

Original Research Article

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## Study of Formulation, Sensory Evaluation and Microbiological Study of Whey Beverage from Camel and Buffalo Milk

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### ABSTRACT

Whey and juices of pomegranate and watermelon were utilized at various combinations (whey: pomegranate, 89.5:5, 79.5:15 and 69.5:25) (whey: watermelon, 89.5:5, 84.5:10, 79.5:15 and 74.5:20) with constant amount of sugar (4.5%) and black salt (1%) in all samples. Control treatment (T<sub>0</sub>) was the whey added with sugar and salt as that of treatments for preparation of nutritious beverages and evaluated for sensory attributes and microbial during storage. The storability of the beverage was studied at 4±1°C for 12 days. The study revealed that the beverage prepared with 69.5% whey and 25% pomegranate juice and 74.5% whey and 20% watermelon juice scored maximum for almost all sensorial quality attributes such as appearance, color, flavor, taste and over all acceptability. From the study it was concluded that fruit juice incorporated whey beverage of good quality could be products as of developed products (69.5% whey and 25% pomegranate juice and 74.5% whey and 20% watermelon juice) and the same could be used for its shelf life study during refrigerated storage. The standard plate Counts was high ranging from 4.49 ± 0.003 - 5.40 ± 0.006 CFU/mL. Coliform count was ranging from 2.06 ± 0.017- 2.80 ± 0.004. Mould and yeast count varied between 0.0 -2.33 ± 0.009 CFU/mL. This research is aimed at production of whey based beverage.

#### Keywords

Formulation,  
Sensory evaluation,  
Microbiological  
study, Buffalo milk

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### Introduction

Whey is a valuable by-product obtained during coagulation of milk by using acid and/or rennet or physico-chemical process for the preparation of cheese, paneer, chhana, chakka and casein. The main biological activities of whey proteins are suggested to include cancer prevention, increase of glutathione levels, antimicrobial function and

increase of satiety response (Madureira *et al.*, 2007). However, in spite of being a nutritive product, whey is still little used in human diet (Drgalic *et al.*, 2005). Previously, whey was used mainly in animal feed or surplus. With advances in technology and recent discoveries of functional and bioactive roles of whey proteins, whey and whey components are now viewed as precious ingredients. The recognition of whey as a source of unique

physiological and functional attributes provides opportunity for the food industry to incorporate whey and whey components into a variety of foods. Whey beverages have been recognized as a genuine thirst quencher, light, refreshing, healthful and nutritious (Prendergast, 1985).

By adding some simple ingredients in the whey, like sugar, colour and flavour to it, results in improvement of its nutritive value, taste and acceptability. So utilization of such whey for the conversion into best beverage would be one of the important ways to utilize it. There is a lot of scope to explore the possibility of its utilization in beverage industries (Sakhale *et al.*, 2012).

Fruit extract of Pomegranate (*Punica Granatum*) can be blended with whey to prepare a health drink. Pomegranate fruit juice is a great source of ellagic acid as antioxidant and omega-5 polyunsaturated fatty acid which is highly beneficial for cell regeneration and proliferation. The juice of this fruit is an exceptional source of vitamin A, C and E and minerals such as calcium, phosphorous, potassium, iron, folic acid, niacin, thiamin, folates and riboflavin. Looking towards all of its health benefits an attempt was made to utilize whey in combination with different proportions of pomegranate juice to develop pomegranate based whey beverage also the inclusion of pomegranate juice makes better the sensory quality and enhances the acceptability of beverage (Negi *et al.*, 2003).

Watermelon (*Citrullus lanatus*) is one of the most abundant and cheap fruits that is available in India. It is available throughout the year, but production is highest in the summer. This fruit is a rich natural source of lycopene, a compound responsible for its red colour (Perkins-Veazie *et al.*, 2001). Intake of lycopene containing-products has been associated with a reduced incidence of

coronary heart disease and some types of cancer (Giovannucci, 2002). Looking towards all of the health benefits of pomegranate and watermelon juice an attempt was made to utilize whey procured from camel and buffalo milk in combination with different proportions of pomegranate and watermelon juice to develop naturally flavoured whey beverages which are nutritious as well as palatable.

## **Materials and Methods**

### **Material collection and sample preparation**

Fresh buffalo milk was obtained from buffaloes maintained under the project "Establishment of live demonstration models of diversified livestock production systems for motivating adaption to enhancing agricultural income (RKVY-15)" C.V.A.S., RAJUVAS, Bikaner and was kept at refrigeration temperature till further use. Fresh camel milk was collected from camel dairy maintained at ICAR-NRC on Camel, Bikaner. All samples, collected manually in sterile bottles once per day (usually in the morning).

In a different study on coagulation properties of camel milk for channa production, 70% of camel milk and 30 % of buffalo milk was standardized for production of channa with good yield and binding properties. The by-products of that study were used for the preparation of good quality whey beverage. Briefly, admixed milk was heated at 80°C and milk was coagulated using 2% citric acid solution followed by continuous stirring resulted in complete coagulation of milk protein (casein). The liquid (whey) was filtered using muslin cloth and stored for further use. Fresh pomegranate, watermelon, sugar and black salt were procured from the local market to prepare juice for incorporation in whey to form naturally flavoured whey beverages from camel and buffalo milk. Pomegranate juice was extracted from the

edible part (arils+ seeds). The edible part of pomegranate was grinded in a juicer and the prepared juice was then filtered through a double layered muslin cloth for a clear pomegranate juice and stored. Fresh and best quality watermelon was procured from the local market. For the extraction of juice watermelon was peeled and cut into small pieces. After separating the seeds the fruit pieces were grinded in a mixture and the pulp was then filtered through a double layered muslin cloth and a clear watermelon juice and stored.

### **Product development**

The different formulations (treatments) of pomegranate based whey beverage were prepared by using constant level of sugar 4.5% and black salt 1% in different combinations of whey and pomegranate juice viz. T<sub>0</sub> (94.5% whey: 0% pomegranate juice), T<sub>1</sub>P<sub>1</sub> (89.5% whey: 5% pomegranate juice), T<sub>1</sub>P<sub>2</sub> (79.5% whey: 15% pomegranate juice) and T<sub>1</sub>P<sub>3</sub> (69.5% whey: 25% pomegranate juice).

The different formulations (treatments) of watermelon based whey beverage were prepared by using constant level of sugar 4.5% and black salt 1% in different combinations of whey and watermelon juice viz. T<sub>0</sub> (94.5% whey: 0% watermelon juice), T<sub>2</sub>W<sub>1</sub> (89.5% whey: 5% watermelon juice), T<sub>2</sub>W<sub>2</sub> (84.5% whey: 10% watermelon juice), T<sub>2</sub>W<sub>3</sub> (79.5% whey: 15% watermelon juice) and T<sub>2</sub>W<sub>4</sub> (74.5% whey: 20% watermelon juice). The treatments were heated to dissolve the added ingredients followed by filling into sterilized glass bottles then sealed.

### **Sensory evaluation**

The beverage samples were evaluated for their sensory characteristics namely color and appearance, taste, flavor and overall acceptability by a trained panels comprising of 10 panelists drawn from faculty members and

post graduate students of the Department. The panelists were asked to record their observations on the sensory sheet based on a 8 point hedonic scale (8 and 1 points showing like extremely and dislike extremely).

### **Microbial tests**

Microbiological qualities of the beverage samples are analyzed during storage were examined for the SPC count, coliform count, yeast and mold count. Standard plate count (SPC) was determined with plate count agar medium, and the plates of different dilutions were incubated at 37°C for 24 hour. The total number of colonies per log (cfu/ml) was determined. Violet Red Bile (VRB) agar medium was used for determination of coliform bacteria and the plates of different dilutions were incubated at 37°C for 24 hour by pour plate method, and the number of dark red colonies was calculated. Yeast molds (Y-M) count take place by Potato dextrose agar (PDA) medium by pour plate method and the plates of different dilutions were incubated at 37°C for 24 hour, for yeast and mold count.

### **Statistical analysis**

All the experiments of study were repeated three times and samples were drawn in duplicate. Data collected during the present investigation were subjected to statistical analysis by adopting appropriate methods of analysis of variance as described by Snedecor and Cochran (1994).

Wherever, the variance ratio were found significant at 5 per cent and highly significant at 1 per cent levels of probability, the significance of mean differences were tested by Duncan's New Multiple Range Test (Duncan's Range Test) as modified by Kramer (1957).

### **Results and Discussion**

**Sensory evaluation**

The treatments (beverages) in figure 1 indicate that the panelists, on average, prefer the treatments T<sub>1</sub>P<sub>3</sub> (69.5% whey: 25% pomegranate juice) in pomegranate based whey beverage and T<sub>2</sub>W<sub>4</sub> (74.5% whey: 20% watermelon juice) in watermelon based whey beverage for, appearance/ colour, flavor, taste and overall acceptability.

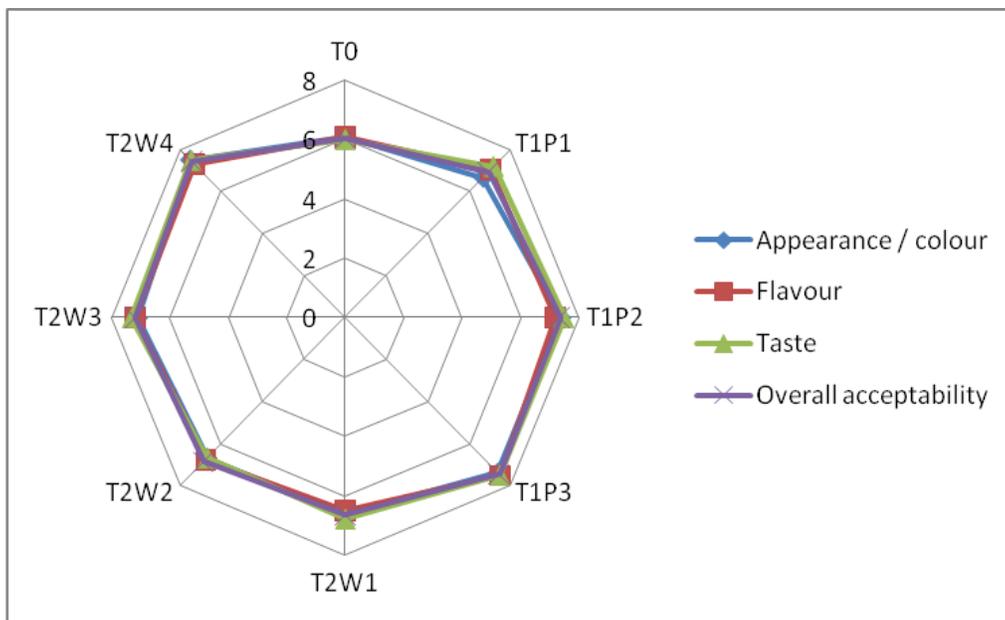
To summarize, it can be concluded that T<sub>1</sub>P<sub>3</sub> made with 69.5% whey, 25% pomegranate juice, 4.5% sugar and 1% black salt is the most appreciated in pomegranate based whey beverage and T<sub>2</sub>W<sub>4</sub> made with 74.5% whey, 20% pomegranate juice, 4.5% sugar and 1% black salt is the most appreciated in watermelon based whey beverage. Hence these formulas were used to evaluate microbial quality of beverage at refrigeration temperature. For further studies T<sub>1</sub>P<sub>3</sub> used as T<sub>1</sub>, T<sub>2</sub>W<sub>4</sub> used as T<sub>2</sub> and control as T<sub>0</sub>. The result of sensory evaluation of naturally flavoured whey beverages has been shown in

figure 1.

**Microbial analysis**

The beverage samples were analysis periodically for total plate count and mould and yeast count. The data obtained with respect to microbial load are summarized in Table 1. Total standard plate count of bacteria increases and after the completion of (12 days) storage it reaches from  $4.49 \pm 0.003$  log (cfu/ml),  $4.60 \pm 0.008$  log (cfu/ml) and  $4.53 \pm 0.011$  log (cfu/ml) to  $5.42 \pm 0.074$ ,  $5.40 \pm 0.006$  and  $5.38 \pm 0.002$  in sample T<sub>0</sub>, T<sub>1</sub> and T<sub>2</sub> respectively. Ismail *et al.*, (2011) studied the microbial and chemical evaluation of whey based mango beverage and reported that standard plate count significantly increased with increase of storage of whey based mango beverage. Similar results was obtained by Yonis *et al.*, (2014) who studied the utilization of sweet whey in production of whey guava beverages and observed significant increase in the standard plate count with increase of storage period.

**Fig.1** The result of sensory evaluation of naturally flavoured whey beverages



**Table.1** Microbial analysis of whey beverages

Parameter	Storage period	Samples		
		T0	T1	T2
<b>Bacterial count**</b> (CFU/ml)	0	4.49 <sup>a</sup> ± 0.003	4.60 <sup>a</sup> ± 0.008	4.53 <sup>a</sup> ± 0.011
	3	4.76 <sup>b</sup> ± 0.003	4.84 <sup>b</sup> ± 0.011	4.78 <sup>b</sup> ± 0.003
	6	4.94 <sup>c</sup> ± 0.002	5.09 <sup>c</sup> ± 0.003	5.04 <sup>c</sup> ± 0.006
	9	5.19 <sup>d</sup> ± 0.001	5.27 <sup>d</sup> ± 0.006	5.23 <sup>d</sup> ± 0.006
	12	5.42 <sup>e</sup> ± 0.074	5.40 <sup>e</sup> ± 0.006	5.38 <sup>e</sup> ± 0.002
<b>Coli form count**</b> (CFU/ml)	0	Nil	Nil	Nil
	3	Nil	Nil	Nil
	6	2.06 <sup>a</sup> ± 0.017	2.23 <sup>a</sup> ± 0.010	2.15 <sup>a</sup> ± 0.018
	9	2.29 <sup>b</sup> ± 0.010	2.53 <sup>b</sup> ± 0.006	2.50 <sup>b</sup> ± 0.008
	12	2.55 <sup>c</sup> ± 0.007	2.80 <sup>c</sup> ± 0.004	2.72 <sup>c</sup> ± 0.007
<b>Yeast and mould count (CFU/ml)</b>	0 to 9 days	Nil	Nil	Nil
	12	2.19 ± 0.013	2.33 ± 0.009	2.25 ± 0.009

\*\* = Significant at 1% (P<0.01)

The coliform count was not observed at day 0 and 3 in sample T<sub>0</sub>, T<sub>1</sub> and T<sub>2</sub>, respectively. Coliform count increases from day 6 to day 12 from 2.06 ± 0.017 log (cfu/ml), 2.23 ± 0.010 log (cfu/ml), and 2.15 ± 0.018 log (cfu/ml) to 2.55 ± 0.007log (cfu/ml), 2.80 ± 0.004 log (cfu/ml), and 2.72 ± 0.007 log (cfu/ml) in sample T<sub>0</sub>, T<sub>1</sub> and T<sub>2</sub>, respectively. Ismail *et al.*, (2011) studied the microbial and chemical evaluation of whey based mango beverage and reported that the coliform count was significantly increased with increases of storage period of whey beverage. Similar results were also obtained by Yonis *et al.*, (2014) who studied the utilization of sweet whey in production of whey guava beverages and observed significant increase in the coliform count with increase of storage of whey beverage.

Mould and yeast count was not detected in all three samples (T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>) upto 9 day of storage whereas it observed on 12<sup>th</sup> day were 2.19 ± 0.013 log (cfu/ml), 2.33 ± 0.009 log (cfu/ml) and 2.25 ± 0.009 log (cfu/ml) in

sample T<sub>0</sub>, T<sub>1</sub> and T<sub>2</sub>, respectively. In spite of the potential benefits offered by fruit juices, concerns over their safety and quality have been raised; as freshly prepared juices have no process or steps to minimize the microorganisms if they are contaminated (Mahale *et al.*, 2008).

It can be concluded that whey can be found successful for the development of pomegranate and watermelon based whey beverages with optimum sensory characteristics. The nutritious beverages with better storage life could be developed by addition of whey up to certain extent. In this study, whey is successfully utilized to develop a watermelon-based fruit beverage with optimum sensory and nutritional properties as well as good storage stability. The beverage possesses high colour, flavour and stability properties. A nutritious beverage with better storage life is developed with the addition of whey, watermelon juice, sugar and black salt in appropriate proportion. In view of the functional properties arising from bioactive

constituents present in fruit and whey, it is proposed that pomegranate based whey beverages with excellent nutritional, sensory and storage properties could be an interesting product in the constantly growing market for functional foods.

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