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EVALUATION OF QUALITY ATTRIBUTES IN THE READY-TO-SERVE (RTS) BLEND BEVERAGE FROM STRAWBERRY (*FRAGARIA ANANASSA* DUCH.), GUAVA (*PSIDIUM GUAJAVA* LINN.) AND APPLE (*MALUS DOMESTICA* BORKH)

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ABSTRACT

A study was undertaken for preparation of ready to serve using strawberry, guava and apple with respect to pulp percentage and the processed ready to serve was analysed in CRD (Completely Randomized Design) Physico-chemical parameters *viz*. TSS, acidity, ascorbic acid, reducing sugars, non-reducing sugars and total sugars as well as organoleptic attributes *viz*, colour, flavour, taste and overall acceptability of ready to serve were evaluated at an interval of 0 months up to 4 months of storage. An overall result of fruit pulp ready to serve prepared from strawberry, guava and apple Treatment T_5 (10% blend comprising 45% strawberry pulp + 30% guava pulp + 25 apple pulp) was best compared to others treatments. Results indicate that TSS, acidity, reducing sugars, and total sugars were increasing in trend whereas ascorbic acid, non-reducing sugars, and sensory parameters were decreasing with duration of storage. The different in organoleptic quality of treatments was noticeable because of raw material combination both ambient temperature (27.1-41.9°C) and low temperature (7.9°C). Ready to serve was stored up to 4 months both ambient and low temperature without any losses in quality of organoleptic.

Key words : Fruit, RTS, Organoleptic quality, Temperature, Storage.

Introduction

Fruits and vegetables are an important nutritional requirement of human beings as these foods not only meet the quantities needs to some extent but also supply vitamins and minerals which improve the quality of the diet and maintain health. Fruit beverages are becoming increasingly popular in comparison to synthetic drinks, evidently because of their taste, flavour and nutritive value. These beverages also serve as healthy alternative for the children and elderly people who have difficulties in handling the whole fruits (Kanchan *et al*., 2020).

Strawberry (*Fragaria ananassa* Duch.) is an important fruit crop belongs to family Rosaceae and is rich source of vitamins and minerals. It is a good source of vitamin-C and contains 60 mg ascorbic acid per 100 g of pulp. The fruit contain 5 per cent total sugars, 0.9-1.8 per cent acidity in terms of maleic and citric acid, protein 0.7 g, carbohydrates 8.4 g, vitamin A 60 IU, Iron 1 g, calcium 21 mg, phosphorous 21 mg and potassium 164 mg per 100 g fruit (Sherzad *et al*., 2017). Their short post-harvest life is mainly due to their susceptibility towards mechanical injury, physiological deterioration, water loss and microbial decay (Paliyath *et al*., 2008). The post-harvest losses of strawberry fruits can be minimized by developing techniques to prepare various

value added products either in the form of whole fruit or pulp during peak harvesting season (Durrani *et al.*, 2010).

Guava (*Psidium guajava* Linn.) the poor man's fruit and apple of the tropics is a popular tree fruit of tropical and sub-tropical climate is an important fruit crops belong to the family of Myrtaceae. It contains the highest concentration of ascorbic acid (up to 228.3 mg/100 g, fresh weight). Large amounts of essential oils, triterpenes, phenols, flavonoids, saponins, lectins, fiber and pectin as well as fatty acids are also found in guava (Omayio *et al.*, 2019). By processing and preserving the fruit into various value-added products including guava juice, nectar, jam, jelly, wine, toffee and as an additive to other fruit juices or pulps, these losses of the seasonal excess of guava fruit can be avoided (Leite *et al.*, 2006).

Apple (*Malus domestica* Borkh.) belongs to family Rosaceae is an important and most widely grown temperate fruit crop in the world.It is a rich source of carbohydrates, proteins, minerals like calcium, phosphorous, iron, sugars, potassium, thiamine and vitamin B_6. Carbohydrates found in apple consist of sugars, dextrin, starch, hemicellulose, cellulose and pectic substances. The excellent nutritive and therapeutic value of apple offers great potentiality for processing it into several quality products which can attract national and international markets (Bal, 2014). There are a lot of post-harvest losses during peak production of apple because it is harvested over a limited period of time. Losses in fruit quality are mostly due to their relatively high metabolic activity during storage (Hafez and Haggag, 2007).

A variety of fruits can be used to produce the blended beverage, which has adequate palatability and is a good source of nutrients, flavour, therapeutic and nutritional qualities. The development of beverages from the blends of strawberry, guava and apple would provide the opportunities for best use of these perishable raw materials with less post-harvest loss and simultaneously availability of palatable drinks of medicinal values to the consumers. To utilize the produce at the time of glut and to save it from spoilage, the processing technology for preparation blend RTS beverage is highly required. Today's consumers expect more and more pleasure from food. They want to drink such type of beverages which should be lower in fat and sugar.

Materials and Methods

Raw materials

Strawberry (var. Winter Dawn) purchased from farmer field Sultanpur, guava (cv. Sweta) purchased from Horticultural Main Experiment Station, Department of fruit science college of Horticulture & Forestry, Acharya Narendra Deva University of Agriculture & Technology, Narendra Nagar Kumarganj, apple (var. Red delicious) purchased from local market Kumarganj were used for the preparation of RTS beverage.

Extraction of pulp of strawberry, guava and apple

The techniques used for extraction pulp of strawberry, guava and apple are shown in Figs. 1, 2 and 3, respectively.

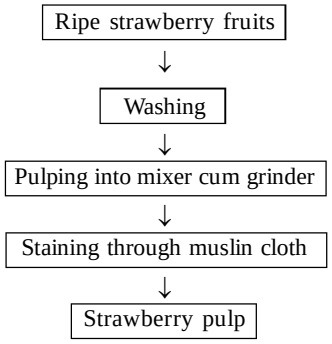

Fig. 1 : Flow chart of pulp extraction from strawberry fruit.

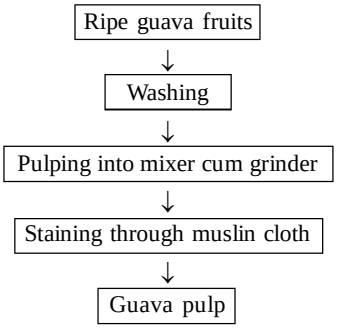

Fig. 2 : Flow chart of pulp extraction from guava fruits.

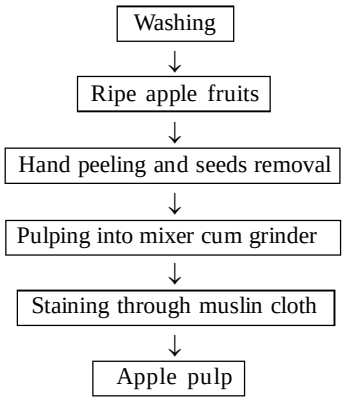

Fig. 3 : Flow chart of pulp extraction from apple fruits.

Standardization of blends for RTS

The RTS containing 10% blends, 13% TSS, 0.3% acidity and 70 ppm SO_2 were prepared from each combination (Treatment) pulp of strawberry, guava and apple to obtain best combination for delectableRTS beverages:

T_1 - 10% blend comprising 100% strawberry pulp + 0% guava pulp + 0% apple pulp with 13% TSS, 0.3% acidity and 70 ppm SO_2.

T_2 - 10% blend comprising 0% strawberry pulp + 100% guava pulp + 0% apple pulp with 13% TSS, 0.3% acidity and 70 ppm SO_2.

T_3 - 10% blend comprising 0% strawberry pulp + 0% guava pulp + 100% apple pulp with 13% TSS, 0.3% acidity and 70 ppm SO_2.

T_4 - 10% blend comprising 33.33% strawberry pulp + 33.33% guava pulp + 33.33% apple pulp with 13% TSS, 0.3% acidity and 70 ppm SO_2.

T_5 - 10% blend comprising 45% strawberry pulp + 30% guava pulp + 25% apple pulp with 13% TSS, 0.3% acidity and 70 ppm SO_2.

T_6 - 10% blend comprising 60% strawberry pulp + 25% guava pulp + 15% apple pulp with 13% TSS, 0.3% acidity and 70 ppm SO_2.

T_7 - 10% blend comprising 60% strawberry pulp + 20% guava pulp + 20% apple pulp with 13% TSS, 0.3% acidity and 70 ppm SO_2.

T_8 - 10% blend comprising 70% strawberry pulp + 15% guava pulp + 15% apple pulp with 13% TSS, 0.3% acidity and 70 ppm SO_2.

T_9 - 10% blend comprising 80% strawberry pulp + 10% guava pulp + 10% apple pulp with 13% TSS, 0.3% acidity and 70 ppm SO_2.

T_{10} - 10% blend comprising 90% strawberry pulp + 5% guava pulp + 5% apple pulp with 13% TSS, 0.3% acidity and 70 ppm SO_2.

Preparation of RTS

For the preparation of delectable RTS one litre RTS of each combination of blend containing 10% blend, 13% TSS, 0.3% acidity and 70 ppm SO_2 were prepared and organoleptically examined by the panel of nine semi trained judges to find to find the best mixing ratio of strawberry, guava and apple juice. Fig. 4 shown the flow chart followed in RTS preparation.

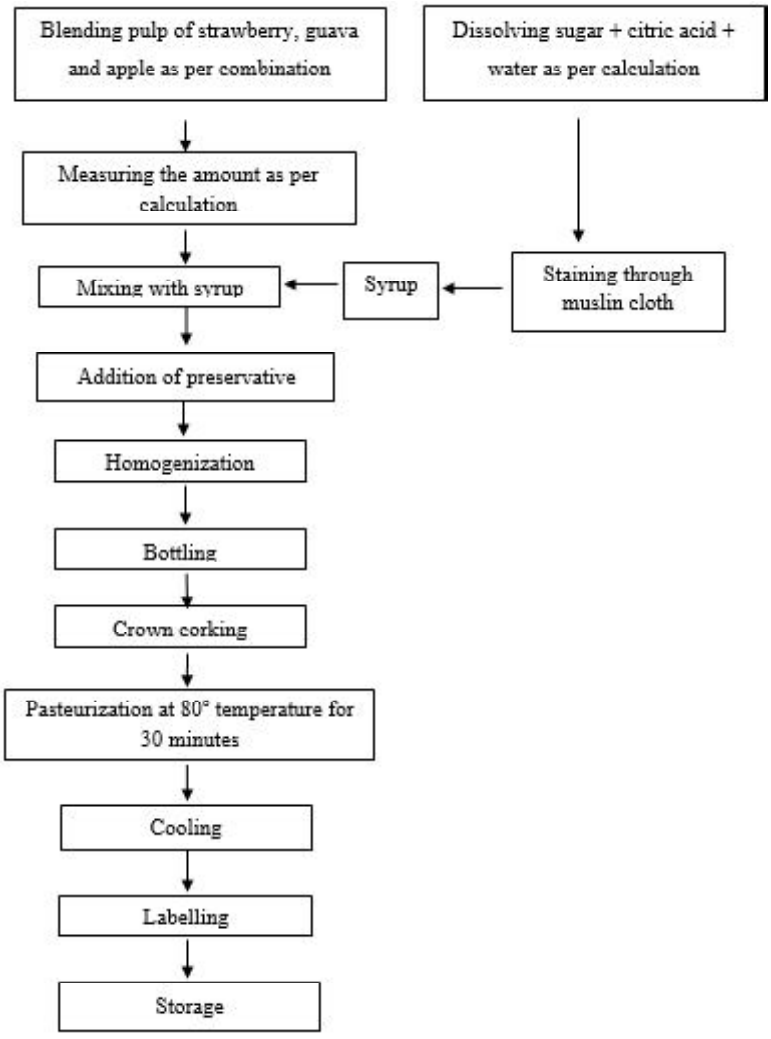

Fig. 4 : Flow chart of strawberry, guava and apple blended RTS preparation.

Storage studies

Eventually for the storability of the product 8 litters from the best combination of RTS blend was prepared, filled into 200 ml capacity of RTS bottles, leaving 2.5 cm head space, crown corked, pasteurized and kept under ambient (27.1 – 41.9°C) and refrigerated (6-9°C) temperatures. During storage observation on changes in TSS, acidity, ascorbic acid (vitamin-C), reducing sugars, non-reducing sugar, total sugars and organoleptic quality were recorded at monthly intervals during five months of storage and are described as follows.

The TSS of the samples was determined by using hand refractometer (Erma Inc. Tokyo Japan, 0-32%, 28-62% and 58-92%) in terms of percentage. The values of TSS recorded at ambient and refrigerated temperature were adjusted to 20°C with the help of reference table and the mean value of the sample was expressed as per cent TSS content. The acidity was estimated by titrating known quantity of sample titrate against 0.1N sodium hydroxide solution using phenolphthalein indicator and expressed in per cent anhydrous citric acid. Ascorbic acid content was determined by titrating known volume of aliquot prepared in 3% HPO_3 (metaphosphoric Acid) then determined by 2,6-dichlorophenol-indophenol dye solution till the appearance of pink colour. The reducing,

non-reducing and total sugars were estimated by using Fehling's solution A and B and methyl blue as an indicator in boiling stage. For the evaluation of organoleptic for assessing the colour, flavour and texture of the RTS, were conducted by a semi trained panel of nine judges, who scored on the following 9.0 point Hedonic Rating Scale.

Statistical analysis

The experiments were conducted in 3replications and the statistical analysis of the data was done as the method described by Panse and Sukhatme (1985) for CRD experiment.

Results and Discussion

Nutritional value pulp of strawberry, guava and apple

The data recorded on the chemical characteristics pulp of strawberry, guava and apple is presented in Table 1 observed that TSS, acidity, vitamin-C, reducing sugars, non-reducing sugar and total sugars of strawberry pulp used in RTS making comprised 5.00 per cent, 0.20 per cent, 56.76mg/100g, 3.17 per cent, 2.65 per cent and 5.82per cent, respectively. Similarly, Sharma *et al.* (2009) observed that strawberry fruit contains 0.52-2.26% acidity, 26-120 mg/100g ascorbic acid, 7-10.2 % TSS, and 3.3-9.1% total sugars. Guava pulp contained 7.00% TSS, 0.30% acidity, 148.35mg/100g vitamin-C, 4.45% reducing sugars, 3.10% non-reducing sugar 7.55 and total sugars and 4.48 pH, respectively. While, Khandare *et al.* (2015) revealed that guava pulp recorded 9% TSS, 4.1pH, 0.64% titrable acidity, 198.7mg/100 ml ascorbic acid, 4.21% reducing sugars, 1.37% non-reducing sugar and 5.58% total sugars. Apple contained 15.00% TSS, 0.10% acidity, 10.30mg/100g ascorbic acid, 9.96% reducing sugars, 0.30% non-reducing sugar and 10.26% total sugars respectively. Whereas, Kanchan *et al.* (2020) reported that apple juice contains 11.50^{0}Bx total soluble solids, 0.46 per cent acidity, 10.26 per cent total sugars and 10.20mg/100ml ascorbic acid.

Table 1 : Nutritional value pulp of strawberry, guava and apple.

S. no.	Chemical attributes	Mean values		
		Strawberry pulp	Guava pulp	Apple pulp
1	Total Soluble Solids (%)	5.00	7.00	15.00
2	Acidity (%)	0.20	0.30	0.10
3	Vitamin-C (mg/100g)	56.76	148.35	10.30
4	Reducing Sugars (%)	3.17	4.45	9.96
5	Non-reducing sugar (%)	2.65	3.10	0.30
6	Total Sugars	5.82	7.55	10.26

Standardization of blends for RTS

Result indicated that the treatment no.5 consisting 45% strawberry pulp + 30% guava pulp + 25% apple pulp outperformed over other treatments for preparation of delectable quality of RTS beverage. Therefore, based on findings 10% blend consisting 45% strawberry pulp, 30% guava pulp and 25% apple pulp along with 13% total soluble solids, 0.30% acidity and incorporated with 70 ppm SO_2 can be used to obtain high quality delightful RTS beverages. The variation in organoleptic quality of treatments is obvious because combinations of raw materials influence the sensory quality of products (Table 2). Manjusha *et al.* (2022) revealed that RTS beverage prepared from 40:60 guava pulp and water were found to be superior over other proportions in respect of mean scores of organoleptic. Shagiwal and Deen (2022) found that 10% blend comprising 60% strawberry pulp, 20% aloe vera gel and 20% ginger juice with 13% Total soluble solids, 0.30% acidity was best for the preparation of RTS. Sherzad *et al.* (2017) revealed that RTS prepared from 50:50 (Strawberry: Grape) blends was found to be best based on sensory scores.

Studies on storage life of prepared RTS

Data recorded on biochemical changes of RTS is presented in Tables 3 and 4 Total soluble solids of the products RTS increased gradually up to the end of the experiment under both ambient (27.1-41.9°C) as well as refrigerated (7-9°C) temperatures from 13.00% to 14.25% and from 13.00% to 13.62%, respectively. An increase in total soluble solids content in blended RTS might probably was due to the conversion of polysaccharides into sugar and also increase in total soluble solids may be due to break down of polysaccharides into monosaccharide and oligosaccharides, while decrease may be due to fermentation of sugars into ethyl alcohol, carbon dioxide and water. The conversion rate was higher in ambient temperature compare to refrigerated temperature, which might be due to temperature effects. This was reported by Harendra and Deen (2021) in mango, kagzi lime, aloe vera and ginger based blended RTS beverage, Khalid *et al.* (2019) in blend RTS beverage of strawberry and dates, Selvi*et al.* (2018) in guava, lime an ginger blended RTS beverage and Nidhi *et al.* (2007) in bael an guava blended RTS beverage. Acidity content of RTS increased continuously up to the end of storage period under both ambient and also refrigerated temperatures. It was increased from 0.20% to 0.42% and from 0.20% to 0.30% respectively. Increased on blended RTS beverage might be due to formation of organic acid by degradation of

Table 2 : Organoleptic quality of RTS prepared from various blends pulp of strawberry, guava and apple.

Treatments	Various combination of blends			Organoleptic quality	
	Strawberry pulp (%)	Guava pulp (%)	Apple pulp (%)	Score	Rating
T_1	100	Nil	Nil	8.00	Like very much
T_2	Nil	100	Nil	7.78	Like moderately
T_3	Nil	Nil	100	7.50	Like moderately
T_4	33.33	33.33	33.33	7.58	Like moderately
T_5	45	30	25	8.45	Like very much
T_6	60	25	15	7.35	Like moderately
T_7	60	20	20	7.69	Like moderately
T_8	70	15	15	7.15	Like moderately
T_9	80	10	10	7.24	Like moderately
T_{10}	90	5	5	7.29	Like moderately
SE.m ±	-			0.12	-
CD at 5%	-			0.36	-

Table 3 : Effect of ambient temperature (27.1-41.9°C) on the Total Soluble Solids (%) during storage of RTS beverages.

Storage period (Months)	TSS (%)	Acidity (%)	Vitamin-C (mg/100ml)	Reducing sugars (%)	Non-reducing sugar (%)	Total Sugars (%)	Organoleptic	
							Score	Rating
0	13.00	0.20	21.52	1.80	0.65	2.45	8.55	LVM
1	13.10	0.25	21.44	1.88	0.58	2.46	8.41	LVM
2	13.37	0.29	21.33	2.01	0.50	2.51	7.65	LM
3	13.76	0.34	21.20	2.24	0.39	2.63	7.10	LM
4	14.25	0.42	21.09	2.53	0.25	2.78	6.45	LS
SE.m±	0.19	0.003	0.01	0.02	0.007	0.04	0.13	
CD at 5 %	0.61	0.011	0.03	0.07	0.023	0.14	0.41	

LVM: Like very much, LM: Like moderately, LS: Like slightly.

ascorbic acid during storage of guava-jamun blended beverage as explained by Sharma *et al.* (2009). Similarly reported to an increase in acidity content during storage of products by Abhangrao *et al.* (2017) in guava RTS, Chavan *et al.* (2015) in mix toffee from strawberry and guava, Mehmood *et al.* (2008) in apple juice and Shakir *et al.* (2008) in mixed fruit jam of apple and pear fruit. Vitamin-C content of blend RTS prepared from strawberry, guava and apple continuously decreased during storage period and content was found to be significantly reduced from (21.52 mg/100ml to 21.09 mg/100 ml and 21.52 mg/100ml to 21.15 mg/100ml) at ambient as well as low temperatures, respectively. The reduction in ascorbic acid (vitamin-c) content might be due to oxidation of ascorbic acid into dehydro-ascorbic acid by oxygen (O_2). These losses of ascorbic acid were attributed to the effect of processing, storage time and exposure to light. Similar findings were recorded by Poonam *et al*. (2022) in guava nectar, Shagiwal and Deen (2022) in blended squash from strawberry, *Aloe vera* and ginger, Bijane *et al*. (2021) in guava syrup and Irfan *et al*. (2008) in papaya mixed RTS beverage. The decreasing trend of ascorbic acid shows that ascorbic acid content was more under low temperature conditions that might be due to temperature influence on ascorbic acid oxidation. The reducing sugars contents of RTS increased continuously up to the termination of storage period under both ambient temperature and low temperature and it was increased from 1.80% to 2.53% and from 1.80% to 2.40%, respectively. The raise in the reducing sugars is caused by the conversion of sucrose to glucose and fructose, due to temperature and acidic condition. Similar considerations were also reported by Khalid *et al*. (2019) in strawberry and dates blend ready to serve drink, Lavanya *et al.* (2018) in preparation of health drink by blending *Aloe vera*, Guava and Jamun, Mehta *et al*. (2018) in RTS beverages of guava and Rahman *et al*. (2018) in guava jam. These findings support the results of present investigation. The non-reducing sugar content of RTS showed gradual decreasing

Table 4 : Effect of refrigerated temperature (7-9°C) on the Total Soluble Solids (%) during storage of RTS beverages

Storage period (Months)	TSS (%)	Acidity (%)	Vitamin-C (mg/100ml)	Reducing sugars (%)	Non-reducing sugar (%)	Total Sugars (%)	Organoleptic	
							Score	Rating
0	13.00	0.20	21.52	1.80	0.65	2.45	8.55	LVM
1	13.05	0.21	21.49	1.85	0.60	2.45	8.46	LVM
2	13.17	0.23	21.40	1.96	0.53	2.49	8.28	LVM
3	13.28	0.25	21.29	2.15	0.44	2.59	7.88	LM
4	13.62	0.30	21.15	2.40	0.30	2.70	7.37	LM
SE.m±	0.33	0.006	0.01	0.34	0.007	0.02	0.11	
CD at 5 %	0.12	0.02	0.04	0.11	0.024	0.09	0.34	

LVM: Like very much, LM: Like moderately.

trend stored under ambient temperature (From 0.65% to 0.25%) and refrigerated temperature (From 0.65% to 0.30%). Contrary to reducing and total sugars, the non-reducing sugar of blended RTS decreased continuously throughout the entire period of storage which might be due of inversion. Similarlyobservations were observed by Gaikwad *et al*. (2022) in guava nectar blended with Anola and Tulsi extract, Hameed *et al*. (2019) in apple juice, Shagiwal and Deen (2022) in blended RTS beverage from strawberry, aloe vera and ginger and Kefayatullah *et al.* (2019) in strawberry squash. The total sugars content of RTS increased gradually from 2.45% to 2.78% and from 2.45% to 2.70 % during storage period under ambient as well as low temperatures, respectively. The increase in total sugars of products might be due to inversion of non-reducing sugar into reducing sugars and also the increased level of total sugar was probably due to conversion of starch and pectin into simple sugars (Kesharwani *et al*., 2015) and more increase might be due to the faster rate of reaction because of high temperature in ambient conditions. The present results on increase of total sugars is also similar to findings of different fruits based beverages, Kumar *et al.* (2022) in RTS beverage from bael, Singh *et al*. (2019) in guava and apple ber cheese, Lavanya and Vaghashiya (2018) in blended Aloe vera, Rashid *et al.* (2018) in guava RTS beverage, Selvi *et al.* (2018) in guava-lime-ginger ready to serve (RTS) beverage and Hamid *et al.* (2017) in ready-to-serve (RTS) beverage from underutilized mulberry. The Organoleptic quality score of RTS decreased continuously with increase storage period and it was acceptable up to 4 months of storage under ambient and refrigerated conditions. It was reduced from 8.55to 6.45 and from 8.55to7.37, respectively. It might be cause of temperature, because temperature plays an important role in biochemical changes that leads to development of off flavour as well as discolouration in the beverages. The reduction in organoleptic quality are also reported in previous studies performed by Kumar *et al.* (2022) in bael RTS beverage, Kadge *et al*. (2020) in lime blended bael syrup, Rani *et al.* (2018) in mandarin and strawberry mixed fruit juice, Selvi *et al.* (2018) in guava-lime-ginger ready (RTS) beverage, Shabi *et al.* (2018) in guava chees, Abhangrao *et al.* (2017) in guava RTS, Singh *et al.* (2017) in bael preserve and candy and Pasupuleti and Kulkarni, (2014) in guava beverage.

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Conclusion

The result obtained in present investigation that RTS prepared form 10 per cent of blend consisting 45% strawberry, 30 percent guava pulp and 25 percent apple pulp adjusted to 13 percent TSS and 0.3 percent acidity with 70 percent SO_2 (T5) was found best on Hedonic Scale by the panel of semi trained judges. The TSS, acidity, reducing sugars and total sugars was increased, whereas vitamin-C, non-reducing sugar and organoleptic quality was decreased during storage under both ambient (27.1-41.9°C) and refrigerated (6-9°C) temperatures. The RTS beverage can be stored with acceptable quality up to 4 months under both ambient as well as refrigerated temperatures.

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