International Journal of Agriculture and Food Science Technology.
ISSN 2249-3050 Volume 5, Number 2 (2014), pp. 47-54

http://www.ripublication.com

Influence of Processing on Physicochemical and Nutritional Composition of *Psidium Guajava* L. (Guava) Products

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Abstract

In this study, the influence of processing on the physicochemical and nutritional composition of *Psidium guajava* L. (Guava) products was evaluated. Mature guavas were washed, cut in quarters, pulped and then the pulp was processed into guava jam and guava nectar. The physicochemical parameters studied were pH, total soluble solids (TSS) and titratable acidity (TA) along with iron, calcium and phosphorus content. Nutritionally these were analyzed for their proximate composition, total carbohydrates, vitamin C and β carotene. The results revealed that processing of guava fruit pulp into jam and nectar resulted in a significant ($p<0.05$) increase in physicochemical properties like TSS and TA but a significant ($p<0.05$) decrease in pH, iron, calcium and phosphorus. Processing of guava pulp into guava jam and guava nectar decreased the nutritional composition when compared with the guava pulp. Moisture, ash, crude fiber, crude protein, crude fat, vitamin C and β carotene decreased significantly ($p<0.05$) except significant ($p<0.05$) increase in the carbohydrate and thereby energy value.

Keywords: *Psidium guajava* L., guava, processing, guava jam, guava nectar, physicochemical, nutritional.

Introduction

Guava (*Psidium guajava*) is a delicious fruit of the plant family Myrtaceae. It is a popular tree fruit of the Asian subcontinent, it is commonly known as “Apple of Tropics” and locally by different names such as Amrud, Peru, Piyara, Koyya, Sede

Pandu etc. (Zamir et al. 2007). Guava (*Psidium guajava* L.) is valued as a potential source of pectin, ascorbic acid (vitamin C), sugars and minerals (Hassimotto et al. 2005). Guava is popular among the people of all social strata due to its comparative low price than some other fruits, nourishing value and
good taste. However, because guava is a highly perishable fruit, it is often processed into nectar, jam and jelly to extend its shelf life and make the fruit available throughout the year. Several guava products have been studied with regard to the influence of processing and storage time on their lycopene and vitamin C contents, but there is dearth of information on the effects of processing methods on the physicochemical and nutritional composition of guava products. So, the aim of our research was to investigate the influence of processing on the physicochemical, nutritional and phytochemical composition of Guava products.

Materials and methods

Procurement and Preparation of samples: Guava (*Psidium guajava* L.) fruit was purchased from local market of Anantapur, Andhra Pradesh (India). Fully mature fruits were selected, washed thoroughly with distilled water and non edible portion of fruits were removed and was processed into Guava pulp, Guava jam and Guava nectar.

***Physicochemical analysis*:** Titratable acidity, pH and total soluble solids were determined by methods as given by Ranganna (1997). Iron in the mineral extract was determined by Wong's method given by Raghuramulu et al.2004. Calcium was determined by the method of Hawk et al.1957 and phosphorus by the method of Fiske Subba Rao as given by Raghuramulu et al.2004.

***Nutritional analysis*:** Moisture, ash, crude fiber were determined using standard methods of AOAC (1990). Crude fat was determined by method of Huber and Newman (1975). Crude protein was determined in the sample by following the method given by Lowry et al. (1951), while the carbohydrate content was estimated by anthrone method (Hedge and Hofreiter, 1962). Vitamin C content was analyzed by the method given by Ranganna (1997). β carotene was extracted on alumina column and determined spectrophotometrically (Raghuramulu et al. 2004).

Statistical analysis: The data obtained was analyzed statistically for analysis of variance in a completely randomized design (Sendecor and Cochran, 1994).

Results and Discussion

Table 1 lists the physico chemical properties and mineral composition of guava pulp, guava jam and guava nectar. Guava fruit pulp had 4.7$\pm$ 0.3 pH, 10.2$\pm$ 0.2 ^{0}Brix total soluble solids (TSS) and 0.72$\pm$ 0.8 g (g citric acid /100g fresh mass) titratable acidity (TA). pH, TSS and TA values were similar to those reported by Brunini et al. (2003) and Dos Reis et al. (2007). The transformation of fruit pulp into jam and nectar naturally increased TSS because of the added sugar. However, jam had higher TSS than nectar as formulation of nectar took in dilution with water. pH of jam and nectar are comparatively lesser than the fruit pulp as citric acid was added as a preservative in both the products which brought down the pH in jam and nectar. TA was also found to be higher in jam and nectar as compared to the fruit pulp due to the addition of citric acid as preservative (Ordonez-Santos LE and Vazquez- Riascos A, 2010). Iron content of guava jam and guava nectar decreased significantly when compared with the guava pulp which can be due to the addition of sugar to the fruit pulp in the processing of guava jam and guava nectar. However, the decrease in the iron content of guava nectar was lesser when compared with guava nectar which can be due to the fact that certain food processing procedures enhance the proportion of diffusible iron as compared to the unprocessed food. The constituent organic acids in fruit juices namely citric, ascorbic and malic acids were found to be potentially responsible for enhancing the iron availability (Hazell and Jhonson, 2007). Calcium content was found to decrease slightly in products viz. guava jam and guava nectar as compared to guava fruit pulp. Heating (60- 70^{0}C) of tissue causes disruption of membranes and decompartmentation of cell constituents. Heat induced firming is believed to start with damage to cell membranes that causes increase in impermeability. This leads to liberation of Ca^{2+} and its diffusion to the cell formation of Ca^{2+} and Mg^{2+} ionic cross linkages between carboxyl groups of pectin (Haard and Chism, 2005). Compared with the guava fruit pulp, tremendous decrease in phosphorus content of 92 and 84% ($p<0.01$) was observed in guava jam and guava nectar. However, guava nectar had comparatively higher content of phosphorus than guava jam due to uptake of minerals from water used in the preparation of nectar (Rickman et al, 2007).

Influence of processing on the nutritional composition of guava is presented in Table 2. As clear from Table 2; moisture, ash, crude fiber, crude fat and crude protein content was lowest in guava jam as compared to guava nectar and guava pulp. Addition of sugar in jam and nectar resulted in an increase in total carbohydrates and calorific value. Data pertaining to these parameters of guava pulp was found coinciding with data given by Gopalan et al. (1997). However, crude fiber content was found to be slightly higher than the reported value which can be attributed to varietal differences. Crude fiber content when compared with guava fruit pulp decreased by 81 and 68% ($p<0.05$) in guava jam and nectar. This decrease can be attributed to the addition of sugar and removal of seeds in the preparation of jam whereas, the addition of sugar and dilution with water in case of guava nectar. Crude protein content decreased in guava jam and guava nectar as during heat treatment proteins undergo denaturation/ degradation and thus reduction in the crude protein content (Whitaker, 1981). Crude fat content estimated in guava fruit and its products indicated a decrease of 65% and 39% ($p<0.05$) respectively in guava jam and nectar. Higher percent decrease in fat content in jam as compared to nectar can be due to thermal degradation of fats at higher temperatures (Fennema, 1997). Carbohydrate content was found to significantly increase in guava jam (68%) and guava nectar (93%) ($p<0.05$) when compared with guava fruit pulp. This increase in carbohydrate content can be due to addition of sugar during the formulation of products. However, guava nectar had more carbohydrate content as compared to guava jam as no considerable heating is involved in the processing of nectar (Whistler and Daniel, 1985). Vitamin C was found to decrease by 97% in guava jam and 94% in guava nectar when compared with guava fruit pulp. This tremendous decrease in vitamin C content in jam is due to the addition of sugar and use of heat treatment in the processing. Comparatively lesser decrease in vitamin C was seen in guava nectar as no considerable heat treatment is used in the processing of nectar. Also, these losses of vitamin C are probably due mainly to oxidation; in particular the oxidation of vitamin C to dehydroascorbic acid which is followed by the hydrolysis of the latter to 2,3- diketogulconic acid, which then undergoes polymerization to other nutritionally inactive products (Dewanto et al. 2002). β carotene decreased by 57 % and 28 % ($p<0.01$) in guava jam and guava nectar respectively. This decrease is due to the addition of sugar during the processing of jam and nectar. Besides, preparation of jam involves heating above 100 ^{0} C which causes degradation of β carotene. Carotenoids are thus susceptible to loss of provitamin A activity through oxidation during processing (Salunkhe et al. 1991). Energy calculated was comparatively higher for the guava jam and guava nectar as compared with the guava fruit pulp. However, energy content of guava nectar was higher than guava jam owing to the thermal degradation of macronutrients during the processing of jam. When compared with each other, jam had lesser nutritional composition than guava nectar as processing of jam includes addition of sugar and use of high heat treatment which leads to degradation of nutrients whereas, in guava nectar the reduction can be due to dilution with water and addition of sugar (Ordonez-Santos and Vazquez- Riascos, 2010).

Table 1: Influence of processing on the physicochemical and mineral composition of guava pulp, jam and nectar

Sample/ Parameters	Guava Pulp	Guava Jam	Guava Nectar
pH	4.7 ±0.3	3.5 ± 0.7	3.2 ± 0.3
Total soluble solids (^{0}Brix)	10.2 ± 0.2	70.0 ± 0.1	24.04 ± 0.7
Titratable acidity (g citric acid/100g fresh mass)	0.72 ± 0.8	0.87 ±0.3	0.97 ± 0.9
Iron (mg %)	6.2± 0.7	1.6±0.5	6.7±0.8
Calcium (mg %)	28.2± 0.8	26.7± 1.1	27.6±0.9
Phosphorus (mg %)	17.9± 1.1	1.3± 0.1	2.7±0.5

Values are mean ± SEM of 3 observations

Table 2: Influence of processing on the nutritional composition of guava pulp, jam and nectar

Sample/ Parameters	Guava Pulp	Guava Jam	Guava Nectar
Moisture (g %)	81.1 ±0.3	19.9 ± 0.6 (75)	45.5 ± 0.7 (43)
Ash (g %)	0.6 ± 0.6	0.3 ± 0.5 (58)	0.4 ± 0.7 (33)
Crude fiber (g %)	9.1 ± 0.8	1.8 ±0.5 (81)	2.4 ± 0.7 (68)
Crude Protein (g %)	4.5 ± 0.4	2.8 ± 0.9 (37)	3.4 ± 0.4 (24)
Crude Fat (g %)	2.6 ± 0.9	0.09 ± 0.5 (65)	0.16 ± 0.7 (39)
Carbohydrate (g %)	23.5 ± 1.1	39.5 ± 1.3 (68)	45.4 ± 1.5 (93)
Vitamin C (mg/100g fresh mass)	246.9±0.8	7.5±1.1 (97)	15.6±1.0 (94)
β carotene (mg/100g fresh mass)	0.01±0.09	0.006±0.07 (57)	0.009±0.3 (28)
Energy (Kcal)	114.1 ± 1.2	170.2 ± 1.3 (48)	204.6 ± 1.5 (79)

Values are mean ± SEM of 3 observations
Figures in the parenthesis indicate % increase/decrease over the fruit pulp values

Conclusion

Processing of Guava fruit pulp into jam and nectar resulted in a significant increase in physico chemical properties like TSS and TA but brought down a significant decrease in pH and mineral composition. Also, processing of Guava fruit pulp into jam and nectar brought down the nutritional composition of the products except significant increase in the carbohydrate and thereby energy value. Although there is a decrease in the nutritional and composition of Guava products than pulp but it can be said that processing of Guava fruits into jam and nectar ensures the safety and quality of the products without much loss of nutritional and antioxidant benefits, which is not feasible with the Guava fruit as such owing to its perishable nature.

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