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DEVELOPMENT AND EVALUATION OF PROTEIN ENRICHED GUAVA NECTAR BLENDED WITH SOYMILK

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ABSTRACT
Guava nectar blended with soymilk was developed with an aim to produce protein enriched nectar (PEN). The treatments comprising different blends of guava nectar and soymilk were evaluated for physic - chemical and sensory characteristics and shelf life in ambient condition of storage. The study revealed that the guava nectar supplemented with soymilk had increased protein content as much as 2.6% to 5.34% at fresh preparation. The analysis for other parameters like total soluble solids, Titratable acidity, pH, ascorbic acid, reducing sugars, non-reducing and total sugar contents of the product were done at thirty days interval. T. S. S, pH, ascorbic acid, protein and total sugars content of the PEN decreased during storage, while the acidity of the product increased rapidly after 60 days causing the off-odour. As a result, sensory scores decreased after 60 days of storage. The recipe with 70% guava nectar and 30% soymilk recorded highest sensory scores and maximum protein (2.62%) and ascorbic acid (118.9 mg/100g) content.

INTRODUCTION

Guava (*Psidium guajava* L.), a member of the botanical family Myrtaceae, is one of the major fruit crops grown in tropical and subtropical regions of the world. Owing to its nutritional superiority, cheaper prices and characteristic flavor, it has gained wide popularity amongst rich as well as poor strata of the society. It has good potential for marketing both in raw and processed forms because of its taste, texture, colour, and potentiality for processing into products. Also, guava is one of the richest sources of vitamins, and is known to contain five folds more vitamin-C than oranges (Conway, 2001). It has been reported that, consumption of guava plays a key role in preventing the diseases such as scurvy, cancer, stroke, heart disease and urinary tract infection. Allahabad, a district in the state of Uttar Pradesh, is well known for producing excellent quality guava fruits, especially the leading variety of India *viz*. Allahabad Safeda. This elite variety not only ranks first in the cultivation of raw fruits production, but also for use in processing. Considering the unique blend of taste and nutrition, guava is one of the most suited candidate fruits for value addition.

Soybean (*Glycine max* L.) is a leguminous crop which is widely appreciated for its nutritional properties. Soybean is called as consummate and functional food since it contains more proteins than beef, more calcium than milk, more lecithin than egg and several minerals, vitamins and biologically active compounds (Tripathi and Mishra, 2005). It plays important role in prevention of heart diseases, osteoporosis, cancer, kidney diseases and bone diseases and gives relief in menopausal symptoms (Bakhit *et al*., 1994 and Messina *et al.*, 1999). Since soybean and soy products are of prime importance from health point of view, their popularity is observed to be increasing day by day. Nowadays, the common protein supplement, the cow milk, suffers from frequent price hikes, adulterations and controversies such as use of oxytocin. Soymilk, one of the important products of soybean, is richer in protein content, cost effective and more importantly, is plant based, and hence could be effectively used as an alternative to cow milk. As per the report of Tripathi and Mishra (2005), soymilk is found to be *on par* with the cow milk in its amino acids profile and hence, it is a convenient source of protein for fast expanding population worldwide. Due to these advantages, soybean and soy products are being incorporated as a component in many processed products *viz*. mango-soy fruit bar (Chauhan *et al*., 1997), soy chunks (Sharma *et al.,* 2006), soy enriched apple bar (Agrahari *et al.,* 2007), apricot toffees (Thakur *et al.,* 2007) *etc*.

Protein and fat of excellent quality are available in soybeans which could be utilized for enrichment of products. The guava nectar is widely accepted refreshing product of guava, but is deficient in protein. The present paper concerned an attempt to fortify the guava nectar with protein supplemented through soymilk.

MATERIALS AND METHODS

The present investigation was carried out at the Department of Horticulture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad during 2009-10. Fruits of Allahabad Safeda variety were freshly procured from the local market of Rambaug, Allahabad during Mrig bahar.

Similarly, soybean of a local variety was obtained from the local market. Fruits and soybean were subjected to the physical and chemical tests before utilizing for the preparation of the product. Guava nectar was prepared from the fruits following the methodology given by Srivastava and Kumar (1993); whereas soymilk and protein enriched nectar (the blend of nectar and soymilk) was prepared following the method described by Chauhan and Joshi (2000). Treatments comprising of 11 varying blends were designed and the experiment was laid using Completely Randomized Design. The prepared products were evaluated for the physico-chemical, sensory parameters and shelf life studies at ambient condition.

Table 1: Chemical composition of guava nectar and soymilk

Sr. no.	Particulars	Guava nectar	Soymilk
1.	Moisture (%)	83.12	89.3
2.	T.S.S (°B)	9.6	4.5
3.	Titrable acidity (% CA)	0.25	0.12
4.	pH	3.65	4.60
5.	Ascorbic acid (mg/100g)	153.12	-
6.	Reducing sugars (%)	3.96	-
7.	Non-reducing sugars (%)	4.83	-
8.	Total sugars (%)	8.79	-
9.	Protein (%)	0.9	4.3
10.	Fats (%)	0.26	2.5

Total soluble solids (T.S.S., expressed in °B) and pH of the product were determined using hand refractometer and digital pH meter, respectively. The protein estimation was carried out by the micro-Kjeldahl method. Acidity was determined by titrimetric method and expressed as percent citric acid, whereas ascorbic acid (mg/100g) was determined by titrating the product against 2, 6-dichlorophenol indophenol indicator. Sugars were estimated by Lane and Eynon's method in terms of reducing, non-reducing and total sugars (Ranganna, 1997). The sensory evaluations for assigning scores for sensory attributes of samples were conducted by a panel of five judges and the recipes were rated on a 9- point hedonic scale (Amerine *et al.,* 1965) for colour, flavor and texture. The products were stored at ambient condition and the shelf life was judged.

RESULTS AND DISCUSSION

In the present investigation, possibilities were explored for preparation of refreshing guava nectar blended with soymilk using different recipes. Physico- chemical parameters were

Table 2: Total soluble solids, Titratable acidity and pH of PEN as influenced by different treatments during storage at ambient temperature

Treatments(Nectar : soymilk)	T.S.S (°B)			Titratable acidity (% C. A)			pH		
	Fresh	30	60	Fresh	30	60	Fresh	30	60
T_1(control)	13.0	11.3	10.1	0.25	0.25	0.59	3.65	3.60	3.29
T_2(95:05)	15.0	10.9	10.0	0.25	0.25	0.63	3.21	3.20	3.14
T_3(90:10)	15.0	10.1	10.0	0.25	0.25	0.44	3.26	3.29	3.23
T_4(85:15)	15.0	12.6	11.4	0.25	0.25	0.68	3.27	3.20	3.14
T_5(80:20)	15.0	12.8	11.1	0.25	0.25	0.92	3.26	3.23	3.22
T_6(75:25)	15.0	11.4	8.7	0.25	0.25	0.83	3.42	3.23	3.15
T_7(70:30)	15.0	11.1	11.0	0.25	0.29	0.85	3.52	3.30	3.29
T_8(65:35)	15.0	12.7	10.7	0.25	0.32	1.15	3.57	3.24	3.20
T_9(60:40)	15.0	12.6	11.7	0.25	0.38	1.34	3.83	3.28	3.23
T_{10}(55:45)	15.0	13.7	12.2	0.25	0.51	1.87	3.91	3.51	3.36
T_{11}(50:50)	15.0	12.8	11.2	0.25	0.51	1.72	3.97	3.41	3.26
Mean	-	12.0	10.8	-	0.32	1.00	3.53	3.32	3.23
SEm ±	-	0.90	1.38	-	0.01	0.06	0.02	0.04	0.03
CD (5%)	-	2.63	4.03	-	0.04	0.17	0.06	0.12	0.09
F-test	-	S	NS	-	S	S	S	S	S

Table 3: Ascorbic acid and protein content of PEN as influenced by different treatments during storage

Treatments(Nectar: soymilk)	Ascorbic acid (mg/100g)			Protein (%)		
	Fresh	30	60	Fresh	30	60
T_1(control)	141.1	139.2	130.5	0.87	0.87	0.87
T_2(95:05)	130.5	123.7	120.8	2.62	2.04	1.75
T_3(90:10)	128.5	123.7	77.3	2.62	2.33	2.04
T_4(85:15)	127.6	123.7	72.5	2.52	2.04	1.75
T_5(80:20)	126.6	119.0	74.6	2.62	2.62	1.75
T_6(75:25)	121.8	116.0	68.6	2.62	2.62	2.04
T_7(70:30)	118.9	85.0	70.5	2.62	2.62	2.42
T_8(65:35)	113.1	77.3	64.7	2.91	2.62	2.42
T_9(60:40)	102.4	58.0	59.9	2.91	2.62	2.33
T_{10}(55:45)	93.7	50.2	47.3	3.50	2.62	2.52
T_{11}(50:50)	70.5	27.0	27.0	5.34	4.08	4.27
Mean	115.88	94.8	73.97	2.83	2.46	2.20
SEm ±	3.61	3.12	2.21	0.11	0.17	0.33
CD (5%)	10.55	9.13	6.45	0.58	0.51	0.99
F-test	S	S	S	S	S	S

Table 4: Reducing, non-reducing and total sugars content of PEN as influenced by different treatments during storage at ambient temperature

Treatments	Reducing sugars (%)			Non- reducing sugars (%)			Total Sugars (%)		
	Fresh	30	60	Fresh	30	60	Fresh	30	60
T_1(control)	4.62	5.58	5.69	8.13	5.57	3.95	12.79	11.16	9.65
T_2(95:05)	4.82	5.72	6.60	8.47	6.15	3.90	13.27	11.97	10.52
T_3(90:10)	4.93	5.83	5.77	8.57	5.33	4.67	13.51	11.16	10.45
T_4(85:15)	5.33	6.33	6.70	8.97	4.54	2.10	14.31	10.88	7.24
T_5(80:20)	5.35	6.25	6.25	9.00	5.59	4.51	14.36	11.84	10.76
T_6(75:25)	5.55	5.85	6.53	9.20	3.51	3.07	14.76	10.11	9.60
T_7(70:30)	5.69	5.72	5.73	9.36	7.60	4.61	15.04	10.35	10.33
T_8(65:35)	6.25	6.29	6.68	9.29	5.83	5.86	15.54	12.55	12.12
T_9(60:40)	6.57	6.60	6.57	9.27	5.07	4.27	15.84	11.67	10.84
T_{10}(55:45)	7.24	7.60	7.63	9.27	4.31	3.01	16.50	12.07	10.62
T_{11}(50:50)	7.09	7.20	7.30	9.13	5.87	3.99	16.23	13.13	11.38
Mean	5.77	6.27	6.50	8.97	5.40	4.00	14.74	11.49	10.36
SEm ±	0.37	0.44	0.25	0.70	0.53	0.34	0.34	0.85	0.45
CD at 5%	1.076	1.287	0.721	2.039	1.543	0.994	3.98	2.49	1.32
F-test	S	NS	S	NS	S	S	S	NS	S

Table 5: Sensory scores of PEN as influenced by different treatments during storage at ambient temperature

Treatments	Colour			Flavour			Texture			Overall acceptability		
	0	30	60	0	30	60	0	30	60	0	30	60
T_1(control)	6.6	6.0	6.6	6.6	6.6	4.0	6.3	6.0	6.6	6.1	5.6	5.4
T_2(95:05)	6.3	6.3	5.3	6.3	5.3	3.3	5.6	5.6	6.3	5.4	5.3	5.3
T_3(90:10)	5.0	5.3	4.6	5.6	5.0	1.6	5.6	5.3	6.3	5.2	5.2	5.0
T_4(85:15)	6.0	4.6	4.6	5.6	5.0	2.6	5.6	4.6	6.3	5.2	5.4	4.8
T_5(80:20)	6.3	5.6	3.6	5.6	4.3	2.6	5.6	4.6	5.0	5.4	5.3	4.3
T_6(75:25)	7.3	6.0	3.6	7.0	5.3	2.6	6.3	6.3	5.3	6.0	6.0	4.2
T_7(70:30)	8.6	8.0	5.0	8.0	8.3	2.6	8.3	7.6	5.6	7.5	7.3	7.0
T_8(65:35)	8.3	6.6	4.6	7.0	7.0	2.6	7.3	6.6	4.3	7.2	7.1	6.9
T_9(60:40)	7.3	6.6	3.6	6.0	5.6	2.6	6.3	6.0	3.3	7.1	6.9	6.4
T_{10}(55:45)	7.0	5.3	3.0	6.0	5.3	2.6	5.6	5.6	3.0	5.5	6.9	6.5
T_{11}(50:50)	7.0	5.3	3.0	5.6	5.0	2.6	6.0	5.0	3.0	6.2	6.3	6.3
Mean	6.88	5.96	4.31	6.30	5.70	2.70	6.25	5.74	5.00	6.0	6.1	5.7
SEm±	0.43	0.41	0.79	0.49	1.33	0.56	0.47	1.12	0.90	0.16	0.26	0.21
CD (0.05%)	1.28	1.21	2.30	1.44	1.88	1.64	1.38	1.58	2.63	0.50	0.37	0.31
F-test	S	S	S	S	S	S	S	S	S	S	S	S

evaluated for freshly prepared guava nectar, soymilk and protein enriched guava nectar. The prime components *viz*. ascorbic acid of the nectar and protein of soymilk were observed to be 153.12 mg/100g and 4.3%, respectively (Table 1). These values show more or less resemblance with the values reported by earlier researchers (Phandis, 1970; Schaafsma and Steijns, 2000).

Effect of different blend ratios and storage duration on chemical parameters of the product has been depicted in Table 2. There were significant differences amongst the TSS contents of the treatments during initial 30 days of storage, however they became non significant after 60 days. Maximum TSS content was recorded in the treatment comprising nectar and soymilk in 55:45 combinations. T.S.S content reduced in all the treatments during storage period. This might be due to the loss of moisture and conversion of polysaccharides to monosaccharides (Chauhan *et al*., 1993). Acidity content was found to increase during storage duration and as an obvious phenomenon, the corresponding pH showed a marked decline. The change in acidity during storage might be due to formation of sulphurous acid from SO_2, ascorbic acid degradation or hydrolysis of pectin (Chauhan *et al*., 1997). Decrease in pH content during storage has been documented by Sood *et al*. (2009) in storage study of cheese and soy whey bael squash.

Table 3 represents the data regarding nutritional characteristics of the preparations. Ascorbic acid decreased significantly with increase in the soymilk concentration at all three observation periods. Nectar was found to be rich in ascorbic acid, but soymilk lacked it completely, and hence addition of soymilk decreased the ascorbic acid content of the products. Further, the content was also found to be influenced by the storage duration, which affected it adversely. Similar trends were observed in mango-soy bar (Chauhan *et al*., 1997), soy enriched apple bar (Agrahari *et al*., 2007) and apricot-soya toffees (Thakur *et al*., 2007). Reverse was the case with regard to the protein content, which was observed to increase with increase in soymilk proportion in the blend. Similar findings were recorded by Agrahari *et al*. (2007) in soy enriched apple bar prepared from the pulp of culled apples and soy protein isolates (3%). Also, Chauhan *et al*. (1993) reported that protein content of apricot-soya toffees increased with increase in soy slurry or soya isolates as the result of high protein content in soybean. Protein content of the product showed decreasing trend during storage.

Reducing-, non reducing- and total sugars content of the product have been presented in Table 4. All three sugars showed a positive trend with increase in soymilk content of

the product. Reducing sugar was observed to increase during storage period, whereas non reducing and total sugars showed a declining trend during storage. As also reported by Chauhan and Joshi, 2000, increase in reducing sugar may be due to the acid hydrolysis of sucrose.

Data pertaining to the organoleptic evaluation of the products over a period of 60 days has been represented in Table 5. There were significant differences amongst different treatments at different storage durations. Treatment 7 comprising of nectar and soymilk in the ratio of 70: 30 was found to be the most accepted treatment for all the parameters judged. In this ratio the protein (2.62%) and ascorbic acid (118.9 mg/100g) content were found to be superior. The product prepared using T_7 recipe received maximum ratings at all three durations. This treatment was found on par with treatment 8 (nectar: soymilk: 65:35) in all the parameters and storage durations. In preparation of protein enriched mango fruit bar, the ratio of 70:30 was observed to be best for commercial preparations (Chauhan *et al*., 1997). The present study also shows relevance with the studies carried out in soya toffees (Thakur *et al.*, 2007) and soy enriched apple bar (Agrahari *et al*., 2007).

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