Unit V - Topic 3

Clarifiers - butter churns – ghee manufacture - equipment

Clarification

Definition and objective :

As an alternative to filtration, clarification can also be 7 employed to remove insoluble impurities especially the finer ones. It involves the use of a centrifugal machine called 'clarifier'. Thus, clarification is a process of subjecting milk to a centrifugal force in order to eliminate the finer but heavier particles from milk, somatic cells, dust particles, etc. Although part of bacteria are also removed along with the extraneous matter, clarification cannot be considered an effective means of bacteria removal. Hence, one should be aware that it cannot be a substitute for a suitable heat treatment in order to ensure safety against pathogenic (disease-causing) microorganisms.

Principle of clarification : As we have studied, when milk is introduced between two adjacent rotating conical discs (in a stack of several discs) of a centrifuge bowl, it is subjected to a centrifugal force. This force causes the heavier dirt particles to be thrown out into the sludge space surrounding the discs where it is collected during the run, while the comparatively lighter milk continuously flows inward and upward to the outlet. There is no separation of fat globules (cream) and skim milk in a clarifier.

Operation of a clarifier : Raw milk is made to pass usually under a pump pressure, down a central pipe of a rotating bowl and led to the outer edge of the clarifier discs through a distributor in the bottom and then onto the spinning discs, where milk and dirt are separated. The milk is led to the discharge port at the top of the bowl whereas the dirt is accumulated in the sediment space. The accumulated sludge is removed from the bowl by dismantling the clarifier at regular intervals. The interval may range from 1 to 8 hours depending on size of the clarifier and the amount of impurities in the milk. However, most large-size modern clarifiers are self-desludging or 'partial desludging' type in which periodical sludge removal takes place during the clarification process, without interruption of the clarifier operation. Such desludging results in about 0.05-0.10% of milk being lost and the sludge being liquid rather than solid as in the non-self-desludging machines.

As for the milk filter, clarifier may be located in the raw milk line between the raw milk tank and pasteurizer. Alternatively, milk may be clarified warm/hot by placing the clarifier at a suitable point in the regeneration section of the HTST unit or between the regeneration and heating sections. The clarifier sludge or clarifier 'slime' consists primarily of dust and dirt particles, blood cells, microorganisms and milk protein. Its composition will depend on whether it is liquid (82-86% water, 6-8 % protein), or solid (65-69% water, 24-28% protein).

BUTTER MAKING MACHINES

20.1 Introduction

Generally the extra fat of milk is best preserved by converting it either into butter or ghee. In this chapter different types of the butter making equipments are described.

20.2 Batch Butter Churns

20.2.1 Rotating churns

The rotating butter churn was introduced in the nineteenth century and gradually from farm butter making it was adopted for the factory butter making by the butter industry. The rotating churns consisted mainly of a barrel rotated on an axis with shelves of various kinds to increase the agitation effect. The first combined churn and butter worker was introduced in USA in 1890. The combined churn and butter worker was of short barrel type.

20.2.2 Batch method using rotating churns

The use of batch churn for butter manufacture is on decreasing trend because of increase in popularity of improved designs of continuous butter making machines. In India, however, the butter produced by organized dairies is made by batch churns, except a few leading dairies.

The capacity of batch churns varies from 100 to 3000 Kg of cream per batch. The shape is mostly cylindrical with front opening , cone with cylinder, single cones and double cone etc. The churn is short in length and large in diameter. Baffles are fitted internally to improve agitation. In some designs, ribbed rollers are fitted through which butter grains pass. The fittings like air vent, sight glass, butter milk outlet, opening for cream inlet, and outlet for butter are mounted on barrel. Butter does not adhere on the wood, while the metal churns, the inside surface is roughened (sand or lead shot blasting) to allow film of moisture on the surface between the metal and the butter.

The degree of mixing depends on the amount of cream in the churn and on the rate of revolution. Too low a rate will not give sufficient turbulence and with too high a speed there is the danger that the centrifugal force (m ω2R) will exceed the gravitational force (mg) and that the cream will stick to the periphery and rotate there with drum. The best condition for churning i.e. maximum turbulence, are achieved when the force of gravity just exceeds the centrifugal force.

i.e. $m\omega^2 R < mg$
$(2\pi n)^2 R < g$
Or $n < [g/R]^{1/2} \cdot 1/2\pi \approx 1/(2\sqrt{R})$

The energy consumption is about 7 - 11 kWh per 1000 kg of butter of which about 90% is used in churning and 10% in working. The lower values are for the cream with a higher fat content.

1. Loading the cream

Pasteurized cream with 35 - 40 percent fat, properly aged is pumped into the churn. Cream is filled to 40 - 45% of the volume of the churn. The cream may be ripened.

2. Churning

The churn can be operated at different speeds. The range of speed depends on the size and shape of the churn. The cream is churned at the churning speed (60 - 100 rpm). The cream is well whipped by the corners, edges and other irregularities in the churn. Chilled water is sprayed over the churn during churning operation. It takes about 35 – 40 minutes for the formation of butter granules of peanut size.

3. Buttermilk draining

The churn is stopped and buttermilk is drained off. Equal quantity of pasteurized wash water is added.

4. Washing

The churn is started again. The wash water is drained off after some time. Two or three washings are generally given.

5. Working

The wash water is drained off and salt is added. The churn is then operated at lower speed (25 - 50 rpm) for working as compared to that at churning. After 3 – 5 min., sample is taken and moisture is adjusted by adding required quantity of water. The working is carried out till desired body and texture is attained. Applying vacuum of 5 m of water gauge during working gives close texture by reducing the content of air.

6. Unloading and packing

The butter is unloaded in trolleys and then packed for sale. Different types of packing machines are employed for the required size of packages.

Care of churns

1. Driving gear should be filled with lubricating oil and every alternate year replace it.
2. Never change the speed while the churn is running.
3. Solid foundation is necessary.
4. Gaskets to be maintained leak proof.
5. Proper roughness inside of the churn should be maintained.
6. Proper cleaning of the churn after the operation is over.

METHODS OF GHEE PREPARATION

35.1 Introduction

Ghee production is the largest segment of milk utilization in India. Most of the dairy plants have ghee production facility to meet the demand of the market as well as to utilize the excess fat in profitable manner. Since simple technology involved in ghee production and relatively less investment for ghee production unit as already plant have steam boiler with them. Method of production varies from small scale to large scale. Cost reduction on energy consumption for production of unit quantity of ghee is the recent trend and equipments are designed to meet the requirement. Following are the various processes available in the industry to make ghee including Desi method which is following largely at rural household level.

35.2 Methods of Preparation

The principle involved in ghee preparation include;

1. concentration of milk fat in the form of cream or butter.

2. Heat clarification of fat rich milk portion and thus reducing the amount of water to less than 0.5%.

3. Removal of the curd content in the form of ghee residue.

There are five methods of ghee making:

i. Desi or Indigenous Method

ii. Direct Cream Method

iii. Creamery Butter Method

iv. Prestratification Method

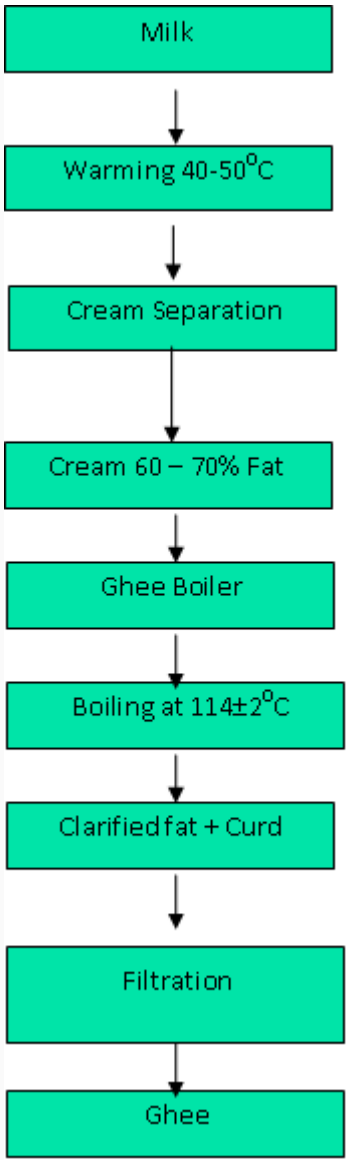
v. Continuous Method

35.3 Desi Method

This was the practice from age-old days in rural areas where excessive milk will be cultured and kept for overnight for fermentation. Resultant curd was churned using hand driven wooden beaters to separate the milk fat in the form of desi butter. Some follow slightly different method wherein milk is heated continuously to about 80°C, the malai (creamy layer) that forms over the surface was collected manually. This malai is then churned to get the desi butter. After collection of desi butter over a period of time, this butter is melted in a metal pan or earthenware vessel on an open fire. Extent of frothing is an index to judge when to terminate heating. Heating should be stop when sudden foaming appears and leave the contents undisturbed after

heating. Curd particles starts settling down over a period of time and decant the clear fat carefully. In this method it is possible to achieve only 75 – 85% fat recovery.

35.4 Direct Cream Method



This method involves separation of cream of 60 to 70% fat from milk by centrifugation process, fresh cream or cultured cream is heated to 114±2°C in a stainless steel, jacketed ghee kettle. This kettle is fitted with an agitator, steam control valve, pressure and temperature gauges. A movable hollow stainless tube centrally bored for emptying out the contents or alternatively provision can be made for tilting device on the ghee kettle to decant the product. Heating is discontinued as soon as the colour of the ghee residue turns to golden yellow or light brown. Usually, first plenty of effervescence accompanied by a crackling sound in the preliminary stages of boiling but both gradually subsides when the moisture content decreases. When almost all the moisture is evaporated, the temperature of the liquid medium suddenly spurts up and care has to be exercised at this stage to control the heating. The end point is indicated by the appearance of second effervescence, which is subtler than the first one accompanied by the browning of curd particles. At this stage the typical ghee flavour emanates and this indicates that the final stage in the preparation of ghee.

Advantages of this method are

1. No need for butter production prior to manufacturing of ghee.

Limitations

1. Long heating time to remove the moisture.

2. High content of serum solids in the cream may also produce a highly caramelized flavour in the ghee.

3. 4 – 6% loss of butter fat in the ghee residue & during the handling operations.

4. So, 70 – 80% fat cream is recommended to minimize both fat loss and steam consumption

GHEE MAKING MACHINES

21.1 Introduction

Generally the extra fat of milk is best preserved by converting it either into butter or ghee. In this chapter different types of the ghee making equipments are described.

21.2 Ghee Making Equipments

Steps for ghee making

1. Concentration of milk fat
2. Breaking of fat in water emulsion to bring fat in continuous phase.
3. Development of typical ghee flavour.
4. Control of moisture
5. Removal of ghee residue

Concentration can be done by centrifugal separation and heating the cream. Alternatively, cream can be churned into butter and then heated. Ghee flavour is developed when the fat is heated with milk solids at high temperatures.