

# Microbiology of Cream



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# What is Cream?

**Cream is the fat rich portion of milk obtained on keeping it undisturbed for sometime or on centrifuging.**

**(Market cream, Manufacturing cream, Baker's cream)**

<b>Table Cream (20-25% fat)</b>	<b>Coffee Cream (20-25% fat)</b>	<b>Light Cream (20-25% fat)</b>
<b>Whipping Cream (20-25% fat)</b>	<b>Heavy Cream (30-40% fat)</b>	<b>Plastic Cream (65-85% fat)</b>

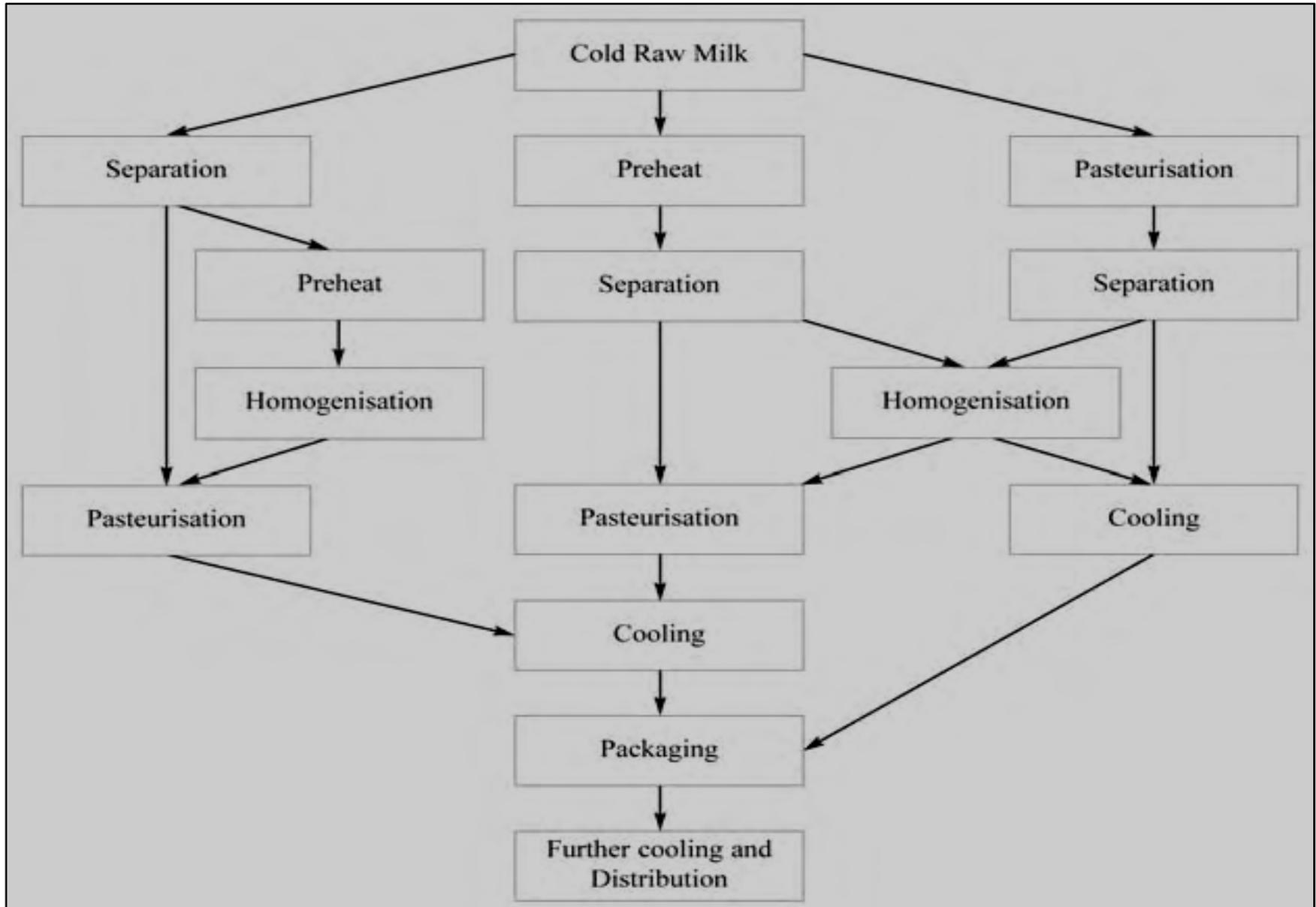
**“Untreated cream” not treated by heat.**

**“Pasteurized cream” shall be either (a) heated to a temperature at 63 C for 30 min or heated to a temperature at 72 C for not less than 15 s to eliminate vegetative pathogenic microorganisms.**

**“Sterilized cream” has been subjected to sterilization (not less than 108 C for 45 mins) in the container in which it is to be supplied to the consumer.**

**“Ultra-high-temperature (UHT) cream” has been subjected in continuous flow to an appropriate heat treatment (not less than 140 C for 2 s) and has been packaged aseptically.**

# Flow Diagram of Production and Processing of Cream



# Microenvironment of Cream

The initial microflora of cream are essentially same to those of the raw milk (influenced by microflora on the cow's udder, milk-handling equipment and storage conditions).

- **Microbial Number:** Bacteria being static form clumps in cream thereby, leading to lower count. Cream processed in poorly cleansed plants gave initial colony counts at 32 C (include psychrotrophic bacteria) of about  $10^4$  per ml, which increased to about  $10^7$  per ml after 5 days cold storage.

- **Type of Microflora:**

**Bacteria:** Micrococci, streptococci, corynebacteria and sporeformers (original flora); Gram negative rods, staphylococci and lactobacilli (contaminating flora); pathogenic m.o's might be cow-derived or dairy personnel

Cream not cooled properly to 5 C leads to predominance of staphylococci, lactobacilli and *Bacillus cereus*. Unclean plant includes high number of psychrotrophs. Prolonged storage leads to psychrotrophs and psychrophiles (proteolytic and lipolytic).

**At 5 C: *Pseudomonas, Alcaligenes, Aeromonas, Acinetobacter***

**At 30 C: *Bacillus, Lactobacillus, Micrococcus, Staphylococcus***

**The predominance of micro-organisms in heat treated cream depends on the type of heat treatment.**

**Canned cream (sterilized): Anaerobic sporeformers**

**Pasteurized cream: Sporeformers, Thermoduric organisms**

**Yeast and Molds: *Candida pseudotropicalis, Torulopsis sphaerica, Torula cremoris, Geotrichum candidum***

# Factors Affecting Microbiological Quality of Cream

- **Raw Milk Quality:** Poor quality raw milk contains high spore (*B. cereus*) and thermoduric counts leading to poor keeping quality of cream. So, hygienic production of raw milk at farm level and raw milk used for cream separation should not be stored for long and higher temperatures. Low temperature might avoid souring of milk but lead to growth of psychrotrophic and psychrophilic count. Although, these organisms get killed during subsequent heat treatment of cream, their heat stable enzymes may survive leading to proteolytic and lipolytic spoilage.
- **Separation process:** Separation is the concentration of the fat globules and their removal from the milk. In centrifugal separators, solid particles of debris and somatic cells in the milk collect on the outer wall of the separator bowl and form a layer of slime.

Separation is ideally carried out at a temperature of 40-50 C, a temperature at which rapid microbial growth is possible. Therefore, higher temperatures (55-63 C) are often recommended; viscous creams are generally produced using these high temperatures. Some separators used to produce high-fat creams (40% fat content) are able to operate at 5 C, at which temperature significant growth will not occur.

- **Holding of cream before processing:** Holding of cream at higher temperatures for longer time leads to microbial proliferation and consequent rise in microbial number especially in farm level.

- **Standardization:** Standardization of the cream for fat content is usually necessary after separation, since separators give a slightly higher than required fat content, and whole or skimmed milk is then added to give the correct value. Standardized cream should always be heat treated, cooled and packaged immediately. During processing, milk and cream should be held at very low (about 5 C) or very high temperature (above 60 C).
- **Homogenization:** Homogenization can lead to extra contamination of cream due to extra treatment, increase in microbial numbers, and increased lipolytic activity due to easy action of lipase on increased surface area of fat. Homogenization after heat treatment helps to reduce problems with rancidity caused by lipases present in the milk. UHT-treated cream is normally homogenized after heat treatment.

- **Heat Treatment:** To ensure a safe and longer shelf-life product. Pasteurization treatments for cream is 72 C for 15 s (HTST), 65 C for 30 mins (Holder) and 65 C or higher for 30 mins (In-bottle). High-temperature, short time (HTST) processes achieve a longer shelf life.

Cream may also be sterilized in containers either by batch or continuous rotary retorting at 110-120 C for 10-20 min. For homogenized fat cream, heat treatments (121 C for 15 min) are given.

**UHT sterilization:** 132 C for 1 s (cream becomes free from both viable cells and spores). UHT processing is most suitable for single and half cream.

**Autothermal Thermophilic Aerobic Digester (ATAD) friction process:** Preheating of cream to 70 C followed by heating at 140 C for 0.54 s.

- **Holding of cream after processing:** The pasteurized cream when stored at 5 C can exhibit an increase in the psychrotrophic organisms.
- **Packaging/canning:** Lapse in hygienic storage and during aseptic packaging and sealing could lead to entry of microbes to the product. The unhygienic surroundings may contaminate the atmosphere with bacteria, yeasts and molds during packaging. Filling operation during canning can act as potent source of contamination.
- **Storage and distribution:** The erratic demand and distribution pattern of cream result in storage of product for variable lengths of time and its handling. Longer storage under unfavorable atmospheric temperatures might involve microbiological problems. So, storage should be preferably at 0 C.

## Processing of Other Creams

- Whipping cream contains added sugar and stabilizers. The stabilized cream is then pasteurized and held at 5 C for 24 hrs. Compressed air or nitrogen is then introduced into the mix. This provides an excellent aerobic medium for microbial growth, thereby increasing the chances of spoilage.
- Clotted creams are made by heating double cream over a layer of skimmed or whole milk, in a large, shallow jacketed tray until a crust is formed or heating a thin layer of high-fat cream (54–59% milk fat) at 77– 85 C to form a crust. The more severe heat treatments result in aerobic spore-formers however, slow cooling and poor hygiene are more likely to lead to the growth of spoilage molds, coliforms and other contaminants.

**Key to obtain sufficient shelf-life are the microbiological quality of the raw milk, good hygiene in processing, and effective temperature control during distribution and storage**

# Spoilage Microorganisms

Cream usually receives more severe heat processes than milk, and the post-heat treatment microbial population therefore, consists almost entirely of relatively heat-resistant species.

Aerobic spore-forming bacteria survive pasteurization and psychrotrophic strains of *B. cereus*. Heat-resistant sp. such as *B. licheniformis*, *B. coagulans*, and *B. subtilis* may survive sterilization and even UHT processes, and may cause bitterness and thinning in sterilized creams. *B. pumilus* and *B. sporothermophilus* are now recognized as potential contaminants in cream, primarily carried over from raw milk. Heat-resistant lipases produced by psychrotrophic bacteria growing in the raw milk may also survive high-temperature processing and cause spoilage in UHT cream.

The keeping quality of cream is greatly affected by post-process contamination. Psychrotrophic bacteria (pseudomonads) may contaminate pasteurized cream during processing and are important spoilage organisms. The high fat content of cream means lipolytic spp. (*Pseudomonas fluorescens* and *P. fragi*) are a particular problem.

Yeasts and molds are rarely implicated in the spoilage of cream. Few yeasts are able to ferment lactose, but species such as *Candida lipolyticum* and *Geotrichum candidum* may occasionally spoil bakers' whipping cream where sucrose has been added. Cream stored at very low temperatures (0-1 C) prolong the shelf life but mold growth, (*Penicillium* spp.) may develop on the cream surface.

**Defective cans or leaking seams could cause spoilage of cream due to entry of bacteria from cooling water or other sources, e.g. a waterborne organism (*Proteus*) can cause bitterness and thinning, coliforms can produce gas, and lactococci could result in acid curdling.**

**In the case of cream-based desserts, thermoduric organisms are most likely to be an issue due the more use of aggressive heat treatments. In addition, the added sugar increases the range of contaminants that could grow in the product. Fruit conserves, if added, will lower the pH of the product thus favoring the growth of yeasts and molds.**

# Pathogenic Microorganisms

Unpasteurized cream carries a high risk from the presence of foodborne pathogens. Food-poisoning outbreaks have been associated with linkage of products prepared with cream.

1. *Salmonella*: Salmonellae will not survive the heat treatment applied to cream and therefore their presence is likely to be due to post-pasteurization contamination. The cells are likely to survive for extended periods in contaminated cream, but growth is not possible unless significant temperature abuse occurs. Storage at below 5 C will prevent multiplication. *S. typhimurium* DT40 infection in UK was due to consumption of cream-filled profiteroles. Another outbreak in Spain (1991) was due to *S. enteritidis* for consuming contaminated confectionery custard and whipped cream.

2. *Listeria monocytogenes*: It might survive cream pasteurization processes and then grow during chilled storage. Post-pasteurization contamination of cream could be a potentially serious problem.
3. *Staphylococcus aureus*: It may be introduced into cream as a post-process contaminant, particularly from infected food handlers. However, it is incapable of growth below 7 C, and high numbers will only develop following significant temperature abuse.
4. *Bacillus cereus*: Being common in milk, its endospores are able to survive pasteurization. Some strains are also psychrotrophic, and capable of growth in refrigerated dairy products. Nevertheless, *B. cereus* food poisoning outbreak has been associated with the consumption of pasteurized cream ( $3 \times 10^7/\text{g}$ ).

- 5. *E. coli* O157:H7:** It is destroyed by proper pasteurization, but occurrence of cross-contamination between raw and pasteurized cream can lead to recontamination. It could survive for prolonged periods in cream. Outbreak was associated with consumption of raw cream from a small farm dairy.
  
- 6. Viruses:** In 1975 in Scotland, an outbreak of hepatitis A infection occurred associated with cream consumption. It was due to handling of the cream by an infected cook during preparation.

# Relationship between Microbiological Quality and Condition of Cream

<b>Microbial Counts</b>	<b>Interpretation of Quality</b>
<b>High total count and high coliforms</b>	<b>Inadequate heat treatment or unhygienic manufacture and storage at high temperature</b>
<b>High total count but low coliforms</b>	<b>Good hygiene but storage at high temperatures</b>
<b>Low total count but high coliforms</b>	<b>Poor hygiene in manufacture but storage at low temperatures</b>
<b>Low total count and coliforms but high yeasts</b>	<b>Good hygiene except contamination from fruits</b>
<b>Low total count and coliforms but high molds</b>	<b>Good hygiene except aerial contamination</b>
<b>Low total count and coliforms but high aerobic spores</b>	<b>Cream made from milk having high spore count</b>

# **Causes of Microbial Defects**

- 1. Unhealthy udder of the milch animal can give rise to infected milk and ultimately an unsafe cream.**
- 2. Unhygienic production of milk leading to high microbial population in milk or cream. Separation of cream in improperly clean cream-separator.**
- 3. Storage of cream in unhygienic containers.**
- 4. Lack of proper cooling of milk or cream at various stage especially before heat processing.**
- 5. Inadequate heat treatment during the pasteurization or sterilization.**
- 6. Unhygienic personnel handling the cream after heat processing.**
- 7. Faulty filling/packing/ canning of the product.**
- 8. Delayed distribution of market cream coupled with storage under ambient conditions.**

# Microbial Defects in Cream

Types of Defects	Microorganisms responsible	Effects
Souring (uncontrolled acid development)/sweet-curdling	Lactic acid producing bacteria/ <i>B. cereus</i>	Conversion of lactose to lactic acid by $\beta$ -galactosidase activity/ production of milk clotting enzymes
Bitterness	<i>Pseudomonas</i> , <i>Achromobacter</i> , <i>Proteus</i> , <i>Bacillus subtilis</i>	Biodegradation of proteins to peptones, poly-peptides and peptides
Rancidity	<i>P. fluorescens</i> , <i>P. fragi</i> , <i>Geotrichum candidum</i> , <i>Candida lipolytica</i>	Lipases break down fats to fatty acids and glycerol
Fruity flavour	<i>P. fragi</i>	Apple like flavour
Cheesy/putrid flavour	<i>P. putrefaciens</i>	Growth of proteolytic bacteria

Types of Defects	Microorganisms responsible	Effects
<b>Slimy/ropy</b>	<i>Alcaligenes viscolactis</i>	<b>Sliminess</b>
<b>Malty taint</b>	<i>S. lactis</i> subsp. <i>maltigenes</i>	<b>Growth of the organism</b>
<b>Discolouration</b>	<i>Pseudomonas nigrifaciens</i>	<b>Growth of pigment producing bacteria</b>
<b>Yeasty flavour</b>	<i>Candida pseudotropicalis</i> , <i>Torulopsis sphaerica</i>	<b>Growth of lactose fermenting yeasts with gas production</b>
<b>Musty flavour</b>	<i>Geotrichum candidum</i>	<b>Mat on the surface</b>