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Various Variables Influencing to Production of Star Apple (*Chrysophyllum Cainito)* Juice

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Abstract.

Star apple is a non climacteric fruit, with high nutritional and health benificary as well as high antioxidant capacity. It has a great potential in international markets due to its flavor and appearance. In the present study, various technical parameters influencing to production of star apple (*Chrysophyllum cainito)* juice were clearly investigated such as ratio of pulp: water, sugar supplementation; pasteurization, storage condition to stability of star apple juice. Optimal results showed that ratio of pulp: water (1.0: 2.0 w/v); 8% of sugar supplementation; 95^{o}C, 30 seconds in pasteurization; 28^{o}C within 6 weeks of preservation could maintain stability of star apple juice.

Keywords*:* Star apple, juice, sugar, pasteurization, preservation, stability

I. INTRODUCTION

Chrysophyllum cainito L. (Sapotaceae), known commonly as star apple or caimito, is a tropical tree that bears edible fruits (Xiao-Dong Luo et al., 2002). Star apple is an apple size fruit commonly round with a smooth and waxy skin. The pulp is white or creamy white, with numerous small, shiny, dark brown seeds embedded in it. Star apple is a non climacteric fruit, with high antioxidant capacity and high nutritional and health potential. The sweet fleshy fruit is an excellent source of Vitamin C, iron (Oluwole Oluwatoyin Bolanle et al., 2017). In the harvesting season, its commercial price goes down very fast because it is very easy to be decomposed. Moreover, damage of fruits by insect pests is one of the major problems faced by fruit sellers (Ugwu, J.A.; Umeh, Vincent., 2015). In order to maintain a good quality, fruit must be kept at 3-6°C and 90% RH. Under these conditions fruit present a shelf life of three weeks, and can benefit further from an adequate modified atmosphere system (Yahia, 1998).

Several researches mentioned to production of star apple fruits. Adindu M.N. et al., (2003) wrapped star apples in perforated polythene, moist jute material and without wrapping for storage. Amusa N. A. et al., (2004) investigated the biodeterioration of the African star apple fruits in storage. Chukwumalume R.C. et al., (2012) carried out the microbiological assessment of preservative methods for African star apple juice. Nguyen Phuoc Minh et al. (2018) used chitosan as edible coating on storage of star apple (*Chrysophyllum Cainino*) fruit.

In the present study, various technical parameters influencing to production of star apple (*Chrysophyllum cainito)* juice were clearly investigated such as ratio of pulp: water, sugar supplementation; pasteurization, storage condition to stability of star apple juice.

II. MATERIALS AND METHOD

2.1 Material

We collected star apple fruit in Soc Trang province, Vietnam. They must be cultivated following VietGAP to ensure food safety. After harvesting, they must be conveyed to laboratory within 8 hours for experiments. Fruits were washed thoroughly under turbulent washing to remove dirt, dust and adhered unwanted material. Besides star apple fruits we also used other materials during the research such as sugar, Petrifilm-3M. Lab utensils and equipments included pH meter, refractometer, viscometer, blender, thermometer, oven, refrigerator, incubator, colony counter.

Figure 1. Star apple (*Chrysophyllum cainito)*

2.2 Researching procedure

2.2.1 Effect of water addition (pulp: water) during the blending process

The fruits were washed under running tap water, hand peeled, decored, deseeded and the pulp blended using an electric blender. The pulp was then filtered. Water was added in different ratio (1:1 w/v, 1:1.5 w/v, 1:2 w/v, 1:2.5w/v, 1:3 w/v) of (pulp/water) to facilitate the blending process. Viscosity, sensory measurements were applicated to demonstrate the optimal ratio of pulp: water.

2.2.2 Effect of sugar addition

The fruits were washed under running tap water, hand peeled, decored, deseeded and the pulp blended using an electric blender. The pulp was then filtered. Water was added in 1:2 w/v. Different amount of sugar (2%, 4%, 6%, 8%, 10%) was added to the star apple juice. Viscosity, sensory measurements were applicated to demonstrate the optimal ratio of sugar addition.

2.2.3 Effect of pasteurization

The fruits were washed under running tap water, hand peeled, decored, deseeded and the pulp blended using an electric blender. The pulp

was then filtered. Water and sugar were added in 1:2 w/v and 8% respectively. Star apple juice was pasteurized in different condition (80^{o}C, 60 seconds; 85^{o}C, 50 seconds; 90^{o}C, 40 seconds; 95^{o}C, 30 seconds and 100^{o}C, 20 seconds). Viscosity, sensory, microbial measurements were applicated to demonstrate the optimal condition of pasteurization.

2.2.4 Effect of storage condition to stability of star apple juice

The fruits were washed under running tap water, hand peeled, decored, deseeded and the pulp blended using an electric blender. The pulp was then filtered. Water and sugar were added in 1:2 w/v and 8% respectively. Star apple juice was pasteurized in 95^{o}C, 30 seconds. Pasteurized star apple juice was store under refrigeration temperature (4°C) and ambient temperature (28°C) for 6 weeks. Samples were analysed for brix, titratable acidity (g citric acid/100 g), pH, aerobic mesophilic bacteria and moulds/yeasts counts and *coliform* counts at regular intervals of one week.

2.3 Physico-chemical and biological analysis

Star apple juice was filtered on a cotton cloth and the volume (yield) of juice obtained from each sample was measured using a 500 ml volumetric flask. The moisture, crude protein (N x 6.25), crude fat and ash contents of star apple pulp and star apple juice were determined using relevant AOAC methods (AOAC, 1984). Titratable acidity (g citric acid/100 g) and pH of the samples were determined according to the methods described by Egan et al. (1981). Total soluble solids (TSS) were measured by refractometer. The viscosity measurement was made by using a viscometer. For sensory evaluation of the juices, the product was evaluated by a panel of 30 semi trained panelists. Panelists were required to evaluate the odour, colour, taste, sweetness and overall acceptance using the 9-point hedonic scale (1 = dislike extremely, 9 = like extremely). 3M-Petrilm was used to analyze TPC, *Coliform*, *E. Coli*.

2.4 Statistical analysis

The experiments were run in triplicate with three different lots of samples. Data were subjected to analysis of variance (ANOVA) and mean comparison was carried out using Duncan's multiple range test (DMRT). Statistical analysis was performed by the Statgraphics Centurion XVI.

III. Result & Discussion

3.1 Nutritional composition in star apple pulp and star apple juice

Nutritional composition in star apple pulp was primarily examined. Results were elaborated in table 1.

Table 1. Nutritional composition in star apple pulp

Parameter	Star apple pulp
Moisture (%)	79.83±0.02
Protein (%)	2.19±0.01
Ash (%)	0.65±0.02
Carbohydrate (%)	16.50±0.01
Total sugar (g/100g)	10.22±0.01

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 1 gave the physicochemical composition of star apple pulp and star apple juice. This result was similar to finding by Morton (1987); Pino *et al.* (2002); Alvarez *et at.* (2006), Parker *et at.* (20 I0). The fruit-pulp has been reported to contain signifcant amount of ascorbic acid (Adepoju O, Adeniji TPO, 2012), vitamins, iron and food flavors, fat, carbohydrate and mineral elements (Ureigho UN, 2010; Christopher EA, Dosunmu MI, 2011).

3.2 Effect of water addition (pulp: water) during the blending process

The fruits were washed under running tap water, hand peeled, decored, deseeded and the pulp blended using an electric blender. The pulp was then filtered. Water was added in different ratio (1:1 w/v, 1:1.5 w/v, 1:2 w/v, 1:2.5w/v, 1:3 w/v) of (pulp/water) to facilitate the blending process. Viscosity, sensory measurements were applicated to demonstrate the optimal ratio of pulp: water. From table 2, the optimal ratio of pulp: water should be 1.0: 2.0.

The viscosity, shear stress and shear rate of African star apple juice (*Chrysophyllum albidium*) at different concentrations of 8 % to 32% total solid concentration and temperature range of 20°C to 70°C were obtained in order to determine the effect of changes in concentration and temperature on the rheological properties of the juice. Increase temperature decreases the viscosity of the juice (Awolu OO et al., 2013).

3.3 Effect of sugar addition

The fruits were washed under running tap water, hand peeled, decored, deseeded and the pulp blended using an electric blender. The pulp was then filtered. Water was added in 1:2 w/v. Different amount of sugar (0%, 2%, 4%, 6%, 8%, 10%) was added to the star apple juice. Viscosity, sensory measurements were applicated to demonstrate the optimal ratio of sugar supplementation. From table 3, the optimal sugar addition should be 8%.

Table 2. Effect of water addition (pulp: water) during the blending process

Pulp: water (w/v)	1.0: 1.0	1.0: 1.5	1.0: 2.0	1.0: 2.5	1.0: 3.0
Viscosity (cp)	1,217±0.08^a	1,131±0.17^b	1,090±0.12^b	995±0.06^c	948±0.11^d
Sensory score	5.35±0.01^c	6.08±0.01^b	7.31±0.02^a	4.22±0.01^d	3.11±0.02^e

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 3. Effect of sugar addition

Sugar addition	0%	2%	4%	6%	8%	10%
Viscosity (cp)	1,090±0.12^{b}	1,118 ±0.17^{b}	1,145 ±0.04^{b}	1,221 ±0.17^{b}	**1,270 ±0.15^{b}**	1,323 ±0.11^{b}
Sensory score	7.31±0.02^{cd}	7.39 ±0.01^{c}	7.81 ±0.02^{bc}	7.94 ±0.02^{b}	**8.23 ±0.02^{a}**	7.00 ±0.01^{d}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 4. Effect of pasteurization

Pasteurization	80^{o}C, 60 s	85^{o}C, 50 s	90^{o}C, 40 s	95^{o}C, 30 s	100^{o}C, 20 s
Viscosity (cp)	1,290±0.11^{a}	1,288±0.16^{ab}	1,280±0.21^{b}	**1,275±0.09^{bc}**	1,262±0.04^{c}
Sensory score	6.11±0.02^{c}	7.42±0.03^{b}	8.04±0.02^{ab}	**8.39±0.02^{a}**	8.20±0.02^{a}
Coliform (cfu/g)	0	0	0	**0**	0

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 5. Effect of storage condition to stability of star apple juice

Parameters	Storage temperature (4^{o}C), week			Storage temperature (28^{o}C), week		
	0st	3rd	6th	0st	3rd	6th
Total soluble solid (^{o}Brix)	16.15 ±0.02^{a}	15.79 ±0.01^{ab}	15.48 ±0.01^{b}	16.15 ±0.02^{a}	15.72 ±0.02^{ab}	15.40 ±0.02^{b}
Titratable acidity (g citric acid/100 g)	1.22 ±0.01^{a}	1.20 ±0.03^{ab}	1.17 ±0.02^{b}	1.22 ±0.01^{a}	1.18 ±0.03^{ab}	1.16 ±0.02^{b}
pH	4.44 ±0.02^{b}	4.45 ±0.01^{ab}	4.46 ±0.02^{a}	4.44 ±0.02^{b}	4.46 ±0.03^{ab}	4.48 ±0.01^{a}
TPC (cfu/g)	1.2x10^{1} ±0.02^{b}	1.3x10^{1} ±0.01^{ab}	1.5x10^{1} ±0.01^{a}	1.2x10^{1} ±0.02^{b}	1.4x10^{1} ±0.00^{ab}	1.8x10^{1} ±0.02^{a}
Mold (cfu/g)	0	0	0	0	0	0
Coliform (cfu/g)	0	0	0	0	0	0

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Fruit juices have become an important part of the modern diet in many communities. They are nutritious beverages and can play a signifcant part in a healthy diet because they offer good taste and a variety of nutrients found naturally in fruits. They are available in their natural concentration or processed form. The values of viscosity strongly depend on temperature and soluble solids content (Lesław Juszczak et al., 2010).

3.4 Effect of pasteurization

The fruits were washed under running tap water, hand peeled, decored, deseeded and the pulp blended using an electric blender. The pulp was then filtered. Water and sugar were added in 1:2 w/v and 8% respectively. Star apple juice was pasteurized in different condition (80^{o}C, 60 seconds; 85^{o}C, 50 seconds; 90^{o}C, 40 seconds; 95^{o}C, 30 seconds and 100^{o}C, 20 seconds). Viscosity, sensory, microbial measurements were applicated to demonstrate the optimal condition of pasteurization. From table 4, the optimal condition in pasteurization should be 95^{o}C, 30 seconds.

Fruits are perishable commodities and their quality is deteriorated during transportation due to the action of environmental factor (temperature and sunlight) and enzymes (Muhammad Adil Rehman et al., 2014). Juice pasteurization is based on a 5 log reduction of the most resistant microorganisms (Leonardo Petruzzi et al., 2017). With the application of innovative technologies deterioration can be minimized and juices can be stored for longer period of time (Muhammad Adil Rehman et al., 2014).

3.5 Effect of storage condition to stability of star apple juice

The fruits were washed under running tap water, hand peeled, decored, deseeded and the pulp blended using an electric blender. The pulp was then filtered. Water and sugar were added in 1:2 w/v and 8% respectively. Star apple juice was pasteurized in 95^{o}C, 30 seconds. Pasteurized star apple juice was store under refrigeration temperature (4°C) and ambient temperature (28°C) for 6 weeks. Samples were analysed for total soluble solid (^{o}Brix), titratable acidity (g citric acid/100 g), pH, aerobic mesophilic bacteria and moulds/yeasts counts and *coliform* counts at regular intervals of three week. From table 5, the star apple juice had a stable quality in ambient temperature during preservation.

Fruit juice is a clear or uniformly unfermented liquid, intended for direct consumption, recovered from sound, ripe fruits by pressing and other mechanical means. The juice may be clear or turbid. Fruit juices have become an important part of the modern diet in many communities (Awolu OO et al., 2013).

IV. CONCLUSION

Star apple is a non climacteric fruit. It has a very pleasant flavor and nice appearance when cut in half. Fruit juices are getting more attention. We have successfully optimized

various technical parameters influencing to production of star apple (*Annona muricata)* juice were clearly investigated such as ratio of pulp: water, sugar addition during the blending process; pasteurization, storage condition to stability of star apple juice. They are nutritious beverages and can play a signifcant part in a healthy diet because they offer good taste and a variety of nutrients found naturally in fruits. They are available in their natural concentration.

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