Food Chemistry 145 (2014) 23–27

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

Effect of storage time and temperature on the physicochemical and sensory characteristics of commercial apricot jam

Noureddine Touati [a], Martha Patricia Tarazona-Díaz [b], Encarna Aguayo [b], Hayette Louaileche [a,*]

[a] Laboratory of Applied Biochemistry, Department of Food Sciences, Faculty of Natural Sciences and Life, University of Bejaia, 06000 Bejaia, Algeria
[b] Postharvest and Refrigeration Group, Department of Food Engineering, Technical University of Cartagena, Paseo Alfonso XIII, 48, 30203 Cartagena, Murcia, Spain

ARTICLE INFO

Article history:
Received 9 April 2013
Received in revised form 30 July 2013
Accepted 1 August 2013
Available online 16 August 2013

Keywords:
Amino acids
Hydroxymethylfurfural
Total sugars
Jam stability
Physicochemical parameters
Organoleptic quality

ABSTRACT

Storage conditions are important factors for jam quality. The objective of this study was to monitor the physicochemical stability and sensorial profile of apricot jam during storage for 60 days at 5 °C, 25 °C and 37 °C. For that purpose, special attention was paid to total soluble solids (TSS), titratable acidity (TA), colour, free amino acids (FAA), total sugars (TS) and hydroxymethylfurfural (HMF). The decreasing parameter for jam at the end of storage under 5 °C, 25 °C and 37 °C, respectively, were 16.81%, 34.30% and 56.01% for FAA, and 5.52%, 9.02% and 7.46% for TS; likewise, the increasing were 19.81%, 22.94% and 25.07% for TA, 3.15%, 4.08% and 4.47% for TSS, 15.96%, 112.76% and 150% for HMF. Jam stability was better at 5 °C than 25 °C and 37 °C. The interaction time–temperature factor had significant effects on pH, TS, FAA and HMF, unlike TA, TSS and sensorial profile.

1. Introduction

Apricot fruit (*Prunus armeniaca*. L) is native from China and is widely adapted to Mediterranean climate. It is consumed around the world due to its pleasant and delightful aroma (Gutierrez-Martinez, Schorr-Galindo, & Ragazzo-Sanchez, 2007). Nutritionally, apricot is a rich source of sugars, fibers, minerals, and vitamins like thiamine, riboflavin, niacin and pantothenic acid (Sartaj, Tariq, & KashifSarfraz, 2011). In addition, apricot fruit is known to contain appreciable amounts of carotenoids (mainly β-carotene), and bioactive phytochemicals such as chlorogenic, caffeic, *p*-coumaric and ferulic acids (Dragovic-Uzelac, Levaj, Mrkic, Bursac, & Marija Boras, 2007).

The world production of apricot has increased considerably during the last 20 years. Indeed, the production doubled from 1.2 million tonnes in 1992 to 2.3 million tonnes in 2010. Apricot, the 16th cultivated fruit in the world, is largely cultivated in Mediterranean region. Algeria is currently the 5th world producer with 239,700 tonnes (FAO, 2010).

Apricot is a climacteric fruit with a very short storage life due in part to a high respiration rate and a rapid ripening process. Thus, in order to reduce post-harvest losses, numerous techniques and process for fruit conservation into jam, jelly, marmalade, as well as nectar have been developed.

Historically, jams originated as an early effort to preserve fruit for consumption during the off-season. It is an intermediate moisture food prepared by boiling fruit pulp with sugar, pectin, acid and other ingredients (preservatives, colouring and flavouring substances) until obtaining a reasonably thick consistency. Generally, fruit jam storage at high temperature leads to a significant decrease of nutritive values and sensorial properties (Vidhya & Narain, 2011; Wicklund et al., 2005).

To our knowledge, the literature available at present is poor in references about evolution of apricot jam properties during storage in different conditions (Aslanova, Bakkalbasi, & Artik, 2010; Rababah et al., 2011). Thus, the aim of this paper is focused on the assessment and monitoring of physicochemical parameters and organoleptic quality of apricot jam during storage, and the determination of the interaction time–temperature effect.

2. Material and methods

2.1. Preparation of samples

Three units each from two batches of apricot jam marketed in Algeria where provided from the manufacturer. Based on the details indicated on the label, jam is composed of apricot pulp, sugar (sucrose), pectin (E440) and citric acid (E330). The samples were divided into three groups. The first group was stored at 5 °C, the second at 25 °C and the third at 37 °C. The tested

* Corresponding author. Tel.: +213 34214762.
E-mail address: haylouaileche@yahoo.fr (H. Louaileche).

0308-8146/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.foodchem.2013.08.037

parameters were determined in the freshly manufactured samples of each batch, and after 20, 40 and 60 days.

2.2. Chemicals

Sodium hydroxide and methanol (HPLC grade) were purchased from Panreac Química SA (Barcelona, Spain). Individual amino acids were all purchased from Sigma–Aldrich Química SA (Madrid, Spain). Ultrapure water was obtained by using a Milli-Q system (Academic Gradient A10, Millipak™ 40, Millipore, París, France).

2.3. Physicochemical parameters

2.3.1. Hydrogen potential, titratable acidity and total soluble solids

Hydrogen potential measurements were performed using pH meter (Metrohm model 692, Herisau, Switzerland) at 20 °C. Total acidity (TA) was determined by titration with 0.1 N of sodium hydroxide solution. Briefly, 1 g of sample was put into a 100 mL beaker and 75 mL of distilled water were added. This solution was titrated until end point (pH = 8.2 ± 0.1). The volume of sodium hydroxide was converted to percentages of citric acid. Total soluble solids (TSS) were determined by measurement of the refraction index with a refractometer (Atago N1, Tokyo, Japan). Refractive index was recorded and expressed as percentages. Measurements were performed at 20 °C.

2.3.2. Colour evaluation

Jam colour was measured using a CR-200 Minolta Chroma meter (Chuo-Ku, Osaka, Japan). A Minolta standard-white reflector plate was used to standardise the instrument under CIE (Commission Internationale de l'Eclairage). Samples of apricot jam were filled into 60 mL glass assay tubes and CIE Lab values were determined. The L^*, a^*, b^* colour values were determined using the 1976 CIELAB system.

The colour parameters were measured using Eq(2).

$$Cr = (a^{*2} + b^{*2})^{1/2} \quad (1)$$

where: *Cr*: chroma is the grade of quantitative difference of Hue parameter with reference to grey colour, a is a measure of red tones and varies from $-a$ to $+a$ ($-a$ = green, $+a$ = red), and b is a measure of yellow tones and varies from $-b$ to $+b$ ($-b$ = blue, $+b$ = yellow).

$$^{\circ}Hue = (\tan^{-1} b^*/a^*) \quad (2)$$

where °*Hue*: Hue angle, is the qualitative attribute of colour. It defines the difference of a colour with referent to grey; L^* represents the brightness measure and the luminosity at range from 0 to 100 (100 = white; 0 = black).

2.3.3. Free amino acid content

One gram of jam was mixed with 6 mL of ultrapure water and homogenized for 1 min with a vortex. The mixture was then centrifuged at 3000g for 10 min at 4 °C (Heraeus Fresco 21, Thermo Scientific, Germany) and filtered (0.45 μm). Free amino acid analysis was performed as reported by Özcan and Şensuya (2006), by HPLC with UV–vis detector (Water 2695, Alliance, Singapore). The chromatographic separations were performed on a Zorbax Bonus-RP, narrow-bore column using the isocratic mixture of 0.01 mM acetic acid in a 0.2% aqueous solution of formic acid. Individual amino acids, asparagines (Asn), prolin (Pro), glutamic (Glu) and aspartic acid (Asp), were quantified using their respective standards and results expressed as mg/100 g of jam.

2.3.4. Sugar content

The sugars were determined from 0.02 mL of the extract used for amino acid analysis. Glucose, fructose and sucrose contents were analysed by ion chromatography (Metrohm 850 system) using injection valve along with the Pixel Array Detector (PAD) anion exchange column (1–150 Metrosep-Carb) and isocratic high-pressure pump for the channel PAD 818 IC. Operating conditions reported by Moraga, Martínez-Navarrete, and Chiralt (2006) for performance liquid chromatography were used, with minor modifications (mobile phase NaOH 80 mM, at 0.9 mL/min flow rate).

2.3.5. Hydroxymethylfurfural

The HMF content was determined according to Rada-Mendoza, Olano, and Villamiel (2002). Samples were placed in a flask of 25 mL; 2 mL each of Carrez I and II reagents were added and the volume adjusted with ultrapure water. After decantation for 30 min, the supernatant was filtered (0.45 μm) and then injected (50 μL) into the chromatograph (Nova-Pak® C18 column at room temperature). The mobile phase consisted of methanol: water, using a linear gradient from 5:95 to 80:20 in 6 min. Isocratic elution was then continued for 6 min and, finally, initial conditions were re-established in 1 min and held for 10 min. The flow rate was 1 mL/min. The UV detector was set at 283 nm. The quantification was made using HMF standard and the results were expressed as mg/100 g of jam.

2.3.6. Sensory properties

All evaluation sessions were held in a food laboratory at the Universidad Politécnica de Cartagena and were conducted by an untrained panel consisting of 10 students (4 males and 6 females) with 26 years mean age. The jam samples were prepared at room temperature 3 h before serving. Colour, aroma, taste, spreadability and overall acceptability were evaluated according to the hedonic scale of nine points (9 = like extremely to 1 = dislike extremely) as reported by Basu, Shivhare, Singh, and Beniwal (2011).

2.3.7. Statistical analysis

The results were submitted to a bi-factorial (time and temperature) analysis of variance (ANOVA). The mean values were compared using the least significant difference test (LSD) at 5% level using infostat software. All the test were performed in triplicates and the results average ($n = 3$). Finally, Pearson's correlation analysis was performed on the studied parameters.

3. Results and discussion

3.1. Effect of storage time and temperature on pH, TA and TSS

Prior storage, pH, TA and TSS values of apricot jam were 3.54, 0.82% and 64.42%, respectively. The pH and TA were higher than those found by Aslanova et al. (2010) for apricot jam, unlike TSS. These authors reported 3.34, 0.441% and 70.55% for pH, TA and TSS, respectively.

During storage, the decrease in pH was significant ($p < 0.05$) from day forty at 5 °C and day twenty at both 25 °C and 37 °C. After prolonged storage, the initial value of pH decreased to 3.39, 3.34 and 3.21 under temperature storage of 5 °C, 25 °C and 37 °C. Statistical analysis revealed that time–temperature interaction factor had a significant effect ($p < 0.05$).

The TA is one of a number of physicochemical parameters which affect product quality; to a large extent, acidity protects against the development of microorganisms. During storage, TA increased significantly ($p < 0.05$) from day forty under all temperature storage. At the end of period storage, the initial values increased to 0.98%, 1.01% and 1.03% at 5 °C, 25 °C, and 37 °C, respectively. Furthermore, the interaction time–temperature factor shows no significant effect ($p < 0.05$).