



## FORMULATION OF WHEY-SWEET ORANGE BASED READY-TO-SERVE FRUIT BEVERAGE

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### ABSTRACT

Whey is the largest by-product of huge dairy industry and is one of the most troublesome byproduct produced which in Biological Oxygen Demand (BOD) value of waste water making the disposal costly and problematic. Whey based beverages with different concentrations of sweet orange juice and standard ingredients of RTS beverage were prepared. These beverages were analyzed for physic 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 results indicated that on storage, acidity and reducing sugars increased significantly, whereas pH, total sugars, ascorbic acid and lycopene decreased significantly in all the treatments. TSS did not change appreciably during storage and no microbial growth was observed up to 30 days. Scores for all sensory parameters decreased with the increase in storage period. Significant decrease in scores was observed after 45 days to 60 days of storage.

**KEYWORDS:** Whey, Fruit beverage, Sweet orange, 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<sup>1</sup>. 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 (Horton, 1995). 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<sup>2</sup>. 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.<sup>3</sup>. 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<sup>4</sup>.

### **Composition of whey**<sup>5, 6</sup>

Different workers have reported the composition of whey which on an average contains fat in the range of 0.006-0.07%; protein 0.30-0.90 %; lactose 3.04-5.00 %; and ash from 0.50-0.62% in cheddar cheese whey. Composition of chhana/paneer whey has reported to contain fat 0.2-0.5%; protein 0.2-1.0 %; lactose 4.9-5.1%; ash 0.4-0.6%; and lactic acid. Acid casein whey has been reported to contain fat between 0-0.2%, protein 0.7-1.0%, lactose 4.3-5.1%, ash 0.4 -0.7%. Cow milk paneer whey has been reported to contain total solids 6.06 percent, pH 5.50 per cent, protein 0.30 per cent, fat 0.13 per cent, lactose 5.03 percent and ash 0.60 per cent.

## MATERIALS AND METHODS

### **Procurement and preparation**<sup>7, 8</sup>

For the present study, milk procured from local market and paneer was prepared by the

method of Arora (1972), using buffalo milk. Milk was heated to 90 °C and then coagulated at 72 °C using 1.0 per cent citric acid solution. Whey obtained as by product of paneer was used for the present study. Fresh fully ripe sweet orange fruits were procured from local market. Commercial grade, white, crystalline sugar was used throughout the experiment. To prevent protein coagulation during pasteurization and de-emulsification of juice during subsequent storage and to increase the apparent viscosity of the beverage, colloidal stabilizer pectin and emulsifier Carboxy Methyl Cellulose (CMC) were added to formulate mix. Sweet oranges are peeled manually and the juice was removed by using extractor and filtered through a muslin cloth and utilized for preparation of beverage<sup>11</sup>.

### **Experimental details**<sup>9, 10</sup>

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

#### **Experiment-1**

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

#### **Procedure**

Various proportion of sweet orange juices 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 the corking machine.

#### **Treatment details**

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

**Table 1**  
**Composition of various RTS beverages**

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

Sensory evaluation of above blends showed that only two blends with the sweet Orange juice (4 and 5) were acceptable. Hence, only these combinations were used for the study. These are  
4 - O<sub>1</sub>: Whey and sweet orange (70:30)  
5 - O<sub>2</sub>: Whey and sweet orange (65:35)

### Experiment-2

- Storage study of whey based RTS fruit juice blends.
- Interval of analysis: At 15 days interval till products get spoiled.
- Parameters studied: TSS (Total soluble solids), pH, acidity, ascorbic acid, reducing sugars, total sugars, lycopene, organoleptic, total bacterial count, yeast and mold count.
- The following parameters were analyzed for the selected combinations of whey based beverages in fresh & stored samples.
- The products prepared in Experiment-1 were analyzed at 15 days interval for the parameters of pH, TSS (Brix), ascorbic

acid, sugars, lycopene, microbial spoilage, total bacterial count, yeast and molds and organoleptic evaluation<sup>12</sup>.

## RESULTS AND DISCUSSION

### Physico chemical changes of whey based sweet orange RTS beverage during storage pH

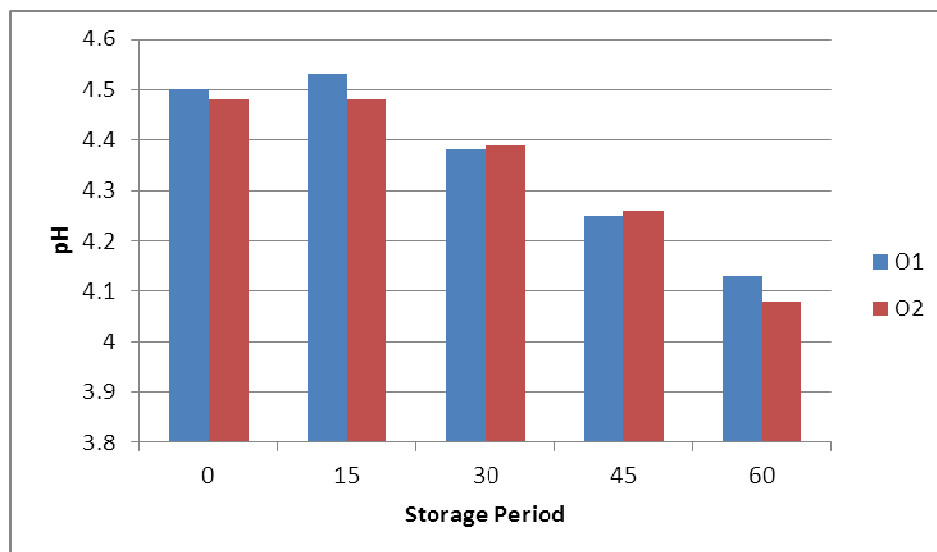
The data in Table 2 showed that decrease in pH was not significant during storage from 0 day to 15 days. However, the significant change in pH was observed from 15<sup>th</sup> day to 60 days of storage. No significant change in pH was observed between treatments.

**Table 2**  
**Effect of storage period on pH in whey based sweet orange RTS beverage**

Treatments / days	0	15	30	45	60
O <sub>1</sub>	4.5	4.53	4.38	4.25	4.13
O <sub>2</sub>	4.48	4.48	4.39	4.26	4.08

O<sub>1</sub> – whey and Sweet orange (70:30); O<sub>2</sub> – whey and sweet orange (65:35)

**Graph 1**  
**Effect of storage period on pH in whey based sweet orange RTS beverage**



**Acidity**

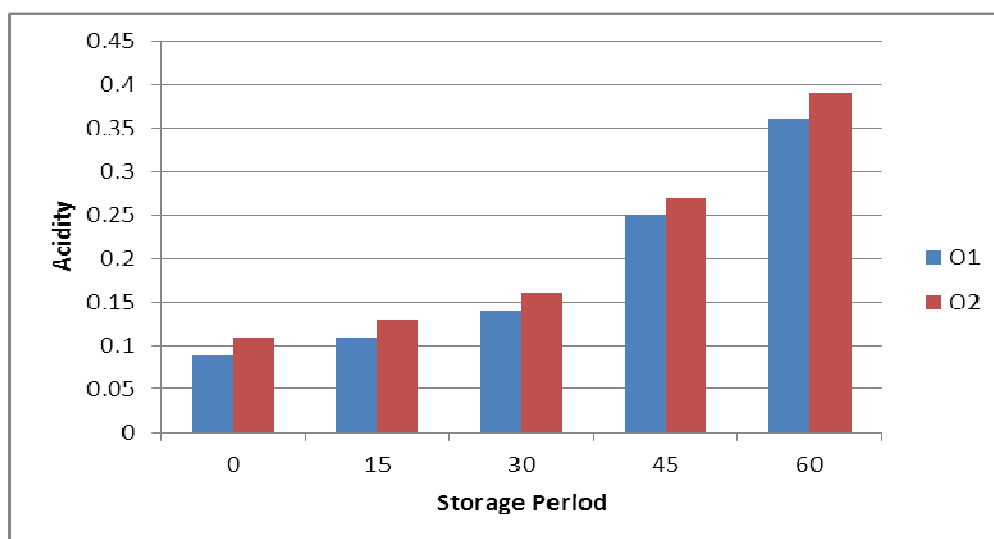
Data in Table 3 indicates that there was significant difference in the beverages studied during storage period. Significant increase in acidity was observed from 15<sup>th</sup> day to 60 days of storage. Whey: sweet orange beverage (65:35) exhibited significantly higher acidity values as compared to whey: sweet orange beverage (70:30).

**Table 3**  
**Effect of storage period on acidity in whey based sweet orange RTS beverage**

Treatments/days	0	15	30	45	60
O <sub>1</sub>	0.09	0.11	0.14	0.25	0.36
O <sub>2</sub>	0.11	0.13	0.16	0.27	0.39

O<sub>1</sub> – whey and Sweet orange (70:30); O<sub>2</sub> – whey and sweet orange (65:35)

**Graph 2**  
**Effect of storage period on acidity in whey based sweet orange RTS beverage**

**TSS**

The data of TSS is presented in Table 4. Significant differences were not observed during the storage period from 0 day to 30 days. Highest TSS was recorded in whey: sweet orange beverage (65:35) followed by whey: sweet orange beverage (70:30).

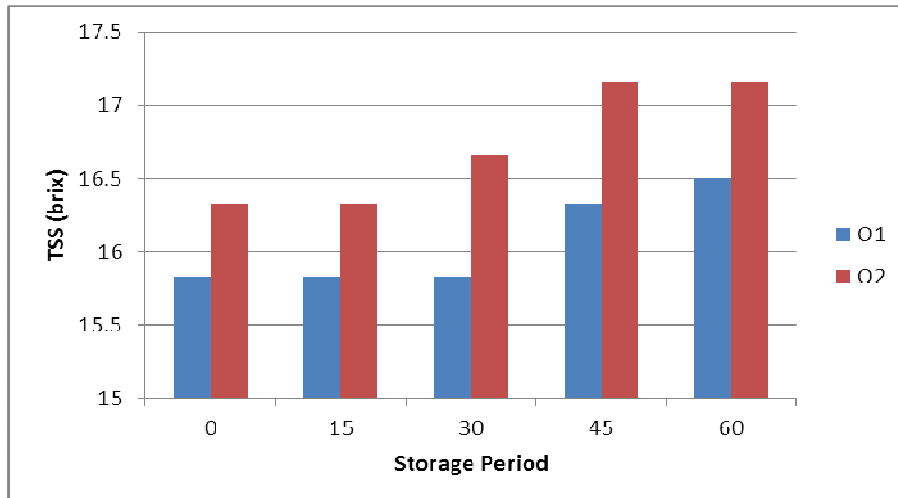
**Table 4**  
**Effect of storage period on TSS (brix) in whey based sweet orange RTS beverage**

Treatments/days	0	15	30	45	60
O <sub>1</sub>	15.83	15.83	15.83	16.33	16.50
O <sub>2</sub>	16.33	16.33	16.66	17.16	17.16

O<sub>1</sub> – whey and Sweet orange (70:30); O<sub>2</sub> – whey and sweet orange (65:35)

**Graph 3**

**Effect of storage period on TSS (brix) in whey based sweet orange RTS beverage**



**Ascorbic acid**

The results of ascorbic acid in whey based sweet orange RTS beverage are presented in Table 5. The results indicate significant difference during the period of storage. With the advancement of storage, significant decrease was observed from 0 day to 60

days. Highest ascorbic acid was observed in whey: sweet orange beverage (65:35) followed by whey: sweet orange beverage (70:30). Significant decrease in ascorbic acid content was observed from 0 to 60 days in whey: sweet orange beverage (65:35).

**Table 5**

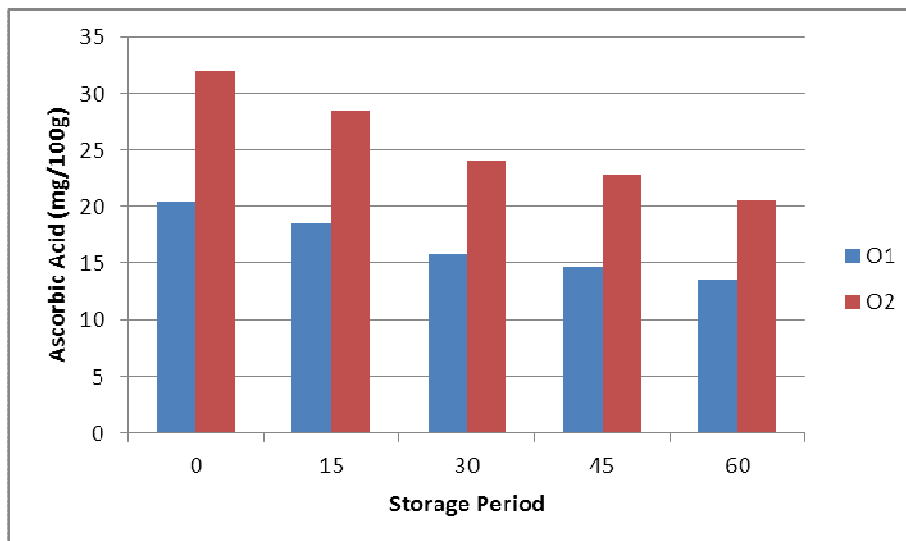
**Effect of storage period on ascorbic acid (mg/100g) in whey based sweet orange RTS beverage**

Treatments/days	0	15	30	45	60
O <sub>1</sub>	20.50	18.53	15.83	14.73	13.56
O <sub>2</sub>	31.93	28.47	24.13	22.80	20.66

O<sub>1</sub> – whey and Sweet orange (70:30); O<sub>2</sub> – whey and sweet orange (65:35)

**Graph 4**

**Effect of storage period on ascorbic acid (mg/100g) in whey based sweet orange RTS beverage**



**Total sugar**

Significant changes were observed in total sugar content during the storage period indicated in Table 6. Total sugar content varied significantly between the treatments. Total sugars were higher in whey: sweet orange beverage (65:35) followed by whey: sweet orange beverage (70:30). With the advancement of storage, significant changes

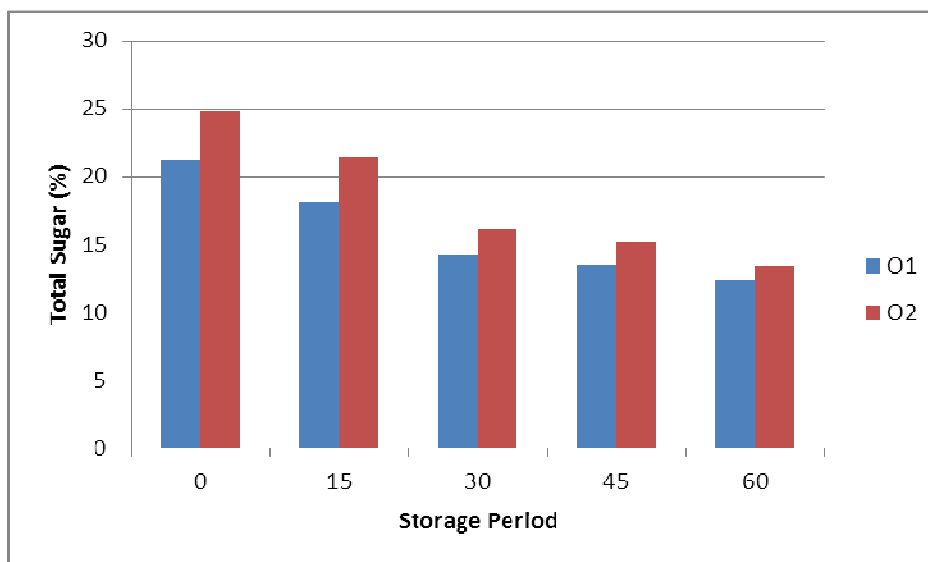
were observed. There was decrease in total sugar content from 0 day to 60 days. Significant changes were observed in the interaction effects of period of storage and treatments. Higher total sugar content was observed in whey: sweet orange beverage (65:35) on all the days of storage followed by whey: sweet orange beverage (70:30).

**Table 6**  
**Effect of storage period on total sugar (%) in whey based sweet orange RTS beverage**

Treatments/days	0	15	30	45	60
O <sub>1</sub>	21.24	18.14	14.24	13.45	12.33
O <sub>2</sub>	24.74	21.36	16.13	15.19	13.41

O<sub>1</sub> – whey and Sweet orange (70:30); O<sub>2</sub> – whey and sweet orange (65:35)

**Graph 5**  
**Effect of storage period on total sugar (%) in whey based sweet orange RTS beverage**



**Reducing sugars**

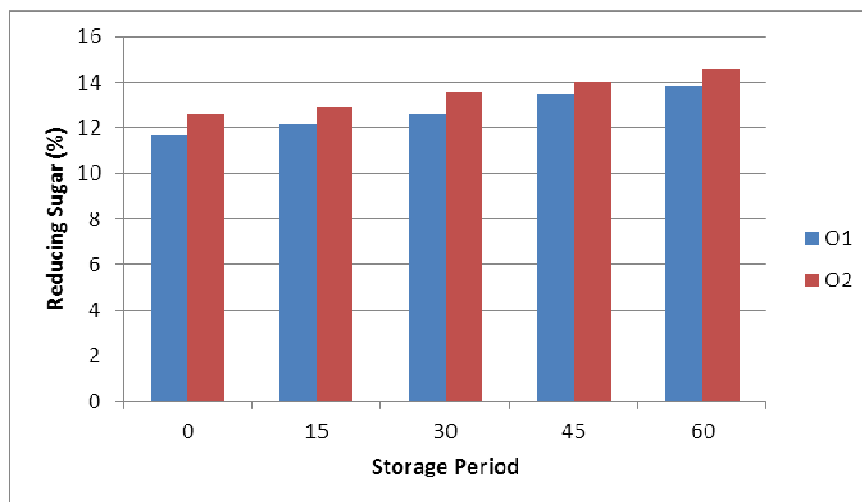
The results in Table 7 showed that the reducing sugars significantly increasing from 0 day to 60 days. Higher reducing sugars were observed in whey: sweet orange beverage (65:35) compared to whey: sweet orange beverage (70:30). Higher reducing sugars were observed on 60<sup>th</sup> day in all treatments as compared to other days.

**Table 7**  
**Effect of storage period on reducing sugar (%) in whey based sweet orange RTS beverage**

Treatments/days	0	15	30	45	60
O <sub>1</sub>	11.71	12.14	12.62	13.43	13.84
O <sub>2</sub>	12.60	12.90	13.55	14.04	14.54

O<sub>1</sub> – whey and Sweet orange (70:30); O<sub>2</sub> – whey and sweet orange (65:35)

**Graph 6**  
**Effect of storage period on reducing sugar (%) in whey based sweet orange RTS beverage**



**Sensory evaluation of whey based sweet orange RTS beverage**

The average sensory scores for each attribute of whey based sweet orange RTS beverage are presented in Tables 8, 9, 10, 11 and 12.

**Colour and appearance**

Data on appearance and colour in whey based sweet orange RTS beverage is given in Table

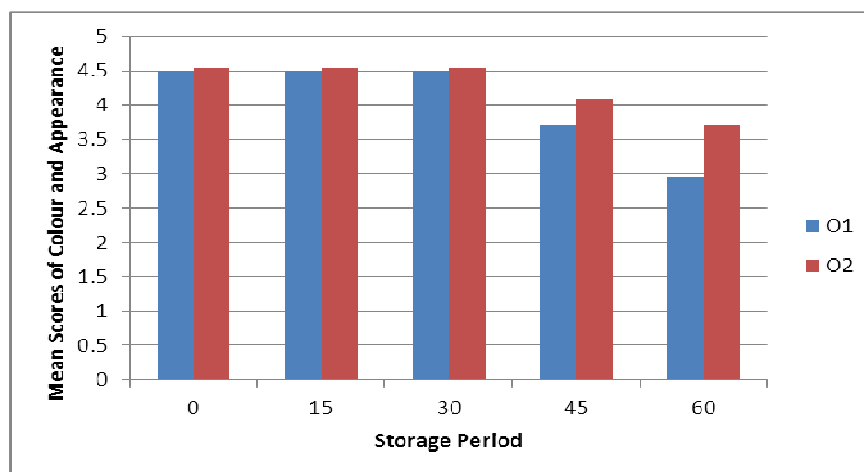
8. Change in colour and appearance was not significant up to 30 days of storage. Colour and appearance decreased significantly during storage from 30 days to 60 days. Among the treatments whey: Sweet orange RTS beverage (65:35) recorded higher score than other treatments.

**Table 8**  
**Mean scores for colour and appearance of whey based sweet orange RTS beverage**

Treatments/days	0	15	30	45	60
O <sub>1</sub>	4.50	4.50	4.50	3.70	2.95
O <sub>2</sub>	4.55	4.55	4.55	4.10	3.70

O<sub>1</sub> – whey and Sweet orange (70:30); O<sub>2</sub> – whey and sweet orange (65:35)

**Graph 7**  
**Mean scores for colour and appearance of whey based sweet orange RTS beverage**



**Taste**

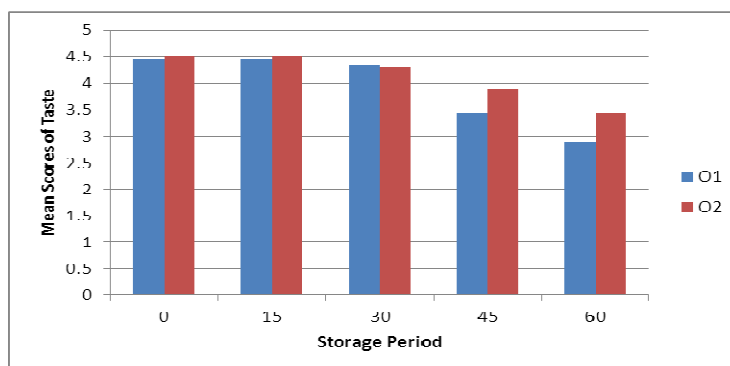
The results in Table 9 showed that the taste of whey based sweet orange RTS beverage changed significantly during storage. The taste decreased significantly from 0 day to 60 days. Whey: Sweet orange beverage (65:35) scored high compared to all others treatments.

**Table 9**  
**Mean scores for taste of whey based sweet orange RTS beverage**

Treatments/days	0	15	30	45	60
O1	4.45	4.45	4.35	3.45	2.90
O2	4.50	4.50	4.31	3.90	3.45

O<sub>1</sub> – whey and Sweet orange (70:30); O<sub>2</sub> – whey and sweet orange (65:35)

**Graph 8**  
**Mean scores for taste of whey based sweet orange RTS beverage**



**Flavour**

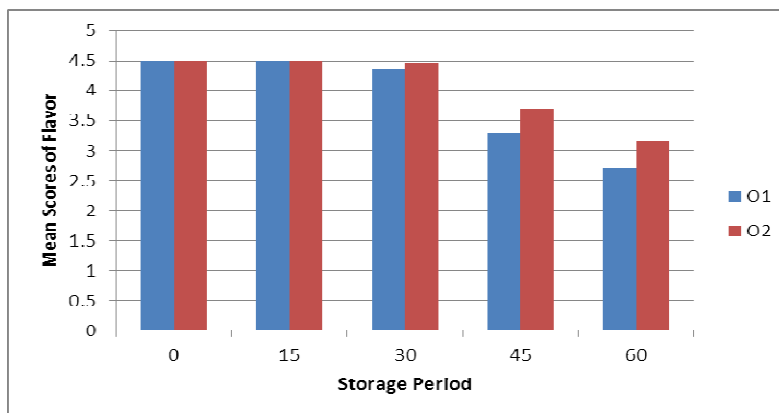
There were significant changes in flavor of whey based sweet orange RTS beverages during the storage period (Table 10). Flavour is significantly decreased from 0 day to 60 days. Higher flavor were observed in whey: sweet orange beverage (65:35) followed by whey: sweet orange beverage (70:30).

**Table 10**  
**Mean scores for flavor of whey based sweet orange RTS beverage**

Treatments/days	0	15	30	45	60
O1	4.50	4.50	4.35	3.3	2.70
O2	4.50	4.50	4.45	3.7	3.15

O<sub>1</sub> – whey and Sweet orange (70:30); O<sub>2</sub> – whey and sweet orange (65:35)

**Graph 9**  
**Mean scores for flavor of whey based sweet orange RTS beverage**





### Consistency

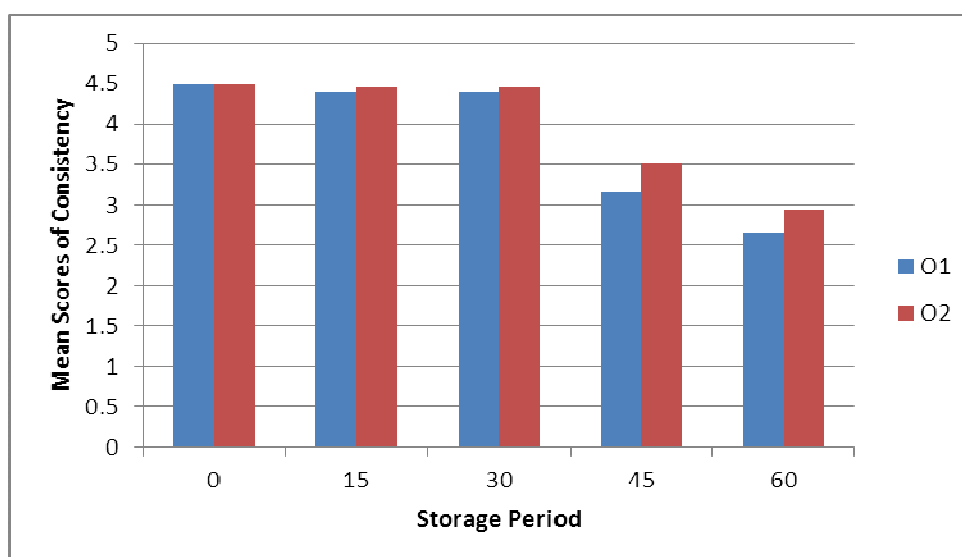
There had been significant changes in consistency of whey based sweet orange beverages during the storage period (Table 11). Consistency is decreased significantly from 0 day to 60 days of storage. Higher consistency was observed in whey: sweet orange beverage (65:35) followed by whey: sweet orange beverage (70:30).

**Table 11**  
**Mean scores for consistency of whey based sweet orange RTS beverage**

Treatments/days	0	15	30	45	60
O <sub>1</sub>	4.50	4.40	4.40	3.15	2.65
O <sub>2</sub>	4.50	4.45	4.45	3.50	2.95

O<sub>1</sub> – whey and Sweet orange (70:30); O<sub>2</sub> – whey and sweet orange (65:35)

**Graph 10**  
**Mean scores for consistency of whey based sweet orange RTS beverage**



### Overall acceptability

Data on overall acceptability of whey based sweet orange RTS beverages is presented in Table 12 and the data indicates significant changes during storage. Overall acceptability is decreased significantly during storage. No significant difference was observed up to 30

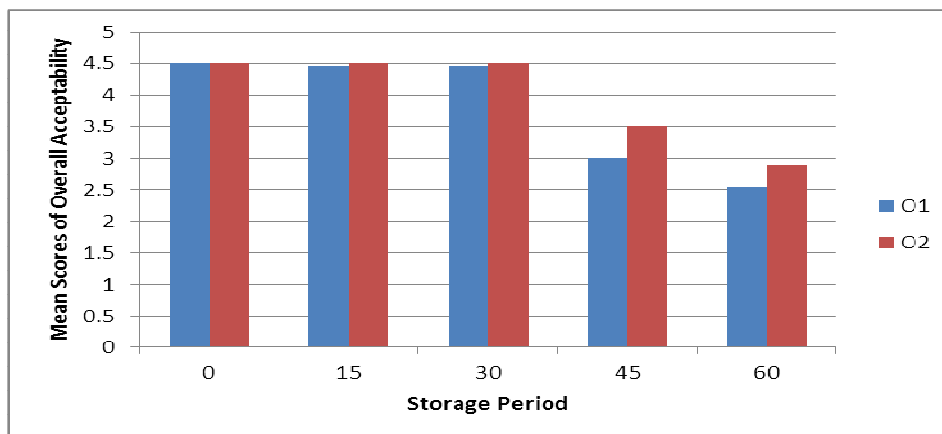
days of storage, but after that the overall acceptability decreased. Among the treatment whey: sweet orange beverage (65:35) scored higher acceptability when compared to other treatments. Overall acceptability rapidly decreased from 30 days to 60 days in all treatments.

**Table 12**  
**Mean scores for overall acceptability of whey based sweet orange RTS beverage**

Treatments/days	0	15	30	45	60
O <sub>1</sub>	4.50	4.45	4.45	3.00	2.55
O <sub>2</sub>	4.50	4.50	4.50	3.50	2.90

O<sub>1</sub> – whey and Sweet orange (70:30); O<sub>2</sub> – whey and sweet orange (65:35)

Graph 11

**Mean scores for overall acceptability of whey based sweet orange RTS beverage****Microbial evaluation of whey based sweet orange RTS beverage**

Microbial examination showed that the samples were free from microbial spoilage up to 30 days of storage (Table 13). Bacterial growth was observed after 30 days of storage. Higher load was recorded at 60 days of storage in whey: sweet orange beverage

(65:35) followed by whey: sweet orange beverage (70:30). Yeast and mold growth was observed from 45 days to 60 days of storage with a higher load of (2 cfu/g) and (4 cfu/g) in whey: sweet orange beverage (70:30) followed by (1 cfu/g) and (3 cfu/g) in whey: sweet orange beverage (65:35) respectively.

**Table 13**  
**Microbial count (cfu/g) of whey based sweet orange RTS beverage**

Treatments/Days	0		15		30		45		60	
	B	Y&M	B	Y&M	B	Y&M	B	Y&M	B	Y&M
O1	-	-	-	-	-	-	10	2	12	4
O2	-	-	-	-	-	-	13	1	15	3

O<sub>1</sub> – whey and Sweet orange (70:30); O<sub>2</sub> – whey and sweet orange (65:35)  
B – Bacteria; Y&M – Yeast and Mold; CfU/g – Colony forming units per gram

**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: sweet orange juice, two treatments of whey: sweet orange juice was selected for study due to their better acceptability.
- ✓ The changes observed in the experiment are: 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 sweet orange. 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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