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Colour Stability in Sour Cherry Jam During Storage

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Nowadays, consumers prefer low-calorie foods with sugar substitutes to decrease calorie intake to control body weight and health problems such as diabetes and hypoglycemia. Reduced sugar sour cherry jam is one of these foods and rich in anthocyanins. The objectives of this study were to assess effect of storage on colour stability of reduced calorie sour cherry jam. The samples were stored at room temperature (20 ºC) and refrigerator temperatures (4 ºC) for 8 months. Results showed that during storage period, changes in L, b, total anthocyanin, colour density, pH and total acidity were significant ($p < 0.05$). The effects of storage temperature on total anthocyanin, pH, total acidity and a value were also significant ($p < 0.05$). Average total anthocyanin decrease of the samples stored at room temperature and refrigerator temperature were 15.74 and 6.91 %, respectively. Total anthocyanin content decreased *ca*. 28.21 % after 8 months of storage.

Key Words: Anthocyanin, Colour, Jam, Sour cherry.

INTRODUCTION

The prevalence of diabetes is increasing worldwide. According to the recent global estimates of the World Health Organization, there will be 300 million people with diabetes by the year 2025. Overall crude prevalence of diabetes was 7.2 % (previously undiagnosed, 2.3 %) and IGT (impaired glucose tolerance), 6.7 % nationwide in Turkey[1]. Type II diabetes, also called adult-onset diabetes, is the most common type with 85-90 % of all diabetics having it. Type II diabetes often develops in the elderly and is probably multifactorial, where lifestyle, dietary habits, infection and genetic factors may be involved. This form of diabetes does not always require medical treatment and can often be handled through regular exercise and good dietary control[2].

Low calorie products were originally developed for diabetics and people with specific health problems. Nowadays, consumers' demand for low calorie products has raised in an attempt to limit health problems, to lose or stabilize their weight and to work within the frame of a healthier diet[3].

In Turkey, consumers are increasingly better informed about diet and health and as a result, desire more foods which offer fewer calories. Especially, people with diabetics and obesity problems prefer low/reduced calorie jams. Reduced sugar sour cherry jam is one of these foods and rich in anthocyanins.

Although the reduced calorie deserts such as jam, jelly, marmalade are in great demand, there is little research concerning this subject. Ragab[4] produced low calorie apricot jam for diabetics using saccharin and xylitol as sweetening agents. Raghab[4] produced jams according to eight different formulations and investigated the changes that occured in the chemical characteristics of apricot jam during storage for 8 weeks. Gaspar *et al.*[5] studied the gelling agents gellan, xanthan and locust bean gums instead of using low-methoxyl pectin in the production of reduced-calorie grape juice jelly with total sugar content ranging from 14 to 46 °Brix and total gum concentration ranging from 0.3 to 0.7 %. The best reduced-calorie grape juice jelly contained 39.3 % total sugar, 0.54 % total gum. Gajar and Badrie[6] worked processing and quality evaluation of a low-calorie christophene jam (*Sechium edule* (Jacq.)) Swartz. Abdullah and Cheng[7] produced reduced calorie tropical mixed fruit jam and investigated the acceptability of the formulated jams. Khouryieh *et al.*[8] prepared 3 jelly formulations using sucralose, low-methoxyl pectin and maltodextrin with either xanthan gum or locust bean gum used singly or in combination and stored at 4 or 43 °C for shelf life evaluation.

This work was carried out to follow the quality changes in reduced calorie sour cherry jams depending on storage period and temperature.

EXPERIMENTAL

Reduced calorie sour cherry jams containing sorbitol were obtained from a commercial factory (Erden, Eskisehir, Turkey). A total of 30 samples each were in 300 g jars were brought to the laboratory. 12 of the samples were stored at room temperature (20 °C) in darkness and 12 of them at refrigerator temperature (4 °C). Samples were analyzed in triplicate and some characteristics of jams were determined in 0, 2, 4, 6 and 8 month intervals.

The total soluble solids contents of jam were estimated at 20 ºC using an Abbe refractometer. Total solids were determined by drying at 70 ºC under vacuum. Total acidity was determined by titration to pH 8.1 with 0.1 M sodium hydroxide solution; results were expressed as grams of citric acid per 100 g of sample. pH value of jam was determined at 20 ºC using a pHmeter (Nel-890, Turkey) according to the methods described by AOAC[9]. Reducing, non-reducing and total sugars were determined by Luff-Schrool general volumetric method[10].

Total anthocyanin (TACN) content was determined by the differential method as described by Wrolstad[11]. Absorbance was 515 nm, calculation was based on cyanidine-3 glucoside (m.w. = 445.2, e = 29,600). Colour density was determined according to Spayd *et al.*[12].

Colour was evaluated by measuring Hunter L (brightness, 100 = white, 0 = black), a (+, red; -, green) and b (+, yellow; -, blue) parameters by means of a reflectance colorimeter (CR 300, Chromometer, Minolta, Japan). A white till (No: 21733001) was used to standardize the instrument.

Hydroxymethyfurfural (HMF) was determined quantitatively following the procedure described by the IFFJP[13] based on the colorimetric reaction between barbituric

acid, *p*-toluidine and HMF forming a red coloured complex. Intensity of red colour was measured at 550 nm with a Jasco UV-Visible V-530 spectrophotometer.

Statistical analysis: The data are the mean of three independent determinations and were statistically evaluated by analysis of variance (ANOVA) and Duncan's multiple range test at $p < 0.05$ using the statistical analysis program (SPSS 11.5).

RESULTS AND DISCUSSION

Some chemical characteristics of reduced calorie sour cherry jams before storage are given in Table-1. Table-2 shows changes in some parameters of reduced calorie sour cherry jams during storage and the effects of storage temperature on these parameters are given in Table-3.

TABLE-1
CHEMICAL CHARACTERISTICS OF REDUCED CALORIE SOUR CHERRY JAM BEFORE STORAGE

Component	Mean
Hydroxymethylfurfural (mg kg^{-1})	2.33
Total sugar (g kg^{-1})	67.61
Reducing sugar (g kg^{-1})	62.19
Non- reducing sugar (g kg^{-1})	5.15
Total soluble solids (%)	74.00
Total solids (%)	76.55

TABLE-2
EFFECTS OF STORAGE PERIOD ON SOME CHARACTERISTICS OF REDUCED CALORIE SOUR CHERRY JAM

Months	Hunter values			Total anthocyanin (mg kg^{-1})	Colour density	pH	Total acidity (g 100 g^{-1})
	L	+a	+b				
0	15.09c	3.80	1.97a	191.28a	11.75a	3.21e	1.12a
2	16.52b	3.37	1.61b	180.19ab	11.02b	3.27b	1.10ab
4	17.73a	3.64	1.49b	173.34b	10.10c	3.26c	1.06bc
6	16.73ab	3.32	1.46b	165.98b	9.81c	3.28a	1.06c
8	17.86a	4.06	1.60b	137.32c	9.71c	3.25 d	1.07bc

Column values with the same letter are not significantly different ($p > 0.05$)

During storage period, L, b, total anthocyanin, colour density and total acidity showed changes as storage time increased (Table-2). No change was observed in +a showing redness value. Total anthocyanin content decreased about 28.21 % at the end of 8 months storage. Colour density also decreased due to decrease of total anthocyanin.

The effects of storage temperature on changes in L, b value and colour density were not significant (Table-3). Total anthocyanin content and redness value a of the

samples stored in refrigerator were higher than the samples stored at room temperature. Average total anthocyanin loss was 15.74 % for the samples stored at room temperature and 6.91 % for the samples stored in refrigerator. These results show the importance of storage temperature on total anthocyanin retention.

TABLE-3
EFFECTS OF STORAGE TEMPERATURE ON SOME CHARACTERISTICS OF REDUCED CALORIE SOUR CHERRY JAM

Parameters	Room temperature (20 ºC)	Refrigerator temperature (4 ºC)
Hunter values		
L	16.64	16.94
+a	3.41b	3.87a
+b	1.58	1.68
Total anthocyanin (mg kg^{-1})	161.17b	178.07a
Colour density	10.01	10.95
pH	3.26a	3.24b
Total acidity (g $100g^{-1}$)	1.07b	1.10a

Line values with the same letter are not significantly different ($p > 0.05$)

Sugars and their degradation products accelerate the degradation of anthocyanins. Fructose, arabinose, lactose and sorbose have greater degradative effects on anthocyanins than glucose, sucrose or maltose. Rate of anthocyanin degradation is associated with the rate at which the sugar itself is degraded to furfural-type compounds. These compounds mostly derive from Maillard reaction. These degradation products readily condense and/or react with anthocyanins, ultimately leading to formation of colourless or complex brown coloured compounds. In reduced calorie jams, the absence of glucose and fructose and low contents of total sugar and hydroxymethylfurfural reduced total anthocyanin loss. According to Garcia-Viguera *et al.*[14] total anthocyanin contents of the red raspberry jams stored at 20 °C for 6 months reduced down 4-7 % of the initial anthocyanins. In research performed by Garcia-Viguera *et al.*[15], anthocyanins concentrations of strawberry jams produced from 3 strawberry cultivars and stored at 20 °C decreased by 96.55 % during 200 days storage period. Tosun[16] investigated total anthocyanin loss in 72 % soluble solid containing blackberry jams during 6 months of storage and found that the total anthocyanin decrease of the samples stored at room temperature and refrigerator temperature were 50.41 and 15.24 %, respectively. Difference between anthocyanin losses indicates the importance of sugar concentration. Another important factor in colour retention is pH. Tosun[16] found a negative correlation between pH and total anthocyanin contents of jam samples and the present results (Table-3) agree with those previously reported.

The effects of storage temperaturex storageperiod on changes in Hunter values were not significant ($p > 0.05$). The effects of storage temperature and storage

period on total anthocyanin content, colour density, pH and total acidity are shown in Figs. 1-4, respectively. As shown in these figures, the storage period × storage temperature effect was significant for total anthocyanin, colour density, pH and total acidity ($p < 0.05$). As can be seen from Figs. 1 and 2, there is a rapid decrease in total anthocyanin content and colour density of the samples stored at room temperature compared with the samples stored in refrigerator. Until the 6th months of storage at room temperature, the pH value of the samples increased, total acidity decreased and both changes were rapid but although the pH value of the samples stored in refrigerator increased with respect to the begining of storage, the changes were less than the samples stored at room temperature (Figs. 3 and 4).

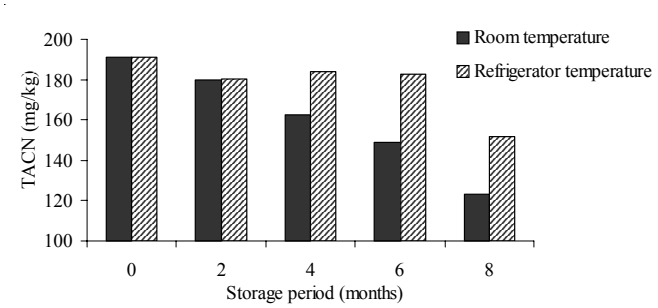

Fig. 1. Effects of storage period and temperature on total anthocyanin

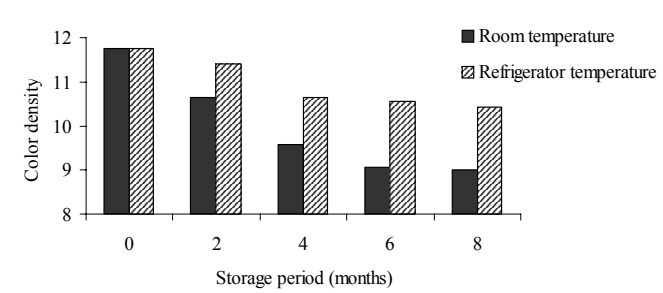

Fig. 2. Effects of storage period and temperature on colour density

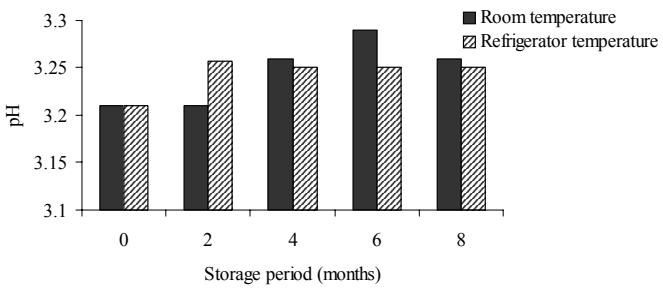

Fig. 3. Effects of storage period and temperature on pH

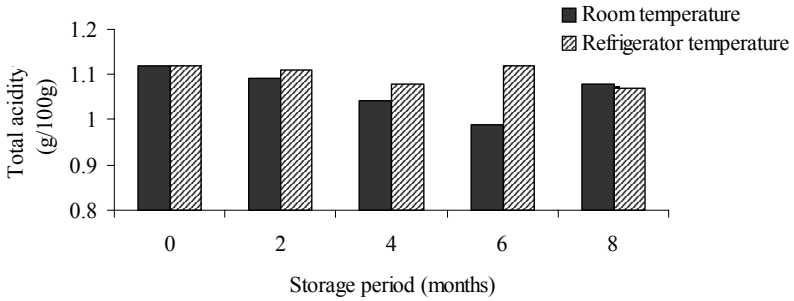

Fig. 4. Effects of storage period and temperature on total acidity

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