



Development and Qualitative Evaluation of Banana and Kinnow Based RTS Beverage

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A study was conducted to develop banana and kinnow based fruit beverage and its qualitative evaluation during storage. The TSS, acidity and optical density of banana and kinnow RTS beverage increased with increase in the level of banana juice ratio at different storage condition. The pH decreased with increase in the level of kinnow juice and pH values of the samples composition B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ after 90 days of storage were observed as 1.60, 1.41 and 1.20 respectively at refrigeration condition. The microbial growth increased during storage period irrespective of banana juice ratio at different storage condition. The vitamin-C (ascorbic acid) of the RTS samples was decreased during storage period. The minimum ascorbic acid of the sample of juice ratio (banana: kinnow) B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ after 90 days of storage were observed as 1.50, 2.00 and 2.60 respectively at refrigeration condition. However, the overall acceptability of beverage decreased with increase in storage period. The refrigeration storage method was found to be superior over other methods for storage of banana and kinnow based RTS beverage followed by BOD incubator and room temperature conditions.

Key words: TSS, acidity, ascorbic acid, optical density, pH, total plate count and overall acceptability.

Fruit juices are valuable from the nutritional point of view as they are rich in minerals, vitamins and other nutritive factors. Besides these are delicious and have universal appeal. In developed countries fruit juices commonly form part of breakfast and are produced in very large quantities. In our country preparation of the juice is limited mostly to home scale production. The fruits generally used for making juice are orange, grape, apple, pomegranate, melon, mango etc. Production of fruit beverages on a commercial scale was practically unknown till about 1930, but since then it has gradually become an important industry. Beverages are an important part of diet for human beings. They are easily digestible, highly refreshing, thirst quenching, appetizing and nutritionally far superior to many foods (Srivastav and Kumar, 2009). Today, a wide variety of beverages are consumed at home, at work place and sport stadium. Worldwide share of India in the banana was 20% during the year 2010 (FAO STAT Agriculture Data). India ranks first in production (20%) followed by Brazil, China, Ecuador and Philippines. Maharashtra is the largest banana producing state followed by Tamilnadu, Gujarat, Karnataka, Andhra Pradesh, Bihar, Madhya Pradesh, Assam, West Bengal, Kerala and other. Banana is rich in potassium.

Banana contains about 90 to 93 calories per 100 g. This energy is easily absorbed by the body and hence eating 3 to 4 bananas daily, especially with milk, is often recommended to gain weight. At the same time, banana is useful for losing weight. Since it has only 90 calories per 100 g (butter has about 700 calories

per 100 g), banana reduces your calorie intake and thus helps in weight loss. Overweight people, should of course, stop eating banana chips to lose weight. Preparation of the juice is limited mostly to home scale production. The manufacture of squashes on a commercial scale has made some progress (Manay, Shakuntala and Shadaksharaswamy, 2008).

“Kinnow is a citrus cultivar of mandarin. It is a hybrid of two citrus cultivars; “King” and “Willow Leaf” and is classified as kinnow mandarin. It was first introduced from California – USA to the Punjab Agricultural College and Research Institute, Lyallpur (Now University of Agriculture, Faisalabad and Punjab, Pakistan) in the Sub-continent in 1943-44. This “easy peeler” citrus has assumed special economic importance and export demand being acknowledged for its high juice content, special flavour, delicious taste and nutritional compositions which are equally benefited for all age groups. In Pakistan, approximately 60 per cent of total citrus production is comprised of mandarin being popularly known as ‘Kinnow’. The composition of citrus fruit juice is beneficial with respect to its mineral and ascorbic acid contents. Citrus has naturally sympodial growth habit, forming a large bush (18 - 20 feet tall) if left un-pruned. Pruning, the judicious removal of any vegetative part, is an important culture operation for the fruiting trees (Saeed Ahmed *et al.*, 2006).

Materials and Methods

Development of RTS beverage

The fully matured, firm ripe and healthy fruits of banana and kinnow were selected for this study.

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Both the fruits were collected from local market near Sardar Vallabhbhai Patel University of Agriculture and Technology Meerut (U.P.) India. Ready-to-serve beverage consists essentially of an amount of 10 to 15 per cent fruit juice. Kinnow and banana were washed in potable water to remove dust, dirty particles and some bacteria. Peeling was done manually. Juice of banana was extracted by electric mixer and strained through muslin cloth. Kinnow juice was extracted by hand driven screw press. The RTS beverage was prepared from the extracted kinnow and banana juice, adjusting its total soluble solid and acidity as per FPO specification for RTS beverage by mixing the juice with required quantity of sugar syrup prepared from sugar, citric acid, preservative (KMS) and mixed water. The beverage was filled in bottles leaving a head space of 2.5 to 3.0 cm, crown corked and processed in water for 4 to 6 min. at 85 °C for pasteurization. Labeled bottles were stored at different temperature.

The samples prepared at various proportions viz. B₉₀:K₁₀, B₈₀:K₂₀, B₇₀:K₃₀, B₆₀:K₄₀, B₅₀:K₅₀, B₄₀:K₆₀ of banana and kinnow, were prepared and evaluated by sensory panel. Panel recommended three compositions viz. B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ of banana and kinnow. RTS beverage was immediately filled in glass bottle after preparation. They were cooled at room temperature for storage condition. Physico-chemical and sensory characteristic were evaluated after 15, 30, 45, 60, 75 and 90 days of storage at room temperature, refrigeration and BOD temperature.

Sensory rating

Hedonic rating test method was used for the evaluation recommend by (Pandey, 2005). A panel of members measured the consumer acceptability. Sample were served to the panelist and they were asked to rate the acceptability of the product through the sense of organs. Different attributes viz., colour, texture, flavour and taste were rated on the basis of hedonic scale, ranging from 1 (extremely dislike/ most undesirable) to 9 (extremely like/ most desirable) (Ranganna, 1977).

Results and Discussion

The study was undertaken to develop RTS beverage using banana and kinnow, and its qualitative

analysis was done during storage period. For the evaluation of quality of banana and kinnow based RTS, several physico-chemical parameters viz. TSS, pH, acidity, optical density, ascorbic acid, microbial studies (TPC) and sensory parameters were selected. RTS samples were packed in sterilized glass bottles. Evaluation of quality parameters was carried out for fresh as well stored samples after 0, 15, 30, 45, 60, 75 and 90 days under different storage conditions.

Effect on TSS

The TSS of samples having banana and kinnow juice in the ratio B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ were measured as 13.00, 12.2 and 12.00 °Brix, respectively in the fresh samples. During storage, it was observed from the Table 1 that TSS of all the samples was increased at 0, 15, 30, 45, 60, 75 and 90 days of storage. This increase in the TSS may be due to the fact that the banana juice contains more TSS in comparison to juice obtained from kinnow. The TSS values of the sample B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ after 90 days of storage were observed as 17.5, 16.5, and 16 °Brix at refrigeration condition. The TSS values of the sample B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ after 90 days of storage were observed as 19.0, 17.5 and 17.0 °Brix at room temperature and 18.8, 17.5 and 16.5 °Brix at B.O.D. temperature condition. The highest TSS 19.0 °Brix of the sample having juice ratio B₇₀:K₃₀ was observed at room temperature storage after 90 days. However, in general higher value of TSS was found after 90 days in each case of storage conditions. Baramanray *et al.*, (1995) and (Pandey, 2004) observed that the increase in TSS value of RTS beverages during storage were probably due to conversion of polysaccharides into soluble sugars. In conformity of this, similar results were also observed in the present study.

Effect on Acidity

The acidity of samples having banana and kinnow juice ratio B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ were measured as 0.125, 0.128 and 0.131 respectively, in the fresh samples. During storage, it was observed from the Table 2 that acidity of all the samples were increased at 0, 15, 30, 45, 60, 75 and 90 days of storage. The increase in the value of acidity was observed with either increase in the ratio of kinnow juice or decrease in the ratio of banana juice in the developed RTS.

Table 1. Effect on TSS of samples of banana and kinnow based RTS beverage at different storage conditions.

Storage period (Days)	TSS								
	Room Temperature				Refrigeration			B.O.D.	
	B ₇₀ :K ₃₀	B ₆₀ :K ₄₀	B ₅₀ :K ₅₀	B ₇₀ :K ₃₀	B ₆₀ :K ₄₀	B ₅₀ :K ₅₀	B ₇₀ :K ₃₀	B ₆₀ :K ₄₀	B ₅₀ :K ₅₀
0	13.0±0.00	12.2±0.047	12.0±0.00	13.0±0.00	12.2±0.047	12.0±0.00	13.0±0.00	12.2±0.047	12.0±0.00
15	13.6±0.188	13.0±0.141	12.5±0.047	13.5±0.081	13.0±0.047	12.5±0.368	14.5±0.00	14.0±0.047	13.0±0.141
30	14.1±0.023	13.6±0.235	13.0±0.471	14.2±0.282	13.5±0.141	13.0±0.235	15.0±0.047	14.5±0.235	14.0±0.141
45	14.5±0.047	14.0±0.471	13.5±0.047	14.8±0.472	14.0±0.00	13.5±0.048	15.5±0.235	15.0±0.00	14.5±0.471
60	15.5±0.377	15.0±0.00	14.6±0.623	15.8±0.471	15.5±0.047	14.5±0.472	16.0±0.758	15.5±0.849	15.0±1.027
75	16.5±0.047	16.0±0.00	15.5±0.377	16.5±0.00	16.0±0.048	15.5±0.042	17.5±0.00	16.5±0.471	15.5±0.141
90	19.0±0.707	17.5±0.355	17.0±0.472	17.5±0.163	16.5±0.408	16.0±0.00	18.8±0.707	17.5±0.942	16.5±0.235

The acidity values of the samples with B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ after 90 days of storage were observed as 0.165, 0.170 and 0.180 at refrigeration condition. The acidity values of the samples composition B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ after 90 days of storage were observed as 0.160, 0.170 and 0.177 at room temperature and 0.160, 0.165 and 0.170 at B.O.D. temperature condition. The highest acidity 0.180 of the sample having juice ratio B₅₀:K₅₀ was observed at refrigeration temperature storage after 90 days. However, in general higher value of acidity was found

Table 2. Effect on acidity of samples of banana and kinnow based RTS beverage at different storage conditions.

Storage period (Days)	Acidity (%)								
	Room Temperature			Refrigeration			B.O.D.		
	B ₇₀ :K ₃₀	B ₆₀ :K ₄₀	B ₅₀ :K ₅₀	B ₇₀ :K ₃₀	B ₆₀ :K ₄₀	B ₅₀ :K ₅₀	B ₇₀ :K ₃₀	B ₆₀ :K ₄₀	B ₅₀ :K ₅₀
0	0.125±0.001	0.128±0.004	0.131±0.004	0.125±0.001	0.128±0.004	0.131±0.004	0.125±0.001	0.128±0.004	0.131±0.004
15	0.127±0.00	0.130±0.001	0.135±0.002	0.130±0.001	0.135±0.004	0.140±0.001	0.130±0.001	0.135±0.00	0.140±0.002
30	0.129±0.002	0.133±0.004	0.140±0.001	0.135±0.002	0.140±0.00	0.145±0.001	0.135±0.002	0.140±0.00	0.150±0.001
45	0.130±0.001	0.136±0.002	0.145±0.002	0.140±0.003	0.145±0.004	0.155±0.00	0.140±0.004	0.145±0.001	0.155±0.00
60	0.140±0.001	0.148±0.003	0.154±0.002	0.150±0.006	0.154±0.003	0.160±0.001	0.145±0.001	0.150±0.00	0.160±0.002
75	0.145±0.001	0.155±0.009	0.165±0.00	0.155±0.009	0.165±0.003	0.170±0.002	0.150±0.001	0.155±0.009	0.165±0.003
90	0.160±0.001	0.170±0.002	0.177±0.005	0.165±0.003	0.170±0.001	0.180±0.004	0.160±0.001	0.165±0.003	0.170±0.001

the ratio of banana juice in developed RTS. The decrease in the value of pH was observed with either increase in the ratio of kinnow juice or decrease in

Table 3. Effect on pH of samples of banana and kinnow based RTS beverage at different storage conditions.

Storage period (Days)	pH								
	Room Temperature			Refrigeration			B.O.D.		
	B ₇₀ :K ₃₀	B ₆₀ :K ₄₀	B ₅₀ :K ₅₀	B ₇₀ :K ₃₀	B ₆₀ :K ₄₀	B ₅₀ :K ₅₀	B ₇₀ :K ₃₀	B ₆₀ :K ₄₀	B ₅₀ :K ₅₀
0	2.97±0.050	2.70±0.00	2.40±0.282	2.97±0.050	2.70±0.00	2.40±0.282	2.97±0.050	2.70±0.00	2.40±0.282
15	2.70±0.355	2.50±0.009	2.20±0.032	2.70±0.00	2.50±0.141	2.30±0.355	2.71±0.356	2.50±0.009	2.30±0.141
30	2.50±0.009	2.20±0.032	2.00±0.00	2.50±0.014	2.30±0.188	2.10±0.141	2.50±0.009	2.30±0.189	2.10±0.141
45	2.00±0.00	1.90±0.141	1.70±0.00	2.20±0.048	2.10±0.141	2.00±0.142	2.20±0.488	2.10±0.142	1.90±0.141
60	1.80±0.141	1.70±0.142	1.50±0.143	2.00±0.141	1.90±0.141	1.70±0.00	2.00±0.014	1.90±0.205	1.70±0.00
75	1.60±0.282	1.50±0.00	1.44±0.056	1.80±0.141	1.60±0.094	1.40±0.136	1.80±0.141	1.60±0.282	1.41±0.141
90	1.40±0.00	1.30±0.329	1.22±0.00	1.60±0.282	1.41±0.136	1.20±0.00	1.60±0.282	1.50±0.070	1.30±0.141

as 1.60, 1.41 and 1.20 at refrigeration condition. The pH values of the sample composition B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ after 90 days of storage were observed as 0.140, 0.130 and 0.122 at room temperature and 1.60, 1.50 and 1.30 at B.O.D. temperature condition. The pH decrease in may be due to the fact that pH has inverse relationship with acidity and it may be inferred from the results obtained. The lowest pH (0.120) of

Table 4. Effect on ascorbic acid of the samples of banana and kinnow based RTS beverage at different storage conditions.

Storage period (Days)	Ascorbic Acid (mg/100 ml)								
	Room Temperature			Refrigeration			B.O.D.		
	B ₇₀ :K ₃₀	B ₆₀ :K ₄₀	B ₅₀ :K ₅₀	B ₇₀ :K ₃₀	B ₆₀ :K ₄₀	B ₅₀ :K ₅₀	B ₇₀ :K ₃₀	B ₆₀ :K ₄₀	B ₅₀ :K ₅₀
0	4.00±0.00	4.30±0.424	4.72±0.395	4.00±0.00	4.30±0.424	4.72±0.395	4.00±0.00	4.30±0.424	4.72±0.395
15	3.80±0.551	4.00±0.00	4.50±0.00	4.06±0.094	4.50±0.496	5.00±0.075	4.06±0.094	4.40±0.353	5.10±0.00
30	3.60±0.391	3.90±0.141	4.20±0.070	3.80±0.395	4.00±0.00	4.50±0.707	3.33±0.863	4.00±0.00	4.40±0.496
45	3.20±0.070	3.60±0.391	4.00±0.00	3.33±0.353	3.70±0.075	4.10±0.075	3.00±0.00	3.40±0.419	4.00±0.00
60	2.77±0.391	3.31±0.014	3.80±0.103	2.81±0.369	3.10±0.075	3.60±0.042	2.53±0.047	3.00±0.00	3.55±0.040
75	2.50±0.235	2.80±0.303	3.00±0.00	2.00±0.081	2.70±0.042	3.00±0.141	2.00±0.141	2.55±0.040	3.00±0.00
90	1.40±0.141	1.80±0.142	2.20±0.00	1.50±0.216	2.00±0.047	2.60±0.042	1.54±0.169	1.90±0.070	2.50±0.00

after 90 days in each case of storage conditions.

Effect on pH

The pH of the samples of different banana and kinnow juice ratio of B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ were measured as 2.97, 2.70 and 2.40 respectively, in the fresh samples. During storage, it was observed from the Table 3 that pH of all the samples were decreased at 0, 15, 30, 45, 60, 75 and 90 days of storage. The decrease in the value of pH was observed with either increase in the ratio of kinnow juice or decrease in

the ratio of banana juice in the developed RTS. The pH values of the sample composition B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ after 90 days of storage were observed

the sample having juice ratio B₅₀:K₅₀ was observed in refrigeration temperature storage after 90 days. However, in general lower value of pH was found after 90 days in each case of storage conditions.

Effect on ascorbic acid

The ascorbic acid of the samples of different banana and kinnow juice ratio of B₇₀:K₃₀, B₆₀:K₄₀

Table 5. Effect on optical density of the samples of banana and kinnow based RTS beverage at different storage conditions.

Storage period (Days)	Optical Density								
	Room Temperature			Refrigeration			B.O.D.		
	B:K 70:30	B:K 60:40	B:K 50:50	B:K 70:30	B:K 60:40	B:K 50:50	B:K 70:30	B:K 60:40	B:K 50:50
0	0.050±0.008	0.040±0.004	0.030±0.001	0.050±0.008	0.040±0.004	0.030±0.001	0.050±0.008	0.040±0.004	0.030±0.001
15	0.055±0.00	0.045±0.002	0.035±0.002	0.065±0.003	0.055±0.001	0.045±0.002	0.065±0.00	0.060±0.002	0.055±0.001
30	0.060±0.004	0.050±0.002	0.040±0.001	0.075±0.008	0.065±0.00	0.055±0.00	0.075±0.008	0.065±0.00	0.060±0.001
45	0.066±0.005	0.055±0.00	0.044±0.028	0.080±0.001	0.070±0.001	0.064±0.002	0.080±0.016	0.072±0.002	0.066±0.005
60	0.075±0.010	0.065±0.00	0.055±0.003	0.085±0.004	0.080±0.004	0.070±0.001	0.085±0.004	0.077±0.004	0.071±0.001
75	0.085±0.004	0.075±0.009	0.065±0.000	0.090±0.001	0.084±0.004	0.075±0.009	0.090±0.005	0.082±0.003	0.075±0.010
90	0.099±0.00	0.088±0.002	0.082±0.001	0.094±0.001	0.086±0.002	0.080±0.002	0.095±0.005	0.085±0.004	0.081±0.00

and B₅₀:K₅₀ were measured as 4.00, 4.30 and 4.72 respectively, in the fresh samples. During storage, it was observed from the Table 4 that ascorbic acid of

all the samples decreased at 0, 15, 30, 45, 60, 75 and 90 days of storage. The decrease in ascorbic acid of the RTS samples during the storage period

Table 6. Effect on microbial growth of the samples of banana and kinnow based RTS beverage at different storage conditions.

Storage period (Days)	Microbial Growth (10 ⁵ cfu/ml)								
	Room Temperature			Refrigeration			B.O.D.		
	B:K 70:30	B:K 60:40	B:K 50:50	B:K 70:30	B:K 60:40	B:K 50:50	B:K 70:30	B:K 60:40	B:K 50:50
0	ND	ND	ND	ND	ND	ND	ND	ND	ND
15	1.024±0.0004	1.021±0.0014	1.018±0.0004	1.020±0.942	1.015±0.496	1.010±0.075	1.022±0.0942	1.018±0.0353	1.015±0.000
30	1.035±0.0005	1.028±0.0004	1.020±0.0010	1.028±0.0008	1.020±0.0009	1.015±0.0007	1.036±0.0033	1.026±0.0011	1.020±0.00
45	1.050±0.00	1.045±0.0010	1.035±0.0012	1.040±0.0007	1.035±0.0008	1.026±0.0006	1.046±0.0008	1.036±0.0008	1.030±0.0013
60	1.060±0.0004	1.055±0.0004	1.048±0.0005	1.055±0.0005	1.049±0.0005	1.040±0.0011	1.060±0.0012	1.051±0.0004	1.040±0.0005
75	1.095±0.0008	1.080±0.0012	1.066±0.0004	1.066±0.0012	1.060±0.0009	1.050±0.0012	1.080±0.0017	1.067±0.0018	1.060±0.0004
90	1.135±0.0008	1.127±0.0009	1.111±0.00	1.070±0.0008	1.065±0.00	1.056±0.0009	1.099±0.0004	1.090±0.0005	1.081±0.0014

might be due to oxidation or irreversible conversion of L-ascorbic acid in to dehydro ascorbic acid in the presence of enzyme ascorbic acid oxidase

(ascorbinase) caused by trapped or residual oxygen in the glass bottles. The ascorbic acid of the sample of juice ratio (banana: kinnow) B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀

Table 7. Changes in colour, of the samples of banana and kinnow based RTS beverage at different storage conditions

Storage period (Days)	Colour								
	B:K 70:30			B:K 60:40			B:K 50:50		
	Temp.→	Ref.(50C)	BOD (250C)	Room (30-350C)	Ref. (50C)	BOD (250C)	Room (30-350C)	Ref.(50C)	BOD (250C)
After 24 hours	8.5	6.9	7.7	7.4	7.3	7.1	8.1	7.7	7.5
15	8.3	6.7	7.5	7.2	7.1	6.9	8.0	7.5	7.2
30	8.0	6.5	7.2	7.0	6.9	6.7	7.8	7.2	7.0
45	7.8	6.2	6.9	6.8	6.6	6.4	7.5	6.9	6.7
60	7.5	5.9	6.5	6.5	6.3	6.2	7.1	6.5	6.2
75	7.1	6.0	6.2	6.2	6.0	5.8	6.7	6.0	5.8
90	6.7	5.1	5.8	5.8	5.5	5.2	6.2	5.8	5.4

after 90 days of storage were observed as 1.50, 2.00 and 2.60 at refrigeration condition. The ascorbic acid values of the sample composition B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ after 90 days of storage were observed as 1.40, 1.80 and 2.20 at room temperature condition and 1.54, 1.90 and 2.50 at B.O.D. temperature condition. The lower ascorbic acid value 1.40 of the sample having juice ratio B₇₀:K₃₀ were observed at room temperature storage after 90 days. However, in general lower values of ascorbic acid for different samples were found lowest after 90 days of storage conditions. The decrease in ascorbic acid of the RTS samples during the storage period might be due to oxidation or irreversible conversion of L-ascorbic acid in to dehydro ascorbic acid in the presence of

enzyme ascorbic acid oxidase (ascorbinase) caused by trapped or residual oxygen in the glass bottles. Similar, reduction in ascorbic acid content in guava beverages was reported by (Baramanrayet *al.*, 1995 and Pandey, 2004).

Effect on optical density

The optical density of the samples of different banana and kinnow juice ratio B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ were measured as 0.050, 0.040 and 0.030 respectively, in the fresh samples. During storage, it was observed from the Table 5 that optical density of all the samples was increased at 0, 15, 30, 45, 60, 75 and 90 days of storage. The study also revealed that, in general, the optical density slightly increased

Table 8. Change on flavour of the samples of banana and kinnow based RTS beverage at different storage conditions

Storage period (Days)	Flavour								
	B ₇₀ :K ₃₀			B ₆₀ :K ₄₀			B ₅₀ :K ₅₀		
Temp.	Ref.(5°C)	BOD (25°C)	Room (30-35°C)	Ref.(5°C)	BOD (25°C)	Room (30-35°C)	Ref.(5°C)	BOD (25°C)	Room (30-35°C)
After 24 hours	8.1	7.8	7.4	8.0	7.8	7.7	8.6	8.1	7.8
15	7.9	7.6	7.2	7.8	7.5	7.2	8.2	7.9	7.5
30	7.6	7.3	7.0	7.5	7.2	7.0	8.0	7.5	7.2
45	7.2	7.0	6.7	7.1	6.8	6.7	7.8	7.2	7.0
60	7.0	6.7	6.3	6.8	6.5	6.3	7.5	6.8	6.5
75	6.7	6.4	5.9	6.5	6.0	5.7	6.5	6.3	6.0
90	6.3	6.0	5.5	6.1	5.7	5.1	6.0	5.7	5.3

with increase in storage period. This increase in optical density may be attributed to non-enzymatic browning which would have taken place during storage. Non-enzymatic maillard browning reaction

may take place between nitrogenous compounds and sugar, nitrogenous compound and organic acids, and among organic acids themselves. The optical density values of the sample composition B₇₀:K₃₀,

Table 9. Change in taste of the samples of banana and kinnow based RTS beverage at different storage conditions

Storage period (Days)	Taste								
	B ₇₀ :K ₃₀			B ₆₀ :K ₄₀			B ₅₀ :K ₅₀		
Temp.→	Ref.(5°C)	BOD (25°C)	Room (30-35°C)	Ref.(5°C)	BOD (25°C)	Room (30-35°C)	Ref. (5°C)	BOD (25°C)	Room (30-35°C)
After 24 hours	8.7	8.0	7.6	8.1	8.0	7.6	8.6	8.1	7.7
15	8.5	7.8	7.3	7.9	7.8	7.3	8.3	7.9	7.5
30	8.2	7.5	7.0	7.6	7.5	7.0	8.0	7.6	7.2
45	7.8	7.1	6.7	7.3	7.2	6.7	7.8	7.0	6.7
60	7.5	6.7	6.4	7.0	6.8	6.4	7.5	6.7	6.4
75	7.0	6.3	6.0	6.5	6.0	5.7	6.8	6.2	6.0
90	6.6	5.5	5.8	6.0	5.7	5.2	6.0	5.6	5.8

B₆₀:K₄₀ and B₅₀:K₅₀ after 90 days of storage were observed as 0.094, 0.086 and 0.080 at refrigeration condition. The optical density values of the sample composition B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ after 90 days of storage were observed as 0.096, 0.088 and 0.082 at room temperature and 0.095, 0.085 and 0.081 at

B.O.D. temperature condition. It was observed from the data with increase in the level of banana juice ratio in RTS. The highest optical density 0.099 of the sample having juice ratio B₇₀:K₃₀ was observed at room temperature storage after 90 days. The study also revealed that, in general, the optical density

Table 10. Change in texture of the samples of banana and kinnow based RTS beverage at different storage conditions.

Storage period (Days)	Texture								
	B ₇₀ :K ₃₀			B ₆₀ :K ₄₀			B ₅₀ :K ₅₀		
Temp.	Ref. (5°C)	BOD (25°C)	Room (30-35°C)	Ref.(5°C)	BOD (25°C)	Room (30-35°C)	Ref.(5°C)	BOD (25°C)	Room (30-35°C)
After 24 hours	7.9	7.1	7.6	7.6	7.1	7.3	7.8	7.5	7.2
15	7.6	6.8	7.1	7.4	6.9	7.0	7.6	7.3	7.0
30	7.3	6.5	6.8	7.1	6.6	6.8	7.3	7.0	6.8
45	7.0	6.2	6.5	6.7	6.2	6.5	7.0	6.7	6.4
60	6.8	5.8	6.1	6.5	5.9	6.2	6.7	6.3	6.0
75	6.5	5.5	5.8	6.1	5.4	5.8	6.2	5.7	5.7
90	6.0	5.2	5.3	5.6	5.1	5.5	5.8	5.4	5.0

slightly increased with increase in storage period. This increase in optical density may be attributed to non-enzymatic browning which would have taken place during storage. Non-enzymatic maillard browning reaction may take place between nitrogenous compounds and sugar, nitrogenous compound and organic acids, and among organic acids themselves (Srivastav and Kumar, 2002).

Effect on microbial growth

The microbial growth (TPC values) of the samples of different banana and kinnow based RTS beverage

were observed as 1.024×10⁵cfu/ml, 1.021×10⁵cfu/ml and 1.018×10⁵cfu/ml of B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ at room temperature after 15 days. The microbial growth of the samples of different proportions of banana and kinnow RTS beverage were observed as 1.020×10⁵cfu/ml, 1.015×10⁵cfu/ml and 1.010×10⁵cfu/ml of B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ at refrigeration temperature condition after 15 days and microbial growth value of banana and kinnow RTS beverage were observed as 1.022×10⁵cfu/ml, 1.018×10⁵cfu/ml and 1.015×10⁵cfu/ml of B₇₀:K₃₀, B₆₀:K₄₀ and B₅₀:K₅₀ at B.O.D. temperature condition after of 15 days. It was

Table 11. Overall acceptability of the samples of banana and kinnow based RTS beverage at different storage conditions.

Storage period (Days)	Overall acceptability								
	B ₇₀ :K ₃₀			B ₆₀ :K ₄₀			B ₅₀ :K ₅₀		
Temp.	Ref.(5°C)	BOD (25°C)	Room (30-35°C)	Ref.(5°C)	BOD (25°C)	Room (30-35°C)	Ref. (5°C)	BOD (25°C)	Room (30-35°C)
After 24 hours	8.30	7.45	7.57	7.77	7.55	7.42	8.27	7.85	7.55
15	8.07	7.22	7.27	7.57	7.32	7.10	8.02	7.65	7.30
30	7.77	6.95	7.00	7.30	7.05	6.87	7.77	7.32	7.05
45	7.45	6.62	6.70	6.97	6.70	6.57	7.52	6.95	6.70
60	7.20	6.27	6.32	6.70	6.37	6.27	7.20	6.50	6.275
75	6.82	6.05	5.97	6.32	5.85	5.75	6.50	6.05	5.87
90	6.40	5.45	5.60	5.87	5.50	5.25	6.0	5.62	5.37

observed from Table 6 that microbial growth of all the samples was increased at 0, 15, 30, 45, 60, 75 and 90 days of storage. The microbial growth value after 90 days of storage were observed as 1.070×10^5 cfu/ml, 1.065×10^5 cfu/ml and 1.056×10^5 cfu/ml for the sample stored at refrigeration condition. The study revealed that the microbial growth increased with increase of storage period. The highest microbial growths were observed as 1.135×10^5 cfu/ml in case of sample having banana and kinnow B₇₀:K₃₀ at room temperature period condition after 90 days of storage. (Saravana and Manimeglai, 2005) reported the microbial load as $1-2 \times 10^6$ bacteria, $1-2 \times 10^4$ fungi and $1 \times 2 \times 10^5$ per gram yeast in whey based papaya juice blended RTS beverage up to 90 days of storage in refrigeration condition, which was considered safe for consumption

Effect on overall acceptability

Sensory qualities were evaluated for all fresh as well as stored samples after 0, 15, 30, 45, 60, 75 and 90 days. The samples were served to panelists. Colour, flavour, texture and taste were selected as sensory attributes on 9-point Hedonic scale (Ranganna, 2001). That, in general no definite trends of sensory score for individual attributes were observed for fresh samples. The highest score awarded for colour was 8.5 to the sample having banana and kinnow juice composition B₇₀:K₃₀ at refrigeration temperature after 24 hours. Whereas, the lowest score 5.1 of the sample B₇₀:K₃₀ at B.O.D. temperature after 90 days. Except two samples, B₇₀:K₃₀ and B₆₀:K₄₀, all other samples were rated between "Like extremely" and "Like slightly" (Table 7). The flavour was found to have scored best 8.6 in the samples having fruit juice composition B₅₀:K₅₀ at refrigeration temperature after 24 hours sample and the lowest score 5.1 of the sample B₆₀:K₄₀ at room temperature after 90 days. Except two samples, B₅₀:K₅₀ and B₇₀:K₃₀ were rated between "Like extremely" and "Like slightly" (Table 8). The highest score awarded for taste was 8.7 of the sample (B₇₀:K₃₀) at refrigeration temperature condition after 24 hours. Whereas, the lowest score 5.2 of the sample B₆₀:K₄₀ at room temperature condition (Table 9) after 90 days. The highest score was awarded for texture was 7.9 of the sample B₇₀:K₃₀ at refrigeration temperature condition and the lowest

score 5.0 for the sample B₅₀:K₅₀ at room temperature (Table 10). All other samples were rated between "Like extremely" and "Neither like nor dislike". In general, decline in sensory score were observed in samples after 0, 15, 30, 45, 60, 75 and 90 days of storage period. In few cases increase in score were also observed unexpectedly. This increase in sensory score during storage could not be understood. However, the possible reason may be the replacement of few members of the panel by the new members and also because of inconsistency were not very high; they did not remarkably affect the overall score. (Table 11) shows that after the storage of 90 days all the samples were in fairly good condition. Overall sensory scores after 90 days of storage were lowest B₆₀:K₄₀ (5.25) at room temperature "Like slightly and highest (8.30) B₇₀:K₃₀ at refrigeration "Like extremely after 24 hours. Sensory evaluation could not be conducted after 90 days of storage due to visible microbial growth in all the stored samples.

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