

# Studies on process standardization of ultra-filtered pineapple flavoured shrikhand whey beverage

S.D. Katke and P.S. Patil

The present investigation demonstrates utilization of the shrikhand whey (which is a by-product of the dairy industry) for the preparation of carbonated fruit flavoured beverages. A process for preparation of carbonated fruit flavoured shrikhand whey beverage by blending with different levels of pineapple juice concentration has been standardized. In the present study, highly acceptable 12.0% sugar level was used as beverage base. The shrikhand whey beverage base was blended with different levels of concentrations of pineapple juice *i.e.* 18.0, 20.0, 22.0 and 24.0%. The ultrafiltered shrikhand whey beverage base with 22% ultrafiltered pineapple juice scored higher overall acceptability *i.e.* 8.26. The selected beverage was carbonated at three different levels of carbonation *i.e.* 25, 30, 35 psi at  $4 \pm 1^\circ\text{C}$  temperature and was subjected to organoleptic evaluation. The ultrafiltered pineapple flavoured beverage scored 8.53 at 30 psi for overall acceptability.

**Key Words :** Acidic whey, Ultrafiltered shrikhand whey, Shrikhand whey beverage, Carbonated, Whey beverage, Pineapple flavoured whey beverage

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## INTRODUCTION

Milk and milk products (butter, *Ghee*, khoa, cheese, paneer, shrikhand, and ice-cream) are popular food items in all over world but rapid changes in socio-economic status and increase urbanization leads to the static milk consumption tendency. Therefore, dairy industries are now looking for new products which can be prepared from byproducts (contain valuable milk solids) (Singh *et al.*, 2002 and GOI, 2002). The major by-products of the dairy industry are skim milk, butter milk and whey. The utilization of these by-products has not only increased the availability of functional food but has also increased

the commercial viability of these products. Whey can be defined as the opaque, greenish, yellow, watery fluid obtained as a by-product when milk is coagulated either by acid or rennet for the preparation of chhana, paneer, cheese, casein and shrikhand. It contains many nutrients like whey proteins, lactose, thiamine, riboflavin, vitamin B6, Vitamin C, calcium and phosphorus except casein and fat (Belhe *et al.*, 1982). The whey solids has excellent functional properties such as solubility, gel formation, emulsification, water binding, whipping etc. which can be potentially utilized for the production of lactose, alcohol, organic acid, protein recovery and as dried powder in various bakery products, dried infant food, beverages, dried soup, frozen desserts, dry mixes etc. (Belhe *et al.*, 1982; Gandhi, 1989 and Patel *et al.*, 1991). It can also be utilized in the preparation of ethanol, wine, acetic acid, dairy gels, lactose based sweeteners, whey syrups, crackers, vegetable soups etc. (Singh *et al.*, 1994). The

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present scenario of whey indicates that out of 85 million tones of global production 40% is still disposed as raw in to sewage which leads to serious environmental pollution due to high biological oxygen demand (3,00,000–5,00,000 ppm) (Hofer, 1995). There is a approx estimate that more than 3 million tones of whey is produced in country while more than 2 lakh tones of it containing valuable nutrients which are dumped in to gutter (Khamrui and Rajorhia, 1998). A study indicates that treating 5 lakh litres of whey in sewage would cost \$10,000 per day for primary treatment and \$14,500 for tertiary treatment (Durham *et al.*, 1997). In India, cheese whey accounts for the major part of the total whey production *i.e.* nearly about 95 per cent. About 80 % of total whey produced is obtained from chhana, paneer and shrikhand production (Gupta and Mathur, 1989). In our country, 12 lakh tones of chhana production yield about 8 million tones of whey per year (Aneja, 1997). The various whey processing methods (condensation, drying and fermentation) found to be uneconomical and energy consuming (Shaikh *et al.*, 2001).

Beverages are considered to be alcoholic or non-alcoholic nourishing drink which can be consumed by the people of all age groups. Most dairy beverages are alcoholic or non-alcoholic that provides energy, regulates body temperature, prevents dehydration, quenches thirst and removes physiological tension (Jandal, 1996 and Gupta and Mathur, 1989). Many plain, carbonated and alcoholic whey beverages have been successfully developed and marketed all over the world. There are various whey beverages already have achieved success in India (Whevit, Acidowhey), Europe (Rivellia: a deproteinized, fermented whey beverage), Switzerland (whey champagne), Poland (Kwas), Netherland (Taksi, Yor), Japan (Milfull plain) and U.S.S.R (Bodrost) market. Recently whey and partially hydrolyzed lactose syrup based and whey and herbal extract containing non-fermented nutritious soft drink have been developed (Fresnel and Moore, 1978; Gupta and Mathur, 1989; Gupta, 2000 and Ghosh *et al.*, 1995).

There are very few literatures are available on carbonated fruit flavoured beverage. So, the present investigation has been designed to develop a nutritious carbonated beverage by utilizing shrikhand whey and fruit juices.

## METHODOLOGY

### Raw Materials :

Milk, fresh pineapple juice was procured from the

local market while freeze dried starter culture of *Streptococcus thermophilus* and *Lactobacillus bulgaricus* was obtained from National Dairy Research Institute (NDRI), Karnal.

### Preparation, Clarification and Ultrafiltration of Shrikhand Whey :

Standardized milk (6.0% fat) was heated upto 85°C for 10 minutes then cooled to 28-30°C. After cooling 2.0% starter culture was added in the mixture and incubated at 30°C for 15-16 hours. For the complete whey drainage, curd was firstly broken then hanged and gently squeezed for 8-10 hours. The fresh shrikhand whey was passed two times through the cream separator (New Dairy Engineering and Trading Company Private Limited, Delhi) at high speed to remove the residual fat. The acidity of defatted whey was adjusted to 0.8% by citric acid. The shrikhand whey was deproteinized (precipitation of proteins) by keeping undisturbed for 5-6 hours after heating at 98°C for 15 minutes. The whey was passed through the cotton pad and double folded muslin cloth (Cheese Layer) to get the suspended free product. The whey was passed through vaccum filter by using Whatman Filter Paper No. 41 to get clarified shrikhand whey. The clarified shrikhand whey was then prefiltered by passing through “Microfibre Glass Filter and Mixed Esters of Cellulose” by applying vaccum to get clear, fat free, greenish yellow coloured whey. The prefiltered shrikhand whey was subjected to ultrafiltration by using “Millipore Stirred Cell Ultrafiltration Unit - 8200 (Polyether Sulphone Biomax Ultrafiltered Disc)” having ‘Nominal Molecular Weight Limit (NWML)’ of 300 KD and diameter of 63.5 mm. The final obtained shrikhand whey was sparkling clear in appearance.

In the same manner fresh pineapple juice was prefiltered by passing through “Microfibre Glass Filter and Mixed Esters of Cellulose” by applying vaccum and further it was subjected to ultrafiltration by using “Millipore Stirred Cell Ultrafiltration Unit - 8200”.

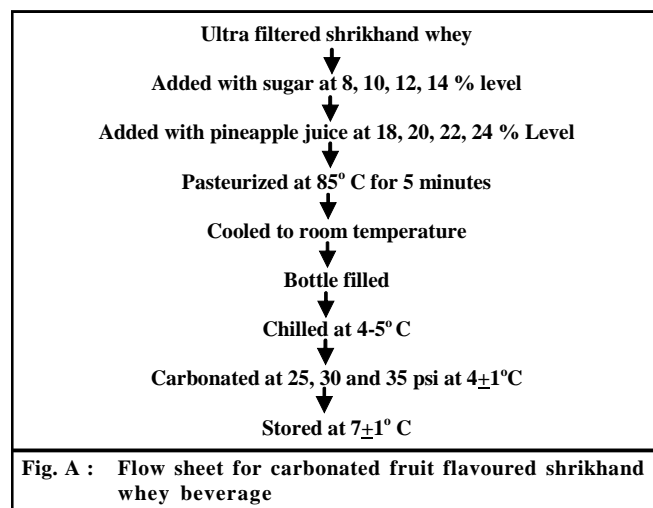
### Preparation of whey beverage base and fruit flavoured beverage :

Ultrafiltered shrikhand whey was used for preparation of beverage base. The acidity level of whey was kept constant at 0.8%. Sugar was added at the level of 8, 10, 12 and 14% in the form of clear sugar syrup. Then, it was pasteurized at 85°C for 5 minutes and cooled

below 50°F temperature. Thus, the prepared whey bases were subjected to organoleptic evaluation. The optimum whey beverage bases were subjected to the preparation of whey based fruit beverages (pineapple juice) at 18, 20, 22 and 24% concentration. The optimized beverage with respect to sugar and fruit juice level was carbonated at three different pressures of 25, 30 and 35 psi at  $4 \pm 1^\circ\text{C}$  temperature. The carbonated whey beverage was stored at refrigeration temperature till it was subjected to further studies.

### Physico-chemical and organoleptic evaluation of beverage :

The beverages were subjected to organoleptic evaluation for appearance, colour, taste, aroma, consistency, mouth feel and overall acceptability by semi-trained panelists on 9 point hedonic scale (Gupta, 1976). The different physical properties *i.e.* color (Lovibond Tintometer), specific gravity, viscosity [Haake's Roto Viscometer (RV-20 Model)], total solids, sedimentation per cent and turbidity has been analysed in shrikhand whey and its beverages. The proximate composition, titrable acidity and lactose content were determined as per the procedure described in AOAC (1990) and Kanwar and Chopra (1976), respectively. The nutritional aspects of shrikhand whey beverage like calcium, phosphorus determined by using 'Flame Photometer' as per the method described by Tondon (1993) while ascorbic acid and vitamin-content was determined as per the procedure cited in Raganna (1986) and High Performance Liquid Chromatography (HPLC) as described by Nielsen (1992).



### Statistical analysis :

The data obtained for various characteristics were compiled, tabulated and statistically analyzed by Completely Randomized Design as per the method given by Panse and Sukhatme (1985) in order to draw a meaningful conclusion.

### OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

#### Changes in physical properties of (shrikhand whey) due to ultrafiltration :

The physical properties *viz.*, colour, specific gravity, viscosity, sedimentation and turbidity of different types of shrikhand whey are mentioned in Table 1. After ultrafiltration the colour and specific gravity was decreased. The reduction in specific gravity is may be due to the removal of large size particles during the process of filtration. Due to presence of lower amount of fat and protein the viscosity was lower. The negligible amount of constituents present after ultrafiltration leads to the decrease in sedimentation values. In the same manner the decrease in turbidity per cent was observed due to minimum presence of constituents having less adverse effect on the transmission of light. The results are in accordance with the findings reported in ultrafiltered shrikhand whey with pineapple juice (Suresha and Jayaprakash, 2003).

#### Changes in proximate composition ultrafiltration of shrikhand whey :

The proximate compositions of ultrafiltered shrikhand whey are depicted in Table 1. After ultrafiltration the total solids, protein, lactose and ash content was decreased. The reduction in protein content was mainly due to the deporteinization during ultrafiltration process while reduction in fat content is due to respiration and filtration of shrikhand whey. The results showed that acidity of clarified shrikhand whey was higher due to the more conversion of lactose in to lactic acid. The results are comparable to the findings reported by Kulkarni *et al.* (1987); Jadhav *et al.* (1991) and Khamrui and Rajorhia (1988).

The similar observations have been found out in pineapple juice after ultrafiltration (Shukla *et al.*, 2004).

**Table 1 : Physico-chemical properties of ultrafiltered shrikhand whey**

Parameters	Ultrafiltered shrikhand whey
Colour	0.1 R + 1 Y
Specific gravity	1.015
Viscosity (cp)	1.24
Sedimentation (%)	1.52
Turbidity (%)	4.00
Moisture (%)	94.38
Total solids (%)	5.62
Fat (%)	Nil
Protein (%)	0.29
Lactose (%)	4.78
Ash (%)	0.50
Acidity (%)	0.81
pH	4.36

### Standardization of shrikhand whey beverage with fruit juices :

Ultrafiltered shrikhand whey was used to standardize the beverage base with respect to levels of sugar on the basis of sensory evaluations. It has been found out that the higher value for overall acceptability were recorded for 12% sugar level in whey beverage base. Thus, the results of the present study are in accordance with the results of Shaikh *et al.* (2001). The effect of levels of pineapple juice on the sensory quality of ultrafiltered shrikhand whey beverage is shown in Table 2. The results clearly showed that pineapple juice at 22% level of concentration scored highest. The average score for aroma was found to be 8.00 for ultrafiltered shrikhand whey beverage. The highest score of 8.10 *i.e.* 'liked very much' was obtained to the ultrafiltered shrikhand whey beverage. It can be observed from Table 2 that overall acceptability score for ultrafiltered shrikhand whey beverage was superior *i.e.* 8.26. Suresha and Jayaprakasha (2003) reported that pineapple flavour whey permeate beverage was found to be most acceptable and

had highest mean overall acceptability score of 8.65 *i.e.* 'liked very much'. The results were also found to be statistically significant for all parameters of sensory quality. Shaikh *et al.* (2001) observed that overall acceptability score of 8.06 for pineapple flavoured whey beverage and also reported that this beverage was better than orange flavoured beverages.

### Shrikhand whey beverage from pineapple juice :

The results of the present study are in close confirmation with those reported by Gagrani *et al.* (1987). The results were also found to statistically significant and the level of concentration of fruit juice had significant effect on all parameters of sensory quality irrespective of type of shrikhand whey used. Shaikh *et al.* (2001) recorded 7.60 scored for overall acceptability of mango flavoured whey beverage. Gagrani *et al.* (1987) recorded average mean score of 7.06 for pineapple flavoured whey beverage with 25% level of concentration. The results of the present findings are comparable to those mentioned above.

### Physical properties of shrikhand whey beverage :

The beverage adjudged as a best for each fruit juice was selected for further studies. The beverage from pineapple flavoured ultrafiltered shrikhand whey was used for further studies with respect to physical, chemical and nutritional aspects. The physical properties *viz.*, colour, specific gravity, viscosity, sedimentation, turbidity of selected shrikhand whey beverage were determined and tabulated in Table 3. It can be noted that the colour of ultrafiltered pineapple flavoured shrikhand whey beverage was 1Y+0.1B. The specific gravity is lowest for ultrafiltered pineapple flavoured shrikhand whey beverage. From Table 3 it can be observed that viscosity of ultrafiltered pineapple flavoured shrikhand whey beverage was lower. Sedimentation value of ultrafiltered pineapple

**Table 2 : Effect of levels of pineapple juice on sensory quality of shrikhand whey beverage**

Type of Shrikhand whey	Fruit juice (%)	Appearance (%)	Colour	Taste	Aroma	Consistency	Mouthfeel	Overall acceptability
Ultrafiltered	18	6.00	5.95	6.00	5.80	6.10	5.85	6.01
Ultrafiltered	20	6.35	6.30	6.25	6.13	6.40	6.15	6.33
Ultrafiltered	22	7.10	8.30	8.10	8.00	8.06	8.10	8.26
Ultrafiltered	24	6.70	7.56	6.96	6.23	7.10	7.00	6.53
S.E.±	NS	0.07	0.06	0.07	0.11	0.10	0.11	0.04
C.D. (P=0.05)	--	0.22	0.21	0.22	0.33	0.33	0.34	0.14

NS=Non-significant

flavoured shrikhand whey beverage was 4.00%. The lowest value was found in ultrafiltered pineapple flavoured shrikhand whey beverage due to negligible amounts of constituents responsible for sedimentation value. The % turbidity of ultrafiltered pineapple flavoured shrikhand whey beverage was only 5% due to decrease in protein content during ultrafiltration process which increased the clarity of beverage (Table 3). The specific gravity and viscosity value for ultrafiltered pineapple flavoured shrikhand whey beverage reported by Suresha and Jayaprakash (2003) are in accordance with results of present study.

**Table 3 : Physico-chemical properties of shrikhand whey beverage**

Physical properties	Ultrafiltered pineapple flavoured shrikhand whey beverage
Colour	1Y + 0.1B
Sp. gravity	1.057
Viscosity (cp)	1.252
Sedimentation (%)	4.00
Turbidity (%)	5.00
Moisture (%)	84.10
Total solids (%)	15.90
Fat (%)	Nil
Protein (%)	0.25
Lactose (%)	3.20
Ash (%)	0.42
Sugar (%)	12.00
Acidity (%)	0.31
pH	4.46
Calcium (ppm)	401.80
Phosphorus (mg/100g)	255.00
Vit. C (mg/100g)	10.85
Vit. A (IU/100g)	686.785

### Proximate composition of shrikhand whey beverage:

The proximate composition of ultrafiltered pineapple flavoured shrikhand whey beverage is depicted in Table 3. It can be noted from Table 3 that the ultrafiltered

pineapple shrikhand whey beverage contained 15.90% total solids Table 3 further indicated that the protein content of the ultrafiltered pineapple flavoured shrikhand whey beverage was 0.25 %. It is because of the deproteinization operation carried out during prefiltration stage of ultrafiltration process. It can be further observed from Table 3 that there was no fat in ultrafiltered beverage. It is because of defatting of the shrikhand whey and process of filtration which removed the fat to a greater extent. It can be observed from the Table 3 that the acidity of ultrafiltered shrikhand whey beverage was 0.31%. The results of the ultrafiltered pineapple flavoured shrikhand whey beverage in present study are well comparable with those reported by Suresha and Jayaprakash (2003). They reported that total solids, total protein, lactose and ash content of pineapple flavoured ultrafiltered whey permeate beverage were 15.97, 0.28, 5.01 and 0.56%, respectively.

### Nutritional quality of shrikhand whey beverage :

The nutritional quality of ultrafiltered pineapple flavoured shrikhand whey beverage is depicted in Table 3. The results in Table 3 shows that the calcium content of ultrafiltered pineapple flavoured shrikhand whey beverage was highest *i.e.* 401.8 ppm. It is revealed from Table 3 that the phosphorus content of ultrafiltered pineapple flavoured shrikhand whey beverage was highest *i.e.* 255 mg/100g. The ascorbic acid content of ultrafiltered pineapple flavoured shrikhand whey beverage was higher *i.e.* 10.85 mg/100g. The high value of ascorbic acid is mainly due to the higher content of ascorbic acid in pineapple juice. From Table 3, it is revealed that the vitamin-A content of ultrafiltered pineapple flavoured shrikhand whey was 686.785 IU/100 g.

### Changes in sensory parameters due to carbonation of shrikhand whey beverage :

The ultrafiltered pineapple flavoured shrikhand whey beverages was carbonated at a pressure of 25, 30, 35 psi

**Table 4 : Effect of level of carbonation on sensory quality of selected shrikhand whey beverage**

Shrikhand whey beverage	Carbonation level (psi)	Appearance (%)	Colour	Taste	Aroma	Consistency	Mouthfeel	Overall acceptability
Ultrafiltered	25	7.90	7.80	7.66	7.00	7.53	7.86	7.83
	30	8.33	8.30	8.26	8.16	8.33	8.53	8.53
	35	7.90	7.86	7.70	7.53	7.53	7.93	7.90
S.E.±	--	0.08	--	0.12	0.09	0.11	0.05	0.05
C.D. (P=0.05)	--	0.25	--	0.35	0.27	0.34	0.15	0.17

at  $4 \pm 1^\circ\text{C}$  temperature. The effect of levels of carbonation on sensory quality of these beverages is depicted in Table 4. The data in Table 4 indicates that effect of carbonation on all sensory parameters of beverage except colour was significant. It can also be seen from Table 4 that scores for appearance parameter of sensory quality is higher for ultrafiltered pineapple flavoured shrikhand whey beverage at 30 psi. It is due to the tingling air bubbles in ultrafiltered pineapple flavoured shrikhand whey beverage which add to the sparkling appearance. It further indicates that ultrafiltered pineapple flavoured shrikhand whey beverage obtained higher score for taste parameter at 35 psi and 30 psi, respectively. It is due to the tingling taste at these pressure levels which was 'liked extremely' by the judges. It can be further stated from Table 4 that the highly acceptable shrikhand whey beverage was ultrafiltered pineapple flavoured shrikhand whey beverage with a highest score of 8.53 at a pressure of 30 psi. The results of the present study are in close agreement with those of the results reported by Suresha and Jayaprakasha (2003).

### Conclusion :

It may be concluded that the process developed for preparation of carbonated pineapple flavoured shrikhand whey beverage was found to be highly acceptable considering the organoleptic, physico-chemical and nutritional qualities. The ultrafiltered shrikhand whey beverage with 12% sugar, 0.8% acidity and 22% pineapple juice concentration was found to be superior. In addition to this carbonation at 30 psi scored highest *i.e.* 8.53 for overall acceptability of beverage.

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