Unit I – Topic 4

Principles and Methods Transfer of Milk

PRINCIPLES OF HEAT TREATMENT

Introduction

In the dairy industry, thermal processing is accepted terminology to describe heat treatment required to eliminate/minimize chances of spoilage of milk and occurrence of food borne illness there-from. Pasteurization is one type of thermal processing designed for a specific pathogenic microorganism, but it does result in a shelf stable product without refrigeration. Thermal treatment is the transfer of heat energy into milk. Such heat treatment of milk consumes a lot of energy. The objective of the heat treatment is to completely inactivate all microorganisms and most of the enzymes contained in milk. Primarily, heat treatment is a hygiene-oriented activity within the entire framework of processing. On the other hand, it is a dominant factor for improving the shelf life of all fresh milk products and is a legal obligation. The most common thermal process is pasteurization.

Pasteurization

It is the thermal inactivation of microorganisms at temperatures around 72-78°C for specific time period, which improves the hygienic quality of milk and achieves a certain level of preservation.

The main objective is to kill pathogens to avoid health hazard. At the same time, a significant reduction in the total bacterial count is accomplished increasing the shelf life of milk and milk products made thereof. Apart from the hygiene aspect, gentle heat treatment must be achieved which results in time-temperature profiles meeting the following requirements:

• The percent destruction of microorganisms has to be > 99%; for pathogenic germs, it must be 100%.

• Milk must be treated gently in order to retain the nutrients and vitamins to the maximum possible extent as well as preserving its organoleptic quality.

• Process economics must be profitable, and the installation cost must be low.

Other processes that can decrease the microbial population in milk include bactofugation.

Other methods include:

• Radiation with UV, X-rays or gamma-rays.

• Ohmic heating. This is the advanced thermal processing method where in the milk,

which serves as an electrical resistor, is heated by passing electricity through it. Electrical energy is dissipated into heat, which results in rapid and uniform heating. Ohmic heating is also called electrical resistance heating, joule heating, or electro heating.

• High-pressure process, using pressures of 2000-6000 bar at temperatures of 40-¬60°C.

• Ultrasound process.

• Microwave treatment.

The last process is a very interesting one for the thermal treatment of foods. During heating with microwaves, the product is exposed to an electromagnetic field having a frequency of 800-3000 Hz. The heat is caused by the rotation of the dipoles and oscillation of ions in the food. The microwave energy is created by transforming a current in a generator magnetron or klystron, from which the microwaves are fed through a rectangular channel (to conduct the waves) into an applicator and heat treatment unit. The product enters the sealed and protected chamber, and the microwaves are fed into it (with an antenna, slit and/or other sharp inserts and other facilities for distributing the microwaves), and penetrate the food evenly.

These processes are not yet widely applied. Their main disadvantage is their low inactivation effect, legal barriers, and high costs.

Influence of Heat Treatment on Milk

The inactivation effect and the chemical-physical, nutritional and organoleptic changes in milk during heat treatment are characterized by the following parameters:

• Temperature and time profile

• Type of microorganisms and the initial level of contamination

• Acidity of milk

• Flow conditions and heat transfer in the installations

TRANSPORTATION OF MILK

Introduction

In rural India milk production is largely a subsidiary activity to agriculture in contrast to organized dairying in western countries. Small farmers and landless labourers usually maintain one to three milch animals. As a result, small quantities of milk are produced by each of the dairy farmers who are widely spread all over the country. This situation makes the task of milk collection and transportation complex. For efficient transportation, planning of routes by means of extensive

survey is most important. In this connection, one must consider the availability of milk, road access to the milk collection points and their distance from the site of the dairy plant. The collected milk is generally filled in cans for transportation to the chilling center or directly to the milk plant. Milk must be brought to the chilling or dairy plant within three hours of milking.

Transportation of Milk

The milk should be transported to the dairies under chilled conditions (< 4°C) to prevent bacterial growth. In India, raw milk collected at various collection centers in the rural areas is dispatched to the dairy plant in two ways:

Transporting milk through cans

Suitable when milk volume handled is low.

Transporting milk through tankers (2000 to 10,000 liters of chilled milk)

This method is useful especially for transporting chilled milk from bulk milk coolers or chilling centers. Refrigerated/insulated tanker (Fig. 9.1) is important for transporting market milk, butter milk and other perishable dairy products.

Advantages of Tanker Over Cans

- quick mode of transportation
- low transport cost per liter
- better temperature control
- less risk of contamination
- time and labors savings
- overall savings in detergents