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Quality evaluation of prepared guava-orange fruit bar

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Abstract
Fruit bars is the dehydrated fruit based product. In the present study the fruit bars were prepared by different guava and orange pulp ratio (0:100, 30:70, 40:60, 50:50, 60:40, 70:30, 100:0). It was found that the ash, protein, fat, TSS, total sugar, ascorbic acid, total phenol and pectin of guava pulp is higher than the orange pulp. The moisture content of fruit bar ranges from 12.96 to 19.33% (w.b.). The ash, fat and protein content of prepared fruit bar ranges between 0.196 to 1.58%, 1.4 to 4.8% and 1.79 to 2.07% respectively. The acidity of different samples varies from 0.64-0.32% and ascorbic acid content of different fruit bar increases with increase in guava concentration in fruits bars. Total sugar, total phenolic compounds and lycopene varies from 121.29 mg/g to 64.12 mg/g, 0.57 mgGAE/g to 10.73 mgGAE/g and 0.23 to 0.29% respectively. The guava-orange fruit bar prepared with 50:50 (guava: orange) and 0:100 (guava: orange) was found most acceptable fruit bar.

Keywords: Fruit bar, guava, orange, preservation, fruit leather, mixed fruit bar, etc.

Introduction

Guava (*Psidium guajava*) are cultured in many tropical and subtropical regions. It belongs to family Myrtaceae. It is known as ‘poor man’s apple’ and is available in plenty at a low price during fruiting seasons (Kamath *et al.*, 2008) [20]. Guava is considered to be a good source of vitamins and minerals especially vitamin A, ascorbic acid, thiamine, etc. (Ghosh and Chattopadhyay, 1996; Das *et al.*, 1995) [15, 10]. It contains 83-127 and 278-401 mg ascorbic acid per 100g of pulp in the fruits of rainy and winter season crops respectively (Jauhari *et al.* 1969) [18]. Guava is effective against bacterial infections, cancer, inflammation and pain. Because of high pectin content, it is extensively used to make candies, preserves, jellies, jams and marmalades and also for juices (Srivastava and Kumar, 2007) [44]. It can be processed into various value added products to minimize losses and maintain the cost (Das *et al.*, 1995) [10].

Orange (*Citrus sinensis*) belongs to citrus fruit species in the family Rutaceae. The orange is a hybrid between pomelo and mandarin (Xu *et al.* 2013) [46]. It is also called sweet orange (Kimball 1999) [21]. Oranges are dried and pulverized, and the orange powder is added to baked goods as flavoring. *Citrus sinensis* are commonly utilized in salads, gelatins, fruit cups and numerous other desserts, and as garnishes on cakes, meats and poultry dishes. It is rich in vitamin C which prevents osteoarthritis, asthma and rheumatoid arthritis. Oranges are proven to help fight a number of varieties of cancer including that of the skin, lung, breast, stomach and colon (Xu *et al.* 2013) [46].

Asparagus racemosus locally called as Shatavari in Marathi and Hindi and it belongs to family asparagaceae (Singh *et. al*., 2013) [42]. Roots and leaves of Shatavari are used as one of the most powerful nutritive and spermatogenic herb. Rhizome is extensively used in medical applications and food supplements (Gomase *et al*., 2010) [16]. It is considered as general tonic and female reproductive tonic, it implies its ability to increase fertility and vitality. In Ayurveda Shatavari roots to be effective as antispasmoadic, appetizer, stomach tonic, aphrodisiac, galctogogue, and astringent, antidiarrheal & anti-dysenteric laxative, anticancer, blood purifier antiepileptic, increases intelligence and promote learning and memory (Sharma and Bhatnagar, 2011, Kohli *et al*., 2017, Kohli *et al*., 2018) [41,22,23].

Fruit leather or bar is dehydrated fruit based product. The destruction of original fruit structure by pureeing, cooking and restructuring in dehydrated sugar-acid- pectin gels called “fruit leathers” provide attractive and coloured products. Fruit leathers also allow left over ripe fruits to be preserved (Natalia *et al*. 2012) [34]. The main advantage of making fruit leathers is to preserve fruit by drying and, hence, controlling post-harvest losses. Although fruit leather/bar is a relatively well established product in India, only few studies have been published about fruit leather or bar preparation. The fruits leather preparation have been studied by many investigators viz Guava (Kuchi*et. al.*, 2014, Vijayanand *et al.*, 2000 and Chavan & Shaik, 2015) [24, 45, 8], apple-banana (Parimita and Arora, 2015) [35], pawpaw-guava (Babalola *et. al.*, 2002 and Ashaye *et al.*, 2005) [5, 4], papaya (Cherian & Cheriayan, 2003 and Kumar *et al.*, 2010) [9, 26], sapota-papaya (Kumar *et al.*, 2012) [25] and guava-papaya (Singh, 2012) [43]. However, the guava orange and asparagus fruit bar has not been investigated and a very few information are available in the literature.

The objective of this work was to standardize appropriate combination of guava-orange-asparagus blends for preparation of fruit bar, to evaluate the effects of blend ratio on the chemical constituents and to analyze sensory quality of different blend ratios.

Material and method

Samples of guava and orange fruits were procured from local market in Dehradun, Uttarakhand. Samples of asparagus roots were procured from local market of Yamuna Nagar, Haryana. Fruits selection criteria were homogenous size, absence of skin damage, visible absence of microbes and physiological maturity. The process variable with their selected levels was guava and orange pulp ratio (0:100, 30:70, 40:60, 50:50, 60:40, 70:30, 100:0)

Preparation of Leather from Blends

Leathers was prepared from the above guava-orange- roots powder blends as per standard procedure using 1 kg blended pulp, 1.25 kg sugar, 4-5ml citric acid, 30gm table butter, 10% asparagus. (Srivastava & Kumar, 2007) [44]. the bar was prepared by cooking the mixture. The total soluble solids content of pulp was raised to 75º Brix. Clean stainless steel trays, smeared with butter were taken and the prepared pulp was spread on these trays to a thickness of 15-20mm. These trays were loaded into a tray dryer maintained at 60±2 ºC. The pulp was dried to a thickness of 5-10mm. After drying to optimum moisture content, the dried pulp was cut into bars (Chavan & Shaik, 2015) [8]. The experimental plan is given in Table 1. Fruit bar were wrapped in aluminum foil, followed by enclosing them in LDPE pouches (Srivastava and Kumar, 2007) [44]. Packaged fruit bars were stored at ambient temperature and bio-chemical observations were carried out.

Quality Attributes Evaluation

Moisture content was measured by standard oven drying method by keeping 2g of sample in a moisture box in oven at 105 ± 2 ºC for 2 hr (AOAC, 1995) [2]. Protein content in the samples was determined using Bradford method. Fat content was determined using (AOAC, 1984) [1] soxhlet extraction method. Total ash content was determined by AOAC, 1984 [1] method. Total soluble solids (TSS) were estimated by hand refractometer (30-90º Brix). TA (expressed as % citric acid) was determined by titration (AOAC, 2000) [3]. The ascorbic acid content (mg/100g) of the samples was determined by the titramitric method (Sawhney and Singh, 2014) [40] in which visual titration method of reduction of 2, 6 dichlorophenolindophenol dye was used.

Lycopene Content (mg/100g) of the samples was determined by spectrometric method. The petroleum ether extract was observed at 503nm O.D. (Ranganna, 1991) [36]. Total pectin content was estimated by the method of Ranganna, 2003 [37] and it was expressed as percentage of citric acid. Total Phenols (mg/GAE/g) was determined by the method of Makkar *et al*, 2007 and Makkar *et. al*, 1993 [30, 29]. This spectrometric method was carried at 725nm. Total sugar of the samples was determined by phenol-sulfuric method using glucose as standard under the O.D. of 490nm (Dubois *et. al.*, 1956) [11]. Reducing sugars was estimated by the method of Miller, 1959 [31] using DNS reagent. This spectrometric method was carried out at 540nm. Non-reducing sugars was determined by the method of Lane and Eynon, 1923 [28]. Fruit bars were subjected to sensory evaluation by panel of judges following the hedonic rating scale described by Ranganna, 2003 [37].

Statistical Analysis

The data in the present investigation were subjected to analysis of variance (ANOVA) techniques and analyzed according to completely randomized design in excel. The critical difference value at 1 per cent level was used for making comparison among different treatments.

Result and discussion

Chemical and nutritive characteristics of fresh guava and orange pulp

The fresh guava and orange fruits were evaluated for various chemical and nutrtional characteristics and the results recorded have been presented in Table 1. It was found that fat content of guava (0.70%) and protein content of guava (2.38%) was slightly higher than fat (0.38%) and protein (2%) content of orange. The ash content of guava (1.31%) is also much higher than that of orange (0.52%). It was also found that ascorbic content of guava (346.45mg/100g) was approximately four times higher than the ascorbic content of orange (52.65mg/100g) and pectin content of guava (6.58%) was almost twice to that of orange (3.71%). The orange (1.96%) was found to be more acidic as compared to guava (0.704%). The total soluble solid of guava (10.57° Brix) was slightly higher than that of orange (7°Brix). The total phenol of guava (6.59 mg GAE/g) is also higher than that of orange (2.55 mg GAE/g). Similar results were observed by Yan *et al.*, 2006 [47] and Chakrabortya and Athmaselvi, 2014 [7] on different variety of guava and orange.

Table 1: Chemical characteristics of fresh Guava and Orange pulp

Sr. No.	Parameters	Guava*	Orange*
1	Ash Content (%)	1.31±0.57	0.52±0.22
2	Moisture Content (%)	88.66±0.2	90.16±0.7
3	Protein (%)	2.38±0.11	2±0.07
4	Fat (%)	0.70±0.13	0.38±0.10
5	TSS (%)	10.57±1.4	7±0.707
6	Total Sugars (mg/g)	86.21±0.28	67.3±0.3
7	Reducing Sugars (mg/g)	34.74±0.46	47.52±0.45
8	Titrable Acidity (%)	0.704±0.09	1.96±0.27
9	Ascorbic Acid (mg/100g)	346.45±4.86	52.65±3.77
10	Lycopene (mg/100g)	0.227±0.042	0.354±0.015
11	Pectin (%)	6.58±0.27	3.71±0.077
12	Total Phenols (mgGAE/g)	6.59±0.44	2.55±0.42
13	Non-reducing Sugars (mg/g)	51.46±0.38	19.67±0.42

*****The values are mean ± S.D. of three replicates

Fig 1: 100% Orange Fruit Bar (0-100)

Fig 2: 30-70% Guava-Orange Fruit Bar

Fig 3: 40-60% Guava-Orange Fruit Bar

Fig 4:50-50% Guava-Orange Fruit Bar

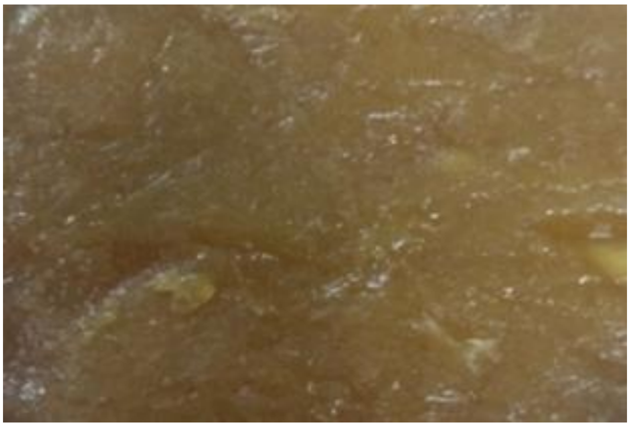

Fig 5: 60-40% Guava-Orange Fruit Bar

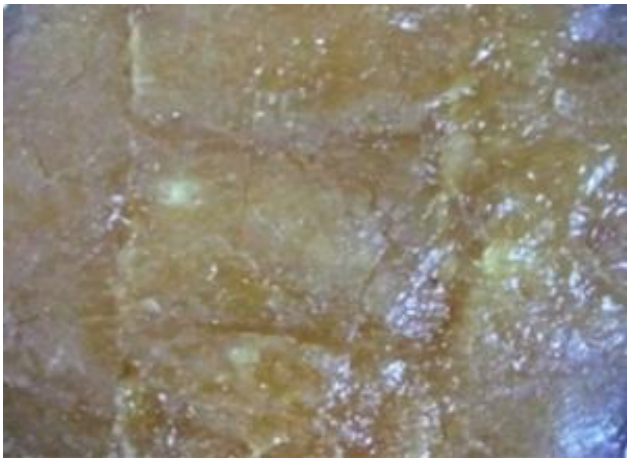

Fig 6: 70-30% Guava-Orange Fruit Bar

Fig 7:100% Guava Fruit Bar (100-0)

Nutritional and chemical characteristics of Guava-Orange fruit bar

Moisture Content

The results pertaining to the moisture content of freshly prepared fruit bars of different ratios is presented in Fig 8. There is a significant (p<0.01) change in moisture content of fruit bar ranges from 12.96 to 19.33% (w.b.). Variation in moisture content of fruit bars under different treatments might be due to the influence of the type of fruits, drying process, temperature and humidity. The natural acidity and sugar content of fruit also influenced the moisture content of fruit leather. Higher moisture content in the fruit bars increases the growth of undesirable microorganisms (Fontana, 2000) [14]. Less moisture content in the fruit bar increases the shelf life of food but Figiel *et al*. (2006) [13] and Huang and Hsieh

(2005) [17] also reported that the moisture content adversely affects the texture of fruit leather.

Protein

The variation of the protein content of freshly prepared fruit bars of different samples are shown in Fig 9. There is a significant (p<0.01) change in protein content throughout the results. The protein content of fruits bars ranged between 1.79 to 2.07%. The results shows that the prepared fruit bar of ratio 70:30 found to be rich in protein while minimum protein was observed in guava orange pulp ratio of 50:50 samples but in the acceptable range.

Fat Content

The variation of the fat content in freshly prepared fruit bars of different samples are presented in Fig 10. There is a significant (p<0.01) change in fat content of prepared fruit bar or leather. The fat content of the prepared fruit bars ranged between 1.4 to 4.8%. Maximum fat content was obtained in 70:30 guava:orange fruit bar whereas minimum was in 40:60 guava:orange fruit bar.

Ash Content

The variation of the ash content of prepared fruit bars of different ratios is presented in Fig 11. There is a significant (p<0.01) change in ash content of the prepared fruit bar and it ranges between 0.196 to 1.58%.

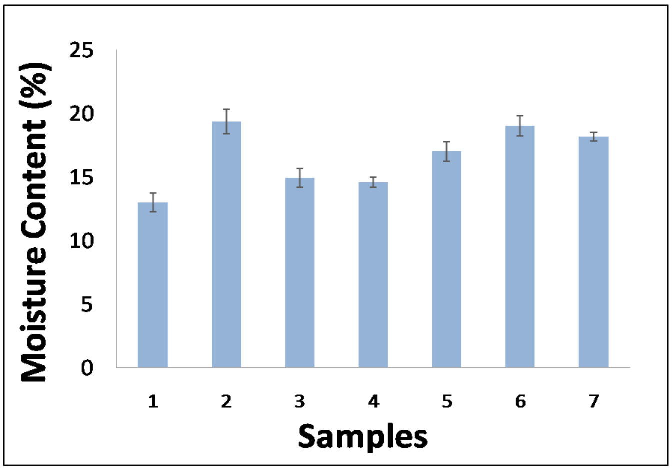

Fig 8: Variation of moisture content in different bars

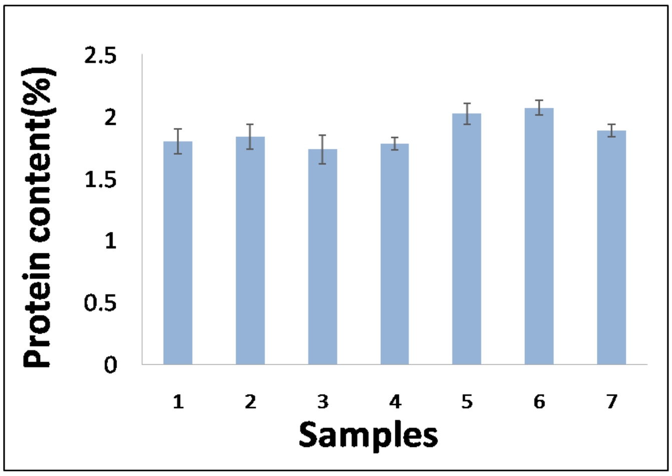

Fig 9: Variation of protein content in different bars

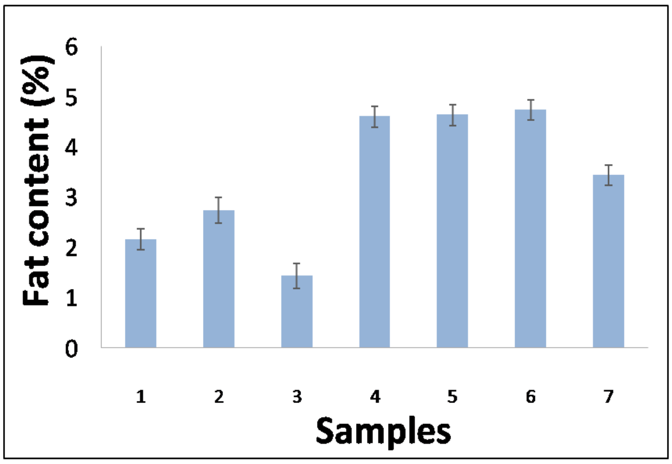

Fig 10: Variation of fat content of different bars

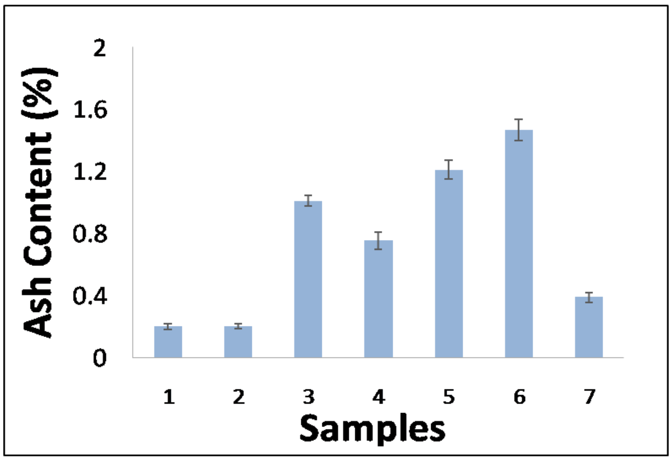

Fig 11: Variation of ash content of different ash content

Chemical characteristics of Guava-Orange Fruit bar

Ascorbic Acid

Higher consumption of ascorbic acid helps in curing of several health disorders like lowering of blood pressure, prevention of dental diseases, eye problems and diabetes. The ascorbic acid content of different fruit bar varies from 17.54 – 175.26 mg/100gm. The fruit bar made of 100:0 guava orange pulp ratio found to hold the highest ascorbic acid among all prepared fruit bars while the fruit bar made of 0:100 guava orange pulp ratio found lowest value of ascorbic acid which is due to higher content of ascorbic acid in guava as compared to orange. It was found that there is significant (p<0.01) increase in ascorbic acid content in fruit bars with the increase in ratio of guava pulp. Ascorbic acid is sensitive to heat, oxygen and light, and therefore, vitamin C content of developed products might be low due to the fact that it readily got oxidized. There is reduction in ascorbic acid in processed product as compared to fresh fruit because of the attributed to the loss of ascorbic acid during preparation (Kadam*et al.*, 2012) [19]. Thermal degradation during processing and oxidation may also have contributed to this reduction as AA is very sensitive to heat (Brock *et al.*, 1998) [6]. The variation of ascorbic acid in different fruit bar is being represented graphically in Fig 12.

Total Soluble Solids

The TSS of various prepared samples varies from 81 – 73 °Brix. The 0-100% fruit bar contains highest amount of soluble solids as compared to other blends. There was significant (p<0.01) difference in total soluble solids of various guava-orange fruit bar samples. The variation of TSS of different samples is shown in Fig. 13.

Titrable Acidity
The titrable acidity of fruits bars significant ($p<0.01$) varies. The acidity of different samples varies from 0.64 - 0.32%. It was found that 100% orange fruit bar has the highest acidity may be because of orange is highly acidic as compared to guava. High acidity in fruit leather can prevent the growth of microorganisms and also helps to maintain the color and flavour of the fruit (Minakschhi, 2011) [32]. The variation of acidity is shown in Fig. 14.

Lycopene
The lycopene of prepared bar is less than the fresh pulp which may be due to thermo labile nature of lycopene. There is a significant ($p<0.01$) variation in lycopene of different fruit bars and it ranges from 0.23 to 0.29%. The variation of lycopene in fruit bar is shown in Fig. 15.

Pectin
Pectin helps in binding the chemical compounds together. It helps in increasing the gelation property of the food materials. The pectin content of different samples varies from 4.25 – 14.81%. The 100% orange blend containsleast amount of pectin may be because it has heat labile characteristics so lost its property. It was found that there is significant ($p<0.01$) change in pectin of different samples. The variation of pectin content of different samples is shown in Fig. 16.

Total Phenolic Compounds
Total phenols were recorded maximum in 100% guava blend and minimum in 30-70% blend. Total phenolic compounds significantly ($p<0.01$) increases with range of 0.57 mgGAE/g to 10.73 mgGAE/g. The phenolic compounds are highly volatile compounds and it easily oxidizes to give brown products of high molecular weight. The decrease in total phenols during storage is might be due to their condensation into brown pigments (Fennema, 1976) [12]. The variation of total phenol is shown in Fig. 17.

Total Sugars
Total sugars of blended fruit bars changed significantly ($p<0.01$). Total sugars were recorded maximum in 60-40% and 50-50% blended fruit bars while it was recorded minimum in 40-60%. It varies from 121.29 mg/g to 64.12 mg/g. There was a gradual and significant increase in total sugars of guava-orange fruit bar. The increase in total sugars might be due to inversion of sugars as reported by Roy and Singh (1979) [39]. They conducted studies on bael slab and toffee, and concluded that increase in total sugars might be due to hydrolysis of polysaccharides like pectin and starch into simple sugars. The variation of total sugar is represented in Fig. 18.

Reducing Sugars
Reducing sugar of products changed gradually. This difference in reducing sugars might be due to acid hydrolysis of sucrose (Labuza*et al.*, 1970; Rao and Roy, 1980) [27, 38]. There was significant ($p<0.01$) change in reducing sugars. Reducing sugars were recorded maximum in 50-50% blended fruit bar where as minimum reducing sugars were recorded in 40-60% blend. The increase in reducing sugars might be due to inversion of non-reducing into reducing sugars and hydrolysis of polysaccharides. Similar results were reported by Muhammad *et al.* (2008) [33] in apple jam. The variation of reducing sugar in different bars is graphically represented on Fig. 19.

Non-reducing Sugars
There is significant change (p<0.01) observed with maximum in 60-40% blend fruit bar while it was recorded minimum in 100% guava blend. The variation of non-reducing sugar is graphically represented in Fig. 20.

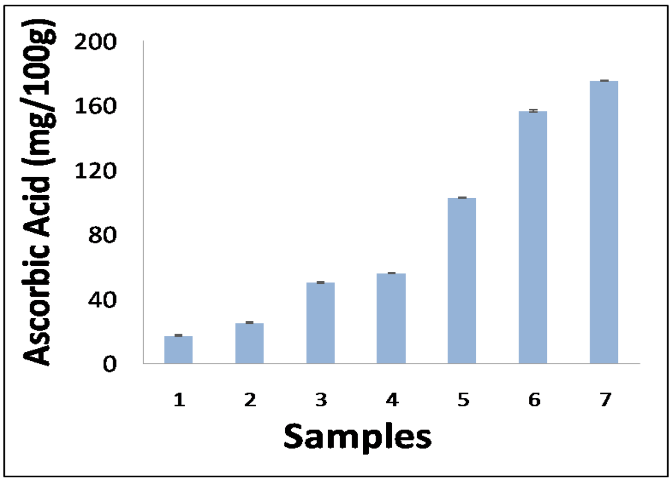

Fig 12: Variation of ascorbic acid in different fruit bar

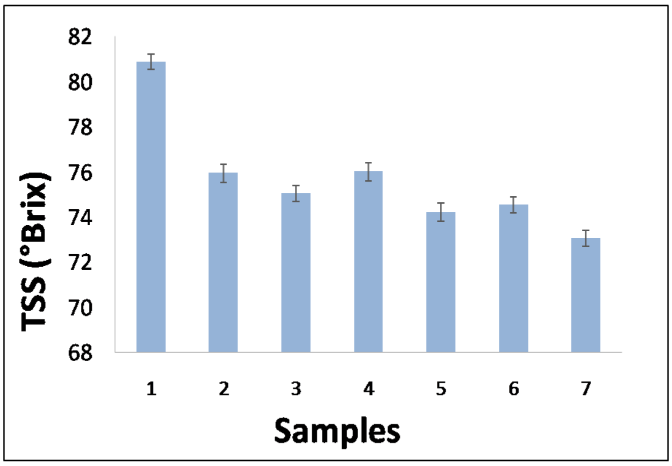

Fig 13: Variation of total soluble solids in different fruit bar

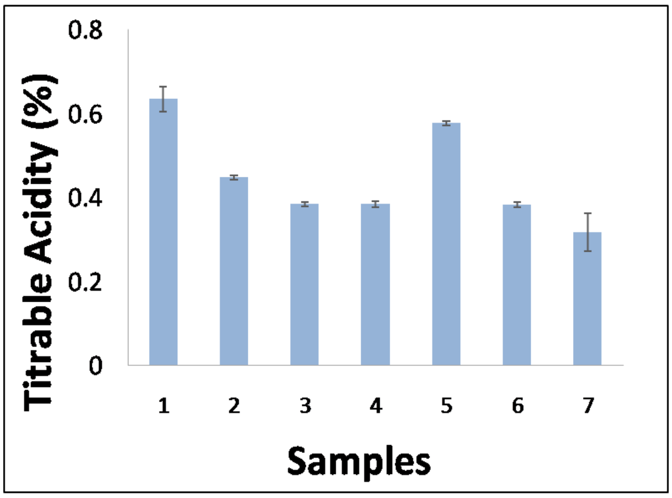

Fig 14: Variation of titrable acidity of different fruit bars.

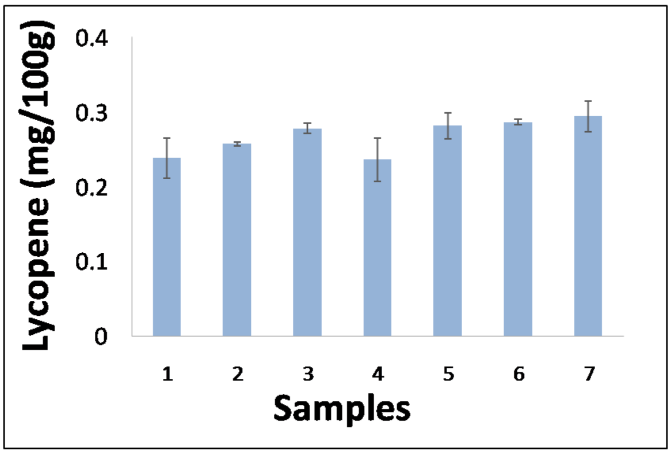

Fig 15: Variation of lycopene of different fruit bars

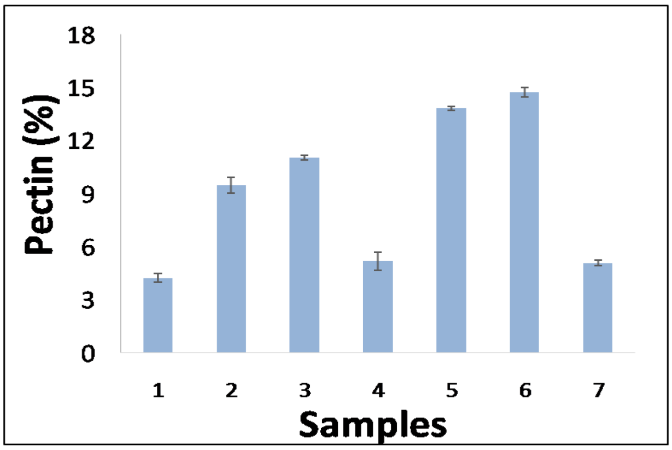

Fig 16: Variation of pectin content of different fruit bars

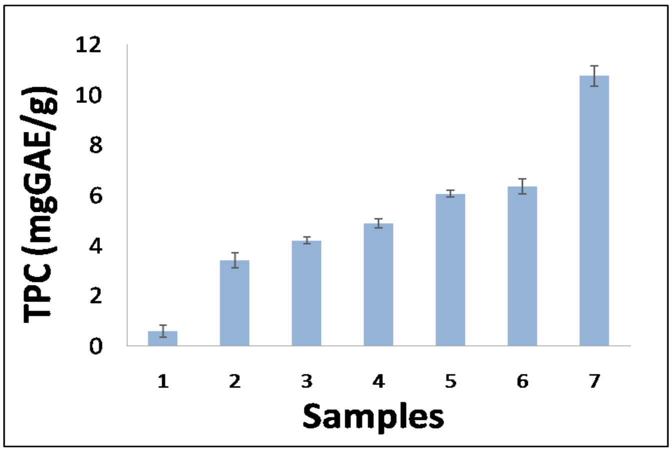

Fig 17: Variation of total phenols of different fruit bars

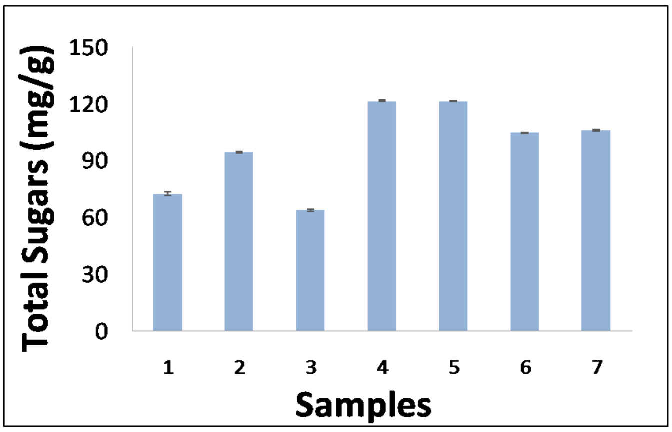

Fig 18: Variation of total sugars in different bars

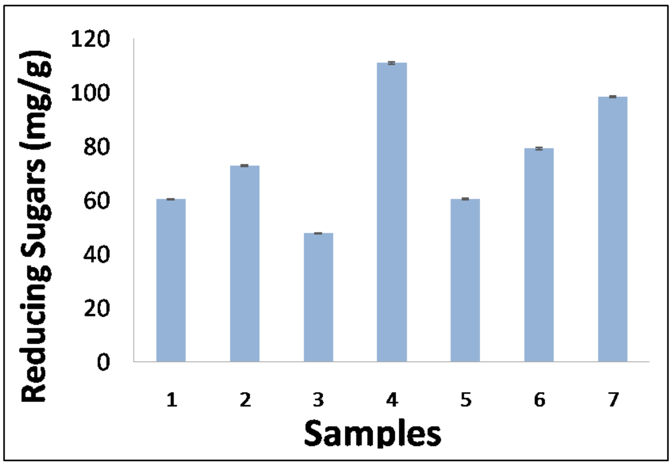

Fig 19: Variation of reducing sugars in different bar

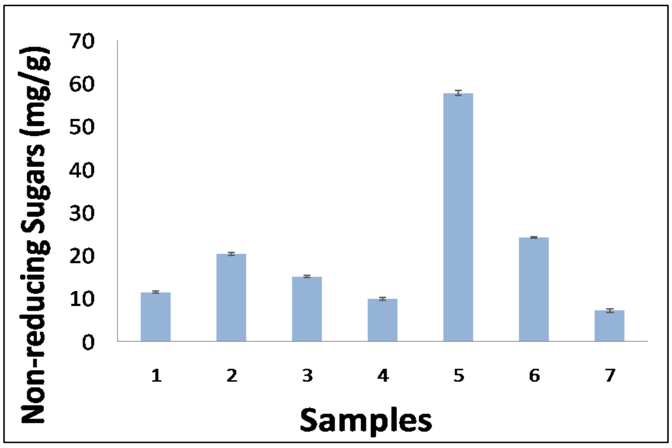

Fig 20: Graphical representation of different blend ratios on non-reducing sugars

Sensory Evaluation of Guava-Orange Fruit bar

The data of sensory evaluation is graphically represented in Fig. 21. It was observed that 100% orange blend, 50-50% and 100% guava blend was liked moderately to very much by the panel of judges on the basis of flavor of the prepared bars. It was also found that the 100% orange blend was more liked on the basis of colour, texture and appearance of fruit bars as compared to other blends. So the 100% orange blend was overall acceptable in the attributes of sensory.

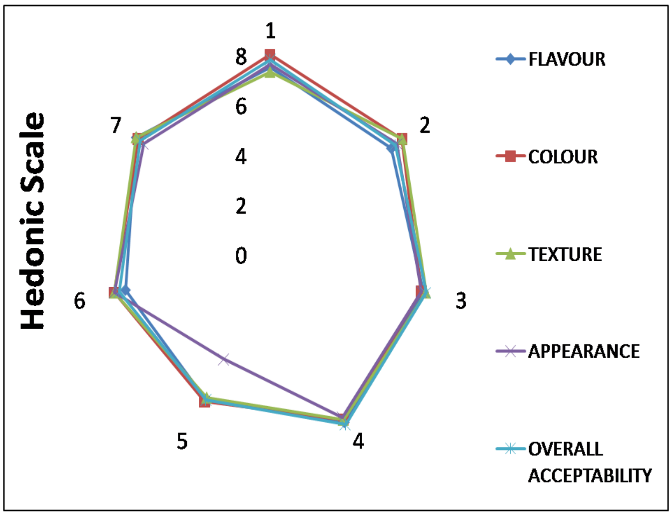

Fig 21: Graphical representation of different ratio blends on organoleptic acceptability

Table 2: Chemical Characteristics of Guava-Orange Fruit bar.

Parameters	Blended Fruit bar (Guava % - Orange %)						
	0-100*	**30-70***	**40-60***	**50-50***	**60-40***	**70-30***	**100-0***
Moisture Content (%)	12.96±0.75	19.33±0.96	14.9±0.75	14.57±0.4	16.96±0.75	19±0.8	18.13±0.32
Protein (%)	1.8±0.1	1.83±0.1	1.73±0.1	1.78±0.04	2.02±0.08	2.07±0.06	1.88±0.05
Fat (%)	2.16±0.2	2.73±0.25	1.43±0.25	4.6±0.2	4.63±0.2	4.73±0.2	3.43±0.2
Ash Content (%)	0.19±0.01	0.20±0.01	1.01±0.03	0.75±0.04	1.21±0.06	1.46±0.06	0.38±0.03
Ascorbic Acid	17.47±0.42	25.37±0.46	50.31±0.42	56.17±0.33	102.93±0.36	156.66±0.55	175.20±0.22
Total Soluble Solids	80.86±0.32	75.93±0.40	75.03±0.35	76±0.4	74.2±0.4	74.53±0.35	73.03±0.35
Titrable Acidity	0.63±0.03	0.44±0.005	0.38±0.005	0.38±0.006	0.57±0.004	0.38±0.006	0.31±0.045
Lycopene	0.23±0.02	0.25±0.002	0.27±0.006	0.23±0.02	0.28±0.01	0.28±0.003	0.29±0.02
Pectin	4.24±0.24	9.5±0.44	11.03±0.13	5.19±0.49	13.83±0.11	14.75±0.26	5.1±0.17
Total Phenols	0.57±0.24	3.39±0.30	4.18±0.13	4.86±0.18	6.04±0.13	6.33±0.30	10.73±0.40
Total Sugars	72.32±0.96	94.24±0.41	63.61±0.54	121.29±0.39	121.23±0.23	104.54±0.29	105.90±0.32
Reducing Sugar	60.22±0.22	72.78±0.31	47.61±0.27	110.77±0.43	60.28±0.29	78.98±0.35	98.31±0.32
Non-reducing Sugars	11.50±0.30	20.34±0.31	15.15±0.24	9.90±0.28	57.8±0.55	24.26±0.18	7.25±0.40

*The values are mean ± S.D. of three replicates

Summary and Conclusion

The present study concludes that the ash, protein, fat, TSS, total sugar, ascorbic acid, total phenol and pectin of guava pulp is higher than the orange pulp. The ascorbic acid, total phenols content of guava-orange fruit bar increased significantly with an increase in guava pulp concentration. The total soluble solids decreased significantly in guava-orange fruit bar as the ratio of guava pulp increases. Total sugars of guava-orange fruit bar showed significant variation throughout the blend ratios. The protein and ash content of the fruit bars decreases as compare to the contents of raw fruits which may be because of cooking process of fruit bars. Guava-orange fruit bar prepared with 50:50 (guava: orange) and 0:100 (guava: orange) was found most acceptable fruit bar.

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