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Research Article

Studies on Preparation of Carbonated Ready to Serve Beverage of Nagpur Mandarin (*Citrus reticulata* Blanco)

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Abstract

Presently 95 percent of the mandarin orange production goes for fresh fruit market. It's worth noting that mandarin loss is roughly 25-30% due to insufficient post-harvest infrastructure, and just 5% of the overall supply is now processed. As a result, the only way to fully utilize the abundant supply of mandarin is to make it possible to convert it into juice and other juice-based goods. RTS (Ready to Serve) Beverage of various fruits is most attractive and demanded fruit product among the all age groups. As a result, research was conducted with the goal of converting readily available huge quantities of mandarin oranges into more valuable products by inventing technology for carbonated RTS beverage manufacture. Standardization of mandarin orange juice based carbonated RTS beverage were carried out under 70, 80, 90, 100 and 110 psi (pound per square inch) carbonation level, packed in glass and kept at ambient temperature and in cold storage (5 ± 2°C) conditions. Based on the chemical analysis, organoleptic evaluation and microbial quality the mandarin orange based carbonated RTS beverage was prepared using 40 mL mandarin orange syrup having 55°Brix of total soluble solids (TSS) to make 200 mL final volume of RTS by keeping pressure of 90 Psi of CO_2 with TSS (from 12.51 to 13.86°Brix) and acidity (from 0.36 to 0.48%) during 180 days in cold storage was found to be the best among all the treatments.

Keywords: Nagpur mandarin, CO_2 pressure, RTS beverage, storage, sensory, chemical composition, yeast and mold count, cost of preparation

Introduction

The Nagpur mandarin (*Citrus reticulata* Blanco) is a popular citrus fruit with a vibrant colour and a pleasant taste and flavour. Citrus is grown in 114 different nations. There are 53 countries that commercially grow citrus, with a total production of more than 115 million tonnes. China leads the pack in terms of output with 22.9 million tonnes, followed by Brazil (22.7 million tonnes) and the United States (10.4 million tonnes). India is in fourth place with 10.48 million tonnes [3]. Citriculture, behind mango and banana, is India's third largest fruit sector, according to [22]. It accounts for 10.8% of total fruit production and occupies 9.4% of total area under fruits in the country. In India, citrus trees cover 7.49 million hectares, yielding 63.3 million tonnes of fruit. Citrus is planted on 9.87 lakh ha in India, with a total yield of 96.38 lakh tonnes and a productivity of 9.76 tonnes [7]. Citrus is produced on 2.87 lakh ha in Maharashtra, with a total yield of 17.25 lakh tonnes and a productivity of 6 tonnes. In terms of area and output, Maharashtra is first, followed by Andhra Pradesh and Punjab. Mentioned the same information [6]. Noticed that, Citrus fruits have been known to reduce the proliferation of many cancer cells. Gastric cancer is one of the most common diseases worldwide, and multiple studies have found that the flavonoids in citrus fruit inhibit cancer cell development [20].

Citrus fruits, are considered one of the healthy fruits since they are high in â-carotene, ascorbic acid, and folic acid [17]. Citrus fruits are a good source of ascorbic acid, pectin, carotenes, citric acid, and minerals including calcium and phosphorus, according to [13]. Citrus fruit juice has a mineral and ascorbic acid composition

that is useful. This fruit has a lot of potential for usage in value-added products. The composition of citrus fruit juice is beneficial with respect to its mineral and ascorbic acid contents. There is a great potential to use this fruit in value added products such as diet drinks [15]. These citrus drinks are undoubtedly the most well-known and widely accepted fruit beverages.

Mandarins are high in ascorbic acid (13-54 mg per 100 gm), calcium (25-46 mg per 100 gm), and have a water content of about 80% to 90% [19]. Citrus fruits are prized for their nutritional and therapeutic properties [21]. Oranges are high in vitamins C, A, B, and phosphorus [5]. These are available in both fresh and processed forms. On the basis of nutrition target in case of fruit consumption per day per capita availability is 80 g and needed 137 g. Fruit production in India, which is the second largest in the world (10%).

Because orange growers lack cold storage facilities, the oranges cannot be held for a longer period of time after harvesting, hence the manufacture of post-harvest products increases farmers' profits [14].

He [19] found that oil extraction from seed is one of the most important economic aspects of mandarins. Oil obtained from Mandarins and other citrus seeds is used as cooking oil, in soap manufacture, and in the plastic industry. The high-protein seed waste is good for human consumption and as a bovine feed ingredient, while the hulls are used in fertilizer blends.

Currently, 95% of the produce is destined for the fresh fruit market. It's worth noting that mandarin loss is roughly 25-30% due to insufficient post-harvest infrastructure, and that only 5% of overall crop is now processed [3]. The only way to fully utilize the abundant supply of mandarin is to make it possible to convert it into juice and other juice-based goods. RTS of various fruits is most attractive and demanded fruit product among the all age groups. So research work will be carried out with an aim to convert easily available large production of mandarin orange into more valued products by developing technology for preparation of carbonated RTS Beverage. In the present study, attempts are exclusively made to study the storage behavior of carbonated ready to serve beverage (RTS) prepared from mandarin orange with following objectives.

- To study the storage behavior of carbonated ready to serve beverage (RTS) prepared from mandarin orange Nagpur variety.
- To study the cost economics of prepared product.

Experimental materials

The present research entitled "studies on preparation of carbonated ready to serve beverage from Nagpur Mandarin" was carried out in the Post-Harvest Technology Centre, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri during the year 2015 - 2016.

Nagpur mandarin fruits

For the creation of carbonated ready to serve (RTS) beverage, fully ripened, mature, fresh, and sound fruits were acquired from an orange orchard in Ahmednagar, as well as components such as citric acid and sodium benzoate from the local market. Fruit was washed with tap water, peeled, and utilised in the following process as experimental materials:

RTS preparation

RTS were made from syrup; 40 mL of syrup was put to 200 mL transparent glass bottles, which were then filled with carbonated chilled water and sealed simultaneously using a carbonation machine and a sealer (Figure 1). All of the samples were sterilised before being stored in various settings. As a result, the study used a total of ten therapy combinations (Table 1). The RTS samples were air cooled under a fan, and the carbonated RTS beverage was stored in cold storage (5 ± 2°C) and room temperature for physiochemical analysis, sensory evaluation, and microbial count at 0, 30, 60, 90, 120, 150, and 180 days for physiochemical analysis, sensory evaluation, and microbial count.

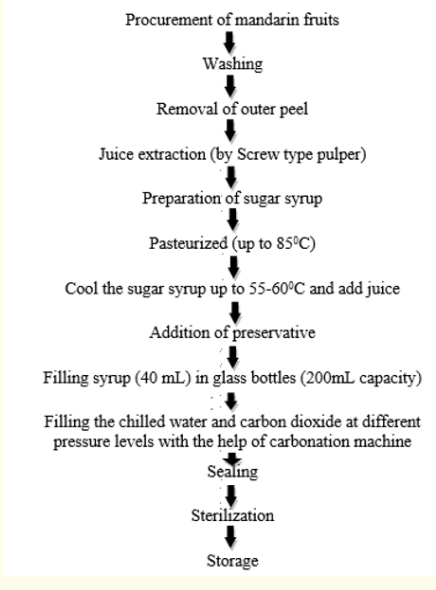

Figure 1: Preparation of carbonated RTS (Ready to Serve) beverage.

Tre. NO	Treatment Combinations		
		Storage condition	Carbonation pressure
TI	S1C1	Room Storage	70 psi
T2	S1C2	Room Storage	80 psi
T3	S1C3	Room Storage	90 psi
T4	S1C4	Room Storage	100 psi
T5	S1C5	Room Storage	110 psi
T6	S2C1	Cold Storage	70 psi
T7	S2C2	Cold Storage	80 psi
T8	S2C3	Cold Storage	90 psi
T9	S2C4	Cold Storage	100 psi
T10	S2C5	Cold Storage	110 psi

Table 1: Treatments details.

S= Storage Condition; C= Carbonation Pressure; Psi= Pound Per Square Inch.

Observations were recorded

Physical parameters of fresh mandarin fruit

The physical parameters such as Fruit weight (g), Peel weight (g), Seed weight (g), Juice weight (g), Pomace weight (g), peel thickness (cm), fruit length (cm), fruit breadth (cm) and Segment (pcs= pieces) were recorded.

Chemical analysis

The chemical parameters such as TSS, Titratable acidity, pH, Ascorbic acid (vitamin C), Total sugars, and Reducing sugars was determined by the standard method as suggested by [1,26].

Sensory evaluation

For assessing sensory quality attributes, organoleptic evaluation was carried by panel of 8-10 judges by using 9-point hedonic scale as given by [2,26].

Microbial quality

The microbiological analysis (yeast and mould) In order to make Nagpur mandarin carbonated RTS beverage, 1mL of each sample was taken and mixed with 9 mL of sterilised distilled water. All samples were serially diluted (10-6). 1 mL of each from the appropriate dilution was plated in the necessary medium (PDA) and incubated. The average count of colonies present on Petri plates was multiplied by the dilution factor and expressed as CFU (colony forming unit)/mL of sample in each count following incubation [4].

Statistical analysis

With three replications, the experiments were planned and carried out using Factorial Completely Randomized Design (FCRD). According to [24] the data obtained in this study from chemical composition and sensory characteristics were examined for statistical significance.

Results and Discussion

The carbonated RTS beverage of Nagpur mandarin was prepared by adding 40 mL of syrup with TSS (55 ^{0}Brix) and 5 levels of CO_2 pressure (70, 80, 90, 100, and 110 Psi) to 200 mL glass bottles filled with chilled water and stored for up to 6 months (180 days) to study the effect of the various treatments on its quality characteristics and overall acceptability. This chapter presents and discusses the findings of an experiment to standardize a carbonated RTS beverage made from Nagpur mandarins, as well as quality evaluation factors.

Physico-chemical composition of fresh Nagpur Mandarin fruit

The results for physico-chemical composition of fresh mandarin orange fruit Cv. Nagpur mandarin are presented in table 1. The data revealed that the fresh Nagpur mandarin had 128.8 g fruit weight, 19.59 g peel weight (15.21%), 3.10 g seed weight (2.41%), 68.39 g juice weight (53.09%), 37.72 g pomace weight (29.29%), 0.24 cm peel thickness, 5.6 cm fruit length, 6.21 cm fruit breath, 11 pieces of segments, 10.72 ^{0}Brix total soluble solids, 0.621 per cent acidity, 3.89 pH, 43.46 mg/100 mL ascorbic acid, 9.68 per cent total sugars and 3.89 per cent reducing sugars, respectively. Similar results were also recorded by [19,28] in Nagpur mandarin.

Initial chemical composition of Nagpur mandarin carbonated ready to serve beverage

The results for initial chemical composition of carbonated ready to serve beverage are presented in Table 3. The data revealed that the carbonated ready to serve beverage Nagpur mandarin had T.S.S. (12.51 ^{0}B), Acidity (0.36%), pH (4.23), Ascorbic Acid (3.86 mg/100 mL), Total Sugars (10.81%) and Reducing Sugars (4.83%).

Chemical composition of Nagpur mandarin carbonated ready to serve beverage during storage

The data for changes in chemical composition of carbonated ready to serve beverage from Nagpur mandarin subjected to different carbonation levels and storage period are given and discussed below.

S. no	Parameters	Contents
1	Fruit wt. (g)	128.8 (100%)
2	Peel wt. (g)	19.59 (15.21%)
3	Seed wt. (g)	3.10 (2.41%)
4	Juice wt. (g)	68.39 (53.09%)
5	Pomace wt. (g)	37.72 (29.29%)
6	peel thickness (cm)	0.24
7	fruit length (cm)	5.60
8	fruit breadth (cm)	6.21
9	Segment (pcs)	11.00
10	T.S.S. (^{0}B)	10.72
11	Acidity (%)	0.621
12	pH	3.89
13	Ascorbic Acid (mg/100 mL)	43.46
14	Total Sugars (%)	9.68
15	Reducing Sugars (%)	3.89

Table 2: Physico-chemical characteristics of Nagpur mandarin fruit (average of 30 fruit).

S.no	Parameters	Contents
1	T.S.S. (^{0}B or Brix)	12.51
2	Acidity (%)	0.36
3	p H	4.23
4	Ascorbic Acid (mg/100 mL)	3.86
5	Total Sugars (%)	10.81
6	Reducing Sugars (%)	4.83

Table 3: Initial chemical parameters of Nagpur mandarin carbonated RTS beverage (average of 30 sample).

RTS= Ready to Serve.

Total soluble solids (T.S.S.) (˚B or Brix)

From the data given in table 4, it was observed that TSS content increased during storage period, which might be due to reduction of moisture content, conversion of insoluble carbohydrates into soluble sugars and increasing total sugar content of carbonated RTS Beverage during storage.TSS content of carbonated ready to serve beverage was statistically Non-significant. The TSS of carbonated ready to serve beverage ranged from 12.54 to 12.89 ˚B in different treatments. The highest TSS observed in T1 (12.89 ˚B) while lowest TSS in T10 (12.54 ˚B).

The results are in agreement with the research work carried out by [25] in carbonated RTS of Jamun and [18] in carbonated RTS of sweet orange.

Acidity (%)

The results presented in table 4 showed that there was non-significant difference in acidity of carbonated ready to serve beverage during the 180 days of storage. The acidity of carbonated ready to serve beverage increased during 6 months of storage period. During storage, increase in acidity of carbonated ready to serve beverage from mandarin orange was observed which might be due to decrease in pH. The highest value of acidity was observed in treatment T1 as 0.413 per cent and the lowest value was observed in treatment T10 as 0.366 per cent. Similar results are reported by [10] in RTS of Sweet orange.

pH

The data for changes in pH of carbonated RTS beverage from Nagpur mandarin is showed in table 4. The pH content of carbonated RTS beverage from Nagpur mandarin was decreased during the advancement of storage period. All the treatments were found to be non-significant in the pH content of carbonated RTS beverage from Nagpur mandarin during 180 days of storage. The decrease in value of pH occurred due to degradation of pectin substances. The highest value of pH was observed in treatment T10 (4.23) and the lowest value of pH was observed in treatment T1 (4.09). Similar results were also recorded by [11] in RTS of Kinnow aonla blend RTS.

Ascorbic acid (mg per 100 mL)

The result showed that there was statistically non- significant difference in ascorbic acid of carbonated RTS beverage from Nagpur mandarin during storage of 180 days as it showed in table 4. The ascorbic acid content of carbonated RTS beverage from Nagpur mandarin during 180 days storage was decreased. The decrease of ascorbic acid content with duration of storage might be due to oxidation of ascorbic acid. The highest value of ascorbic acid was observed in treatment T10 as 3.752 mg/100 mL and the lowest value of ascorbic acid was observed in treatment T1 as 3.627 mg/100 mL.

Similar results were also reported by [13] in mandarin beverage and [12] for mango RTS.

Total sugars (%)

The data on changes in total sugars content of carbonated RTS beverage from Nagpur mandarin during storage is presented in

table 4. The results showed that, there was non-significant effect of total sugars of carbonated RTS beverage from Nagpur mandarin during advancement of storage period. The total sugars during storage period were increased might be due to loss of moisture in carbonated RTS beverage from Nagpur mandarin or due to conversion of starch and carbohydrates into sugars. Statistical non-significant increase in total sugars content were observed in all treatments with the increase in storage period of 180 days. The maximum value of total sugars content of carbonated RTS beverage from Nagpur mandarin was observed in treatment T1 (12.57%) and the lowest value of total sugars content of carbonated RTS beverage from Nagpur mandarin was observed in treatment T10 (10.92%). Similar results were also reported by [16] in carbonated RTS of guava.

Reducing sugars (%)

The observation regarding the changes in reducing sugars content of carbonated RTS beverage from Nagpur mandarin are presented in table 4. The data revealed that, there was increase in reducing sugars content during 180 days' storage. During storage, the reducing sugars were increased which might be due to hydrolysis of non-reducing sugars to reducing sugars. The maximum value of reducing sugars content of carbonated RTS beverage from Nagpur mandarin was observed in treatment T1 as 5.80 per cent and minimum value of reducing sugar content was observed in treatment T10 as 4.89 per cent.

The reducing sugars content of kinnow mandarin RTS beverage increased when stored for 24 weeks at room temperature [27].

Sensory evaluation of Nagpur mandarin carbonated ready to serve beverage

Colour

Colour is the main quality parameter for RTS beverages. The data on changes in colour of carbonated RTS beverage from Nagpur mandarin during storage is presented in table 5. All treatments had statistically non-significant effect on colour. The data indicates that the scores for colour and appearance decreased continuously during 180 days of storage. The highest scores for colour of carbonated RTS beverage from Nagpur mandarin was observed for treatment T10 (6.89) followed by T9 (6.76) while the lowest scores were observed for treatment T1 (5.68) during 180days storage. Similar results were also reported by [9] in Citrus juice.

Particulars	Storage period (days)	Treatments													
		T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	SE. m (±)	CD @ 5%	GM	CV (%)
Color															
	0	5.68	5.71	5.72	5.98	6.20	6.24	6.44	6.57	6.76	6.89	0.047	NS	6.22	1.30
	30	5.60	5.63	5.64	5.90	6.12	6.16	6.36	6.49	6.68	6.81	0.051	NS	6.14	1.45
	60	5.52	5.55	5.56	5.82	6.04	6.08	6.28	6.41	6.60	6.73	0.055	NS	6.06	1.58
	90	5.48	5.51	5.52	5.78	6.00	6.04	6.24	6.37	6.56	6.69	0.069	NS	6.02	1.99
	120	5.40	5.43	5.44	5.70	5.92	5.96	6.16	6.29	6.48	6.61	0.092	NS	5.94	2.69
	150	5.37	5.40	5.41	5.67	5.89	5.93	6.13	6.26	6.45	6.58	0.121	NS	5.91	3.55
	180	5.30	5.33	5.34	5.60	5.82	5.86	6.06	6.19	6.38	6.51	0.162	NS	5.84	4.80
Flavor															
	0	5.93	6.56	7.53	6.69	5.78	6.21	7.66	7.98	7.85	5.80	0.047	0.139	6.80	1.19
	30	5.84	6.47	7.44	6.60	5.69	6.12	7.57	7.89	7.76	5.71	0.051	0.153	6.71	1.33
	60	5.76	6.39	7.36	6.52	5.61	6.04	7.49	7.81	7.68	5.63	0.055	0.165	6.63	1.45
	90	5.65	6.28	7.25	6.41	5.50	5.93	7.38	7.70	7.57	5.52	0.069	0.206	6.52	1.84
	120	5.61	6.24	7.21	6.37	5.46	5.89	7.34	7.66	7.53	5.48	0.092	0.274	6.48	2.47
	150	5.51	6.14	7.11	6.27	5.36	5.79	7.24	7.56	7.43	5.38	0.121	0.360	6.38	3.29
	180	5.37	6.00	6.97	6.13	5.22	5.65	7.10	7.42	7.29	5.24	0.162	0.480	6.24	4.49

Taste														
	0	5.87	6.50	7.47	6.63	5.72	6.15	7.60	7.92	7.79	5.74	0.047	0.139	6.74	1.20
	30	5.80	6.43	7.40	6.56	5.65	6.08	7.53	7.85	7.72	5.67	0.051	0.153	6.67	1.33
	60	5.71	6.34	7.31	6.47	5.56	5.99	7.44	7.76	7.63	5.58	0.055	0.165	6.58	1.46
	90	5.61	6.24	7.21	6.37	5.46	5.89	7.34	7.66	7.53	5.48	0.069	0.206	6.48	1.85
	120	5.57	6.20	7.17	6.33	5.42	5.85	7.30	7.62	7.49	5.44	0.092	0.274	6.44	2.48
	150	5.38	6.01	6.98	6.14	5.23	5.66	7.11	7.43	7.30	5.25	0.121	0.360	6.25	3.36
	180	5.21	5.84	6.81	5.97	5.06	5.49	6.94	7.26	7.13	5.08	0.162	0.480	6.08	4.61
Overall Acceptability														
	0	5.83	6.26	6.91	6.43	5.90	6.20	7.23	7.49	7.47	6.14	0.047	0.139	6.59	1.23
	30	5.75	6.18	6.83	6.35	5.82	6.12	7.15	7.41	7.39	6.06	0.051	0.153	6.51	1.37
	60	5.66	6.09	6.74	6.27	5.74	6.04	7.07	7.33	7.30	5.98	0.055	0.165	6.42	1.49
	90	5.58	6.01	6.66	6.19	5.65	5.95	6.99	7.24	7.22	5.90	0.069	0.206	6.34	1.89
	120	5.53	5.96	6.61	6.13	5.60	5.90	6.93	7.19	7.17	5.84	0.092	0.274	6.29	2.55
	150	5.42	5.85	6.50	6.03	5.49	5.79	6.83	7.08	7.06	5.74	0.121	0.360	6.18	3.40
	180	5.29	5.72	6.37	5.90	5.37	5.67	6.70	6.96	6.93	5.61	0.144	0.429	6.05	4.13

Table 5: Sensory parameters of Nagpur mandarin carbonated RTS (six months storage).

Flavour

The results regarding the flavour score of carbonated RTS beverage from Nagpur mandarin is presented in table 5. All the treatments had statistically significant effect on flavour score. The score of flavor in all treatments of carbonated RTS beverage from Nagpur mandarin was decreased with increase of storage period. From statistical point of view, treatment T8 (7.98) was found to be best over the all other treatments having highest score of flavor followed by the treatment T9 (7.85), T7 (7.66) and T3 (7.47). The lowest flavor score was found in treatment T5 (5.78). Similar results were also reported by [23] in mandarin juice.

Taste

The data regarding taste score of carbonated RTS beverage from Nagpur mandarin during storage is presented in table 5. All the treatments had statistically significant effect on taste scores. From table it is observed that, the scores of tamarind RTS decreases gradually for 180-day storage period. From statistical point of view, treatment T8 (7.92) was found to be best over the other treatments having highest score of taste followed by treatment T9 (7.79) and the lowest taste score was found in treatment T5 (5.72). Similar results were also reported by [8] in Kinnow mandarin juice.

Overall acceptability

The data on changes in overall acceptability as influenced by storage period of 180 days are presented in table 5. The scores for overall acceptability of carbonated RTS beverage from Nagpur mandarin decreased gradually during 180-day storage period. Statistically, treatment T8 (7.49) was found to be the best over the other treatments having highest score of overall acceptability followed by treatment T9 (7.47), T7 (7.23), T3 (6.91) and the lowest score was observed for treatment T1 (5.83). Similar results were also reported by [17] in Kinnow RTS and [13] in mandarin beverage.

Microbial quality (yeast and mould) of Nagpur mandarin carbonated ready to serve beverage

table 6 shows that no microbiological (yeast and mould) growth occurred in the carbonated RTS beverages of Nagpur mandarin after 60 days of storage in both room and cold storage conditions, which were made under relatively sanitary conditions. The increase in microbial load after 60 days of storage, from 90 to 180 days, was insignificant and safe to eat. This demonstrates that the acidic environment and CO_2 gas in Nagpur mandarin orange carbonated RTS kept the beverage safe and inhibited microbiological growth. The microbiological safety of RTS beverages is also well

established to be dependent on the formulation, raw materials, pH control, and manufacturing conditions. Contamination of raw materials and equipment, additional processing conditions, improper handling, and the prevalence of unhygienic conditions all contribute significantly to the entry of pathogens into fruit beverages; however, since all of these safety precautions were taken into account in the current study, there was no microbial growth in the carbonated RTS beverages of Nagpur mandarin up to 60 days of storage, and from 90 up to 180 days of storage was negligible.

Tre. combination 0 days		Storage period/count period						
		30 days	60 days	90 days	120 days	150 days	180 days	
TI	S1C1	ND	ND	ND	1.34	1.42	1.48	1.52
T2	S1C2	ND	ND	ND	1.3	1.38	1.44	1.48
T3	S1C3	ND	ND	ND	ND	ND	1.42	1.46
T4	S1C4	ND	ND	ND	ND	1.31	1.37	1.41
T5	S1C5	ND	ND	ND	1.23	1.27	1.33	1.37
T6	S2C1	ND	ND	ND	1.19	1.25	1.31	1.35
T7	S2C2	ND	ND	ND	1.17	1.21	1.27	1.31
T8	S2C3	ND	ND	ND	ND	ND	1.23	1.27
T9	S2C4	ND	ND	ND	1.04	1.12	1.18	1.22
T10	S2C5	ND	ND	ND	1.03	1.11	1.17	1.21

Table 6: Changes in Microbial count (Yeast and Mold) of Nagpur mandarin carbonated RTS beverage during storage. count (No. x 10^6 cfu/mL).

ND= Not Detected.

Cfu= Colony Forming Units.

Shelf life analysis

The shelf life of reconstituted Nagpur mandarin carbonated based RTS beverage stored in cold and room storage was evaluated over a period of 180 days according to chemical composition, sensory evolution scores and fungi count data discussed above.

Cost of preparation of carbonated ready to serve beverage from Nagpur Mandarin

It could be observed from the table 7 that the cost of preparation of 200 mL of carbonated ready to serve (RTS) beverage from Nagpur Mandarin fruits was found to be 4.08 Indian rupees (Rs.).

Sr. No.	Particulars	Quantity	Rate (Rs.)	Cost (Rs.)
I. Fixed cost				
1.	Interest @12 % on fixed assets of carbonation Unit is Rs 98000/- (Rs 11760 for 365 days i.e. Rs 32.22 per day). Working time 8 hours			1.65
2.	Depreciation @10 % on fixed assets of carbonation Unit is Rs 98000/- (Rs 9800 for 365 days i.e. Rs 26.84 per day). Working time 8 hours			1.40
Total				3.05
II. Variable cost				
1.	Nagpur mandarin syrup	1.00 liter	55.02	55.02
2.	Water charges	4.00 liter	1.00/ liter	4.00
3.	Preservative	5.6 g	1000/ kg	5.60
4.	CO_2 gas	-	-	4.00
5.	Crown cork	25	0.60	15.00
Total				83.62
6.	Overhead charges (@ 10%) including Labor, Electricity charges, Pasteurization cost (Gas)			8.362
Total				91.98
Grand Total				95.03
200 mL RTS cost without bottle				3.80
200 mL RTS cost with bottle @ 7/bottle				10.80
200 mL RTS cost with bottle @ 7/bottle (Reused for 25 times)				4.08

Table 7: Cost of preparation of Nagpur mandarin carbonated RTS beverage.

Rs. = Indian Rupees.

Summary and Conclusion

The storage behavior of carbonated RTS beverages prepared from mandarin orange syrup using different carbonation levels packed in glass bottles stored at ambient and cold storage was studied. The

data regarding chemical composition revealed that, there was increase in in TSS, acidity, total sugars, reducing sugars while pH and ascorbic acid decreased in all treatment combination of carbonated RTS beverage during 180 days of storage. During sensory evaluation decrease was observed in colour, flavour, taste, overall acceptability of carbonated RTS beverage during 180 days of storage. The microbial quality viz. yeast and mould count of carbonated RTS beverage were found to be increased during 180 days of storage. The microbial growth was observed within acceptable level in all treatment combinations of carbonated RTS beverage. The treatment T8 (S2C3) was found to be superior in respect of chemical composition, sensory evolution and microbial quality followed by T9 (S2C4). The cost of preparation of 200 mL of carbonated RTS beverage from Nagpur mandarin orange fruits was found to be Rs. 4.08 for best treatment combination of S2C3 i.e. cold storage + 90 psi CO_2 pressure. The Nagpur mandarin carbonated RTS beverage could be prepared by using 40 mL of syrup having 550B TSS to make 200 mL final volume in glass bottle by using 90 psi carbonated child water and stored for 180 days at cold storage (5 ± 2°C).

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