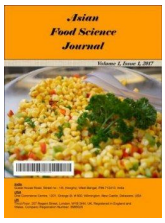

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The Effect of Pasteurisation on the Physicochemical and Nutritional Quality of Soursop (Annona muricata L.) Juice

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Authors' contributions

This work was carried out in collaboration between both authors. Author JAA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author BQ managed the analyses of the study and managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

The effect of pasteurisation on the nutritional and physicochemical quality of soursop juice was investigated. Soursop juice was prepared from soursop fruit pulp and pasteurised at different temperatures (63, 71, 78, 83 and 95°C) for different durations. The effect of pasteurisation on ascorbic acid level, total phenolic content and total antioxidant capacity of the juice was analysed. Additionally, the changes in pH, total soluble solids, titratable acidity and colour (L*a*b*) were determined. The pH, total soluble solids and titratable acidity were not significantly affected by pasteurisation. Pasteurisation affected the total phenolic content and total antioxidant capacity of the juice. For the same pasteurisation temperature, an increased duration of pasteurisation resulted in a reduction of total antioxidant capacity. Ascorbic acid levels in the juice decreased with increased duration and temperature of pasteurisation. A first-order kinetic model was developed to explain the effect of pasteurisation on the degradation of ascorbic acid in soursop juice. A degradation rate constant of 0.035 min^{-1} and an activation energy of 83 kJ/mol were obtained.

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Keywords: Soursop juice; pasteurization; ascorbic acid; total phenolic content.

1. INTRODUCTION

Soursop is an important fruit rich in vitamins and minerals as well as several bioactive phytochemicals such as alkaloids, phenols and flavonoids [1]. Soursop is, however, considered an underutilised fruit [2]. Among the factors accounting for the underutilisation of soursop include the short shelf life of the fruit after harvest [2]. Although studies on improving the postharvest shelf life of soursop fruit have been carried out [3], processing of the fruit pulp into other products such as juice offers the opportunity to realise the full potential of soursop as an economically important fruit crop. The production of packaged soursop juice can, therefore, give the opportunity to expand the usage of soursop fruit. The pulp of soursop fruit, is especially, suitable for processing into juice due to its high percentage recovery rate [4].

To produce soursop juice, soursop fruit have to be peeled and the juice expressed from the pulp. This process can increase the chance of microbiological contaimination leading to increase susceptibility of the juice to spoilage [5]. The juice, therefore, have to be processed, either thermally or using other food processing methods, to reduce the action of microorganisms that would hasten spoilage. The chosen processing method should be able to inactivate microorganisms without signifcantly affecting the nutritional and physicochemical quality of the juice [6]. Pasteurisation, a thermal processing method, can be used to achieve this desired effect.

The aim of this work was, therefore, to investigate the effect pasteurisation on the nutritional and physicochemical quality of soursop juice. Soursop juice was prepared from the fruit pulp and pasteurised under different temperature-time conditions. The effect of pasteurisation on ascorbic acid levels, total phenolic content and total antioxidant capacity of the soursop juice were analysed. Also, the changes in pH, total soluble solids, titratable acidity and colour of the juice were determined. Additionally, a kinetic model was developed to explain the effect of pasteurisation on the changes in ascorbic acid levels in the soursop juice.

2. MATERIALS AND METHODS

2.1 Preparation of Soursop Juice

Soursop fruits (*Annona muricata* L.) were obtained from a farm in the Central Region of Ghana. Fruits of uniform size and firmness were harvested and immediately transported to the University of Cape Coast for storage. All fruits were stored in an incubator at 30°C until ripening was observed.

Prior to the preparation of the juice, soursop fruits were first cleaned with water to remove surface debris after which the surface of the fruits (the peel) were disinfected with sodium hypochlorite solution (1.4% available chlorine). Copious amounts of sterile water was then used to wash the disinfected fruits to remove residual hypochlorite. The juice was extracted from the fruits after peeling and removal of seeds using an electric powered juice extractor. All containers used in the preparation of the juice were either sterilised by autoclaving or disinfected with hypochlorite solution prior to been used.

2.2 Pasteurisation of Soursop Juice

The soursop juice was pasteurised on a water bath (Y28VF, Grant Water bath) and cooled rapidly in ice cold water. Four replicate heating experiments per temperature and time point were carried out.

The pH, total soluble solids, titratable acidity and colour of the soursop juice were determined on the same day pasteurisation was carried out. All other pasteurised juice samples were stored at -80°C until the analysis of ascorbic acid levels, total phenolic content and total antioxidant capacity. Unpasteurised soursop juice were also analysed, and the results used as the control.

2.3 Determination of pH, Total Soluble Solids, Titratable Acidity and Colour

The pH and the total soluble solids (determined as degree Brix) content of the soursop juice were determined using a pH meter (B10P Benchtop pH Meter) and digital refractometer (MA871, Milwaukee Instruments USA), respectively. Titratable acidity was determined by titrating 5 mL of the juice against 0.1 N NaOH using phenolphthalein as indicator. The titratable acidity was expressed as grams of citric acid per

liter of juice [7]. The colour of the juice was determined using colour meter (CS-10, CHN Spec, China) based on the L*a*b colour scale.

2.4 Analysis of Ascorbic Acid Levels, Total Phenolic Content and Total Antioxidant Capacity

Ascorbic acid levels in the juice were determined using the 2,4- dinitrophenylhydrazine based assay [8]. Ascorbic acid was extracted with metaphosphoric-acetic acid solution, and the extract filtered through a 0.45 µm filter disk. Bromine water was then added after which thiourea and 2, 4-dinitrophenylhydrazine were added. The mixture was incubated for 3 h at 40°C and 6 mL of 80% sulphuric acid was added. The absorbance was measured at 540 nm. L-ascorbic acid was used as the standard, and the results expressed as mg ascorbic acid per 100 g of soursop juice.

The total phenolic content of the juice was determined using the Folin-Ciocalteu reagent based assay [9]. A methanolic extract was prepared by mixing equal volumes of soursop juice and 80% methanol solution. After incubation and centrifugation, the clear solution was pipetted and used for the analysis of both total phenolic content and total antioxidant capacity. Folin-Ciocalteu's reagent (750 µL) was added to 100 µL of the methanolic extract, and the mixture incubated at 35°C for 3 h. The absorbance was measured at 725 nm. Gallic acid was used as the standard and the total phenolic content expressed as mg Gallic acid equivalent per 100 g of soursop juice.

The total antioxidant capacity was determined based on the scavenging activity of 2,2-diphenyl-1-picrylhydrazyl (DPPH). DPPH solution (1 mL of 0.135 mM) was mixed with 1 mL of methanolic extract. The reaction mixture was shaken vigorously and left in the dark at room temperature for 30 min. The absorbance was measured using spectrophotometer at 517 nm. A control was prepared that contained only methanol and DPPH [10]. The total antioxidant capacity was expressed as mg Gallic acid equivalent per 100 g of soursop juice.

2.5 Kinetic Modelling of Ascorbic Acid Changes during Pasteurisation

A model to explain the changes in ascorbic acid in the soursop juice after pasteurisation was developed by fitting a first-order (Eq. 1) kinetic model to the data obtained.

$$\frac{d[AA]}{dt} = k_{AA} \cdot [AA] \quad (1)$$

In the first-order kinetic model, $\frac{d[AA]}{dt}$ was the rate of change of ascorbic acid, [AA] was the measured concentrations of ascorbic acid and k_{AA} was the first-order rate constant. The temperature dependence of the rate constant was modelled with the Arrhenius equation (Eq. 2):

$$k_{AA} = k_{AA,ref} \cdot e^{\frac{E_a}{R}\left(\frac{1}{T_{ref}} - \frac{1}{T}\right)} \quad (2)$$

where $k_{AA,ref}$ was the reference first-order rate constant at a chosen reference temperature, E_a was the activation energy in J/mol and R was the universal gas constant (8.314 J/mol/K). T was the temperature in Kelvin, and T_{ref} was the reference temperature which was set at 100°C (373 K).

2.6 Statistical Analysis

Statistical analysis to determine the effect of pasteurisation on the soursop juice was carried out using analysis of variance (ANOVA). The effect of pasteurisation on the nutritional and physicochemical properties of soursop juice was assessed by comparing to the unpasteurised soursop juice. Significant differences between the different pasteurised soursop juices were determined using the Tukey test (IBM, SPSS Statistics 20). The difference among means was identified at a significance level of 0.05.

3. RESULTS AND DISCUSSION

3.1 Effect of Pasteurisation on the pH, Total Soluble Solids, Titratable Acidity and Colour of Soursop Juice

The nutritional and physicochemical quality of the unpasteurised soursop juice is shown in Table 1. The pH of the unpasteurised soursop was 3.71, while the total soluble solids and titratable acidity were 15.63 (°brix) and 248.91 mg/100 g, respectively. The ascorbic acid level, total phenolic content and total antioxidant capacity were 46.07, 176.42 and 310.68 mg/100 g soursop juice, respectively.

Table 1 also shows the effect of the different pasteurisation conditions on the pH, total soluble solids, titratable acidity and colour of soursop juice. The pH of the pasteurised soursop juice ranged from 3.67 - 3.87. The pH of soursop juice pasteurised at 63, 71 and 78°C were not significantly affected by the conditions of pasteurisation, however, the juice pasteurised at 83 and 95°C recorded significantly lower pH compared to the control (Table 1). Generally, thermal treatments has also been observed not to significantly affect the pH of fruit samples [11].

The total soluble solids of the pasteurised soursop ranged from 15.2 - 16.8 (°brix) while the titratable acidity ranged from 239.26 - 265.70 mg/100 g soursop juice (Table 1). Total soluble solids were only significantly different from the control at pasteurisation temperatures of 83 and 95°C. The titratable acidity of the soursop juice was not significantly affected by the different pasteurisation conditions.

With respect to the effect of pasteurisation on the colour of soursop juice, significantly higher L* values were generally observed for the pasteurised compared to the unpasteurised soursop juice. The L* values ranged from 63.71 - 67.14. Generally the L* values did not differ significantly within a particular pasteurisation temperature. For example at a pasteurisation temperature of 83°C, the L* values changed from 64.02 to 63.84 and to 63.71 at pasteurisation times of 0.5, 1 and 5 min, respectively.

The a* values generally increased within pasteurisation. For example, at a pasteurisation temperature of 78°C, the a* value increased from -5.11 to -5.30 and to a final value of -5.37 at pasteurisation temperatures of 1, 3 and 5 min, respectively. Even though an increased in a* values was observed with increasing temperature of pasteurisation, these increases were not significantly different from each other.

The b* values of the soursop juice was also significantly affected by the pasteurisation conditions. Within a specific pasteurisation temperature, the b* values generally decreased with increased duration of pasteurisation. Also, at the same duration on pasteurisation, lower b* values were observed with increasing pasteurisation temperature (Table 1).

3.2 Effect of Pasteurisation on the Total Phenolic Content, Total Antioxidant Capacity and Ascorbic Acid Levels of Soursop Juice

Table 2 shows the effect of the different pasteurisation conditions on the total phenolic content and the total antioxidant capacity of soursop juice. Generally, a decrease (although not significantly different compared to the control) in the total phenolic content of the juice was observed with increasing duration of pasteurisation at a particular temperature. At a pasteurisation temperature of 95°C, the total phenolic content of the juice decreased from 176.42 mg/100 g for the unpasteurised juice to 158.65 and 145.35 mg/100 g after 1 and 3 min of pasteurisation, respectively. For the same duration of pasteurisation, lower total phenolic contents were observed for the juice samples that were pasteurised at higher temperatures. After 3 min of pasteurisation for example, the total phenolic content of the soursop juice at pasteurisation temperatures of 78, 83 and 95°C were 148.74, 143.66 and 145.34 mg/100 g, respectively. This observed decrease in the total phenolic content of the juice were, however, not significantly different from each other. A decrease in phenolic content have also been observed in other fruit juices upon thermal treatment. In pomegranate [12] and pineapple [13] juices decreases in phenolic contents were observed upon thermal processing.

The effect of the different pasteurisation conditions on the ascorbic content of soursop juice is also shown in Table 2. There was a general significant reduction (compared to the control) in ascorbic acid upon pasteurisation. The results show that at a particular temperature, the ascorbic acid level of the juice decreased with increasing duration of pasteurisation. For example, at a pasteurisation temperature of 63°C, the ascorbic acid level decreased from an initial value of 46.07 mg/100 g for the unpasteurised juice to 32.74 and 24.97 mg/100 g after 20 and 45 min of pasteurisation, respectively. Comparing the effect of temperature, the degradation of ascorbic acid at higher temperatures were higher for the same duration of pasteurisation. For example after 3 min of pasteurisation, the observed ascorbic acid degradation was 12.5, 26.6, 30.5 and 40.1% after pasteurisation at temperatures of 71, 78, 83 and 95°C, respectively.

Table 1. Effect of different pasteurisation time-temperature conditions on some physicochemical properties of soursop juice

Temperature	Time	pH	TSS	TAA	Colour		
(°C)	(min)		(ºbrix)	(mg/100 g)	L*	a*	b*
Unpasteurised		3.71 ± 0.10^{A}	15.63 ± 0.62^{A}	248.91 ± 16.51^{A}	63.29 ± 0.20^{A}	-4.82 ± 0.05^{A}	6.61 ± 0.05^{A}
63	5.00	3.74 ± 0.08^{A}	15.37 ± 0.60^{A}	255.91 ± 21.18^{A}	64.44 ± 0.51^{B}	-4.94 ± 0.08^{A}	6.24 ± 0.07^{B}
	10.00	3.68 ± 0.18^{A}	16.03 ± 0.38^{A}	252.34 ± 7.58^{A}	65.45 ± 0.30^{B}	-5.20 ± 0.18^{B}	5.70 ± 0.28^{B}
	20.00	3.73 ± 0.08^{A}	16.63 ± 0.52^{A}	252.75 ± 11.33^{A}	66.45 ± 0.35^{B}	-5.06 ± 0.16^{B}	6.02 ± 0.20^{B}
	30.00	3.67 ± 0.22^{A}	15.20 ± 0.40^{A}	265.70 ± 10.14^{A}	66.33 ± 0.17^{B}	-4.76 ± 0.10^{A}	5.64 ± 0.28^{B}
	45.00	3.70 ± 0.10^{A}	16.47 ± 0.65^{A}	261.62 ± 13.28^{A}	66.50 ± 0.48^{B}	-5.04 ± 0.08^{B}	6.07 ± 0.17^{B}
71	3.00	3.75 ± 0.09^{A}	16.20 ± 0.36^{A}	249.90 ± 23.62^{A}	65.45 ± 0.46^{B}	-4.96 ± 0.06^{B}	5.61 ± 0.20^{B}
	5.00	3.76 ± 0.09^{A}	15.47 ± 0.74^{A}	263.36 ± 20.70^{A}	66.99 ± 0.24^{B}	-5.17 ± 0.14^{B}	5.81 ± 0.22^{B}
	10.00	3.73 ± 0.04^{A}	15.73 ± 0.80^{A}	254.92 ± 8.42^{A}	66.31 ± 0.93^{B}	-4.83 ± 0.12^{A}	6.04 ± 0.20^{B}
	15.00	3.78 ± 0.05^{A}	15.97 ± 0.32^{A}	250.89 ± 14.49^{A}	64.72 ± 0.26^{B}	-5.90 ± 0.07^{B}	5.91 ± 0.14^{B}
	20.00	3.75 ± 0.07^{A}	15.53 ± 0.64^{A}	254.03 ± 10.89^{A}	67.14 ± 0.25^{B}	-4.73 ± 0.10^{A}	5.19 ± 0.56^{B}
78	1.00	3.74 ± 0.07^{A}	16.27 ± 0.70^{A}	255.24 ± 7.87^{A}	64.24 ± 1.02^{B}	-5.00 ± 0.15^{B}	5.38 ± 0.27^{B}
	2.00	3.76 ± 0.04^{A}	15.60 ± 0.72^{A}	245.15 ± 27.46^{A}	64.44 ± 1.32^{B}	-5.08 ± 0.13^{B}	5.21 ± 0.16^{B}
	3.00	3.69 ± 0.02^{A}	15.63 ± 0.67^{A}	253.98 ± 10.29^{A}	64.11 ± 0.32^{B}	-5.09 ± 0.13^{B}	5.53 ± 0.65^{B}
	5.00	3.70 ± 0.15^{A}	15.43 ± 0.25^{A}	265.62 ± 10.17^{A}	64.63 ± 0.35^{B}	-5.70 ± 0.18^{B}	5.01 ± 0.13^{B}
	10.00	3.72 ± 0.03^{A}	15.47 ± 0.96^{A}	252.25 ± 10.03^{A}	64.96 ± 0.14^{B}	-5.74 ± 0.05^{B}	4.85 ± 0.22^{B}
83	0.50	3.86 ± 0.01^{B}	16.70 ± 0.10^{B}	248.64 ± 14.09^{A}	64.02 ± 0.41^{B}	-5.42 ± 0.11^{A}	4.62 ± 0.12^{B}
	1.00	3.86 ± 0.02^{B}	16.73 ± 0.31^{B}	247.74 ± 12.85^{A}	63.84 ± 0.41^{B}	-5.84 ± 0.10^{A}	4.50 ± 0.08^{B}
	2.00	3.87 ± 0.01^{B}	16.70 ± 0.20^{B}	239.26 ± 16.36^{A}	64.77 ± 0.31^{B}	-5.95 ± 0.06^{A}	4.25 ± 0.19^{B}
	3.00	3.86 ± 0.01^{B}	15.63 ± 0.55^{A}	250.62 ± 4.25^{A}	64.53 ± 0.47^{B}	-5.82 ± 0.11^{A}	4.15 ± 0.17^{B}
	5.00	3.87 ± 0.01^{B}	16.00 ± 0.20^{A}	258.90 ± 15.15^{A}	63.71 ± 0.35^{B}	-5.88 ± 0.10^{A}	4.37 ± 0.13^{B}
95	0.17	3.87 ± 0.01^{B}	15.90 ± 0.56^{A}	251.55 ± 10.42^{A}	65.05 ± 1.01^{B}	-4.75 ± 0.15^{A}	4.86 ± 0.34^{B}
	0.50	3.85 ± 0.02^{B}	15.87 ± 0.25^{A}	246.60 ± 9.90^{A}	65.59 ± 0.43^{B}	-5.53 ± 0.34^{B}	4.33 ± 0.20^{B}
	1.00	3.86 ± 0.01^{B}	16.87 ± 0.32^{B}	250.09 ± 6.44^{A}	65.20 ± 0.13^{B}	-5.03 ± 0.12^{B}	4.25 ± 0.18^{B}
	2.00	3.86 ± 0.01^{B}	16.53 ± 0.12^{B}	260.21 ± 8.50^{A}	64.94 ± 0.41^{B}	-5.15 ± 0.09^{B}	4.41 ± 0.10^{B}
	3.00	3.85 ± 0.01^{B}	16.50 ± 0.10^{B}	251.49 ± 9.60^{A}	66.51 ± 0.43^{B}	-4.88 ± 0.37^{A}	4.52 ± 0.11^{B}

TSS = Total soluble solids, TAA = Titratable acidity

**Different superscript letters in the same column indicate a significance difference ($p<0.05$) compared to the unpasteurised (control) juice.*

**The means are replicates of four independent experiments while the errors represent the standard deviation.*

Table 2. Effect of different pasteurisation time-temperature conditions on ascorbic acid levels, total phenolic content and total antioxidant capacity of soursop juice

Temperature (°C)	Time (min)	Ascorbic acid mg/100 g	Total phenolic content mg/100 g	Total antioxidant capacity mg/100 g
Unpasteurised		46.07 ± 3.02^{A}	176.42 ± 22.65^{A}	310.68 ± 52.09^{A}
63	5	37.29 ± 0.91^{B}	173.46 ± 18.09^{A}	305.46 ± 31.85^{A}
	10	34.82 ± 1.82^{B}	159.90 ± 12.86^{A}	302.06 ± 16.61^{A}
	20	32.74 ± 1.37^{B}	154.14 ± 16.98^{A}	306.58 ± 33.18^{A}
	30	27.39 ± 1.53^{B}	141.40 ± 14.55^{A}	298.99 ± 29.10^{A}
	45	24.97 ± 2.75^{B}	148.13 ± 9.68^{A}	310.15 ± 3.00^{A}
71	3	40.32 ± 2.33^{B}	174.09 ± 18.84^{A}	310.28 ± 33.76^{A}
	5	36.29 ± 1.92^{B}	161.93 ± 15.44^{A}	306.50 ± 32.08^{A}
	10	31.41 ± 2.24^{B}	165.12 ± 16.88^{A}	295.06 ± 24.76^{A}
	15	28.37 ± 1.33^{B}	155.79 ± 13.43^{A}	296.22 ± 16.06^{A}
	20	23.57 ± 2.18^{B}	145.73 ± 19.52^{A}	306.31 ± 26.09^{A}
78	1	41.42 ± 1.75^{B}	162.94 ± 14.21^{A}	306.91 ± 6.43^{A}
	2	37.05 ± 3.36^{B}	169.78 ± 16.53^{A}	298.99 ± 29.10^{A}
	3	33.81 ± 2.32^{B}	148.74 ± 16.24^{A}	303.62 ± 29.16^{A}
	5	30.77 ± 2.67^{B}	153.85 ± 17.84^{A}	304.38 ± 9.15^{A}
	10	27.63 ± 1.48^{B}	138.76 ± 11.36^{A}	296.35 ± 15.27^{A}
83	0.5	42.95 ± 2.77^{A}	167.94 ± 12.59^{A}	310.15 ± 3.00^{A}
	1	37.77 ± 1.70^{B}	153.58 ± 14.27^{A}	301.31 ± 29.77^{A}
	2	34.95 ± 1.17^{B}	160.69 ± 13.65^{A}	282.98 ± 24.04^{A}
	3	32.02 ± 1.77^{B}	143.66 ± 16.53^{A}	252.99 ± 29.11^{A}
	5	28.30 ± 1.86^{B}	145.51 ± 12.81^{A}	296.02 ± 13.94^{A}
95	0.167	42.72 ± 1.57^{A}	167.07 ± 6.07^{A}	294.21 ± 10.70^{A}
	0.5	35.87 ± 1.79^{B}	160.99 ± 2.99^{A}	300.34 ± 34.05^{A}
	1	33.35 ± 2.40^{B}	158.65 ± 15.15^{A}	299.63 ± 10.79^{A}
	2	30.05 ± 1.62^{B}	146.79 ± 19.62^{A}	299.93 ± 40.62^{A}
	3	27.60 ± 1.50^{B}	145.35 ± 15.53^{A}	290.13 ± 11.03^{A}

**Different superscript letters in the same column indicate a significance difference ($p<0.05$) compared to the unpasteurised (control) juice.*

**The means are replicates of four independent experiments while the errors represent the standard deviation.*

A decrease in ascorbic acid levels with heating have also been observed in other fruits juices and products. A significant decrease in ascorbic acid levels was observed in mango, guava and marula during heating [11]. Under isobaric-isothermal heating conditions, ascorbic acid degradation was also observed in orange juice and tomatoes [14]. Ohmic heating of acerola pulp also resulted in the degradation of ascorbic acid [15]. In Pomegranate juice [16] and orange juice [17] ascorbic acid degradation was observed during heating.

3.3 Kinetic Modelling of Ascorbic Acid Degradation

The kinetic model developed to explain the degradation of ascorbic acid during pasteurisation and the estimation of the model parameters was implemented in Optipa [18]. Fig. 1 shows a plot of the modelled changes in ascorbic acid levels against the experimentally determined values. A reaction rate constant and activation energy of 0.035 min^{-1} and 83 kJ/mol, respectively were obtained. The statistical analysis of the obtained model parameters were estimated using an error based bootstrap resampling technique. By bootstrapping the complete dataset multiple times, the model was fitted to the obtained bootstrap datasets several times, hence obtaining the distribution around individual parameters from which the standard deviations were estimated. The obtained standard deviations for the reaction rate constant and activation energy were 0.0021 and 3000, respectively.

The obtained first-order rate constant is within the range of constants that have been reported for the activation energy of ascorbic acid in different fruits. In grape juice, a low ascorbic acid degradation constant of $6.5x10^{-4}$ min^{-1} was observed [19], while a very higher value of $5.2x10^{12}$ min^{-1} was observed in orange juice [20].

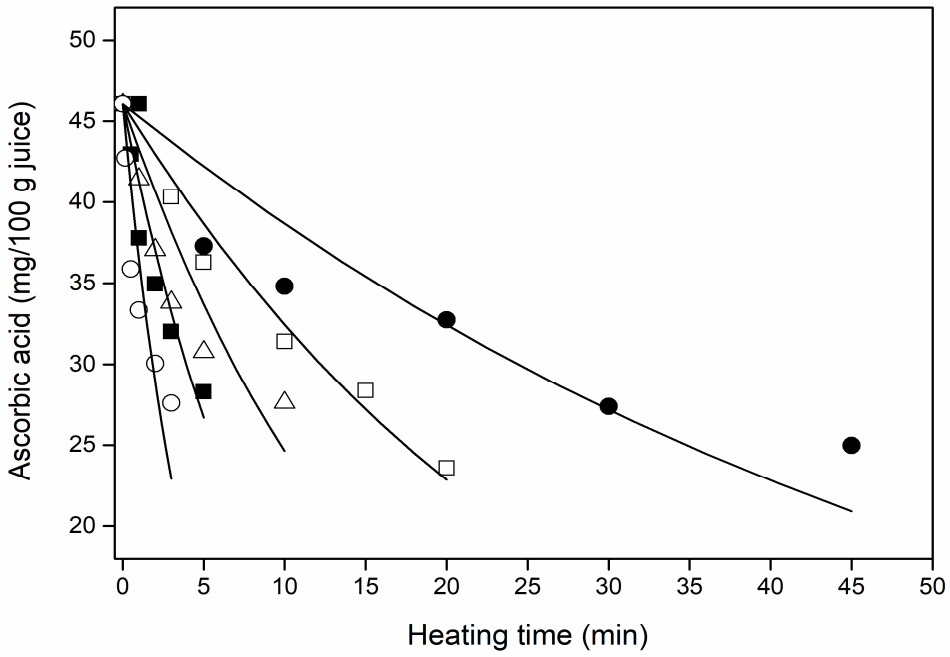

Fig. 1. Modelled changes in ascorbic acid levels in soursop juice at different pasteurisation time-temperature conditions

The modelled ascorbic acid levels (solid lines) are plotted along with the experimentally determined values in the soursop juice (63 °C, ●; 71 °C, □; 78 °C, △; 83 °C, ■; 95 °C, ○). The measured data points are the average of 4 replicates.

The degradation rate of ascorbic acid in soursop juice is lower compared to that observed in other fruits such as orange juice [20] and cupuaçu nectar [21]. However, the degradation rates of ascorbic acid in soursop juice is higher compared to grape juice [19]. The observed activation energy for the degradation of ascorbic acid in soursop juice was within the reported range observed in other studies [11,17,19,20,21].

4. CONCLUSION

Soursop juice is a rich source of ascorbic acid and antioxidants. The degradation of ascorbic acid in soursop juice is temperature dependent. Higher degradations of ascorbic acid were observed at higher temperatures for the same duration of pasteurisation. The total phenolic content and total antioxidant capacity of soursop juice were affected by the conditions of pasteurisation, however the pH, total soluble solids and titratable acidity were not generally affected by pasteurisation. Considering the limited storage shelf life pasteurisation offers the opportunity to extend the usage of soursop.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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