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Effects of high hydrostatic pressure (HHP) on sensory characteristics of yellow passion fruit juice

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Abstract

The aim of this study was to investigate the effects of high hydrostatic pressure on the sensory properties of passion fruit juice by quantitative descriptive analysis (QDA). The growing demand in Brazil for processed fruit pulp arouses juice industry interest to search for novel technologies with competitive advantages. High hydrostatic pressure (HHP) is an innovative technology which minimizes loss of sensory and nutritional quality, as compared to pasteurization, matching consumer demands for fresh-like foods. QDA and principal components analysis (PCA) results revealed high similarity among juice sensory attributes from *in natura* and pressurized samples both differing from commercial ones. Results suggest that HHP may be successfully used to preserve yellow passion fruit pulp, yielding a ready to drink juice with improved sensory quality, as compared to commercial juices available in the Brazilian market and evaluated in this study.

Keywords: Yellow passion fruit juice; High hydrostatic pressure; Quantitative descriptive analysis

Industrial relevance: The findings achieved in the study have important implication to the industry, because they demonstrated the positive effect of pressurization on the sensory properties of passion fruit juice. Pressurized juice should meet consumer's expectation and demand regarding a more natural, and free of cooked and artificial flavor attributes, yielding a product more similar to the freshly made one.

1. Introduction

The term passion fruit comprises several species from genus *Passiflora* L., family Passifloraceae. The genus *Passiflora* consists of approximately 400 species, with over 150 being native from Brazil (Bruckner & Picanço, 2001). The most important variety cultivated in Brazil for commercial purposes is yellow passion fruit (*Passiflora edulis* Sims f. *flavicarpa* Degener), according to Teixeira et al. (1994), being used for the processing of pulp and juice (Nogueira, De Melo, Righetto, & Sannazzaro, 2003; Sandi et al., 2004).

Yellow passion fruit is an ovoid shaped fruit much appreciated for its unique exotic flavor and yellow to reddish-orange color due to the presence of carotenoids. Its pulp has an intense acid flavor and water and sugar are usually added to obtain a palatable juice. Despite being marketed worldwide, only few studies regarding the sensory properties of this fruit have been reported in the literature (Deliza, MacFie, & Hedderley, 2004).

Ecuador, Colombia and Brazil supply the major part of the world market, and the European countries and the United States are the main importers, with a growing demand for the product in the form of concentrated juice (50 °Bx), as stated by Turano, Faveretti Filho, Lima and De Paula (2000), Teixeira (2005), and Vilela (2005). Brazil is the largest yellow passion fruit producer and consumer in the world, with a production of 492,000 tons in 2004 (IBGE, 2006). One of the most promising segments in Brazil is ready to drink fruit juice, showing an increasing production of 350 million L in 2004 which represented R$

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900 million. This market share is being disputed by several industries which look for possibilities of developing novel foods (Monteiro, 2006). Passion fruit juice is the third most produced juice in the Brazilian market (Aguiar & Santos, 2001). Yellow passion fruit juice has good acceptability, pure or in combination with other juices and is considered an important source of vitamins, minerals, soluble and insoluble fibers (Righetto, Beleia, & Ferreira, 1999).

Traditional food processing methods have relied on high temperatures to ensure prolonged shelf-life and food safety. Heat, however, leads to quality deterioration in certain foods by producing undesirable changes in sensory and nutritional characteristics due to slow heating and cooling rates (Thakur & Nelson, 1998). Food scientists and the food industry are therefore searching for novel methods which may destroy undesirable microorganisms with less adverse effects on product quality (Rosenthal & Silva, 1997; Cardello, Schutz, & Lesher, 2007).

Volatile compounds responsible for aroma and flavor of passion fruit juice are extremely sensitive to heat treatment. Kuo, Chen, Wu and Chen (1985) reported up to 35% loss in volatile compounds during passion fruit juice thermal treatment. Pasteurization is, therefore, responsible for major undesirable sensory changes, which tend to intensify during storage of yellow passion fruit juice (Sandi, Chaves, Parreiras, De Souza, & Da Silva, 2003).

High hydrostatic pressure (HHP) is being investigated as a non-thermal processing technique to destroy food-borne pathogens and inactivate enzymes in order to enhance safety and shelf-life of perishable foods (Knorr, 1993). HHP processing subjects food to pressures of 100–900 MPa, and between 300 and 700 MPa in commercial systems, employing normally water as the pressure transmitting medium (San Martín, Barbosa-Cánovas, & Swanson, 2002). At ambient temperatures, application of pressures in the range of 300–500 MPa inactivates vegetative microorganisms and reduces the activity of enzymes combined with retention of small molecules responsible for taste and color and many vitamins, resulting in a pressurized product which can be stored for a considerable time at 4–6 °C (Cheftel, 1995).

HPP of fruit and vegetable products offers the chance of producing food of high quality, greater safety and increased shelf-life (Butz et al., 2003). The main requirement that this new technology must meet is to ensure product microbial safety while preserving sensory and nutritional characteristics to obtain products more similar to fresh foods. HPP can enable ready to drink juice processors to produce innovative products with fresh-like, natural-like attributes and natural-looking colors which are all aspects valued by consumers nowadays (Deliza, Rosenthal, Abadio, Silva, & Castillo, 2005).

In order to meet these demands stated by consumers worldwide, the evaluation of yellow passion fruit juice sensory quality is essential. It can be carried out using conventional profiling techniques, such as quantitative descriptive analysis (QDA). QDA was developed during the 1970's and involves discrimination and description of both the qualitative and quantitative sensory components of a product by trained panels of judges (Stone, Sidel, Oliver, Woolsey, & Singleton, 1974; Stone & Sidel, 1998, 2004). The qualitative aspects include appearance, aroma, flavor, texture, aftertaste and sound properties of a product which distinguish it from others. By using QDA, trained panelists identify, characterize and quantify the sensory properties of food (Murray, Delahunty, & Baxter, 2001).

Descriptive analysis is often used within the food industry to allow relationships between descriptive sensory and instrumental or consumer preference measurements to be determined. This methodology can be used for quality control, for the comparison of product prototypes to understand consumer responses in relation to products' sensory attributes, and to for sensory mapping and product matching. It may also be used to track product changes over time with respect to understanding shelf-life and packaging effects and to investigate the effects of ingredients or processing variables on the final sensory quality of a product (Zook & Wessman, 1977; Stone & Sidel, 1998; Murray et al., 2001).

The objective of this study was to obtain a sensory comparative description of *in natura*, HHP processed with five commercial thermally treated yellow passion fruit juices.

2. Material and methods

2.1. Yellow passion fruit pulp

The yellow passion fruit pulp (*in natura*, not thermally treated) was provided by a fruit juice processor and transported refrigerated to Embrapa Food Technology, Rio de Janeiro, RJ. After arriving, it was packed in 1 L bottles and immediately frozen at −20 °C and kept frozen until the beginning of the study. Samples of the referred *in natura* pulp were submitted to physicochemical and microbiological analyses according to AOAC (2000) and FDA (2001, 2002, 2003). The following physicochemical parameters were determined: pH, total soluble solids (°Bx) and total titrable acidity expressed as citric acid (g/100 g). The microbiological analyses comprised: coliform bacteria at 35 °C and 45 °C counting, detection of *Salmonella*, and yeast and molds counting.

2.2. Yellow passion fruit pulp high pressure processing and juice formulation

In natura yellow passion fruit pulp was taken from the freezer on the day before the HHP processing, and kept in the fridge. Samples were packed in pressure-resistant polyethylene bags, heat sealed and pressurized at 300 MPa for 5 min at 25 °C. This process condition was identified in previous study (Rosenthal et al., 2005) employing an isostatic equipment, Stansted Food Lab 9000 (Stansted Fluid Power Ltd., England). Water and sugar were added to the *in natura* and pressurized pulps to produce juice. The amount of water and sugar used (1 part pulp/6.33 parts water and 9% sucrose) was previously determined by ideal dilution and ideal sucrose concentration tests, according to Deliza (2001) and Laboissière, Deliza, Rosenthal, Junqueira and Barros (2005). The pressurized pulp was submitted to the same physicochemical and microbiological analyses mentioned before for the *in natura* pulp.