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Evaluation of Quality Attributes in the Nectar Blend Beverage from Strawberry (*Fragaria ananassa* Duch.), Guava (*Psidium guajava* Linn.) and Apple (*Malus domestica* Borkh)

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Abstract

An experiment was conducted to prepare nectar beverage by blending strawberry, guava and apple. Juice of Strawberry, guava and apple were mixed in different combinations viz., 100:0:0 (T1), 0:100:0 (T2), 0:0:100 (T3), 33.33:33.33:33.33 (T4), 45:30:25 (T5): 60:25:15 (T6), 60:20:20 (T7), 70:15:15 (T8), 80:10:10 (T9) and 90:5:5 (T10) and sugar, citric acid, distilled water and Sulphur dioxide were mixed considering the recommendations for nectar beverages. T_5 (20% blend comprising 45% strawberry pulp + 30% guava pulp + 25 apple pulp) was found best compared to other treatments. And the selected combination was evaluated for its physico-chemical and sensory qualities. During the storage period under both ambient temperature (27.1-41.9 °C) and low temperature (7.9 °C), TSS, acidity, reducing sugars, and total sugars were increasing in trend whereas ascorbic acid, non-reducing sugar, and sensory parameters were decreasing with duration of storage. Nectar was stored up to 4 months both ambient and low temperature without any losses in quality of organoleptic.

Keywords: Fruit, Nectar, Organoleptic Quality, Temperature, Storage

1. Introduction

The perishable fruits and vegetables are available as seasonal surpluses during certain parts of the year in different regions and are wasted in large quantities due the absence of facilities and know-how for proper handling, distribution, marketing and storage. The main objective of fruit and vegetable processing is to supply wholesome, safe, nutritious and acceptable food to consumers throughout the year and that can be achieved through value addition products like, squash, jams, tomato sauces, pickle, etc., besides earning foreign exchange by exporting finished or semi-processed products (Srivastava and Kumar, 2020).

Strawberry (*Fragaria ananassa* Duch.) is an important fruit crop belongs to family Rosaceae and is a good source of vitamin-C and contains 60 mg ascorbic acid per100 g of pulp. The fruits are consumed mostly fresh. However, various products like jam, jelly, fruit juice, piece, syrup, candy, ice-cream, preserve etc. are prepared, appealing colour and pleasing flavour enhanced the requirement of juice of strawberry in the last ten years (Sherzad *et al*., 2017). 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. Food industry considering new ingredients for developing new commercial food products. In this regard fruits of strawberry probably have appealing colour and better taste along with bioactive compounds (Durrani *et al*., 2010).

Guava (*Psidium guajava* Linn.) also known as "apple of tropics" is an important fruit crops belong to the family of Myrtaceae. It has significant minerals levels, including calcium, phosphorous, iron and vitamins such as niacin, pantothenic acid, thiamin, riboflavin and vitamin A. Guava contains both polyphenolic compounds and carotenoids that give antioxidant property to the fruit making it one of the fruit with highest antioxidant values (Omayio *et al*., 2019). Around 60% of the carbohydrates are sugars, with a predominance of fructose (about 59 %), followed by 35% glucose and 5% sucrose (Yusof, 2003).

Apple (*Malus domestica* Borkh.) is an important crop most widely grown temperate region in the world. And most frequently consumed fruits in many regions across the world, constituting and important part of the human diet as a source of sugars, minerals and dietary fibres (Boetret *et al*., 2012). Although, India ranks 10th in apple production in the world and the productivity is still very low as compared to many advanced countries yet, it is an important fruit of India in terms of economic values. Total area under apple cultivation in India is 301 thousand hectares with an annual production of 2327 thousand metric tons (NHB, 2018). Apples are good source of soluble fibres and phytochemical like flavonoids which impart anti-oxidant, anti-cancer, anti-neurodegenerative and anti-obesity activities (Lee, 2012, Rana and Bhushan, 2016).

Therefore, the present study was conducted to extend the shelf life and 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.

Materials and Methods A. Raw Materials

Strawberry (var. Winter Dawn) Procured 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, Kumarganj, and fully matured and ripe apple (var. Red delicious) free from mechanical damage,

bruises and fungal attack were obtained from local market Kumarganj were used for the preparation of nectar with different pulp concentration.

Extraction Pulp of Strawberry, Guava and Apple

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

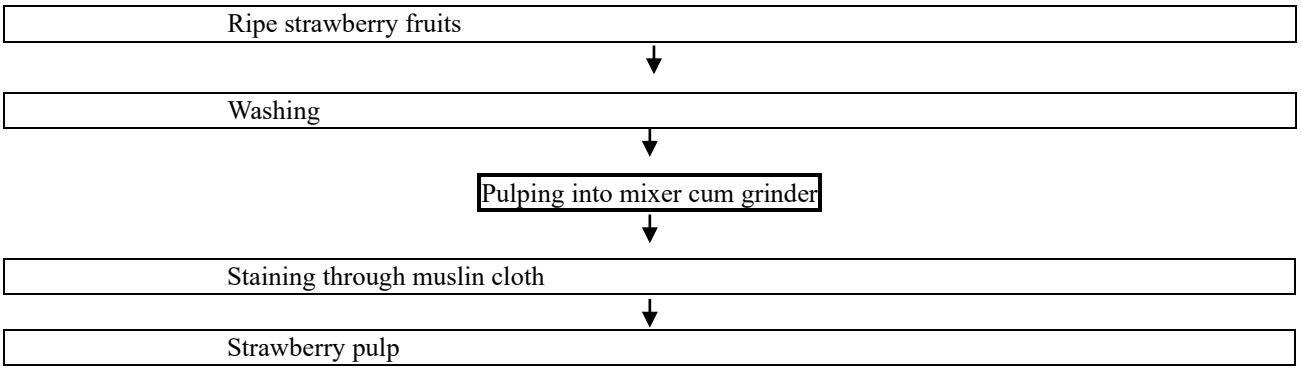

FIG 1: FLOW CHART OF PULP EXTRACTION FROM STRAWBERRY FRUIT

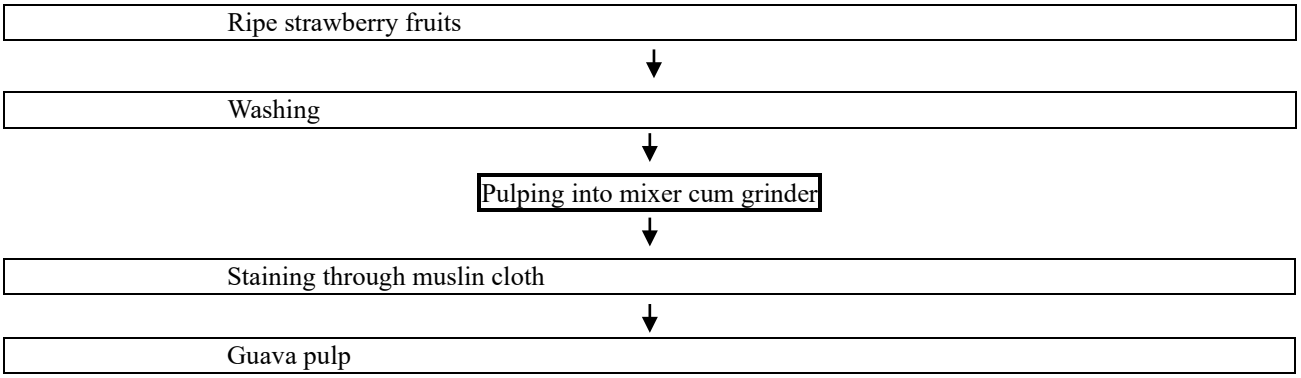

Fig 2: FLOW CHART OF PULP EXTRACTION FROM GUAVA FRUITS

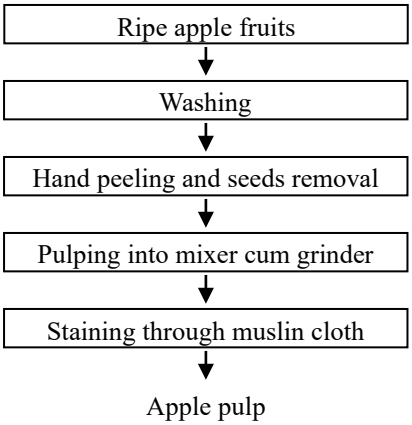

FIG 3: FLOW CHART OF PULP EXTRACTION FROM APPLE FRUITS

B. Standardization of blends for Nectar

The following combination treatment were observed to determine the optimal combination for the preparation and examine of delectable nectar beverages, the nectar comprising 20% blends, 15% TSS, 0.3% acidity and 70 ppm SO_2 was prepared from various combinations pulp of strawberry, guava and apple to observe the best combination from the following combination treatments:

T_1 - 20% blend comprising 100% strawberry pulp + 0% guava pulp + 0% apple pulp with 15% TSS, 0.3% acidity and 70 ppm SO_2.

T_2 - 20% blend comprising 0% strawberry pulp + 100% guava pulp + 0% apple pulp with 15% TSS, 0.3% acidity and 70 ppm SO_2.

T_3 - 20% blend comprising 0% strawberry pulp + 0% guava pulp + 100% apple pulp with 15% TSS, 0.3% acidity and 70 ppm SO_2.

T_4 - 20% blend comprising 33.33% strawberry pulp + 33.33% guava pulp + 33.33% apple pulp with 15% TSS, 0.3% acidity and 70 ppm SO_2.

T_5 - 20% blend comprising 45% strawberry pulp + 30% guava pulp + 25% apple pulp with 15% TSS, 0.3% acidity and 70 ppm SO_2.

T_6 - 20% blend comprising 60% strawberry pulp + 25% guava pulp + 15% apple pulp with 15% TSS, 0.3% acidity and 70 ppm SO_2.

T_7 - 20% blend comprising 60% strawberry pulp + 20% guava pulp + 20% apple pulp with 15% TSS, 0.3% acidity and 70 ppm SO_2.

T_8 - 20% blend comprising 70% strawberry pulp + 15% guava pulp + 15% apple pulp with 15% TSS, 0.3% acidity and 70 ppm SO_2.

T_9 - 20% blend comprising 80% strawberry pulp + 10% guava pulp + 10% apple pulp with 15% TSS, 0.3% acidity and 70 ppm SO_2.

T_{10} - 20% blend comprising 90% strawberry pulp + 5% guava pulp + 5% apple pulp with 15% TSS, 0.3 % acidity and 70 ppm SO_2.

C. Preparation of Nectar

In order to prepare delicious nectar beverage, A flow chart for the nectar preparation process is presented in Fig.-4. One litre of each combination of blend comprising 20 % blend, 15 % TSS, 0.3 % acidity and 70 ppm SO_2 was prepared and organoleptically evaluated by a panel of nine semi trained judges to determine which blend combination was best.

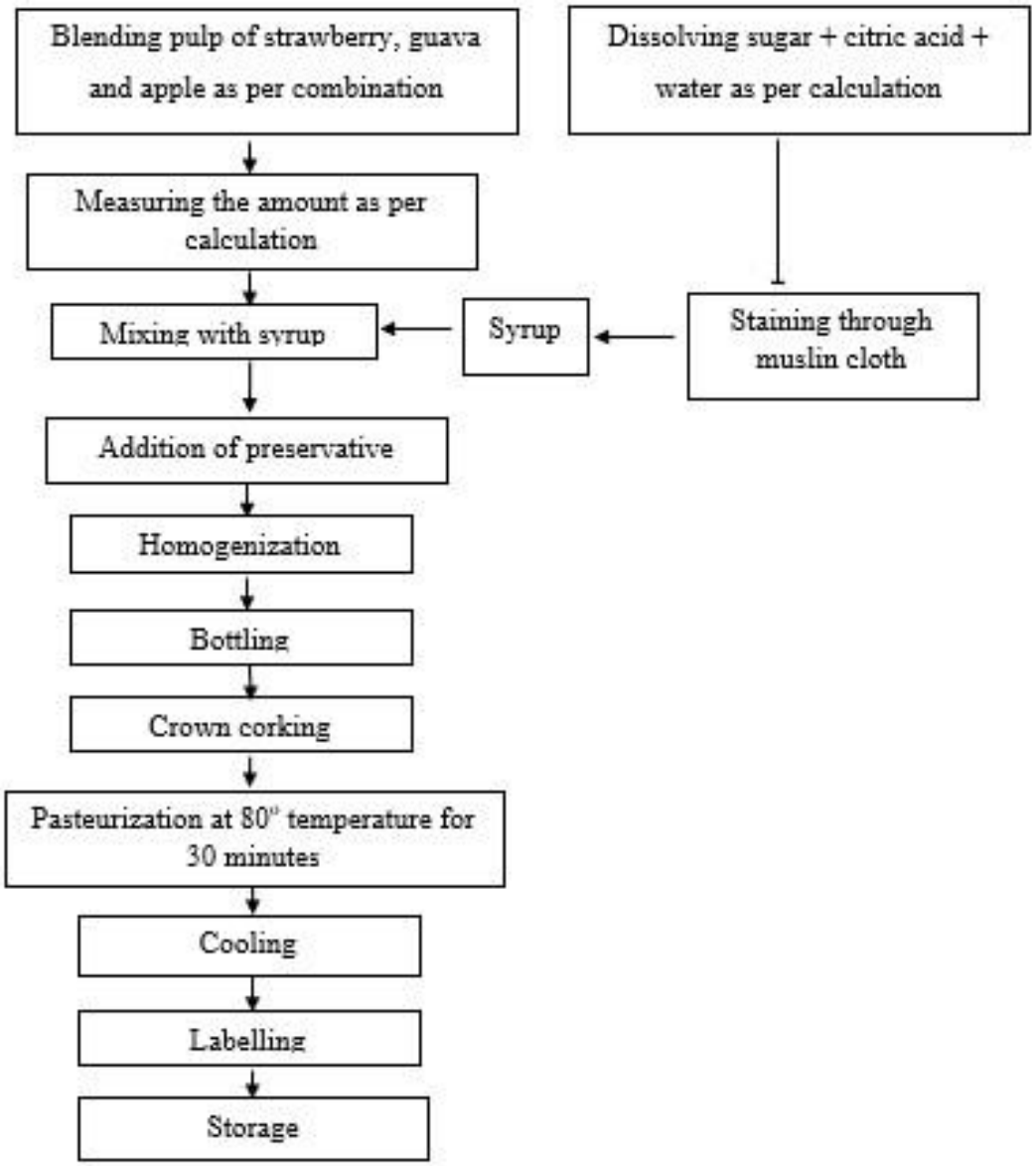

FIG 4: FLOW CHART FOR THE PREPARATION OF STRAWBERRY, GUAVA AND APPLE BLENDED NECTAR

D. Storage studies

In the end eight litters of the best nectar blend beverage were 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 ºC) temperatures. Under storage condition, physico-chemical qualities of consumer accepted nectar beverage of strawberry, guava and apple were measured for TSS, titrable acidity, ascorbic acid, reducing sugars, non-reducing sugar, total sugars and organoleptic quality for 4th months at monthly interval. Sensory qualities were measured using 9.0 point hedonic scale with

30 semi-trained panel members. (Score 1 is for "dislike extremely" and 9 for "like extremlay"). The TSS of the samples was determined by using hand refractometer and result was expressed in terms of percentage. The acidity of samples was estimated by titrating known quantity of sample titrate against 0.1N sodium hydroxide solution using phenolphthalein indicator in accordance with AOAC (1970) Ascorbic acid content was determined by titrating method using 2,6dichlorophenol-indophenol dye as recommended by (Ranganna 2010). The reducing, non-reducing and total sugars were estimated by using Fehling's solution A and B as well as methyl blue as an indicator during the boiling stage. For the evaluation of organoleptic for assessing the colour, flavour and texture of the nectar, were conducted by a semi trained panel of nine judges, who scored on the following 9.0 point Hedonic Rating Scale.

E. Statistical analysis

The experiments were conducted in 3 replications 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 no.1 observed that TSS, acidity, vitamin-C, reducing sugars, non-reducing sugar, and total sugars of strawberry pulp used in nectar making comprised 5.00 per cent, 0.20 per cent, 56.76mg/100g, 3.17per cent, 2.65per cent and 5.82per cent respectively. Similarly Chavan *et al.* (2015) revealed that fresh toffees from guava and strawberry pulp contained on an average moisture 8.73 %, TSS 83.21ºBrix, titrable acidity 0.3%, total sugars 73.1 % and ascorbic acid 64.1 mg/100 g. 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. Kadam *et al.* (2012) reported that fresh pulp of guava fruit content 7.5 % total soluble solids, 0.34 % acidity, and 41.5 mg/ 100g ascorbic acid respectively. 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, Atashi *et al*. (2015) concluded that between two cultivar, that vitamin-C content of Red Delicious (227.8 mg/100g) was higher than Golden Delicious (161.46 mg/100g).

Standardization of Blends for Nectar

The result showed treatment no. 5 which included 45% strawberry pulp + 30% guava pulp + 25% apple pulp performed better than other treatments for preparation of delectable quality of nectar beverage. Therefore, based on findings 20% blend consisting 45% strawberry pulp, 30% guava pulp and 25% apple pulp along with 15% total soluble solids, 0.30% acidity and incorporated with 70 ppm SO_2 can be used to obtain high quality delightful nectar beverages. Because of different combinations of raw materials affect the sensory quality of products, there is a clear variance in the organoleptic quality of treatments (Table-2). Jolhe *et al.* (2020) noticed that the colour and appearance, texture, taste, overall acceptability score of 9 cv. Lalit treatment combination T_3 (100% juice + 3g citric acid + 750g sugar) was found to be the superior than others. Khalid *et al.* (2019) reported that organoleptically score was found finest among all other combinations of RTS to serve drink in strawberry and dates blend ready to serve drink in ratio (7:3) + 0.01% sodium benzoate as preservative and mixed 20% with 10ºbrix sugar solution of calculated value in storage of three months with gap of 15 days at ambient temperature. Gautam (2015) mentioned on his research that organoleptic score decreased in guava and aloe vera blended beverages during storage period.

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

Studies on Storage Life of Prepared Nectar Beverage

The biochemical alteration of nectar is presented in Table -3 and Table-4 Total soluble solids increased gradually up to the end of the experiment under both ambient (27.1-41.9 °C) as well as refrigerated (7-9 ºC) temperatures rising from 15.00% to 15.92% and from 15.00% to 15.49% respectively. An increase in total soluble solids content in blended nectar beverage might probably was due to the conversion of polysaccharides into sugar. The conversion rate was higher in ambient temperature compare to refrigerated temperature, which might be due to temperature effects. This was reported by Poonam *et al*. (2022) in guava nectar beverage from different cvs. Lalit, L-49, Shewta and Gwalior-2, Singh *et al.* (2019) in blend nectar beverage of guava and aloe vera, Chandel *et al.* (2018) in guava nectar. Acidity content of nectar increased continuously up to the end of storage period under both ambient and also refrigerated temperatures. It was increased from 0.20% to 0.39% and from 0.20% to 0.33% respectively. Increased on blended nectar beverage might be due to formation of organic acid by degradation of 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 Ahmad *et al.* (2014) in guava nectar, Bal *et al.* (2014) in guava nectar beverage, Shinde *et al.* (2014) in carambola nectar, and Jain *et al.* (2007) in aonla nectar. Vitamin-C content of blend nectar beverage prepared from strawberry, guava and apple continuously decreased during storage period and content was found to be significantly reduced from (10.77 mg/100ml to 10.33 mg/100 ml and 10.77 mg/100ml to 10.40 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 (O2). These losses of ascorbic acid were attributed to the effect of processing, storage time and exposure to light. Similar findings were recorded by Byanna and Gowda (2012) in sweet orange cv. Sathgudi

nectar beverage, Choudhary and Dikshit (2006) in guava nectar, El-Mansy *et al.* (2005) in mango and papaya blended nectar beverage, and Yadav *et al.* (2022) in blended squash of watermelon and sugar beet. The reducing sugars contents of nectar increased continuously up to the termination of storage period under both ambient temperature and low temperature and it was increased from 0.88% to 1.60% and from 0.88% to 1.43% 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 Sherzad *et al.* (2017) in strawberry blended squash beverage, Malav *et al.* (2018), in orange, pomegranate, aonla and ginger juice blended RTS beverage, and Jakhar (2008) in blended RTS of ber and jamun beverage. These findings support the results of present investigation. The nonreducing sugar content of RTS showed gradual decreasing trend stored under ambient temperature (From 0.40% to 0.01%) and refrigerated temperature (From 0.40% to 0.09%). 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. Similarly observations were observed by Tiwari and Deen. (2012) in Bael and Aloe vera blended RTS beverage, Hossain *et al.* (2015) in Strawberry squash, 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 nectar increased gradually from 1.28% to 1.61% and from 1.28% to 1.52 % 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, Selvi *et al.* (2018) in guava, lime and ginger RTS beverage, Lavanya and Chauhan *et al*. (2016) in Bael RTS beverage, Chalk *et al.* (2012) in RTS beverage of fallen unripe mango, and Hamid *et al.* (2017) in ready-to-serve (RTS) beverage from underutilized mulberry. The Organoleptic quality score of nectar 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 8.80 to 7.23 and from 8.80 to 7.46, 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 Kadge *et al.* (2020) in lime blended bael syrup, Byanna and Doreyappa Gowda (2012) in sweet orange and pomegranate blended RTS beverage, Jakhar *et al.* (2012) in guava and Barbados cherry (RTS) beverage, Abhangrao *et al.* (2017) in guava RTS, Shabi *et al.* (2018) in guava chees, Kalsi and Dhawan (2001) in guava fruit bar and Choudhary *et al.* (2008) in guava nectar beverage.

TABLE 2: ORGANOLEPTIC QUALITY OF NECTAR 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	8.50	Like very much
T_2	Nil	100	Nil	7.77	Like moderately
T_3	Nil	Nil	100	7.69	Like moderately
T_4	33.33	33.33	33.33	7.59	Like moderately
T_5	45	30	25	8.80	Liege very much
T_6	60	25	15	7.25	Like moderately
T_7	60	20	20	7.71	like moderately
T_8	70	15	15	7.73	Like moderately
T_9	80	10	10	7.35	Like moderately
T_{10}	90	5	5	7.20	Like moderately
SE.m±	-			**0.12**	-

CD at 5%	-	**0.35**	-

TABLE 3: CHANGES IN THE CHEMICAL CONSTITUENTS OF THE BLEND SQUASH UNDER AMBIENT TEMPERATURE (27.1-41.9 ^{O}C)

Storage period (Months)	TSS (%)	Acidity (%)	Vitamin-C (mg/100ml)	Reducing sugars (%)	Nonreducing sugar (%)	Total Sugars (%)	Organoleptic	
							Score	Rating
0	15.00	0.20	10.77	0.88	0.40	1.28	8.80	LVM
1	15.15	0.23	10.69	0.99	0.35	1.34	8.76	LVM
2	15.35	0.27	10.54	1.18	0.24	1.42	8.21	LVM
3	15.62	0.31	10.42	1.38	0.15	1.53	7.77	LM
4	15.92	0.39	10.33	1.60	0.01	1.61	7.23	LM
SE.m±	0.02	0.006	0.008	0.02	0.006	0.01	0.81	
CD at 5%	0.07	0.019	0.02	0.07	0.01	0.06	0.25	

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

TABLE 4: CHANGES IN THE CHEMICAL CONSTITUENTS OF THE BLEND SQUASH UNDER AMBIENT REFRIGERATED TEMPERATURE (7-9 ^{O}C)

Storage period (Months)	TSS (%)	Acidity (%)	Vitamin-C (mg/100ml)	Reducing sugars (%)	Nonreducing sugar (%)	Total Sugars (%)	Organoleptic	
							Score	Rating
0	15.00	0.20	10.77	0.88	0.40	1.28	8.80	LVM
1	15.04	0.22	10.72	0.93	0.38	1.31	8.79	LVM
2	15.11	0.25	10.65	1.09	0.29	1.38	8.45	LVM
3	15.26	0.28	10.53	1.28	0.20	1.45	8.14	LVM
4	15.49	0.33	10.40	1.43	0.09	1.52	7.46	LM
SE.m±	0.01	0.004	0.01	0.01	0.01	0.01	0.15	
CD at 5%	0.03	0.014	0.02	0.03	0.03	0.05	0.47	

LVM: Like very much, LM: Like moderately.

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Conclusion

The result obtained in present investigation that nectar beverage prepared by using 20 per cent of blend consisting 45% strawberry, 30 per cent guava pulp and 25 per cent apple pulp adjusted to 13 per cent TSS and 0.3 per cent acidity with 70 per cent SO_2 (T5) received high score based 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 (27.1-41.9ºC) and refrigerated (6-9ºC) temperatures. **Data Availability Statement**

Data is contained within the article

Funding Statement

The authors did not receive support from any organization for the submitted work.

Authors Contribution Statement

All authors contributed to the study conception and design, Material preparation, data collection and analysis were performed by (Rahmat Gul Hassanzai), (Bhau Pratap), and (Hitesh Kumar). The first draft of the manuscript was written by (Rahmat Gul Hassanzai) and all authors commented on previous version of the manuscript. All authors read and approved the final manuscript.

Authors Contributions

Conceptualization, (Rahmat Gul Hassanzai, Bhau Pratap, and Hitesh Kumar); Methodology); Methodology (Rahmat Gul Hassanzai, Bhau Pratap); Formal analysis and investigation, (Rahmat Gul Hassanzai, and Hitesh Kumar); Writing – original draft preparation (Rahmat Gul Hassanzai); writing review and editing (Rahmat Gul Hassanzai, and Hitesh Kumar), Funding acquisition), ((Rahmat Gul Hassanzai, Bhau Pratap, and Hitesh Kumar); Super vision (Bhanu Pratap). All the authors have read and agreed to the published vision of the manuscript. **Conflict of Interest**

The authors declare no conflict of interest

Authors Consent:

Respected Sir/ Madam

Sub. Submission of manuscript for Publication in African Journal of Biological Science.

I hereby submitting the manuscript for publication in African Journal of Biological Science. I assure that this manuscript has neither been published in any other journal. I and on behalf of other authors, I declare no conflict of interest. Kindly consider the manuscript for publication on your journal. I abide all rules and regulation of the journal. In future if any litigation arises in this article I will cooperate with the editor to resolve the issue. I accept the decision of the editor would be final.

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