Pak. J. Sci. Ind. Res. 2007 **50**(4) 288-292

Studies on the Preparation and Composition of Guava (*Psidium guajava* L.) Toffee and Slab Bars

Mohammad Nisar Khan Alizai
PCSIR Laboratories Complex Peshawar, Jamrud Road, Peshawar 25120, Pakistan

(received October 20, 2005; revised May 16, 2007; accepted June 15, 2007)

Abstract. Guava toffee/slab bars were made from guava pulp using hot air dehydration. No artificial colour, preservative or essence was added to the product. Comparative investigation of the fresh guava pulp and the product was conducted. Moisture, ash, soluble pectin, ascorbic acid, tannins, sugar, citric acid along with mineral contents i.e. calcium, sodium, potassium and phosphorus were determined. Shelf life of the product was monitored for more than twelve months and organoleptic evaluation was conducted. No change in colour, flavour or texture was observed during the storage at room temperature.

Keywords: guava product, nutrients, minerals

Introduction

Guava (*Psidium guajava* L.) is a tropical fruit with appealing taste and aroma and is abundantly produced in Pakistan. It has many varieties and colours. Most of the produce has yellow colour though fruit of off-white, greenish yellow, reddish white and greenish white shades are also available in the Northern Pakistan. Physical characteristics of the fruit vary depending upon the variety. High amount of ascorbic acid is found in fresh raw fruit as well as in Juices (Khan *et al.*, 1991; Ahmad, 1961).

There is little utilization of the fruit in commercial products, though one report (Khedkar *et al.*, 1982) suggests utilization of a fraction of the fruit in jelly production. Dehydration of the fruit has been earlier reported for its utilization in pectin and jelly formation (Mann and Termazi, 1967). Most of the fruit is wasted due to browning, irregular packaging or over loading of the carriers. Shelf life of fresh fruit is very limited, approx. ten days. The colour of fruit changes on ripening, or due to bruising, cutting or mishandling during transportation. Control of browning in raw apple and fresh guava juice/ concentrate through the use of polyphenol oxidase inhibitor and the chelating agents has earlier been reported (Alizai and Ahmad, 1997; Alizai and Rehman, 1993). For maximum utilization of guava fruit and enhancing its shelf life, the present work was undertaken to formulate guava products in the forms of guava toffee and slab bars, without using any artificial colour, flavour or preservative. Organoleptic evaluation and nutritional analyses were also conducted to judge the suitability of the product for human consumption. Being natural nutritional food having vitamins, minerals and negligible sugar as compared to the synthetic product, available in the market, it is envisaged that this product will attract consumers in the local market as well as abroad. Techno-economic feasibility report of guava toffee manufacture has also been prepared to assist the investor, a summary of which is given in Table 5 at the end of the text.

Materials and Methods

Guava fruit produce was purchased from the local market of Kohat (NWFP) and transported to the laboratory. Fruit was thoroughly washed with clean tap water and damaged or bruised brown portions were discarded through sorting. Pieces of good quality, wholesome parts of the ripe fruit were made using stainless steel knives and kept in water to prevent browning. The pieces were passed through pulper and sieve to make pulp and to separate out the seeds and waste material. Prior to passing the fruit through pulper, approx. 500 g pieces were slected from the lot, sealed in polyethylene bags and stored at -20 °C for further analysis/investigation.

Approximately 2-5% sugar (w/w) was added to the guava slurry obtained from the pulper (brix. 13), with continuous stirring, to enhance the sweetening. Apart from sugar, 0.2% liquid glucose and 0.1-0.15% honey were also added with the stabilizer; addition of honey depends upon the consistency of the product. The polyphenol oxidase inhibitors were also added to prevent browning and to give shining to the product. Addition of sugar depends upon the variety of guava as some varieties are sweeter than the other. The mixture was thoroughly blended to a uniform consistency. The pulp was then evenly spread in stainless steel trays, already covered with polyethylene sheet, each tray containing 1.5 to 2 kg material. The trays were placed in thermostatically controlled cabinet hot air dryer. Temperature of the pre-heated dryer was 70 °C which was then run overnight at

60 °C to get product of approx. 6% moisture. The product was removed from the polyethylene sheet after thirty hours and placed on aerated iron trays for further ten hours in hot air dryer. The product was evenly cut into one inch square pieces, each weighing approx. 4 g, wrapped in toffee wrapper and then seal-packed in polyethylene bags and stored at room temperature. Guava slab bars were also prepared in the same way; slab bars of approx. size 1.5″ x 3″ each, were packed in labelled polyethylene transparent bags and stored for further use. The product was analysed for moisture, ash, soluble pectin, tannins, sugar, citric acid and ascorbic acid. Organoleptic evaluation was conducted following the procedure of Larmond (1977). Evaluation was based on a scale of ten points each for flavour, colour and texture, the final value being the average of fifteen judgments (Table 4).

Besides fresh fruit, the product was also analysed for the nutrient composition at three months intervals. pH was determined by Digital Corning 102 pH meter. Moisture, soluble pectin and tannin were estimated following the method of Ruck (1956). Total soluble solids were measured with Abbe's refractometer at 20 °C and total acidity was determined by titration against 0.1 N sodium hydroxide solution. The results were expressed as percent of citric acid, whereas ascorbic acid and sugars were determined by the method of AOAC (1975). Ash was made from the seedless fruit at 525 °C in furnace, in which calcium, magnesium, phosphorous, potassium and sodium were determined. Calcium was determined titrimeterically in solution of ash by precipitating as calcium oxalate, while the filtrates and the washings were used for the determination of magnesium. Magnesium was precipitated, dried, ignited and weighed as magnesium pyrophosphate (AOAC, 1975). Phosphorus was determined using Shimadzu double beam UV 200S spectrophotometer. Jenway PEP 7 model digital flame photometer was used to estimate sodium and potassium in the product. All the chemicals used were of A.R. analytical grade.

Results and Discussion

A uniform sheet of the dehydrated guava pulp (approx. 3.38 sq ft) contains more than 170 toffees, each weighing approx. 4.0 g. Composition of dehydrated guava pulp without addition of sugar, stored at room temperature, for the period of three, six, nine and twelve months is given in Table 1. These results are compatible for dehydrated guava beverage base reported by Khan *et al.* (1991) and Singh *et al.* (1983). Amount of pectin is some what low, obviously due to ripening of the fruit, during storage, while the amount of tannin increased. Non-enzymatic browning is due to Maillard reaction which can be controlled through quick processinng of the fruits, whereas, enzymatic browning can be controlled with PPO inhibitors and their chelating agents or keeping fruit dipped in water during cutting, slicing etc. to avoid oxidation (Alizai and Ahmad, 1997; Alizai and Rehman, 1993).

Enzymatic browning can be controlled in some fruits/vegetable products by blanching, so as to inactivate polyphenol oxidase (McCord and Kilara, 1993; Ma *et al.* 1992; Hall, 1989). Blanching cannot be used in guava because it adversely affects the flavour and texture; alternately, other approaches to control the browning such as exclusion of oxygen and application of browning inhibitors can be considered (Alizai, 2001, 2000).

Comparsion of nutritional constituents of freshly dehydrated guava fruit product, stored for two, three, six, nine and twelve months at room temperature is given in Table 2. Although analyses were conducted without addition of sugar but it was a little higher than reported by Khan *et al.* (1991) and Siddiqui and Farooqui (1959).

Table 1. Composition of fresh and dehydrated guava fruit product

Status of the product	Moisture (%)	Ash (%)	Soluble pectin (%)	Tannins (%)
Freshly dehydrated				
Sample I	4.0	1.20	1.7	0.6
Sample II	4.5	1.15	1.82	0.05
Sample III	5.0	1.10	1.6	0.07
Mean	4.75	1.15	1.3683	0.06
SD	0.3535	2.05	0.3970	0.01
Three months old				
Sample I	4.11	1.16	1.85	0.062
Sample II	5.00	1.19	1.70	0.054
Sample III	5.12	1.09	1.65	0.23
Mean	4.743	1.146	1.5133	0.202
SD	0.55	0.051	0.3729	0.388
Six months old				
Sample I	4.5	1.16	1.62	0.065
Sample II	5.4	119	1.68	0.058
Sample III	5.8	1.08	1.63	0.076
Mean	5.233	1.143	1.66	0.161
SD	0.665	0.058	0.346	0.1723
Nine months old				
Sample I	5.62	1.18	1.32	0.075
Sample II	6.00	1.19	1.55	0.60
Sample III	6.2	1.08	1.58	0.80
Mean	5.086	1.15	1.4833	0.4916
SD	1.1687	0.86	0.1422	0.3744
Twelve months old				
Sample I	6.9	0.99	1.26	0.078
Sample II	7.2	1.00	1.40	0.65
Sample III	7.4	1.80	1.50	0.8
Mean	7.166	1.03	1.3866	0.516
SD	0.2516	0.608	0.12055	0.3887

Ascorbic acid content of fresh fruit is variable as the percentage of Vitamin C content decreases on ripening of the fruit due to conversion of ascorbic acid to sugar. Amount of ascorbic acid found in the dehydrated pulp (Table 2) is compatible with the findings of Khan *et al.* (1991); Jabbar *et al.* (1988); Pollard and Timberlake (1971). For control of browning, ascorbic acid (Vitamin C) is the best substitue of sulphite. However, guava is highly prone to browning despite the high content of ascorbic acid; this is due to formation of dehydro-ascorbic acid and finally quinone, which can accumulate and undergo browning (Sapers, 1993). Special measures such as packing of material under anaerobic conditions and storage in controlled atmospheric conditions could improve the situation. In the present study, browning of fruit was controlled through the use of polyphenol oxidase (PPO) inhibitor. The prepared toffees/slab bars are golden or pale yellow in colour or slightly golden yellow with brownish streaks on the side of the dehydrated guava pulp sheet.

Mineral constituents of dehydrated guava product (Table 3) is in agreement with the data published for Pakistani varieties of the guava though wide variations in mineral constituents are reported in foreign varieties of guava. Hardicka (1959) has reported calcium content as 43 mg/100 g; Ma *et al.* (1992) found 10 mg/100 g in Australian guava fruit. Similar variations are found in potassium and sodium contents. In the present study, percentage of potassium was found to be lower but that of sodium higher, as compared to the findings reported for Indian and Australian guava fruit. Concomitantly, the ascorbic acid content reported in the literature, is tenfold higher in guava produced in different areas of the world. This may be due to the particular variety, climatic effect or the soil composition of that particular area. Apart from analytical investigation of fresh guava toffee and slab bars, organoleptic/sensory evaluation was conducted at different intervals (Table 4) to judge the suitability of the product for human consumption.

Table 2. Nutritional constituents of dehydrated guava fruit toffee at different intervals

Status of the product	Sugar			Citric acid (%)	Ascorbic acid mg/100 g
	Reducing (%)	Non reducing (%)	Total (%)		
Fresh					
Sample I	11.2	82.0	93.02	1.38	220.00
Sample II	12.4	84.4	96.8	1.45	215.6
Sample III	13.1	81.0	94.0	1.50	210.5
Mean	12.23	82.46	94.67	1.443	215.36
SD	0.9609	1.7473	1.933	0.0602	4.7542
Two months old					
Sample I	11.8	81.6	93.0	1.35	217.3
Sample II	12.1	83.4	94.0	1.41	211.8
Sample III	13.1	81.00	95.5	1.42	206.00
Mean	12.35	81.83	94.26	1.413	213.7
SD	0.845	1.464	1.250	0.065	5.050
Three months old					
Sample I	12.3	81.1	93.2	1.31	210.6
Sample II	12.9	83.1	94.4	1.40	213.1
Sample III	13.8	81.5	94.3	1.45	204.5
Mean	13.0	81.9	94.06	1.4	209.4
SD	0.754	1.058	0.757	0.0626	4.423
Six months old					
Sample I	13.1	80.7	93.35	1.28	210.8
Sample II	13.35	80.0	93.50	1.38	210.5
Sample III	14.2	79.8	95.0	1.43	203.0
Mean	13.55	80.16	93.8	1.3877	208.1
SD	0.5766	0.472	0.803	0.0651	4.4192
Nine months old					
Sample I	13.45	80.2	94.35	1.25	208.8
Sample II	13.5	80.9	93.65	1.28	209.1
Sample III	14.5	79.5	95.1	1.41	201.0
Mean	13.816	80.2	94.15	1.3133	206.3
SD	0.5923	0.7	0.983	0.0850	4.593
Twelve months old					
Sample I	13.25	79.0	93.25	1.20	208.0
Sample II	13.8	80.0	94.00	1.23	208.5
Sample III	15.0	78.0	95.20	1.40	200.5
Mean	14.0	79.0	94.15	1.2766	205.66
SD	0.89	1.0	0.915	0.1078	4.4814

Table 3. Mineral composition of guava toffee (mg/100 g)

Status	Calcium	Potassium	Phosphorus	Magnesium	Sodium
Fresh, sample I	0.029	0.464	0.014	0.036	0.011
Fresh, sample II	0.0285	0.465	0.016	0.038	0.0095
Two months old, sample III	0.0288	0.465	0.015	0.038	0.0102
Three months old, sample IV	0.0287	0.464	0.015	0.037	0.010
Mean	0.02875	0.4645	0.015	0.3725	0.0101
SD	0.000208	0.000577	0.000816	0.000957	0.000624

Table 4. Sensory evaluation of guava toffee

Status	Taste (10 pts.)	Colour (10 pts.)	Texture (10 pts.)	Total score (30 pts.)
Fresh toffee				
Sample I	9.0	9.0	9.0	27
Sample II	8.5	9.0	8.0	25.5
SampleIII	8.0	8.5	8.5	25.0
Mean	8.5	8.83	8.5	25.8
SD	0.5	0.288	0.149	1.0408
Three months old				
Sample I	8.5	9.0	9.0	26.5
Sample II	8.5	8.5	8.5	25.5
Sample III	9.0	8.0	9.0	26.0
Mean	8.66	8.5	8.83	26.0
SD	0.2886	0.5	0.288	0.5
Six months old				
Sample I	8.5	8.5	8.5	25.5
Sample II	8.5	8.5	8.5	25.5
Sample III	9.0	8.0	9.0	26.0
Mean	8.66	8.3	8.6	25.6
SD	0.2886	0.2886	0.2886	0.5
Nine months old				
Sample I	7.0	7.5	7.0	21.5
Sample II	7.5	7.0	7.0	21.5
Sample III	8.0	7.0	7.5	22.5
Mean	7.5	7.16	7.16	21.83
SD	0.5	0.2886	0.2886	0.577

N.B.: values are average of fifteen judgements

Table 5. Summary of value addition to guava

1.	Average cost of fresh guava/kg	Rs.10.00
2.	Preparation losses approx. 20%	200 g/kg
3.	Material available for processing	800 g/kg
4.	Total material processed (including sugar 200 g)	1000 g
5.	Toffee: total material ratio	3:1
6.	Weight of toffee prepared	333 g
7.	No. of toffees (each weighing approx. 4 g)	83
8.	In-put value (processing, packaging plus sugar)	Rs.20.00
9.	Sale price per packet of ten toffees	Rs.10.00
10.	Total sale price	Rs.83
11.	Actual gain = sale price - input	Rs.63/- = 83-20
12.	Value addition %: $\frac{\text{sale}}{\text{input}} \times 100$	$\frac{83}{20} \times 100 = 415\%$

Conclusion

Keeping in view the short life of guava which is produced in large quantities in the country and to minimize the financial loss of growers, guava toffee/slabs were successfuly formulated with enhanced shelf life and easy availability to the common cunsumers. The product has intact Vitamins and minerals of the raw fruit. Manufacture of the product is feasible to investors/industrialists/manufacturers and can compete in local market with other synthetic products; moreover, it has the capability of earning foreign exchange for the country.

References

Ahmad, R. 1961. Dehydration of tropical fruit. *Pak. J. Sci. Ind. Res.* **19:** 8-17.

Alizai, M.N. 2001. Mode of action and structural properties of polyphenol oxidases. *Pak. J. Sci.* **53:** 111-116.

Alizai, M.N. 2000. Control of polyphenol oxidase activity: Review. *Pak. J. Sci.* **52:** 5-9.

Alizai, M.N., Ahmad, Z. 1997. Comparative investigation to control enzymatic/non-enzymatic browning of guava juice/concentrates. *Sarhad J. Agric.* **13:** 95-101.

Alizai, M.N., Rehman, F. 1993. Ascorbic acid derivatives and ploypheno1 oxidase inhibitors used to control the enzymatic browning in apples and pears. *Sci. Int.* **5:** 207-210.

AOAC 1975. *Official Methods of Analysis of the Association of Official Analytical Chemists*, pp. 397-398, 12th edition, AOAC, Washington DC., USA.

Hall, G.C. 1989. Refrigerated frozen, and dehydrofrozen apples. In: *Processed Apple Products*, D. L. Downing (ed.), pp. 239-256, Van Nostrand Reinhold, New York, USA.

Hardika, J. 1959. Enzymatic and nonenzymatic properties of fruits. *Food. Eng.* **24:** 141-150.

Jabbar, A., Khan, M.R., Sufi, N.A., Iqbal, S. 1988. Quality characteristics of some guava varieties grown in NWFP. *J. Sci. Tech. Univ. Peshawar* **12:** 45-47.

Khan, F.M., Eijazuddin, Jabbar, A. 1991. Studies on the preparation and composition of dehydrated guava beverage base. *Pak. J. Sci. Ind. Res.* **34:** 315-318.

Khedkar, D.M., Ansarwadkar, K.W., Dabhade, R.S., Ballal, A.L. 1982. Extension of storage life of guava var. L-49. *Indian Food Packer* **36:** 49-54.

Larmond, E. 1977. *Laboratory Methods of Sensory Evaluation of Foods*. Research Branch, Canadian Govt. Publ. No. 1637, Publ. Center, Ontario, Canada.

Ma, S. X., Silva, J.L., Hearnsberger, J.O., Garner, J.O.Jr. 1992. Prevention of enzymatic darkening in frozen sweet potatoes [*Ipomoea batatas* L. Lam] by water blanching;

Reltionship among darkening, phenols, and polyphenol oxidase activity. *J. Agric. Food Chem.* **40:** 864-867.

Mann, A.R., Termazi, S.A. 1967. Dehydration of guava fruit. *Pak. J. Sci. Ind. Res.* **19:** 8-17.

McCord, J.D., Kilara, A. 1993. Control of enzymatic browning in processed mushrooms (*Agaricus bisporus*). *J. Food Sci.* **48:** 1479-1483.

Pollard, A., Timberlake, C.F. 1971. Fruit juices. In: *The Biochemistry of Fruits and Their Products,* A. C. Hulme (ed.), pp. 573, 4th edition, Academic Press, London, UK.

Ruck, J.A. 1963. *Chemical Methods for Analysis of Fruits and Vegetable Products,* Canada Deptt. of Agric. Canada Publ. No. 1154, Ottawa, Canada.

Sapers, G.M. 1993. Browning of foods: control by sulphites, antioxidants and other means. *Food Technol.* **47:** 75-84.

Siddiqui, M.K., Farooqi, M.A. 1959. Non-enzymatic browning in dehydration of fruits and vegetables during storage. *J. Sci. Res.* **11:** 29-37.

Singh, R., Kapoor, A.C., Gupta, O.P. 1983 The effect of cultivars, season and storage on the nutritive value and keeping quality of guava cheese. *Indian Food Packer* **37:** 71-77.