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Studies on Effect of Different Packaging Materials on Shelf-Life of Blended Guava-Papaya Fruit Leather

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To study the effect different packaging materials on shelf-life and quality of blended fruit leather.
Place of Study: The present investigation was carried out at the Department of Post-Harvest Technology and Agri. Engineering, Indian Institute of Horticultural Research (IIHR), Bengaluru.
Methodology: Guava variety 'Allahabad Safeda' and papaya variety 'Taiwan Red Lady' fruit leathers were prepared by blending their pulp at different ratios of 100:0, 80:20, 60:40, 50:50, 40:60, 20:80 and 0:100 respectively. Citric acid at 0.3% and KMS (Potassium meta-bisulphite) at 600 ppm was added to the blended pulp and TSS was adjusted to 20°B. The pulp according to treatments were then dried in a cabinet drier at 55 to 60°C till the desired moisture content (approx. 15%) was achieved.
Results: Blended guava-papaya (40:60) leather was found best among the treatments in terms of better nutritional and sensory characteristics at initial and also during the subsequent storage periods. The prepared fruit leathers that were packed in biaxially oriented polypropylene showed better results with better nutrient retention (ascorbic acid 90.1 mg/100 g and carotenoids 947.2 µg/100 g) and higher organoleptic score (70.03 overall acceptability out of 100) to those packed in punnets (ascorbic acid 73.2 mg/100 g, and carotenoids 893.0 µg/100 g) during the storage period

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of 4 months. The microbial examination also revealed that all the samples were found to be safe from the consumption point of view till the end of four months of storage.
Conclusion: The blended fruit leather can be a good source of various heath promoting phytochemical nutrients with a unique taste and acceptability having a storage stability for safe consumption till 4 months.

Keywords: Fruit leather; blending; punnet; BOPP; storage.

1. INTRODUCTION

Guava (*Psidium guajava* L.) and papaya (*Carica papaya* L.) are two commercially important tropical fruit crops. Guava is a rich source of vitamin C next to aonla whereas papaya is a rich source of beta-carotene (precursor of vitamin A) next to mango. Besides, both fruits contain various other health-promoting phytochemicals like vitamins, minerals, antioxidants, dietary fibre, etc. However, both of these fruits are highly perishable in nature leading to a huge postharvest loss. These problems can be mitigated to a certain extent by processing and preservation methods which better utilize and conserve the resources. Blending of different fruits by processing into nutritious fruit leather can be explored to phyto-nutritional benefits from both fruits [1,2].

Guava fruit has white or red pulp according to the cultivar characteristic with a pleasant flavour and slightly acidic taste which can be mixed with papaya fruit attributed with blood-red pulp and good taste to give a quality blended product. Blending guava and papaya into a product will also improve nutritional qualities, sensory qualities (color, texture and flavor) and storage stability. Further, the good availability of both fruits almost throughout the year is another factor for the successful blending of the fruits.

Fruit leather or bar or slab is a self-stable confectionary, dehydrated product with a soft gel-like texture. It has a long shelf life and does not require refrigeration for long term preservation. It can be prepared from the fresh pulp, frozen pulp or canned fruit. It is made by drying a very thin layer of fruit puree and other ingredients in cabinet drier in the form of leathery sheets [3]. Natural fruit pulp-based fruit leathers are tastier and more nutritious since a substantial quantity of dietary fibres, mineral, vitamins, and other phytochemicals are present [4]. Fruit leathers add value to fruits which may otherwise not acceptable for the fresh produce market.

Accordingly, an experiment to investigate the storage characteristic of blended guava-papaya fruit leather under different packaging material i.e. punnets and biaxially oriented polypropylene (BOPP) were conducted.

2. MATERIALS AND METHODS

2.1 Raw Material

Guava var. 'Allahabad Safeda' and papaya var. 'Taiwan Red Lady' were procured from the farm of Indian Institute of Horticultural Research (IIHR), Bengaluru, India.

2.2 Samples Preparation

2.2.1 Pulp preparation

Fresh fruits, uniform in size and shape, free from transportation injuries, bruises, insect damage and diseases which are uniformly ripened were selected. Both fruits were washed properly with running tap water to remove any adhering foreign matter. Guava fruits were peeled by lye peeling technique (using 0.5% NaOH boiling solution for 2 min.) then repeatedly washed using tap water while papaya fruits were hand peeled. To prevent browning, ascorbic acid (100 mg/ 100 g) was added to guava pulp. Both peeled fruits were cut into small pieces and pulped using a mixer. Pulp was then passed through a fine sieve to obtain a fine pulp separately.

2.2.2 Fruit leather preparation

The pulp from both guava and papaya fruits were mixed at seven different ratios designated as different treatments viz. T_1 - 100:0, T_2 - 80:20, T_3 -60:40, T_4 -50:50, T_5 - 40:60, T_6 - 20:80 and T_7 - 0:100 respectively. The total soluble solids and acidity were adjusted to 20 °B and 0.3% acidity by adding required amount of sugar and citric acid. Preservative potassium metabisulphite (KMS) at 600 ppm was added in all treatments. Different treatment of mixed pulp of 1 kg was spread on polyethylene lined stainless steel drier trays in the form of a sheet at the rate of 250 g/sq. ft. The trays were then kept for drying in a cabinet drier at 55 to 60°C till moisture content of 15% (approx.) was achieved. The dried sheets of

different fruit leather treatments were weighed and cut into rectangular slabs of dimension 3.5 x 7.5 cm and kept for equalization in air-tight plastic boxes overnight.

2.2.3 Packaging and storage of fruit leather

The prepared blended fruit leathers were then packed in punnet and BOPP (water vapor transmission rate of 4×10^{-3} kg/m^2/d at 90% RH, 38°C and an OTR of 2.5 L/m^2/d atmosphere at 25°C) then labeled properly for storage at ambient temperature of 22 to 26°C with RH 70 to 77% for a period of four months.

2.3 Methods of Analysis

2.3.1 Physico-chemical analysis

Physico-chemical analysis of the fresh pulp and prepared blended fruit leathers were carried out at initial and after four months of storage. Various physico-chemical constituents like moisture, titratable acidity, ascorbic acid, carotenoids, reducing sugar, non-reducing sugar and total sugar of both fresh pulps and prepared blended leathers were analyzed by the methods described by A.O.A.C. [5]. Data regarding the yield of the blended fruit leathers were also recorded. Total soluble solids were recorded using hand refractometer (Erma, Japan), non-enzymatic browning (OD at 440 nm) by UV visible spectrophotometer (Model T70, PG Instrument) [6] and water activity by water activity meter (Rotronic, Hygro Lab).

2.3.2 Microbial analysis

Microbial analysis of prepared leathers was carried out for total colony forming units, yeast, mould, lactic acid bacteria and coliform bacteria at the end of storage (4 months) by pour-plate method incubating at 28±2°C for 24 to 48 hrs. [7].

2.3.3 Organoleptic evaluation

Organoleptic quality evaluation of blended fruit leather was done by a panel of semi-skilled judges (6) by adopting a hedonic rating system having 100 points as overall acceptability with various sub-scores as colour (30), texture (30) and flavor (40).

2.4 Statistical Analysis

The experiment was laid out in completely randomized design [8] comprising of 4 replications. The mean values were evaluated by critical difference (CD) test at 5% level of significance by using ANOVA.

3. RESULTS AND DISCUSSION

3.1 Physico-chemical Characteristic of Fresh Guava Pulp and Papaya Pulp and Yield of Prepared Leather

The physico-chemical characteristics of fresh guava pulp var. 'Allahabad Safeda' and papaya pulp var. 'Taiwan Red Lady' used for preparation of blended guava-papaya fruit leathers are reproduced in Table 1. Yield and drying ratio of prepared blended leathers are shown in Fig 1. Maximum yield (29.18%) was obtained in fruit leather prepared by 100 per cent guava pulp (T_1) while minimum yield (24.07%) in fruit leather prepared by 100 per cent papaya pulp (T_7). Similar observation in the yield of prepared papaya fruit leather was reported [9].

Table 1. Physico-chemical composition of the fresh guava var. 'Allahabad Safeda' and papaya var. 'Taiwan Red Lady's pulp used for the experiment

Chemical Parameters	Guava	Papaya
Pulp Recovery (%)	48.71	35.46
Moisture (%)	89.35	88.97
Total Solids (TS) (%)	10.65	11.03
Acidity (%)	0.44	0.25
Total Soluble Solids (°Brix)	8.73	12.20
Ascorbic acid (mg/100 g)	225.2	51.41
Carotenoids (mg/100 g)	Nil	13.18
Reducing Sugars (%)	4.20	6.10
Non-reducing Sugars (%)	1.79	1.21
Total Sugars (%)	5.99	7.31

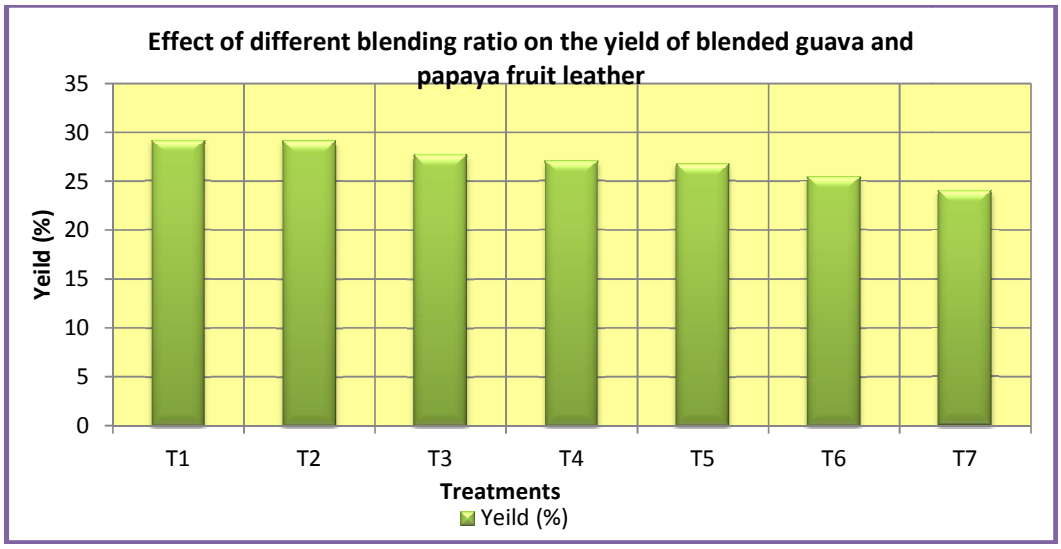

Fig. 1. Effect of different blending ratio on the yield of blended guava and papaya fruit leather

3.2 Physico-chemical Changes of Prepared Leathers during Storage Period

The moisture content of different treatment differed non-significantly during initial period and it ranges from 13.89% to 15.75% (Table 2). Preparations of solar dried jackfruit leather with moisture content of 18.50% [10] and mango-soy fruit leather with moisture content of 12 to 15% [11] are already reported. The final moisture content after four months of storage also differed non-significantly among treatments and ranges from 11.70% to 13.89%. Reduction in moisture content during storage was also reported in the storage of fruit leather [12].

Initial maximum titratable acidity (1.46%) was recorded in fruit leather prepared by 100 per cent guava pulp (T_1) while the minimum (1.11 %) was recorded in fruit leather prepared by 100 per cent papaya pulp (T_7) (Table 2). After 4 months of storage, maximum and minimum titratable acidity increase was recorded again in T_1 (1.52%) packed in punnets and T_7 (1.16%) packed in both punnets and BOPP respectively. Increase in titratable acidity content in blended fruit leather might be due to the loss of moisture, resulting in concentration of the product during storage [13,14]. The increase in acidity may also be due to degradation of ascorbic acid due to formation of sulphurous acid from SO_2 or hydrolysis of pectin [15].

Water activity (a_w) value among the treatments ranged from 0.56 to 0.59 during initial period (Table 2). After four months of storage, it ranges from 0.55 to 0.57. Decrease in water activity value of blended leather may be attributed to decrease in moisture content [16]. The rate of non-enzymatic browning and other enzymatic activity is low at the range of water activity value (0.55 to 0.59) observed in this experiment [17].

Blended fruit leather prepared with more proportion of guava had higher ascorbic acid content due to guava being a richer source of ascorbic acid. High content of ascorbic acid may be due to additional ascorbic acid (100 mg/100 g) added to guava pulp while pulping. Maximum ascorbic acid (226.6 mg/100 g) content was observed in fruit leather prepared by 100 per cent guava pulp (T_1) while minimum (43.8 mg/100 g) in fruit leather prepared by 100 per cent papaya pulp (T_7) at initial period (Table 3). After four months, significantly maximum retention of ascorbic acid (138.5 mg/100 g) was observed in fruit leather prepared by 100 per cent guava pulp (T_1) packed in BOPP while the minimum retention (21.3 mg/100 g) in fruit leather prepared by 100 per cent papaya pulp (T_7) packed in punnets. The loss in ascorbic acid might be due to its oxidation to dehydro-ascorbic acid followed by further degradation to 2, 3 - diketogulonic acid and finally to furfural compounds. Thermal degradation during processing, subsequent oxidation and light reaction were other possible cause for reduction of ascorbic acid content [18]. Protective effect of KMS on ascorbic acid was reported in seabuckthorn (*Hippophae salicifolia*) leather [19]. Better retention of ascorbic acid in BOPP might

be due to lower permeability to light and oxygen [20].

Among the treatments, initial carotenoid content ranged from nil to 1600.2 µg /100g. Highest carotenoid content (1600.2 µg /100g) was observed in fruit leather prepared using 100 per cent papaya pulp (T_7) while fruit leather prepared by 100 per cent guava pulp (T_1) recorded no carotenoids content (Table 3). There was reduction in carotenoids content during storage period. After 4 months of storage, highest carotenoid content (1428.2 µg /100g) was observed in fruit leather prepared by 100 per cent papaya pulp (T_7) packed in BOPP. Better retention of carotenoid was observed in samples packed in BOPP. Loss of carotenoids content during storage could be due to non-oxidative changes (cis-trans isomerization, epoxide formation of thermal degradation) or oxidative changes [21]. Improved retention of carotenoids content in fruit leather might be due to protective action of SO_2 [22]. Similar observations were made in jackfruit bar [23,24] and fortified mango bar [25].

Non-enzymatic browning (OD at 440 nm) values among the treatments were very low, non-significant and ranged from 0.121 to 0.173 at initial stage of storage. During four months of storage, non-enzymatic browning (NEB) is minimum (0.297) in fruit leather prepared by guava 40 per cent and papaya 60 per cent pulp (T_5) packed in BOPP whereas it is maximum (0.387) in fruit leather prepared by 100 per cent guava pulp (T_1) packed in punnets. The increase in non-enzymatic browning may be due to loss of sulphur dioxide, loss of ascorbic acid and inversion of sugar [26,27]. Higher NEB was observed in sample packed in punnets due to more permeability to gas and moisture. Similar result was reported in guava bar [28] and in banana bar [29] packed in different packaging material.

Initially highest reducing sugar (46.10%) was recorded in fruit leather prepared by guava 100 per cent pulp (T_1) on par with T_1 and T_2 (Table 4) while lowest reducing sugar (35.74%) was recorded in fruit leather prepared by 100 per cent papaya pulp (T_7). Reducing sugar content increases gradually during storage period irrespective of packaging material used. After 4 months of storage, maximum increase in reducing sugar (49.86%) was recorded in fruit leather prepared by guava 100 per cent pulp (T_1) packed in punnets on par with T_1, T_2 and T_4 packed in punnets. On the other hand, the minimum increase (39.01%) was recorded in fruit leather prepared by 100 per cent papaya pulp (T_7) packed in BOPP. The increase may be due to hydrolysis of polysaccharides and their subsequent inversion to reducing sugar. Similar increase is also reported in mango-guava sheet [30], blended sapota-papaya bar [31] and guava bar [32]. Among different treatments, initial maximum non-reducing sugar (32.83%) content was recorded in fruit leather prepared by 100 per cent papaya pulp (T_7) on par with T_6 while minimum content (21.89%) was observed in fruit leather prepared by 100 per cent guava pulp (T_1). Non reducing sugar decreases significantly owing to inversion of non-reducing sugar to reducing sugar. Maximum non-reducing sugar (29.15%) was recorded in fruit leather prepared by 100 per cent papaya pulp (T_7) on par T_6 and T_7 packed in BOPP while minimum (15.13%) was recorded in fruit leather prepared by 100 per cent guava pulp (T_1) packed in BOPP. Total sugars content is found to be decreasing during storage upto four months. Fruit leather prepared by 50 per cent guava and 50 per cent papaya pulp (T_4) packed in BOPP recorded maximum total sugar (71.86%) while the lowest content (63.05%) was recorded in fruit leather prepared by 80 per cent guava pulp and 20 per cent papaya pulp (T_2) in BOPP after 4 months of storage. These results conform with the findings by other workers [33].

3.3 Sensory Evaluation of Prepared Leather during Storage Period

Sensory score of the blended guava-papaya fruit leathers is reproduced in Table 5.

3.3.1 Colour

Initially highest colour score (25.57) was recorded in fruit leather prepared by 100 per cent papaya pulp (T_7) while lowest score (22.43) in fruit leather prepared by 80 per cent guava and 20 per cent papaya pulp (T_2). Leather prepared from 60 per cent guava and 40 per cent papaya pulp (T_3) packed in BOPP was best acceptable colour (20.87) after four months of storage. Decrease in colour score may be due to non-enzymatic browning reaction which decreases its acceptability. It was also observed that blended guava and papaya fruit leather when packed in BOPP packaging showed more acceptability on colour score. Similar results of higher acceptability of colour for blended papaya and mango leather was reported [34].

Table 2. Effect of different blending ratio and packaging material on blended guava-papaya fruit leather on moisture, acidity and water activity at initial and 4 months after storage

Treatments	Moisture (%)			Acidity (%)			Water activity		
	Initial	4 months after storage		Initial	4 months after storage		Initial	4 months after storage	
		Punnets	BOPP		Punnets	BOPP		Punnets	BOPP
T_1	14.16	11.85	12.80	1.46	1.52	1.49	0.59	0.57	0.57
T_2	14.39	12.12	12.66	1.43	1.49	1.48	0.58	0.56	0.56
T_3	14.26	12.31	13.23	1.29	1.35	1.36	0.58	0.56	0.56
T_4	13.92	12.04	12.53	1.25	1.30	1.28	0.58	0.55	0.55
T_5	15.75	13.89	13.65	1.22	1.27	1.29	0.59	0.57	0.57
T_6	13.89	11.70	12.34	1.14	1.20	1.19	0.56	0.55	0.55
T_7	13.99	11.84	12.81	1.11	1.16	1.16	0.57	0.55	0.55
Sem±	0.64	0.58	0.54	0.08	0.04	0.04	0.03	0.02	0.02
CD at 5%	NS	NS	NS	0.23	0.14	0.12	NS	NS	NS

Table 3. Effect of different blending ratio and packaging material on blended guava-papaya fruit leather on ascorbic acid, carotenoids and non-enzymatic browning (NEB) at initial and 4 months after storage

Treatments	Ascorbic acid (mg/100 g)			Carotenoids (µg/100 g)			NEB (OD at 420 nm)		
	Initial	4 months after storage		Initial	4 months after storage		Initial	4 months after storage	
		Punnets	BOPP		Punnets	BOPP		Punnets	BOPP
T_1	226.6	127.3	138.5	0.0	0.0	0.0	0.121	0.387	0.328
T_2	206.3	119.3	129.2	880.3	362.2	384.8	0.148	0.334	0.313
T_3	180.6	102.4	114.7	998.3	376.3	439.2	0.156	0.316	0.305
T_4	158.4	91.3	100.6	1224.5	573.2	609.4	0.187	0.344	0.326
T_5	132.6	73.2	90.1	1380.2	893.0	947.2	0.124	0.302	0.297
T_6	116.3	64.8	68.3	1529.1	1067.3	1181.3	0.158	0.329	0.315
T_7	43.8	21.3	26.6	1600.2	1319.6	1428.2	0.173	0.311	0.301
Sem±	4.7	3.2	3.2	38.0	24.8	26.9	0.016	0.019	0.015
CD at 5%	14.3	9.8	9.9	115.5	75.3	81.7	NS	0.058	0.044

Table 4. Effect of different blending ratio and packaging material on blended guava-papaya fruit leather on reducing, non-reducing and total sugar at initial and 4 months after storage

Treatments	Reducing sugar (%)			Non-reducing sugar (%)			Total sugar (%)		
	Initial	4 months after storage		Initial	4 months after storage		Initial	4 months after storage	
		Punnets	BOPP		Punnets	BOPP		Punnets	BOPP
T_1	46.10	49.86	48.03	21.89	16.03	15.13	67.99	65.89	63.16
T_2	44.42	48.01	46.16	22.01	15.49	16.89	66.43	63.50	63.05
T_3	41.40	44.98	44.27	26.73	20.78	21.77	68.13	65.76	66.04
T_4	44.50	48.82	47.99	27.48	22.45	25.87	73.07	71.27	71.86
T_5	39.44	42.01	40.37	29.41	25.81	27.01	68.85	67.82	67.38
T_6	37.99	41.86	39.48	32.69	27.20	27.24	69.97	67.06	66.72
T_7	36.49	39.61	39.01	32.83	28.58	29.15	69.32	68.19	66.16
Sem±	0.90	0.98	0.81	0.81	0.76	0.69	1.24	1.17	1.37
CD at 5%	2.75	2.98	2.48	2.44	2.30	2.09	NS	3.19	4.16

Table 5. Effect of different blending ratio and packaging material on blended guava-papaya fruit leather on colour, texture, flavour and overall acceptability at initial and 4 months after storage (MAS)

Treatments	Colour (30)			Texture (30)			Flavour (40)			Overall acceptability (100)		
	Initial	4 MAS		Initial	4 MAS		Initial	4 MAS		Initial	4 MAS	
		Punnets	BOPP		Punnets	BOPP		Punnets	BOPP		Punnets	BOPP
T_1	24.86	18.27	19.26	23.46	18.26	19.48	31.14	23.25	24.89	79.46	59.78	63.63
T_2	22.43	18.65	18.98	24.36	19.26	19.52	26.71	23.26	24.16	73.50	61.16	62.66
T_3	22.71	19.55	20.87	22.57	18.27	20.66	26.14	22.32	23.26	71.43	60.14	64.76
T_4	23.43	19.88	20.25	24.36	21.27	23.25	29.33	21.27	23.41	77.12	62.41	66.92
T_5	25.00	20.85	21.36	25.57	22.36	24.56	30.21	21.90	24.12	80.78	65.10	70.03
T_6	24.86	21.55	21.27	24.58	20.25	22.49	27.33	22.26	23.23	76.76	64.06	66.98
T_7	25.57	21.99	21.65	24.14	20.26	23.15	29.14	23.21	23.22	78.86	65.46	68.02
Sem±	0.67	0.67	0.51	0.78	0.87	1.17	0.84	0.97	0.77	1.89	1.22	1.30
CD at 5%	2.03	2.02	1.54	NS	2.65	3.45	2.53	NS	NS	5.73	3.75	3.97

Table 6. Effect of different blending ratio and packaging material on the microbial population at 4 months after storage

Treatments	Microbial population (cfu/g) at 4 months after storage									
	Punnets					BOPP				
	Total viable count	Yeast	Mould	Lactic acid bacteria	Coliform bacteria	Total viable count	Yeast	Mould	Lactic acid bacteria	Coliform bacteria
T_1	8×10^1	1×10^1	3×10^1	Nil	4×10^1	1×10^1	Nil	1×10^1	Nil	Nil
T_2	2×10^1	1×10^1	1×10^1	Nil	7×10^1	2×10^1	Nil	Nil	Nil	Nil
T_3	3×10^1	Nil	1×10^1	Nil	Nil	1×10^1	Nil	1×10^1	Nil	Nil
T_4	4×10^1	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	1×10^1
T_5	6×10^1	Nil	1×10^1	Nil	Nil	Nil	Nil	Nil	Nil	Nil
T_6	1×10^1	Nil	2×10^1	Nil	Nil	1×10^1	Nil	Nil	Nil	Nil
T_7	2×10^1	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

3.3.2 Texture

The score of texture at initial period showed non-significant differences and ranges from 22.57 to 25.57. Reduction in texture score during subsequent storage period was observed and after 4 months of storage, maximum texture score (24.56) was observed in fruit leather prepared by 40 per cent guava and 60 per cent papaya pulp (T_5) packed in BOPP while lowest score (18.26) was obtained by fruit leather prepared by 100 per cent guava pulp (T_1) packed in punnets. The better texture of blended fruit leather compared to single type fruit leather may be due to contribution to the acceptable texture by both fruits. Variation in texture score of blended fruit leather has been reported [30,31,35].

3.3.3 Flavour

Fruit leather prepared by 100 per cent guava pulp (T_1) had highest flavour score (31.14) while minimum score (26.14) in fruit leather prepared by 60 per cent guava and 40 per cent papaya pulp (T_3) at initial period. There was gradual reduction in flavor score during storage. Highest score (24.89) was obtained by fruit leather prepared by guava 100 per cent pulp (T_1) packed in BOPP while the lowest score (21.27) in fruit leather prepared by 50 per cent guava and 50 per cent papaya pulp (T_4) packed in punnets after four months of storage. However, samples packed in BOPP have better score for flavour compared to punnets after four months of storage. These findings conform to the reports on blended papaya-mango bar [34] and in apricot-soy bar [35].

3.3.4 Overall acceptability

Initially overall acceptability score ranges from 71.43 to 80.78 out of 100. After four months of storage, there was decrease in overall acceptability score and highest overall score (70.03) was obtained by fruit leather prepared by 40 per cent guava and 60 per cent papaya pulp (T_5) packed in BOPP while the lowest score (59.78) was obtained by fruit leather prepared by guava 100 per cent pulp (T_1) packed in punnets. The findings revealed that samples packed in BOPP was superior till four months of storage. These results conform to the findings on organoleptic properties of guava leather [36,37] and papaya bar [34]. The result indicated that fruit leather prepared using only guava pulp was equally acceptable at initial but it loses its acceptability after storage. On the other hand, blending with papaya was found effective in maintaining better sensory properties besides improved nutritional status during storage.

3.4 Microbial Stability of Blended Fruit Leathers after 4 Months of Storage

Data on microbial load after four months of storage revealed that both punnets and BOPP packed and stored blended leathers had most of microbial growth within log 1 population and in some case the microbial count was nil (Table 6). These experimental findings confirm that all the treatment irrespective of blending ratio and packaging material showed a microbial stability for consumption till 4 months of storage. The microbial load is within the specification laid down by 'Food Safety and Standard Authority of India' [38] for acceptable growth of mould and yeast in fruit leather. Some growth of microbial populations was observed in very low dilution in some treatments although it is below the admissible levels in all the plates analyzed during storage. Similar kind of low microbial growth was reported in papaya leather [39]. Most of the microorganisms can barely survive a water activity lower than 0.60 and strikingly water activity value of the blended guava and papaya fruit leather was below 0.60. Also, different preservation factors, such as preservatives, pH and water activity act synergistically to inhibit microbial growth [40]. Similar results of microbial stability of fruit leather are also reported in guava bar [41] and mango bar [42].

4. CONCLUSION

From the present investigation, it has been concluded that different blending ratio and packaging material had significant effect on the quality of blended guava and papaya fruit leather. According to sensory quality attributes, blended fruit leather prepared by 40 per cent guava and 60 per cent papaya pulp (T_5) packed in BOPP was found best and also combines the nutritional benefits of both fruits. The growths of micro-organism were also well within the safe limit for consumption till 4 months of storage period. It is anticipated that this technology or value addition would certainly improves the nutrient intake of consumers and also enabling small scale self-employment in rural sector thus certainly helps in income generation of the entrepreneurs.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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