CONTAMINATION, SPOILAGE AND PRESERVATION OF FOOD (CONTINUED)

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Canned Meat Products

- Putrefactive anaerobes such as *Clostridium sporogenes* can occur in canned meat.
- If the product is under-processed cured, canned meat products.

Microbiological Spoilage of Dairy Products

Types of Spoilage Microorganisms

1. **Psychrotrophs :** These organisms represent a substantial percentage of bacteria in raw milk.

- Pseudomonads and related aerobic, Gram-negative, rod-shaped bacteria are predominant groups.
- Typically, 65–70% of the psychrotrophs isolated from raw milk are *Pseudomonas* species

- Pseudomonads are characterized by their grow at low temperatures (3–7◦C) and ability to hydrolyze and use large molecules of proteins and lipids for growth.

- Other important psychrotrophs associated with raw milk include members of the genera *Bacillus*, *Micrococcus*, *Aerococcus*, and *Lactococcus* and of the family Enterobacteriaceae.

- Pseudomonads can reduce the diacetyl content of buttermilk and sour cream leading to a "green" or yogurt-like flavor

2. Coliforms:

- Can reduce the diacetyl content of buttermilk and sour cream subsequently producing a yogurt-like flavor.

- In cheese production coliforms grow and production of gas before starter culture is able to produce lactic acid since coliforms have short generation times under such conditions.

- In also grow in mold-ripened cheeses, the pH increases during ripening,

3. Lactic Acid Bacteria (LAB):

- Excessive viscosity can occur in buttermilk and sour cream from the growth of encapsulated, slime-producing lactococci.

- Heterofermentative lactic acid bacteria such as lactobacilli and *Leuconostoc* can develop off-flavors and gas in ripened cheeses.

- Metabolism of tyrosine by certain lactobacilli causes a pink to brown discoloration in ripened cheeses.

- They metabolize lactose, subsequently producing lactate, acetate, ethanol, and CO_2.

- Their growth is favored over that of homofermentative starter culture bacteria when ripening occurs at 15°C rather than 8°C.
- Cracks in cheeses can occur when excess gas is produced by certain strains of *Streptococcus thermophilus* and *Lactobacillus helveticus*.

4. Fungi

- Yeasts can grow well at the low pH of cultured products such as in buttermilk and sour cream to produce off-flavors.
- Yeasts can metabolize diacetyl in these products.
- Contamination of cottage cheese *Geotrichum candidum* often results in a decrease of diacetyl content

- The diacetyl concentrations in low cottage cheese is also reduced by this organism after 15–19 days of storage at 4–7°C.

- Yeasts are a major cause of spoilage of yogurt and fermented milks in which has low pH.

- Common contaminating yeasts of cheeses include *Candida* spp., *Kluyveromyces marxianus*, *Geotrichum candidum*, *Debaryomyces hansenii*, and *Pichia* spp.

- In packaged cheeses, mold growth is limited by oxygen availability.
- Molds commonly found growing in vacuum packaged cheeses include *Penicillium* spp. and *Cladosporium* spp.
- *Penicillium* is the mold genus most frequently occurring on cheeses.

- Cream cheeses are susceptible to spoilage by heat-resistant molds such as *Byssochlamys nivea*.
- It is capable of growing in reduced oxygen atmospheres, including in atmospheres containing 20, 40, and 60% carbon dioxide with less than 0.5% oxygen.

5. Spore-Forming Bacteria

- The common source of spore-forming bacteria in finished dairy products is raw milk.
- They can also contaminate milk after processing
- *Bacillus licheniformis*, *B. cereus*, *B. subtilis*, *B. mycoides*, and *B. megaterium*

- The heat of pasteurization activates (heat shock) many of the surviving spores so that they are primed to germinate at a favorable growth temperature.

Fig. 1: Gassy Swiss cheese caused by *Clostridium tyrobutyricum*

5. Other Microorganisms

Eubacterium sp.:

- a facultative anaerobe that is able to grow at pH 5.0–5.5 in the presence of 9.5% salt.
- It can cause gassiness in Cheddar cheese.

Enterococcus faecalis subsp. *liquefaciens* :

- An unusual white-spot defect in Swiss cheese.
- It is inhibitory to propionibacteria and *Lactobacillus fermentum*, resulting in lack of flavor in the cheese.

Enzymatic Degradation:

- This is an indirect cause of spoilage in dairy product.
- Microbial enzymes- proteases, phospholipases, and lipases, some of which may remain active in the food after the enzyme-producing microbes have been destroyed.
- Extracellular proteases affect the quality of milk products largely by producing bitter peptides.

- Thermally resistant proteases have caused spoilage of ultra-high-temperature (UHT) milk.

- Heat-stable bacterial lipases have been associated with the development of rancid flavors in UHT milk.

FOOD PRESERVATION

Chemical Preservatives are mostly organic acids exert various internal metabolic effects.

- microbiostatic action of their pH effect the preservative
- activity of organic acids is dramatically affected by the pH of the food
- The proportion of fat and water in the food further affects the antimicrobial activity of organic acids.

1. Sorbic acid.

- It is relatively insoluble in water (<0.2%).
- Most food applications use the sodium or

potassium salts of sorbic acid, as these are about 50% soluble in water.

- The sorbates are effective in preventing mold and yeast growth
- Also effectively prevents bacterial growth

2. Propionic acid.

- It is produced in Swiss cheese by *Propionibacterium*.
- Commonly used in foods in the calcium salt form.
- Moderately effective against molds
- Has little activity against yeasts or bacteria.
- it is widely used to prevent mold spoilage in yeast-leavened baked goods. It is the only preservative

3. Benzoic acid.

- Commonly used in the sodium salt form
- It possesses some antibacterial activity, is moderately active against molds,
- very effective against yeasts.
- widely used to prevent yeast spoilage in hermetically sealed acidic foods that are
- not subject to mold spoilage because of the absence of oxygen

4. Methyl and propyl parabens :

- Formed by synthetic additions to benzoic acid
- parabens are widely used to preserve cosmetic and pharmaceutical products
- have limited use in foods because of their flavor
- are effective against molds, are moderately effective against yeasts, and have limited activity against bacteria.
- Methyl paraben is used in foods more often than propyl paraben

5. Carbon dioxide :

- carbon dioxide inhibits the growth of obligately aerobic microorganisms such as molds and pseudomonads.
- used as a component of headspace gases in packaged bakery and meat products.
- Its inhibitory effect can be enhanced by the addition of small amounts of ethanol to the headspace of bread products.
- When used in carbonated beverages, the principal antimicrobial effect of carbon dioxide is quite likely exerted by its soluble form, carbonic acid.

6. Nisin
7. Potassium lactate and sodium diacetate
8. Sodium bisulfite

Thermal Processes