

---

# EXPERIMENT 8 PASTEURIZATION OF MILK

---

## Structure

- 8.1 Introduction
- 8.2 Objectives
- 8.3 Experiment
  - Principle
  - Requirements
  - Procedure
  - Observations
  - Results
- 8.4 Precaution

---

## 8.1 INTRODUCTION

---

Pasteurization is a process of heating every particle of milk to 62.8°C (145°F) for 30 minutes or 71.7°C (161°F) for 15 seconds continuously and cooling to 5°C instantaneously. Pasteurization involves destruction of enzymes and pathogenic organisms present in milk. The extent of destruction of micro-organisms by heat depends upon the time and temperature combination employed during processing. Instantaneous cooling is important as it arrests the growth of survival microorganisms.

Pasteurization of milk can be carried out by holding or batch method by heating milk in a tank/vat to 62.8°C with the help of steam/hot water or by circulating through a plate heat exchanger and holding for 30 minutes followed by cooling to 5°C chilled water. High temperature short time (HTST) method employed to heat the milk at 71.7°C (161°F) for 15 seconds in plate heat exchanger.

---

## 8.2 OBJECTIVES

---

- ensure safety of milk by destroying pathogenic organisms and inactivating enzymes of milk.
- prolong the keeping quality of milk without any marked effect on the flavour, food value or physico-chemical properties.
- study the functions of various parts of pasteurising plant and principles of its operation.
- operate the batch and HTST pasteurizer units.

---

## 8.3 EXPERIMENT

---

### i. Principle

#### A. Batch pasteurization

A batch of milk heated to 62.8°C held for 30 minutes and cooled to 4-5°C.

#### B. H.T.S.T.Pasteurization

In the process of pasteurization, milk is pumped either from the dump tank or from

the storage tank to float controlled tank from where it is pumped to regeneration section to raise its temperature to about 45°C by outgoing heated milk on the other side of the plates. Then milk passes through filter/clarifier for removal of extraneous material, if any, to the heating section, where the temperature of milk is raised to at least 71.7°C by hot water or intermittent steam. This hot milk enters in the holding section or holder tube of the pasteurizer. Milk takes at least 15 seconds to pass through it. A flow diversion valve is fixed at the end of the holding section to control proper heating and holding of milk. Only pasteurized milk passes through the valve. Properly pasteurized milk then enters into the regeneration cooling section where it heats the incoming raw milk and, in turn, it gets cooled. Finally, this passes to the cooling section where milk is cooled to 4-5°C. Thus, the pasteurized milk is ready for packing.

Phosphatase test is conducted to know the status of pasteurization. If the test result is negative then the pasteurization is understood to be satisfactory else, it requires repasteurization.

## ii. Requirements

Batch pasteurizer, HTST pasteurizer, SS Container, stirring device, plate heat exchanger, multipurpose tank, centrifugal pump, steam raising equipment, thermometers, cans, bottles/pouch filling system, detergents, sterilizing agents etc.

## iii. Procedure

### A. Batch Pasteurization

- i) Take the desired quantity of milk in a stainless steel holding tank.
- ii) Open the steam valve and heat the milk in the holder or multipurpose tank (vat), while stirring the milk by means of a mechanical agitator.
- iii) As soon as the temperature of 62.8°C (145°F) is reached maintain it for 30 minutes.
- iv) Close the steam valve.
- v) Cool the milk first with cold water and then with chilled water to 4-5°C or below.
- vi) Fill in the cans /bottles /polyethylene pouches.
- vii) Store the pasteurized milk below 4-5°C for delivery to consumers.

### B. HTST Pasteurization

- i) Clean the plant by circulating detergents, followed by warm water.
- ii) Sterilize the HTST unit by circulating hot water.
- iii) Start the vacuum pump and adjust the vacuum by adjusting the temperature of pasteurizer.

OR

Start the air compressor unit in case the unit is air operated.

- iv) Circulate hot water and maintain the temperature at 71.7°C (161°F) by regulating the steam valve.
- v) Pump milk to the balance tank through the clarifier and maintain the level of milk.
- vi) Pump the milk to the regeneration section.
- vii) Set the setting needle, temperature setting needle of the thermograph at a slightly higher temperature, say 73°C (162.5° F), to ensure proper pasteurization.
- viii) Collect the pasteurized milk in a sterilized storage tank or pack in containers.

#### iv. Observations

Record the following observations:

##### A. Batch Pasteurization

- i) Make of the equipment:
- ii) Capacity of the pasteurizer:
- iii) Capacity of the pumps, storage tank:
- iv) Temperature of raw milk:
- v) Temperature of milk after final heating:
- vi) Temperature of milk after cooling
- vii) Total quantity of milk pasteurized:
- viii) Fat percent of milk:
- ix) Acidity of milk:
- x) Starting time of heating the milk:
- xi) Holding time of milk at 145 deg.F (62.8° C):
- xii) Result of posphatase test: positive or negative?

##### B. HTST Pasteurization

- |  |       |          |
|--|-------|----------|
| i) Equipment:  | Make  | Capacity |
| a) Vacuum pump   |       |          |
| b) Float controlled balance tank                       |       |          |
| c) Centrifugal pump                                    |       |          |
| d) HTST pump   |       |          |
| e) Milk storage tank                                   |       |          |
| ii) Composition and strength of the detergent solution |       |          |
| iii) Sterilizing agent used                            |       |          |
| iv) Time taken for sterilization                       |       |          |
| v) Temperature of raw milk                             |       |          |
| vi) Temp. of milk after regeneration                   |       |          |
| vii) Temp. of milk after final heating                 |       |          |
| viii) Percentage of regeneration obtained              |       |          |
| ix) Temperature of milk after cooling                  |       |          |
| ix) Total quantity of milk pasteurized                 |       |          |
| x) Composition of milk:                                | Fat % | SNF%     |
| xi) Temperature of hot milk on recording thermometer.  |       |          |
| And on indicator thermometer.                          |       |          |
| xii) Temperature and time for diversion of milk.       |       |          |
| xiii) Readings of phosphates test:                     |       |          |

#### v. Results

- i) Quality of Milk Pasteurized
- ii) Pasteurization efficiency.

---

## 8.4 PRECAUTIONS

---

1. Clean, and sterilize the utensils coming in contact with milk using boiling water.
2. Heat the milk to a specified temperature for the required time and cool it to the desired temperature as soon as possible.
3. Before taking milk in pasteurizer, ensure that the flow diversion valve, time-temperature recorder, float controlled balance tank, centrifugal pump etc. are functioning properly.

---

# EXPERIMENT 9 DETERMINATION OF THE EFFICIENCY OF PASTEURIZATION

---

## Structure

- 9.1 Introduction
- 9.2 Objectives
- 9.3 Experiment
  - Principle
  - Requirements
  - Procedure
  - Observations
  - Results
- 9.4 Precaution

---

## 9.1 INTRODUCTION

---

One of the most important aspects of pasteurization is to make the milk safe for human consumption by destroying pathogenic organisms present in it. Heating time temperature combination for pasteurization has been determined on consideration of inactivation of constitutive alkaline phosphates enzyme, which is virtually destroyed under conditions of efficient pasteurization.

---

## 9.2 OBJECTIVES

---

- determine whether the pasteurization of milk ensures destruction of all the pathogens.
- assess the extent of post pasteurization contamination.
- know inadequate heating of milk.

---

## 9.3 EXPERIMENT

---

### i. Principle

Phosphatase of raw milk is destroyed at the temperature –time combination of heating necessary for efficient pasteurization. To test whether the heat treatment by holding or HTST method is properly carried out, the treated milk is subjected to the phosphatase test which helps to indicate the presence or absence of phosphatase enzyme. Phosphatase present in milk is destroyed by just about the same heat treatment necessary for the destruction of *Mycobacterium tuberculosis*, the most heat resistant index pathogen likely to be present in milk. When heat treatment is less than that specified in the method, some of the phosphatase remains active and will liberate phenol (blue) from disodium phenylphosphate or paranitrophenol (yellow) from r-nitrophenyl disodium orthophosphate under the alkaline conditions of test. The colour is a measure of the phosphatase content of the milk sample. Therefore, if phosphatase is present, it follows that the milk has been inadequately heated, or has been contaminated after the heating process by raw milk.

## ii. Requirements

### 1. Equipments and apparatus:

- i) The all-purpose Lovibond Comparator complete with stand for work in reflected light.
- ii) Standard discs, giving 0,6,10,18,42, or 0,6,10,14,18,24,42 readings
- iii) Fused glass cells-25 mm : 2Nos.
- iv) A water bath at 37.5°C +/- 0.5 °C.
- v) Pipettes: 5ml, 1ml straight sided, NPL grade B specification.
- vi) Test tubes: 15 ml 1.9 cm with ring at 10 ml fitted with rubber stoppers.
- vii) Graduated flask : 1000ml- one
- viii) Measuring cylinder : 100ml- one

### 2. Chemicals and reagents

- i) Buffer solution: 3.5 g anhydrous Na<sub>2</sub>CO<sub>3</sub> (Sodium Carbonate) and 1.5 g of NaHCO<sub>3</sub> (sodium bicarbonate) dissolved in water and made upto 1 litre.
- ii) Substrate: r-nitrophenyl disodium orthophosphate not less than 95% pure.
- iii) Buffer substrate solution: Transfer 0.15 g of the substrate into a 100 ml measuring cylinder or stoppered graduated flask and make up to mark with the buffer solution. The solution should not be stored for long periods but may normally be kept protected from light in a refrigerator for upto one week. The solution is practically colourless; when viewed through a 25 mm cell in the All-purpose comparator, it should give a reading of less than "10" on the disc.

## iii. Procedure

- i) Fill 5 or 10 ml of the buffer substrate solution into test tubes marked at 5 or 10 ml and heat to 37-38 deg.C in a water bath.
- ii) Add 1 or 2ml (depending on 5 or 10 ml of buffer substrate are used) of the milk to be tested, close the tubes with rubber stoppers and invert to mix.
- iii) Prepare in the same way a blank from a boiled milk of the same type as that under test.
- iv) Incubate all the tubes at 37-38°C for 2 hours.
- v) Read the yellow colour after 30 minutes, return to the water bath and take a second reading after incubation for a further 90 minutes. The yellow colour is read in a Lovibnd All Purpose Comparator on a resazurin stand, fitted with the disc calibrated in microgram of: r-nitrophenol.
- vi) The blank is placed on the left of the stand and the sample on the right.
- vii) Reading are taken by looking down on to the two appertures with the comparator facing a good source of day light; the disc is revolved until the sample is matched; readings falling between two standards are recorded to the nearest reading.
- viii) After a further 20 minutes of incubation, remove the test tubes from the water bath and mix them well by gradual inversion and read the colour as before.

#### iv. Observations

Record the disc readings:

Time of incubation (min)	Disc readings
0	
30	
60	
90	
120	

#### v. Results

Interpretation of result is done as follows:

i) Disc reading after 30 min incubation	Interpretation
0 or trace	Properly pasteurized.
6	Doubtful
10 or over	Under pasteurized
ii) Disc reading after 2 hour incubation	Interpretation
0 to 10	Properly pasteurized
Over 10 to 18	Slightly under pasteurized
Over 18 to 42	Under pasteurized
Over 42	Not pasteurized

---

### 9.4 PRECAUTIONS

---

- i) The 30 min. test will reveal only serious fault in pasteurization but 2 hour test enables minor errors to be detected.
- ii) Positive phosphatase test in pasteurized milk may be due to:
  - a) Inadequate holding period
  - b) A temperature indicated by recorder is faulty.
  - c) Contamination with raw milk.