
EXPERIMENT 11 STUDY OF MILK STERILIZER, STERILIZATION OF MILK AND DETERMINATION OF STERILIZATION EFFICIENCY

Structure

- 11.1 Introduction
- 11.2 Objectives
- 11.3 Experiments
 - Principle
 - Requirements
 - Procedure
 - Observation
- 11.4 Precautions

11.1 INTRODUCTION

Sterilization (in-bottle) is a term often applied to a heat processing treatment, which has a bactericidal effect greater than pasteurization. Milk processed at time-temperature recommended for sterilization gives the processed milk a longer shelf life. This is achieved partly by using a more severe heat treatment (about 110-130°C for 20–30 min) and partly by applying the treatment after the container (bottle) is filled and sealed. This ensures that the thermally processed milk is not exposed to the risk of post processing contamination. As a result of the long holding time at the elevated temperature, the product has a cooked flavour and a pronounced brown colour. It is therefore generally not practiced for plain milk and is more often used for processing of flavoured milk. The flavoured sterilized milk also has food grade colour compatible with the flavour incorporated into the product, which thereby also masks the brown colour that develops during heat treatment.

Sterilization is performed in retorts that are either batch type or continuous in operation. For small or medium level operations batch type sterilizers are generally used. Batch type sterilizers may be either vertical or horizontal. Horizontal retort is simple to use and can be easily loaded or unloaded. Horizontal retort, however, occupies more floor space in the plant. Horizontal retort also contains concentric cages in which the filled bottles can be loaded horizontally. The cages are supported by guide rails, which slowly rotate them. Rotation of the retort while the product is being heated leads to continuous stirring of the milk in the sealed bottles thereby increasing heat transfer rate, heating the product more uniformly and preventing excessive browning. Vertical retort also operates on the same principle and follows the same sequence of operation. The one difference is that while horizontal retort is loaded from the opening on one of the sides, vertical retort is loaded from the top.

11.2 OBJECTIVES

- learn how to prepare sterilized milk
- know the operation of batch sterilizer
- learn how to determine sterilization efficiency

11.3 EXPERIMENT

i. Principle

Sterilized milk refers to a product obtained by heating milk (after filling and sealing) in a container (generally glass bottles) in a commercial sterilizer to generally a temperature of 121°C for 15-20 min. This severe treatment destroys all the microorganisms and the enzymes in milk so that the shelf life of the product is extended for long period at room temperature (up to 6 months). The length of time and magnitude of temperature employed during processing depend on the type of the product, number and heat resistance of microorganisms and enzymes present in milk. As *Clostridium botulinum* is considered an index organism for assessing thermal sterility in foods, destruction of this organism is a minimum requirement for satisfactory sterilization. In low acid foods like milk it is recommended to achieve 12 decimal reductions for *C. botulinum* which requires heating the product at 121°C for 3 min ($F_0 = 3$). However spores like *B. stearothermophilus* or *B. sporothermodurans*, which are very heat resistant, are likely to be present in milk. It is therefore desirable that the milk is sterilized at more severe temperature conditions (121°C/15-20 min).

ii. Requirements

A. Materials

- i) Milk
- ii) Milk bottles
- iii) Crown caps
- iv) Sugar
- v) Flavour concentrate
- vi) Food grade colour

B. Equipment

- i) Pre-heater
- ii) Homogenizer
- iii) Bottle washer
- iv) Bottle filler
- v) Crown corking/bottle sealing machine
- vi) Batch sterilizer

iii. Procedure

Flow Chart

Receiving milk

—

Standardization

—
Clarification
—
Forewarming (50-55°C)
—
Homogenization
—
Preheating (85°C flash)
—
Bottling
—
Crown corking
—
Sterilization at 121°C for 15-20 minutes
—
Cooling
—
Storage (room temperature)

a) Reception of milk

Only good quality milk, which can withstand sterilization temperature, should be procured for sterilization. The quality of milk should be therefore tested for the following:

- i) Organoleptic quality
- ii) Acidity/pH
- iii) Alcohol stability
- iv) MBRT or 10 min Resazurin test for bacteriological quality

b) Standardization of milk

- i) The milk should be standardized to desired fat and solid-not-fat (SNF) contents depending on the type of final product (toned milk, double toned milk; refer Exercise-2 for details).

c) Addition of the ingredients

- i) Dissolve the required quantity of sugar (6-7% by weight of milk) in twice the amount of clean potable water, strain it and mix with the milk
- ii) Measure the required quantity of essence, mix with small quantity of milk and then mix it thoroughly with the remaining milk
- iii) Add to the milk, measured quantity of food grade colour compatible with the type of flavour added.

d) Forewarming

- i) The milk should be warmed to 50-55°C for homogenization

e) Homogenization

- i) Homogenize the milk at 175 kg/cm² in the first stage and 35 kg/cm² in second stage operating pressure.
- ii) Preheat the homogenized milk to 80-85°C either in a continuous plate type heat exchanger or in a batch type multi purpose vat.

f) Bottle filling and capping

- i) Adjust the filling machine to deliver specified quantity of milk to the bottle and start the operation. Care should be taken to fill the bottle only upto 80% of the total capacity to allow space for boiling of milk when the sterilization is performed.
- ii) Put the crown caps on to the bottles and seal them properly so as to prevent any leakage.

g) Sterilization

- i) Place the bottles into the crates or cages of the batch sterilizer
- ii) Load the sterilizer with the crates/ cages
- iii) Put adequate water (nearly half full) into the sterilizer, close the lid and secure it tightly
- iv) Open the steam valve, allow the steam to enter the sterilizer and come out of the air vent.
- v) Close the air vent and allow the pressure to build upto 1.2 kg/cm²
- vi) Maintain the steam pressure and continue the heating for 20 min. If there is provision to rotate the sterilizer, rotate it while the heating is on so as to ensure uniform heating of the product
- vii) Close the steam valve, slowly open the water inlet valve and allow the water to enter the sterilizer. Open the drain pipe valve and adjust the flow of cold water such that the pressure inside the sterilizer slowly drops down to zero.
- viii) Continue the cooling operation for 20-30 min so as to attain the product temperature of around 30°C. Rotation of the sterilizer should continue during the cooling operation to accelerate heat transfer rate.
- ix) Close the water inlet valve, drain all the water from the sterilizer and open the sterilizer lid.
- x) Take out the crates/cages and remove the sterilized milk bottles.
- xi) Pick random samples from the lot, examine these for visual colour and flavour besides conducting tests for determination of sterilization efficiency.

h) Testing efficiency of sterilization

- i) Weigh 1 gm of ammonium sulphate into an Erlenmeyer flask (50 ml).
- ii) Measure 20 ml of milk sample with graduated cylinder and transfer it to the same flask.
- iii) Shake well for 1 min to completely dissolve the ammonium sulphate. Set it aside for 10 min.
- iv) Filter through a filter paper (Whatman no. 12 or equivalent) and collect 5 ml of clear filtrate in a test tube.
- v) Keep the test tube immersed in boiling water bath.
- vi) Examine it for turbidity by moving the tube before a source of light.
- vii) No sign of turbidity indicates satisfactory sterilization.

Production chart
Sterilized milk

Particulars of milk:

Type:..... % fat:....., % SNF:.....

Acidity:.....% lactic acid MBRT/Resazurin grade:.....

Alcohol test:.....

Quantity of milk:.....kg

Sugar, flavor and colour

Quantity of sugar:, Rate of addition:....., Brand :.....

Quantity of flavour:....., Rate of addition:....., Brand:

Quantity of colour:, Rate of addition:....., Brand:

Forewarming temperature:

(Method followed:))

Homogenization pressure: 1st stage Kg/cm²

2nd stage Kg/cm²

Preheating temperature:

(Method followed:))

Bottle size..... No of bottles.....

Sterilization time: Time of start:, Time stopped:.....

Total time taken for sterilization:

Total holding time:.....

Total coming up time:

Time taken for cooling:

11.4 PRECAUTIONS

- i) If glass bottles are being used for filling milk, care should be taken to discard bottles with chipped mouth as it may lead to improper sealing and contamination of the product.
- ii) Always follow operating instructions in the manual provided by manufacturer of the batch sterilizer.
- iii) Sterilizer should be opened only when the pressure inside has come down to zero and the product has attained room temperature.