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# Studies on preparation of fruit bar from papaya and guava

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**Abstract**
The objective of this research work wastodevelop atechnology for preparation of fruit bar from papaya and guava pulp and to study the changes in chemical composition and sensory properties of fruit bar during storage in butter paper with metallic paper and polyethylene bag. Preliminary studies were carried out to standardize the optimum levels papaya and guava pulp with pectin. Fruit bar prepared from this combination were found to be better than other combinations in respect to organoleptic properties and nutritional quality. The fruit bar prepared were wrapped in butter paper with metallic paper, polythene bag and stored at ambient (27 ± 2 $^0$C) for 180 days. The stored samples were drawn periodically at 30days interval for organoleptic and chemical analysis.
The chemical composition indicated that the fresh fruit bar contained on an average moisture 15.80 percent, TSS 74.70 $^0$Brix, titrable acidity 0.97 percent, total sugars 68.05 percent reducing sugar 16.68 percent and ascorbic acid 120.37 mg/100 g, calcium 8.74 mg/100g and β-carotene 132.74 µg/100g. The mean score of fresh fruit bar for colour and appearance was 7.71, texture 7.20, flavour 7.86, taste 7.71 and overall acceptability 7.75 on 9 point hedonic scale. The cost of fresh fruit bar was ranged from Rs. 568 per kg for various combinations of ingredients. The storage study indicated that the TSS, reducing sugars, acidity and total sugars increased with the advancement of storage period, while moisture content, ascorbic acid, calcium and β-carotene decreased. The rates of increase or decrease were relatively higher polyethylene bag than butter paper with metallic paper packaging material. The fruit bar prepared from 30% sugar, 2% pectin, 1% citric acid and 60% guava + 40% papaya pulp was found superior over other combinations in respect of organoleptic properties throughout storage period. However, fruit bar were found to be acceptable even after 180 days storage at ambient conditions in both packaging material.

**Keywords:** Papaya and guava fruit, β-carotene, calcium, pectin microbial growth

## 1. Introduction
Papaya (*Carica papaya* L.) and Guava (*Psidium guajava*) are important tropical fruits and claim superiority over other fruits by virtue of their commercial and nutritional values**.** Guava, the poor man's apple, is one of the most common fruits grown widely in tropical and subtropical regions of the world. It was originated in tropical America, stretching from Mexico to Peru and gradually became a crop of commercial significance in several countries because of its hardy nature, prolific bearing, high vitamin C content, minerals and high remuneration with less maintenance. The high vitamin C content of guava makes it a powerhouse in combating free radicals and oxidation which are key enemies that cause many degenerative diseases (Kadam *et al*., 2012) [7].
In India, guava has become an important fruit crop contributing to 4 percent of total fruit production and ranks fourth in production after mango, banana, and citrus with an estimated production of 4083 lakh tones from 251 lakh hectares (NHB database, 2014-15) [11]. The fresh papaya and guava fruits have a limited shelf life. Therefore, it is necessary to utilize this fruit for making different products to increase its availability over an extended period and to stabilize the price during glut season. Papaya (*Carica papaya* L.) is regarded as the wonder fruit of the tropics and subtropics. It was originated in Mexico as a result of a cross between the two species of the genus Carica. It is the fifth most important crop in India after mango, banana, citrus, and guava. The fruit is an excellent source of vitamin A (2020 IU/100g) and also a rich source of other vitamins like thiamine, riboflavin, nicotinic acid (Jain *et al*., 2011). India is the largest producer of papaya in the world with an annual production of about 5508 lakh tones from an area of about 126 lakh hectares (NHB 2014-15) [11].
Bars can be made from a wide variety of fruit including guava, banana, apple and wood apple. Fruit bars are high calorie foods and are a rich source of the vitamins and minerals. Fruit bars being principally made out of fruit pulps, retain most of these ingredients and form a good Nutritional supplement. Fruit bars are so far made from pulpy fruits or by mixing the pulps of fruits that are commercially in demand (Take *et al*., 2012) [17].

## 2. Materials and Methods
The experiment was conducted in the laboratory of Department of Food Science and Technology, Post Graduate Institute at Mahatma Phule Krishi Vidyapeeth, Rahuri during the year 2018-2019.The papaya and guava fruit was collected from the local market. The major ingredients for the preparation of products were sugar, citric acid, pectin and other chemicals were used from the laboratory store.

### 2.1. Preparation of papaya and guava pulp
Taiwan 786 and Sardar L-49 were used for extraction of pulp for fruit bar preparation of papaya and guava. These fruits were washed in clean tap water. Then, they were cut into pieces. By using pulp extractor (Mixer) papaya and guava pulp was extracted. Guava seeds were separated from pulp by sieve. The pulp recovery is more in papaya fruit (80.90%) when compared to guava fruit (70.64%).

### 2.2. Chemical analysis of papaya and guava fruit bar
The method described in A.O.A.C. (1990) for determining moisture was used for moisture estimations in fruit bar. The titratable acidity was determined by the procedure as reported by Ranganna (1986). The ascorbic acid content in the products was estimated by titrimetric method as summarized by Ranganna (1986) using 2-6, dichlorophenolindophenol dye and sugars by Lane and Eynon (1923) as reported by Ranganna (1986) method. Calcium content was estimated by AOAC method (2000). The total soluble solids of papaya guava fruit bar was measured by using procedure as given by Ranganna (1986). ß-carotene content of the selected samples was determined by the method of A.O.A.C. (1980).

### 2.3. Methods used for preparation of fruit bar
The papaya guava fruit bar was prepared by mixing the pulp (1kg) in different proportions as per the treatment with 300g sugar. The mixture was heated with continuous stirring till it reached to 50°Brix. The boiled mass was slightly cooled and 500 ppm of KMS was added**.** The concentrated pulp mixture was spread on trays (smeared with glycerine) up to 0.5 cm thickness and dried in hot air oven at 65 °C. After five hours of drying, second layer of 0.5 cm thickness was spread over the first layer and continued for ten hours. The product was dried before packing. Dried sheets of each blend were cooled and cut into rectangular pieces of 4 × 1.5 cm size. The cut pieces were packed individually in butter paper with metallic paper and polyethylene bag labelled with details of treatments and replications and stored at temperature 28±2 °C. The fruit pulp from these varieties was blended at different proportions as per the treatments. Papaya guava fruit bar was prepared according to the methodology given in flow chart. Then processed pulp mixture was loaded in aluminium trays and kept in hot air oven for drying. The treatment combinations are given in table 1.The flow chart for various steps in jelly making is presented in (Fig-1).

**Table 1:** Treatment details

| Treatment | Guava pulp% | Papaya pulp% |
|---|---|---|
| $T_0$ | 100 | 0 |
| $T_1$ | 80 | 20 |
| $T_2$ | 60 | 40 |
| $T_3$ | 40 | 60 |
| $T_4$ | 20 | 80 |
| $T_5$ | 0 | 100 |

### 2.4. Sensory evaluation of papaya guava fruit bar
Sensory evaluation of papaya guava fruit bar was carried out according to the method of Amerine *et al.,* (1965) [2] on 9 point hedonic scale. The average scores of the seven semi-trained judges for different quality characteristics *viz.* colour and appearance, flavour, texture, taste and overall acceptability were recorded.

### 2.5. Packaging and storage of papaya guava fruit bar
The selected treatment ($T_2$) of papaya guava fruit bar was packed in butter paper with metallic paper and polyethylene bag and stored at ambient (28± 2 $^0$C) for 180 days. The samples were drawn at an interval of 30 days and evaluated for chemical and sensory quality.

### 2.6. Microbiological analysis of papaya guava fruit bar (yeast and mould count)
Standard plate count of papaya guava fruit bar was taken as per the method of Harridan and McCance (1966) [6].

**Flow Chart**

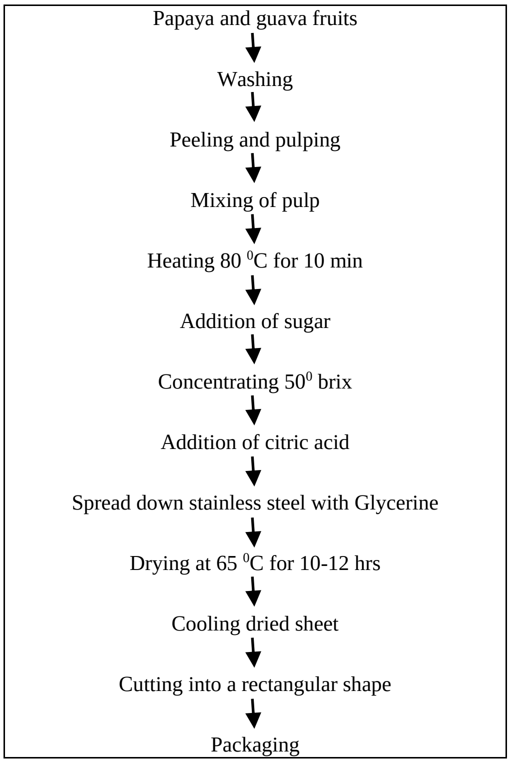


**Fig 1:** Flow chart for preparation of papaya guava fruit bar

### 2.7. Statistical analysis
During storage study of jelly data were recorded at monthly interval on different parameters were subjected to statistical analysis using Factorial Completely Randomized Design (FCRD) using three replications (Rangaswamy, 2010) [14].

## 3. Results and Discussion
The results of various experiments conducted during the study period are summarized below:

### 3.1 Biochemical changes during storage of dragon fruit jelly during storage
The data on biochemical changes during storage of papaya guava fruit bar after 6 months storageare tabulated in Table 2. The fruit bar stored at ambient condition were analyzed for moisture, TSS, acidity reducing sugars, total sugars, ascorbic acid, calcium and ß-carotenecontent at every month.

**Table 2:** Biochemical changes during storage of papaya guava fruit bar after 6 months storage

| Interaction | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $T_0P1$ | 13.65 | 74.69 | 1.09 | 22.67 | 67.78 | 104.29 | 8.92 | 65.12 |
| $T_0P2$ | 13.42 | 74.84 | 1.10 | 22.96 | 67.96 | 99.70 | 8.89 | 61.13 |
| $T_2P1$ | 15.05 | 76.44 | 1.09 | 24.34 | 69.72 | 65.54 | 8.37 | 111.73 |
| $T_2P2$ | 14.90 | 76.62 | 1.09 | 24.59 | 70.09 | 62.65 | 8.31 | 105.44 |
| SEm(±) | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| CD5% | 0.03 | NS | NS | 0.03 | 0.03 | 0.03 | NS | 0.03 |
| GM | 14.30 | 75.65 | 1.10 | 23.64 | 68.89 | 83.05 | 8.63 | 85.86 |
| CV (%) | 0.14 | 0.02 | 1.56 | 0.07 | 0.02 | 0.02 | 0.20 | 0.02 |

Where,

| | |
|---|---|
| T- Treatments | PM- Packaging Material |
| $T_0$- 100% Guava pulp | P1- Butter paper with Metallic paper |
| $T_2$- 60% Guava+40% Papaya | P2- Polyethylene bag |

### 3.1.1 Moisture
The data indicate that the there was no significant variation in moisture content of both packaging material during storage period 180 days. The rate of moisture decreased slightly higher in polyethylene packaging material than butter paper with metallic paper. Moisture decrease in control from 15 to 13.42 percent in butter paper with metallic paper, 15 to 13.65 percent in polyethylene bag while in treatment 16.6 to 15.05 percent in butter paper with metallic paper and 16.6 to 14.90 percent in polyethylene bag was observed. It was reported decreased in moisture content during storage of guava-leather 15.29 to 14.09 (Chavan and Shaikh. 2015) [5] and also the moisture content in papaya guava fruit bar was found to be decreased with increase in storage period from 15.05 to 15.02 percent (Laxman *et al*., 2017) [10]. It is might be due to the loss in moisture content in the fruit bar (Bhatt and jha. 2015) [3].

### 3.1.2 Total soluble solids (TSS)
The data indicate that there was no significance variation in TSS content of fruit bar in both packaging material during storage study of 180 days. The TSS increase in control from 74 to 74.69 °Brix in butter paper with metallic paper, 74 to 74.84 °Brix in polyethylene bag while in treatment 75.5 to 76.44 °Brix in butter paper with metallic paper and 75.5 to 76.62 °Brix in polyethylene bag were observed. The increase in total soluble solids with the advancement of storage period was reported from 76.10 to 77.20 °Brix guava leather (Chavan and Shaikh. 2015) [5] and similar result was reported in papaya guava fruit bar which showed an increase in TSS of fruit bar from 74.15 to 75.39 (Laxman *et al*., 2017) [10]. An increase in total soluble solids content in fruit bar during storage period probably was due to loss of moisture content (Chavan and Shaikh. 2015) [5].

### 3.1.3 Titratable acidity
The data indicate that there was no significant variation in titrable acidity in both packaging material during storage. Acidity increased in control from 0.99 to 1.09 percent in butter paper with metallic paper, 0.99 to 1.10 percent in polyethylene bag while in treatment 0.96 to 1.09 percent in both butter paper with metallic paper and polyethylene bag was observed. The increase in acidity was slightly faster in the case of the product stored in a polyethylene bag. The gradual increased in the titratable acidity of guava leather stored at room temperature as well as the cold temperature was reported (Chavan and Shaikh. 2015) [5]. The reason for the increase in titratable acidity might be due to the formation of organic acids by the degradation of the ascorbic acid as it decreased with the storage period of the fruit bar (Kumar and Deen. 2017) [9].

### 3.1.4 Reducing sugars
The data indicate that the significant variation in reducing sugars content in both packaging material. Reducing sugars increase in control from 16.17 to 22.67 percent in butter paper with metallic paper, 16.17 to 22.96 percent in polyethylene bag while in treatment 17.20 to 24.34 percent in butter paper with metallic paper and 17.20 to 24.59 percent in polyethylene bag was observed. The increase in reducing sugars during storage was reported from 14.32 to 17.32 percent in guava leather (Chavan and Shaikh. 2015) [5] and from 35.27 to 37.42 in papaya guava fruit bar (Laxman *et al*., 2016). The increase in reducing sugars content of fruit bar could be due to inversion of non-reducing sugars into reducing sugars as decreases in non-reducing sugars corresponded to increase in reducing sugars content. Hydrolysis of polysaccharides like pectin and starch could also be one of the reasons for the increase in the sugars content (Kumar and Deen. 2017) [9].

### 3.1.5 Total sugars
The data indicate that there was no significant variation in the first month only afterward variation observed in both packaging material. Reducing sugars increase in control from 67.38 to 67.78 percent in butter paper with metallic paper 67.38 to 67.96 percent in polyethylene bag while in treatment 68.75 to 69.72 percent in butter paper with metallic paper and 68.75 to 70.09 percent in polyethylene bag were observed within the storage period of 180 days. It was reported that the change in total sugars from 68.72 to 69.08 percent in guava fruit leather (Chavan and Shaikh. 2015) [5]. It was reported that the total sugars content increased in papaya guava fruit bar from 69.31 to 69.51 percent during storage (Laxman *et al*., 2017) [10]. The results obtained in the present study are in agreement with the literature.

### 3.1.6 Ascorbic acid
The data indicate that there was a significant variation in ascorbic acid content in both packaging material during storage study. The ascorbic acid decreased in control from 145.75 to 104.29 mg/100g in butter paper with metallic paper 145.75 to 99.70 mg/100g in polyethylene bag while in treatment 95 to 65.59 mg/100g in butter paper with metallic paper and 95 to 62.65 mg/100g in polyethylene bag was observed within a storage period of 180 days. The ascorbic acid was reported to decrease from 125.28 to 98.46 mg/100g in guava fruit leather (Chavan and Shaikh. 2015) [5]. Similar, results were found in the case of mango sapota fruit bar where a decrease in ascorbic acid content from 269.30 to 142.36 mg/100g (Chavan *et al*., 2016). Gradual loss on ascorbic acid content of fruit bar due to the oxidation of ascorbic acid into dehydroascorbic acid followed by further degradation to 2, 3

diketogluconic acid and finally to the furfural compound which enters browning reaction (Sharma *et at.*, 2013) [16].

### 3.1.7 Calcium

The data indicate that among storage intervals, there was no significant variation in the calcium content of the fruit bar at both packaging conditions during storage study of 180 days. The calcium content decrease in control from 9.02 to 8.92mg/100g in butter paper with metallic paper 9.02 to 8.89 mg/100g in polyethylene bag while in treatment 8.47 to 8.37 mg/100g in butter paper with metallic paper and 8.47 to 8.31 mg/100g in polyethylene bag was observed within storage period of 180 days.

### 3.1.8β-carotene

The data indicate that among storage intervals, there was significant variation in β-carotene content of fruit bar at both packaging conditions. The β-carotene content decrease in control from 98.23 to 65.12 µg/100g in butter paper with metallic paper, 98.23 to 61.13 µg/100g in polyethylene bag while in treatment 167.26 to 111.73 µg/100g in butter paper with metallic paper and 167.26 to 105.44 µg/100g in polyethylene bag was observed within storage period of 180 days. It was reported that the β-carotene content of papaya fruit rollups was decreased from 643.7 to 295.0 µg/100g and 746.0 to 397.7 µg/100g in 10-week storage study (Saranya *et al.*, 2017) [15].

### 3.2Microbial quality of fruit bar

The data on microbial quality of fruit bar are presented in Table 3. The microbial count was taken at 0 days. However, no very much microbial colonies were observed on PDA media during the initial period. The microbial counts of fruit were 0 or nil at zero days. This may be due to the addition of potassium meta-bisulphite and presence of a high percentage of sugar content in the fruit bar and high heating temperature during preparation of fruit bar. But on 180 days storage, standard plate count was noticed as $5\times10^5$cfu/g in polyethylene bag, while $4\times10^5$cfu/g in butter paper with metallic paper packaging material. Less microbial growth was observed in the fruit bar samples stored in butter paper with metallic paper than polyethylene bag. This indicates that the packaging material i.e. Butter paper with metallic paper controlled the microbial growth. It was reported that microbial count at zero days' storage was observed as nil. It may be due to the high amount of sugar, less microbial growth was observed in the leather samples (Chavan and Shaikh. 2015) [5]. It was reported molds and yeasts were not detected while the total bacterial counts showed gradual negligible increases as the 6 month storage period prolonged particularly in the samples stored at room temperature (Kourany *et al.*, 2017) [8].

**Table 3:** Changes in the microbial count of papaya guava fruit bar during storage.

| Standard plate count ($\times 10^3$cfu/g) of mold/yeast | | | | |
|---|---|---|---|---|
| | Initial (0 Days) | | Final (180 Days) | |
| T/PM | $T_0$ | $T_2$ | $T_0$ | $T_2$ |
| P1 | 0 | 0 | 4 | 4 |
| P2 | 0 | 0 | 4 | 5 |

### 3.3Changes in sensory quality of fruit bar during storage

The data sensory scores of dragon fruit jellies during storage for parameters like colour and appearance, flavour, taste, texture and overall acceptability of fruit bar samples are tabulated in Table 4.

### 3.3.1 Colour and appearance

The data indicate that colour and appearance decrease in control from 8.20 to 6 in both butter paper with metallic paper and polyethylene bag while in treatment 8.50 to 7in butter paper with metallic paper and 8.50 to 6.50 in polyethylene bag was observed within storage period of 180 days. It was reported that the colour and appearance score decreased gradually from 8.35 to 7.45 in 90 days of storage study (Chavan and Shaikh. 2015) [5].

**Table 4:** Sensory quality of fruit bar after 180 days of storage

| T/PM<br>PM | Colour and appearance | Flavour | Taste | Texture | Overall acceotability |
|---|---|---|---|---|---|
| P1 | 6.50 | 6.75 | 6.75 | 6.25 | 6.50 |
| P2 | 6.25 | 6.25 | 6.50 | 6.00 | 6.25 |
| SEm(±) | 0.006 | 0.006 | 0.006 | 0.006 | 0.006 |
| CD5% | 0.018 | 0.018 | 0.018 | 0.018 | 0.018 |
| Treatments | | | | | |
| $T_0$ | 6.00 | 6.25 | 6.25 | 6.00 | 6.00 |
| $T_2$ | 6.75 | 6.75 | 7.00 | 6.25 | 6.75 |
| SEm(±) | 0.006 | 0.006 | 0.006 | 0.006 | 0.006 |
| CD5% | 0.018 | 0.018 | 0.018 | 0.018 | 0.018 |
| Interaction | | | | | |
| $T_0$P1 | 6.00 | 6.50 | 6.50 | 6.00 | 6.00 |
| $T_0$P2 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 |
| $T_2$P1 | 7.00 | 7.00 | 7.00 | 6.50 | 7.00 |
| $T_2$P2 | 6.50 | 6.50 | 7.00 | 6.00 | 6.50 |
| SEm(±) | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| CD5% | 0.03 | NS | 0.03 | 0.03 | 0.03 |
| GM | 6.38 | 6.50 | 6.63 | 6.13 | 6.38 |
| CV (%) | 0.27 | 0.26 | 0.26 | 0.28 | 0.27 |

Where,

T- Treatments PM- Packaging Material

$T_0$- 100% Guava pulp P1- Butter paper with Metallic paper

$T_2$- 60% Guava+40% Papaya P2- Polyethylene bag

### 3.3.2 Flavour
The data indicate that flavour values decrease in control from 8.50 to 6.50 in butter paper with metallic paper, 8.50 to 6.0 in polyethylene bag while in treatment 8.57 to 7.0 in butter paper with metallic paper and 8.57 to 6.50 in polyethylene bag was observed within storage period of 180 days. The loss of flavour was reported from 8.20 to 7.55 in guava fruit leather (Chavan and Shaikh. 2015) [5].

### 3.3.3 Taste
The data indicate that taste score that decreases in control from 8.50 to 6.50 in butter paper with metallic paper, 8.50 to 6.0 in polyethylene bag while in treatment 8.60 to 7.0 in both butter paper with metallic paper and in polyethylene bag was observed within storage period of 180 days.

### 3.3.4 Texture
The data indicate that texture score decreases in control from 8.20 to 6.0 in both butter paper with metallic paper and in polyethylene bag while in treatment 8.50 to 6.50 in butter paper with metallic paper and 8.50 to 6.0 in polyethylene bag was observed within storage period of 180 days. It was reported that a gradual decrease in texture score from 8.56 to 8.27 in 90 days of storage study (Chavan and Shaikh. 2015) [5].

### 3.3.5 Overall acceptability
As storage period up to 180 days there was a decrease in the overall acceptability score. The rate decreased was slightly higher in the sample stored in a polyethylene bag compare to butter paper with metallic paper during a storage period of 180 days. Overall acceptability score that decreases in control from 7.80 to 6.0 in both butter paper with metallic paper and polyethylene bag while in treatment 8.50 to 7.0 in butter paper with metallic paper and 8.50 to 6.50 in polyethylene bag was observed within storage period of 180 days. This decrease was due to an undesirable change in the fruit bar. It was reported that the overall acceptability score was decreased from 8.38 to 7.53 in guava leather within 90 days storage study (Chavan and Shaikh. 2015) [5] and from 8.39 to 8.03 in papaya guava fruit bar during storage study (Laxman *et al*., 2017) [10]. It was reported that a decrease in overall acceptability due to changes in the composition of product and loss of colour and flavour (Parekh *et al*., 2014). The results presented in this investigation are similar to the literature cited.

## 4. Conclusion
The experimental results related to the different levels of pulp used for preparation of papaya guava fruit bar outlined that the papaya guava fruit bar prepared with different recopies was acceptable throughout the storage period of 180 days at ambient temperature. As per the chemical parameters the TSS, acidity, reducing sugars, total sugars increased with decrease in the moisture, calcium, β-carotene and ascorbic acid content of the papaya guava fruit bar respective of the treatment. Among the different pulp levels used, the papaya guava fruit bar prepared 60% guava and 40% papaya pulp recorded appreciable. The highest score in overall acceptability observed in treatment ($T_2$) after 180 days storage study. On the basis of organoleptic properties and chemical analysis of the papaya guava fruit bar with 60% guava and 40% papaya pulp, 30 percent sugar, 1 percent citric acid and 500ppm KMS was considered as the best in comparison to the other treatments.

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