

# Physicochemical Stability of Natural or Pre-Sweetened Frozen Passion Fruit Juice

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## ABSTRACT

Passion fruit juice, pure and sucrose sweetened (1:1, w:v), was frozen and stored for 8 months in freezers. The effect of storage time and sucrose addition on physicochemical properties of the juices was evaluated, in the fresh juice, and then every two months in the stored samples. Concentration of soluble solids, organic acids, total and reducing sugars and ascorbic acid, as well as pH were not affected by storage time. Initially sucrose addition modified the juice color, but not during storage time, while the natural juice became more yellow during storage. *β*-carotene content decreased as a function of storage time, 51.3 % in the pure juice and 29.7 % in the sweetened juice.

**Key words:** passion fruit, frozen storage, fruit juices

## INTRODUCTION

Fruit juices are consumed for their characteristic aroma and flavor and are considered a source of vitamins, minerals, soluble and insoluble fibers. Yellow passion fruit (*Passiflora edulis* var. *flavicarpa*) has a very acidic pulp, highly intense aroma and flavor and its juice has good acceptability in different markets, pure or in combination with other juices. Storing the fruit is difficult, but the juice may be stored in frozen or pasteurized form. Volatile compounds, responsible for aroma and flavor are very susceptible to heat treatment and during pasteurization up to 35% of the volatile compounds in the juice may be lost (Kuo *et al.*, 1985). Freezing is well suited for preserving physicochemical and sensory properties of fruit pulps and juices, although it has a higher cost of production and storage (Soler, 1988). Sugars are mostly used for their sweetening property, but also as humectants, plasticizers and flavor enhancers (BeMiller & Whistler, 1996). In fruit-flavored powders for reconstitution of drinks, sugar functions as bulking agent, flavor, aroma and color carrier (Godshall, 1988). The ability of carbohydrates to absorb and retain volatiles

during drying processes has been commercially explored and it has important implications and applications in flavor quality of foods (Godshall, 1988; Dziezak, 1988). A pre-sweetened juice needs only dilution for consumption and has the added advantage of the preservative properties of sugar.

The objective of this study was to characterize changes in physico-chemical properties of passion fruit juices, natural or sucrose sweetened, during frozen storage.

## MATERIALS AND METHODS

Yellow passion fruit, characterized by large fruit with the pedicel still attached was bought in bulk quantity from a wholesale market. Fruits were selected, washed, cut in half and pulp with the seeds was scooped out. The juice was processed in a blender, avoiding the breakage of seeds by using the blender intermittently and finished by sieving in a plastic 2 mm sieve. To sweeten the juice 100 g of sucrose was added to 100 g juice (1:1) and dissolution was facilitated

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by using a blender. The single strength and sweetened juices were vacuum packed in plastic bags in 70 mL portions, frozen and stored in domestic freezers (average temperature -18° C). Physicochemical analysis was performed in the fresh juice and every two months in stored samples, up to 8 months of storage.

The total soluble solids were determined in a refractometer ( Carl Zeiss Instruments) at 25°C, pH in a digital potentiometer (Alphalab model PA 200), titratable acidity by titration with 0.1 N sodium hydroxide acidity being expressed as citric acid. Total sugars was determined by the phenol-sulfuric colorimetric method (Dubois *et al.*, 1956) and reducing sugars by Nelson's method (Nelson, 1944). Ascorbic acid was determined by titration with 2,6 - dichlorophenolindophenol (AOAC, 1990) and  $\beta$ -carotene by the classic procedure of open column chromatography (Rodriguez-Amaya *et al.*, 1989). Juice color was measured as reflectance in a colorimeter (Photovolt 575). All analysis were performed in duplicate on three repetitions, for the fresh juice and the four storage times.

Data analysis of physicochemical determinations, as a function of storage time, were subjected to the analysis of variance, mean comparison (Tukey test) and regression, using SAS (Statistical Analysis System Institute, Inc., 1995). The treatments were analyzed separately as sugar addition altered the concentration of the juice components.

## RESULTS AND DISCUSSION

Juice processing yielded 18% seeds, 50% skins and 30% juice, within the average for passion fruit juice extraction (Luh, 1980; Lara *et al.*, 1980). The natural juice froze solid, while the sweetened juice formed a viscous solution. Juice composition was very stable during storage, with the exception of  $\beta$ -carotene. There was no change for pH or soluble solids for pure or sweetened juices as a function of storage time. Natural juice had values between 12.8 and 13.2% for soluble solids, above the minimum of 9% required in passion fruit juice (SIVP,

1972). Sucrose addition increased the soluble solids to values between 54.7 and 55.6% (Table 1).

Color is one of the most important attribute of food appearance (McLaren, 1980). Passion fruit juice color varies from yellow to reddish-orange and results from the presence of carotenoids. Average reflected wave length for the pure juice was 591 nm (orange) and from the sweetened juice 582 nm (orange-yellow), which is typical for passion fruit juice (Lara *et al.*, 1980; Casimir *et al.*, 1978). Sucrose addition altered the color of the juice to orange-yellow but it remained stable during storage, while in the natural juice had a slight and constant change in color during storage. Regression analysis, for the natural juice showed a linear decrease in the average reflected wave length to a lighter color, - 1.4 nm month<sup>-1</sup> ( $r^2 = 0.966$ ), during the storage period. Reduction in color intensity could be related to decreasing concentration of  $\beta$ -carotene and probably because of oxidation of other carotenoids present in the juice. Passion fruit juice contains  $\alpha$ ,  $\beta$ ,  $\xi$ , and  $\gamma$  corotene, neurosporene, aurochrome, cryptochrome, lycopene and auroxanthin, with  $\xi$ - carotene as the principal pigment and  $\beta$ -carotene as the main source of vitamin A activity (Cecchi & Rodriguez-Amaya, 1972).

In the natural juice  $\beta$ -carotene initial concentration was 6  $\mu\text{g/g}$  and there was a linear decrease of 0.34  $\mu\text{g month}^{-1}$  of storage ( $r^2=0.848$ ), for a total reduction of 51.3 % after 8 months. Cecchi, (1978) found 10.9  $\mu\text{g/g}$  of  $\beta$ -carotene in juice of fresh passion fruit and 1.6  $\mu\text{g/g}$  in juice of refrigeration stored fruits. Sweetened juice had an initial concentration of 2.7  $\mu\text{g/g}$  and after 8 months 1.9  $\mu\text{g/g}$  or 29.6 % reduction. The sweetened juice had 450 I.U. of vitamin A/100 g of juice initially and still retained 316 I. U./100g of juice after the storage time. It is possible that the sugar played a role in stabilizing the  $\beta$ -carotene, since that was the only difference between treatments.

Organic acids, total sugars and reducing sugars did not change as a function of storage time in natural or sweetened juices. Ascorbic acid

varied from 14.9 to 16.1 mg/ 100 g of natural juice and 7.8 to 8.2 mg/ 100g for sweetened juices, due the dilution caused by the sugar addition. In both treatments loses were lower than 5% during the 8 months of storage. Venning *et al.*, 1989 analyzing kiwi pulp found that total vitamin C had an average reduction of

6% and that pH, titratable acidity and total soluble solids were unaffected by frozen storage for one year, in both deaerated and non-deaerated pulp, at -18°C or lower storage temperature.

**Table 1.** Physicochemical determinations in frozen passion fruit juices a function of storage time. Treatments were analyzed separately.

Sweetened samples	Ascorbic acid mg/100g	$\beta$ -carotene $\mu$ g/ 100 g	Organic acids %	Color nm	pH	° Brix	Total sugars %	Reducing sugars %
Fresh	8.2 a	2.8	2,3	584	2.84	55.6	65.9	1.9
2 months	8.2 a	2.3	2.4	584	2.89	55.3	65.5	2.1
4 months	8.1 ab	2.2	2.4	583	2.80	54.7	62.5	1.9
6 months	7.9 ab	2.0	2.5	581	2.79	54.7	65.4	1.9
8 months	7.8 b	1.9	2.5	581	2.81	54.7	64.1	1.8
<b>Natural</b>								
Fresh	15.4	6.0 a	4.0	597	2.82	13.1	8,8	3.7
2 months	16.1	5.5 a	4.1	592	3.09	13.1	8.4	3.6
4 months	15.8	5.1 b	4.2	591	2.81	12.9	8.6	3.6
6 months	15.1	4.8 b	4.2	588	2.80	12.8	8.6	3.5
8 months	14.9	2.9 c	4.3	585	2.83	12.7	8.3	3.5

a-c: numbers with the same letter in the column, by treatment, are not different  $p < 0.05\%$ .

## CONCLUSIONS

Soluble solids, organic acids, total and reducing sugars, ascorbic acid content and pH were not affected by the storage time in both the treatments. Sucrose addition modified the color of the juice, but there was no further color alteration during storage. Pure juice changed color along the storage time, which could be cause by carotenoids degradation.  $\beta$ -carotene was reduced to 50% of its initial value in pure juice and to 68% in the sweetened juice. Analysis of variance of sensory evaluation data for the fresh juices showed no difference for pure or sweetened juices in sweet and passion fruit aromas and for acid and passion fruit flavors, residual flavor was reduced in the sweetened juice. After 8 months of storage, sweetened juice, compared to pure juice, had higher values for all sensory attributes, with the exception of acidity.

## RESUMO

Suco de maracujá, puro ou previamente adoçado com sacarose, 1:1 (p:v), foi congelado e armazenado por 8 meses em congeladores com temperatura de -18° C. O efeito de tempo de armazenamento e adição de sacarose sobre propriedades físico-químicas foi avaliada inicialmente no suco fresco e a cada dois meses nas amostras congeladas. Concentrações de sólidos solúveis, ácidos orgânicos, açúcares totais e redutores e ácido ascórbico, assim como pH, não foram afetados por tempo de armazenamento. Inicialmente a adição de sacarose alterou a cor do suco, mas esta se manteve durante o armazenamento, enquanto o suco natural alterou a cor para amarelo durante o armazenamento. Concentração de  $\beta$ -caroteno diminuiu em função do tempo de armazenamento, 51,3% no suco puro e 29,7% no suco previamente adoçado.

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