UNIT 6 METHODS OF MANUFACTURE OF PANEER AND CHHANA

Structure

6.0 OBJECTIVES

After reading this unit we should be able to:

- manufacture of paneer from buffalo and cow milk.
- know the process of manufacturing paneer from recombined/reconstituted milk.
- manufacture of chhana from cow and buffalo milk.

6.1 INTRODUCTION

Paneer, the indigenous variety of soft cooking type cheese, is obtained by the heat and acid coagulation of milk at relatively higher temperature. The chemical and physical changes in casein and whey proteins brought about by the combined action of heat and acid treatments, form the basis of paneer making. When milk is acidified, the colloidal calcium phosphate in the casein micelles progressively solubilises and aggregation of the casein occurs as the isoelectric point is approached. In milk of normal pH, the casein micelles are stabilized by hydration and steric repulsion due to their negative charge. On acidification the micelles become unstable and aggregate as a result of charge neutralization, leading to the formation of chains and clusters that are linked together to give a three-dimensional network. In milks preheated at high temperatures (90^{o}C), gelation occurs more rapidly at a higher pH than in unheated milk. Interaction of whey proteins with casein micelles on heating milk at its natural pH may increase the hydrophobicity of the micellar surface and reduce the hydration barrier against aggregation, thus allowing aggregation and gelation to occur at a higher pH than in unheated milk. Heating milk also results in dissociation of k-casein from micelles, and this could further sensitize the α-s-casein framework to calcium-induced aggregation. The development of typical rheological characteristics of paneer could be due to the intensive heat induced protein-protein interactions. Paneer manufacture essentially involves the formation co-precipitates due to

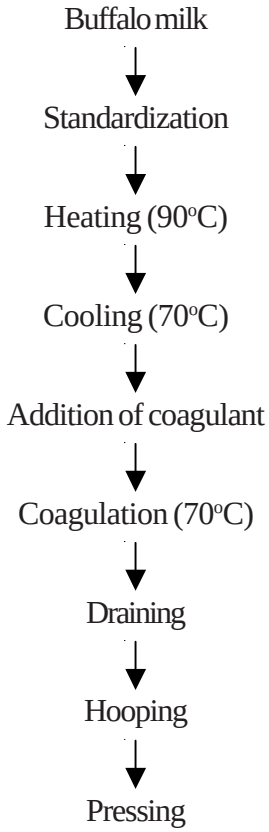
complexing of whey proteins denatured by the heat and the casein. Serum proteins, particularly β-Lactoglobulin, are bonded to κ-casein via disulphide bridges and calcium linkages. The higher the degree of co-precipitation, the greater will be the total solids recovery and yield of paneer.

6.2 METHOD OF MANUFACTURE OF PANEER

The manufacture of paneer involves standardization of milk, heat treatment, coagulation, draining of whey, pressing, dipping in chilled water and packaging.

i. Buffalo Milk Paneer

Buffalo milk is an ideal raw material for manufacture of good quality paneer. Buffalo milk is standardized to a fat level of 5.8 to 6.0 per cent using fresh buffalo skim milk. The standardized milk is heated to 90°C without holding. Thereafter, the temperature of milk is brought down to 70°C and coagulated at this temperature using 1 per cent citric acid solution. The temperature of citric acid solution is also maintained at 70°C. Citric acid solution is added with continuous stirring till clear whey separate out. After complete coagulation, the stirring is stopped and the coagulated mass (curd) is allowed to settle down for about 5 minutes. The whey is then drained through stainless steel strainer. The temperature of the content is not allowed to drop below 63°C until this stage. The curd is collected and filled in hoops (with holes on all its sides to facilitates the expulsion of whey) lined with clean fine cloth. The hoops containing curd is pressed for about 10-20 minutes. Thereafter, the pressed block of curd is removed, cut into pieces and immersed in chilled water of 5-6°C for about 2 hours. Dipping of paneer pieces facilitates cooling of product and also it absorbs moisture and improves the body and texture of paneer. The chilled pieces of paneer are then removed from water and placed on wooden planks for 10-15 minutes to allow loose water to drain. The paneer is cut into desirable size and packaged in suitable packaging material. Finally it is stored under refrigeration till marketing and consumption. The flow chart for manufacture of buffalo milk paneer is given in Fig. 6.1.



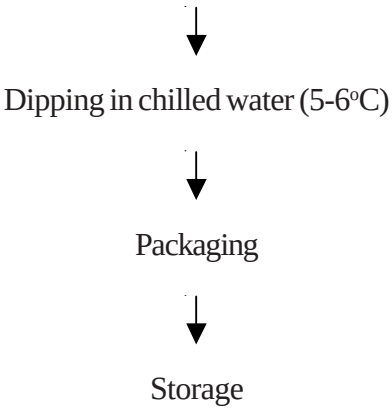


Fig. 6.1 Flow chart for manufacture of paneer from buffalo milk

ii. Cow Milk Paneer

Cow milk is standardized to a fat level of 4.5 to 5.0 per cent using fresh cow cream. To this milk calcium chloride is added at the rate of 0.05 to 0.10 per cent. The milk is heated to 90°C without holding. Thereafter, the temperature of milk is brought down to 85°C and coagulated at this temperature using 2 per cent citric acid solution. The citric acid solution is heated to 85°C prior to its addition to milk. Rest of the manufacturing process is same as in case of buffalo milk Paneer. The flow chart for manufacture of cow milk paneer is presented in Fig. 6.2.

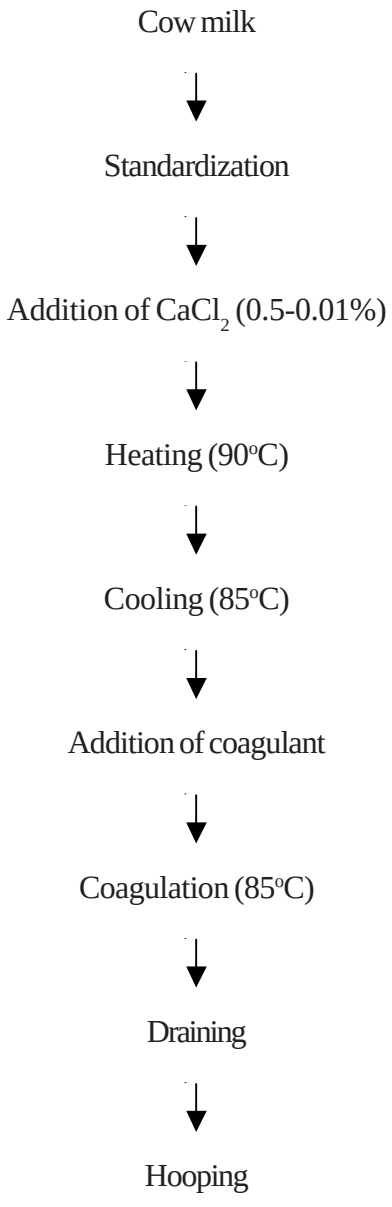


Fig. 6. 2 Flow chart for manufacture of paneer from cow milk

Check your Progress I

1) Which milk is more suitable for manufacture of paneer and why?

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2) How will you improve the quality of cow milk paneer?

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3) What is the optimum temperature of coagulation of buffalo milk for paneer making?

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4) Why milk is heated to 90°C for paneer making?

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iii. Recombined Milk Paneer

The manufacture of paneer from recombined milk is not too difficult provided appropriate modifications are made to the standard paneer making techniques. The recombined milk is prepared by blending skim milk powder, with butter oil/ cooking butter/ cream and potable water. The milk is standardized to a fat and SNF content of 5.8 and 9.5 per cent, respectively using skim milk powder and fat from above mentioned sources. The standardized milk is suitably homogenized. The milk is kept aside fro 3-4 hours for complete interaction and hydration of milk constituents. The milk is heated to 90°C without holding. Prior to coagulation, 0.10 to 0.15 per cent calcium chloride is added to milk. The milk is coagulated using 10 per cent citric

acid solution heated to 90°C. The citric acid solution is added with continuous stirring till clear whey separated out. The remaining steps are same as employed incase of conventional paneer.

iv. Reconstituted Milk Paneer

The whole milk powder of good quality is required for manufacture of acceptable paneer. The low-heat milk powder is preferred for desirable quality paneer. The whole milk powder is dissolved in potable water at 50°C and kept aside for 3-4 hours for proper hydration of milk constituents. To this 0.1 to 0.15 per cent calcium chloride is added and then content is heated to 90°C without holding. The milk is coagulated with 10 per cent citric acid solution at 90°C. The remaining steps are the same as followed in case of conventional paneer making. Normally, the total solids content in reconstituted milk is kept higher (18-20% TS). The purpose of increasing the total solids level in milk is to reduce the bulk handling and also to reduce the requirements of coagulant, water, energy and labour for manufacture of paneer.

v. Filled Paneer

Filled paneer technology involves blending of skim milk with vegetable oils or vanaspati and coagulation of milk with suitable coagulant at desired temperature. Filled milk is prepared by homogenization/ blending/ mixing of skim milk with vegetable oil or vanaspati fat at 40°C. This milk is converted into paneer employing the remaining steps same as in conventional paneer making.

Check your Progress 2

1) Write definition of recombined milk.

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2) Define reconstituted milk.

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3) What is filled milk?

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4) Describe recombined, reconstituted and filled milk paneer.

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6.3 METHODS OF MANUFACTURE OF CHHANA

Chhana making is essentially a process involving destabilization of casein particle by acidification of milk with dilute acid at relatively higher temperature. Acidification affects the stability of casein directly by disturbing the charges carried by the particles and indirectly by releasing the calcium ion from colloidal calcium phospho caseinate.

The destabilization results in formation of large aggregates from the normal colloidal dispersion of casein micelles in which milk fat, serum proteins and other constituents get entrained together. Thus, the large structural aggregates formed is known as coagulum.

i. Traditional Method

Milk for chhana making is brought to boil by heating it directly in a large iron *karahi* over an open fire with continuous stirring to prevent burning. This hot milk is ladled out in batches of about 1-1.5 litre in a separate coagulation vessel and adequate amount of coagulant solution normally cleansed sour chhana-whey is added to it while gentle stirring the contents. After complete coagulation, the contents is poured over a piece of clean muslin cloth stretched over another vessel. The process is repeated till all the milk is used up. The cloth containing the coagulated mass is then removed, tied into a bundle and hung up to drain out the whey completely without applying any external pressure.

ii. Bulk Method

In this method, the same steps are followed as mentioned above except instead of small lots of 1-1.5 litres, all the milk (normally 5-20 litres) is coagulated in one bulk. Coagulant solution is added slowly with uniform constant stirring till clear whey separate out. The coagulated solid mass is collected by straining it through a muslin cloth.

iii. Improved Method

The method of production of chhana remains the same as mentioned above with some improvements. These involve consideration of equipment, quality of milk, conditions of coagulation and method of straining etc. In this process boiling, cooling, coagulation of milk are accomplished in the same steam jacketed stainless steel kettle by employing steam or tap water as and when required, coagulation of milk is carried out at 80^{o}C by adding 1-2 per cent citric acid solution (pH of coagulation 5.4). The coagulant solution is added with in 30-60 seconds and while addition of coagulant a slow stirring is preferred so as to avoid foam formation and also breakage of curd into fines. After attaining complete coagulation of milk the coagulated mass is strained as mentioned above.

iv. Continuous Method

In order to overcome problems of small scale, attempts have been made to mechanize chhana production. A prototype machine with a capacity of 40 kg chhana per hour has been developed at NDRI, Karnal. The major components of the equipment are a balance tank, injection chamber, tubular heat exchanger, cooling chamber, mechanized strainer, whey tank etc. In this mechanized process, standardized cow milk is pumped from a balance tank at the rate of 250-litres/ hour to an injection chamber where culinary live steam is directly injected into the milk. Steam gets completely condensed in milk and raises its temperature to 90-95^{o}C. Thereafter, milk is brought in contact with coagulant solution, the quantity of which is regulated manually in proportion to the rate of flow of milk. The mixture of milk and coagulant is circulated through a holding coil to facilitate complete coagulation of milk. The coagulated product, along with the whey is then pumped to a double-jacketed cooling tank, where it is cooled down to room temperature. Finally, the coagulated mass is directed to a mechanical strainer, a double jacketed inclined sieve, where it is drained thoroughly. Chhana with 55-65 per cent moisture is discharged through the outlet and collected in the basket. Drained whey is transferred to a separate tank for subsequent use. Finally the chhana is packaged in suitable packaging material and stored in cold room.

6.4 TYPE OF CHHANA

i. Cow Milk Chhana

For chhana production, cow milk is preferred since it yields a soft-bodied and smooth textured product, which is highly suitable for preparation of high-grade chhana sweets such as *rasogulla, sandesh*, etc. Cow milk is standardized to 4.0 per cent fat. The milk is heated to near boiling without holding. Thereafter, the temperature of milk is brought down to 82°C and coagulated at this temperature using coagulating acid solution of 1-2 per cent concentration. Acid solution is added to milk with constant stirring till clear whey separated out. The coagulated mass collected in a muslin cloth and hung up for complete drainage of whey. Finally chhana is packaged in suitable packaging material and stored under refrigeration/ cold store. The flow chart for manufacture of cow milk chhana is presented in Fig. 6.3.

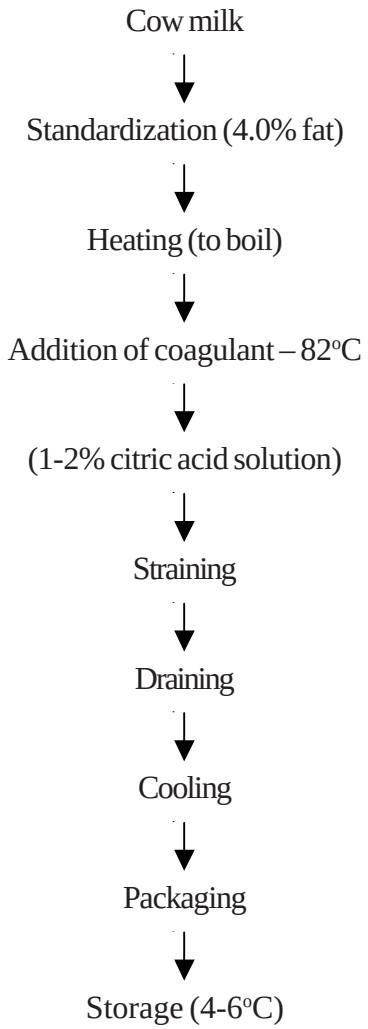

Fig. 6.3 Flow chart for manufacture of cow milk chhana

ii. Chhana from Buffalo Milk

As mentioned above cow milk is an ideal raw material fro chhana making because it yields soft body and smooth textured product which is suitable for chhana based sweets. Buffalo milk, because of many inherent differences in physico-chemical make-up than that of cow milk, poses many technological problems in preparation of good quality chhana and chhana-based sweets. As such buffalo milk yields hard body and coarse textured product, which is not desirable for chhana and chhana based sweets. In order to utilize buffalo milk for chhana making, various technological modifications have been made viz. admixing of cow and buffalo milk (75 parts cow and 25 part

buffalo milk), incorporation of additives (sodium dihydrogen phosphate, disodium hydrogen phosphate, CMC, guar gum, sodium citrate, sodium alginate, etc.), dilution of buffalo milk with 25 per cent water (v/v), and homogenization of milk. A method has been developed at National Dairy Research Institute, Karnal for production of chhana for rasogulla making. The standardized method involve: standardization of buffalo milk to 5.0 per cent fat and heating to boiling temperature, addition of 0.05 per cent sodium alginate followed by filtration and cooling to 40°C. Thereafter, the milk is coagulated with 1.0 per cent citric acid solution. The coagulated mass is collected and pressed employing a pressure of 0.05 kg/cm^2 to achieve desired quality. The flow chart for manufacture of buffalo milk chhana is presented in Fig. 6.4.

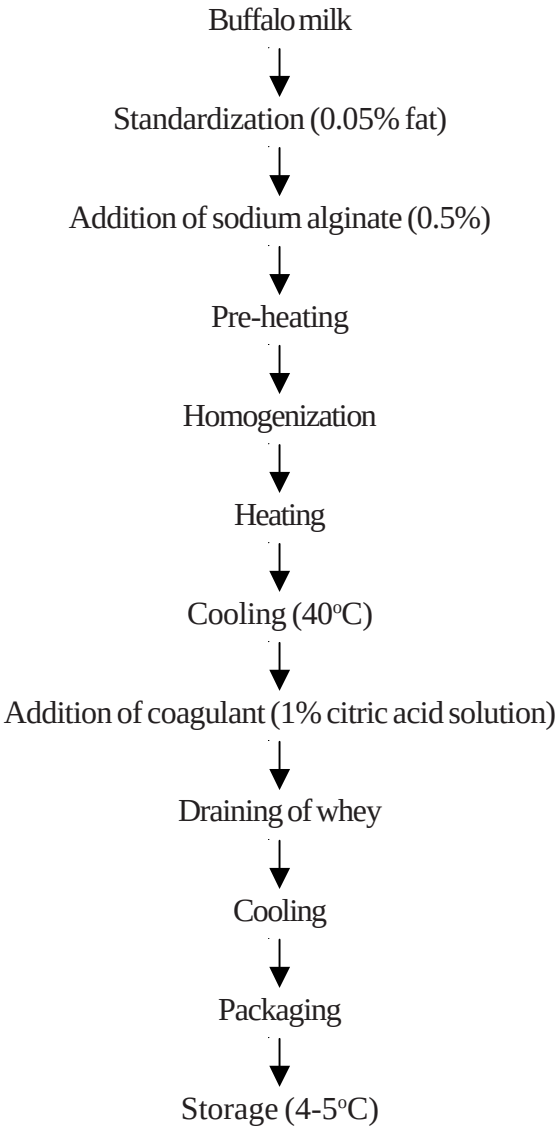

Fig. 6.4 Flow chart for manufacture of buffalo milk chhana

6.5 YIELD OF PANEER AND CHHANA

The yield of paneer and chhana is largely depend upon the total solids content of milk, type of milk, manufacturing conditions and moisture retained in the paneer and chhana. Normally, the average yield of chhana is about 20 per cent from cow milk and about 25 per cent from buffalo milk. The yield of paneer depends on the fat and solids-not-fat content of milk, manufacturing conditions and moisture, fat retained in the paneer. An average yield of about 19-20 percent for buffalo milk and about 16-17 per cent for cow milk is generally obtained.

Check your Progress 3

1) Why cow milk is more suitable for chhana making?

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2) Write the modifications, which you suggest for preparation of good quality chhana from buffalo milk.

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3) What is the improved method for manufacture of chhana?

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4) What is average yield of paneer from cow and buffalo milk?

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6.6 LET US SUM UP

Paneer, the indigenous variety of soft cooking type cheese, is obtained by the heat and acid coagulation of milk at relatively higher temperature. The chemical and physical changes in casein and whey proteins brought about by the combined action of heat and acid treatments, form the basis of paneer making. The manufacture of paneer involves standardization of milk, heat treatment, coagulation, draining of whey, pressing, dipping in chilled water and packaging.

Buffalo milk is an ideal raw material for manufacture of good quality paneer. Buffalo milk is standardized to a fat level of 5.8 to 6.0 per cent per cent using fresh buffalo skim milk. The standardized milk is heated to 90^{o}C without holding. Thereafter, the temperature of milk is brought down to 70^{o}C and coagulated at this temperature using 1 per cent citric acid solution. The whey is then drained through stainless steel strainer. The curd is collected and filled in hoops and pressed for about 10-20 minutes. Thereafter, the pressed block of curd is removed, cut into pieces and immersed in chilled water of 5-6^{o}C for about 2 hours. The chilled pieces of paneer are then removed from water and packaged in suitable packaging material. Finally it is stored under refrigeration till marketing and consumption.

For manufacture of cow milk paneer milk is standardized to a fat level of 4.5 to 5.0 per cent using fresh cow cream. To this milk calcium chloride is added at the rate of 0.05 to 0.10 per cent. The milk is heated to 90^{o}C without holding. Thereafter, the temperature of milk is brought down to 85^{o}C and coagulated at this temperature using 2 per cent citric acid solution. The remaining steps are same as employed incase of conventional paneer.

Recombined milk paneer is manufactured from recombined milk, blending skim milk powder, with butter oil/ cooking butter/ cream and potable water. For manufacture of reconstituted milk paneer the low-heat milk powder is preferred. Filled paneer technology involves blending of skim milk with vegetable oils or vanaspati and coagulation of milk with suitable coagulant at desired temperature. Chhana making is essentially a process involving destabilization of casein particle by acidification of milk with dilute acid at relatively higher temperature. Acidification affects the stability of casein and results in formation of large aggregates from the normal colloidal dispersion of casein micelles in which milk fat, serum proteins and other constituents get entrained together. Thus, the large structural aggregates formed are known as coagulum. Milk for chhana making is brought to boil by heating it directly in a large iron *karahi* over an open fire with continuous stirring to prevent burning. This hot milk is ladled out in batches of about 1-1.5 litre in a separate coagulation vessel and adequate amount of coagulant solution normally cleansed sour chhana-whey is added to it while gentle stirring the contents. After complete coagulation, the contents are poured over a piece of clean muslin cloth stretched over another vessel. The process is repeated till all the milk is used up. The cloth containing the coagulated mass is then removed, tied into a bundle and hung up to drain out the whey completely without applying any external pressure.

In case of bulk method, the same steps are followed as mentioned above except instead of small lots of 1-1.5 litres, all the milk (normally 5-20 litres) is coagulated in one bulk.. In order to overcome problems of small scale, attempts have been made to mechanize chhana production. A prototype machine with a capacity of 40 kg chhana per hour has been developed at NDRI, Karnal.

For chhana production, cow milk is preferred since it yields a soft-bodied and smooth textured product, which is highly suitable for preparation of high-grade chhana sweets such as *rasogulla*, *sandesh*, etc. Buffalo milk yields hard body and coarse textured product, which is not desirable for chhana and chhana based sweets. In order to utilize buffalo milk for chhana making, various technological modifications have been made viz. admixing of cow and buffalo milk (75 parts cow and 25 part buffalo milk), incorporation of additives (sodium dihydrogen phosphate, disodium hydrogen phosphate, CMC, guar gum, sodium citrate, sodium alginate, etc.), dilution of buffalo milk with 25 per cent water (v/v), and homogenization of milk.

The yield of chhana is largely depend upon the total solids content of milk, type of milk, manufacturing conditions and moisture retained in the chhana. Normally, the average yield of chhana of about 20 per cent from cow milk and about 25 per cent from buffalo milk.

The yield of paneer depends on the fat and solids-not-fat content of milk, manufacturing conditions and moisture, fat retained in the paneer. An average yield of about 19-20 percent for buffalo milk and about 16-17 per cent for cow milk is generally obtained.

6.7 KEY WORDS

Coagulants : The ingredients which are used for coagulation of milk are known as coagulants. In paneer and chhana making citric acid is mainly used. Other coagulants such as acetic acid, lactic acid hydrochloric acid, etc. can also be satisfactorily used for coagulation of milk in paneer or chhana making.

Acidulant : A substance added to food or beverages to lower pH and to impart a tart, acid taste. Phosphoric acid is an acidulant added to cola drinks.

Whey : The serum or watery part of milk that is separated from the curd in making cheese or Paneer.

Sour Whey : Whey containing high acidity.

Filled milk : This refers to the product obtained form blending skim milk with vegetable fats/ or oils.

Filtration/ clarification : To improve the aesthetic quality of milk by removing visible foreign matter which is unsightly and may therefore cause consumer complaints? While filtration removes suspended foreign particles by straining process, clarification removes the same by centrifugal sedimentation.

Homogenization : Homogenization refers to the process of forcing the milk through a homogenizer with the object of sub-dividing the fat globules into tiny sizes. This causes sub-division of the original fat globules to less than 2 micro sizes.

Recombined milk : This refers to the product obtained when butter oil (also called anhydrous milk fat), skim milk powder and water are combined in the appropriate proportions to yield fluid milk. The milk fat may also be obtained from other sources such as cooking butter or plastic cream.

Reconstituted milk : Milk prepared by dispersing whole milk powder in water in appropriate ratio. For reconstitution usually spray dried powder is used, since it is more soluble and produces less sediments.

6.8 SOME USEFUL BOOKS

Anantakrishnan, C.P. and Srinivasan, M.R. (1964). Milk Products of India, ICAR Publications.

Aneja, R.P., Mathur, B.N., Chandan, R.C. and Bajerjee, A.K. (2002). Technology of Indian Milk Products. A Dairy India Publications, Delhi.

De, S. (1980). Outlines of Dairy Technology. Oxford University Press, New Delhi.

Rangappa, K.S. and Acharya, K.T. (1974). Indian Dairy Products. Asia Publishing House, New Delhi.

6.9 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) i. Buffalo milk is highly suitable for paneer making. Typically, paneer manufactured from buffalo milk is marble white in appearance, having slightly spongy body, close-knit texture, sliceable and possessing a sweetish-acidic nutty flavour.

2) i. Cow milk yields weak, soft and pasty paneer. To overcome this problem, milk is heated at higher temperature and calcium chloride is added. Cow milk is coagulated at higher temperature, 80-90oC with citric acid solution. The combined effect of high temperature of coagulation and addition of calcium chloride improve the quality of paneer.

3) i. The optimum temperature of coagulation of buffalo milk for paneer making is 70^{o}C. Higher temperature, above 70^{o}C results in harder product, low moisture retention and reduced yield.

4) i. Milk is heated to 90^{o}C for paneer making. This high heat treatment results in denaturation of whey protein and it is retained in paneer as co-precipitate. It also improves the body and texture of paneer.

Check Your Progress 2

1) i. Blending of skim milk with cooking butter/ butter oil/ plastic cream in appropriate proportion.

   ii. Heating the blend at suitable temperature.

   iii. Homogenization of the blend using homogenizer at appropriate pressure.

2) i. Dissolve milk powder in water at appropriate proportion.

   ii. Keep the reconstituted milk for some times for hydration of casein/ protein and better interaction of milk solids with water.

3) i. Blending of skim milk with vegetable fats/ oils in appropriate proportion.

   ii. Contents may be homogenized at suitable pressure.

   iii. High shear mixer can also be used in place of homogenizer.

4) i. Paneer from recombined milk is known as recombined milk paneer.

   ii. Paneer obtained from reconstituted milk is termed as reconstituted milk paneer.

   iii. Paneer made from filled milk (skim milk and vegetable fats/ oils blend) is called filled paneer.

Check Your Progress 3

1) i. Cow milk yield soft and spongy bodied chhana.

   ii. Cow milk yields good quality chhana based sweets.

2) i. Standardization of buffalo milk to 5% fat.

   ii. Addition of sodium citrate (0.05%) to milk.

   iii. Homogenization of milk at 176 kg/cm^2.

iv. Holding coagulated mass in whey for about 30 minutes.

v. Cooling the mass for 15-20 minutes.

3) i. Use of large size equipment.

ii. Process boiling of milk, cooling and coagulation are accomplished in the same steam jacketed stainless steel kettle.

iii. In case of continuous method steam is directly injected to milk.

iv. The mixture of milk and coagulant is circulated through a holding coil to facilitate complete coagulation of milk.

v. Coagulated mass is separated by draining whey using mechanical strainer.

vi. Finally chhana is collected in a basket.

4) i. Yield of paneer depends on the fat and solids not fat content of milk, manufacturing conditions, moisture and fat retained and solids loss in whey.

ii. Average yield of paneer from buffalo milk is about 19-20 percent.

iii. About 16-17 percent yield from cow milk is generally obtained.