

Review Article

Technological Innovations in the Manufacture of Traditional Fermented Dairy Product: A Review

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ABSTRACT

Fermented dairy products are very popular in our country because of their sensory and health-promoting properties. Fermentation involves a process of biochemical reactions in which aroma and other desirable products are produced. They are classified based on the type of microorganisms used, the metabolites produced by them and the physical form of the final product. The manufacturing procedures, organoleptic quality and the types of various ingredients used during fermentation process of the cultured dairy products produced across the world vary considerably. This paper covers technological innovations in the manufacturing of different types of traditional fermented dairy products namely dahi, misti dahi, fruit dahi and probiotic dahi which are very popular in the Indian subcontinent. Recently developed and introduced probiotic dahi/curd in the Indian market enhance human health after consumption and also implant desirable microorganisms to gastro intestinal tract, which are highly specific and effective on human digestive systems and helps in nutritional physiology.

Keywords

Fermented Dairy Product, Dahi or Indian curd

Introduction

Dahi or Indian curd, is a well-known fermented milk product consumed by large sections of the population throughout the country, either as a part of the daily diet or as a refreshing beverage. Being one of the oldest, most popular and widely consumed fermented milk of India, dahi, resembles Western yogurt in most aspects. The use of dahi has been prevalent since Vedic times, and it is mentioned in ancient scriptures like Vedas, Upanishads and various hymns. Dahi is an intermediate product for manufacture of traditional butter and ghee and is used as a base for preparation of related products such as lassi, chhash, shrikhand, curd rice etc. It is largely made at home using traditional kitchen recipes, involving milk of buffaloes, cows and goats. Generally a mixture of cow and buffalo milk is used.

Milk is boiled and cooled, inoculated with dahi starter, usually the left over from the previous day's stock, and incubated undisturbed at ambient temperature for four to six hours until it acquires a thick consistency.

Like dahi, yoghurt is a semi-solid fermented product made from a standardized milk mix by the activity of a symbiotic blend of *Streptococcus thermophilus* and *Lactobacillus delbrueckii subsp. bulgaricus* cultures. The body and texture of yoghurt depends largely on the composition of milk employed in its manufacture.

The FSSAI defines Dahi or curd as a semi-solid product, obtained from pasteurized or boiled milk by souring (natural or

otherwise), using a harmless lactic acid or other bacterial cultures. Dahi may contain additional cane sugar. It should have the same minimum percentage of fat and solids-not-fat (SNF) as the milk from which it is prepared. Where dahi or curd, other than skimmed milk dahi, is sold or offered for sale without any indication of the class of milk, the standards prescribed for dahi prepared from buffalo milk shall apply. The Bureau of Indian Standards (BIS) specifications for fermented milk products are based on the type of culture used in their preparation. Mild dahi is made from mesophilic lactococci. *Leuconostocs* may be adjunct organisms for added buttery odour and flavour.

Sour dahi contains additional cultures belonging to the thermophilic group, which are generally employed in the manufacture of yoghurt. These thermophilic organisms grow rapidly at 37-45°C, producing dahi in less than 4 hours.

Classification

In general, dahi may be classified into two types:

For direct consumption.

For churning into desi butter (makkhan)

The consumers have different taste preferences for traditional products varying from region to region. The technological developments have led to the commercialization of this product. Dahi may be classified on the following basis.

According to use

Dahi for direct consumption

Dahi for the production of chakka, shrikhand, lassi and butter milk.

Dahi for the production of desi butter and ghee.

According to consumption

Whole milk dahi

Skim milk dahi

Toned milk dahi

Standard milk dahi

Dahi from special milk

According to flavour

Sweet dahi (acidity not more than 0.7%).

Sour dahi (acidity not less than 0.7%)

Sweetened dahi

Fruit dahi

Composition

Dahi made from buffalo milk produces a thick bodied product because of its high SNF content. It is recommended to make dahi/ yoghurt from a mix containing 11-13 percent SNF. Higher milk solids also keep the product from wheying off. Dahi prepared from whole milk contains about fat 5-8, protein 3.2 – 3.4, lactose 4.6 – 5.2, Ash 0.70 – 0.72, and titratable acidity 0.60 –0.80 percent.

Method of Manufacture

Traditional Method

In this method dahi is prepared at small scale, either in the consumer's household or in the confectionary (Halwais) shop. In the household, the milk is boiled, cooled to room temperature, inoculated with 0.5 to 1.0 percent starter (previous day's dahi or butter milk) and then incubated undisturbed for setting for about overnight. In cold weather, the dahi setting vessel is usually wrapped up with woollen cloth to maintain appropriate temperature. In the confectionary shops, the

method employed for preparation of dahi is more or less same except that the milk is concentrated in an open pan before inoculation and usually dahi is set in earthenware.

Standardized Method

As stand process on the basis of scientific lines has been developed for dahi making in the organized sector. Fresh, sweet, good quality milk is received, pre-heated and subjected to filtration and clarification. The milk is standardized to 2.5 to 3.0 percent fat and 10 percent solids not fat, pre-heated to 60°C and homogenized single-stage at a pressure of 176-kg/sq cm. The milk is heated to 85 – 90°C for 15-30 minutes, cooled to 22-25°C and inoculated with 1-2 percent of specific dahi starter culture. It is then filled in suitable packaging containers of the appropriate size and incubated at 22-25°C for 16-18 hours. After proper setting of the dahi, the acidity of dahi reaches 0.6 to 0.7 percent and a firm curd is formed. The curd is cooled by circulating chilled water or air around the containers and then transferred to cold room maintained at about 4-5°C. The flow diagram for manufacture of dahi is presented here under (Fig. 1).

Mishti Dahi

Mishti dahi or mishti doi is a popular traditional sweetened fermented milk product. The eastern parts of India, especially in West Bengal, Assam, Bihar and Orissa, the sweetened variety of dahi known as Mishti dahi, Lal dahi or Payodhi is quite popular. The product is prepared by the Halwais on a small scale. It is a delicacy of choice during religious festivities and is considered an auspicious item to serve while starting journey or any important work. The product is commonly sold in earthen pots of varying sizes, and served chilled.

Composition of Mishti Dahi

Mishti dahi is a fermented milk product, having creamish to light brown colour, firm body, smooth texture, sweet-acidic flavour, and pleasant aroma. As such, there is no legal standard for mishti dahi. In the absence of legal standards, mishti dahi differs in terms of chemical composition as well as sensory attributes. The quality of mishti dahi depends upon the type of milk, level of concentration, and fermentation conditions employed in its manufacture. The typical composition of mishti dahi is given in table 1.

Method of Manufacture of Mishti Dahi

Traditional method

Traditionally, mishti dahi is prepared from cow or mixed milk. The fresh good quality milk is boiled with a required amount of sugar and partially concentrated by simmering over a low fire. This heating is continued for quite some time during which milk develops a distinctive light cream to light brown caramel colour and flavour. The content is then cooled to ambient temperature and cultured with dahi (lactic) culture). It is then filled into earthen pots of consumer size or bulk size vessels and incubated overnight. Normally the curd is set within 12-14 hours. After firm setting of curd, it is transferred to a cooler place or stored under refrigeration.

Industrial Production

In the organized sector, mishti dahi is manufactured employing developed technological process. A wide range of milk products for sourcing milk solids is used in the production of mishti dahi. For this purpose, milk solids are used from fresh cow/ buffalo milk, cream, skim milk powder

(SMP), whole milk powder (WMP), evaporated whole milk, sweetened condensed milk and white butter.

The required ingredients is blended in proper proportion, keeping in view the final compositional standard of the product in terms of fat, SNF, and sugar. There is a need to select fresh and good quality ingredients in relation to microbial and sensory quality. The raw material milk used for mishti dahi preparation should be fresh, free from off-flavours and clot-on-boiling negative.

The most common sweetening agent used in preparation of mishti dahi is cane sugar. Other sweeteners such as corn sugar, corn syrup, and also sugar or maltose can be used as sweetening agent. Some times in preparation of some special varieties of mishti dahi, fresh palm jaggery is used as a sweetener. Commercially cane sugar of high microbiological quality and free from extraneous matter is used as sweetening agent.

Mishti dahi is colored and flavored commonly with caramel. Caramel is prepared from heating sugar and it is available commercially in a viscous form (76% TS). Caramel is soluble in water and having a specific gravity of 1.315 to 1.345. Synthetic flavours like caramel, vanilla, cardamom, rose, pineapple, etc may also be used. Fruits and dry fruit, nuts may also be used for developing a wide variety of mishti dahi.

The most critical and important step in the manufacture of the mishti dahi is the selection of appropriate type of starter culture since it affects the flavour, consistency and acidity development in the presence of sugar and caramel at relatively higher TS levels. As such starter culture is regarded as heart of mishti dahi preparation.

Mixed strain culture may be used since it yields a superior product and most reliable under variable processing conditions. The optimum activity of the mishti dahi culture is expected in a narrow temperature range of 40-42°C. Normally a good starter culture with 1.0 percent inoculum develops 0.70 percent acidity within 6-8 hours.

Process

The required quantities of milk, cream, skim milk powder and sugar are blended. Caramel is added normally at the rate of 0.10 to 0.12 per cent. The mix is heated to 80° – 90°C in a vat or a plate heat exchanger. Various time- temperature combinations have been tried but heating the mix to 85°C for 15 minutes resulted in a highly desirable flavour and textural qualities. After heat treatment, the mix is cooled to 40-42°C either employing heat exchanger or by circulating chilled water in the jacket of vat. The starter culture is added to the mix at the rate of 1.0 percent and thoroughly mixed using stirrer. Thereafter, the mix is filled in sanitized cups of required sizes and covered with lids. The cups are properly heat sealed to make them airtight and prevent leakage. These cups are then incubated at 40-42°C for about 6-8 hours till the acidity develops to about 0.70 to 0.80 percent LA. At this acidity the mix will well set and a desired consistency and firmness is attained. After proper setting, these cups are transferred to a cold store of 4-5°C temperature. For long storage, normally the temperature of cold store is maintained at 0°C.

Production of Mishti Dahi from Buffalo Milk

Fresh buffalo milk is standardized to 3.5% fat and 9.0% SNF, heated to 65°C in a plate heat exchanger and homogenized at a pressure of 56 kg/cm² (one stage).

Table.1 Composition of different grades of mishti dahi

Constituent (%)	Low fat	Medium fat	High fat
Milk fat	2-3	4-5	8-9
Milk SNF	13-14	11-13	10-11
Sugar	17-19	17-18	17-18
Total solids	32-35	32-36	35-38

Fig.1 Manufacture of Dahi

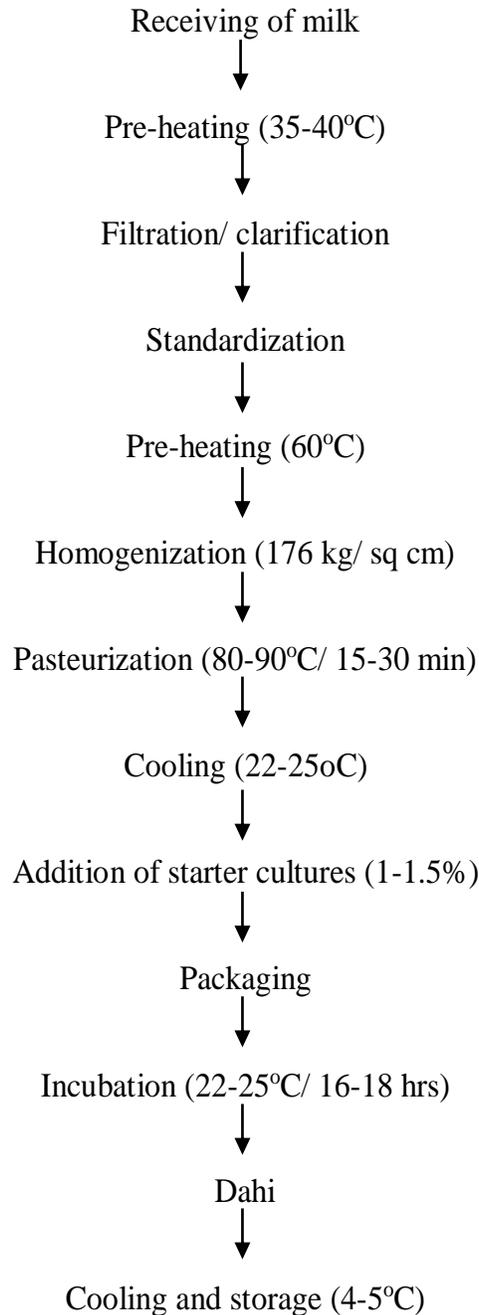


Fig.2 Flow diagram for manufacture of Mishti Dahi

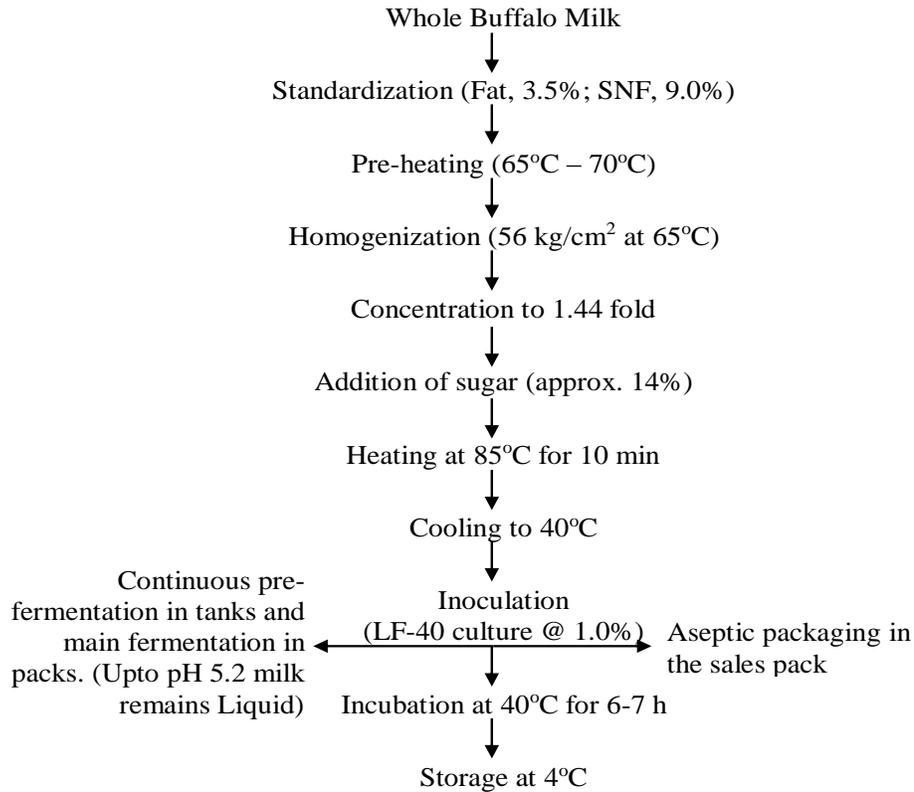
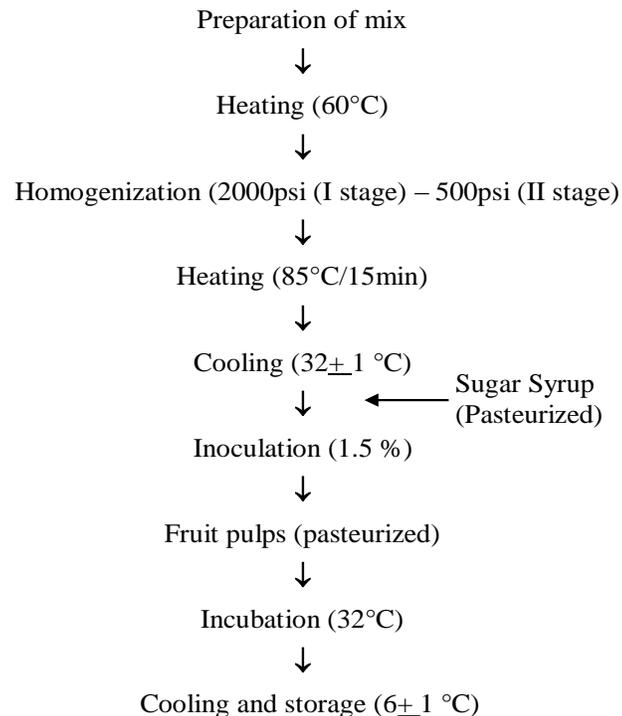


Fig.3 Schematic Diagram for Fruit Dahi Manufacture



Milk is concentrated at 1.44 fold in a vacuum evaporator. After adding cane sugar, the milk is heated at 85°C for 5 min to generate cooked flavour. The mix is water cooled to 40°C before inoculation with the mixed culture (LF-40). In some cases, sugar caramel, jaggery and artificial colors are added to impart brown colour. The inoculated mix is aseptically distributed into pre-sterilized polystyrene containers (200 ml) and mechanically transferred to incubation chamber at 40°C. After 7 h of incubation, the product is shifted to cold store maintained at 4°C. During gel formation, milk must remain stationary. In the flow chart (Fig.2), fermentation is designed as a batch process. In all post fermentation activities, gel should be subjected to a minimum amount of external influences.

Probiotic Dahi

Probiotic foods are the most important discipline of functional foods, which are defined as foods containing live microorganisms, which actively enhance the health of consumers by improving the balance of microflora in the gut when ingested, live in sufficient numbers. Several studies have related the promising health benefits of consuming cultured and culture containing milks. There have been long term interests of using cultured milk products with various strains of LAB and other probiotic bacteria to improve the health of humans. The consumption of probiotic products is helpful in maintaining good health, restoring body vigour, and skirmishing intestinal and other diseases. Fuller (1989) listed out the claimed beneficial effects and therapeutic application of probiotic bacteria in humans, which includes: (i) beneficial effects, such as maintenance of normal intestinal realm, augmentation of immune system, reduction

of lactose intolerance, reduction of in serum cholesterol levels, anticarcinogenic activity, and improved nutritional value of foods, and (ii) therapeutic applications, such as prevention of urogenital infections, mitigation of constipation, protection against travellers' diarrhea, prevention of infantile diarrhea, reduction of antibiotic induced diarrhea, prevention of hypercholesterolemia, protection against colon/bladder cancer and prevention of osteoporosis, etc. Probiotic bacteria, thus, offer new dietary alternatives for the management of such conditions through stabilization of intestinal microflora, promotion of colonization resistance, regulation of the immune response and preservation of intestinal integrity.

Recently, at NDRI probiotic dahi has been developed with enhanced health attributes. The probiotic lactobacilli viz. *L. acidophilus* and *L. casei* used to prepare dahi either alone or in combination with mesophilic dahi culture *Lactococcus lactis ssp. lactis biovar. diacetylactis*-60 and mixed dahi culture 167 (BO4). Standardized buffalo milk (fat 4%) as well as milk with different fat % (1 to 3%) is used for preparation of two types of Dahi. Dahi incubation carried out at 37°C for 9-10 hours. After incubation dahi is stored at 4°C (approx.). Dahi exhibited good taste and flavour, also good; texture is firm exhibiting pH 4.27 to 4.47 and titratable acidity ranging from 1.08-.1.21. A number of probiotic organisms are 7.1×10^{10} approx. Number of probiotic organisms is ranged from 3.8×10^{10} - 4.24×10^{10} .

Fruit Dahi

India is also amongst largest fruit producing countries, with vast horticulture base consisting wide range of fruit varieties. The production of fruits in India is confined to

27.8 MT, which amounts to 8.1% of the total world fruit production. Post harvesting losses in India are also amongst highest in the world at 30-35 % resulting in a great loss to our economy (Indian Economic Review, 2001). The major hurdle in the successes of fruit process industry is the lower demand of processed fruits. The poor purchasing power of Indian consumers and current fruit market structure does not offer a competitive environment to fruit processing industry. Also there is a need to create new avenues for fruit products as our fruit production is increasing rapidly. All these factors demand creation of new avenues for the utilization of fruit products. Keeping in view, the market trend in western dairy market, incorporation of fruits in to fermented milk product would generate a great demand for processed fruits, which might help checking the post-harvest losses and the economic loss to the nation and would enhance the profitability of milk and fruit producer as well as processors.

Manufacture of Fruit Dahi

The processing parameters for manufacture of fruit dahi have been standardized for the development of good quality fruit dahi using various fruits, such as mango, pineapple and banana (Fig.3). Appropriate starter cultures have been employed to get desired flavour and consistency in the product. The rheological properties of the fruit dahi have been enhanced by incorporation of exopolysaccharide producing cultures and hydrocolloids. The shelf life of the product is about 3 weeks at refrigeration temperature. This newly developed fruit dahi with firm body, smooth texture and with delicate balance of fresh fruity aroma and a typical dahi flavour will have greater aesthetic appeal and will cater to the growing needs of Indian dairy industry. The millions of milk producers and fruit growers will be benefited with this technological

development. The technology has tremendous techno-economic feasibility.

Fermented milks have been produced and consumed since ancient times. Dahi has managed its popularity in Indian diet despite changing life styles and food habits with time. It is preferred over milk due to good taste high nutritive and therapeutic value and most importantly, enhanced keeping quality than milk in a tropical climate like ours. It is being consumed as plain, sweetened or salted and spiced. At present several types of fermented milk products such as dahi, mishti dahi, fruit dahi, probiotic dahi, lassi, yoghurt, shrikhand, etc. are being produced and marketed. Many people recognized the dietetic and prophylactic properties of fermented products and their healing effects in certain conditions. As a result, the use of various types of fermented milks has found a wide application.

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