Days)				
		1	10	20	30	60
pH	**SS**	3.82 ± 0.01^{a}	3.81 ± 0.01^{a}	3.80 ± 0.00^{b}	3.80 ± 0.00^{b}	3.79 ± 0.01^{b}
	PBSS	4.03 ± 0.00^{a}	4.03 ± 0.00^{a}	4.02 ± 0.00^{b}	4.02 ± 0.00^{b}	4.02 ± 0.01^{b}
TSS (°Brix)	**SS**	5.10 ± 0.00^{a}	5.10 ± 0.00^{a}	5.10 ± 0.00^{a}	5.10 ± 0.00^{a}	5.07 ± 0.06^{a}
	PBSS	5.30 ± 0.00^{a}	5.30 ± 0.00^{a}	5.30 ± 0.00^{a}	5.30 ± 0.00^{a}	5.27 ± 0.06^{a}
TA (%)	**SS**	0.16 ± 0.00^{a}	0.16 ± 0.00^{a}	0.16 ± 0.00^{a}	0.16 ± 0.00^{a}	0.16 ± 0.01^{a}
	PBSS	0.15 ± 0.00^{a}	0.15 ± 0.00^{a}	0.15 ± 0.00^{a}	0.15 ± 0.00^{a}	0.15 ± 0.01^{a}

Values followed by different letters within the same line are significantly different ($p < 0.05$) ($n = 3 \pm SD$). SS (sirkencubin syrup); PBSS (purple basil sirkencubin syrup); TSS (total soluble solids content); TA (titratable acidity).

Table 2. TPC, TFC, DPPH, CUPRAC, TS, HMF and ascorbic acid analysis results of samples.

Analysis	Samples	Storage Period (Days)				
		1	10	20	30	60
TPC (mg GAE/L)	**SS**	81.03 ± 0.50^{a}	80.92 ± 0.56^{a}	80.98 ± 0.46^{a}	80.72 ± 0.25^{a}	80.26 ± 0.11^{a}
	PBSS	96.79 ± 0.11^{a}	96.53 ± 0.23^{a}	95.91 ± 0.15^{b}	95.83 ± 0.05^{b}	94.42 ± 0.26^{c}
TFC (mg CE/L)	**SS**	4.61 ± 0.13^{a}	4.53 ± 0.16^{a}	4.57 ± 0.04^{a}	4.54 ± 0.07^{a}	4.51 ± 0.11^{a}
	PBSS	8.23 ± 0.05^{a}	8.17 ± 0.01^{ab}	8.16 ± 0.08^{ab}	8.02 ± 0.07^{bc}	7.88 ± 0.07^{c}
DPPH (% inhibition)	**SS**	37.57 ± 0.29^{a}	36.99 ± 0.19^{b}	36.81 ± 0.06^{b}	36.77 ± 0.07^{b}	36.56 ± 0.23^{b}
	PBSS	41.39 ± 0.11^{a}	41.19 ± 0.06^{a}	40.79 ± 0.03^{b}	40.66 ± 0.02^{bc}	40.51 ± 0.13^{c}
CUPRAC (% inhibition)	**SS**	56.50 ± 0.14^{a}	56.30 ± 0.17^{a}	56.12 ± 0.13^{ab}	55.82 ± 0.03^{bc}	55.50 ± 0.25^{c}
	PBSS	58.73 ± 0.11^{a}	58.16 ± 0.16^{b}	57.84 ± 0.10^{b}	57.72 ± 0.08^{b}	57.19 ± 0.29^{c}
TS (gr/L)	**SS**	58.40 ± 0.00^{a}	58.40 ± 0.02^{a}	58.40 ± 0.02^{a}	58.39 ± 0.02^{a}	58.39 ± 0.03^{a}
	PBSS	58.41 ± 0.01^{a}	58.41 ± 0.01^{a}	58.40 ± 0.00^{a}	58.40 ± 0.00^{a}	58.39 ± 0.01^{a}
HMF (mg/L)	**SS**	0.48 ± 0.00^{a}	0.48 ± 0.00^{a}	0.49 ± 0.01^{a}	0.49 ± 0.02^{a}	0.51 ± 0.02^{a}
	PBSS	0.47 ± 0.00^{a}	0.47 ± 0.01^{a}	0.48 ± 0.01^{a}	0.48 ± 0.01^{a}	0.48 ± 0.00^{a}
Ascorbic acid (mg/100mL)	**SS**	0.25 ± 0.03^{a}	0.23 ± 0.01^{ab}	0.23 ± 0.01^{ab}	0.21 ± 0.01^{ab}	0.20 ± 0.01^{b}
	PBSS	0.28 ± 0.02^{a}	0.26 ± 0.02^{ab}	0.25 ± 0.02^{ab}	0.23 ± 0.01^{ab}	0.21 ± 0.01^{b}

Values followed by different letters within the same line are significantly different ($p < 0.05$) ($n = 3 \pm SD$). SS (sirkencubin syrup); PBSS (purple basil sirkencubin syrup); TPC (total phenolic content); TFC (total flavonoid content); TS (total sugar); HMF (hydroxymethyl furfural);GAE (Gallic acid equivalent); DDPH (radical scavenging activity); CUPRAC (Cupric Reducing Antioxidant Capacity).

end of the storage period, TPC (mg GAE/L) was determined as 17.64% more than the SS samples for the PBSS sample. The least change during storage was found in the SS sample with 0.77 mg GAE/L.

Table 2 indicates that there was no significant difference ($p > 0.05$) in TFC values for sirkencubin syrup during the storage period. However, statistically significant differences were detected in PBSS samples during the storage. It was reported that this reduction in phenolic substances during storage may result from the change in the polymerization of phenolic substances (Wang et al., 2000). At the end of the storage period, while the SS sample was 4.51 mg CE/L, the PBSS sample was determined as 7.88 mg CE/L. Comparing sirkencubin syrup with purple basil sirkencubin syrup, the purple basil syrup contains more TFC (42.77%) at the end of the storage period. The amount of TPC and TFC during storage of SS and PBSS syrups were positively correlated with CUPRAC, DPPH, TS and ascorbic acid amounts, but it was statistically significant ($p < 0.05$). However, TPC and TFC amounts of SS and PBSS syrups were found to be negatively correlated with HMF (mg/L) amounts (Table 3). With the addition of purple basil, the bioavailability of sirkencubin syrup was increased.

Antioxidants prevent the formation of active oxygen or cleanse the active oxygen, which prevents oxidation-induced injury on a cellular basis and hence the formation of degenerative diseases (Rice-Evans et al., 1997; Vattem et al., 2005). Table 2 shows the statistically significant differences ($P<0.05$) between the measurement of DPPH amounts of the SS sample for the first day and the other storage days. At the end of the storage period, PBSS samples contained 9.75% more DPPH than the SS sample. Statistically significant differences between the CUPRAC amounts of SS and PBSS were not detected during storage ($p < 0.05$). CUPRAC amounts in PBSS samples were higher than SS samples. At the end of storage, the least change was observed in sirkencubin syrup with 1% inhibition reduction from CUPRAC (Table 2). There was no statistically significant difference in total sugar (g/L) amounts in storage conditions ($P > 0.05$). CUPRAC amounts of SS and PBSS syrup during storage showed a negative correlation with HMF amounts ($p> 0.05$). However, TPC and TFC amounts of SS and PBSS syrups were found to be negatively correlated with HMF (mg/L) amounts (Table 3). There were no statistically significant differences in HMF (mg/L) levels of sirkencubin syrup and purple basil sirkencubin syrup ($p > 0.05$). At the end of the storage period, the HMF amounts in SS and PBSS samples were found to increase by 5.8% and 2.1%, respectively, with mg/kg determined below the values of the reference values. HMF values showed a negative correlation with all other syrup samples (Table 3). There was no statistically significant change in the total sugar content of the samples (Table 2).

Statistically significant changes were detected in the amount of ascorbic acid in SS and PBSS samples during storage (Table 2). At the end of the storage period, PBSS sample had higher ascorbic acid content than the SS sample. However, decreases in the amount of ascorbic acid in all samples were detected over time during storage. SS samples showed a positive and significant correlation with TPC, DPPH, CUPRAC and TS prefixes. However, SS and PBSS samples were found to have a negative correlation with HMF amounts (Table 3).

3.3 Color

Table 4 shows the variation of L^*, a^*, b^*, C, and h values of sirkencubin syrup and purple basil sirkencubin syrup samples. The differences between L^* values during the storage period of SS and PBSS samples were not statistically significant ($p < 0.05$). Decreases in L^* values were detected in the SS and PBSS samples during the storage. Statistically significant differences were not found between α^* color values in 1, 10, and 20 days storage of sirkencubin syrup ($p > 0.05$). In PBSS samples, statistically significant differences were found between a^* values on days 20, 30 and 60 of storage ($p < 0.05$). Decreases in L^*, a^* and b^*

Table 3. Correlation between TPC, TFC, DPPH, CUPRAC, TS, ascorbic acid and HMF of sirkencubin syrup and purple basil sirkencubin syrup.

Syrup	Analysis	TPC (mg GAE/L)	TFC (mg CE/L)	DPPH (% inhibition)	CUPRAC (% inhibition)	TS (gr/L)	HMF (mg/L)	Ascorbic acid (mg/100mL)
SS	**TPC (mg GAE/L)**	1	0.766	0.717	0.927*	0.847	-0.928*	0.891*
	TFC (mg CE/L)	0.766	1	0.853	0.774	0.632	-0.628	0.875
	DPPH (% inhibition)	0.717	0.853	1	0.881*	0.654	-0.766	0.915*
	CUPRAC (% inhibition)	0.927*	0.774	0.881*	1	0.896*	-0.929*	0.974*
	TS (gr/L)	0.847	0.632	0.654	0.896*	1	-0.745	0.890*
	HMF (mg/L)	-0.928*	-0.628	-0.766	-0.929*	-0.745	1	-0.838
	Ascorbic acid (mg/100mL)	0.891*	0.875	0.915*	0.974*	0.890*	-0.8377	1
PBSS	**TPC (mg GAE/L)**	1	0.999*	0.998*	0.974*	0.622	-0.973*	0.732
	TFC (mg CE/L)	0.999*	1	0.997*	0.964*	0.588	-0.967*	0.711
	DPPH (% inhibition)	0.998*	0.997*	1	0.976*	0.636	-0.985*	0.743
	CUPRAC (% inhibition)	0.974*	0.964*	0.976*	1	0.779	-0.972*	0.862
	TS (gr/L)	0.622	0.588	0.636	0.779	1	-0.709	0.938*
	HMF (mg/L)	-0.973*	-0.967*	-0.985*	-0.972*	-0.709	1	-0.776
	Ascorbic acid (mg/100mL)	0.732	0.711	0.743	0.862	0.938*	-0.776	1

2-tailed test of significance was used; *Correlation is significant at the 0.05 level. SS (sirkencubin syrup); PBSS (purple basil sirkencubin syrup); TPC (total phenolic content); TFC (total flavonoid content); TS (total sugar); HMF (hydroxymethyl furfural); GAE (Gallic acid equivalent); DDPH (radical scavenging activity); CUPRAC (Cupric Reducing Antioxidant Capacity).

values were detected in the SS and PBSS samples during the storage period. The reduction in color values was suggested to be related to anthocyanin degradation and the formation of maillard reaction products (Aguiló-Aguayo et al., 2009). Statistically significant differences were not found between b* color values in 1, 10, and 20 days storage of purple basil sirkencubin syrup ($p > 0.05$). There were statistically significant differences between chromosomal color values of 60 days and other days ($p < 0.05$). Statistically significant differences were not found between h tone angle values at 30 and 60 days storage of SS sample ($p > 0.05$). When the h tone angle values of purple basil sirkencubin syrup were examined, it was determined that they increased during storage (Rein & Heinonen, 2004).

3.4 Microbiological analysis

In this study, general microbiological analyses were found to be successful for sirkencubin syrup and purple basil sirkencubin syrup (Table 5). The total amount of *Enterobacteriaceae* could not be determined during the storage period in both samples. Total number of aerobic plate counts was 3.79 CFU/mL at the end of storage for Sirkencubin syrup. It is thought that the increase in total aerobic plate counts of SS and PBSS samples during storage can be caused by the development of bacteria present in vinegar. Yeast and mold content were determined in SS sample <1 CFU/mL. In the PBSS sample, more yeast and mold were thought to originate from purple basil.

3.5 Sensory analysis

The changes in the results of sensory analysis evaluation of sirkencubin syrup and purple basil sirkencubin syrup samples during storage are shown in Table 6. Although the sensory characteristics of the foods are important for consumers to adopt or not to adopt the product, the most important indicator for the quality of food is sensory analysis. Sensory analysis plays an important role in the liking and utilization of food products (Choi et al., 2014). Statistically significant differences were not found in scoring of the sensory evaluation criteria of appearance, smell, flavor, color, taste, clarity, mouth feel, and overall acceptability during storage ($p>0.05$). Odor intensity scores were statistically different in PBSS samples ($p < 0.05$). As a result of the evaluation of SS and PBSS samples by panelists, it was seen that PBSS samples were more successful for all criteria. At the end of storage, PBSS was found to be very successful with 8.40 points for the overall acceptability score of panelists.

3.6 Blood Pressure and general characteristics of the research group

Table 7 shows the anthropometric measurements of the participants. The mean age of the study group was 20.20 ± 0.78 years. The mean and standard deviation values of the heights of women and men participating in the study were 169.66 ± 5.60 cm and 178.50 ± 6.19 cm, respectively. The average body weight of men was 68.40 ± 4.31 kg, while the mean body weight of women was

Table 4. Color analysis results of samples.

Analysis	Samples	Storage Period (Days)				
		1	10	20	30	60
L*	**SS**	47.02 ± 1.73^{a}	45.07 ± 0.64^{ab}	45.38 ± 1.40^{ab}	44.06 ± 0.28^{b}	42.81 ± 0.61^{b}
	PBSS	34.55 ± 0.10^{a}	33.40 ± 0.07^{b}	32.96 ± 0.19^{c}	31.35 ± 0.20^{d}	30.78 ± 0.11^{e}
a*	**SS**	22.27 ± 1.01^{a}	21.03 ± 0.35^{a}	21.39 ± 0.83^{a}	18.63 ± 0.15^{b}	18.22 ± 0.34^{b}
	PBSS	12.67 ± 0.01^{a}	12.69 ± 0.08^{a}	11.96 ± 0.16^{b}	11.42 ± 0.20^{c}	10.08 ± 0.03^{d}
b*	**SS**	19.34 ± 0.47^{bc}	18.66 ± 0.32^{c}	18.96 ± 0.33^{bc}	20.25 ± 0.09^{a}	19.66 ± 0.11^{ab}
	PBSS	13.51 ± 0.23^{a}	13.62 ± 0.19^{a}	13.23 ± 0.09^{ab}	12.85 ± 0.07^{b}	11.73 ± 0.15^{c}
C	**SS**	29.50 ± 1.07^{a}	28.11 ± 0.08^{ab}	28.59 ± 0.83^{abc}	27.52 ± 0.16^{bc}	26.80 ± 0.27^{c}
	PBSS	18.57 ± 0.22^{a}	17.94 ± 1.22^{a}	17.83 ± 0.17^{a}	17.19 ± 0.10^{a}	15.46 ± 0.12^{b}
h	**SS**	40.98 ± 0.62^{b}	41.58 ± 0.94^{b}	41.56 ± 0.66^{b}	47.38 ± 0.12^{a}	47.18 ± 0.49^{a}
	PBSS	46.98 ± 0.61^{c}	47.02 ± 0.58^{c}	47.88 ± 0.17^{bc}	48.38 ± 0.62^{ab}	49.33 ± 0.31^{a}

Values followed by different letters within the same line are significantly different ($p < 0.05$) (n = 3 ± SD). SS (sirkencubin syrup); PBSS (purple basil sirkencubin syrup); *L**: represents luminance value *a**: represents red and green; *b**: represents yellow and blue; C (chroma); h (hue angle).

Table 5. Microbiological results for sirkencubin syrup and purple basil sirkencubin syrup.

Analyses	Samples	Microbiology				
		Storage Period (Days)				
		1	10	20	30	60
Total Enterobacteriaceae count (log CFU/mL)	**SS**	ND	ND	ND	ND	ND
	PBSS	ND	ND	ND	ND	ND
Total aerobic plate count (log CFU/mL)	**SS**	3.20 ± 0.07^{a}	3.34± 0.12^{ab}	3.49 ± 0.18^{abc}	3.61 ± 0.07^{cb}	3.76 ± 0.08^{c}
	PBSS	3.23 ± 0.08^{a}	3.28 ± 0.01^{a}	3.46 ± 0.05^{b}	3.58 ± 0.11^{bc}	3.66 ± 0.11^{c}
Yeast and mold count (log CFU/mL)	**SS**	<1	<1	<1	<1	<1
	PBSS	1.62 ± 0.22^{a}	1.31 ± 0.12^{a}	1.36 ± 0.11^{a}	1.30 ± 0.11^{a}	1.34 ± 0.08^{a}

Values followed by different letters within the same line are significantly different ($p < 0.05$) (n = 3 ± SD). SS (sirkencubin syrup); PBSS (purple basil sirkencubin syrup); ND: not detected, log CFU/mL.

Table 6. Results of sensory feature analysis values.

Sensory feature	Sample	Storage Period (Days)				
		1	10	20	30	60
Appearance	**SS**	7.25 ± 0.86[a]	7.38 ± 0.62[a]	7.94 ± 0.68[a]	7.44 ± 0.73[a]	7.50 ± 0.97[a]
	PBSS	8.06 ± 0.68[a]	7.88 ± 0.50[a]	8.25 ± 0.68[a]	7.56 ± 0.73[a]	7.80 ± 0.79[a]
Smell	**SS**	7.25 ± 0.58[a]	7.19 ± 0.54[a]	7.38 ± 0.62[a]	7.38 ± 0.81[a]	7.70 ± 0.48[a]
	PBSS	8.50 ± 0.52[a]	7.88 ± 0.81[a]	8.19 ± 0.66[a]	8.19 ± 0.66[a]	8.10 ± 0.32[a]
Odor intensity	**SS**	7.19 ± 0.40[a]	7.25 ± 0.58[a]	7.06 ± 0.68[a]	6.94 ± 0.68[a]	6.80 ± 1.03[a]
	PBSS	8.31 ± 0.70[a]	7.81 ± 0.54[b]	7.63 ± 0.62[ab]	7.75 ± 0.68[ab]	7.50 ± 0.71[b]
Flavor	**SS**	7.13 ± 0.62[a]	6.88 ± 0.62[a]	7.31 ± 0.79[a]	7.06 ± 0.85[a]	7.10 ± 0.74[a]
	PBSS	8.19 ± 0.54[a]	7.56 ± 0.81[a]	7.81 ± 0.66[a]	7.69 ± 0.79[a]	7.80 ± 0.63[a]
Color	**SS**	7.75 ± 0.68[a]	7.69 ± 0.48[a]	7.88 ± 0.81[a]	7.69 ± 0.70[a]	7.80 ± 0.79[a]
	PBSS	8.38 ± 0.50[a]	8.31 ± 0.48[a]	8.50 ± 0.52[a]	8.25 ± 0.58[a]	8.60 ± 0.52[a]
Taste	**SS**	7.19 ± 0.75[a]	7.31 ± 0.60[a]	7.69 ± 1.01[a]	7.31 ± 0.87[a]	7.00 ± 0.67[a]
	PBSS	8.25 ± 0.86[a]	8.00 ± 0.63[a]	8.13 ± 1.09[a]	7.88 ± 0.81[a]	8.10 ± 0.74[a]
Clarity	**SS**	7.19 ± 0.40[a]	7.25 ± 0.58[a]	7.44 ± 0.81[a]	7.00 ± 0.82[a]	7.50 ± 0.97[a]
	PBSS	7.94 ± 0.68[a]	7.50 ± 0.73[a]	7.75 ± 0.68[a]	7.56 ± 0.63[a]	8.10 ± 0.32[a]
Mouth feel	**SS**	7.13 ± 0.62[a]	7.19 ± 0.54[a]	7.13 ± 0.62[a]	6.75 ± 0.77[a]	6.90 ± 0.74[a]
	PBSS	7.81 ± 0.66[a]	7.75 ± 0.58[a]	7.50 ± 0.52[a]	7.81 ± 0.83[a]	7.70 ± 0.82[a]
Overall acceptability	**SS**	7.56 ± 0.51[a]	7.38 ± 0.81[a]	7.75 ± 0.68[a]	7.81 ± 0.75[a]	7.70 ± 0.95[a]
	PBSS	8.56 ± 0.51[a]	8.06 ± 0.57[a]	8.38 ± 0.62[a]	8.13 ± 0.81[a]	8.40 ± 0.52[a]

Values followed by different letters within the same line are significantly different ($p < 0.05$) (n = 3 ± SD). SS (sirkencubin syrup); PBSS (purple basil sirkencubin syrup).

Table 7. Mean and standard deviation values of age and anthropometric measurements of individuals by sex.

	Women (n=6)	Men (n=4)	Total	p-value
Age (year)	20.50 ± 0.54	19.75 ± 0.95	20.20 ± 0.78	0.150[1]
Body Weight (kg)	63.23 ± 11.58	68.40 ± 4.31	65.30 ± 9.37	0.426[1]
Length (cm)	169.66 ± 5.60	178.50 ± 6.19	173.20 ± 7.14	0.047[1]
BMI (kg / m^2)	21.88 ± 2.98	21.57 ± 1.82	21.76 ± 2.46	0.859[1]
Waist circumference (cm)	75.33 ± 6.40	81.00 ± 4.08	77.60 ± 6.07	0.159[1]
Hip circumference (cm)	102.33 ± 7.71	96.25 ± 2.62	99.90 ± 6.72	0.130[2]
Waist / hip ratio	0.73 ± 0.02	0.84 ± 0.03	0.77 ± 0.06	0.001[1]
BMR (kcal)	1415.50 ± 172.93	1756.00 ± 124.20	1551.70 ± 229.51	0.010[1]
Amount of body fat (kg)	17.96 ± 6.03	9.45 ± 2.84	14.56 ± 6.50	0.032[1]
Body fat percentage (%)	27.78 ± 4.64	13.77 ± 4.12	22.18 ± 8.36	0.001[1]
Amount of body water (kg)	32.70 ± 4.15	42.92 ± 2.93	36.79 ± 6.35	0.003[1]
Body water percentage (%)	52.20 ± 3.43	62.77 ± 2.75	56.43 ± 6.23	0.001[1]
Body Muscle Mass (kg)	42.96 ± 5.51	56.00 ± 4.14	44.18 ± 8.24	0.004[1]
Fat-free mass (kg)	45.26 ± 5.83	58.95 ± 4.35	50.74 ± 8.66	0.004[1]

[1]Independent Samples test; [2]Mann-Whitney U test, $p < 0.05$ (Mean ± SD). BMI: Body mass index; BMR: Basal metabolic rate; n: Number of people

63.23 ± 11.58 kg. The mean Basal Metabolic Rate (BMR) values of men (1756.00 ± 124.20 kcal/day) were higher than that of women (1415.50 ± 172.93 kcal/day). The male waist / hip ratio (0.84 ± 0.03) was higher than the female waist hip ratio (0.73 ± 0.02) and the body fat percentage (13.77 ± 4.12%) was lower than the female body fat percentage (27.78 ± 4.64%) ($p < 0.05$). The difference in body weight, BMI, waist circumference, and hip circumference measurements by gender was not statistically significant, while the differences for other anthropometric measurements were statistically significant.

As a result of the research, there was no significant change in systolic blood pressure of students 30 min before drinking and after drinking sirkencubin syrup ($p>0.05$). There was significant change in diastolic blood pressure of students 30 min before drinking and after drinking Sirkencubin syrup ($p<0.05$). Likewise, there was no significant change in systolic and diastolic blood pressure of students 30 min before drinking and after drinking purple basil sirkencubin syrup ($p>0.05$) (Table 8 and Figure 1).

In our study, it was concluded that sirkencubin syrup and purple basil sirkencubin syrup had no acute effect on blood pressure. In a study similar to our study, it was observed that grape juice hardaliye had no effect on blood pressure (Amoutzopoulos et al., 2013). In a study examining the antihypertensive effects of vinegar on spontaneous hypertensive rats, it was found that acetic acid, the main component in vinegar, significantly reduced blood pressure ($p<0.05$) compared to controls without acetic acid

Table 8. Blood pressure of the participants before and after drinking sirkencubin syrup and purple basil sirkencubin syrup.

Blood Pressure (mmHg)	Samples	Before	After	t	p-value
SBP	**SS**	117.0 ± 10.59	115.5 ± 8.96	1.000	0.343
	PBSS	111.0 ± 9.94	113.0 ± 9.49	-1.500	0.168
DBP	**SS**	78.5 ± 9.44	75.0 ± 7.07	2.333	0.045
	PBSS	71.0 ± 7.38	73.0 ± 8.23	-1.500	0.168

SBP (systolic blood pressure); DBP (diastolic blood pressure); SS (sirkencubin syrup); PBSS (purple basil sirkencubin syrup); t (paired samples test). (Mean ± SD).

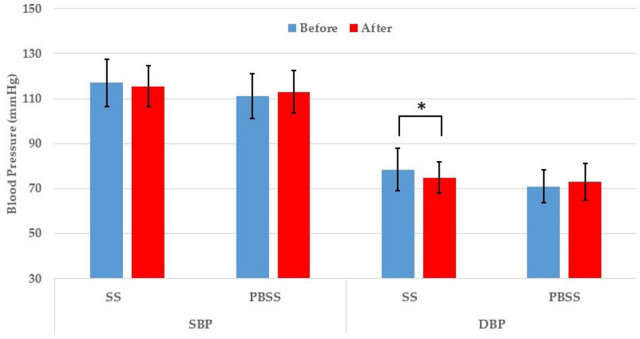

Figure 1. Blood pressure of the participants before and after drinking sirkencubin syrup and purple basil sirkencubin syrup (*p < 0.05, SBP: Systolic blood pressure; DBP: Diastolic blood pressure; SS: Sirkencubin syrup; PBSS: Purple basil sirkencubin syrup).

or vinegar. As a result of the study, it was suggested that the antihypertensive effect of vinegar is caused mainly by acetic acid (Kondo et al., 2001). In the literature, there are studies suggesting that certain doses of apple vinegar drunk over a certain period of time in hypertensive individuals leads to decreases in blood pressure in particular (Tanaka et al., 2009).

It is known that energy drinks, which are consumed significantly by the adolescent group, have negative side effects. (Dikici et al., 2012). For this reason, the use of sirkencubin syrup and purple basil sirkencubin syrup is recommended in our study as healthy drink.

4 Conclusions

In this study, total phenolic, total flavonoids, ascorbic acid content, and total antioxidant capacity were found to be higher in purple basin sirkencubin syrup than sirkencubin syrup. The color values of purple basil sirkencubin syrup were found to be better. There was no significant variation during the storage time for physicochemical parameters (pH, titration acidity, °Brix). At the same time, although the amount of HMF increased at the end of storage, reliable levels were determined. The sensory evaluation of the panelists was found to be successful in both samples, and the purple basil sirkencubin syrup was found to be more successful. There was no negative effect on blood pressure in healthy subjects. When the results were evaluated, the purple basil sirkencubin syrup was safe for the health of the consumer, highly appreciated by the consumer and was high in bioactive properties showing that it could be used successfully. It is thought that non-thermal food preservation methods for bioactive compounds, where reductions in storage time occur, will be useful in new investigations.

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