Chapter 4

Fluid Milk Varieties and Special Milks

Learning objectives

- To know about various types of fluid milk and their preparation
- To know about special milks and their preparation

Introduction

The term market milk refers to processed milk which is being sold in the market. Market milk should satisfy the mandatory legal requirements of the nation. Although, India stands first in milk production, only 16-17% of the milk produced is processed by organized sector. India is the world's most significant consumer of fluid milk with annual consumption of 47.1 million tonnes in 2010. The majority of India's milk production is consumed as fluid milk rather than processed in other products as is the case in other regions. In India, Food Safety and Standards Authority of India (FSAAI) prescribe various standards to processed milk which is intended to sell in India. These standards are compulsory standards and all manufacturers in India must follow this. The FSSAI has been established under Food Safety and Standards Act, 2006. It is the manufacturers' responsibility to declare the type of milk, nutritional value, manufacturing date, 'use before' date, storage prescription, maximum retail price (MRP) and customer care number on the package of all food commodities. According to FSSAI, the following types of fluid milk can be packed and marketed in India, with their minimum fat and solids-not-fat (SNF) level as mentioned against each type.

Apart from the above mentioned types (Table 4.1), there are three more categories such

as cow milk (3.5% fat and 8.5% SNF) buffalo milk (6.0% fat and 9.0%SNF) and mixed milk (4.5% fat and 8.5% SNF), however some relaxation in fat level is permitted in some states (minimum 3.0% fat in case of cow milk in Mizoram and Orissa and to minimum 5.0 % fat in case of buffalo milk in several states).

Table 4.1. Different grades of milk

Sl. No.	Type	Fat (%)	SNF (%)
1	Toned Milk (TM)	Minimum 3.0	Minimum 8.5
2	Double-toned milk (DTM)	Minimum 1.5	Minimum 9.0
3	Standardized milk (STDM)	Minimum 4.5	Minimum 8.5
4	Skimmed milk (SM)	Not more than 0.5	Minimum 8.7
5	Full cream milk (FCM)	Minimum 6.0	Minimum 9.0

Processing of Raw Milk to Prepare TM/DTM/STDM/SM/FCM

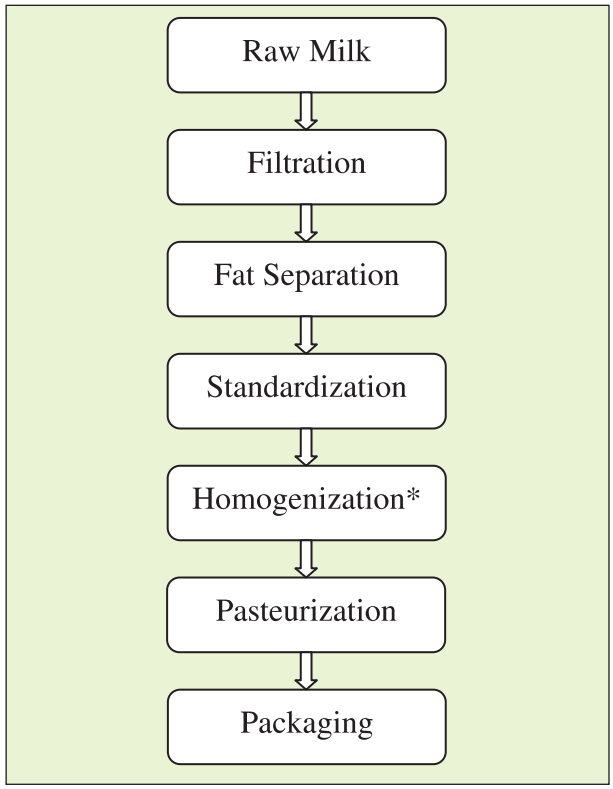
Processing of raw milk includes several operations to be given to it, in order to make it safe for human consumption and to meet the legal requirements. Processing also improves the physico-chemical and microbiological quality of the product. These operations include filtration, separation, standardization, homogenization, pasteurization and sterilization. Most of these operations are synchronized with the HTST pasteurizer, thereby facilitating a continuous process operation.

In India milk production is scattered and mostly restricted to small and medium scale farmers who are holding one or few animals. Raw milk (unprocessed milk) is collected from these farmers (also referred as milk producers) by village cooperative society or private entrepreneurs. Milk is then pooled and chilled at chilling centre or at main processing plant, whichever is closer. Chilled milk is then stored in the raw milk silo for further processing.

In the processing plant, raw milk is pumped from raw milk silo to float controlled balance tank (FCBT) of pasteurizer unit using stainless steel pump of suitable capacity. Milk then passes to regenerative heating section-I of pasteurizer, wherein milk is heated from 5°C to 40°C. At this temperature, milk is routed to the filter assembly for filtration. Filtration is carried out using duplex filter unit, in which one filter is usually kept as standby to facilitate continuous processing during cleaning operations. After filtration, milk passes into

the cream separator. Several types of separators are available, among which, those with online standardization units help to standardize the milk to desired fat level. Otherwise, milk needs to be standardized to desired fat and SNF level before taken into HTST pasteurizer for production of toned, double toned milk etc. After separation and/or standardization, milk moves back to pasteurizer for further heating. Milk is then heated from 40°C to 65°C in regenerative heating section-II and then taken out for homogenization. Homogenization is suitable for high fat milk, wherein milk fat size reduces to less than two micron size and thus reduces the cream plug formation during the storage. Cream plug formation occurs due to the difference in density of fat and SNF. Homogenization also brightens the colour of milk due to more scattering of light and reduces the curd tension, thereby improving the digestibility of milk. After homogenization, milk is again moved back to pasteurizer for further heating. Milk is heated to final pasteurization temperature of 72°C or higher in heating section using hot water as heating medium. After heating section, milk moves to the holding section, wherein it is held at temperature not less than 72°C for 15 seconds. At the end of the holding section, flow diversion valve (FDV) is fixed to verify whether each and every particle has reached the pasteurization temperature or not. If any part of milk has not attained the pasteurization temperature, FDV diverts that part of milk to FCBT for reprocessing, thus ensuring the safety of pasteurized milk. Properly heat treated milk moves back to regenerative cooling section-II and then regenerative cooling section-I and finally chilled to less than 5°C in chilling section. Chilled water is used as cooling medium in chilling section. Minimum back pressure is necessary in heating section to prevent boiling of milk. It should be higher than the pressure of heating medium or chilling medium in pleat heat exchanger to avoid any risk of cross contamination. Chilled milk is stored in pasteurized milk silos, from where it is transferred to packaging section after ensuring its safety and quality parameters.

The production flow chart that may be used for pasteurized toned, double toned and standardized milk is given in Fig.4.1.



NOTE: * Homogenization is optional for low fat products like DTM/TM and applicable in high fat milk like STDM/FCM

Fig.4.1. Flow chart for the production of toned, double toned and standardized milk

Standardization of fat and SNF is the only difference among the different types of market milk. During standardization, the milk fat is removed if it is excess than desired and added in the form of cream to milk, if it is less. Similarly SNF is also standardized to desired level by adding skim milk or skim milk powder (SMP) in case of shortage. Excess SNF can be adjusted by adding milk of low SNF than is desired.

Production of Reconstituted Milk

The term reconstituted milk is used when milk is prepared from the dry powder or milk powder. It may be prepared from either SMP and/or whole milk powder (WMP).

There are no preset standards for reconstituted milk. However, it should meet the other appropriate general standards of SM/TM/DTM/STDM after reconstitution. The schematic diagram of reconstitution process is shown in Fig.4.2.

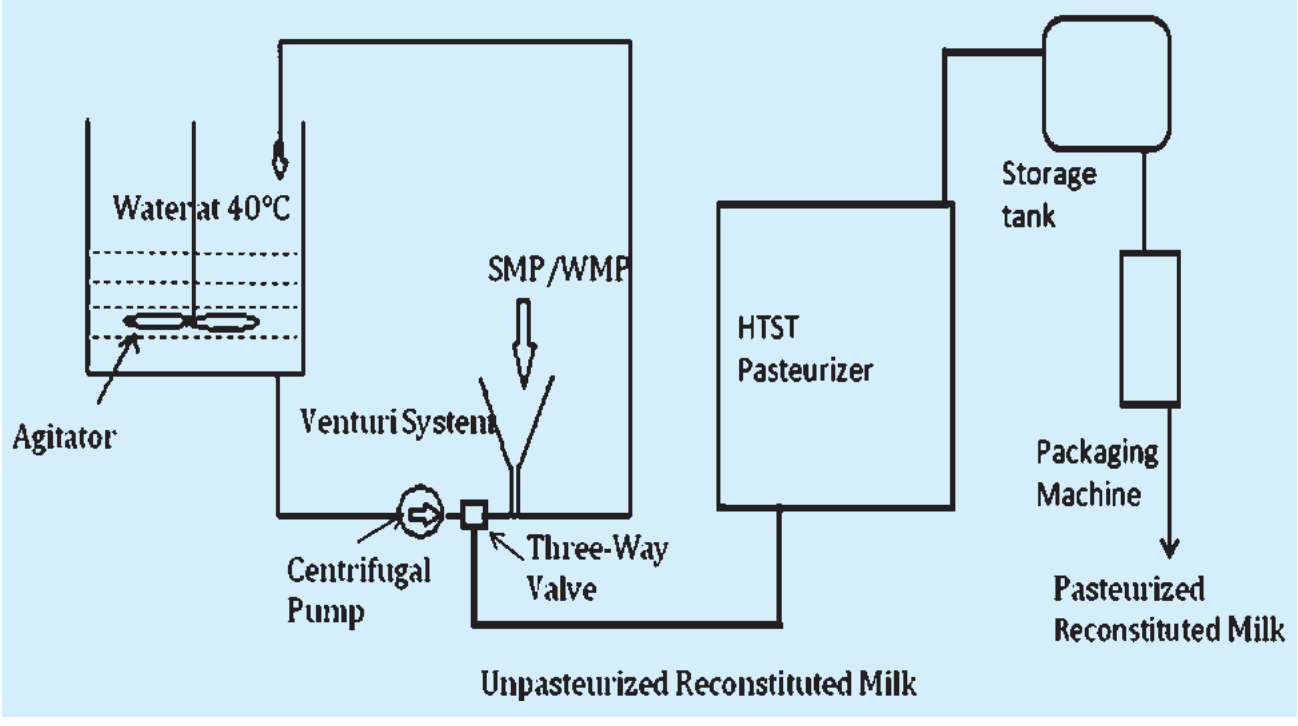


Fig.4.2. Schematic diagram of reconstitution process

The milk powder is dissolved in lukewarm water at 40°C in a double jacketed vat equipped with an agitator for uniform mixing of the contents. The heating medium circulated in the jacket is usually hot water. Dry powder is added through venturi system. Water being a major raw material for reconstituted milk, the water quality which is used for dispersion of milk powder is important and should be checked routinely for its chemical and physical

quality parameters. It must also be free from harmful microorganisms. Soft water is preferred because high mineral content in water disturbs the colloidal stability of milk at high temperature processing during later stages. After addition of powder into water, contents are recirculated and agitated till complete dissolution of powder. The complete hydration of milk powder is very much essential in order to prevent chalkiness (a defect) in the finished product. The hydration time varies with the powder quality. Good quality powder must hydrate completely within 30 minutes. After complete hydration, reconstituted milk is transferred to float controlled balance tank of the pasteurizer for heat processing. The pasteurized reconstituted milk is stored in pasteurized milk storage tank till its packaging. At commercial level, reconstituted milk is used only for standardization purpose.

Production of Recombined Milk

According to FSSR-2011, recombined milk is defined as the homogenized product prepared from milk fat, non-fat-milk solids and water. The recombined milk shall be pasteurised and shall show a negative phosphatase test. It should have minimum 3.0% fat and 8.5% SNF.

The scarcity of fresh milk in lean season is the reason for production of recombined and reconstituted milk so as to meet the market demand. This also helps to utilize the milk solids that get converted and stored in the form of SMP, WMP, butter and butteroil due to excess collection of milk during the flush season. Recombined milk can be produced in hilly areas and other places where there is limited availability of raw milk.

The milk fat sources for recombined milk are generally butter oil or anhydrous fat and/or unsalted butter. Therefore, homogenization is an essential step in preparing recombined milk since fat source is added into the water. The solids-not-fat source dissolves easily in water, but the fat source needs homogenization to disperse in the water. Homogenization helps in creating an oil-in-water emulsion that is native to milk. The schematic diagram of reconstitution process is shown in Fig.4.3. Homogenization is done at 65°C in a two stage homogenizer at a pressure of 150 kg/cm^2 and 50 kg/cm^2 in first and second stage respectively. Therefore milk is heated to 65°C in the HTST pasteurizer and routed from the regeneration section out into the homogenizer at this temperature. After homogenization, milk is again goes back to HTST pasteurizer for completing the pasteurization.

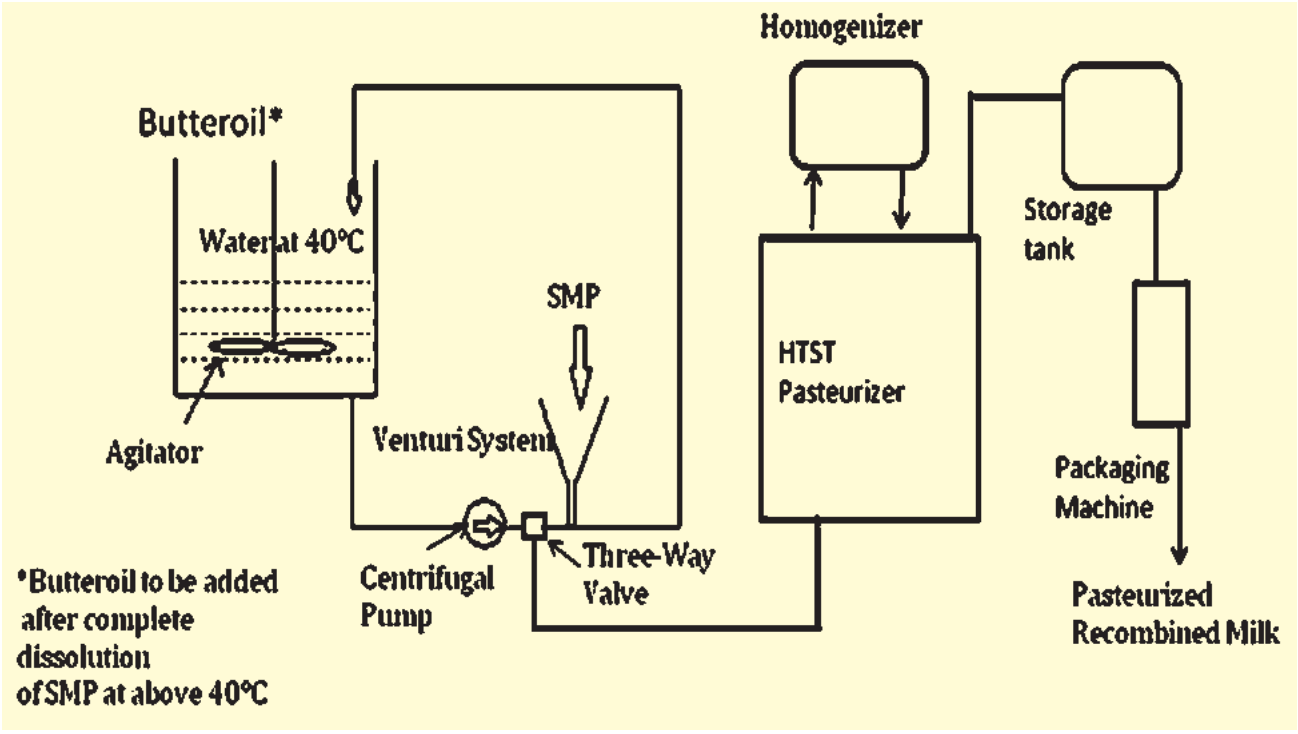


Fig.4.3. Schematic line diagram of recombined milk processing

Activities Suggested

1. Visit your local market and perform the followings.

a. collect the various types of fluid milks available

b. Note down the colour of the pouch used for different fluid milk varieties

c. Note down the prices per 500ml of each fluid milk varients

d. Label declarations on each pouch including fat and SNF level

2. Visit local dairy plant and see the process lines and manufacturing process

REVIEW QUESTIONS

1. What are the FSSR-2011 standards suggested for different fluid milks?
2. Which milk contains highest total solids?
3. Write briefly on the process of preparation of recombined milk

4. Write the differences between recombined and reconstituted milk

5. Write the schematic diagram of reconstitution process and explain

Special Milks

Learning Objectives

- *To know about the manufacturing process of various special milks*
- *To know about the various ingredients used various special milks*

a. Flavoured Milk

It is a special type of milk produced to attract the consumers, particularly children. Flavoured milk generally contains sugar, permitted food grade flavors and colours. The product is heat treated in order to ensure its safety to consumers and also to extend the keeping quality. Flavoured milk is marketed as pasteurized flavoured milk packaged in low density polyethylene (LDPE) pouches, ultra-high temperature (UHT) treated flavoured milk packaged aseptically in a multi-layer laminates and sterilized flavoured milk packaged in glass or retortable plastic bottles. Pasteurized flavoured milk has a limited shelf-life of two days at refrigerated temperature, whereas UHT treated and sterilized flavoured milk will stay safe for 4-6 months at ambient temperature. Sugar, suitable colour and flavours are added to increase the flavor and appearance of the product. The commercial products are available in a variety of flavours such as rose, elaichi (cardamom), badam (almond), strawberry or butterscotch.

FSSR-2011, prescribes the standards to flavoured milk in terms of fat and SNF. Flavoured milk shall meet the minimum fat and SNF level of double toned milk/ toned milk/ standardized milk. Therefore, manufacturer has to clearly declare the type of milk on its label. Flavoured milk may also contain nuts, coffee, chocolate in addition to cane sugar. Sugar is added at the rate of 7-8% based on the flavor. Chocolate and coffee flavoured milk requires slightly higher amount of sugar for better palatability. Only permitted and food grade colour and flavours should be used, the level varying with the type of flavor. Flavour is usually dosed at the rate of 0.1 to 0.2% level and maximum colour addition is 100 parts per million (ppm) for artificial colours. Natural colours like â-carotene is added as per requirement. Following are the various artificial colour compounds used to obtain different colours in flavoured milk (Table 4.2).

Table 4.2. Artificial colours used in flavoured miles

S. No.	Colour desired	Colour compound
1	Yellow	Tartarzine
2	Red	Ponceau 4 R
3	Orange	Sunset Yellow
4	Blue	Brilliant Blue
5	Green	Tartarzine + Brilliant Blue
6	Pink	Carmosine

Pasteurized flavoured milk involves treatment like filteration, homogenization, standardization, pasteurization and packaging similar to general market milk. Milk is standardized to higher fat and SNF levels so that when sugar and other ingredients are added later fat and SNF level meets the desired level. Standardized milk is then homogenized in two stage homogenizer to avoid cream plug or cream layer formation during the storage of the product. After, mixing with other ingredients like sugar, flavor and colour, the milk is filtered and pasteurized at slightly higher temperature than the market milk. The pasteurization treatment is usually at 76-78°C/ 15 seconds, with immediate cooling thereafter to 4°C. The pasteurized flavoured milk is then packaged in the form-fill-seal (FFS) machine in the form of 200 ml or 500 ml pouches and stored at refrigerated temperature. The detailed process flow diagram is given in Fig. 4.4.

Sterilized flavoured milk is prepared to extend the shelf life of the flavoured milk, steps are similar to pasteurized flavoured milk till filtration. Thereafter, flavoured milk is filled into the bottles of 200 ml capacity and capped. These bottles are placed on the trolley of the retort sterilizer and sterilized at temperature of 117-118°C for 20 minutes. Steam is used as the heating medium for the retort sterilizer. After sterilization, bottles are allowed to cool to room temperature, labeled and packed in secondary package (cardboard trays) for distribution and transportation. UHT treated flavoured milk is also prepared in the same manner, except here the product is expose to high temperature like 135 to 140°C for few seconds and packaged aseptically in a multi-layered cartons.

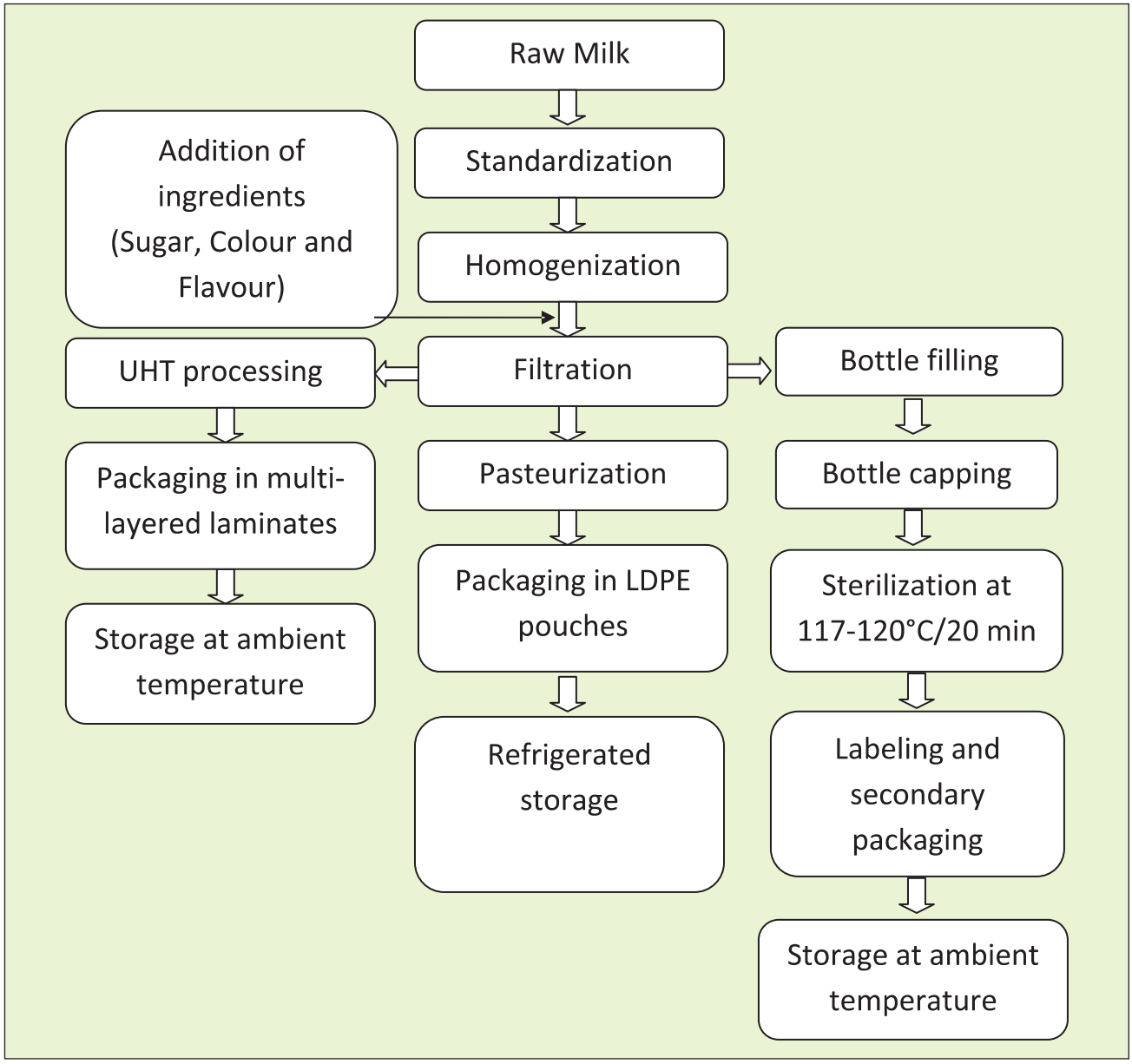


Fig.4.4. Process flow diagram of flavoured milk

b. Fortified Milk

The term 'fortification' means the addition of nutrients at levels higher than those found in the original food. Prevalence of vitamin A deficiency in India is above than the cut off level suggested by Food and Agricultural organization (FAO). Similarly, population who are suffering from other micronutrient deficiency (Iron, Calcium and Vitamin D) are also at higher percentage in India. Therefore, fortification is adopted as part of public health measures targeted at addressing specific micronutrient inadequacies. Milk can be considered as good vehicle for fortification because of its availability and ability to reach large population

at affordable price. Generally, milk is fortified with vitamin A, vitamin D, calcium and iron. Vitamin A is essential for better vision and vitamin D is necessary for calcium absorption in our body. Calcium supports the bone health while iron fortification helps in reducing the risk of anaemia. Generally, vitamin A is fortified at the rate of 2000IU and vitamin D is fortified at the rate of 400IU per liter of milk respectively. Many dairy co-operatives and private manufacturer do have the practice of fortification of milk with Vitamin A. Calcium fortified milk is also available in market with additional calcium. Iron fortification to milk is a challenging area because it affects sensorial parameters of milk and research work is under progress at National Dairy Research Institute, Karnal to explore the possibility of iron fortified milk.

Activities Suggested

1. Visit local market and collect the following information
   a. Various flavoured milks available with their brand name
   b. Colour used for each flavor
   c. Nutritional information and ingredients listed in their label
2. Visit dairy plant near to you and see the production lines of flavoured milk

REVIEW QUESTIONS

1. Explain with the flow diagram the process of sterilized flavoured milk manufacturing
2. What are the different flavours that are commonly used in flavoured mik preparation
3. List various food grade colour chemicals and their respective colours
4. What do you understand by the term fortified milk and explain briefly the uses of this?