Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.2547

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (1):** 338-348 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Standardization of Product Development Protocol of Strawberry (*Fragaria ananassa*) Based Blended Nectar Beverage and Its Storage

Rashad Ahmad Sherzad*, K. N. Sreenivas, G. K. Sadananda, H. Mohamad Tayeeb Ulla and Sayed Esmail

Department of Postharvest Technology, College of Horticulture, UHS Campus, Bengaluru, Karnataka, India

*Corresponding Author E-mail: rashad20sherzad@gmail.com

Received: 5.02.2017 | Revised: 12.02.2017 | Accepted: 16.02.2017

ABSTRACT

Strawberry blended nectar beverages was developed by blending with muskmelon, grape, ginger and lime juices, prepared Product were stored at ambient (28±3ºC) and refrigerated temperature (4ºC) for 120 days period. At the end of 120 days of storage, the nectar beverage prepared with 20% blended juice with 15ºB TSS and 0.3% acidity (T_7) was found to be best as compared to other recipes (treatments). The biochemical constituents like total sugar was increased from 12.42 per cent to 15.55 per cent and 12.42 per cent to 15.13 per cent, TSS from 15ºB to 18.20ºB and 15ºB to 17.61ºB, p^H from 3.78 to 3.94 p^H and 3.78 to 3.88 p^H in ambient and refrigerated conditions, respectively, during storage, while, anthocyanin were decreased from 2.90 to 1.58 mg $100g^{-1}$ and 2.90 to 2.29 mg $100g^{-1}$ while, ascorbic acid from 72.00 to 54.00 mg $100g^{-1}$ and 72.00 to 63.00 mg $100g^{-1}$, titratable acidity from 0.3% to 0.25% and 0.3% to 0.27% decreased in ambient and refrigerated conditions, respectively. The product was free from spoilage microbes during storage study.

Key words: *Strawberry, Nectar, Blend, Beverage, Ambient, Refrigerated, Storage*

INTRODUCTION

Strawberry (*Fragaria ananassa)* is an important fruit crop belong to family rosaceae and is rich source of vitamin C, sugar, organic acids, anthocyanin, phosphorus, iron, flavonoids, fructose, glucose, sucrose, malic acid, and other minerals. It is characterized by fruity, sweet and tart flavor and it is widely appreciated for its characteristic aroma, bright red fruit color and juicy texture. It is consumed in large quantities, either as fresh or in prepared foods such as preserves, fruit juice, pies, ice creams, milkshakes, and chocolates. Also it is utilized for the production of purees, juice concentrate, juice, jams, preserves and red wine alone or in combination with other fruits[1]. Artificial strawberry flavorings and aromas are also widely used in many products like lip gloss, candy, hand sanitizers, perfume and many others.

Cite this article: Sherzad, R.A., Sreenivas, K.N., Sadananda, G.K., Ulla, H.M.T and Esmail, S., Standardization of Product Development Protocol of Strawberry (*Fragaria ananassa*) Based Blended Nectar Beverage and Its Storage, *Int. J. Pure App. Biosci.* **5(1):** 338-348 (2017). doi: http://dx.doi.org/10.18782/2320-7051.2547

Certain studies have suggested that strawberry consumption may have beneficial effects in humans such as lowering blood Low- density lipoprotein (LDL) cholesterol levels, total cholesterol, reducing the oxidation of LDL cholesterol, and decreasing the spike in blood sugar after high sugar meals and the spike in blood cholesterol seen after high-fat meals[2]. Grapes most important, delicious and refreshing sub-tropical fruit of the world also grown successfully in the tropical and temperate areas of the world and are grown for its juicy and tasty berries. It is a nutritive and palatable desert fruit. The berries are good source of sugar, acid, minerals like Ca, Mg and Fe and vitamins like B_1, B_2 and C. Grapes most important, delicious and refreshing sub-tropical fruit of the world also grown successfully in the tropical and temperate areas of the world are used as table fruit they are used for making wine, juice and raisin.

There are a number of bioactive compounds which are responsible for providing various medicinal properties of ginger. The major bioactive constituents in ginger are gingerols, of which 6-gingerol is the most abundant. It exhibits a significant potential due to its antibiotic, antioxidant, hypoglycemic, hypotensive, anti-inflammatory, lipid lowering, antiplatelet aggregation, and chemo preventive properties[3]. Limes (*Citrus aurantifolia*), are acidic in nature and serve as rich source of vitamin C, citric acid, sugar, certain minerals like calcium and phosphorus, it finds its importance for its acidic sour juice which is preferred for ingestion along with water. Acidic juice of lime facilitates the lipid and alcohol absorption and neutralizes excessive bile produced by the liver and reduces gastric acidity by counteracting with the effects of greasy food[4].

With the health benefits and nutraceutical properties with the bioactive ingredients which protect or promote health in addition to providing traditional nutrients. In order to fulfil the human needs, the blend of ancient knowledge of medicine, modern nutritional sciences and phytonutrient technology, there is need for the creation of a winning synergistic formation which has universal appeal and taste sensation. To have a healthy living, efforts are made to develop the products by blending constituents of highly useful, cost effective plants such as strawberry, grape, muskmelon, lime and ginger in an accepted manner. Therefore, the order of the day is to process them into value added products, attempts were made to develop the recipe for preparing consumer acceptable products.

MATERIAL AND METHODS

The investigation was carried out at department of post-harvest technology, college of horticulture, university of horticultural sciences campus, gandhi krishi vignana kendra, bangalore, during the year 2014-2015.

Raw Materials:

The raw material required for experiment like Strawberry, Grape, Muskmelon, Lime and Ginger were obtained from Horticulture Produce Cooperative Marketing Society (HOPCOMS), Lalbagh, and Bengaluru. Fruits which were healthy and uniformly ripe, free from injuries, pests and diseases were selected and utilized in the present investigation for the development of product.

Extraction of Fruit Juice:

Strawberry fruits of uniform colour, size and shape were selected and thoroughly washed in clean water, thee fruits were blended in a mixer grinder. The muskmelon fruit was washed and then peeled. Than the fruits were cut into halves and the seeds were removed and then the juice was extracted using JM Series Colloid Miller machine.

Grape berries of uniform colour, size and shape were selected. The berries were separated from rachis. The diseased and immature berries were removed. Juice was extracted from berries by JM Series Colloid Miller machine and sieved to remove the seed and skin from juice. Clear juice was obtained by blending and sieving. Fresh limes were washed in clean water and they were cut into two halves. Then the juice was extracted by using lime squeezer.

Ginger rhizomes were washed in clean water and the skin was peeled off by using a

sharp stainless steel knife. The rhizomes were cut into small pieces and were crushed in mixer grinder and the juice was extracted from JM Series Colloid Miller machine. The juice was extracted in the ratio of 1:2 (ginger and water).

The blended juice used for the preparation of products was prepared by mixing strawberry with muskmelon, grape, ginger and lime juice of difference pulp concentration. The blended juice was used for preparation of nectar as per the following recipes:

Recipe for Nectar:

	Treatments details	Juice base (%)	Juice ratio (%)					TSS°B	Acidity (%)
			S	G	M	L	GI		
T_1	Juice blend 60:40 % S: M	20	60	-	40	-	-	15	0.3
T_2	45:40:10:5 % S: M: L: GI	20	45	-	40	10	5	15	0.3
T_3	45:40:10:5 % S: G: L: GI	20	45	40	-	10	5	15	0.3
T_4	40:45:10:5 % S: M: L: GI	20	40	-	45	10	5	15	0.3
T_5	60:40 % S: G	20	60	40	-	-	-	15	0.3
T_6	40:15:30: 10:5 % S: G: M: L: GI	20	40	15	30	10	5	15	0.3
T_7	Juice blend 50:50 % S: G	20	50	50	-	-	-	15	0.3
T_8	50:35:10:5 % S: G: L: GI	20	50	35	-	10	5	15	0.3
T_9	Control 100 % Strawberry juice	20	100	-	-	-	-	15	0.3
T_{10}	Control 100 % Grape juice	20	-	100	-	-	-	15	0.3
T_{11}	Control 100 % Muskmelon juice	20	-	-	100	-	-	15	0.3

T: Treatments, S: Strawberry, G: grape, M: Muskmelon, GI: Ginger and L: Lime

Preparation of Products and Chemical Analysis:

Sugar syrup was prepared by adding cane sugar to the boiling water. The strength of sugar syrup was ascertained by testing with digital hand refractometer. Then, the prepared syrup was filtered through a muslin cloth to remove all impurities. Extracted juice from fruits and freshly prepared hot syrup was mixed together in the preparation of recipe on weight basis. Extra syrup of known quantity was added to adjust the final TSS. Desired quantity of citric acid was added wherever necessary and finally Sodium Benzoate (600 ppm/kg juice) was mixed into it after dissolving in the little quantity of juice. The colloidal juice was divided into eleven parts to serve as replication then the prepared nectar was filled into pre-sterilized bottles of 200 ml capacity and sealed airtight using crown caps with the help of crown corking machine. Then the product was processed in boiling water for 25 minutes, cooled immediately stored at room and refrigerator temperature for further observations.

Chemical analysis:

The prepared products (Nectar) was analysed for p^H, titratable acidity, total soluble solids, ascorbic acid, total sugars, total anthocyanin content, visual observation for microbial spoilage during storage at 30, 60, 90 and 120 days' interval in ambient and refrigerated condition.

p^H of the nectar was recorded using Toshniwal digital p^H meter (model DI 707). Using "Digital-hand refractrometer" the total soluble solids of the products were recorded and expressed in degree Brix (°B).

Vitamin C content was determined by 2, 6-Dichlorophenol indophenol (DCPIP) method[5]. Ten grams of juice was mixed thoroughly with 4% oxalic acid solution, squeezed through a muslin cloth and volume was made up to 50 ml. Vitamin C content present in the solution was estimated by titrating a known quantity of the extract against DCPIP. Vitamin C content was calculated as mg of ascorbic acid equivalents per 100 g fresh weight using a standard curve of L-Ascorbic acid.

$$Vitamin\ C\ (mg\ 100g^{-1}) = \frac{\text{Titre Value X Std. Value X Total Volume of Extract X 100}}{\text{Assay Volume X Weight of Sample}(g)X1000}$$

Titratable acidity was determined by titration method[6]. Nectar juice was homogenized in a blender and 10 ml of juice was mixed with distilled water and volume was made up to 50 ml. A known volume of the filtrate (10 ml) was titrated against 0.01N NaOH using phenolphthalein as indicator. Acidity was calculated as percentage of citric acid equivalents using citric acid standard curve.

$$\text{Acidity (\%)} = \frac{\text{Titre Value X Std. Value(mg)X Total Vol. of Extract X CorrectionFactor X 100}}{\text{Assay Volume X Weight of Sample}(g)X1000}$$

Anthocyanin estimation was made as per the procedure cited in hand book of analysis and quality control[7]. Five ml of nutraceuticals prepared from juice sample was taken in 100 ml conical flask and 50ml of 0.1N HCl was added. It was shaken well for 10 minutes in mechanical shaker and kept in dark place for one hour. The absorbance was measured at 510 nm against blank. A standard curve was plotted on graph showing absorbance against the standard.

$$\text{Total O.D./100g} = \frac{\text{O.D.} \times \text{Volume made up} \times 100}{\text{ml of juice taken}}$$

$$\text{Totalanthocyanin(mg/100ml)} = \frac{\text{TotalO.D./100ml}}{87.3}$$

Stastical analysis:

The experiment consisted of 11 treatments, each treatment was replicated four times with 5 samples per replication and the observations were recorded at regular intervals. Analysis of variance was carried out by CRD (Complete Randomized Design) was used for conducting the experiment and results were analyzed as per the guide lines suggested[8].

RESULTS AND DISCUSSION

TSS (°Brix):

TSS content of the strawberry blended juice varied significantly during the storage period, among the different treatments. TSS of prepared nectar beverage with 20 % increase in both at ambient and refrigerated storage at 120 days after storage. The maximum increase in TSS was found when the bottles were stored at ambient condition.

The total soluble solids of the samples exhibited an increasing trend during the storage period (Table 1). The maximum increase in TSS (18.20°B) was recorded in treatment T_7 from initial 15°B at 120 DAS which, followed by T_1 with TSS of 18.11°B and whereas, the least TSS was observed in treatment T_6 (17.21°B) at room temperature. At refrigerated storage condition, maximum increase in TSS (17.61°B) was noticed in treatment T_7 and the lowest TSS was recorded in treatment T_6 (16.59°B) at 120 days after storage with blending juice ratio of 40:15:30:10:5 (S: G: M: L: GI) at refrigerated storage condition.

This increase in TSS might be due to higher rate of solubilisation and another possible explanation of increased TSS may be the conversion of acids to sugars. Minimum increase in total soluble solids under refrigerated storage might be due to low temperature, thus reducing hydrolysis of poly-saccharides and acids. Similar results were obtained in Kinnow mandarin juice blends[9].

p^H:

Significant increases in the p^H of nectar beverage was observed in both room and refrigerated storage condition. The maximum increases in p^H of blended beverages during storage was observed in ambient condition. A continuous increasing trend was observed in p^H throughout the storage period (Table 2). In treatment T_7 initial p^H was 3.78 and increased to 3.94 p^H at 120 DAS, whereas, the minimum increase in the p^H was observed in treatment T_6 from initial 3.50 to 3.67 at 120 DAS at ambient condition. Similarly, in refrigerated condition, there was minimum changes were recorded from initial p^H of 3.78 and 3.88 were increased to 3.50 and 3.60 at 120 DAS in the treatment T_7 and T_6 respectively.

The cause of maximum increase in p^H content is due to higher corresponding decrease in acidity of these products recorded

in ambient condition, and the minimum increase in p^H in refrigerated storage was due to low temperature. Similar observations were recorded in kiwi fruit squash[11 & 12], in Simarouba-kokum squash in amla juice[12].

Titratable acidity (%):

TA decreased significantly in the 20 % juice nectar beverage in ambient and refrigerated condition, during storage. The maximum decrease was recorded in nectar stored in ambient condition. There was a decline in acid content during the storage period (Table 3). The maximum decrease 0.20% in TA was observed in T_7 and T_1 followed by in treatment T_5 and T_{11} 0.21% and the minimum decrease in TA was recorded in treatment T_6 0.25% at 120 DAS in ambient condition. While, at refrigerated condition, maximum and minimum TA of 0.21% and 0.27% was recorded in T_7 and T_6 respectively at 120 days after storage.

The acidity of the stored juice decreased due to oxidation during storage period. The decrease in acidity might also be due to hydrolysis of polysaccharides and non-reducing sugars, where, the acid is utilized for converting into reducing sugars. These results are supported by the findings in amla juice [9,13,14,12]. The degree of reduction in acidity is dependent on concentration of sugar and it is a general phenomenon during storage of beverages in the presence of sugars[16]. Reduction in acidity during storage was also noticed in most fruit beverages[17].

Ascorbic acid (mg 100g-$^{1)}$):

Ascorbic acid content in nectar decreased significantly in both ambient and refrigerated storage condition. The maximum decrease was observed in blended beverage when stored at ambient condition. The blended nectar showed a gradual decline of ascorbic acid content during the storage period (Table 4). Maximum retention of ascorbic acid was recorded in T_6 (54.00 mg 100g-^{1}) with initial ascorbic acid concentration of 72.00 mg $100g^{-1}$, which accounted for minimum loss of 25.00% at the end of the storage period, however, minimum retention was observed in T_{10} (22.50 mg $100g^{-1}$) which, has shown 37.50% loss of ascorbic acid at 120 DAS in ambient storage condition. Similarly, in refrigerated storage condition, maximum retention of ascorbic acid was recorded in T_6 63.00 mg $100g^{-1}$ from initial concentration of 72.00 mg $100g^{-1}$, which accounted for minimum loss of 12.50% at the end of the storage period, whereas, minimum retention was observed in T_{10} (27.00 mg $100g^{-1}$) which showed 25.00% loss at 120 DAS.

Ascorbic acid is highly sensitive to heat, hence, its degradation was more in ambient storage conditions as compared to refrigerated storage condition. The ascorbic acid decreased due to oxidation as the period of storage advanced. It has been reported that ascorbic acid is very sensitive to oxidation and converted to dehydro-ascorbic acid or furfural by the enzyme ascorbinase. These results are supported by the findings, the decrease was lower under refrigerated storage condition, which, may be attributed to low temperature and high relative humidity in storage, which inhibited the conversion of acid in sugars and decreased rate of ascorbic acid oxidation[17] and similarly in kinnow mandarin blended juice[18].

Total sugars (%):

Significant increase in total sugar of nectar was recorded in the both ambient and refrigerated temperature, during the storage period of 120 days and the maximum increase was recorded in ambient condition. The total sugars content of blended nectar increased throughout the storage period (Table 5). The maximum total sugar content of 15.55% was observed in treatment T_7 and minimum 14.54% was recorded in T_6 at 120 DAS when bottles were stored at ambient condition. Whereas, in refrigerated storage condition, maximum total sugar content was observed in treatment T_7 15.13% and the minimum was recorded in T_6 13.74% at 120 DAS when bottles were stored at refrigerated storage temperature.

The cause of increase in total sugars content was due to higher rate of solubilization of starch molecules and increase in TSS by addition of sugars during preparation and by the conversion of acids in to sugars. Minimum increase in total sugars under refrigerated

storage might be due to low temperature, thus reducing hydrolysis of poly-saccharides and acids. The finding in Kinnow mandarin juice blends[9], similarly in squash and nectar prepared from bael fruits[19]. An increase in reducing and total sugars corresponding to the increase in total soluble solids and ultimate decrease in non-reducing sugars[20].

Anthocyanin (mg 100g^{-1}):

Anthocyanin content of nectar decreased significantly during 120 days of storage in both ambient and refrigerated condition, during the storage period (Table 6). Significant maximum anthocyanin content was recorded in T_9 (1.58 mg 100g^{-1}) followed by T_7 (1.39 mg 100g^{-1}) and the lowest anthocyanin content was recorded in T_{11} (0.29 mg 100g^{-1}) at 120 DAS in ambient condition. Whereas, in refrigerated condition at initial highest and lowest was noticed in T_9 (2.90 mg 100g^{-1}) and T_{11} (0.94 mg 100g^{-1}) respectively and it was decreases to 2.29 mg 100g^{-1} and 0.50 mg100g^{-1} at 120 DAS.

Loss of anthocyanin might be due to their high susceptibility to auto-oxidative degradation and due to heat degradation during storage. More retention of this characteristic in the product might be due to slower rate of auto-oxidation of anthocyanin in the refrigerated storage condition, than ambient condition[17&21].

Spoilage (%):

Containers used for storing products were pre-sterilised and dried before filling beverages and all bottles were kept in aseptic condition during product preparation. Hence, there was no spoilage of the products during storage observed.

Strawberry blended nectar was free from microbial spoilage during storage, as sodium benzoate was added as preservative and the bottles were heat processed to inactivate microorganisms. Similar observations were also reported in passion fruit juice [22] and in bael fruit nectar[19].

Table 1: Changes in TSS (^{o}B) of strawberry nectar 20 % blended with muskmelon, grape, lime and ginger during storage

Treatments		Storage Conditions									
		Ambient (Days after storage)					Refrigerated (Days after storage)				
		Initial	30	60	90	120	Initial	30	60	90	120
T_1	Juice blend 60:40 % S: M	15.00	16.51	17.12	17.71	18.11	15.00	16.31	16.82	17.12	17.60
T_2	45:40:10:5 % S: M: L: GI	15.00	15.82	16.41	17.02	17.42	15.00	15.61	16.11	16.41	16.82
T_3	45:40:10:5 % S: G: L: GI	15.00	15.89	16.62	17.22	17.62	15.00	15.72	16.31	16.61	17.02
T_4	40:45:10:5 % S: M: L: GI	15.00	16.02	16.49	17.11	17.51	15.00	15.82	16.19	16.52	16.92
T_5	60:40 % S: G	15.00	16.42	16.99	17.61	18.02	15.00	16.19	16.71	17.02	17.42
T_6	40:15:30: 10:5 % S: G: M: L: GI	15.00	15.58	16.21	16.82	17.21	15.00	15.41	15.92	16.21	16.59
T_7	Juice blend 50:50 % S: G	15.00	16.62	17.19	17.80	18.20	15.00	16.41	16.91	17.19	17.61
T_8	50:35:10:5 % S: G: L: GI	15.00	15.71	16.31	16.88	17.31	15.00	15.51	16.02	16.32	16.72
T_9	Control 100 % Strawberry juice	15.00	16.12	16.72	17.31	17.72	15.00	15.92	16.41	16.71	17.12
T_{10}	Control 100 % Grape juice	15.00	16.22	16.82	17.42	17.78	15.00	16.02	16.52	16.81	17.21
T_{11}	Control 100 % Muskmelon juice	15.00	16.31	16.92	17.52	17.92	15.00	16.12	16.61	16.92	17.32
SEm ±		-	0.0380	0.0377	0.0336	0.0350	-	0.0334	0.0332	0.0330	0.0312
CD @1%		-	0.1704	0.1690	0.1504	0.1570	-	0.1497	0.1488	0.1478	0.1398
F test		-	*	*	*	*	-	*	*	*	*

T: Treatments, S: Strawberry, G: grape, M: Muskmelon, GI: Ginger and L: Lime

* Significant NS: Non Significant SEm: Standard error DAS: Days after storage

Table 2: Changes in p^H of strawberry nectar 20 % blended with muskmelon, grape, lime and ginger during storage

	Treatments	Storage Conditions									
		Ambient (Days after storage)					Refrigerated (Days after storage)				
		Initial	30	60	90	120	Initial	30	60	90	120
T_1	Juice blend 60:40 % S: M	3.76	3.81	3.85	3.89	3.92	3.76	3.79	3.82	3.84	3.86
T_2	45:40:10:5 % S: M: L: GI	3.54	3.58	3.63	3.66	3.71	3.54	3.56	3.59	3.61	3.64
T_3	45:40:10:5 % S: G: L: GI	3.56	3.61	3.65	3.69	3.73	3.56	3.58	3.61	3.64	3.67
T_4	40:45:10:5 % S: M: L: GI	3.55	3.59	3.64	3.67	3.72	3.55	3.57	3.60	3.62	3.64
T_5	60:40 % S: G	3.74	3.79	3.84	3.87	3.91	3.74	3.77	3.80	3.83	3.85
T_6	40:15:30: 10:5 % S: G: M: L: GI	3.50	3.55	3.58	3.63	3.67	3.50	3.52	3.55	3.58	3.60
T_7	Juice blend 50:50 % S: G	3.78	3.82	3.87	3.90	3.94	3.78	3.80	3.83	3.86	3.88
T_8	50:35:10:5 % S: G: L: GI	3.52	3.56	3.61	3.65	3.70	3.52	3.54	3.57	3.60	3.63
T_9	Control 100 % Strawberry juice	3.68	3.73	3.77	3.81	3.84	3.68	3.71	3.73	3.76	3.78
T_{10}	Control 100 % Grape juice	3.70	3.75	3.79	3.84	3.86	3.70	3.72	3.75	3.78	3.79
T_{11}	Control 100 % Muskmelon juice	3.73	3.78	3.81	3.85	3.89	3.73	3.75	3.77	3.80	3.83
SEm ±		0.0032	0.0033	0.0035	0.0036	0.0037	0.0032	0.0035	0.0036	0.0037	0.0038
CD @1%		0.0142	0.0149	0.0155	0.0161	0.0167	0.0142	0.0155	0.0161	0.0167	0.0172
F test		*	*	*	*	*	*	*	*	*	*

T: Treatments, S: Strawberry, G: grape, M: Muskmelon, GI: Ginger and L: Lime

* Significant NS: Non Significant SEm: Standard error DAS: Days after storage

Table 3: Changes in titratable acidity (%) of strawberry nectar 20 % blended with muskmelon, grape, lime and ginger during storage

	Treatments	Storage Conditions									
		Ambient (Days after storage)					Refrigerated (Days after storage)				
		Initial	30	60	90	120	Initial	30	60	90	120
T_1	Juice blend 60:40 % S: M	0.30	0.24	0.22	0.21	0.20	0.30	0.25	0.24	0.23	0.22
T_2	45:40:10:5 % S: M: L: GI	0.30	0.28	0.26	0.25	0.24	0.30	0.28	0.27	0.26	0.25
T_3	45:40:10:5 % S: G: L: GI	0.30	0.27	0.25	0.24	0.24	0.30	0.28	0.27	0.27	0.26
T_4	40:45:10:5 % S: M: L: GI	0.30	0.27	0.25	0.24	0.23	0.30	0.27	0.27	0.26	0.25
T_5	60:40 % S: G	0.30	0.24	0.23	0.22	0.21	0.30	0.26	0.24	0.24	0.23
T_6	40:15:30: 10:5 % S: G: M: L: GI	0.30	0.28	0.27	0.26	0.25	0.30	0.29	0.28	0.27	0.27
T_7	Juice blend 50:50 % S: G	0.30	0.23	0.22	0.21	0.20	0.30	0.24	0.23	0.22	0.21
T_8	50:35:10:5 % S: G: L: GI	0.30	0.27	0.26	0.25	0.24	0.30	0.28	0.28	0.27	0.26
T_9	Control 100 % Strawberry juice	0.30	0.27	0.24	0.24	0.23	0.30	0.28	0.27	0.25	0.24
T_{10}	Control 100 % Grape juice	0.30	0.26	0.24	0.23	0.22	0.30	0.27	0.26	0.24	0.24
T_{11}	Control 100 % Muskmelon juice	0.30	0.25	0.23	0.22	0.21	0.30	0.26	0.25	0.24	0.23
SEm ±		-	0.0028	0.0032	0.0031	0.0031	-	0.0029	0.0030	0.0029	0.0033
CD @1%		-	0.0126	0.0143	0.0138	0.0141	-	0.0129	0.0136	0.0129	0.0147
F test		-	*	*	*	*	-	*	*	*	*

T: Treatments, S: Strawberry, G: grape, M: Muskmelon, GI: Ginger and L: Lime

* Significant NS: Non Significant SEm: Standard error DAS: Days after storage

Table 4: Changes in ascorbic acid (mg $100g^{-1}$) of strawberry nectar 20 % blended with muskmelon, grape, lime and ginger during storage

Treatments		Storage Conditions							
		Ambient (Days after storage)				Refrigerated (Days after storage)			
		Initial	60	120	(%) loss	Initial	60	120	(%) loss
T_1	Juice blend 60:40 % S: M	49.50	39.37	33.75	31.81	49.50	43.87	40.50	18.18
T_2	45:40:10:5 % S: M: L: GI	58.50	46.12	40.50	30.76	58.50	54.00	49.50	16.23
T_3	45:40:10:5 % S: G: L: GI	52.87	43.87	34.87	34.04	52.87	48.37	43.87	17.02
T_4	40:45:10:5 % S: M: L: GI	63.00	55.12	46.12	26.79	63.00	58.50	54.00	14.28
T_5	60:40 % S: G	48.37	39.37	30.37	37.21	48.37	43.87	40.50	16.27
T_6	40:15:30: 10:5 % S: G: M: L: GI	72.00	63.00	54.00	25.00	72.00	67.50	63.00	12.50
T_7	Juice blend 50:50 % S: G	43.87	34.87	25.87	41.03	43.87	39.37	34.87	20.51
T_8	50:35:10:5 % S: G: L: GI	67.50	58.50	49.50	26.66	67.50	63.00	58.50	13.33
T_9	Control 100 % Strawberry juice	54.00	45.00	36.00	33.33	54.00	49.50	45.00	16.66
T_{10}	Control 100 % Grape juice	36.00	27.00	22.50	37.50	36.00	31.50	27.00	25.00
T_{11}	Control 100 % Muskmelon juice	45.00	36.00	27.00	40.00	45.00	40.50	36.00	20.00
SEm ±		1.6732	1.5910	1.5667	-	1.6732	1.6149	1.7296	-
CD @1%		7.4995	7.1309	7.0220	-	7.4995	7.2381	7.7521	-
F test		*	*	*	-	*	*	*	-

T: Treatments, S: Strawberry, G: grape, M: Muskmelon, GI: Ginger and L: Lime

* Significant NS: Non Significant SEm: Standard error DAS: Days after storage

Table 5: Changes in total sugar (%) of strawberry nectar 20 % blended with muskmelon, grape, lime and ginger during storage

Treatments		Storage Conditions									
		Ambient (Days after storage)					Refrigerated (Days after storage)				
		Initial	30	60	90	120	Initial	30	60	90	120
T_1	Juice blend 60:40 % S: M	11.91	12.51	12.94	14.04	15.44	11.91	12.27	12.80	13.78	15.03
T_2	45:40:10:5 % S: M: L: GI	11.48	12.04	12.44	13.45	14.73	11.48	11.82	12.30	13.21	14.35
T_3	45:40:10:5 % S: G: L: GI	11.54	12.10	12.51	13.53	14.83	11.54	11.88	12.37	13.29	14.45
T_4	40:45:10:5 % S: M: L: GI	11.60	12.17	12.58	13.61	14.93	11.60	11.94	12.44	13.37	14.54
T_5	60:40 % S: G	11.85	12.44	12.87	13.95	15.3	11.85	12.20	12.72	13.70	14.95
T_6	40:15:30: 10:5 % S: G: M: L: GI	11.37	11.91	12.30	13.29	14.54	11.37	11.69	11.85	12.69	13.74
T_7	Juice blend 50:50 % S: G	12.42	12.58	13.02	14.13	15.55	12.42	12.34	12.87	13.87	15.13
T_8	50:35:10:5 % S: G: L: GI	11.43	11.97	12.37	13.37	14.64	11.43	11.75	12.24	13.13	14.26
T_9	Control 100 % Strawberry juice	11.66	12.24	12.65	13.70	15.13	11.66	12.01	12.51	13.45	14.64
T_{10}	Control 100 % Grape juice	11.72	12.30	12.80	13.87	15.23	11.72	12.07	12.58	13.53	14.73
T_{11}	Control 100 % Muskmelon juice	11.79	12.37	12.87	13.95	15.34	11.79	12.14	12.66	13.61	14.83
SEm ±		0.1205	0.0137	0.0146	0.0172	0.0207	0.1205	0.0132	0.0138	0.0165	0.0190
CD @1%		0.5402	0.0613	0.0657	0.0770	0.0929	0.5402	0.0590	0.0619	0.0737	0.0852
F test		*	*	*	*	*	*	*	*	*	*

T: Treatments, S: Strawberry, G: grape, M: Muskmelon, GI: Ginger and L: Lime

* Significant NS: Non Significant SEm: Standard error DAS: Days after storage

Table 6: Changes in anthocyanin content (mg 100g^{-1}) 0f strawberry nectar 20 % blended with muskmelon, grape, lime and ginger during storage

Treatments		Storage Conditions											
		Ambient (Days after storage)						Refrigerated (Days after storage)					
		Initial	30	60	90	120	(%) loss	Initial	30	60	90	120	(%) loss
T_1	Juice blend 60:40 % S: M	2.09	1.72	1.31	0.96	0.70	66.50	2.09	1.98	1.74	1.55	1.27	39.23
T_2	45:40:10:5 % S: M: L: GI	1.85	1.60	1.00	0.81	0.45	75.67	1.85	1.77	1.22	1.38	1.11	40.00
T_3	45:40:10:5 % S: G: L: GI	2.22	1.85	1.47	1.21	0.88	60.36	2.22	2.08	1.86	1.70	1.42	36.03
T_4	40:45:10:5 % S: M: L: GI	1.84	1.57	0.98	0.80	0.44	76.08	1.84	1.75	1.53	1.35	1.09	40.76
T_5	60:40 % S: G	2.20	1.80	1.43	1.16	0.80	63.63	2.20	2.05	1.84	1.67	1.39	36.81
T_6	40:15:30: 10:5 % S: G: M: L: GI	2.43	2.03	1.67	1.32	0.93	61.72	2.43	2.30	2.16	1.96	1.65	32.09
T_7	Juice blend 50:50 % S: G	2.69	2.33	1.86	1.71	1.39	47.32	2.69	2.43	2.33	2.19	1.91	28.99
T_8	50:35:10:5 % S: G: L: GI	2.31	1.92	1.57	1.19	0.86	62.77	2.31	2.19	2.04	1.89	1.59	31.16
T_9	Control 100 % Strawberry juice	2.90	2.54	2.04	1.85	1.58	45.59	2.90	2.72	2.62	2.45	2.29	21.03
T_{10}	Control 100 % Grape juice	1.20	0.91	0.63	0.45	0.38	68.33	1.20	1.06	0.90	0.82	0.66	45.00
T_{11}	Control 100 % Muskmelon juice	0.94	0.79	0.55	0.37	0.29	69.14	0.94	0.86	0.78	0.65	0.50	46.80
SEm ±		0.0032	0.0030	0.0037	0.0029	0.0029	-	0.0032	0.0038	0.0035	0.0031	0.0037	-
CD @1%		0.0143	0.0135	0.0168	0.0130	0.0132	-	0.0143	0.0171	0.0155	0.140	0.0164	-
F test		*	*	*	*	*	-	*	*	*	*	*	-

T: Treatments, S: Strawberry, G: grape, M: Muskmelon, GI: Ginger and L: Lime

* Significant NS: Non Significant SEm: Standard error DAS: Days after storage

CONCLUSION

Hence, it can be concluded from the study that, the products developed from strawberry fruits nectar were good sources of vitamin C, anthocyanin and sugars. The study revealed that reduction of anthocyanin, and vitamin C during storage at room temperature, can be prevented by storing the products at refrigeration temperature. Packing of blended juice in the PET bottles and other forms in half to one-liter capacity may be studied.

Future thrusts: There is scope for detailed study of nutraceuticals properties of these blended beverages. Also, evaluation of suitable varieties, cultivars, hybrids for the development of value added beverages, should be considered so as to retain higher nutrition during storage. Further, opportunities may be explored to use some crops for development of other valued added product such as bakery products, dairy products, beverages, ice cream, yogurt, milkshakes, jams, jellies, smoothies,

dietetic products and many other food products.

REFERENCES

1. Mehriz, A.S.M., Abou, D.A. and Hebeishy, E.H., Properties and antioxidant activity probiotic yoghurt flavored with black carrot, pumpkin and strawberry. *Int. J. Dairy Sci.*, **8(2):** 48-57 (2013).
2. Basu, A., Nguyen, A., Betts, N.M. and Lyons, T.J., Strawberry as a functional food: an evidence-based review". *Critical Rev. Food Sci. Nutrn.*, **54(6):** 790-806 (2014).
3. Vasantha, H.P. and Rupasinghe., Recent perspectives on the medicinal potential of ginger biotical. *Targets Therapy*, **5**: 55-63 (2015).
4. Benzie, K. and Strain., Antioxidant activity, phenol and flavonoid contents of 13 citrus species peels and tissues. *Pak. J. Pharmaceutical Sci.*, **22(3):** 277-281 (1996).
5. AOAC., In Official Methods of Analysis, Ascorbic acid, 967.21, 45.1.14. *Association Of Official Analytical Chemists International*, Gaithersburg (2006).
6. AOAC., In Official Methods of Analysis, 17th edn, Titratable acidity of fruit products, 942.15. *Association Of Official Analytical Chemists International*, Gaithersburg (2000).
7. Ranganna, S., Handbook of analysis and quality control for fruits and vegetable products. *2nd ed. Tata McGraw-Hill Publ. Co. Ltd.*, New Delhi (1977).
8. Sunderraj, N., Nagaraju, S., Venkataramana, M.N. and Jagannath, M.K., Design and analysis of field experiments. *University of Agricultural Sciences*, Bangalore (1972).
9. Bhardwaj, R.L., & Nandal, U., Effect of storage temperature on physico-chemical and sensory evaluation of Kinnow Mandarin Juice Blends. *J. Food Process Technol.*, 5, 5-8 (2014).
10. Thakur, K.S. and Barwal, V.S., Studies on preparation and evaluation of squash from unmarketable kiwi fruit. *Indian Food Packer*, **52:** 26-29 (1998).
11. Ramajayam, D. and Jaganath., Studies on the value added Simarouba-kokum and simarouba squash blends. *South Indian Hort.*, **51(6):** 122-125 (2001).
12. Gajanana, K., Processing of aonla (Emblica officinalis Gaertn.) fruits. M.Sc. Thesis. University of Agricultural Sciences, Dharwad. (2002).
13. Palaniswamy, K. P., Muthukrishnan, C.R. and Shanmughavelu, K.G., Studies on the evaluation of certain mango varieties of Tamil Nadu for pulp and squash. *Indian Food Packer*, **28(2):** 5-9 (1974).
14. Nath, A., Yadav, D.S., Pranabjyoti, S. and Dey, B., Standardization of ginger-kinnow squash and its storage. *J. Food Sci. Technol.*, **42(6):** 520-522 (2005).
15. Bhatia, B.S., Siddappa, G.S. and LAL. G., Physico-chemical changes in jack fruit squash during storage. *Indian J. Agrl. Sci.*, **26(4):** 403-414 (1956).
16. Tripathi, V.K., Singh, M.B. and Singh, S., Studies on comparative compositional changes in different preserved product of amla. *Indian Food Packer*, **42(4):** 60-66 (1988).
17. Thakur, N.S., Girish, S.D. and Joshi V.K., Development of wild pomegranate aril-in-syrup and its quality evaluation during storage. *Int. J. Food Fermentation Technol.*, **3(1):** 33-40 (2013).
18. Das, R. C. and Dash, J., The effect of wax emulsion, 2, 4-D and 2, 4, 5-T on the storage behavior of musambi fruits. *Proceeding of International Symposium on Sub-tropical and Tropical Horticulture*, New Delhi (1967).
19. Roy, S.K. and Singh R.N., Bael fruit

(Aegle marmelos). A potential fruit for processing. *Econ. Bot.*, **33(2):** 203-212 (1979).

20. Madan, L.C., Dikshit, S.N. and H. G. Sharma., Studies on preparation and biochemical changes in guava RTS beverage during storage. *J. Indian Arid Hort.*, **1(1):** 78-79. (2006).
21. Gimenez, J., Kajda, P., Margomenou, L., Piggott, J.R. and Zabetakis, I., A study on the colour and sensory attributes of high-hydrostatic-pressure jams as compared with traditional jams. *J. Sci. Food Agri.*, **81:** 1228-1234. (2001).
22. Pruthi, J. S. and Lal, G., Studies on passion fruit juice concentrate and powder. *Indian Food Sci.*, **1:** 8 (1959).