PROCESS DEVELOPMENT FOR OBTAINING A CLARIFIED SPORT DRINK FROM NATURAL JUICES

Wolkoff, D.B.[1]; Pontes, S.M.[2]; Furtado, A.L.[2]; Cabral, L.C.[2]; Moretti, R.H.[3]; Matta, V.M.∗[2]

[1]UERJ, Nutrition Institute; Rio de Janeiro, Brasil. daisyw@attglobal.net

[2]Embrapa Food Technology; Rio de Janeiro, Brasil. vmatta@ctaa.embrapa.br

[3]UNICAMP/FEA. Campinas, São Paulo, Brasil

SUMMARY

A great increasing in the sport drink market has been verified all around the world. In Brazil, from 1996 to 2000, the consumption increased from 30.7 to 59.0 millions of litters. This work aimed at developing a process for obtaining a clear sport drink from fruit juices. The process consisted of the following steps: clarification of the pulping fruit juices by microfiltration in a 0.3μm membrane, formulation with salts, sugar and preservative, and sterilization at 120°C/5s. Cashew apple and acerola juices, natural sources of vitamin C, were the basis of the beverage. Sodium salts and sucrose were added to the juice blend. The sodium and carbohydrate sport drink concentration ranged similarly to the commercial rehydrating beverages. The vitamin C content was 270mg/100mL. The drink properties, including the vitamin C content, were preserved during three months of storage at room temperature.

Key-words: fruit-based drinks, microfiltration, shelf-life, vitamin C, sport drink

INTRODUCTION

Tropical fruit juices as acerola and cashew are natural sources of vitamin C. They also have exotic flavors which are easy to attend consumer's preference. Besides these characteristics, the increasing market of sport drinks, mainly carbohydrate-electrolyte drinks, justifies the development of new beverages containing fruit juices, in order to add functional and nutritive value to those products.

The acerola cultivation presents social and dietary importance. Its vitamin C content ranges from 800 mg/100g to 4000 mg/100g (Asenjo, 1980). In Brazil, the most commercialized acerola products have been the fruit itself, the frozen pulp and the pasteurized single strength juice. However, there is a tendency of diversification with new products, such as juice blends made from acerola and orange, acerola and guarana, and concentrated juices (Martinelli, 1998).

Cashew apple is the edible portion (pseudo fruit) of the cashew fruit, representing 90% of its weight. It is consumed as a fresh fruit. It has rich flavor and aroma, and vitamin C content, being an adequate raw material for juices, exotic beverages and other products. The main objective of the cashew culture is the cashew nut extraction. The use of the pseudo fruit reaches only 12% of the total processed fruit, showing the necessity of development of new cashew apple's products, in order to reduce waste (Paiva *et. al*., 2000).

Beverages obtained from clear, high quality fruit juices, as a blend of acerola and cashew apple juices, can offer new options to consumers, who look for healthier, tasty and refreshing products.

Membrane technology is an alternative to conventional processes of juice clarification, presenting many advantages in relation to the classic separation processes. In general, separation occurs at room temperature, without phase change or the use of thermal source, resulting in energy economy (Mulder, 1991). As the separation is carried out under mild conditions, quality of the final product is improved (Rodrigues *et al.*, 2001).

Sport drinks in general, and carbohydrate-electrolyte drinks in particular, offer to active people the proper beverage to replace the lost nutrients in sports practices. Exercise in hot weather, for at least one hour, causes liquid and mineral losses, such as sodium and chloride. Those electrolytes must be included in sport drinks, as well as some fast absorption carbohydrate source, to prevent or delay the fatigue (Ford, 1999). The most important target is the fluid replacement, offering a cold beverage, with adequate sensory and functional properties according to consumer's view, aiming at stimulating product consumption (Burke & Read, 1993; Coleman, 1996; Armstrong, 2000).

Stability of a microfiltered sport drink from acerola and cashew juices was previously evaluated. The product was stored under 4^{o}C and 25^{o}C, giving excellent results at 4^{o}C, but not at 25^{o}C (Wolkoff *et al.*, 2003). Therefore, this work had as objective to develop a stable sport drink from acerola and cashew juices, using microfiltration, sterilization, and preservative, with quality preserved even when stored at room temperature (25^{o}C).

MATERIAL AND METHODS

Commercial cashew apple pulp and acerola fruit were utilized as raw material. A pulper machine with 0,8 mm sieve was used for acerola fruit pulping. An enzymatic hydrolysis of acerola juice to reduce viscosity, as a pre-treatment for clarification, was carried out in a mixture tank using Pectinex Ultra SP-L enzyme from Novo Nordisk, at 0.01% (v/v), 35^{o}C, for 30 minutes. Clarification was carried out on a tubular microfiltration module presenting a polyethersulfone membrane with a medium pore size of 0.3 μm, with 0.05 m^2 permeation area. Process conditions were 35^{o}C and 100 kPa (Matta *et al.*, 2000).

Acerola and cashew apple juices were clarified and mixed to other formulation ingredients: sodium salts, sucrose, water and preservative. After that, the mix was sterilized at 120^{o}C/5s and filled at 25^{o}C in a *Clean-fill Hood & Sterile Product Outlet*. Sterilized glass and sanitized PET bottles were used. The product was stored at room temperature (25^{o}C) and evaluated each 15 days, during 90 days.

Titrable acidity and pH (Instituto Adolfo Lutz, 1985), soluble solids (AOAC,1997), ascorbic acid (AOAC, 1984) modified by Benassi (1990) and Silva (1999), instrumental color and haze (Ferreira, 1981), microbiological (mould and yeast, total counting, *Salmonella* and coliforms) analyses (Compendium…, 1995) were carried out in all processing stages and during the storage period. In order to characterize the beverage, sodium, chloride, potassium, sugar and proximal composition were analyzed, as well as product's osmolality.

Results were analyzed by multi factorial variance analyses (MANOVA) at 95% significance level.

RESULTS AND DISCUSSION

The final beverage composition was: 42 mg sodium/100g; 39 mg chloride/100g; 49 mg potassium/100g; 5.55 g total sugars (glucose, fructose and saccharose/100g); 6.9ºBrix; 6 g carbohydrate/100g; 0.33 g malic acid/100g; pH 3.77; 274 mg vitamin C/100g.

Sodium, chloride and carbohydrate contents were similar to those of the commercial products available in the market. The American College of Sports Medicine position standard for fluid replacement recommended solutions containing 4-8% carbohydrates (Armstrong, 2000). Those carbohydrates can be sugars (glucose or sucrose) or starch (e.g., maltodextrin). Brouns & Kovacs (1997) and Coleman (1996) recommended from 6% to 8% as an optimal range for carbohydrates. Referring to sodium, the same standard recommended NaCl from 0.5 to 0.7g/L water, while Brouns and Kovacs (1997) suggested from 400 to 600 mg/L.

Potassium losses in sweat ranges from 121 to 225 mg/L (Brouns & Kovacs, 1997), but some sports drinks far exceed this level, even higher than 500%. It is not recommended potassium or magnesium addition to avoid muscle cramp and to keep optimal muscle action. However, the beverage developed in this study has natural sources of potassium. Ford (1999) recommended fruit juice addition, as a natural potassium source, into sports drinks with care, in order to avoid high osmolality.

Vitamin C content of the sport drink was 274 mg/100g after sterilization, representing a high level of this nutrient. In recent Dietary Reference Intake (DRIs), the maximum antioxidants intake level, except for carotenoids, has been proposed as 2000 mg/day for adults. The DRI for vitamin C, considering adult males, is 90 mg, and 75 mg for females (Amaya-Farfan *et al*., 2001). However, such references are numeric values for estimating nutrient consumption, used mainly for planning and evaluating the healthy people diet. Athletes on competitions, or very active people, have no definition for the referred parameters.

Microbiological analyzes of the obtained beverage showed that this product attended to Brazilian requirements for juices and drinks (Brasil, 2001). These parameters were kept during the storage period.

Beverage's osmolality was 312 mOsml/L, measured in a steam pressure osmometer (Knauer A0280). At the end of storage period, however, this value reached 397 mOsmol/L, possibly, due to partial saccharose inversion on acid medium. Optimal effects on absorption and fluid balance are obtained with hypotonic to isotonic solutions (Brouns & Kovacs, 1997). Isotonic solutions must have blood's similar osmolality, from 280 to 300 mOsml/L (Ford, 1999). Hyperosmolality can counterbalance water absorption benefits that are achieved by solute transport. However, small differences don't matter for clinical effects. Therefore, solutions with osmolality from 340 mOsml/L up to 400 mOsmol/L are slightly hypertonic and can still be used as sport drinks (Brouns & Kovacs, 1997).

Vitamin C losses were 2.4% in the clarification stage, and 2.5% after sterilization. This result can be compared to other microfiltration processes of acerola (Matta, 1999) and cashew apple (Campos, 2001) juices that reported losses of 4.5% to 5% in the vitamin C content. Matsuura (1994), in other hand, observed a 12% loss during acerola juice pasteurization. No significant changes in the pH value, soluble solids or titrable acidity occurred during microfiltration and sterilization processes.

The sport drink was submitted to sensory evaluation. Its acceptability was evaluated by one hundred consumers. The results showed that 91% of participants liked the product, and that 72% declared the intention to purchase it, if it was available in the market.

Shelf life evaluation of the parameters showed no difference between the two types of packaging material. Soluble solids, pH, titrable acidity and luminosity had no significant variation, during 90 days of storage at room temperature (25ºC). Vitamin C losses in glass and PET bottles were 4% and 6.6%, respectively. Campos (2002), after 60 days of refrigerated storage of clarified cashew apple juice, reported about 50% vitamin C losses, and even worse results at room temperature (30ºC). Haze has increased during the room temperature storage, although it was not verified through the visual observation. Figure 1 shows the behavior of vitamin C in both packaging materials. Figure 2 shows the haze behavior under the same conditions.

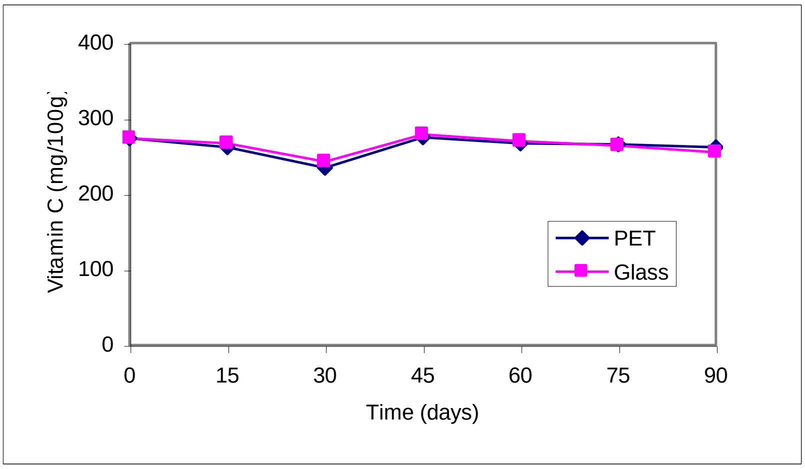

Figure 1 - Vitamin C behavior of sport drink in glass and PET bottles, during 90 days of storage, at 25ºC

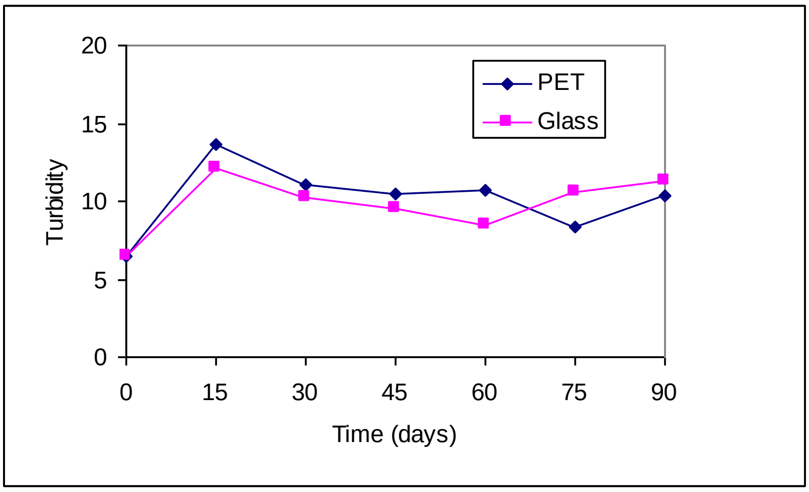

Figure 2 – Haze behavior of sport drink in glass and PET bottles, during 90 days of storage, at 25ºC

CONCLUSIONS

The clarified sport drink, obtained by microfiltration and sterilization, has well preserved the fruit juices main characteristics during the processing steps and during its storage at room temperature (25ºC). Its high vitamin C content, together with the low turbidity, microbiological safety, and high product acceptability may be a promising alternative to consumers.

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