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# **EXPERIMENT 10 STUDY OF HOMOGENIZER, HOMOGENIZATION OF MILK AND DETERMINATION OF HOMOGENIZATION EFFICIENCY**

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## **10.1 INTRODUCTION**

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Milk is an oil-in-water emulsion. While water forms the continuous phase, fat globules are dispersed as fine droplets. The emulsion is not stable indefinitely and upon standing for some time, the fat globules coalesce with each other and separate out. The separation is caused by the difference in density of the fat layer and water. The fat phase being lighter rises to the surface and forms cream layer.

Homogenization is a process of reducing a substance, such as the fat globules in milk, to extremely small particles and distributing it uniformly throughout the system. When milk is properly homogenized, the finely subdivided fat globules will not coalesce and cream will not rise to the top. The process of homogenization is accomplished by forcing the milk through a homogenizer. Homogenizer is a simple heavy-duty, high-pressure pump equipped with a special valve. The milk is passed at very high pressure through very fine passage of the homogenizer valve. This breaks up the fat globules from their normal size of up to 18 micrometres to less than 2 micrometres in diameter.

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## **10.2 OBJECTIVES**

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- learn about the operation of a homogenizer
- know how to prepare homogenized milk
- study the effect of homogenization on creaming properties of milk

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## **10.3 EXPERIMENT**

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### **i. Principle**

The fat globules in the raw milk exist encased in membranes, which are lipophilic (fat loving) on the inside where they remain in contact with the fat and hydrophilic

(water loving) on the outside where they remain in contact with the water phase. The membranes prevent the fat globules from coming in contact with each other. However, upon standing undisturbed for sometime, the fat globules owing to their lower density than the water phase tend to rise to the surface forming cream layer. Fat globules can be prevented from coalescing and rising to the surface if they are divided into smaller units by a mechanical means. The principle underlying the process of homogenization is therefore based on subjecting the fat globules to enough severe conditions by passing it through narrow orifices such that as a result of the mechanical action these are disrupted into smaller globules. The newly formed fat globules are maintained in dispersion for sufficient time to allow new milk fat globule membrane (MFGM) to be formed at the fat-serum interface. The newly formed globules are uniformly distributed through out the water phase and form a more stable emulsion.

## ii. Materials required

- i) Multipurpose milk processing vat (Capacity: 200-500 litres)
- ii) For larger capacity dairy units, HTST pasteurizer
- iii) Homogenizer
- iv) Weighing balance
- v) Gerber centrifuge
- vi) Butyrometer and fat testing chemicals (Sulfuric acid and amyl alcohol)
- vii) Microscope with an oil immersion lens and other accessories
- viii) Two 100 ml graduated cylinder

## iii. Procedure

Operation of homogenizer and preparation of homogenized milk

- i) Check that the oil level in the crank case is up to the indicator mark by looking from the sight glass
- ii) Inspect and tighten the inlet and outlet connections
- iii) Open the product feed valve and introduce water
- iv) Ensure that there is no pressure on the homogenizer valve
- v) Now switch 'on' the machine and circulate water (70-80°C) for about half an hour
- vi) Introduce the milk coming out of the pasteurizer (temperature of milk ~60°C) through the inlet valve and check for any leaks in the feed line
- vii) Keep the product flowing in circulation mode
- viii) Once the product flow is smooth, increase the pressure on the second stage by turning the pressure-regulating handle in clockwise direction to attain necessary pressure
- ix) Now turn the pressure-regulating handle of the first stage in clockwise direction and set the first stage homogenization pressure.
- x) Change the product flow from the circulating mode to the regular mode and allow few litres of milk to pass through
- xi) Collect 500 ml of out going product as sample
- xii) Allow the homogenized milk to pass through pasteurizer (continuous cycle to be maintained in case of HTST pasteurizer)
- xiii) Alternatively, milk can be taken back to multipurpose vat for batch

pasteurization and cooling

- xiv) Fill the cooled, homogenized and pasteurized milk in sachets/bottles of appropriate size and store in cold condition (5 °C)
- xv) While discontinuing the operation, first release the pressure from the 1<sup>st</sup> stage and then from the 2<sup>nd</sup> stage of homogenizing valve
- xvi) Allow water to flow through the homogenizer for 30 min followed by circulation of hot water to ensure cleaning before the machine is shut down.

#### Determination of homogenization efficiency

- i) Examine the size of the fat globules, thorough a microscope, in the sample after making proper dilutions
- ii) Remove a litre of the homogenized milk from the cold store (stored undisturbed for 48 hrs) and carefully draw (without disturbing the liquid) aliquots from the top 100ml, and also a representative sample from remaining portion of milk. Determine % fat in both the portion of milk sample (For a properly homogenized milk, % fat in both the top and the remaining portion should not differ by more than 10%).

#### iv. Observation/ production chart

##### Production Chart Homogenized milk

##### Particulars of milk:

Type .....

Size of fat globules: (smallest....., largest....., average.....)

Fat .....%

Acidity .....% lactic acid

Quantity of milk .....kg

##### Homogenization:

Type of homogenizer: (single stage/double stage.....)

Capacity of homogenizer.....Litre/hour

Temperature of milk.....°C

##### Pressure in homogenizer:

First stage.....kg/cm<sup>2</sup>, Second stage..... kg/cm<sup>2</sup>

Rate of homogenization: .....kg/hour

Temperature of pasteurization: .....°C

Number of bottles of homogenized milk filled: .....

##### Quality of homogenized milk:

a. Flavour.....

b. Fat content in milk after 48 hours:

Top 100 ml of milk layer:.....% fat, Remaining milk:.....% fat.

c. Percentage difference in fat between the two portion of milk.....% fat

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#### 10.4 PRECAUTIONS

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- i) Always ensure that the homogenizer is properly cleaned and sterilized before the product is homogenized

- ii) Temperature of milk while entering the homogenizer should never be less than 55 °C
- iii) Flow of milk, during the first few minutes after the homogenization pressures in both the stage have been set, should be through the balance tank (circulation mode) to ensure that unhomogenized milk does not go to the pasteurizer.
- iv) Homogenization pressure should be always built upto the desirable level first in the 2<sup>nd</sup> stage and then only pressure in the 1<sup>st</sup> stage should be raised.
- v) Always ensure that the set pressure in both the homogenization stages is maintained constant all through the operation.
- vi) Homogenizer should be never run dry.