

Theory

Course Objectives

- To understand the history and evolution of food processing.
- To study the structure, composition, nutritional quality and post-harvest changes of various plant foods.
- To study the structure and composition of various animal foods.

Unit I

Objective, concept and historical evolution of Food Processing; Classification of Food in relation to shelf life, food spoilage, preservation method; Effects of Processing on Food Constituents;

Unit II

Cereal Processing – Rice – Structure and Composition, Parboiling and Milling Methods; Byproducts of Rice and their utilization; Wheat – Structure and Composition, Milling, Byproducts of Milling; Pulse Processing and Products, Toxic constituents in Pulses; Processing of Oilseed; Millets; Structure, composition and nutritive value and processing of millets;

Unit III

Vegetable and Fruit Processing; Classification, Postharvest changes in fruits and vegetables, Pre-processing, processing and preservation; Fruit and Vegetable products;

Unit IV

Milk Processing; Milk composition, processing, storage and products; Egg Processing; composition and nutritive value, egg quality evaluation methods;

Learning Outcomes

After completion of the course, the students will able to

- ✓ learn the different physiological, physical, chemical and nutritional properties of cereals, pulses, fruits and vegetables, milk, egg and meat products.
- ✓ acquire insight in the various forms of storage and preservation methods for different food products.

Recommended Readings

12. Text book of Food science and Technology (2001) by Vijaya Khader

4.1. OBJECTIVES

In this unit you will learn all about processing of milk in terms of initial processing, different types of milk, concentrated milk, and other milk products.

4.2. INTRODUCTION

Milk, though strictly belongs to the category of animal foods, is considered a part of vegetarian diets. India is known for a very high production of milk amounting to 80 million tons per year. Traditionally milk is a highly revered item forming a part of Indian culture. When we refer to milk, it is mostly from cow and buffalo, however, milk of other species like goat, camel, etc. is also used though in lesser quantities.

Nutritionally milk is almost a complete food containing all essential nutrients except iron and vitamin C. Hence, it is a complete food for an infant till 6 months of age. Milk is a highly perishable commodity, hence, it should be used immediately or processed to products which are stable, while a large portion of milk is used as such, the surplus is converted to many products. ★

4.3. INITIAL PROCESSING OF MILK

Milk is processed to ensure that it is free from toxic substances, disease producing bacteria and foreign flavors. Initial processing helps in maintaining low bacterial count and satisfactory keeping qualities and consists of clarification, pasteurization and homogenization. ★

Clarification – Milk is passed through a centrifugal clarifier, the speed of which is adjusted so that the cream is not separated but the filth and cells from the udder and some bacteria are removed.

Pasteurization – It involves heating of milk to a temperature, which destroys pathogenic organisms without affecting the composition or the properties of the product and should be followed by immediate cooling of product to a temperature sufficiently low to check the growth of resistant microorganism. Two methods of pasteurization are used, one method consists of holding every particle of milk for 30 min at 61.7°C, followed by rapid cooling and another method is the high temperature short time method (HTST), where milk is held for not less than 15 sec at 71.7°C. Ultra high temperature treatment at 149.5°C for 1 sec is also employed. Pasteurization makes the milk safe to drink and improves keeping quality by inactivating certain enzymes present in raw milk. It allows sufficient time for packaging and distribution of milk from production plant or dairies to consumers.

Homogenization – Milk is an oil-in-water type of emulsion. A mechanical treatment (homogenization) is given to milk in order to stabilize milk emulsion and making the mixture homogenous. Homogenized milk has a creamier structure, bland flavor and a whiter appearance. Cream does not separate out in homogenized milk on boiling, keeping or chilling procedures.

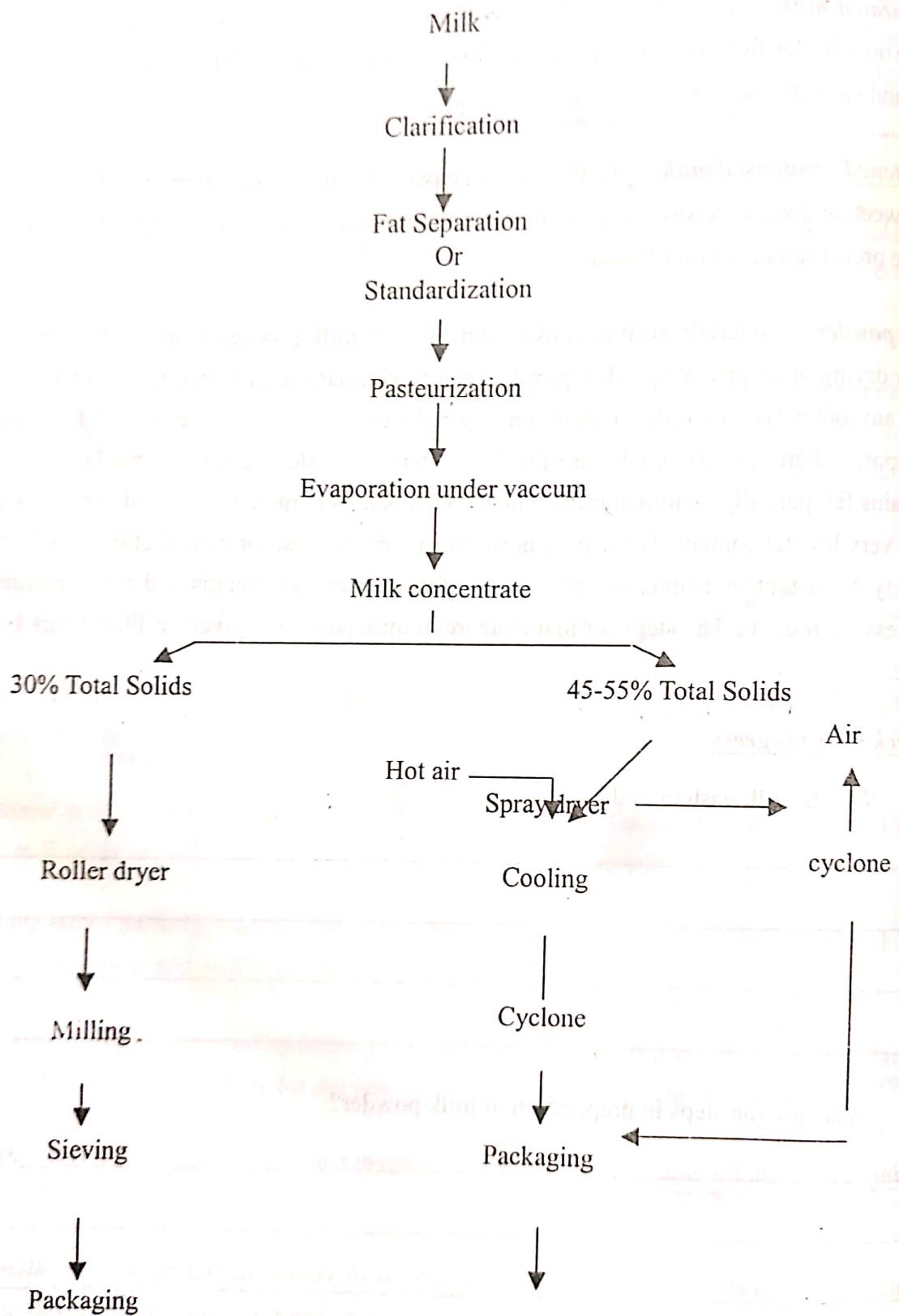
4.4. DIFFERENT TYPES OF MILK

- 1. **Skim milk** – Whole milk from which fat has been removed by centrifugation is skim milk. The fat is separated in a cream separator and the total-solids-not-fat (SNF) content is 8.5% and fat content is 0.05 – 0.1%.
- 2. **Fortified milk** – Various nutrients may be added to milk to get fortified product. These can be vitamins, minerals or non-fat milk solids. Skim milk is fortified with non-fat milk solids. Vitamin A and vitamin D are generally used as fortificants, however, thiamin, riboflavin, niacin, calcium, iron and iodine can be added.
- 3. **Standardized milk** – In standardized milk the fat content is maintained at 4.5% and SNF (solids not fat) at 8.5% and is prepared from a mixture of buffalo milk and skim milk.
- 4. **Toned milk** – It is prepared by mixing milk reconstituted from skim milk powder with buffalo milk containing 7% fat.
- 5. **Double toned milk** - This is prepared by a mixture of cow's or buffalo's milk or both with fresh skimmed milk or by partial removal or addition of milk fat to skim milk.
- 6. **Recombined milk** – Milk fat, nonfat milk solids are homogenized to get recombined milk whose fat content should be less than 3% and SNF 8.5%.
- 7. **Sterilized milk** - Milk is sterilized by heating continuously to a temperature of 115°C for 15 min and preserved at room temperature for not less than 85 days from the date of manufacture.
- 8. **Filled milk** – It is a homogenized product prepared from refined vegetable oil and nonfat milk solids and water.
- 9. **Flavored milk** – Milk is either pasteurized or sterilized and may contain chocolate, coffee or any other edible flavor, edible food color and cane sugar.

4.5. CONCENTRATED MILK

- 1) **Evaporated milk** – It is a whole milk prepared by evaporating more than half its water. Raw whole milk is clarified and concentrated in a vacuum pan at $74^{\circ}\text{C} - 77^{\circ}\text{C}$, homogenized, filled into cans and sterilized at 118°C for 15 min and cooled.
- 2) **Sweetened condensed milk** – The product is prepared from pasteurized milk that is concentrated and sweetened with sucrose. Sugar concentration is about 65% and microorganisms are retarded by the preservative action of sugar.
- 3) **Milk powder** – Generally surplus milk is converted to milk powder by using the technology of roller drying or spray drying. Milk powders can be comparatively stored for a much longer time than any other type of milk product. Drying reduces the bulk of material and facilitates easy transport. There are different types of milk powders available. It can be from whole milk, which contains fat, partially skimmed milk, which contains lesser amount of fat and skim milk powder with very low fat content. These milk powders in turn are used for manufacture of baby foods, a variety of instant or convenience foods, confectionaries, ice creams and for numerous other processed products. The steps for manufacture of milk powder is given in Flow chart 1: on next page.

Flow Chart - 1 : Preparation of Milk Powder



4.6. MILK PRODUCTS

Cream – Milk fat concentrated from the fraction of the original milk is cream. Cream is used in baked products, salad dressings and to prepare butter. The fat content of cream varies from 16 to 54 % depending upon the type of milk and the method of separation.

Butter – Sweet or sour cream is pasteurized at 62.8°C for 30 min and cooled. A culture of desirable microorganism is added which curdles the milk and produces volatile acids, which give the desirable flavor and aroma to the butter. The cream is allowed to ripen at 21.1°C for several hours and churned which brings about denaturation of protein and cream becomes granular and buttermilk separates out. The butter is salted and packed.

Ghee – Ghee is made by separating the cream from milk by a mechanical separator, fermenting it, churning it into butter followed by conversion to ghee. Alternatively, cream is directly clarified to give ghee. In the preparation of ghee, butter obtained from curd or fermented cream is heated in a pan over a low flame till almost all moisture is removed and a pleasant aroma is obtained.

Khoa – Khoa is compact mass of very small uniformly sized granule prepared by stirring milk using heat until it becomes viscous. After cooling it becomes solid and the yield is about 20% of the milk used. Khoa is used for preparation of sweets.

Paneer – Milk is heated to about 70°C - 80°C for 10 min and cooled to about 37°C . Lactic acid (20g /100kg milk) and rennet solution (2ml /100kg milk) are added and milk is allowed to stand for 60 min and is allowed to ripen for 12 – 36 hrs in whey itself.

Channa – Milk is heated and cooled, dilute solution of citric acid is added and stirred. Coagulated curd is filtered through a cloth.

Cheese – There are different types of cheese, which can be prepared. On the basis of moisture content, they can be divided as hard cheese, semi hard cheese and soft cheese. Preparation of a hard variety of cheese is as follows :

- Pasteurized whole milk is heated to 31°C and lactic acid producing starter culture is added. After 30 min, rennin is added, stirred and allowed to set for 30 min.
- The curd is cut into different sized cubes.

- It is heated to 38°C and stirred to prevent matting.
- Heating squeezes out whey from the cubes and increases the acid production rate. Whey is drained off and curd is allowed to mat.
- Matted curd is cut into blocks turning the block at 15 min interval and piling the block on one another. This is called cheddaring.
- Whey is eliminated by adding salt to draw whey out of curd.
- The cheese cubes are pressed under pressure overnight and then the cheese is ripened for 60 days to 12 months depending on the kind of cheese required. During ripening, rennin splits the protein of cheese into nitrogenous product of intermediate size such as peptone and peptides. Ripening also improves the cooking quality.

Cultured dairy products – Three most common cultured dairy products are butter milk, sour cream and yoghurt. You must be using curd or yoghurt everyday at home. For domestic use curd can be prepared by using a culture from ready curd. For commercial production of butter milk, the starting material is low fat milk and for sour cream it is, light cream. The raw material is pasteurized, cooled and inoculated with culture of lactic acid bacteria. It is allowed to ferment till the lactic acid content is 0.6. After this, it is cooled and filled into containers. Cultured products have to be maintained at low temperature till use. For yoghurt, milk is boiled to concentrate, or dry milk solids are added to raise the solids content. The concentrated mixture is then pasteurized and homogenized when hot. It is then cooled and inoculated with bacterial culture and incubated till acid content is 0.84-0.90%. The fermented mixture is packed and cooled. This should also be held at cold temperatures till use.

Ice creams – The basic ingredients for ice cream preparation are milk cream, milk powder, sugar, vegetable gums or gelatin, egg and flavourings. Many additives like fruits, nuts or fruit juices can be used. The mixture of ingredients is pasteurized and homogenized. Stabilizers and emulsifiers are used for desired textural qualities. The mixture is cooled rapidly with agitation to incorporate air. This will give a soft plastic texture to the product, then it is packed into containers and allowed to set at lower temperatures. Ice creams have to be kept at freezing temperatures till used.