Evaluation of quality and stability of chhana whey beverage fermented with lactic acid bacteria

Priti Saha*, P.R. Ray and Tanmay Hazra

Dairy Chemistry Division,
ICAR-National Dairy Research Institute, Karnal–132001, Haryana, India.
Received: 25-10-2016                      Accepted: 26-04-2017
DOI: 10.18805/ajdfr.v36i02.7953

ABSTRACT
A large amount of whey is being produced in India every day during preparation of chhana and chhana based sweetmeats. The drainage of the whey produced not only increases the BOD load of the environment but also causes loss of essential nutrients. Preparation of chhana whey based fermented beverage is one of the key processes of effective utilization of whey. In the present study two chhana whey based beverages were prepared separately by fermenting the whey with two different cultures namely Streptococcus thermophilus NCDC-74 (Beverage I) and Yoghurt culture YC-470 containing Streptococcus thermophilus and Lactobacillus delbrueckii ssp. bulgaricus (Beverage II) by adding at 2% inoculum level. The average total solid, fat, protein and lactose content were found to be 22.30, 0.18, 0.259, 4.39% and 22.79, 0.20, 0.26, 4.31% in beverage I and beverage II respectively. The overall sensory score of both the beverages were significantly higher (P<0.05) than that of control sample. Both the beverages were acceptable up to 20 days when stored at 7±2°C.

Key words: Lactic acid bacteria, Fermented whey beverage, Physico chemical, Sensory, Storage.

INTRODUCTION
There are mainly two types of proteins viz- casein and whey protein present in milk and whey protein contributes near about 20% of total protein present in milk. Practically whey is obtained during manufacture of cheese, chhana, paneer, casein and shrikhand in dairy industries and it has a number of health benefits (Cross and Gill, 2000). Whey is always considered nutritionally superior protein, due to its ample health benefit. Also whey protein nurture desirable microbial community of intestine (Vandna et al., 2014). Research demonstrated that biological components of whey, including lactoferrin, beta-lactoglobulin, alpha-lactalbumin, glycomacropeptide and immunoglobulin’s has a range of immune-enhancing properties (Walzem et al., 2002), that possesses physiological properties both in native form and upon their degradation to bioactive peptides on fermentation or hydrolysis. This property always attracts researchers for effective use of whey for preparation of health beneficial food or beverages. Whey, is considered a good medium for growth of probiotic microorganisms and has gained recognition from a dairy waste to an excellent delivery system for heath beneficial microbes, those are able to produce inhibitory metabolites antagonistic to pathogens (Vandna et al., 2014).

Near about 3 million tones/annum of whey which is generated in India and contains 2 lacs tons of precious milk constituents (Dhamsaniya and Varshney, 2013). Unfortunately due to lack of proper waste management system and unawareness of the commercial value of whey, it is a very common practise to dump it into the environment. Disposal of whey is not only a great loss of nutrients but is also possesses a serious problem of environmental pollution due to the presence of high organic matter. Mishra (2008) reported that whey has a Biological Oxygen Demand (BOD) of 38,000 to 46,000 ppm, even in some cases it reaches up to 76,000 ppm as compared to 200 ppm permissible limit for domestic sewage. It is very much needed for effectively utilization of whey in a view to decrease environment pollution and utilize a great source of nutrients.

The conversion of whey into beverage is one of the most attractive avenues for utilizing whey for human consumption (Kumar et al., 2013). Whey is a genuine thirst quencher unlike most soft drinks. It can replace much of the lost organic and inorganic salts to the extracellular fluid, but also rapidly adsorbed due to absence of fat emulsion.

There are numbers of research being devoted to make whey drinks delicious and to mask its unacceptable taste and flavour (Baljeet et al., 2013;Dhamsaniya and Varshney, 2013). Particularly in our country whey based beverages are preferably prepared from paneer or chhana whey. Conversion of whey into fermented beverage not only reduce environment pollution problem but also resolve lactose intolerance problem for certain group of people as lactic acid bacteria able to ferment lactose into lactic acid in whey beverage. More over whey based beverages would be
a potential for generating huge revenue for dairy industry. The present study was aimed to prepare fermented chhana whey beverages using *Streptococcus thermophilus* (NCDC-74) alone and Yoghurt culture (YC-470) containing *Streptococcus thermophilus* and *Lactobacillus delbrueckii* ssp. *bulgaricus* and determine their physico-chemical, sensory and storage characteristics.

**MATERIALS AND METHODS**

**Procurement of milk and cultures:** Cow milk was procured from the local market at Mohanpur, Nadia, West Bengal, India and was standardized to 3.5% fat and 8.5% SNF. Chhana was prepared by the method described by De (2005). The resultant whey thus obtained was utilized in the preparation of fermented chhana whey beverages. Freeze dried culture *Streptococcus thermophilus* (NCDC-74) was obtained from National Collection of Dairy Culture, Dairy Microbiology Division, National Dairy Research Institute, Karnal, India. Yoghurt culture (YC-470) containing *Streptococcus thermophilus* and *Lactobacillus delbrueckii* ssp. *bulgaricus* was purchased from Danisco (Dange-Saint-Romain, France).

**Propagation and maintenance of cultures:** The freeze dried cultures were inoculated, incubated (37±1°C for 12 hours) and maintained in skim milk medium (5 ml) at 4°C. The cultures were sub-cultured in MRS broth (HiMedia) and incubated at 37±1°C for 12 hours (Dave and Shah, 1996). Working culture was prepared by activating the maintained culture with 1-2 transfer in whey medium. Purity and growth of cultures were checked microscopically before each sub-culturing.

**Preparation of Fermented Chhana Whey Beverages:** Standardized, fresh, sweet cow milk was filtered through a clean muslin cloth and taken in a karahi for heating at 100°C for 10 minute followed by cooling to 80°C. After cooling, the milk was coagulated with 3% citric acid solution with gentle stirring till the clear whey separated out. The coagulated mass was allowed to settle and kept undisturbed for 1hr. Whey was filtered through muslin cloth for removal of casein fraction. The whey was steamed for half an hour and cooled at room temperature before culture addition.

Whey beverages was prepared by using *Streptococcus thermophilus* NCDC-74(Beverage I) and Yoghurt culture YC-470 (Beverage II) at 2% inoculum level, mixed well and incubated at 37±1°C/12 hours (Figure 1). When the pH of whey beverage has reached the desired level of 3.1-3.8, sugar was added to it at 15% and homogenous mixture was made. The product was mixed, cooled to room temperature and put in glass bottles for storing at 7±2°C for 20 days. Non fermented whey beverage was prepared without addition of any culture and used as control.

**Physicochemical Analysis of Fermented Chhana whey beverage:** The products prepared were evaluated for its

![Figure 1: Flow diagram of Fermented Chhana Whey Beverage](image-url)
The microbiological analysis mentioned above was done in triplicates. After incubation, typical plates with counts 30-300 colonies of bacteria were counted with the help of Darkfield Quebec Colony Counter.

**Sensory Evaluation**: The sensory properties of the beverages were determined by using structured nine point hedonic scale (Sand and Narayanan, 2016). The sensory properties of fermented whey beverages were evaluated by a panel of 5 judges comprising research scholars and faculty members of faculty of Dairy Technology, WBUAFS, and Nadia. Color and appearance, mouth feel, sweetness, flavour and overall acceptability were determined.

**Storage Stability of Fermented Chhana Whey Beverage I and II**: The product was stored at 7±2°C. Samples were drawn in 5 days interval up to 20 days. Acidity, pH, microbiological and sensory analysis were performed by the methods as discussed earlier.

**Statistical Analysis**: The results were analyzed by analysis of variance (ANOVA) to test the significance of differences among difference parameters using the SPSS (Version 11.0.1).

### RESULTS AND DISCUSSION

#### Physico-chemical Characterizations:

The titratable acidity, pH, total solids, lactose, protein and fat content of the fermented beverages are shown in Table 1. It was noticed that lactose content was little bit higher for control sample than fermented beverage (I & II). That clearly proved breakdown of lactose to lactic acid due to fermentation. Hence lactic acid increased so that pH decreased (Table 1). Fat content for all three beverages were at per. Total nitrogen is the base of total protein content of a product, it was observed that protein content of all three beverages were at per. So it could be concluded that except acidity and pH other parameters were at per.

**Sensory Evaluation during storage**: Sensory properties of a product are one of the key attribute for acceptability of a beverage. Generally 9 point hedonic scale being used for assessing the sensory properties of food products. Hence for evaluation of sensory score, 9 point hedonic scale was used to evaluate the sensory properties of beverages and the sensory evaluation score of the non-fermented and fermented whey beverages are given in Table 2. From sensory scores it
Table 4: Sensory score of control and fermented beverages during storage at 7±2°C

<table>
<thead>
<tr>
<th>Color and appearance</th>
<th>Mouth feel</th>
<th>Sweetness</th>
<th>Flavour</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non</td>
<td>Bever</td>
<td>Non</td>
<td>Bever</td>
</tr>
<tr>
<td></td>
<td>fermented</td>
<td>age I</td>
<td>fermented</td>
<td>age I</td>
</tr>
<tr>
<td></td>
<td>whey</td>
<td></td>
<td>whey</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>7.50±</td>
<td>8.0±</td>
<td>7.3±</td>
<td>7.90±</td>
</tr>
<tr>
<td></td>
<td>0.05±</td>
<td>0.02±</td>
<td>0.02±</td>
<td>0.01±</td>
</tr>
<tr>
<td>5</td>
<td>7.13±</td>
<td>7.85±</td>
<td>7.05±</td>
<td>7.70±</td>
</tr>
<tr>
<td></td>
<td>0.01±</td>
<td>0.03±</td>
<td>0.04±</td>
<td>0.05±</td>
</tr>
<tr>
<td>1</td>
<td>6.76±</td>
<td>7.45±</td>
<td>6.56±</td>
<td>7.35±</td>
</tr>
<tr>
<td></td>
<td>0.03±</td>
<td>0.03±</td>
<td>0.03±</td>
<td>0.05±</td>
</tr>
<tr>
<td>2</td>
<td>6.35±</td>
<td>6.90±</td>
<td>6.88±</td>
<td>6.95±</td>
</tr>
<tr>
<td></td>
<td>0.01±</td>
<td>0.02±</td>
<td>0.02±</td>
<td>0.05±</td>
</tr>
<tr>
<td>5</td>
<td>5.92±</td>
<td>6.15±</td>
<td>6.65±</td>
<td>5.64±</td>
</tr>
<tr>
<td></td>
<td>0.05±</td>
<td>0.05±</td>
<td>0.05±</td>
<td>0.05±</td>
</tr>
</tbody>
</table>

Average of five (5) replicates expressed as mean ± SD

a, b shows row wise significance (P<0.05), p, q and r shows column wise significance (P<0.05)
(YC-470) containing *Streptococcus thermophilus* and *Lactobacillus delbrueckii ssp. bulgaricus* separately were carried out. Higher sensory scores were observed in the fermented beverages. Both beverages were acceptable up to 20 days when stored at 7±2°C in a glass container. Therefore it can be concluded that chhana whey can effectively be used to prepare therapeutic and thirst quenching fermented beverages by using NCDC-74 and YC-470 culture separately which will also solve the problems associated with the disposal of whey.

**REFERENCES**


