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Shelf Life of Jams in Polypropylene Packaging

Soraia Vilela Borges
Universidade Federal de Lavras,
Departamento de Ciência dos Alimentos,
Brazil

1. Introduction

The shelf life of a product represents the period in which the product remains in good sensory and microbiological for consumption, without harming the taste or health. These conditions are dependent on physical, chemical and microbiological that occur during storage, which depend on the nature of the product, packaging and storage conditions (temperature, relative humidity, storage time) (Man & Jones , 2000).

Jams are generally preserved by applying a combination of obstacles such as lowering the pH, the reduction of water activity by addition of solutes, heat treatment and the use of preservatives and has an expressive consumption in Brazil, given the wide variety existing fruit rich in nutrients, and versatility in the use of these products. From microbiological point of view, these products, according to the packaging and processing conditions and storage, has a shelf life that can vary from 6 months to 1 year (Tfouni & Toledo, 2002), which can be extended by adding sorbic acid and its salts that has good performance in the pH range from 4.0 to 6.0 (Jay 1996).

Among various options for these products packagings stands out the use of polypropylene due to their low water absorption and light (70% at 800nm) compared to cellophane (cheaper), support at high temperatures and low temperatures during the filling and cooling cycle without suffering deformation and be more economical compared to metal packaging (Alves et al., 2007).

Based on the above this chapter aims to report the physical, chemical, physical-chemical, microbiological and sensory occurred in different jams of tropical fruits, stored in jars of polypropylene at different temperature conditions (25-40°C).

2. Materials and methods

2.1 Processing of the jam

The fruits were sanitized with100-ppm chlorine solution, blanched and pulped in a pulper. The jams was processed according to the methodology described by Policarpo *et al*. (2003). The flowchart in Figure 1 contains the elaboration stages of the preserves. Pulp, sugars,

calcium carbonate and other ingredients were placed in a stainless steel pan and concentrated to different concentrations according to fruit (72–78°Brix) by heating with constant stirring, according to the formulation. Pectin and acid were added at the end of the cooking period. The preserve was packaged in fixed amounts (100 g) while still hot, using round polypropylene pots (6.7-cm diameter and 7.1-cm height), in cellophane, and molded in these pots, with the same dimensions.

2.2 Experimental design to determine the shelf life

A factorial experimental design: formulations x packaging materials x storage temperature x evaluation times, with two repetitions were used. The physical, chemical, physicochemical and sensorial alterations were evaluated and their means compared by Tukey's test at the 5% level of probability or by statistical models (Cochram & Cox, 1992).

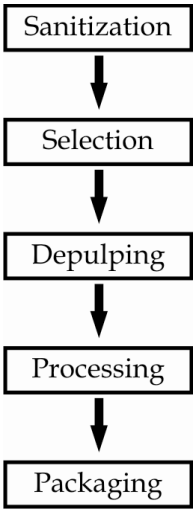

Fig. 1. Flowchart of fruit processing production

2.3 Analytical methods

Chemical and physicochemical analyses were carried out in triplicate according to the following methodologies as described by the Association of Official Analytical Chemists (AOAC 1995): total titratable acidity by titration with NaOH in the presence of phenolphthalein, total and reducing sugars by titration with the Fehling reagent, pH using a potentiometer and total soluble solids by refractometry. Soluble pectin was determined using the methodology described by Bitter and Muir (1962), based on the reaction of the pectin hydrolyzed with carbazol.

Yeasts and molds were determined according to Speak (1976), making serial dilutions with peptone water and plating on potato dextrose agar with or without 18% glucose to detect osmophilic and other species of yeast. Plates were incubated at 25–30 C, and the results were analyzed after 48 and 72 h of incubation and expressed in colony-forming units per gram. Water activity (*A*w) was measured at 33 °C in an AquaLab device (model Cx-2, Decagon Device, Pullman, WA).

Color parameters (*L**, *a**, *b** and hue angle) were determined in a Minolta colorimeter (model CM-3600d, Konica Minolta,Ramsey, NJ), using the standard D65/10° illuminant, without including the shine factor.

Texture profile analysis (TPA) was determined using the TA.TX2i texturometer (Stable Micro Systems, Surrey, UK), operated with the Texture Expert software, using a pretest velocity of 2 mm/s, test velocity of 1 mm/s and posttest velocity of 2 mm/s, with a distance of 5 mm and time of 5 s, the test body being acrylic (P25/L) with a diameter of 25 mm. The product was placed in an aluminium capsule with a diameter of 50 mm and height of 25 mm for standardization. A graph of force x time was constructed, each characteristic peak corresponding to one of the TPA characteristics.

The sensory evaluation of the jams was carried out by 60 potential consumers and the attributes appraised (appearance, aroma, texture, color, flavor and global impression) judged using a structured 9 point hedonic scale (1= disliked extremely to 9= liked extremely). The experiment was applied to a balanced complete block design according to Stone and Sidel (2004), and 20 g of each treatment presented in plastic cups codified with three digit numbers. The tests were carried out in individual booths in the food sensory analysis laboratory. The results were submitted to an analysis of variance (ANOVA) and the differences between the averages compared by the test of Tukey at 5% of probability (Cochram & Cox, 1992).

3. Results

In several studies on the shelf life to tropical fruit jams (banana, guava, umbu, shell passion fruit juice) packaged in polypropylene, physical, physicochemical, chemical and sensory characteristics were recorded during storage, while microbiological characteristics these products were stable for 4-6 months of storage at temperatures of 25-40 ° C (Policarpo et al. 2007; Nascimento, 2002, Menezes et al. 2011; Martins et al, 2010; Martins et al, 2011). This is due to the fact they were manufactured using good manufacturing practices, the products are low pH and high concentration of sugar, and good sealing of packaging, conditions that minimize or prevent microbial growth of fungi and yeasts, this typical range of water activity.

Regarding the physicochemical properties, there was a slight drop in pH and concomitant increase in titrable acidity (Martins, 2009, Martins et al. 2010, Nascimento et al., 2002) and in some products the pH remained unchanged (Policarpo et al.,2007, Menezes et al. 2011). Soluble solids tend to increase due to syneresis or water evaporation during storage at high temperatures as observed in the work of Policarpo et al. 2007; Menezes et al. 2011; Martins et al., 2010; Martins et al. 2011. The syneresis due to conditions of low pH of the gel formed

and inability to retain moisture in the product and considering that polypropylene has a certain permeability is possible the migration of water into the environment during storage, especially the high temperatures (Fizman & Duran, 1992). The total sugars tend to increase for the same reason the total solids (effect of concentration) and sucrose hydrolysis occurs in glucose due to the increased acidity (Policarpo et al., 2007, Menezes, et al. 2011, Martins et al., 2010). These sugars are hygroscopic and reduce the water activity during storage (Martins et al., 2011). Pectins, when added to preserves or jelly to stabilize the gel network formed and increase the firmness, are also hydrolyzed by the increase in acidity during storage, especially at higher temperatures (Policarpo et al., 2007).

Color parameters (L *, a *, b *) and texture profile, depending on the chemical changes that occur are also altered. Was noticed a decrease in the value of L * in all the above products, indicating darkening, which is due to several reactions accelerated by high temperatures, and exposure to light, such as oxidation of vitamins and pigments in fruits and others reactions. In parallel b parameters relating to color tone characteristic of the fruit, by factors similar to the luminosity are reduced (Policarpo et al. 2007; Martins et al, 2010) or increased (Menezes, et al.,2011; Martins et al., 2011), according to the processed fruit. In the texture profile in all work we observed an increase in firmness with increasing soluble solids, and in some cases increasing of gumminess, due to syneresis. Other parameters of texture profile analysis showed no significant changes.

Regarding the sensory evaluation tests for affective attributes of color, texture, flavor and overall impression, using a hedonic scale of 9 points and untrained judges (Stone & Sidel, 2004) showed that there is reduction in all attributes during the storage. For jelly albedo of passion fruit / passion fruit juice the result of global acceptance at 90 days/25° C were averaging close to 7, corresponding to liked moderately (Nascimento et al., 2002). For guava preserve showed an average between 7-6 (like slightly-like moderately) for different attributes to 150 days of storage at 20 ° C, and detected the appearance of crystals after 90 days, enhanced by the use of potassium sorbate as a preservative (Menezes, 2008). For banana cv prata preserve, kept at 20 -30 ^{o} C for 75 days had a good overall acceptance (in the scores in the range 6-7).

4. Conclusions

The packaging of polypropylene due to low gas permeability and light is appropriate and economical for a short time to market for packaging fruit jams (up to 150 days), maintaining acceptable products in terms of sensory and microbiological changes.

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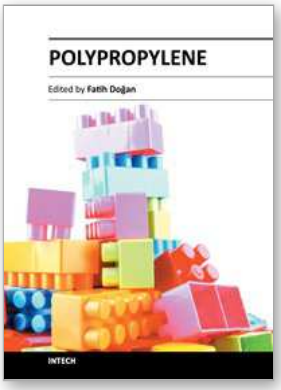

Polypropylene

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This book aims to bring together researchers and their papers on polypropylene, and to describe and illustrate the developmental stages polypropylene has gone through over the last 70 years. Besides, one can find papers not only on every application and practice of polypropylene but also on the latest polypropylene technologies. It is also intended in this compilation to present information on polypropylene in a medium readily accessible for any reader.

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University Campus STeP Ri
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51000 Rijeka, Croatia
Phone: +385 (51) 770 447
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Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821