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Bioactive compounds during processing and storage of sweet guava (conventional and light)

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Abstract

The main form of processed guava consumption is the sweet guava paste. The aim of this work was determine the main bioactive compounds of red guava and stability of the compounds in conventional and light sweet guava paste during processing and storage. Guava fruit, variety Paluma, were obtained from region of Pelotas-RS-Brazil. The pulp and the sweet guava pastes were prepared, than the sweet guava paste were stored for 12 months at room temperature, in the dark. Bioactive compounds, antioxidant activity and color of pulp and sweet guava paste every three months were analyzed. Red guava pulp and sweet guava paste showed high rates of phenolic compounds, whilst the main carotenoid was lycopene. L-ascorbic acid content were high in guava pulp and in sweet guava paste stored up to six months. Results show that guava pulp and sweet guava paste contain significant amounts of compounds with high antioxidant potential.

Introduction

The intake of fruits and vegetables is currently on the increase mainly due to their nutrition value and their potential health benefits. Besides containing macronutrients, fruits and vegetables contain several compounds from the plants specialized metabolism, such as bioactive compounds, some of which contain antioxidants that may prevent certain diseases and promote aging delay. Carotenoids, phenolic compounds, anthocyanins, L-ascorbic acid (Vitamin C) and tocopherols (Vitamin E) are among the most relevant bioactive compounds, highly diffused in nature and present in fruits, leaves and flowers. They are chemo-preventive and antioxidant agents in biological systems (Sousa *et al.*, 2007).

The guava (*Psidiumguajava* L.) of the Myrtaceaefamily,is a round or oval fruit, with a thin, smooth and green rind, containing a red or white pulp, according to the cultivar.The fruit isconsumed either in natura or as sweet, juice, preserve and jelly. The red and white guava fruits contain several compounds, mainly vitamin C, phenolic compounds and carotenoids. Lycopene is highly important within the carotenoid group found in red guava. Although it does not have a pro-vitamin A activity, lycopene is an antioxidant due to its capacity to sequester singlet oxygen.

Vitamin C, an essential nutrition factor against scurvy, has been rather prominent during the last decades mainly due to its antioxidant potential. Moreover, phenolic compounds belong to the class of chemical compounds which comprise a large diversity of simple and complex structures containing at least one aromatic ring with one or more hydroxyl groups (Oliveira *et al*., 2011).

The demand for natural and low calorie (light) foods has triggered the use of fruits as ingredients since the industrialized products are provided with pleasant tastes and, at the same time, with reduced calorie ingestion (Lara *et al*., 2004). Sweet guava paste (known as goiabada) is one of the most popular types of processed guava consumption. It is manufactured by cooking the fruit pulp with sugar till its complete jellification and formation of a consistent sweet. Due to lack of data on bioactive compounds in sweet guava paste, the aim of this work was to determine the main bioactive compounds of the guava, variety Paluma, and evaluates the stability of its compounds during processing and storage of conventional and light sweet guava paste for 12 months at room temperature.

Materials and Methods

Fruit and the preparation of sweet guava paste

Guava fruit, varietyPaluma, harvested in 2012, were obtained from Embrapa Clima Temperado,

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in the region of Pelotas-RS-Brazil, 31º40'47"S and52º26'24"W, at 60 m above sea level. According to Köppen´s classification, the region´s climate is temperate with hot summers and rainfall distributed throughout the year. After harvested, the fruit were sanitized by immersion in a solution of sodium hypochloride at 200 ppm for 10 minutes and rinsed with a solution of sodium hypochloride at 2ppm. The fruit were peeled, cut longitudinally to remove the seeds and pulped. A part of the pulp was used for analyses and the other part for sweet guava pasteproduction, following formulations described by Jacques *et al*. (2009) andChim *et al.* (2006).

The preparation of conventional sweet guava paste comprised guava pulp 50% p/p of total weight; sugar 50% p/p of total weight; pectin ATM 1%, proportional to weight of sugar; citric acid 0.5%, proportional to weight of sugar; sodium benzoate 0.02%, proportional to total weight;and potassium sorbate 0.02%, proportional to total weight.

The preparation of light sweet guava pastecomprised guava pulp 65% p/p of total weight;sugar 35% p/p of total weight; pectin BTM 2%, proportional to weight of sugar;calcium chloride 50 mg/g pectin;citric acid 0.5%, proportional to weight of sugar;sodium benzoate 0.02%, proportional to total weight;potassium sorbate 0.02%, proportional to total weight;cyclamate:saccharine (1:1), in quantities equivalent to the substitution of 30% (weight) of sugar removed.

Pulp, sugar, pectin and sweeteners (for the light sweet guava paste)were mixed and cooked (100 – 110°C) till they reached the final solid rate: 71°Brix for the traditional sweet guava paste and heating time around 30 min; 59°Brix for light sweet guava paste and heating time around 20 min. The sweet guava pastewere taken off the fire and citric acid (0.5%) and preservatives were added; and calcium chloride (50 mg/g pectin)was added for light sweet guava paste. The sweet guava paste was conditioned hot in polyethylene terephthalate vessels, than it was closed and stored for 12 months at room temperature. The sweet guava paste was analyzed every three months in triplicate.

Phenolic compounds

Total phenolic compounds were quantified according to method described by Swains and Hillis (1959). Reading was taken in a spectrophotometer at 725 nm. Results were given in mg gallic acid equivalent (GAE).100g^{-1} of dry sample.

Individual phenolic compounds

Phenolic compounds were extracted following method by Häkkinen *et al*. (1998), with modifications. Cromatograph was based on the HPLC system with automatic injector, UV-visible detector at 280nm, reverse phase column RP-18 CLC-ODS. Mobile phase consisted of elution gradient with acetic acid water solution (99:1, v/v) and methyl alcohol, with a 0.8 mL.min^{-1} flow and total time 45 min, following methodology described by Zambiazi (1997). Results were given in mg of compound.100g^{-1} of dry sample.

Carotenoids

Total carotenoid content was analyzed by method described by Rodriguez-Amaya (2001), with slight modifications. Reading was done by spectrophotometer at 470 nm and results given in μg of lycopene.g^{-1} of dry sample.

Individual carotenoids

A 25 mL aliquot was retrieved from the extract in the 50 mL flask and used for reading of total carotenoid contents by spectrophotometer. Further, 25 μL aliquots of the supernatant were injected in a HPLC system with automatic injector, UV-visible detector at 450 nm and reverse phase column RP-18 CLC-ODS. Separation occurred by a gradient elution system with methanol, acetonitrile and ethyl acetate, at a 1 mL.min^{-1} flow. Analysis started by the mobile phase at 30% methanol and 70% de acetonitrile. Results were given in μg of the compound.g^{-1} of the dry sample (Rodriguez-Amaya, 2001).

L-ascorbic acid

Methodology described by Vinci *et al.* (1995), with few modifications, was employed. Analyses were undertaken in chromatograph conditions with a 0.8 mL.min^{-1} flow, with detection at 254nm. Its movable phases comprised a solution of acetic acid 0.1% in ultra pure water and methanol 100%. Results were given in mg of L-ascorbic acid.g^{-1} of dry sample.

Antioxidant activity

Radical capture method of DPPH (2,2-diphenyl-1-picryl-hydrazyl), described by Rufino *et al*. (2007) was used. It was weighed 4g of pulp or 10 g of sweets, and methanol was added and homogenised in ultraturrax (TURRATEC TE-102) for 2 minutes. The weight difference of the samples was taken into consideration in the calculations. The samples were centrifuged at 3420 g for 20 minutes, which subsequently were filtered. Dilutions of the extracts were done with methanol at concentrations of 0,20; 0,15; 0,10; 0,05; 0,01 g / mL for pulps; and at concentrations of 0.50; 0, 40; 0.35; 0.25; 0.15; 0.10; 0.05 g / mL for sweets. It was taken 0.1 mL of each

Table 1.Bioactive compounds and antioxidant activity in red guava pulp, and in conventional and light sweet guava paste.

Analyses	RP	CS	LS
Phenolic compounds (mg GAE.100g^{-1})	6796.74± 8.10^{a}	649.19± 1.40^{c}	905.19± 0.13^{b}
Gallic acid (%)*	90.90± 1.08^{a}	79.80± 1.03^{b}	82.60 ± 2.61^{b}
Catechin (%)*	9.10±1.08^{c}	20.20± 1.03^{a}	17.40 ± 2.61^{b}
Carotenoids(µg lycopene.g^{-1})	1602.57± 161.35^{a}	50.10± 0.13^{c}	96.39± 1.02^{b}
L-ascorbicacid (mg.100g^{-1})	756.60± 2.30^{a}	57.53± 0.72^{c}	87.88± 1.18^{b}
Antioxidant activity (EC_{50} g.mL^{-1})	1.23± 0.02^{a}	0.37± 0.02^{b}	0.33 ± 0.02^{b}

Means followed by the same letters in the same line, do not differ by Tukey test ($p < 0.05$). RP = Red pulp; CS = Conventional Sweet; LS = Sweet Light. * MS = dry matter. ** Individual phenolic compounds quantified by HPLC.

dilution to test tubes with 3,9 mL the DPPH radical, previously prepared. Readings were performed in spectrophotometer at 515 nm. The absorbances of the different dilutions were plotted and the equation obtained was used to determine the EC50. The results were expressed as EC_{50} (concentration of the extract g.mL^{-1} that are able to inhibit 50% of DPPH radical in the solution). Therefore, lower EC_{50} value means higher antioxidant activity of the extract.

Statistical analysis

Results were analyzed by ANOVA and the means by Tukey´s test at 5% significance, by using the statistical program SAS v8. The degree of correlation between the bioactive compounds and antioxidant activity was evaluated by Pearson's correlation test.

Results and Discussion

Bioactive compounds and antioxidant activity of guava pulp and sweet guava paste

Table 1 shows a significant decrease in the contents of phenolic compounds of red guava pulp when compared to conventional and light sweet guava paste immediately after processing, with up to 10 times reduction for the former and 7 times for the latter. When compared with other guava-derived products, the reduced content rates were still very high.

McCook-Russell *et al.* (2012) reported 952mg GAE.100^{-1}g phenolic compounds for red guava pulp, whereas Haida *et al.* (2011) registered 1739.1 mg.100g^{-1}. Martínez *et al.* (2012) also reported 250mg GAE.100^{-1}g phenolic compounds for red guava pulp. In the case of other guava-derived products, Silva *et al.* (2010) reported contents ranging between 94.9 mg and 128.3mg GAE.100g^{-1} for hot-canned juice; Nascimento *et al.* (2010) registered contents with 217.6mg GAE.100g^{-1} for guava pulp residues.

Two predominant compounds were identified in total phenolic compounds by HPLC analysis (Figure 1a), underscoring gallic acid contents. Gallic acid, which consists of phenolic acid derived from hydroxybenzoic acid, comprises 90.9% of total phenolic compounds identified in the red guava pulp. Catechin, a flavonoid of the flavanol sub-class, was also identified, with 9.1% of total phenolic compounds in the red guava pulp. Chen and Yen (2007) also registered the same phenolic compounds, with 60.7% and 39.3% of gallic acid and catechin, respectively, in the case of guava pulp and 62.3% and 37.7% of gallic acid and catechin, respectively, in the case of dehydrated guava.

Only two phenolic compounds, gallic acid and catechin,were identified in sweet guava paste when analyzed by HPLC. Catechin percentage with only 9.1% of total phenolic compounds in the pulp increased to 20.2% in conventional sweet guava paste(CS) and to 17.4% in light sweet guava paste (LS). Variation must have occurred due to thermic processing which may have released the catechin from the vegetal tissues. Relative increase in catechin reduced the relative quantity of gallic acid, even though the phenolic compound remained predominant.

Red guava pulp showed a significant high carotenoid content, with 1602.57 µg lycopene.g^{-1}. Carotenoid analysis by HPLC revealed two lycopene peaks: the first peak would be trans-lycopene and the second peak would be one of the isomer forms of cis-lycopene (Figure 1b), according to the literature. Carotenoid content was higher than that reported by other authors, such as Silva *et al.* (2014) and Sousa *et al.* (2011) who respectively reported 35 µg lycopene.g^{-1} and 644.9 µg lycopene.g^{-1}. On the other hand, Oliveira *et al*. (2011) reported 6999.3 µg lycopene.g^{-1} which was higher than that in current study.

Guava pulp provided higher amounts than those in products known to be good carotenoid sources, such

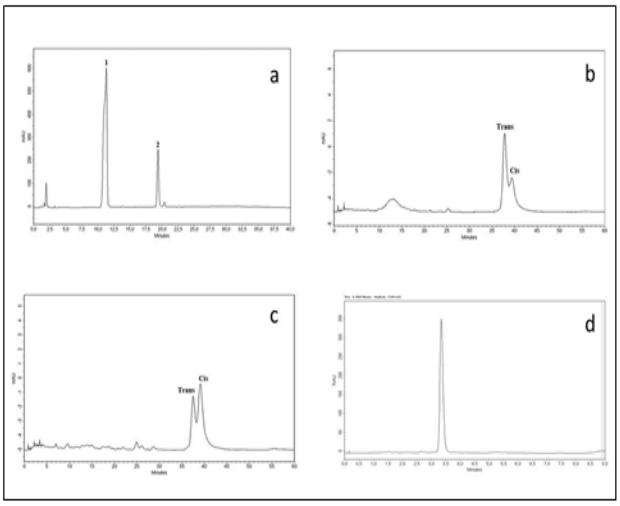

Figure 1.Typical chromatograms: phenolic compounds in sweet guava paste (a), carotenoid separation in red guava pulp (b), carotenoid separation in sweet guava paste (c) and L-ascorbic acid in red guava pulp (d).

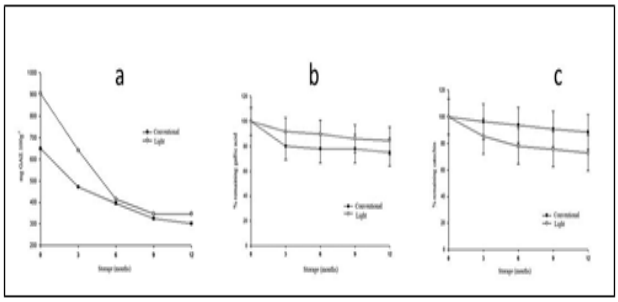

Figure 2.Content of phenolic compounds during storage of sweet guava paste (a). Remaining contents of gallic acid in sweet guava paste during storage (b). Remaining contents of catechin in sweet guava paste during storage periods (c).

as tomato extract (261µg lycopene.g^{-1}) and tomato pulp (177 µg lycopene.g^{-1}) (Kobori *et al.*, 2010). Similar to what occurred in phenolic compounds, carotenoid contents in sweet guava pasteshowed a significant decrease from 1602.57 µg lycopene.g-1in pulp to 50.1 and 96.4 µg lycopene.g^{-1}in conventional and light sweet guava paste, respectively.

Carotenoid separation chromatogram of sweet guava paste and guava pulp by HPLC seems to suggest that one of the peaks consisted of trans-lycopene and the other one of the isomer forms of cis-lycopene (Figure 1c). Although lycopene exists mostly in the form of trans-isomers in natura food, cis-isomers are better absorbed and abundantly found in the human body due to the small ester hindrance of its chain and its better solubility in micelles. Foods´ thermal processing increases the bio-availability of lycopene due to the rupture of the cell wall with the subsequent release in its cis-isomer form (Moritz and Tramonte, 2006).

Fernandes *et al.* (2007) registered 15µg lycopene.g^{-1} in recently processed guava juice and Silva *et al.*(2014) obtained 18 µg licopeno.g^{-1}in guava sub-products, such as peel, pulp waste and seeds; Kong and Ismail (2011) reported 12 µg licopeno.g^{-1}in guava sub-products and the same amount was found by Silva *et al.* (2010) in hot-canned guava. Oliveira *et al.* (2011) analyzed red guava pulp and reported 71.4 mg L-ascorbic acid.100g^{-1}; Mariano *et al.* (2011) registered 64-80 mg L-ascorbic acid.100g^{-1}. The above rates are lower than those in current assay, with the exception of results by McCook-Russell (2012) with 1200 mg L-ascorbic acid.100g^{-1}. Results from guava pulp shows that the guava fruit has a higher quantity of ascorbic acid than several fruits notoriously rich in vitamin C. Forinstance, CoutoandCanniatti-Brazaca (2010) reported between 62.5 and 85 mg L-ascorbic acid.100g^{-1}in several types of oranges and between 21.5 and 32.5 mg L-ascorbic acid.100g^{-1} in tangerines.

Figure 1d shows a typical chromatogram of L-ascorbic acid in red guava pulp. L-ascorbic acid or vitamin C decreases 92% in conventional sweet guava paste and 88% in the light sweet guava paste, explained due to the fact that Vitamin C is thermolabile and easily oxidized (Dantas *et al*., 2010). No specific research is reported in the literature on the contents of L-ascorbic acid in sweet guava paste. In studies on guava-derived products, Mariano *et al.* (2011) analyzed vitamin C rates in slightly processed guavas and registered 80 mg.100g^{-1}, whilst Silva *et al.* (2010) found 33.9 mg.100g^{-1} and 43 mg.100g^{-1}, respectively, for hot-canned juice and aseptically processed juice, or rather, lower rates than those in current study.

Higher contents than those in current study were reported for other products such as sweet guava cake, featuring 118.7 mg.100 g^{-1} (Osorio *et al*., 2011), and sonicated and carbonated guava juice, featuring 125 mg.100 g^{-1} (Chen and Yen, 2007). The greatest loss of ascorbic acid in the conventional sweet compared to light, can be related to hydroxymethylfurfural formation, which is due to the decomposition of L-ascorbic acid, and also in reactions involving sugars, which could be accelerating decomposition of L– ascorbic acid (Burdurlu *et al*., 2005). The high content of bioactive compounds analyzed, especially in relation to the amount of phenolic compounds, probably should have occurred not only by the difference in seasonality in relation to other authors cited, but also due to low rainfall in the months preceding the harvest (Inmet, 2012) compared with previous years. This possibly leads to water stress, hence raising the amount of these compounds in guava, since these are from the specialized metabolism having as part of its function to protect the plant, ie, the increased production of compounds

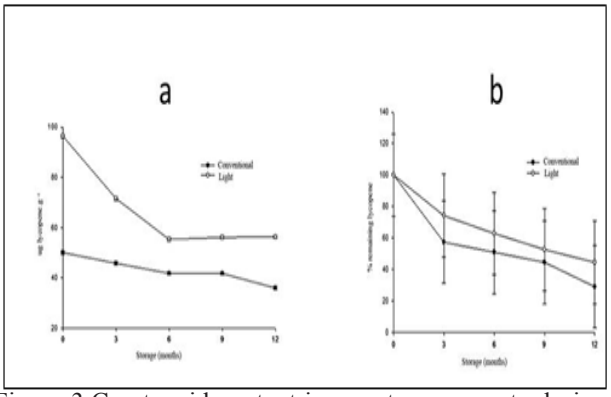

Figure 3.Carotenoid content in sweet guava paste during the entire storage time (a); remaining lycopene contents in sweet guava paste throughout storage period (b).

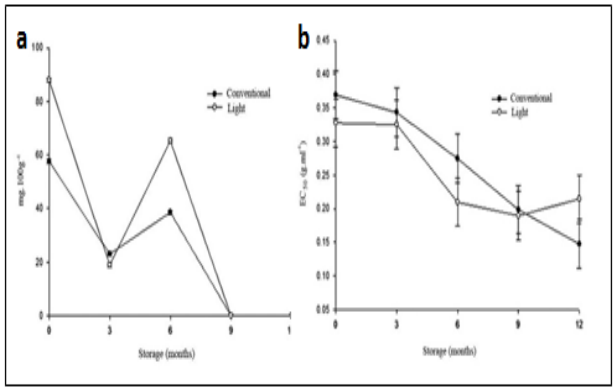

Figure 4.Content of L-ascorbic acid (a) and antioxidant activity (b) in sweet guava paste during storage period.

such as carotenoids, phenolic acid and L-ascorbic it is a defense mechanism for these plants.

Antioxidant activity rate was determined by EC_{50}(g.mL^{-1}) employing the equation of the straight line to define the concentration required to inhibit 50% of DPPH radical. There was a difference between antioxidant activity in red guava pulp and in sweet guava paste, with higher efficiency, even though a partial loss in bioactive compounds occurred in these products. The literature has only scanty data for in vitro antioxidant activity with regard to guava and its products. Nascimento (2010) reported 1.80 EC_{50} g.mL^{-1}for guava residues, or rather, a higher rate than that in current study for guava in natura and sweet guava paste. The guava sweet exhibited antioxidant activity of EC_{50} 12:33 g.mL^{-1} for sweet light, EC_{50} 12:37 g.mL^{-1} for conventional sweet and EC_{50} 1:23 to 1 g.mL for the red pulp. Knowing that the lower the value of EC_{50} is greater the antioxidant activity, the guava sweet light presented the highest antioxidant capacity.

Stability of bioactive compounds and antioxidant activity of conventional and light sweet guava paste during storage

Figure 2a shows a gradual decrease in the contents of phenolic compounds in conventional sweet guava paste during storage. In fact, there was a significant difference throughout the entire period. Immediately after processing, the contents of the phenolic compounds reached 649 mg GAE.100g^{-1}, decreased to 395.44 mg after six months of storage and to 301.55 mg GAE.100g^{-1}after 12 months of storage. Phenolic compound contents in light sweet guava paste failed to show any significant decrease during the last months (between the 9th and 12th month) of storage only. Similarly, the highest decrease in the contents of phenolic compounds occurred during the first six months of storage with a reduction of less than half during the period, or rather, 414 mg GAE.100g^{-1}.

It should be underscored that the contents of phenolic compounds in light sweet guava paste were higher and statistically different throughout the entire period when they were compared to those in conventional sweet guava paste. However, reduction of phenolic compounds content in light sweet guava paste was more intense than the decrease in conventional sweet guava paste during the first six months of storage.

The literature on other guava-derived products also reported a decrease in the content of phenolic compounds during storage. Singh and Pal (2008) analyzed guava under controlled temperature after storage for 30 days at 8°C and reported a reduction from 224.26 mg to 190.56 mg GAE.100g^{-1}. Silva *et al*. (2010) analyzed guava juice after a 50 – 250-day-storage at room temperature and registered a decrease from 128.33 mg to 94.98 mgEAG.100g^{-1}in the hot-canned product and from 96.55 mg to 74.38 mgGAE.100g^{-1}in aseptic-processed bottling of the product.

Figure 2b shows that light sweet guava pastepresented a higher percentage of remaining gallic acid during the entire period when compared to that in conventional sweet guava paste. A retention of 84.5% and 75% of gallic acid occurred respectively for light sweet guava paste and conventional sweet guava paste after a 12-month storage. Throughout the storage period in sweet guava paste, catechin content (Figure 2c) did not differ statistically, although a gradual decrease occurred. Inversely to gallic acid content, light sweet guava pasteshowed a lower amount of remaining catechin than that in conventional sweet guava paste during the entire storage period. Or rather, there was a greater degradation of catechin in light sweet guava paste when compared to degradation percentage in conventional sweet guava paste.

Table 2.Degree of correlation between the bioactive compounds and antioxidant activity

	Phenoliccompouns (1)	Galic Acid (2)	Catechin (3)	Carotenoids (4)	L-ascorbicacid (5)	Antioxidant activity (6)
(1)	1	0.93672 (0.0002*)	0.93672 (0.0002)	0.99425 (<0.0001)	0.99998 (<0.0001)	0.99614 (<0.0001)
(2)		1	-1.00000 (<0.0001)	0.92545 (0.0003)	0.93732 (0.0002)	0.91306 (0.0006)
(3)			1	-0.92545 (0.0003)	-0.93732 (0.0002)	-0.91306 (0.0006)
(4)				1	0.99405 (<0.0001)	0.99278 (<0.0001)
(5)					1	0.99613 (<0.0001)
(6)						1

* values of p

Decrease in gallic acid and catechin contents in both types of sweet guava paste is related to the reduction of total contents of the phenolic compounds. Figure 3a shows that carotenoid content decreased less than the contentof phenolic compounds during storage of conventional sweet guava paste. In fact, it remained constant after 6 and 9 months of storage, respectively with 41.80 µg lycopene.g^{-1}and 41.75 µg lycopene.g^{-1}. Decrease from 96.39 µg lycopene.g^{-1} to 55.33 µg lycopene.g^{-1} was greater in carotenoid content in light sweet guava paste during the first six months of storage, with no further significant difference during the period.

Similarly, carotenoid content in light sweet guava paste also presented higher quantities when compared to that in conventional sweet guava paste throughout the storage period. Difference in contents between the different types of sweet guava paste immediately after processing almost reached 48% and went down to 36% during the 12 months of storage. Fernandes *et al.* (2007) analyzed hot-bottled guava juice without storage and with 30-day storage at 28°C and found 15.1 µg lycopene.g^{-1}and 12.2 µg lycopene.g^{-1}, respectively. Silva *et al.* (2010) also investigated guava juice and reported carotenoid contents at approximately 10 µg lycopene.g^{-1}, without any difference after a 250-day storage.

Decrease in carotenoid rates in sweet guava paste in current study throughout the assay period was higher than that found in the literature. This fact may probably be due to a higher oxidation degree during the storage of sweet guava paste at room temperature. Lycopene was the only carotenoid identified in the guava fruit and thus in its derivatives. Figure 3b shows the graph with the remaining lycopene percentage in the sweet guava paste.

A significant difference in lycopene content occurred between 6 and 9 months of storage in conventional sweet guava paste and only after 12 months in the case of light sweet guava paste. Lycopene contents showed a greater loss during the first three storage months, with a 42.7% reduction in conventional sweet guava paste and a 25.8% reduction in light sweet guava paste. The light sweet guava pasteshowed a lower loss in lycopene, with a 29% loss after 12 months of storage, whereas there was a 63% loss in light sweet guava paste during the same period.

Figure 4a shows that conventional sweet guava paste and light sweet guava paste differed in L-ascorbic acid contents throughout the assay and that the total degradation of vitamin C occurred in both types of sweet guava pasteon the 9th month of storage. After processing, light sweet guava paste provided 87.88 mg.100g^{-1},or rather, a higher content than that in conventional sweet guava paste (57.53 mg.100g^{-1}). Although there was a reduction in both types of sweet guava paste after 3 months, light sweet guava paste still had higher contents after 6 months of storage when compared to conventional sweet guava paste. Although the two types of sweet guava paste were stored in the dark, storage probably interfered since there was a difference in contents for 3 and 6 months of storage. The increase in theascorbic acid content, especially in the sixth month of storage may be due to the heterogeneity of the samples.

Hong *et al*. (2012) reported that L-ascorbic acid rates in guava coated with 2% chitosan ranged between 122 mg (without any storage) and 109 mg L-ascorbic acid.100 g^{-1}(after 12 days storage). Silva *et al*. (2010) found a 28 mg L-ascorbic acid.100 g^{-1} residue in aseptically processed bottled juice stored for 250

days. Results in the literature show great variations in vitamin C contents due to the types of products and conditions in which they were processed. All authors emphasize that L-ascorbic acid is highly degradable for different reasons, especially temperature. In fact, degradation of the vitamin occurred since in current assay of sweet guava pastes were cooked and stored at room temperature.

Time-dependent degradation in phenolic compounds, carotenoids and L-ascorbic acid contents may be lessened if the products are stored under refrigeration or stored at modified temperatures. Storage at room temperature characterized current study since it was the type of storage in grocers and supermarkets. Results in Figure4b show that conventional and light sweet guava paste did not differ during the first 3 months of storage. Rates were close but a gradual reduction of concentration was required to inhibit 50% of DPPH during the remaining period.

Results show that light sweet guava paste contains a lower antioxidant activity only after 12 months of storage when compared with conventional sweet guava paste. During the storage period, the contents of phenolic, carotenoids and vitamin C compounds were higher in light sweet guava paste than those in conventional sweet guava paste. Further, vitamin C degraded in the two types of sweet guava paste after 12 months. Therefore, the total contents of the bioactive compounds evaluated in current assay do not validate a direct relationship with antioxidant activity.

Lycopene and gallic acid contents were also higher in light sweet guava paste during the whole storage period. Catechin contents only were higher in conventional sweet guava pasteafter a 12-months storage during which light sweet guava paste had a lower antioxidant activity. In the table 2, with the exception of catechin, the bioactive compounds content were correlated with each other in a highly significant way; and this was also found between each compound and the antioxidant activity. The catechin showed a significant negative correlation with the others bioactive compounds and with the antioxidant activity. These results suggest that, in general, the content of other bioactive compounds and the antioxidant activity is higher in samples with lower content of catechin.

Conclusion

Red guava pulp and sweet guava pastes have high rates of phenolic compounds, preponderantly gallic acid. Lycopene was the main carotenoid identified in the guava pulp and in sweet guava pastes. L-ascorbic acid content was high in the guava pulp and in the sweet guava paste stored up to 6 months. Excepting vitamin C, the contents of the other bioactive compounds (phenolic and carotenoid compounds) were gradually decreased over the 12-month storage period, even though they still exhibited considerable amounts by the end of the storage period. The guava pulp and the sweet guava pastesshowed a high antioxidant potential. In fact, results show that guava pulp and sweet guava paste are good sources of bioactive compounds and they have high antioxidant activity. Further studies should be undertaken, especially *in vivo* assays, so that the effects on the human health could be corroborated.

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