AJHS
Asian Journal of Home Science
Volume **7** | Issue 2 | December, 2012 | 441-446

Research Paper

Studies on preparation of guava jam blended with sapota

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Received: *26.07.2012*; **Revised:** *09.10.2012*; **Accepted:** *15.11.2012*

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ABSTRACT : Jam is prepared from fruit pulp by boiling with sufficient quantity of sugar to a moderately thick consistency. There are different types of fruit jams like strawberry jam, mango jam, pineapple jam, apple jam, mixed fruit jam. Hence, an attempt was made to find out the possibilities of mixing guava and sapota for making jam and utilizing a major portion of marketable surplus of guava. Guava and sapota pulp were blended in the ratio of 100:0, 90:10, 80:20, 70:30 and 60:40 to prepare blended jams. The treatment T_4 with 60 per cent guava pulp and 40 per cent sapota pulps showed significantly less titrable acidity (1.05%), higher TSS (74.2°Bx) and total sugar (67.28%). Among the blended jams, the highest scores for colour (8.64), flavour (8.88), consistency (8.97), taste (8.12) and overall acceptability (8.78) was judged in the treatment 60 per cent guava pulp and 40 per cent sapota pulp. Treatment T_4, 60 per cent guava pulp and 40 per cent sapota pulp was more in red colour.

KEY WORDS : Sapota pulp, Guava pulp, Blending jam, Chemical analysis, Sensory evaluation

HOW TO CITE THIS PAPER : Take, A.M. and Patil, M.M. (2012). Studies on preparation of guava jam blended with sapota. *Asian J. Home Sci.*, **7** (2): 441-446.

India is bestowed with varied agro-climatic conditions, so it can produce a wide variety of fruits and vegetables. Now, it is the second largest producer of fruits and vegetables after China sharing 10 per cent and 13.28 per cent, respectively in world production. The major fruits grown in India include mango, banana, papaya, orange, mosambi, guava, apple, pineapple, sapota, ber, pomegranate, strawberry, litchi *etc*. In India, less than 2 per cent of the fruits and vegetables produced are processed against 65 per cent in United States. Jams are basically prepared from fruits and various sugars that are made considerable mainly by heat treatment. There are different types of fruit jams like strawberry jam, mango jam, pineapple jam, apple jam, mixed fruit jam. Hence, an attempt was made to find out the possibilities of mixing guava and sapota for making jam and utilizing a major portion of marketable surplus of guava.

Guava (*Psidium guajava* L.) is now cultivated in all parts of India. The tree is almost naturalized in our country and it is common to find this spreading shrub laden with aromatic fruits in some remote corner. The guava is known by different names such as amrud, piyara, peru, koyya, jamakaya, sede pandu etc. Guava is one of the most important commercial fruit crops of India. The fruit is also called "The poor man's fruit" or "Apple of the tropics". It is a popular tree fruit of the tropical and subtropical climates. It excels most other fruit crops in productivity, hardness, adaptability and vitamin C content. The fruit is the richest source of vitamin C. It contains 4-10 times more vitamin C than some citrus fruits. The guava contains very little vitamin A or carotene. However, it is fairly rich in most other mineral nutrients. The vitamin C value of the fruits increases with maturity and is maximum when the fruit is fully ripe. But the vitamin content declines when the fruit is overripe or soft. The guava contains numerous pale coloured seeds which are quite rich in aromatic oil (14%) which is orange yellow in colour.

Sapota or sapodilla is a native of tropical America, having originated in Mexico of Central America. It is a delicious fruit also known as chiku, dilly, nispero, zapotte, sapota plum, sapodilla or prickly pear. India has about 162 thousand hectares of land under cultivation of sapota and produces about 1358 thousand tonnes of sapota per year (Anonymous, 2010). Although sapota is cultivated in India primarily for its edible fruit, it is cultivated in Mexico, Guatemala and Venezuela mainly for the extraction of chicle gum, resinous latex derived

from the bark. Indian production of sapodilla continues to grow and there is an active research programme in this country with specific goals toward improving storage, transport, and marketing strategies. The principal constituents of mature fruit are tannins and carbohydrates. Out of the carbohydrates, free sugars such as glucose, fructose and galactose form a major portion, whereas starch is found in small quantities or absent. The presence of fairly large quantities of tannins imparts an astringent flavour, but this astringency is masked by total sugars. The fruit also contains 1.13 per cent sapotin, the principal bitter component. Ascorbic acid content decreases with the ripening of fruit (Broughten and Wong, 1979). The fruit also has appreciable amounts of protein, fat, fibre and minerals. The present investigation was undertaken to study the making of Guava jam and the blended jams with sapota and to study the effect of sapota blends on the quality, sensory and colour analysis of the guava jam.

■ RESEARCH METHODS

Guava and sapota fruits used for the preparation of pulp were procured from the local market of the Chiplun. Leaves, stalks, blossom ends, defective ones and other undesirable portions were removed from the guava fruits. The ripened guava fruits were thoroughly washed to remove any adhering dust and dirt. The fruits were cut into small pieces with stainless steel knife and water was added at 300 ml/kg of fruit and boiled for about 25-30 min with continuous stirring. The fruits were allowed to cool and then mashed in order to remove the seeds with the help of stainless steel sieves. Then it was grinded in the mixer to form the pulp of uniform thick consistency. This pulp was again passed through the sieves and muslin cloth in order to remove the undesirable portion. This pulp was used for preparation of guava jam (Fig. A). The total soluble solid (TSS) of the guava pulp was in the range of 10.5 to 10.9°Brix. Sapota pulp was extracted by cutting the washed fruit into small pieces and by removing the seeds and core position the sliced pieces were grinded in the mixer grinder and sapota blended jam was prepared as indicataed in Fig. A. The initial physico-chemical parameters of pulp were analyzed as per procedure given by (Ranganna, 1986). Guava and sapota pulp were blended in the ratio of 100:0, 90:10, 80:20, 70:30, and 60:40, respectively to prepare the jams by addition of desired quantities of sugar, citric acid and sodium benzoate.

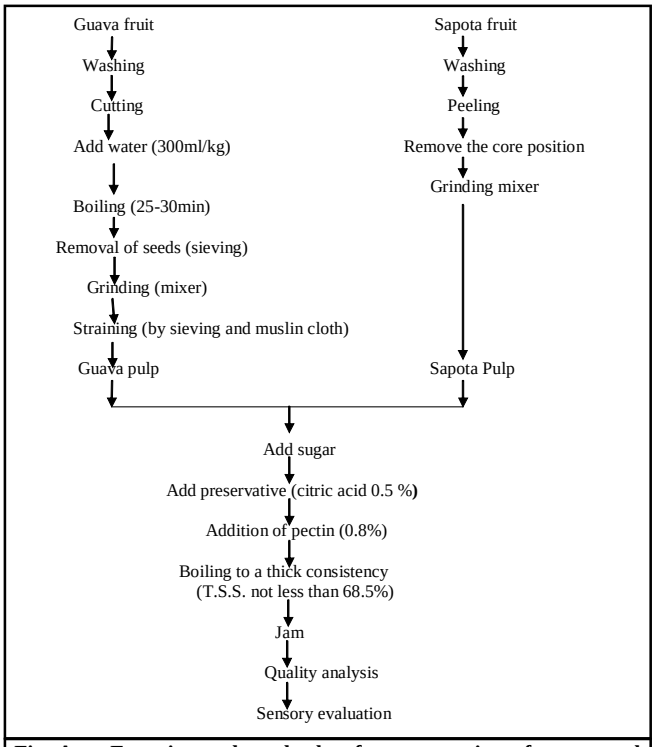

Fig. A: Experimental work plan for preparation of guava and sapota blended jam

Quality analysis of blended jam:

Titrable acidity:

Titrable acidity was determined in percentage as described by Ranganna (1986). A measured volume of sample was taken in a conical flask. Water was added to it and mixed thoroughly. If that mixture was opaque, then it was centrifuged for 5 minute at 4000-6000 rpm. Supernatant was taken and volume was made. Then known amount of that extract was titrated with 0.1N sodium hydroxide using few drops of phenolphthalein solution as indicator. The titre value was noted.

$$\text{Acidity (\%)} = \frac{\text{N. of NaOH x Volume made up x B.R. x Eq. wt. of acid x 100}}{\text{Volume of sample taken x wt. of sample x 1000}}$$

pH:

The pH of the sample was measured with a digital glass electrode pH meter (CD 175 E) at room temperature, which was calibrated prior to sample pH measurement using buffer solutions of pH 4.0 and 7.0 (Ranganna, 1986).

Total soluble solid:

Total soluble solid content was determined by hand refractometer (Erma, Japan, 0-32). A hand refractometer is based on the principle of total refraction. The refractometer is first checked for accuracy before use by placing a few drops of distilled water on the prism in the specimen chamber of the refractometer with the help of a glass rod after folding back the cover.

Reducing sugar:

50 g of sample was taken in 500 ml beaker and 400 ml of water was added. The solution was neutralized with 1N NaOH using phenolphthalein indicator. Then it was boiled gently

for 1hr with occasional stirring. Boiling water was added to maintain the original level. It was then cooled and transferred to a 500 ml volumetric flask. Volume was made up and filtered through whatmen paper No. 4. 100 ml aliquot of neutral lead acetate solution was pipetted out and mixed with 200 ml of water. Then it was allowed to stand for 10 min., and then precipitated the excess of lead with potassium oxalate solution. Made up to mark and filtered.

$$\text{Reducing sugar (\%)} = \frac{\text{Volume made up x Glucose equivalent x 100}}{\text{Burette reading x wt. of sample}}$$

Total sugar:

50 ml of clarified sample solution was taken into a 250 ml conical flask. 5 g of citric acid and 50 ml of water was added. This solution was boiled gently for 10 min. to complete the inversion of sucrose, and then cooled. It was then transferred to 250 ml volumetric flask and neutralized with 1N NaOH using phenolphthalein as indicator. Volume was made up.

$$\text{Total invert sugar (\%)} = \frac{\text{Volume made up x Glucose equivalent x 100}}{\text{Titre x Wt. of sample}}$$

Sucrose (%) = (% total invert sugar – % Reducing sugar) x 0.95

Total sugar (%) = % Reducing sugar + % Sucrose

Ascorbic Acid by 2, 6-Dichlorophenol-Indophenol visual titration method:

Standardization of dye:

10 ml of standard ascorbic acid solution was transferred to the titration flask. Burette was filled with dye solution and titration was carried out till pink colour was persisted for 15 sec. The dye factor was determined *i.e.* mg of ascorbic acid per ml of the dye using formula :

$$\text{Dye factor} = \frac{0.5}{\text{Titre}}$$

Ascorbic acid content:

10-20 ml of sample was taken and titrated against dye solution to a pink colour, which should persist for 15 sec. And this burette reading was noted.

$$\text{Ascorbic acid (mg \%)} = \frac{\text{Titre x Dye factor x Volume made up x 100}}{\text{Vol. of filtrate taken x Wt/Vol. of sample taken}}$$

Sensory evaluation:

Sensory evaluation of all the prepared blended jam was done by taste panel. The tasting panel was consisting of 10 members. They were asked to evaluate the colour, flavour, consistency, taste and overall acceptability by a scoring rate on a 9-point hedonic scale. 9= Like extremely, 8=Like very much, 7= Like moderately, 6= Like slightly, 5= Neither like nor dislike, 4=Dislike slightly, 3= Dislike moderately, 2=Dislike very much and 1=Dislike extremely. The different preferences as indicated by scores were evaluated by statistical methods. The analysis of variance with CRD was used for this evaluation. The difference was quantified by Duncan's Multiple Range Test. The procedures of MSTAT were followed for statistical analysis.

Colour:

The colour of blended jam was measured using a Hunter's Lab colour analyzer. In the Hunter's lab colorimeter, the colour of a sample is denoted by the three dimensions, L*, a* and b*. The L*, a* and b* readings were then recorded in the software provided in a attached PC. The L* value gives a measure of the lightness of the product colour from 100 for perfect white to 0 for black, as the eye would evaluate it. The redness/greenness and yellowness/ blueness are denoted by a* and b* values, respectively. The colour of the samples was measured after putting the samples in front of smallest aperture.

■ RESEARCH FINDINGS AND DISCUSSION

The chemical analysis of jam was carried out by evaluation of different chemical properties such as total soluble solid, titrable acidity, reducing sugar, non reducing sugar, total sugar, ascorbic acid and pH.

Table 1 shows the proximate composition for different levels of guava and sapota on the making of blended jam. There were no significant ($p > 0.05$) difference in titrable acidity between the treatment T_0 (100 % guava pulp), T_1 (90% guava pulp and 10% sapota pulp), T_2 (80% guava pulp and 20% sapota pulp) and treatment T_3 (70% guava pulp and 30% sapota pulp), but treatment T_4 (60% guava pulp and 40% sapota pulp) showed significantly less titrable acidity as compared to the other four treatments. Titrable acidity of treatment T_0 (100 % guava pulp), T_1(90% guava pulp and 10% sapota pulp), T_2(80% guava pulp and 20% sapota pulp) and treatment T_3 (70% guava pulp and 30% sapota pulp) of blended jam was higher than that of treatment T_4 (60% guava pulp and 40% sapota pulp), which may be due to the enzymatic de-esterification and degradation of pectin resulting in an increase of total acid and hence, decrease in pH values. Similar, results were obtained by Iboyaima Singh *et al*. (1999) while working on enzymatic liquefaction of mango pulp. Total soluble solid (°Bx) of treatment T_4 was higher than that of other treatments which may be due to the enzymatic conversion of monosaccharides into sugar molecules and degradation of pectin resulting in an increase of total soluble solids. The increase in total sugar is mainly due to the hydrolysis of starch. Similar results were also obtained by Iboyaima Singh *et al*. (1999), Richard *et al*. (1963) and Rajanala *et al*. (1995), while working on the enzymatic liquefaction of mango, grapes and banana fruits, respectively. They have observed a significant increase in total sugar and reducing sugar contents of grape

Table 1 : Effect of sapota and guava on different parameters of blended jam

Parameters	Chemical analysis				
	T_0	T_1	T_2	T_3	T_4
T.S.S.	66.5 ± 0.2	67.5 ± 0.87	69.5 ± 0.54	69.5 ± 0.54	74.2 ± 0.11
Titrable acidity	1.37 ± 0.03	1. 33 ± 0.54	1. 30± 0.22	1.29 ± 0.44	1.05 ± 0.21
pH	4.07 ± 0.45	4.51 ± 0.22	4.72 ± 0.06	4.88 ± 0.78	4.97 ± 0.45
Total sugar	26.81± 0.8	28.9 ± 0.56	44.24 ± 0.87	53.75 ± 0.02	67.28 ± 0.22
Reducing sugar	4.6 ± 0.78	4.8 ± 0.77	8.21 ± 0.55	10.30 ± 0.87	14.01 ± 0.64
Non-reducing sugar	22.21± 0.54	24.81± 0.71	36.03 ± 0.41	43.45 ± 0.64	53.27 ± 0.11
Ascorbic acid	173.84± 0.22	78.228± 0.54	60.844 ± 0.04	52.152 ± 0.11	50.413 ± 0.21

juice and banana juice prepared using pectinolytic enzymes and the present results are also in agreement with these findings. The increase in total sugar and reducing sugar might be attributed to the breakdown of complex polysaccharides by the enzymes; whereas ascorbic acid was decreased from 173.84 per cent to 50.413 per cent with increase in sapota proportion.

Results drawn from a consumer acceptance test indicated in Table 2 shows that the treatment T_4 was more attractive and preferred by all the panelists because it tasted better in terms of colour, flavour, consistency, taste and overall acceptability. This shows that 60 per cent guava pulp and 40 per cent sapota pulp was effective in preserving the colour, flavour, consistency, taste and overall acceptability of blended jam. It can be found that the scores for colour, flavour, consistency, taste and overall acceptability of blended jam of treatment T_0 were 5.42, 5.64, 6.28, 5.23 and 6.42, respectively. Similarly, the scores for colour, flavour, consistency, taste and overall acceptability of blended jam of treatment T_1 were observed as 4.62, 4.87, 5.97, 4.25 and 4.68, respectively. The scores for treatment T_3 and T_4 for colour, flavour, consistency, taste and overall acceptability of blended jam were 5.72, 5.62, 6.45, 5.87, 5.81 and 8.7, 8.88, 8.64, 8.12, respectively. The maximum score (8.97) for consistency was obtained by blended jam prepared from 60 per cent guava pulp and 40 per cent sapota pulp. Fig. 1 shows the chemical and sensory evaluation of blended jam of treatment T_4.

Statistical analysis of sensory evaluation obtained by various judges:

The statistical analysis was performed on the basis of grade score. The statistical analysis was carried out in MS

Table 2 : Average score of blended jam by consumer panel

Parameter	T_0	T_1	T_2	T_3	T_4
Colour	5.42	4.62	5.75	5.62	8.64
Flavour	5.64	4.87	5.62	6.5	8.88
Consistency	6.28	5.97	6.45	4.75	8.97
Taste	5.23	4.25	5.87	5.87	8.12
Overall acceptability	6.42	4.68	5.81	6.68	8.78

Table 3 : Means of sensory attributes of blended jam incorporated with different levels of guava and sapota pulp

Parameter	Colour	Flavour	Consistency	Taste	Overall acceptability
Sensory score					
T_0	6.42 ±0.64	6.64 ±0.5	6.28 ±0.05	7.23 ±0.45	6.42 ± 0.97
T_1	4.62 ±0..66	4.87 ±0.48	5.97 ±0.21	4.25 ±0.98	4.68 ± 0.32
T_2	5.75 ±0.79	5.62 ±0.55	6.45 ±0.79	5.87 ±0.21	5.81 ±0.46
T_3	6.62 ±0.64	6.5 ±0.44	6.75 ±0.97	6.87 ±0.22	6.68 ±0.02
T_4	8.97 ±0.02	7.88 ±0.02	8.64 ±0.64	8.12 ±0.03	8.78 ±0.02
Anova					
Sum of square	2.92	30.92	10.28	30.08	26.6
Degree of freedom	4	4	4	4	4
Mean sum square	0.73	7.73	2.57	7.52	6.65
F Value	1.380	26.553	5.006	19.22	15.03
P Value	0.255	2.41E-11	0.002	2.77E-09	7.06E-08
F crit	2.578	2.578	2.578	2.578	2.578

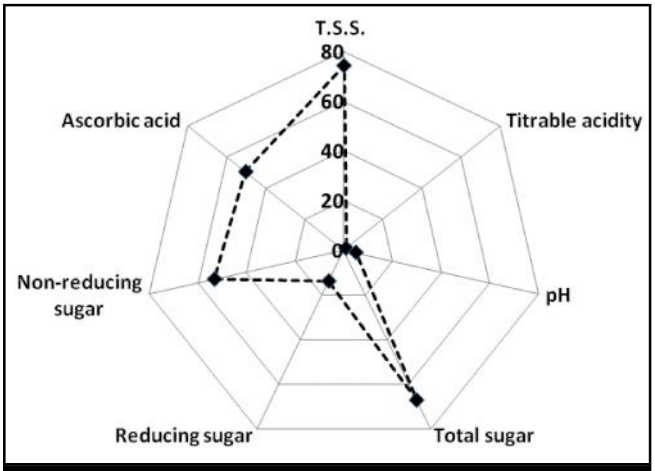

Fig. 1a : Chemical analysis of blended jam of treatment T_4

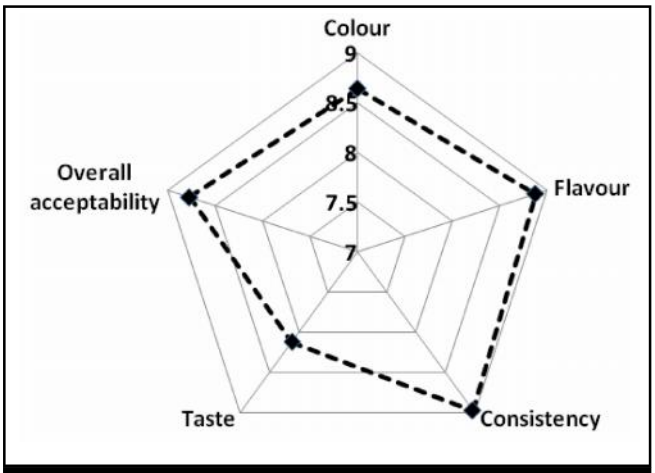

Fig. 1b : Sensory evaluation of blended jam of treatment T_4

excel programme and ANOVA (Analysis of variance) tables were prepared. It is evident from the tables that all the organoleptic qualities were significantly affected at 5 per cent level of significance.

The results of analysis of variance represented in Table 3 show that F_{cal}= 1.380 < F_{crit}= 2.578 (n_1=5). It means that there is no difference in the colour of blended jam**.** The results of analysis of variance show that F_{cal}= 26.553 > F_{crit}= 2.578 (n_1=5), which means that there is a difference in flavour of the blended jam with different proportions of guava and sapota blended jam of different treatments. It was also found that F_{cal}= 5.006 > F_{crit}= 2.578 (n_1=5), which means that there is difference in blended jam's consistency with several additives of guava and sapota pulp. According to the results of analysis of variance F_{cal}= 1.22 < F_{crit}= 2.578 (n_1=5); there is difference in the taste of blended jam with added different proportions of guava and sapota. Likewise the readings F_{cal}=15.03 > F_{crit}=2.578 (n_1=5) also showed difference in overall acceptability of blended jam.

Colour appeared to be a very important criterion for the initial acceptability of the product by the consumer. Hunter color difference measurement values (L, a, and b values) of different treatments were expressed in Table 4. Results of treatment T_4 were not so much significant which is probably due to the release of carotenoids as a result of enzyme addition. The addition of sapota resulted in an increase in the a*. The a* (redness) values of treatment T_4 was increased by increasing sapota pulp. These results confirmed with the result of Saenz *et al*. (1993). In treatment T_4, sapota pulp was more in red color because the hue angle was positive. These results are in accordance with the same results of Tung-Sun *et al*. (1995).

Table 4 : Colour of blended jam with different treatments of guava and sapota

Treatments	L	a*	b*
T_0	63.66±2.01	5.40±2.02	18.85±0.25
T_1	63.83±0.23	5.46±0.62	21.63±2.00
T_2	64.45±0.54	5.55±0.35	18.29±0.25
T_3	65.78±0.64	5.78 ±0.64	15.78± 0.78
T_4	68.15±0.52	5.89± 0.67	19.65± 0.75

Conclusion:

From the results it can be concluded that, the treatment T_4 (60% guava and 40% sapota pulp) has improved the overall quality with special reference to chemical analysis, colour analysis and sensory evaluation of blended jam. The added 60 per cent guava and 40 per cent sapota pulp resulted in moderate titrable acidity and consistency, more stable red colour during colour analysis and highest sensory score in sensory evaluation. It is evident from the finding that this new product can be feasible even at pilot scale level. Hence, it is possible to meet both national and international export demand for blended jam.

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