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Formulation of Whey-Tomato Based Ready-To-Serve Fruit Beverage.

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ABSTRACT

India's milk production has reached 84 million tons and is now looking for new outlets for variety of dairy based convenience foods. Whey is the largest by-product of huge dairy industry and is one of the most troublesome by product produced which in Biological Oxygen Demand (BOD) value of waste water making the disposal costly and problematic. Whey based beverages with different concentrations of tomato and standard ingredients of RTS beverage were prepared. These beverages were analyzed for physico-chemical parameters like pH, acidity, TSS, ascorbic acid, total sugars, reducing sugars, lycopene, microbial quality (bacteria, yeast, and mold), shelf life and acceptability. The beverages were stored till spoilage and analysis was carried out at 15 days interval. The best treatment was found to be whey: tomato (65:35) of all the whey based tomato RTS beverage. From the present study it can be concluded that whey based fruit beverages can be exploited for commercial use.

Keywords: Whey, Fruit beverage, Tomato, Microbial quality, Shelf life, Acceptability

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INTRODUCTION

Whey

Whey is a nutritious by product from cheese, chhana and paneer industry containing valuable nutrients like lactose, proteins, minerals and vitamins etc. which have indispensable value as human food [1]. Whey constitutes 45-50% of total milk solids, 70% of milk sugar (lactose), 20% of milk proteins and 70-90% of milk minerals and most importantly, almost all the water soluble vitamins originally present in milk [2]. In India, it is estimated that about 100 million kg of whey is annually derived as a byproduct which may cause substantial loss of about 70,000 tonnes of nutritious whey solids. Considerable work has been done throughout the world to utilize whey for production of whey protein concentrate (WPC), whey powder, lactose, lactic acid, whey paste etc [3]. The conversion of whey into beverages through fermentation or without fermentation is one of the most attractive avenues for the utilization of whey for human consumption. In terms of functionality, whey protein enhances protein content of beverage while improving its quality [4].

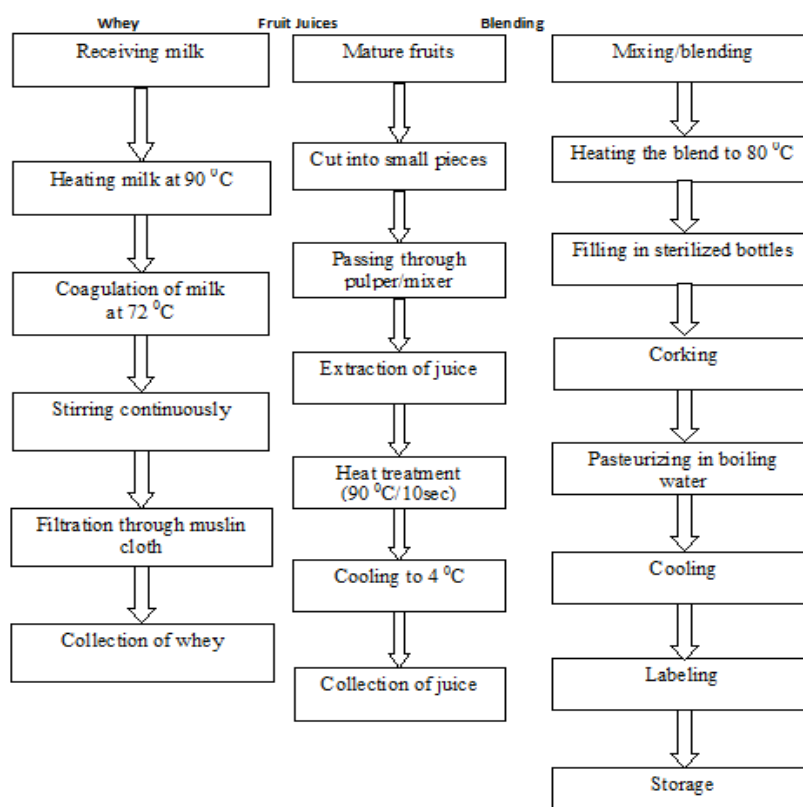
Whey disposal problem

Though whey possesses all these advantages, it is still being drained due to lack of economical processing techniques. The disposal of whey into municipal sewers poses threat to environment and health as it has high BOD ranging between 30,000-50,000 mg/lit which render it most potent pollutant of dairy wastes. The strict environment laws are compelling the dairy industry to concentrate on whey and find means for efficient utilization of its nutrients [5].

MATERIALS AND METHODS

Development of whey based ready-to-serve (RTS) fruit beverages [6]

Schematic diagram for the preparation of whey based ready-to-serve (RTS) fruit beverages is given in the following flow diagrams:



Experimental details

In the present investigation, two experiments were carried out and the experimental details are furnished here under.

Experiment-1 [7]

Formulation of different combinations of fruit juice blends with different proportions using whey.

Procedure

Various proportion of tomato juice and whey along with 8 per cent sugar, pectin 0.05 per cent and Carboxy Methyl Cellulose (CMC) 0.15 per cent were used for the preparation of RTS beverages. The proportion of sugar, pectin and CMC were maintained constant in all the formulations. The blends were heated at 80°C and cooled, sodium benzoate is added as preservative @100ppm i.e 0.1gm/lit, filled in sterilized 200ml bottles and crown corked using corking machine.

Treatment details [8]

For preparing the RTS beverages, whey and tomato juice were blended in different ratios. A total of five blends with different dilutions were prepared as shown in Table 1.

Sensory evaluation of above blends showed that only 3 blends with tomato juice (1, 2 and 3) were acceptable. Hence, only these combinations were used for the study. These are

- 1 - T1: Whey and tomato (75:25)
- 2 - T2: Whey and tomato (70:30)
- 3 - T3: Whey and tomato (65:35)

Table 1: Composition of various RTS beverages

Treatments	Whey (%)	Tomato (%)
1	85	15
2	80	20
3	75	25
4	70	30
5	65	35

Experiment-2 [9, 10]

Storage study of whey based RTS fruit juice blends.

Interval of analysis: At 15 days interval till products gets spoiled.

Parameters studied: TSS (Total soluble solids), pH, acidity, ascorbic acid, reducing sugars, total sugars, lycopene, oranoleptic, total bacterial count, yeast and mold count.

RESULTS AND DISCUSSION

Physico chemical changes of whey based tomato RTS beverage during storage

pH

Data in Table 2 indicates that no significant decrease in pH was observed during storage from 0 day to 15 days, however significant change in pH was observed from 15th day of storage to 60 days. Lower pH was observed in whey: tomato beverage (65:35) and higher pH was observed in whey: tomato (75:25) beverage (Figure 1).

Acidity

Data in Table 3 indicates that there was significant difference in the beverages studied during the storage period. Increase in acidity was observed from 0 day to 60 days of storage. Whey: tomato beverage (65:35) exhibited significantly higher acidity values than other treatments. Lowest acidity value was observed with Whey: tomato (75:25) (Figure 2).

TSS

The data of TSS is presented in Table 4. Significant differences were observed during the storage period. TSS remained almost same till 30 days of storage. The increase was par with each other from 45 days to 60 days of storage. Highest TSS was observed in whey: tomato beverage (65:35) followed by whey: tomato beverage (70:30) and least was observed in whey: tomato (75:25) (Figure 3).

Ascorbic acid

The results of ascorbic acid in whey based tomato beverage were presented in Table 5. The results indicate significant differences during the period of storage. With the advancement of storage, significant decrease from 0 day to 60 days was observed. Highest ascorbic acid content was observed in Whey: tomato (65:35) followed by Whey: tomato (70:30) and least in Whey: tomato (75:25) (Figure 4).

Total sugar

The data of TSS is presented in Table 6. Significant differences were observed during the storage period. Total sugars were more in Whey: tomato (65:35) followed by Whey: tomato (70:30) as compared to in Whey: tomato (75:25). With the advancement of storage period, significant changes were observed. There was a decrease in total sugar content from 0 day to 60 days (Figure 5).

Reducing sugars

The data of reducing sugars is presented in Table 7. Significant differences were observed during the storage period from 0 day to 60 days. Highest reducing sugars were in Whey: tomato (65:35) followed by Whey: tomato (70:30) as compared to whey: tomato beverage (75:25). The interaction effect between periods and treatments was significant. Higher reducing sugar content was observed on 60th day in all the treatments as compared to other days. There was significant increase in the reducing sugar content from 0 days to 60 days in all treatments (Figure 6).

Lycopene

The data on lycopene content in Whey based tomato RTS beverage in Table 8 indicates that there were significant changes during storage, among treatments and also the interaction effects were observed with the increase in storage period. Lycopene content of Whey based tomato RTS beverage is decreased from 0 day to 60 days. Highest lycopene content was in Whey: tomato (65:35) as compared to Whey: tomato beverage (75:25), Whey: tomato beverage (70:30) showed intermediate values. Significant interaction effect was observed between treatments and days of storage. Lycopene content was found to be highest in whey: tomato beverage (65:35) on 0 day as compared to 60th day in whey: tomato beverage (75:25). All treatments exhibited a progressive decrease in lycopene content with increase in storage period (Figure 7).

Sensory evaluation of whey based tomato RTS beverage

The average sensory scores for each contribute of Whey based tomato RTS beverages are presented in Tables 9, 10, 11, 12 and 13.

Colour and appearance

Data on colour and appearance in whey based tomato RTS beverage is presented in Table 9. Though the data indicates significant changes during storage, the change was not significant in colour and appearance up to 30 days of storage. Colour and appearance decreased significantly during storage from 30 days to 60 days of storage. Among the treatments whey: tomato beverage (65:35) recorded higher score compared to other treatments (Figure 8).

Taste

The results in Table 10 showed that the taste of whey based tomato RTS beverages changed significantly during storage. During storage, the taste decreased significantly from 0 day to 60 days. Significant differences were observed among the treatments. Whey: tomato beverage (65:35) scored high as compared to all other treatments (Figure 9).

Flavour

There had been significant changes in flavor of whey based tomato RTS beverages during the storage period. Flavour decreased significantly from 0 day to 60 days. Higher flavor was observed in whey: tomato beverage (65:25) followed by whey: tomato beverage (70:30). Mean scores for flavour of whey based tomato RTS beverages were presented in Table 11 and Figure 10.

Consistency

Data in Table 12 indicates that there were significant differences during the storage period. Decrease in consistency was observed with the advancement of storage period. Higher consistency was recorded in whey: tomato beverage (65:35) followed by whey: tomato beverage (70:30) as compared to whey: tomato beverage (75:25) (Figure 11).

Overall acceptability

Data on overall acceptability of whey based tomato RTS beverages is presented in Table 13. The data indicates significant changes during storage. Overall acceptability decreased significantly during storage. No significant difference was observed up to 30 days of storage, but after that the overall acceptability decreased. Among the treatments whey: tomato beverage (65:35) scored higher acceptability compared to other treatments. Overall acceptability rapidly decreased from 30 days to 60 days in all treatments (Figure 12).

Microbial evaluation of whey based tomato RTS beverage

The results obtained for microbial load in whey based tomato RTS beverage is presented in Table 14 (B-Bacteria; Y&M-Yeast and Mold; Cfug- Colony forming units per gram). Microbial examination showed that the samples were free from spoilage up to 30 days of storage. Bacterial growth was observed after 30 days of storage. Higher load was recorded (20cfu/g) at 60 days of storage in Whey: tomato (65:35) followed by (17cfu/g) in Whey: tomato (70:30) and (13cfu/g) in Whey: tomato (75:25). Yeast and mold growth was observed from 45 days to 60 days of storage with higher load (5cfu/g) and (7cfu/g) in Whey: tomato (65:35) followed by (4cfu/g) and (6cfu/g) in Whey: tomato (70:30) and (3cfu/g) and (5cfu/g) in Whey: tomato (75:25) respectively.

Figure 1: Effect of storage period on pH of whey based tomato RTS beverages

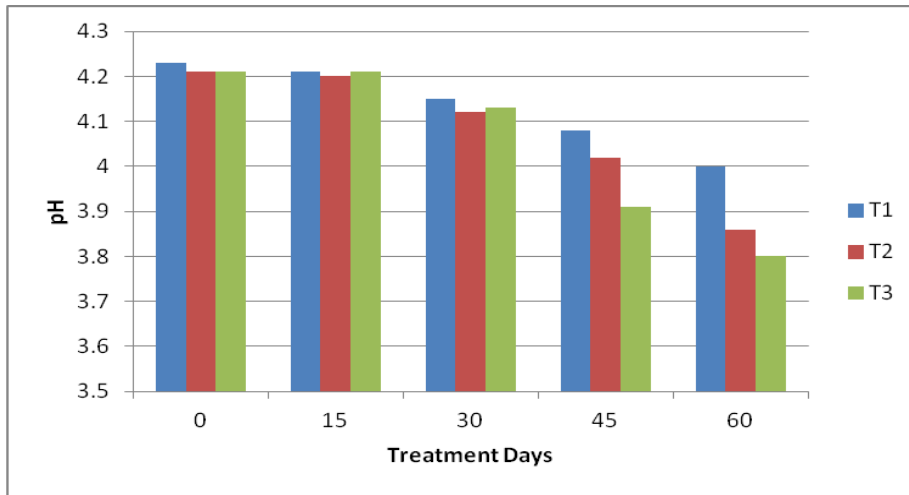


Figure 2: Effect of Storage period on acidity in whey based tomato RTS beverages

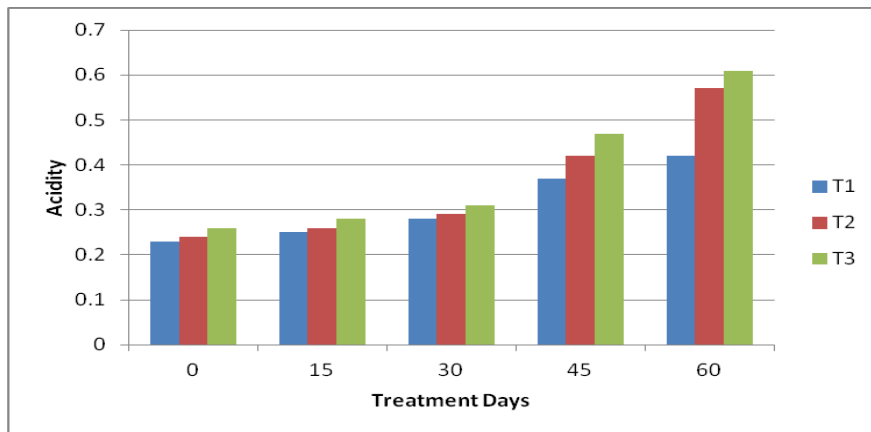


Figure 3: Effect of storage period on TSS (brix) in whey based tomato RTS beverages

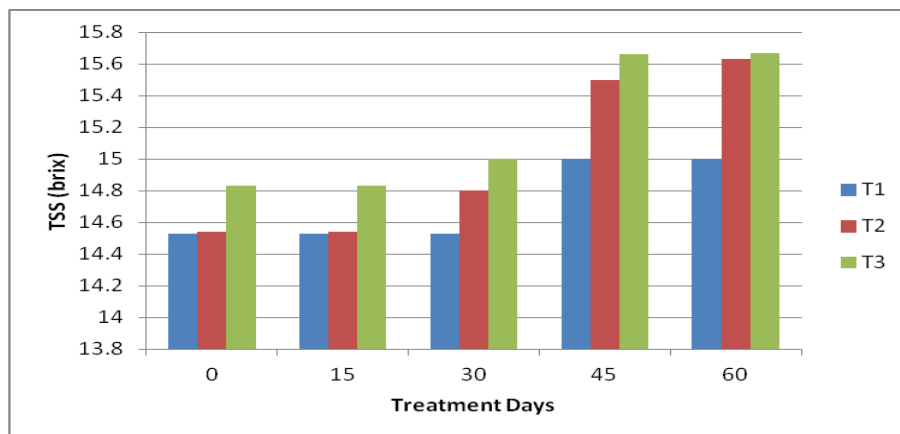


Figure 4: Effect of Storage period on ascorbic acid (mg/100g) in whey based tomato RTS beverage

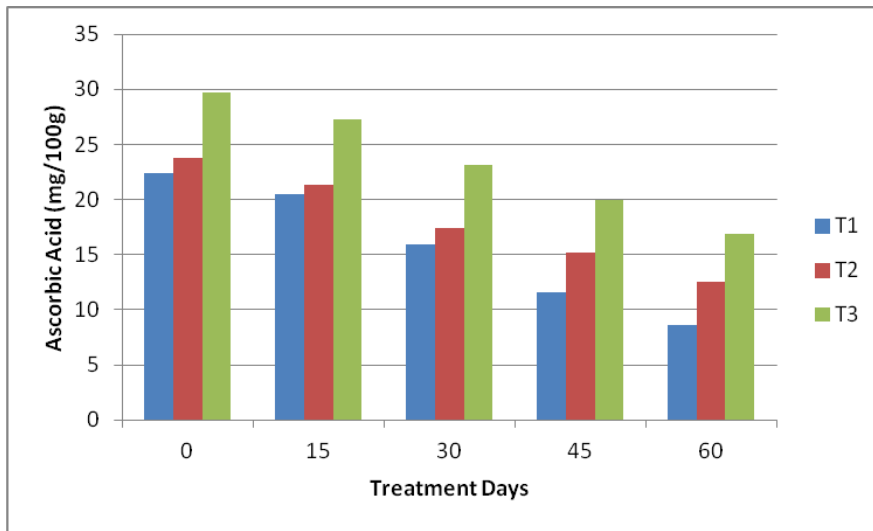


Figure 5: Effect of storage period on total sugar (%) of whey based tomato RTS beverages

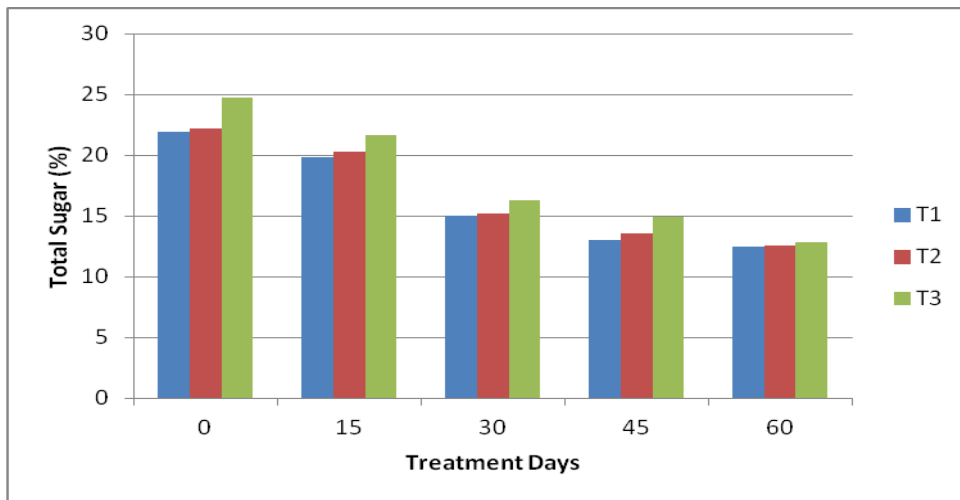


Figure 6: Effect of storage period on reducing sugar in whey based tomato RTS beverages

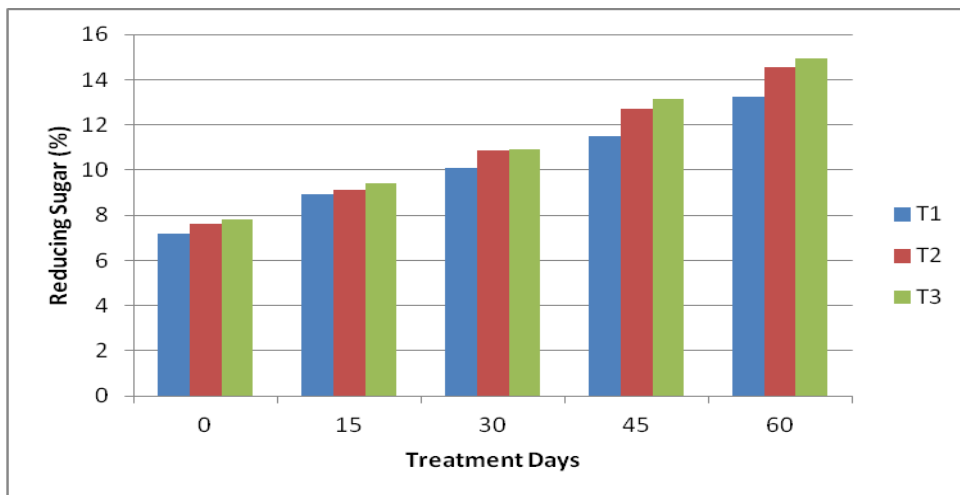


Figure 7: Effect of storage period on lycopene content (mg/ 100g) in whey based tomato RTS beverages

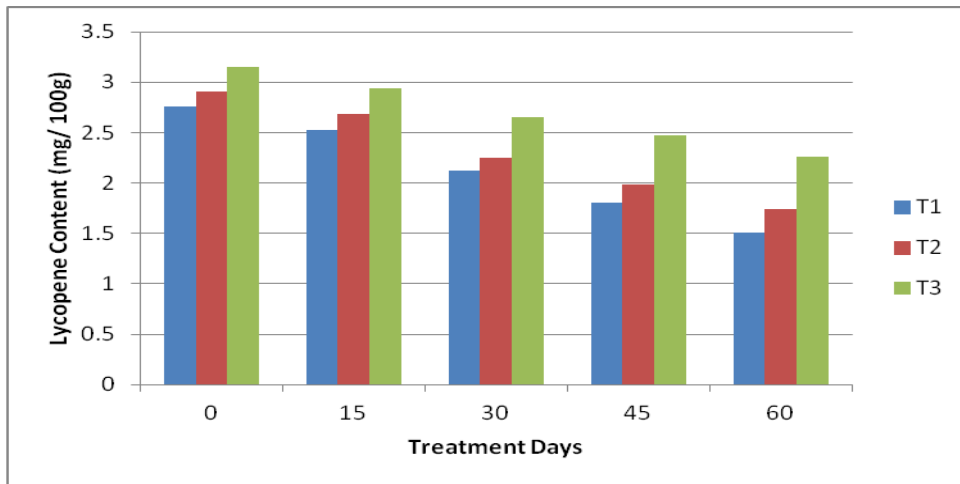


Figure 8: Mean scores for colour and appearance of whey based tomato RTS beverage

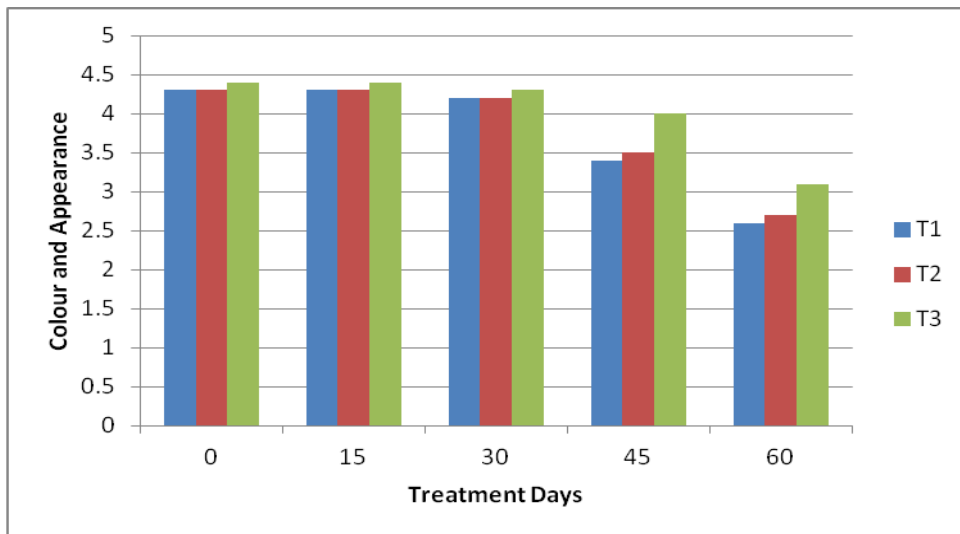


Figure 9: Mean scores for taste of whey based tomato RTS beverage

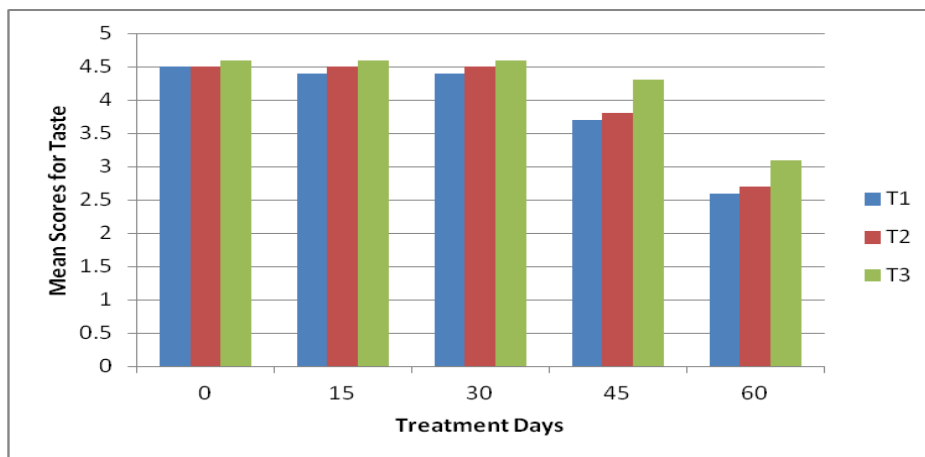


Figure 10: Mean scores for flavour of whey based tomato RTS beverage

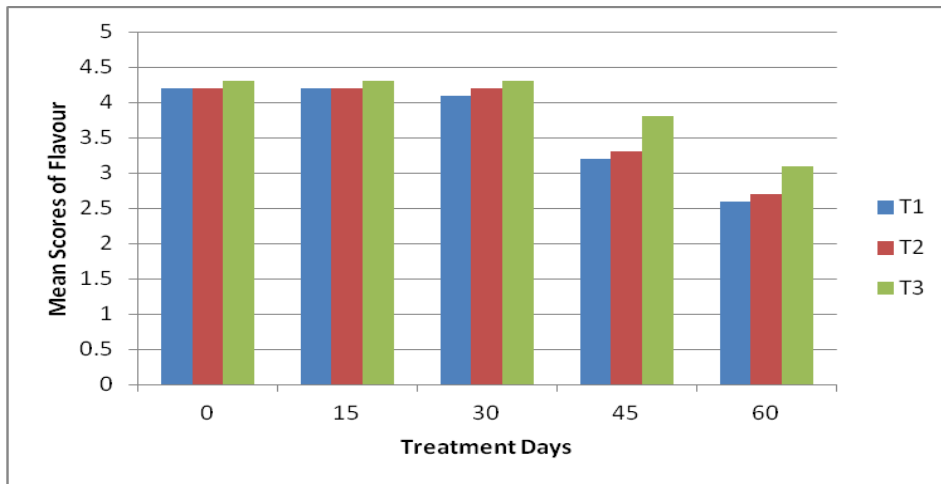


Figure 11: Mean scores for consistency of whey based tomato RTS beverage

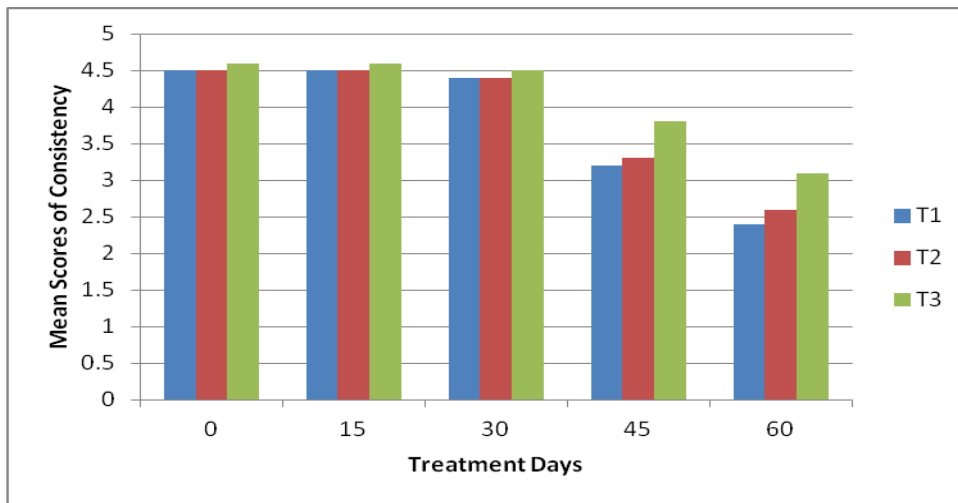


Figure 12: Mean scores for overall acceptability of whey based tomato RTS beverage

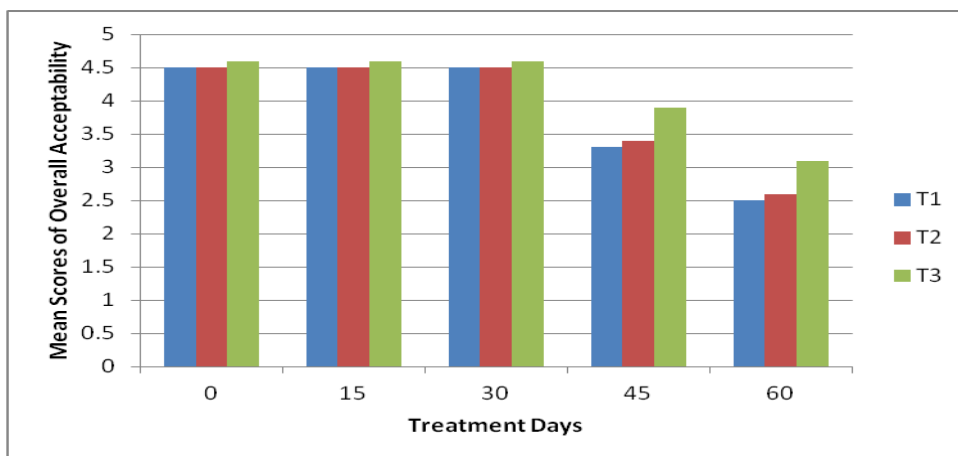


Table 2: Effect of storage period on pH of whey based tomato RTS beverages

Treatments/Days	0	15	30	45	60
T1	4.23	4.21	4.15	4.08	4.00
T2	4.21	4.20	4.12	4.02	3.86
T3	4.21	4.21	4.13	3.91	3.80

Table 3: Effect of Storage period on acidity in whey based tomato RTS beverages

Treatments/Days	0	15	30	45	60
T1	0.23	0.25	0.28	0.37	0.42
T2	0.24	0.26	0.29	0.42	0.57
T3	0.26	0.28	0.31	0.47	0.61

Table 4: Effect of storage period on TSS (brix) in whey based tomato RTS beverages

Treatments/Days	0	15	30	45	60
T1	14.53	14.53	14.53	15.00	15.00
T2	14.54	14.54	14.80	15.50	15.63
T3	14.83	14.83	15.00	15.66	15.67

Table 5: Effect of Storage period on ascorbic acid (mg/100g) in whey based tomato RTS beverage

Treatments/Days	0	15	30	45	60
T1	22.36	20.53	15.90	11.53	8.59
T2	23.80	21.33	17.40	15.16	12.53
T3	29.73	27.25	23.14	19.91	16.90

Table 6: Effect of storage period on total sugar (%) of whey based tomato RTS beverages

Treatments/Days	0	15	30	45	60
T1	21.94	19.82	15.03	13.05	12.47
T2	22.16	20.25	15.23	13.57	12.52
T3	24.73	21.64	16.25	14.93	12.82

Table 7: Effect of storage period on reducing sugar in whey based tomato RTS beverages

Treatments/Days	0	15	30	45	60
T1	7.18	8.91	10.08	11.51	13.24
T2	7.62	9.14	10.85	12.73	14.55
T3	7.82	9.42	10.94	13.15	14.94

Table 8: Effect of storage period on lycopene content (mg/ 100g) in whey based tomato RTS beverages

Treatments/Days	0	15	30	45	60
T1	2.76	2.53	2.12	1.81	1.51
T2	2.91	2.68	2.25	1.98	1.74
T3	3.15	2.94	2.65	2.47	2.26

Table 9: Mean scores for colour and appearance of whet based tomato RTS beverage

Treatments/Days	0	15	30	45	60
T1	4.30	4.30	4.20	3.40	2.60
T2	4.30	4.30	4.20	3.50	2.70
T3	4.40	4.40	4.30	4.000	3.10

Table 10: Mean scores for taste of whey based tomato RTS beverage

Treatments/Days	0	15	30	45	60
T1	4.50	4.40	4.40	3.70	2.60
T2	4.50	4.50	4.50	3.80	2.70
T3	4.60	4.60	4.60	4.30	3.10

Table 11: Mean scores for flavour of whey based tomato RTS beverage

Treatments/Days	0	15	30	45	60
T1	4.20	4.20	4.10	3.20	2.60
T2	4.20	4.20	4.20	3.30	2.70
T3	4.30	4.30	4.30	3.80	3.10

Table 12: Mean scores for consistency of whey based tomato RTS beverage

Treatments/Days	0	15	30	45	60
T1	4.50	4.50	4.40	3.20	2.40
T2	4.50	4.50	4.40	3.30	2.60
T3	4.60	4.60	4.50	3.80	3.10

Table 13: Mean scores for overall acceptability of whey based tomato RTS beverage

Treatments/Days	0	15	30	45	60
T1	4.50	4.50	4.50	3.30	2.50
T2	4.50	4.50	4.50	3.40	2.60
T3	4.60	4.60	4.60	3.90	3.10

Table 14: Microbial count (cfu/g) of whey based tomato RTS beverage

Treatments/Days	0		15		30		45		60	
	B	Y&M	B	Y&M	B	Y&M	B	Y&M	B	Y&M
T1	-	-	-	-	-	-	10	3	13	5
T2	-	-	-	-	1	-	13	4	17	6
T3	-	-	-	-	2	-	15	5	20	7

CONCLUSIONS

Blending of two or more fruit juice for preparation of whey based ready to serve fruit beverages are thought to be a convenient alternative for utilization in order to have some value added product which are of high nutritional and health quality aspects.

The results are:

- Out of five formulations made using whey: tomato juice, three treatments of whey: tomato was selected for study due to their better acceptability.
- The changes observed were decrease in pH, ascorbic acid, total sugar and lycopene content with the concomitant increase in acidity, TSS, and reducing sugar content.
- The scores for sensory attributes decreased on storage.
- Negligible growth of micro organisms was observed in all formulations upon storage.
- All formulations could be stored without deterioration and can be acceptable up to 2 months at room temperature.

From the results of the present study it can be concluded that paneer whey could be profitable in preparation of highly acceptable whey based RTS fruit beverages using tomato. The shelf life of these beverages could be enhanced with the addition of 100 ppm sodium benzoate. Instead of discarding dairy by products like "Whey" it can be used to prepare value added products for use at household and commercial level.



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