

CHEMISTRY OF CHHANA AND DAHI

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Definition of chhana:

According to FSSAI (2011), chhana is the product obtained from cow or buffalo milk or combination thereof by precipitation with sour milk, lactic acid or citric acid. Milk solids may be used in preparation of this product. It shall not contain more than 70% moisture and the milk fat content shall not be less than 50% of the dry matter. Chhana when sold as low fat chhana, it shall not contain more than 70% moisture and the milk fat content shall not more than 15% of dry matter.

Chemical Composition of Chhana (FSSAI, 2011):

Parameter	Chhana	Low fat Chhana
Moisture, maximum, %, (m/m)	65.0 (for Chhana)	65.0 (for Chhana)
Milk fat, %, (m/m), dry matter basis	50.0 (minimum)	15.0 (maximum)

Chemistry of chhana processing:

The process of coagulation of milk in the preparation of chhana due to combined chemical and physical changes in casein brought about by the action of acid and high temperature of coagulation. This involves the formation of large structural aggregates of casein or curd from the normal colloidal dispersion of discrete casein micelles in which fat and coagulated serum protein are entrained together with whey. Then the curd separates from the milk serum as a flocculent. A part of calcium and phosphate losses from the casein micelles during boiling and subsequent coagulation.

Various factors influencing the quality of chhana:

1. Type of milk
2. Fat content in milk
3. Homogenization
4. Calcium level
5. Additives
6. Type and amount of coagulant
7. Temperature of coagulation
8. pH of milk
9. Speed of stirring

Type of milk:

Cow milk is preferred for chhana preparation since it yields a **soft body, smooth texture and small grain** that are suited for making sweet. The chhana from buffalo milk has a slight hard body, a greasy and coarse texture. Buffalo milk contain higher concentration of casein, mainly in the miceller form with bigger size of the micelles, higher proportion of high melting triglycerides and higher content of calcium may be responsible of hard body and coarse texture in buffalo milk chhana.

Fat content in milk:

Fat level in milk affect the final quality of chhana. A minimum fat level of 4% in cow milk and 5% in buffalo milk is essential for satisfactory quality of chhana. Higher fat level would give rise to a softer chhana with higher fat loss in the whey.

Presence of colostrum:

The presence of colostrum in milk tends to produce a pasty texture in the coagulation mass. The adulteration of milk with starch results in a gelatinous mass on coagulation.

Mineral level of milk:

Addition of calcium or magnesium chloride produces a hard chhana whereas sodium chloride, sodium citrate and sodium acetate have negligible effect on the body and texture of chhana

Type of coagulants:

Coagulants generally added are organic acids like citric acid, lactic acid or their salts, lemon juice or sour whey. Lactic acid (0.5-0.75%) tends to produce a granular texture chhana suitable for rosogolla making, while citric acid (1-2%) produces doughy product suitable for sandesh making. Calcium lactate (4%) produces soft body, smooth texture, and pleasant flavour chhana that is suitable for the preparation of sandesh. Generally low acid strength coagulant results a soft body and smooth texture required for rosogolla preparation and high acid strength results a comparatively hard body and less smooth texture required for sandesh preparation.

Coagulation temperature:

Temperature of coagulation exerts a significant influence on physico-chemical attributes. A temperature range of 80-85⁰C and pH 5.4 for cow milk and 70-80⁰C and pH 5.7 for buffalo milk will give better yield and quality. Higher coagulation temperature results hard, granular and graininess texture chhana and lead to lower moisture content but higher percentage of milk solids comprising fat, protein, lactose and ash. The lower temperature imparts in a sticky chhana with slow drainage problem.

Stirring/agitation:

Generally slow stirring is preferred for avoiding foam formation and reduce the shattering of the coagulation mass, whereas fast stirring reduce the moisture content and increased hardness in chhana. Again, delayed straining produced comparatively a soft body and smooth texture with higher yield chhana than immediate straining. Delayed drainage of whey following coagulation results in a softer body and smoother and sticky and less chewy texture and is more acceptable from overall quality.

Proteolysis:

Proteolysis of buffalo milk with enzyme trypsin coagulation produced a chhana with very soft and smooth body having minutes sized micelles and suitable for rosogolla preparation. Addition of 0.3% sodium citrate to buffalo milk produces a chhana similar to cow milk chhana. A mixture of 75% buffalo milk and 25% cow milk produces suitable chhana, which offers good rosogolla.

Fermented milk product:

Dahi (Curd)	Lactic acid bacteria
Yoghurt	Symbiotic cultures of Streptococcus thermophilus and Lactobacillus delbrueckii sub sp. bulgaricus
Alternate Culture Yoghurt	Cultures of Streptococcus thermophilus and Lactobacillus species
Acidophilus milk	Lactobacillus acidophilus.

Dahi

Definition:

According to FSSA (2006), dahi or curd is the product obtained from pasteurized or boiled milk by souring, natural or otherwise, by a harmless lactic acid or other bacterial culture. Dahi may contain additional cane sugar. Milk solids may also be used in preparation of this product. It should have the same percentage of fat and SNF as the milk from which it is prepared. When dahi or curd other than skimmed milk dahi, is sold or offered for sale without any indication of the class of milk, the standard prescribed for dahi prepared from buffalo milk shall apply.

The dahi may be classified into various types depending upon the type of milk used such as whole milk dahi, skim milk dahi and on basis of acidity and addition of sugar it can be classified as: sweet dahi (acidity < 0.7%), sour dahi (acidity > 0.7%) and sweetened dahi .The composition of dahi depends upon the type of milk and the manufacturing condition.

Type of dahi preparation:

Household preparation

During preparation of dahi at home, cow or buffalo or mixed milk is boiled or simmered for a long time to concentrate it, allow cooling to room temperature and then transferred to earthenware pots or pan. A small amount of the previous day's curd is added as a starter culture and then allowed to set undisturbed overnight. The dahi is usually ready within 16 to 20 hours.

Commercial preparation

Fresh, sweet, good quality milk (cow or buffalo or mixed) is received. It is then standardized to have 4-5 percent fat and 10-12 percent solids not fat, preheated to 60⁰C and homogenized at a pressure of around 176 kg/sq. cm. The milk is preheated to 80⁰C to 90⁰C for 15 to 30 minutes, cooled to 40 – 45⁰C and inoculated with 1 to 2 percent of specific starter culture. It is then filled in a suitable containers using automatic filling and sealing machine and incubated at 40 -42⁰C till curdling (3-4 hour). When a firm curd is formed, dahi cups are stored in a cold room temperature.

Biochemical Changes

Break down of lactose:

Hydrolysis of lactose to glucose and galactose by starter organism is the first step in the process of fermentation during the preparation of dahi. The liberated glucose is then enters the classical Embden Meyer Hoff pathway (EMP). But the galactose produced cannot enter the EMP pathway directly but follows a longer route and ultimately enter the EMP pathway via glucose – 1 – phosphate. Each of the simpler sugar is further acted upon by several enzymes successively before arriving at the lactic acid stage. There may be several form of acid end product. The amount of lactic acid produced may range from 75 – 95 % of the total acidity, the rest being volatile acid.

Role of lactic acid:

The lactic acid cause at first an acid flavour combine with calcium of casein to form calcium lactate, then setting free the casein and coagulated it when isoelectric point (4.6) is reached . The fermentation is accompanied by gelling of the solids, principally the proteins and syneresis manifested by appearance of thin exudates of clear whey on the surface of dahi.

Nitrogen content:

Total nitrogen content of milk remains more or less unchanged during fermentation. Appreciable changes occur in non-protein nitrogen, albumin nitrogen, ammonia and dialyzable nitrogen during fermentation. The increase in the non-protein nitrogen during fermentation is attributed to the breakdown of protein.

Salt content:

Considerable changes occur in the mineral contents of milk. The total mineral content is not affected. The soluble calcium and phosphorus are increased during souring. Citric acid is completely disappears during fermentation.

Vitamin content:

Vitamin content of dahi depends on the type of organisms used for fermentation. Fermentation of milk with streptococcus lactic and streptococcus cremoris results in increase in thiamine, riboflavin and folic acid and decrease in vitamin A. The incorporation of propionibacterium shermani in lactic culture would enrich in with riboflavin and folic acid and cynocobalamine (vitamin12). Fermentation of milk with streptococcus cremoris, streptococcus diacetylactis, streptococcus thermopilus and lactobacillus thermophilus results in increase in riboflavin and folic acid and decrease in nicotinic acid.

- During fermentation, the electrical charge on the fat particles is neutralized, causing the globule to coalesce and rise to top. The iso-electric point (pH 4.5 – 4.6) of the fat globule in milk is slightly higher than that of washed globule (pH 4.3) from cream. With respect to acidity, a pure culture is able to neutralize the charge on the fat globule at a lower level (1%) of acidity than a mixed starter (1.3 – 1.5 %).

Misti Doi

In the eastern region of India, sweet variety of dahi known Misti dahi, lal dahi or payondhi is popular. It is creamish to light brown colour, firm consistency, smooth texture and pleasing aroma. It is produced with the addition of 6 -6.5% sugar to milk either during boiling or at the setting stage. Prolong heating of sweetened milk at low temperature leads to milk solid concentration and development of brown colour. It is then cooled , add dahi culture and poured into earthen cups and left undisturbed overnight for fermentation. When a firm body curd has set, it is stored at low temperature of about 4⁰C and served chilled.