International Journal of Agriculture Sciences
ISSN: 0975-3710&E-ISSN: 0975-9107, Volume 9, Issue 28, 2017, pp.-4356-4362.
Available online at http://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

EFFECT OF FORTIFICATION ON NUTRITIONAL AND SENSORY QUALITY OF PAPAYA AND GUAVA FRUIT BAR

APPANI LAXMAN KUMAR* AND MADHUMATHI C.

*Department of Fruit Science, College of Horticulture, Dr Y.S.R. Horticultural University, Anantharajupeta, Andhra Pradesh, 534101
*Corresponding Author: Email- appanilaxman123@gmail.com

Received: May 18, 2017; Revised: May 23, 2017; Accepted: May 24, 2017; Published: June 18, 2017

Abstract- The experiment was taken up with an objective of enhancing the protein content of papaya-guava fruit bar and increasing its nutritional quality by fortifying with defatted soya flour and skimmed milk powder. Different fortified fruit bars contained TSS ranged from 77.45 to 79.24 0°Brix, moisture content from 14.92 to 15.01 percent, pH from 3.38 to 3.87, titrable acidity from 0.80 to 0.98 per cent, reducing sugars from 36.59 to 48.94 per cent, total sugars from 61.15 to 74.45 per cent, ascorbic acid from 81.70 to 133.70 mg/100g, total carotenoids from 849 to 1340 µg/100g and protein content from 0.69 to 2.10 per cent. However, on the basis of sensory evaluation, the treatment T_7 (60% papaya pulp + 40% guava pulp (AS) + 6% skimmed milk powder) found to be the best with maximum score for colour and appearance, flavour, texture, taste and overall acceptability among all treatments at zero as well as 30, 60 days of storage.

Keywords- Papaya -Guava Fruit bar, Fortification, Skimmed milk powder, Storage

Citation: Appani Laxman Kumar and Madhumathi C. (2017) Effect of Fortification on Nutritional and Sensory Quality of Papaya and Guava Fruit Bar. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 9, Issue 28, pp.-4356-4362.

Academic Editor / Reviewer: Dr Karma Diki Bhutia, Dr Anil Kumar, Dr Omveer Singh, Logegaray Veronica Romina

Introduction

Papaya (*Carica papaya* L.) and Guava (*Psidium guajava* L.) are important tropical fruits and claim superiority over other fruits by virtue of their commercial and nutritional values. Papaya (*Carica papaya* L.) is regarded as the wonder fruit of the tropics and subtropics. It was originated in Mexico as a result of cross between the two species of the genus Carica. India is the largest producer of papaya in the world with an annual production of about 5508 lakh tonnes from an area of about 126 lakh hectare [1]. 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 rich source of other vitamins like thiamine, riboflavin, nicotinic acid [2]. Guava (*Psidium guajava* L.) 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. 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 tonnes from 251 lakh hectares [1].

Papaya fruit has blood red pulp, good taste and low acid content hence; it can be used for blending with other fruits and also for preparation of nutritional enriched food products [3]. Whereas guava emits a sweet aroma which is pleasant, refreshing and acidic in flavour and besides being rich source of pectin, its pulp shows compatibility and suitability for blending and making mixed fruit products *viz.*, jam, jelly, Candy, leather etc. However, blending of these two fruits could be an economic preposition to utilize them profitably [2].

Food fortification has come into picture since several decades back and refers to the addition of essential nutrients which are originally deficient or lost during processing. Usually fruits which normally lack protein and fat can be fortified with protein enriched products *viz.,* soya bean or skimmed milk powder. Defatted soy flour contains about 9.0 % moisture, 48% protein, 7.2% ash on dry basis and 1.5 % fat.

Soybean is a cheap and excellent source of quality protein (40-42 %) and fat (18-20 %). Soybean contains less carbohydrate and more proteins and therefore, it forms one of the best foods for diabetic patients. Presence of abundant phosphorous and protein in soybean is made use in curing nervous disorders, rickets, pulmonary diseases and anaemia. Soybean is lactose-free, so it is useful for lactose intolerant people.

Another protein source is Skimmed milk powder (SMP), which is also called 'Non fat dry milk' (NDM) or 'Dried skimmed milk' (DSM), is characterized by having low fat (0.8 g/100 g) content. Skimmed milk powder has a high nutritional value and is a source of high quality animal protein (36g/100g). Skimmed milk powder has a carbohydrate content of 52g/100g, which is predominantly lactose.

Material and Methods

Procurement of Materials

Uniform sized, fully ripened fruits of papaya and guava free from any injury, diseases were procured from farmer field in Kadapa.

Development of papaya –guava fruit bar

Red Lady, Lalit and Allahabad Safeda fruits were used for extraction of pulp for fruit bar preparation from papaya and guava. These fruits are then washed with clean tap water and peeled to remove outer skin. These fruits were cut into pieces. By using pulp extractor papaya and guava pulp was extracted. Guava seeds were separated from pulp by sieve installed in the pulp extractor.

The best combinations obtained in Experiment-I and Experiment-II were fortified with two concentrations of defatted soya flour (4% and 5%) and skimmed milk powder (6% and 8%). The fortified blended pulp mixture was loaded in aluminium trays and kept in cabinet dryer for drying. The treatment combinations are given below in Table. The mixture was heated with continuous stirring till it reached to 50 ^{0}Brix. The boiled mass was slightly cooled and 500 ppm of KMS was added.

The concentrated pulp mixture was spread on trays (smeared with ghee) up to 0.5 cm thickness and dried in cabinet drier at 60 ^{0} C. After five hours of drying, second layer of 0.5 cm thickness was spread over the first layer and continued for eight hours. The product was dried before packing. Dried sheets of each blend were cooled and cut into rectangular pieces of 3 x 0.5 cm size. The cut pieces were packed individually in butter paper and labelled with details of treatments and replications and stored at temperature (25.35° C).

Treatment Details:

Treatments	Treatment details
T_1	60 % papaya pulp and 40 % guava pulp (AS) (experiment-I)
T_2	50 % papaya pulp and 50 % guava pulp (L) (experiment-II)
T_3	60% papaya pulp and 40% guava pulp (AS) + 4 % DSF
T_4	60 % papaya pulp and 40 % guava pulp (AS) + 5 % DSF
T_5	50 % papaya pulp and 50 % guava pulp (L) + 4 % DSF
T_6	50 % papaya pulp and 50 % guava pulp (L) + 5 % DSF
T_7	60% papaya pulp and 40% guava pulp (AS) + 6 % SMP
T_8	60% papaya pulp and 40% guava pulp (AS) + 8 % SMP
T_9	50 % papaya pulp and 50 % guava pulp (L) + 6 % SMP
T_{10}	50 % papaya pulp and 50 % guava pulp (L) + 8 % SMP

AS-Allahabad Safeda, L-Lalit, DSF-Defatted Soya Flour, SMP-Skimmed Milk Powder

Physico-Chemical Analysis of Fruit Bar

The fruit bar prepared by standard method was chemically analyzed for moisture content, total soluble solids (TSS), titrable acidity, pH, reducing sugars, total sugars, ascorbic acid, total carotenoids , protein (%) , microbial count and sensory evaluation were carried out at zero , 30 and 60 days after storage.

Biochemical quality and organoleptic evaluation of papaya guava fruit bar was carried out at zero, 30 and 60 days after storage. Two samples per treatment were subjected to physic-chemical analysis. The parameters such as TSS, pH, total sugars, reducing sugars, titrable acidity, ascorbic acid and overall acceptability were analyzed by the methods suggested by Ranganna (1986)[3]. Moisture content was determined on fresh weight basis [4]. Protein content and total carotenoids in papaya guava bar sample was estimated by using Lowry (1951)[5] method and procedure suggested by Srivastava and Kumar (2009) [6] respectively. Microbial count in the fruit bar was measured based on the procedure described by Harrigan and Mccane (1976)[7].

Statistical analysis

The experiment was carried out by using Completely Randomized Design (CRD).The data obtained in the present investigation were analyzed for the statistical significance according to the procedure given by Panse and Sukhatme (1985)[8].

Physico-chemical parameters of papaya-guava fruit bar

Moisture content (%)

Data with respect to moisture content at zero, 30 and 60 days of storage clearly indicates that there were no significant differences among treatments. In fortified papaya guava fruit bar moisture content ranged from 14.92 % (T_6) to 15.01 % (T_1). Moisture content decreased from (15.01%) to (14.98%) in T_1 (60% papaya pulp + 40 % guava pulp (AS) during 60 days storage period which was highest among all the treatments. Lowest value for moisture content was recorded in T_6 (50% papaya pulp + 50 % guava pulp (L) + 5% defatted soya flour) at zero day of storage (14.95%), at 30 days (14.94%) and at 60 days (14.92%) of storage respectively, this might be due to evaporation from the sample surface [9]. Similar results were obtained on sapota papaya bar by Sreemathi*et al*. (2008) [10] and olive apple blended leather Khan *et al.* (2014)[11].

Total soluble solids (°Brix)

There were no significant difference was observed in total soluble solids at 0, 30 and 60 days of storage of fruit bar. The perusal of data presented in Table indicated that fruit bar with T_8 (60% papaya pulp + 40% guava pulp (AS) + 8% skimmed milk powder) recorded maximum TSS (79.24°Brix) at zero days of storage, at 30 days (79.79°Brix) and at 60 days (80.05°Brix) of storage respectively. The minimum value for TSS was recorded in T_2 (50% papaya pulp + 50% guava pulp (L) which was increased to (78.35°Brix) during 60 days storage period, which might be due to conversion of left over polysaccharides in to soluble sugars by acid hydrolysis [12]. These findings are also in conformity with observations made by other workers in case of guava leather by Safdar*et al.* (2014)[13] and papaya toffee and leather by Attri*et al.* (2014)[14]

Table-1 *Influence of fortification with different concentrations of skimmed milk powder, deffated soya flour of papaya guava fruit bar at different days of storage on moisture content and total soluble solids*

Treatments		Moisture content (%) Days after storage			Total soluble solids (°Brix) Days after storage		
		0	30	60	0	30	60
T_1	60 % papaya pulp + 40 % guava pulp (AS)	15.01	15.00	14.98	77.58	78.56	78.69
T_2	50 % papaya pulp + 50 % guava pulp (L)	15.00	14.99	14.97	77.45	77.56	78.35
T_3	60% papaya pulp + 40% guava pulp (AS) + 4 % DSF	14.99	14.98	14.96	77.65	77.85	78.54
T_4	60 % papaya pulp + 40 % guava pulp (AS) + 5 % DSF	14.98	14.97	14.95	77.89	77.94	78.56
T_5	50 % papaya pulp + 50 % guava pulp (L) + 4 % DSF	14.97	14.96	14.94	77.82	77.97	78.14
T_6	50 % papaya pulp + 50 % guava pulp (L) + 5 % DSF	14.95	14.94	14.92	77.94	77.98	78.32
T_7	60% papaya pulp + 40% guava pulp (AS) + 6 % SMP	15.00	14.99	14.97	78.15	78.84	79.37
T_8	60% papaya pulp + 40% guava pulp (AS) + 8 % SMP	14.98	14.97	14.95	79.24	79.79	80.05
T_9	50 % papaya pulp + 50 % guava pulp (L) + 6 % SMP	14.97	14.96	14.94	78.05	78.43	78.94
T_{10}	50 % papaya pulp + 50 % guava pulp (L) + 8 % SMP	14.96	14.95	14.93	79.12	79.56	79.98
SEM ±		0.25	0.25	0.25	1.32	1.33	1.33
C D @ 5 %		NS	NS	NS	NS	NS	NS

Titrable Acidity (%)

There were significant differences among treatments for titrable acidity at zero, 30 and 60 days of storage. Data on titratable acidity revealed that the highest titrable acidity (0.98%) was recorded in both the treatments T_1 (60 per cent papaya pulp + 40 per cent guava pulp (AS)) and T_2 (50 per cent papaya pulp + 50 per cent guava pulp (L)) during 60 days storage period. The treatment T_1 (0.98%) was on par with T_2 (0.98%), followed by T_9 (0.91%) (50 per cent papaya pulp and 50 per cent guava pulp (L) + 6 per cent skimmed milk powder) at zero day of storage. In contrast, the lowest titrable acidity 0.83 per cent was recorded in T_6 (50 per cent papaya pulp + 50 per cent guava pulp (L) + 5 per cent defatted soya flour) at zero day of storage. Highest titrable acidity (0.97%) was recorded in treatments T_1 and T_2 followed by T_8 (0.89%) where as lowest (0.82%) titrable acidity was recorded in T_4 and T_6 at 30 days of storage. Similar observations were observed at 60 days of storage with highest titrable acidity (0.96%) in T_1 and T_2 followed by T_9 (0.88%) and lowest value (0.80%) was recorded in T_6 (50 per cent papaya pulp + 50 per cent guava pulp (L) + 6% defatted soya flour).As the proportion of defatted soy flour (DFS) increased in papaya guava pulp, the titrable acidity decreased

significantly might be due to dilution of acidic factor of the fruit with the addition of the flour (Anju *et al.,* 2014) [15]. Titrable acidity decreased significantly from (0.98%) to (0.80%) during 60 days storage period might be due to salt formation *i.e*, due to acid base reactions [16]. Similar results were recorded by Attri *et al.* (2014)[14] on papaya toffee and leather and by Sharma *et al.* (2013)[17] apricot fruit bar.

pH

Data with respect to pH at zero, 30 and 60 days of storage clearly indicates there were significant differences among treatments.

The pH of fortified papaya guava fruit bar recorded 3.86, 3.86 and 3.87 in T_6 (50% papaya + 50% guava pulp (L) + 5% defatted soya flour) which was on par with treatments T_2,T_5,T_9 and $T1_0$ and same trend continued up to 60 days storage period and it was significantly highest than other samples. The lowest pH 3.38 was recorded in T_1 (60% papaya pulp + 40% guava pulp (AS) at zero day of storage. There was no change in pH on 30th day of storage. A negligible increase in pH was observed on 60th day of storage in T_1 (3.39). With the progress of storage period negligible increase in pH was noticed in all the treatments, which might be due to formation of free acids and hydrolysis of pectin [18]. Parallel results were obtained on mango pulp by Durrani*et al.* (2010)[19] and wood apple bar by Vidhya and Narain (2011)[20].

Table-2 *Influence of fortification with different concentrations of skimmed milk powder, deffated soya flour of papaya guava fruit bar at different days of storage on titrable acidity and pH*

Treatments		Titrable acidity (%)			pH		
		Days after storage			Days after storage		
		0	30	60	0	30	60
T_1	60 % papaya pulp + 40 % guava pulp (AS)	0.98	0.97	0.96	3.38	3.38	3.39
T_2	50 % papaya pulp + 50 % guava pulp (L)	0.98	0.97	0.96	3.82	3.83	3.83
T_3	60% papaya pulp and 40% guava pulp (AS) + 4 % DSF	0.86	0.85	0.83	3.40	3.40	3.40
T_4	60 % papaya pulp and 40 % guava pulp (AS) + 5 % DSF	0.84	0.82	0.81	3.42	3.42	3.43
T_5	50 % papaya pulp and 50 % guava pulp (L) + 4 % DSF	0.85	0.83	0.82	3.84	3.84	3.84
T_6	50 % papaya pulp and 50 % guava pulp (L) + 5 % DSF	0.83	0.82	0.80	3.86	3.86	3.87
T_7	60% papaya pulp and 40% guava pulp (AS) + 6 % SMP	0.90	0.88	0.87	3.38	3.39	3.39
T_8	60% papaya pulp and 40% guava pulp (AS) + 8 % SMP	0.89	0.87	0.85	3.39	3.39	3.40
T_9	50 % papaya pulp and 50 % guava pulp (L) + 6 % SMP	0.91	0.89	0.88	3.83	3.83	3.83
T_{10}	50 % papaya pulp and 50 % guava pulp (L) + 8 % SMP	0.88	0.86	0.85	3.84	3.84	3.84
SEM ±		0.01	0.01	0.01	0.06	0.06	0.06
C D @ 5 %		0.04	0.04	0.04	0.18	0.18	0.18

Reducing sugars (%)

Significant differences were observed for reducing sugars of fortified papaya guava fruit bar at zero, 30 and 60 days of storage.

The highest reducing sugars of fortified fruit bar recorded (47.45%) in T_8 (60% papaya pulp + 40% guava pulp (AS) + 8 % skimmed milk powder) which was on par with treatments T_9 and T_{10} at zero days of storage. At 30 days of storage, maximum reducing sugars (48.14%) recorded in T_{10} (50% papaya pulp + 50% guava pulp (L) + 8% skimmed milk powder). The lowest reducing sugars per cent (37.54) was recorded in T_4 (60% papaya + 40% guava pulp (AS) + 5 % defatted soya flour). Fortified fruit bar recorded highest reducing sugars per cent of (48.94%) was recorded in T_{10} (50% papaya pulp + 50% guava pulp (L) + 8 % skimmed milk powder) which was on par with treatments T_8 (48.36%) and T_9 (47.34%) at 60 days of storage. The lowest reducing sugars (38.37%) was recorded in T_4 (60% papaya pulp + 40% guava pulp (AS) + 5% defatted soya flour). It was observed that a higher reducing sugar per cent was noticed in fruit bars fortified with skimmed milk powder compared to defatted soya flour. It was clear from the Table that the reducing sugar of fortified papaya guava fruit bar slightly increased during storage which might be due to inversion of non reducing sugars to reducing sugars and conversion of polysaccharides to monosaccharide [17]. The results of increase in reducing sugars was also in conformity with report on papaya toffee and papaya leather by Attri*et al.* (2014) [14]and fortified mango bar by Parekh *et al.* (2014)[21].

Total sugars (%)

There were significant differences among treatments for total sugars in fortified papaya guava fruit bar at zero, 30 and 60 days of storage.

Total sugars were maximum (74.45%) in T_8 (60% papaya pulp + 40% guava pulp (AS) + 8% skimmed milk powder) which was on par with treatment T_7 (73.34%), whereas minimum (64.32%) was recorded in T_6 (50% papaya pulp + 50% guava pulp (L) + 5% defatted soya flour) at zero days of storage. The highest per cent of total sugars (73.32%) recorded in T_8 (60% papaya pulp + 40% guava pulp (AS) + 8% skimmed milk powder) at 30 days of storage. The lowest per cent of total sugars (63.27%) was recorded in T_2 (50% papaya pulp + 50% guava pulp (L). Similarly at 60 days of storage, highest per cent of total sugars (72.61%) was observed in T_8 (60% papaya pulp + 40% guava pulp (AS) + 8% skimmed milk powder) which was on par with treatment T_7 (71.54%) where as lowest per cent (61.15%) of total sugars was recorded in T_2 (50% papaya pulp + 50% guava pulp (L). Total sugars increased in fruit bars with the increase in concentration of skimmed milk powder, as skimmed milk powder is rich in carbohydrate content [22]. The slight decrease in total sugars during storage might be due to inversion of sugars to monosaccharide by acid hydrolysis [23]. These results are in conformity with the findings of on papaya toffee and papaya leather by Attri *et al.* (2014) [14] and wild apricot fruit bar by Sharma *et al.* (2013)[17].

Table-3 *Influence of fortification with different concentrations of skimmed milk powder, deffated soya flour of papaya guava fruit bar at different days of storage on reducing sugars and total sugars*

Treatments		Reducing sugars (%)			Total sugars (%)		
		Days after storage			Days after storage		
		0	30	60	0	30	60
T_1	60 % papaya pulp + 40 % guava pulp (AS)	39.44	39.49	41.65	70.05	69.25	68.30
T_2	50 % papaya pulp + 50 % guava pulp (L)	42.30	43.37	44.89	66.54	63.27	61.15
T_3	60% papaya pulp and 40% guava pulp (AS) + 4 % DSF	38.14	39.51	40.79	68.35	67.15	66.34
T_4	60 % papaya pulp and 40 % guava pulp (AS) + 5 % DSF	36.59	37.54	38.37	67.42	66.39	65.15
T_5	50 % papaya pulp and 50 % guava pulp (L) + 4 % DSF	40.74	41.89	42.54	65.15	64.32	63.23
T_6	50 % papaya pulp and 50 % guava pulp (L) + 5 % DSF	41.37	42.38	43.84	64.32	63.74	62.15
T_7	60% papaya pulp and 40% guava pulp (AS) + 6 % SMP	44.59	45.94	46.56	73.34	72.15	71.54
T_8	60% papaya pulp and 40% guava pulp (AS) + 8 % SMP	47.45	47.95	48.36	74.45	73.32	72.61
T_9	50 % papaya pulp and 50 % guava pulp (L) + 6 % SMP	45.68	46.72	47.34	68.34	66.51	65.32
T_{10}	50 % papaya pulp and 50 % guava pulp (L) + 8 % SMP	47.35	48.14	48.94	69.15	67.75	66.36
SEM ±		0.72	0.73	0.75	1.16	1.14	1.12
C D @ 5 %		2.12	2.16	2.21	3.44	3.37	3.32

Ascorbic acid (mg/100g)

There were significant differences among treatments for the ascorbic acid content

in fortified papaya guava fruit bar at zero, 30 and 60 days of storage Among the treatments, highest ascorbic acid content (133.70 mg/100g) was recorded in T_{10} (50% papaya pulp + 50% guava pulp (L) + 8% skimmed milk powder), followed by T_9 (50% papaya pulp + 50% guava pulp (L) + 6% skimmed milk powder) (131.80 mg/100g), T_2 (127.32 mg/100g), T_8 (120.40 mg/100g) and T_7 (118.90 mg/100g) in decreasing trend and lowest 103.50 mg/100g was recorded in T_4 (60% papaya pulp + 40% guava pulp (AS) + 5% defatted soya flour) at zero day of storage. Ascorbic acid content at 30 days of storage was significantly highest (129.50%) in T_{10} (50% papaya pulp + 50% guava pulp (L) + 8% skimmed milk powder) followed by T_9 (50% papaya pulp + 50% guava pulp (L) + 6% skimmed milk powder) (121.10 mg/100g) whereas lowest value (93.60 mg/100g) recorded in T_4 (60% papaya pulp + 40% guava pulp (AS) + 5% defatted soya flour) at 30 days of storage. Fortified fruit bar prepared with 50 per cent papaya pulp + 50 per cent guava pulp (L) + 6 per cent skimmed milk powder (T_9) had highest ascorbic acid content (108.40 mg/100g) followed by T_2 with 50 per cent papaya pulp + 50 per cent guava pulp (L) (107.32 mg/100 g) and lowest ascorbic acid content of 81.70 mg/100 g was observed in fruit bar with 50 per cent papaya pulp and 50 per cent guava pulp (L) + 5 per cent defatted soya flour (T_6) at 60 days of storage. Bars prepared by using skimmed milk powder retained higher ascorbic acid content from earlier study [22] on sapota papaya bar. There was a gradual decrease in the ascorbic content of fortified papaya guava fruit bar during storage might be due to oxidation of ascorbic acid to dehydroascorbic acid followed by further degradation to 2, 3-diketogluconic acid and finally to furfural compounds which enter the browning reaction [17]. The result of decrease in ascorbic acid during storage was also in conformity with report on sapota papaya bar by Sreemathi *et al*. (2008) [10], guava nectar by Karanjalker*et al.* (2013) [24] and wood apple fruit bar by Vidhya and Narain (2011)[20].

Total Carotenoids (µg/100 g)

There were significant differences among treatments for the total carotenoids content in fortified papaya guava fruit bar at zero, 30 and 60 days of storage.

Among all the treatments, total carotenoids of T_1 (60% papaya pulp + 40% guava pulp (AS) was significantly highest (1340 µg/100g) when compared to other treatments. T_3 (1335µg/100g), T_4 (1333 µg/100g), T_7 (1334 µg/100g) and T_8 (1332 µg/100g) were on par with T_1. Lowest total carotenoids content (1212µg/100g) was observed in T_6 (50% papaya pulp + 50% guava pulp (L) + 5 % defatted soya flour) and T_{10} (50% papaya pulp + 50% guava pulp (L) + 8 % skimmed milk powder). At 30 days of storage, highest carotenoids (1195µg/100g) recorded in T_1 (60 per cent papaya pulp + 40 per cent guava pulp (AS) which was decreased to (1030 µg/100g) at 60 days of storage period. The lowest carotenoids content (1006 µg/100g) was recorded in T_2 (50 per cent papaya pulp + 50 per cent guava pulp (L) at 30 days of storage. The maximum carotenoids content (1030 µg/100g) was recorded in fruit bar with 60 per cent papaya pulp + 40 per cent guava pulp (AS) and lowest carotenoids (849 µg/100g) recorded in T_2 (50 per cent papaya pulp + 50 per cent guava pulp (L) at 60 days of storage period. A close perusal of data indicates that there was a gradual decline in total carotenoids with the advancement of storage period due to the thermo-labile and photo sensitive nature [25]. The decrease in total carotenoids was also in conformity with report on papaya toffee and leather Attri*et al.* (2014) [14]and sea buck thorn leather by Kaushal *et al.* (2013)[26].

Protein (%)

There were significant differences among treatments for the protein content of fortified papaya guava fruit bar at zero, 30 and 60 days of storage The initial (at zero days) protein content of fortified papaya guava fruit bar recorded was 2.10 per cent recorded in T_6 (50% papaya pulp + 50% guava pulp (L) + 5% defatted soya flour) which was highest and decreased to 1.78 per cent after 60 days of storage. T_6 was on par with treatments T_4 (2.04%), T_5 (2.08%) and T_3 (2.01%). Lowest protein per cent (0.96%) was recorded in T_1 (60% papaya pulp + 40% guava pulp (AS) at zero day of storage.

Among the treatments, highest protein per cent (1.97%) was recorded in T_5 (50% papaya pulp + 50% guava pulp (L) + 4% defatted soya flour) and lowest protein per cent (0.83%) was recorded in T_2 (50% papaya pulp + 50% guava pulp (L) at 30 days of storage. Fortified fruit bar recorded highest protein per cent (1.82%) in T_4 (60% papaya pulp + 40% guava pulp (AS) + 5% defatted soya flour) which was on par with treatments T_3, T_6 and T_5, where as lowest protein per cent (0.69%) recorded in T_1 (60 papaya pulp + 40% guava pulp (AS) at 60 days of storage.

Table-4 *Influence of fortification with different concentrations of skimmed milk powder, defatted soya flour of papaya guava fruit bar at different days of storage on ascorbic acid and total carotenoid*

Treatments		Ascorbic acid (mg/100g)			Total carotenoids (µg/100g)		
		Days after storage			Days after storage		
		0	30	60	0	30	60
T_1	60 % papaya pulp + 40 % guava pulp (AS)	115.40	104.65	97.46	1340	1195	1030
T_2	50 % papaya pulp + 50 % guava pulp (L)	127.32	116.29	107.32	1218	1006	849
T_3	60% papaya pulp and 40% guava pulp (AS) + 4 % DSF	105.30	95.80	87.40	1335	1182	1021
T_4	60 % papaya pulp and 40 % guava pulp (AS) + 5 % DSF	103.50	93.60	84.70	1333	1174	1012
T_5	50 % papaya pulp and 50 % guava pulp (L) + 4 % DSF	111.80	99.70	85.60	1215	1068	865
T_6	50 % papaya pulp and 50 % guava pulp (L) + 5 % DSF	108.50	95.40	81.70	1212	1063	861
T_7	60% papaya pulp and 40% guava pulp (AS) + 6 % SMP	118.90	110.50	97.40	1334	1184	989
T_8	60% papaya pulp and 40% guava pulp (AS) + 8 % SMP	120.40	111.40	95.80	1332	1181	983
T_9	50 % papaya pulp and 50 % guava pulp (L) + 6 % SMP	131.80	121.10	108.40	1214	1062	865
T_{10}	50 % papaya pulp and 50 % guava pulp (L) + 8 % SMP	133.70	129.50	105.80	1212	1059	859
SEM ±		1.98	1.81	1.60	21.67	19.05	15.95
C D @ 5 %		5.84	5.34	4.71	63.93	56.21	47.05

The higher protein content (2.10) in treatment T_6 (50 per cent papaya pulp + 50 per cent guava pulp (L) + 5 per cent defatted soya flour) which was mainly due to addition of defatted soy flour having high protein content [15]. A remarkable decrease in protein (%) of the fortified papaya guava fruit.bar during storage has been attributed due to its possible participation in mailliard browning reactions (Anju *et al.,* 2014)[15]. The result of decrease in protein per cent was also in conformity with report on evaluation of apricot soy products Thakur, Neena (1997)[27]and sea buck thorn leather by Kaushal *et al.* (2013) [26].

Sensory evaluation of fortified fruit bars

Colour and appearance

On the basis of rating for colour and appearance of fortified papaya guava fruit bar, it was revealed that there were no significant differences among treatments for colour and appearance in fortified papaya guava fruit bar at zero and 30 days of storage. In contrast, significant differences among treatments for colour and appearance was observed 60 days of storage.

The score for colour and appearance recorded were maximum (8.90 and 8.85) in T_7 (60% papaya pulp + 40% guava pulp (AS) + 6% skimmed milk powder) whereas minimum score (8.35 and 8.15) recorded in T_6 (50% papaya pulp + 50% guava pulp (L) + 5% defatted soya flour) at zero and 30 days of storage of fruit bar respectively. Significantly highest score (8.75) for colour and appearance was recorded in T_7 (60% papaya pulp + 40% guava pulp (AS) + 6% skimmed milk powder) which was on par with treatments T_2 and T_8 . Lowest score (8.00) for colour and appearance recorded in T_6 (50% papaya pulp + 50% guava pulp (L) + 5% defatted soya flour) at 60 days of storage.

Table-5 *Influence of fortification with different concentrations of skimmed milk powder, defatted soya flour of papaya guava fruit bar at different days of storage on protein.*

Protein (%)				
Days after storage				
Treatments		0	30	60
T_1	60 % papaya pulp + 40 % guava pulp (AS)	0.96	0.84	0.69
T_2	50 % papaya pulp + 50 % guava pulp (L)	1.00	0.83	0.71
T_3	60% papaya pulp and 40% guava pulp (AS) + 4 % DSF	2.01	1.91	1.80
T_4	60 % papaya pulp and 40 % guava pulp (AS) + 5 % DSF	2.04	1.92	1.82
T_5	50 % papaya pulp and 50 % guava pulp (L) + 4 % DSF	2.08	1.97	1.76
T_6	50 % papaya pulp and 50 % guava pulp (L) + 5 % DSF	2.10	1.95	1.78
T_7	60% papaya pulp and 40% guava pulp (AS) + 6 % SMP	1.84	1.73	1.55
T_8	60% papaya pulp and 40% guava pulp (AS) + 8 % SMP	1.90	1.79	1.61
T_9	50 % papaya pulp and 50 % guava pulp (L) + 6 % SMP	1.86	1.75	1.58
T_{10}	50 % papaya pulp and 50 % guava pulp (L) + 8 % SMP	1.93	1.82	1.64
SEM ±		0.03	0.03	0.03
C D @ 5 %		0.09	0.09	0.08

In fortified papaya guava bar there was a gradual decline in colour and appearance score might be due to change in colour attributed to maillard, enzymatic browning and polymerization of anthocyanins with other phenolics [28]. The result of decline in colour and appearance score was also in conformity with report on guava leather by Safdar *et al.* (2014) [13], wood apple fruit bar by Bhatt and Jha (2015) [29] and papaya toffee and leather by Attri*et al*. (2014) [14].

Texture

Maximum texture score (8.85) on the basis of rating score of fortified papaya guava fruit bar was recorded in T_7 (60% papaya pulp + 40% guava pulp (AS) + 6% skimmed milk powder) showed a declining trend from 8.85 to 8.75 during 60 days of storage period.

Minimum value for texture score (8.35) was recorded in T_5 (50% papaya pulp + 50 % guava pulp (L) + 4% defatted soya flour), (8.25) in T_3 at 30 days of storage. Significantly highest score for texture (8.75) was recorded in T_7 (60% papaya pulp + 40% guava pulp (AS) + 6% skimmed milk powder) which was on par with treatments T_1, T_2, T_8 and T_{10}. Lowest score for texture (8.00) was recorded in T_5 (50% papaya pulp + 50% guava pulp (L) + 4% defatted soya flour) at 60 days of storage.

In the present study it was observed that composition of fruit bar fortified with skimmed milk powder up to eight per cent has improved the texture of the fruit bar. The addition of defatted soy flour up to five per cent might have attributed hard texture, hence fewer less to the fruit bar texture score for defatted soya flour fortified fruit bars was observed. There was a gradual decline in the texture score of fortified papaya guava fruit bar during storage due to absorption of moisture in fruit bar [21]. These results are in consonance with the findings on peach soy fruit leather by Anju *et al.* (2014) [15], papaya toffee and leather by Attri*et al.* (2014) [14].

Flavour

There were significant differences for flavour score of fortified papaya guava fruit bar among treatments at zero, 30 and 60 days of storage. The flavour scores recorded were 8.95, 8.90 and 8.80 in T_7 (60% papaya pulp + 40% guava pulp (AS) + 6% skimmed milk powder), T_1 (60% papaya pulp + 40% guava pulp (AS) and T_9 (50% papaya pulp + 50% guava pulp (L) + 6% skimmed milk powder) of fortified fruit bar at zero day of storage respectively there were on par with each other. Lowest score for flavour (8.25) was recorded in T_6 (50% papaya pulp + 50% guava pulp (L) + 5% defatted soya flour) at zero day of storage. The score for flavour recorded were maximum (8.90 and 8.80) in T_7 (60% papaya pulp + 40% guava pulp (AS) + 6% skimmed milk powder) which was on par with T_1, T_2, T_9 and minimum score recorded were (8.15) and 8.00) in T_6 (50% papaya pulp + 50% guava pulp (L) + 6% defatted soya flour) at 30 and 60 days of storage respectively. Flavour score decreased significantly during storage might be due to various chemical changes and loss of volatiles [15].The results of present investigation are in accordance with the findings on papaya toffee and leather by Attri*et al*. (2014) [14]and wood apple bar by Bhatt and Jha (2015) [29].

Taste

There were significant differences among treatments for taste score in fortified papaya guava fruit bar at zero, 30 and 60 days of storage .The maximum score of 8.85 was recorded in T_7 (60% papaya pulp + 40% guava pulp (AS) + 6% skimmed milk powder) for taste which was on par with treatments T_1, T_2, T_5, T_9, and T_{10} where as lowest score (8.21) recorded in T_6 (50% papaya pulp + 50% guava pulp (L) + 5% defatted soya flour) at zero day of storage.

The taste scores recorded were 8.80, 8.65 and 8.40 in T_7 (60% papaya pulp + 40% guava pulp (AS) + 6% skimmed milk powder), T_9 (50% papaya pulp + 50% guava pulp (L) + 6% skimmed milk powder), T_1 (60% papaya pulp + 40% guava pulp (AS) and T_2 (50% papaya pulp + 50% guava pulp (L) and they are on par with each other whereas lowest score (8.10) for taste was recorded in T_6 (50% papaya pulp + 50% guava pulp (L) + 5% defatted soya flour) at 30 days of storage.

At 60 days of storage significantly highest score (8.75) for taste was recorded in T_7 (60% papaya pulp + 40% guava pulp (AS) + 6% skimmed milk powder) which was on par with treatments T_1, T_2 and T_9 and lowest score (8.05) was recorded in T_6 (50% papaya pulp + 50% guava pulp (L) + 5% defatted soya flour). There was a gradual decline in the taste score of fortified papaya guava fruit bar during storage might be due to fluctuations in acids, pH and sugar acid ratio [13].The result of decline in taste score was also in conformity with report on papaya toffee and leather by Attri*et al*. (2014) [14]and fortified mango bar by Parekh *et al*. (2014) [21].

Overall acceptability

Data with respect to overall acceptability at zero and 30 days of storage of fortified papaya guava fruit bar had no significant difference among treatments. In contrast, significant difference among treatments was observed at 60 days of storage.

The maximum score for overall acceptability 8.88 and 8.83 were recorded in T_7 (60% papaya pulp + 40% guava pulp (AS) + 6% skimmed milk powder) where as the lowest score of 8.38 and 8.22 was recorded in T_4 (60% papaya pulp + 40% guava pulp (AS) + 5% defatted soya flour) and T_5 (50% papaya pulp + 50% guava pulp (L) + 4% defatted soya flour) at zero and 30 days of storage. Significantly highest score for overall acceptability (8.76) was recorded in T_7 (60% papaya pulp + 40% guava pulp (AS) + 6% skimmed milk powder) which was on par with treatments T_1 (60% papaya pulp + 40% guava pulp (AS) and T_2 (50% papaya pulp + 50% guava pulp (L)) at 60 days of storage.

Lowest score for overall acceptability was recorded in T_5 (50% papaya pulp + 50% guava pulp (L) + 4% defatted soya flour). The product prepared using 60% papaya pulp + 40% guava pulp (AS) + 6% skimmed milk powder (T_7) received maximum ratings in all the three durations (0, 30 and 60 days of storage). The gradual decrease in over all acceptability score during storage might be due to change in composition of the product and loss of colour and flavour [21]. The results of present investigation were in accordance with the findings on guava fruit bar by Vijayanand *et al.* (2000) [30], aonla dehydrated product by Singh *et al.* (2006) [31]and by papaya toffee and leather Attri*et al.* (2014) [14].

Microbial count (cfu/ g)

With respect to microbial analysis of fortified fruit bar prepared and packed in butter paper during 60 days of storage studies, no detectable yeast and mould was observed during the zero days of storage.

At 30 and 60 days of storage maximum growth of yeast and mould was observed in T_{10} (0.3×10^2) and (0.4×10^2) respectively.

Table-6 *Influence of fortification with different concentrations of skimmed milk powder, defatted soya flour of papaya guava fruit bar at different days of storage on overall acceptability score*

Overall acceptability score				
Days after storage				
Treatments		0	30	60
T_1	60 % papaya pulp + 40 % guava pulp (AS)	8.75	8.60	8.48
T_2	50 % papaya pulp + 50 % guava pulp (L)	8.67	8.58	8.50
T_3	60% papaya pulp and 40% guava pulp (AS) + 4 % DSF	8.41	8.28	8.18
T_4	60 % papaya pulp and 40 % guava pulp (AS) + 5 % DSF	8.38	8.22	8.10
T_5	50 % papaya pulp and 50 % guava pulp (L) + 4 % DSF	8.38	8.25	8.00
T_6	50 % papaya pulp and 50 % guava pulp (L) + 5 % DSF	8.40	8.28	8.18
T_7	60% papaya pulp and 40% guava pulp (AS) + 6 % SMP	8.88	8.83	8.76
T_8	60% papaya pulp and 40% guava pulp (AS) + 8 % SMP	8.55	8.37	8.18
T_9	50 % papaya pulp and 50 % guava pulp (L) + 6 % SMP	8.58	8.51	8.40
T_{10}	50 % papaya pulp and 50 % guava pulp (L) + 8 % SMP	8.53	8.51	8.22
SEM ±		0.14	0.14	0.14
C D @ 5 %		NS	NS	0.41

As per WHO (1994) [32] guidelines, yeast and mould should be less than $1x10^4$cfu/g. Therefore, fortified fruit bar prepared might be adjudged safe for consumption. However, the growth of yeast and mould was within the acceptable limit, far below the danger count at 30 and 60 days after storage. The product was highly stable and safe from consumption point of view.

Table-7 *Influence of fortification with different concentrations of skimmed milk powder defatted soya flour of papaya guava fruit bar at different days of storage on microbial count (yeast and mould)*

Microbial count (yeast and mould) (cfu/ g)				
Days after storage				
Treatments		0	30	60
T_1	60 % papaya pulp + 40 % guava pulp (AS)	0	0.01×10^1	0.1×10^1
T_2	50 % papaya pulp + 50 % guava pulp (L)	0	0.1×10^1	0.2×10^1
T_3	60% papaya pulp and 40% guava pulp (AS) + 4 % DSF	0	0.2×10^2	0.4×10^2
T_4	60 % papaya pulp and 40 % guava pulp (AS) + 5 % DSF	0	0.1×10^2	0.3×10^2
T_5	50 % papaya pulp and 50 % guava pulp (L) + 4 % DSF	0	0.1×10^2	0.2×10^2
T_6	50 % papaya pulp and 50 % guava pulp (L) + 5 % DSF	0	0.2×10^2	0.3×10^2
T_7	60% papaya pulp and 40% guava pulp (AS) + 6 % SMP	0	0.05×10^1	0.1×10^1
T_8	60% papaya pulp and 40% guava pulp (AS) + 8 % SMP	0	0.09×10^1	0.2×10^1
T_9	50 % papaya pulp and 50 % guava pulp (L) + 6 % SMP	0	0.2×10^2	0.3×10^2
T_{10}	50 % papaya pulp and 50 % guava pulp (L) + 8 % SMP	0	0.3×10^2	0.4×10^2

Conclusion

Among all the treatments of fortified papaya guava fruit bar with 60 per cent papaya pulp + 40 per cent guava pulp (Allahabad Safeda) + 6 per cent skimmed milk powder (T_7) was judged best based on sensory analysis. The same treatment recorded highest score for colour (8.90), texture (8.85), flavour (8.95), and taste (8.85). Bar prepared with recipe T_7 (60% papaya pulp + 40% guava pulp (Allahabad Safeda) + 6% skimmed milk powder recorded nutrient content *viz.,* ascorbic acid (118.90 mg/100 g), total carotenoids (1334 µg/100 g) and protein (1.84 %).

Acknowledgement: Authors are thankful to College of Horticulture, Dr Y.S.R. Horticultural University, Anantharajupeta, Andhra Pradesh, 534101 for providing stipend and the necessary facilities to carry out of this work

Author Contributions: All author equally contributed.

Abbreviations:

% : per cent
@ : at the rate of
A.P. : Andhra Pradesh
AS : Allahabad Safeda
CD : Critical difference
CFU : Colony forming units
CP : Carrot puree
CRD : Completely Randomised Design
DFS : Defatted soy flour
et al. : and others
Fig. : Figure
g : gram
HDPE : High density polyethylene
Hrs : hours
i.e. : that is
kg : kilogram
L : litre
LDPE : Low density polyethylene
L : Lalit
MP : Metallised polyester
mg : milli gram
ml : millilitres
MT : Million tonnes
N : normal
NaOH : Sodium hydroxide
NS : Non-significant
^oB : Degree brix
^oC : Degree Celsius
PP : Poly propylene
ppm : parts per million
TSS : Total soluble solids
RTS : Ready to serve
SEm : Standard Error Mean
SMP : Skimmed milk powder
Viz., : Namely
Vol : Volume
Dr.YSRHU : Dr Y. S. Rajasekhar Reddy Horticultural University
No. : Number
NHB : National Horticulture Board
pH : puissance de hydrogen
RH : Relative humidity

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Conflict of Interest: None declared

Note*- If in future any Misstep / Flaw / Fluff / Plagiarism / conflict found in article, experimental data, procedure of article, then article will be immediately retracted from publication process.

References

[1] NHB (2014-15) Indian Horticulture Database, *Government of India*. Gurgaon, Haryana.
[2] Jain P.K., Priyanka J. and Nema K.P. (2011) *American Journal of Food Technology,* 6 (6), 507-512.
[3] Ranganna S. (1986) *Handbook of Analysis and Quality Control for Fruits and vegetable Products.* Tata McGraw Hill Publishing Company Limited, New Delhi. pp 150-280.
[4] Saini R.S.K.D., Dhankhar O.P. and Kaushik R.A. (2001) *Laboratory Manual of Analytical Techniques in Horticulture*. Agribios, New Delhi, pp 10-33.
[5] Lowry O. H., Rosbrough N.J., Farr A.L. and Randall R.J. (1951) *Journal of Biological chemistry,* 193 265.
[6] Srivastava R.P. and Kumar S. (2009) *Fruit and Vegetable Preservation.* International Book Distributing Company, Lucknow. pp 35-40.

[7] Harrigan W.F. and Mc Cane M.E. (1976) *Laboratory methods in food and diary microbiology.* Academic press, New York.
[8] Panse V.S. and Sukhatme P.V. (1985) *Indian Council of Agricultural Research*, New Delhi, India.
[9] Ashaye O.A, Babalola S.O, Babalola A.O, Aina J.O. and Fasoyiro S.B. (2005) *World Journal of Agricultural Sciences,* 1(1), 50-51.
[10] Sreemathi M., Sankaranarayanan R. and Balasubramanyan S. (2008) *Madras Agricultural Journal,* 95(1-6), 170-173.
[11] Khan A., Zeb A., Khan M. and Shah W. (2014) *International Journal of Food Science, Nutrition and Dietetics*, 3(7), 134-137.
[12] Baramanray A., Gupta O.P. and Dhawan S.S. (1995) *Haryana Journal of Horticultural Science,* 24, 102-109.
[13] Safdar M.N., Mumtaz A., Amjad M., Siddiqui N., Raza S. and Saddozai A.A. (2014) *Sarhad Journal of Agriculture*, 30 (2), 247-256.
[14] Attri S., Dhiman A.K., Kaushal M. and Sharma R. (2014) *International Journal of Farm Sciences,* 4(3), 117-125.
[15] Anju B., Kumari K.R., Anand V. and Anjum M.A. (2014*) SAARC Journal of Agriculture,* 12(1), *73-88.*
[16] Kuchi V.S., Gupta R., Gupta R. and Tamang S. (2014) *Journal of Crop and Weed Science,* 10(2), 77-81.
[17] Sharma S.K. Chaudhary S.P., Rao V.K, Yadav V.K. and Bisht T.S. (2013) *Journal of Food science and Technology,* 50(4), 784-790.
[18] Imran R., Khan R. and Ayub M. 2000) *Sarhad journal of agriculture*, 16(1), 89-93.
[19] Durrani Y., Ayub M., Muhammad A. and Ali A. (2010) *International journal of Food Safety*, 12, 20-28.
[20] Vidhya R. and Narain A. (2011) *American Journal of Food Technology,* 6(4), 279-288.21.
[21] Parekh H.J., Senapatia A.K., Lalit B. L.M. and Pandit P.S. (2014) *Journal of Bioresource Engineering and Technology*. 2(3), 34-41.
[22] Take M.A.K., Bhotmange G.M. and Shastri N.P. (2012) *Journal of Food Science*, 2 (6), 5-15.
[23] Muralikrishna M., Nanjundaswamy A.M. and Siddappe G.S. (1969) *Journal of Food Science and Technology,* 6, 93-98.
[24] Karanjalker G.R., Singh D.B. and Rajwade V.B. (2013) *International Quarterly Journal of Life Sciences,* 8(2), 631-634.
[25] Mir M.A. and Nath N. (1993) *Journal of Food Science and Technology*, 30(4), 279-282.
[26] Kaushal M., Sharma P.C. and Sharma R. (2013) *Journal of Food Science and Technology*, 50(1), 78-85.
[27] Thakur Neena (1997) Development of apricot-soya products and their quality evaluation. *MS.c Thesis.* Dr .Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan (H.P).54-68.
[28] Garcia V.C., Zafrilla P., Romero F., Abellan P., Artes F. and Barberan F.A.T. (1999) *Journal of Food Science,* 64(2), 243 – 247.
[29] Bhatt D. A. and Jha A. (2015) *International Journal of Pharmaceutical Sciences and Research*, 6(10), 4398-4405.
[30] Vijayanand P., Yadav A.R., Balasubramanyam N. and Narasimham P. (2000) *Lebensmittel- Wissenschaft Und-Technologie-Food Science and Technology,* 33(2),132-137.
[31] Singh R., Dashora L.K. and Upadhyay B. (2006) *Indian Food Packer,* 33, 9-14.
[32] WHO (1994) Guideline value for food and drinking water. *World Health Organization*. Geneva, pp: 3.