



THE UNIVERSITY OF  
MELBOURNE

# FOOD20006

## Food Microbiology & Safety

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# Sources of microorganisms in food-Milk

Ray and Bhunia Chapter 3

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# Intended learning outcomes

Differentiate between normal flora in plant and animal derived foods, contaminants, spoilage organisms, pathogens and functional organisms

Relate the intrinsic and extrinsic factors of food substances to how microorganism can grow and survive

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# Food microbes and food safety

Many aspects of food microbiology are aimed at

- Understanding the sources of microorganisms in food
- Controlling access of some organisms to food
- Killing microorganisms in food or reducing their numbers
- Determining the microbiological quality of food
- Using microbiological standards and specifications for food safety

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Collectively these measures manage product quality

This lecture is about where the microorganisms in food come from.

We will focus on milk, meat, fish and plants

# Milk

Whole , clean, fresh, lacteal secretion obtained by complete removal or milking of one or more healthy cows

A complex mixture of organic and inorganic food substances such as water, fat, carbohydrate, protein, minerals, salt, gases, vitamins, enzymes, hormones, antibiotics , white blood cells, somatic cells and bacteria

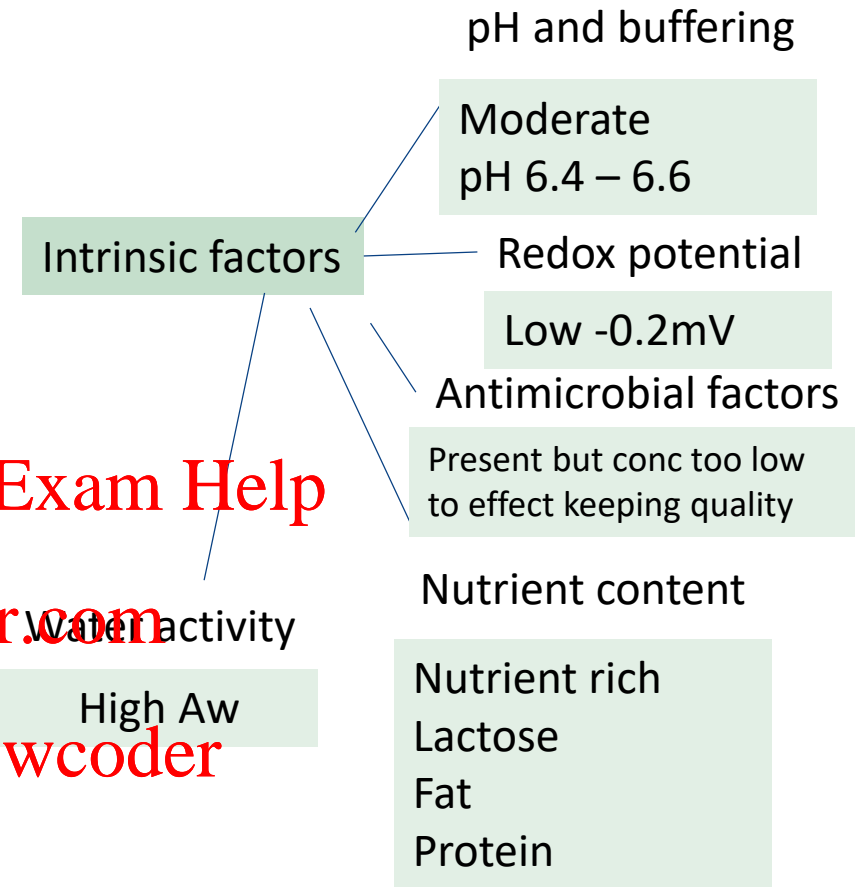
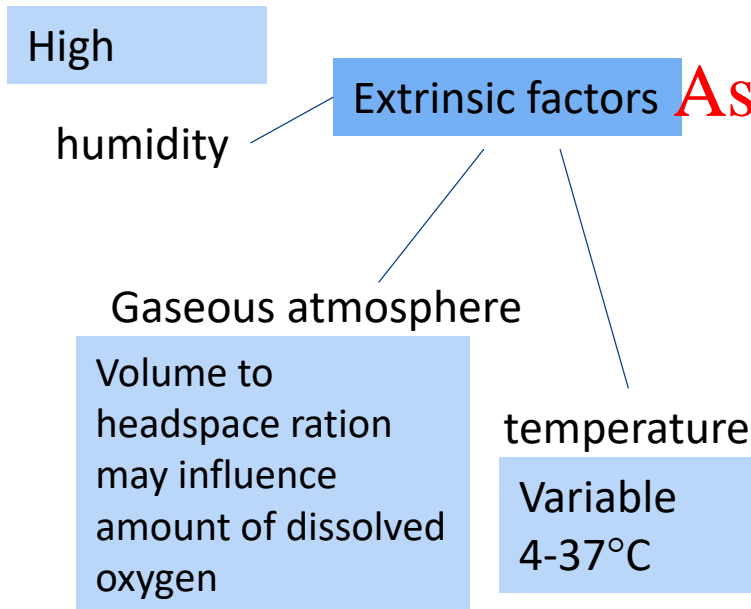
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4.5% fat

2. % protein

4.1% lactose

3 - 5% fat

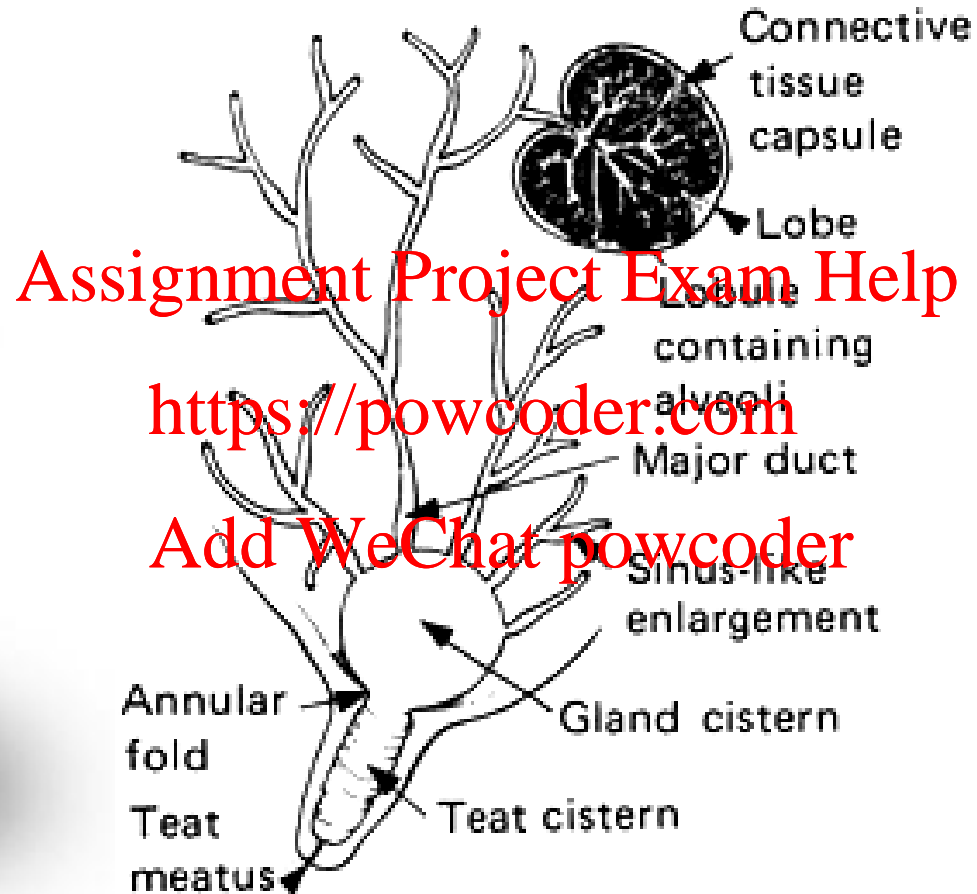
3.4 - 4.9% protein

~5% lactose



Milk from different animals differs slightly in compositions. The season and diet will also have an effect however the main constituents remain the same. Fat, protein and lactose (carbohydrate)

# Sources of microflora of milk



## Udder





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# Sources of microflora of milk

## Exterior of udder

- Faeces
- Environment
- Bedding
- Heavily contaminated udders may contribute  $10^5$  cfu/ml to milk
- Good hygiene can control this

## Interior of udder

Low numbers of bacteria in a healthy cow

udder ( $10^2$ – $10^3$  cfu/ml)

Cow with mastitis may have up to  $10^8$  cfu/ml

of bacteria in her milk

Mastitis is an infection of the mammary

glands caused by bacteria including

- *Pseudomonas aeruginosa*
- *Staphylococcus aureus*
- *Staphylococcus epidermidis*
- *Escherichia coli*
- *Klebsiella pneumoniae*

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# Main health concerns associated with milk

Pasteurization is an effective control measure

Food Safety Australia and New Zealand (FSANZ) set standards for the effective pasteurization of milk

All milk for consumption in Australia must be pasteurized

## Reading

<https://www.foodauthority.nsw.gov.au/sites/default/files/Documents/foodsafetyandyou/raw-milk-advice.pdf>

## RAW MILK ADVICE TO CONSUMERS

Raw milk provides an ideal environment for a range of pathogenic organisms and has been associated with numerous outbreaks of disease and illness in humans.

### Raw milk

Raw milk is milk that has not undergone a pasteurisation process to kill any bacteria that might be present. Raw milk and raw milk products may come from a number of milking animals including cow, goat, sheep, buffalo, horse and camel.

Milk is a highly perishable product and is an ideal medium for the growth and multiplication of harmful microorganisms that can cause illness. Unpasteurised milk presents an increased risk of contamination with bacteria and does not provide any dietary advantage compared with pasteurised milk.

The treatment of milk and milk products to destroy pathogens is required by the Australia New Zealand Food Standards Code (the Food Standards Code) with very few exceptions. It is an important public health and food safety measure supported by scientific studies around the world and in Australia.

### Risks associated with drinking raw milk

People who consume raw milk are at an increased risk of infection due to several different bacteria capable

of causing severe illness and potentially death.

Raw milk is known to carry several disease-causing organisms including:

- *Campylobacter jejuni* (campylobacteriosis)
- *Salmonella*
- *Listeria monocytogenes* (listeriosis)
- *Escherichia coli*
- *Cryptosporidium*
- *Staphylococcus aureus*

Complications from bacteria that can contaminate these products can be extremely severe, such as Haemolytic Uraemic Syndrome (HUS) caused by Shiga toxinogenic *E. coli* which can result in renal failure and death in otherwise healthy people.

### What effect does pasteurisation have on milk?

The nutrient value of milk is generally unaffected by pasteurisation. Aside from 10 percent loss in vitamin C, the rest of the vitamins in milk are not affected by pasteurisation. Also, the main milk enzymes lactoferrin, lacto-

peroxidase, and lysozyme are highly active after pasteurisation.

### What are the laws in NSW for milk?

It is illegal to sell raw milk as a food in Australia. In NSW, all milk sold (except goats milk) must be pasteurised. Unpasteurised goats milk is only permitted subject to compliance with the dairy food safety scheme and an advisory statement that the milk is unpasteurised must be included on the product.

In addition, all raw milk activities in NSW, such as the production of cosmetic products including soaps and bath wash, are also required to be licensed with the NSW Food Authority. This ensures they are produced subject to compliance with the dairy food safety scheme which includes strict licensing requirements underpinned by regulatory controls. These licence conditions prevent inappropriate labelling and packaging of raw milk products which may lead consumers to believe it is a food and will also impose requirements to render the product unpalatable.

The pasteurisation of milk and manufacturing of other dairy



# Primary Production and Processing Standard for Dairy

## FSANZ Standard 4.2.4

### Processing of milk and dairy products

(1) Milk must be pasteurised by –

- (a) heating to a temperature of no less than 72°C and retaining at such temperature for no less than 15 seconds; or
- b) heating, using any other time and temperature combination of equivalent or greater lethal effect on any pathogenic micro-organisms in the milk; or
- (c) using any other process that provides an equivalent or greater lethal effect on any pathogenic micro-organisms; unless an applicable law of a State or Territory otherwise expressly provides.





# Heat treatment of milk

French chemist and microbiologist Louis Pasteur, originally used heat treatment to stop beer and wine souring. The process, called Pasteurisation, was later used to kill pathogens from milk.

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Name of treatment	Temp and time
Low temperature holding (LTH)	63°C for 30 min
High temperature short time (HTST)	72°C 15 sec
Ultra high temperature (UHT)	135°C for 1 sec
“sterilized”	> 100°C 20-40 min



# Raw milk vs Pasteurised milk

Raw milk is milk that has not been heat treated

Pasteurised milk is not sterile

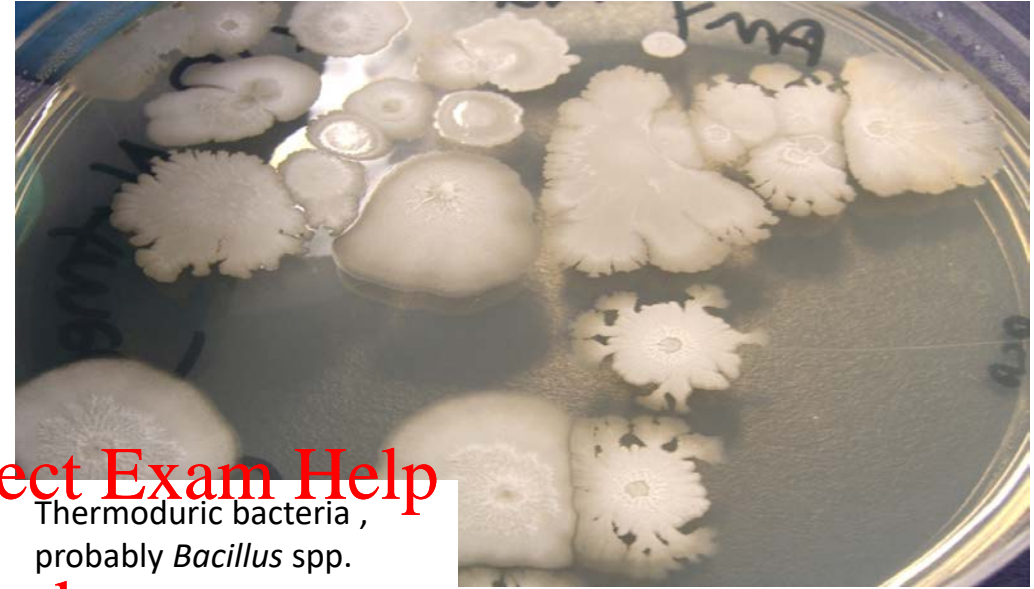
It should have

- $< 3 \times 10^4$  cfu/ml bacteria
- $< 1$  coliform/ml (these are *E. coli*-like bacteria)
- $< 10^5$  cfu/ml after 5 days at 6°C

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MDS



<https://www.cdc.gov/features/rawmilk/index.html>



# Thermotolerant bacteria

A photograph of a petri dish containing several bacterial colonies. The colonies are white, opaque, and have a distinct, radiating, flower-like or dendritic appearance. They are spread across the surface of a dark, agar-based medium. The petri dish itself is clear, and some handwritten markings are visible on its rim.

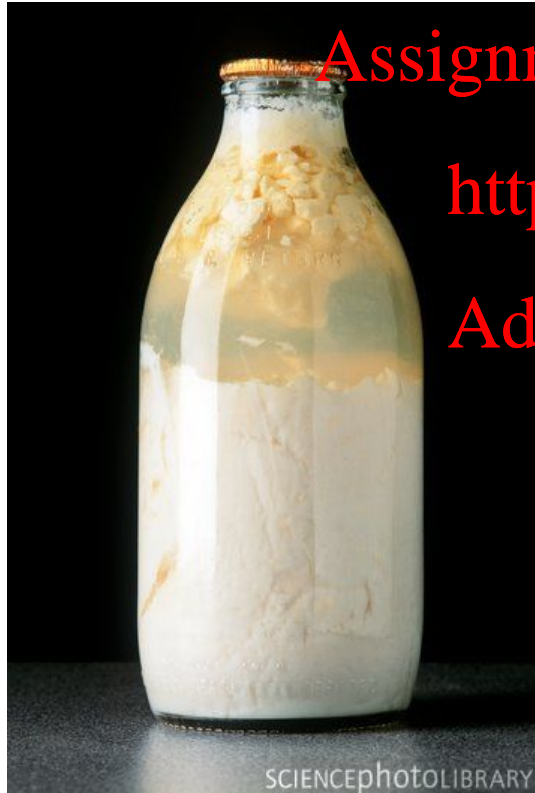
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## Curdled milk

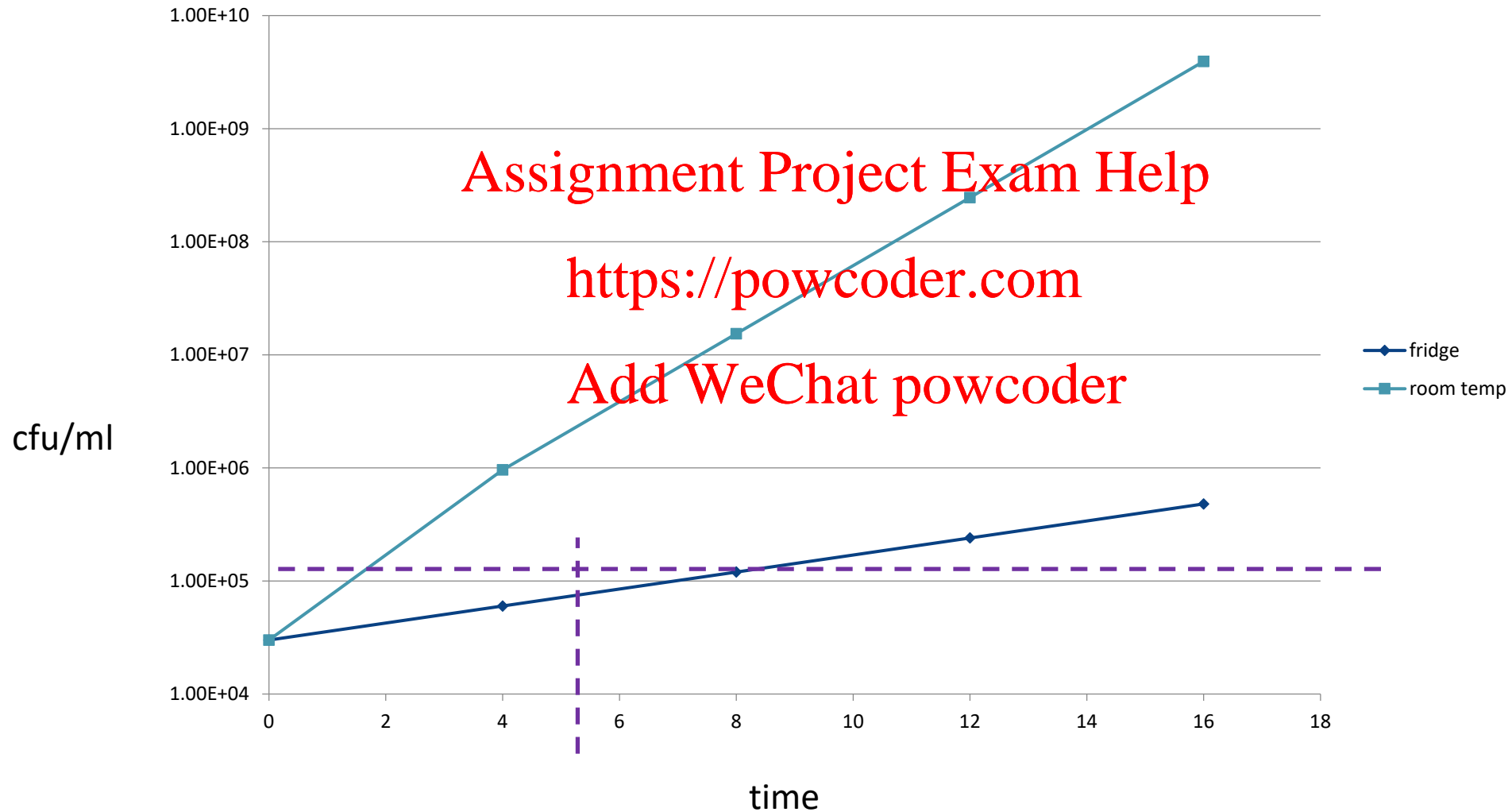
pH of milk drops and milk protein  
precipitates + lipids  
breakdown="curdles"



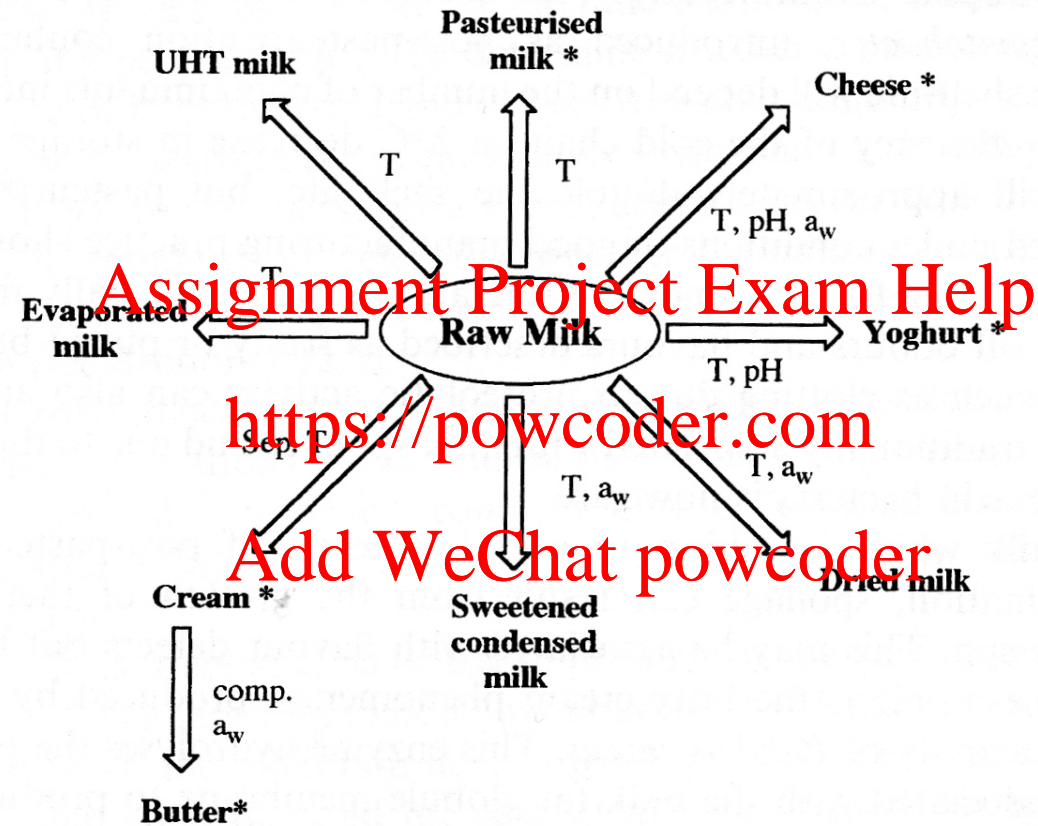
## Bitty Cream syndrome

- *Bacillus cereus* (Gram positive, spore former)
- spores can survive pasteurisation and grow in milk
- Lecithinase digest the phospholipids in milk fat globules
- Remaining protein/fat globules float on surface of hot drinks and clings to glass
- Mainly happens when through improper refrigeration

# Growth of bacteria in pasteurised milk



# Milk products



**Figure 5.3** Milk and milk products. T indicates elevated temperature; pH, reduced pH;  $a_w$ , reduced  $a_w$ ; sep., separation, comp., compartmentalization; and \* stored at chill temperatures



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