



Studies on Suitability to Incorporate Tropical Fruit Pulp in Whey-based Probiotic Beverage[#]

Shital S. Deosarkar¹, S.D. Kalyankar², A.R. Sarode¹, C.D. Khedkar¹

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ABSTRACT

Background: The present investigation was planned to standardize a method for preparation of whey-based fermented probiotic beverage containing Alfonso mango (*Mangifera indica*) pulp. This study was undertaken in view of the fact that the probiotic foods can play an important role in promoting health and reducing public health care costs in a developing country like India. As such the whey is the major dairy by-product, which causes enormous environmental problems leading to enforcement of stringent laws by the pollution control authorities. The Indian dairy industry is exploring the ways to utilize whey in more economical way.

Methods: The lab-made *paneer* whey (Indian milk curd) was utilized in the study. The fresh Alfonso pulp was used for value-addition of the product. The probiotic culture of *Lactobacillus rhamnosus*-MTCC-5463 was used for fermentation. The method was standardized and the product was subjected for its sensory evaluation.

Result: It was observed that the whey-based probiotic beverage containing 15% Alfonso pulp (v/w) was liked most with mean score of 8.75 followed by 10% pulp with mean score 5.39 out of 9.0 in the nine-point Hedonic scale. The product containing 5% Alfonso pulp was disliked by the judges with a mean score of 4.54. It was concluded that the whey-based probiotic beverage containing 10-15% mango pulp can be prepared with probiotic viable counts of 10^7 cfu/ml. This would be one of the promising ways to utilize the whey and developing gastrointestinal health promoting product.

Key words: Beverages, Health benefits, Mango pulp, Probiotics, Whey.

INTRODUCTION

India has emerged as the largest milk producer in the world and enjoying this status since last two decades with a record production level of about 198.4 million tons in 2019-20. Whey is a major dairy by-product, which is receiving increasing attention for its proper utilization by the research workers throughout the world. It is considered as one of the promising nutritive by-product obtained during manufacture of cheese, *chhana*, *paneer* (Indian curds) and other coagulated dairy products. The quantum of whey generated is steadily increasing leading to generation of huge amount of whey. Its composition varies widely depending upon the use of milk (Kosikowski, 1979). Whey is a good source of lactose, minerals, whey proteins and also rich in minor components like calcium, phosphorous, essential amino acids and most water soluble vitamins leading to its biological oxygen demand (BOD) ranging from 39,000-48,000 ppm (Zadow, 1986; Horton, 1995, Ryan and Walsh, 2016). Roughly, the whey constitutes about half the total solids of milk out of which 70% represents lactose, 20% milk proteins and 7-9% milk minerals. Whey proteins contain about 2.5 g cystine and 2.8 g cysteine per 100 g of protein. Whey proteins have shown higher biological value (BV-104), protein efficiency ratio (PER-3.6) and net protein utilization (NPU-95) than other protein sources, namely egg, beef, soya protein and casein (Renner, 1983; Renner and Abd-El-Salem, 1991, Skryplonek and Dmytrow, 2019).

It is estimated that more than 125 million tones of whey is produced annually in the world, out of which 5 million tones is produced in India (Horton, 1995). Most of developed

¹College of Dairy Technology, Warud, Pusad-445 204, Maharashtra, India.

²College of Dairy Technology, Udgir-413 517, Maharashtra, India. Udgir under Swami Ramanand Teerth Marathwada University, Nanded- 431 606, Maharashtra, India.

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Corresponding Author: C.D. Khedkar, College of Dairy Technology, Warud, Pusad-445 204, Maharashtra, India. Email: cdkhedkar@gmail.com

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countries have stringent laws for the treatment of whey prior to disposal in to sewage system. To overcome these problems, efforts have been made to develop new processes for effective utilization of whey including its conversion as such or as permeates after ultra-filtration (UF) into whey beverages, which is one of the promising ways to utilize it.

Whey-based fruit drinks are thirst quenching, light and refreshing, healthful and nutritious, but less acidic than fruit juices and offer good potential profit margins (Gandhi, 1989; Mandal *et al.*, 1997; Khamrui and Rajorhia, 1998 and Beucler *et al.*, 2005). Incorporation of the tropical fruit pulp improves the nutritional value of whey and exhibit excellent flavor derived from these fruits. Additionally, enrichment of

beverage with probiotic organisms gives functional features in the final product for health promotion (Goyal and Gandhi, 2008 and Islam *et al.*, 2021).

Among the major fruits produced in the world, mango (*Mangifera indica* L.) contributes 46.50 million tones of production. India is emerged as a major mango producer and exporter in the world contributing 42.02%. Alfonso is considered as the best variety of mango. It is very popular due to its high nutritive value, delicious taste, excellent flavor and beautiful color shade. The fruit is very popular with the masses due to its wide range of adaptability (Mukund *et al.*, 2019).

In the modern food trends, the consumers are anxious to favour an assured response between food and their health and nourishment. Probiotic drinks have been a crucial growing sector in the exploitation of milk whey all over the world. Large number of fermented products have been developed carrying probiotics having several health benefits (Shori, 2016). Scientific investigations have proved that fermented milks are more easily digested and assimilated by virtue of its buffering action and supply more nutrients than milk. Whey-based tropical fruit beverages containing probiotic organisms are very much useful for geriatrics because of maximum biological value and low calories. It has several beneficial effects to treat wide variety of ailments such as gastrointestinal and related disorders, arthritis and anemia and liver complaints. Therefore, utilization of whey for preparation of tropical fruit beverages containing probiotic organisms has great scope to address the issues of whey disposal and value-addition. In view of these facts, the present investigation was aimed to standardize a method to prepare whey-based probiotic beverage containing Alfonso pulp and to evaluate its sensory characteristics, storage study and probiotic viability.

MATERIALS AND METHODS

Procurement and standardization of whey

Cow milk was used for preparation of *Paneer* by traditional method in the laboratory. Whey obtained was standardized to 4% total solids (0.5% fat and 3.5% SNF) and stored under refrigerated conditions till its utilization for preparation of whey-based probiotic beverage containing Alfonso pulp.

Procurement and composition of Alfonso pulp

Commercially available preserved Alfonso mango pulp was obtained from local market. The average composition of the pulp was protein (0.82%), carbohydrates (17%) and fat (0.27%). It was stored under refrigerated conditions till its use.

Selection and maintenance of probiotic culture

The pure culture of *L. rhamnosus* MTCC- 5463 isolated by Khedkar *et al.*, 1988 and deposited at Institute of Microbial Technology, Chandigarh was used in this study. It was maintained in sterile screw-cap glass tubes containing MRS broth. Before being used for the study at least three sub-culturing were performed to get the desired activity in the culture.

Sugar, stabilizer and preservatives

Fine crystalline sugar of commercial grade was obtained from the local market. Stabilizer, namely carboxy methyl cellulose (CMC) (LOBA Chemie, Bombay) at 0.1% level was used in whey beverages. Sorbic acid (LR grade, SD-fine Chem Ltd., Mumbai) and sodium benzoate (LR grade SD-fine Chem Ltd., Mumbai) were used as preservatives in beverage.

Statistical analysis of data

The data obtained from five replications was statistically analyzed by randomized block design (RBD).

Preparation of whey-based Alfonso beverage containing probiotic organisms

The beverage containing 10^7 cfu/ml of the product was prepared. Flow diagram of the said method as depicted in Fig 1.

Analysis of the whey-based tropical fruit beverage

The whey-based tropical fruit beverage containing three different levels of the fruit pulp was analyzed for its composition, sensory characteristics, viable counts of the probiotic organisms and acceptability based on 9-point Hedonic scale.

Sensory evaluation of the whey-based probiotic beverage containing Alfonso pulp

Fresh samples of whey-based tropical fruit juices prepared and stored in plastic bowls (100 ml) were coded in order to obscure their identity. These were presented to a panel of seven judges to establish the overall acceptability of the product. The nine-point Hedonic Scale was used for judging the product. Prior to actual judging, the judges were informed about the quality attributes of the product and practically acquainted with the same.

RESULTS AND DISCUSSION

Composition of paneer whey used during the investigation

The *paneer* whey after filtration through muslin cloth was pasteurized at 72°C for 15 sec and cooled to 37°C before inoculating the culture. The chemical composition of the whey is presented in Table 1.

Composition of Alfonso pulp used in the investigation

Composition of the mango pulp used for preparation of beverages is given in Table 2. It could be seen from the data that the pulp contains 17% carbohydrates. The carbohydrates in Alfonso pulp comprises of saccharose, fructose and glucose. These results are in conformity with those reported earlier (Germain *et al.*, 2003).

Standardization of a method for preparation of whey-based tropical fruit beverage containing probiotic organisms

While standardizing the methodology utmost importance was focused on the viable counts of the finished product. It

Table 1: Chemical composition of paneer whey*.

Constituents	%
Total solids	4.00
Fat	0.51
Protein	0.91
Lactose	2.38
Ash	0.20
pH	5.3

*Averages of five replications of standardized whey used in the investigation.

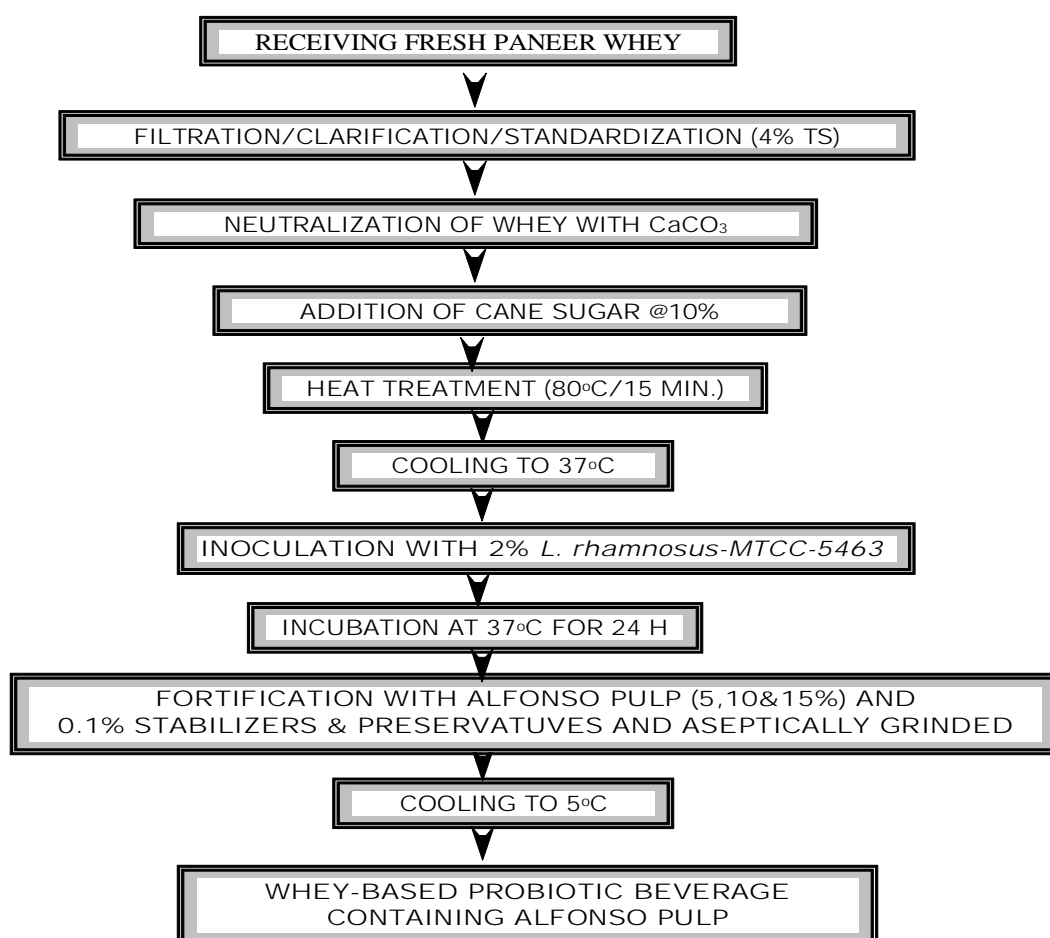
Table 2: Composition of Alfonso mango pulp used for preparation of whey-based probiotic beverage.

Components	Grams per 05 g of mango pulp	Grams per 10 g of mango pulp	Grams per 15 g of mango pulp)
Protein	0.041	0.082	0.123
Carbohydrate	0.85	1.7	2.55
Fat	0.0135	0.027	0.0405

*Averages of five replications of standardized whey used in the investigation.

is earlier suggested by numerous workers that such products should contain at least 10^5 cfu of the probiotics per single dose to achieve the possible health benefits (Deeth and Tamime, 1981; Mitsuoka, 1984; Colombel *et al.*, 1987; Gilliland *et al.*, 1989; Khedkar, 1988, 1993 and Clark and Martin, 1994). Keeping in view such frequent indications, the method was standardized to obtain a probiotic product acceptable and should containing maximum number of the viable cells of the probiotics.

The whey-based tropical fruit beverage was prepared by using *paneer* whey, which was obtained at lab level by heating milk to 80°C and cooling to 70°C then coagulated by adding 1% citric acid. The whey was neutralized by using CaCO_3 . The different levels (5%, 10% and 15%) of the *Alfonso* mango pulp was incorporated. One-lit aliquots of the whey was taken and labeled as M1, M2 and M3 for 5%, 10% and 15% of mango pulp. Sucrose was added as a sweetening agent. A food-grade CMC was added @ 0.1%. It was vigorously shake in domestic mixer-cum-grinder and cooled to 37°C. It was inoculated with 2% active culture of the probiotic organisms to give a final count of 10^7 cfu/ml of the finished beverage. The inoculated aliquots

**Fig 1:** Flow diagram for preparation of whey-based probiotic beverage containing Alfonso pulp.

of beverage samples were aseptically packed in 200 ml quantities in clean and sanitized (soaking in 100 ppm chlorine solution for 15 min) LDPE pouches and stored under refrigerated conditions.

Sensory evaluation of whey-based probiotic beverage containing Alfonso pulp

The beverage was prepared as depicted in Fig 1. It was subjected to a panel of seven judges by employing nine-point Hedonic scale for sensory evaluation of the product. It was observed that the mean flavor scores allotted by the seven judges were 4.89, 5.79 and 8.71, respectively for the beverage containing 5%, 10% and 15% Alfonso pulp. The results are in conformity with those reported by the earlier workers (Cummings and Macfarlane, 1991; Ritika Yadav *et al.*, 2010; Isabel *et al.*, 2011).

Similarly, the body score assigned by seven judges was 5.32, 6.32 and 8.71 respectively, for the beverage containing 5%, 10% and 15% Alfonso pulp. The mean score for colour was 4.54, 5.39 and 8.75 respectively. The mean score for overall acceptability of the product was 4.96, 5.89 and 8.61, respectively. This indicates that in all of the sensory parameters evaluated in present investigation the whey-based probiotic beverage containing 15% Alfonso pulp liked extremely by the judges.

The statistical analyses shows that the different levels of Alfonso pulp showed significantly different acceptability. The results are in close conformity with those recorded by Prajapati *et al.*, 1984, Khedkar (1988 and 1993), Shah, 1997 and Goyal and Gandhi, 2008.

CONCLUSION

The whey obtained from cow milk *paneer* prepared in our laboratory, commercially available Alfonso pulp and probiotic culture *L. rhamnosus* MTCC-5463 was used in the present investigation. The method was standardized and the product was subjected for its sensory evaluation. It was observed that the whey-based probiotic beverage containing 15% Alfonso pulp (v/w) was liked most with mean score of 8.75 followed by 10% pulp with the score 5.39 out of 9.0 in the nine-point Hedonic scale. However, the product containing 5% pulp was disliked by the judges (mean score 4.54). It is concluded that the whey-based probiotic beverage containing 10-15% mango pulp can be prepared with probiotic viable counts of 10^7 cfu/ml. This would be one of the promising ways to utilize the whey.

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Conflict of interest

The authors declare that there is no any conflict of interest among the senior author and the co-authors.

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