Starter culture problems

1. Strain antagonism – mixed cultures – either different growth rates (competition, unstable conditions – temperature, substrate, metabolite, biomass, death) or secretion of inhibitors (acids, bacteriocins)
2. Loss of desired trait – loss of plasmid borne gene; unstable transfer during replication, causing genetic variation
3. Cell death and injury – mainly mishandling of purchased cultures (temperature abuse etc.) – kill cells or inactivate cells to become dormant states
4. Inhibitors in raw materials e.g. antibiotics (penicillin in milk), disinfectant (storage vessels, truck, plant etc.)
5. Bacteriophages – infect and destroy cells

Problems associated with bacteriophages

- If 1 routinely uses pure cultures of bacteria for inoculation of fermented foods, then there is a risk of contamination with bacteriophages
- Bacteriophages expand in numbers with every new batch of fermented food and contaminate the entire manufacturing plant: machinery, floors, pipes etc.
- High levels of bacteriophage will lead to lysis of starter culture and failure of fermentation
- The batch has to be discarded at considerable cost
- Bacteriophages are viruses that infect bacteria, DNA genome surrounded by protein coat, inactive outside bacteria, cannot grow in food

Steps of lytic cycle:

1. Attachment/adsorption of a phage on the bacterial cell wall
2. Injection of phage DNA into the bacterial cell
3. Phage maturation characterized by formation of phage DNA and protein synthesis
4. Maturation of phages and lysis of host cell
5. Release of progeny phages, infecting other cells

Control of Bacteriophages in starter cultures

- sanitation of site/equipment
- phage insensitive media (reduce Ca^{2+})
- rotation of strains (differ in phage receptors)
- use of mixed starter culture strains
- can develop phage-resistant strains (immune system of bacteria) using CRISPR/Cas system; small part of a phage genome is used to detect and destroy new phage entering the cell

<u>Topic 5a Beneficial uses of microorganisms in foods 2</u>

Microbiology of fermented dairy foods (yoghurt and cheese)

2 categories:

1. fermented milk products – all ends up in product
2. cheeses – whey removed in processing

Milk composition and quality:

- fermentation influenced by milk quality/type
- cow's milk varies with breed and season but its major components are protein, lactose, lipid, water and traces of water soluble and lipid soluble vitamins
- rest is water (high water activity)
- lactose is major carbohydrate
- major protein is casein, as colloidal suspension of calcium caseinate
- lipids are in globules of differing size in emulsion

Fermentation adversely affected by

- natural antimicrobial activity of raw milk
- agglutinins, lactoperoxidase (both heat sensitive)
- antimicrobial agents: antibiotics, disinfectants
- enzymes from psychrotrophic bacteria (Pseudomonas) – often heat stable, so persist after pasteurization
- thermoduric bacteria (Bacillus) also survive pasteurization; produce lipase and rearrange lipids globules

Yoghurt fermentation

- semi-solid mass, from coagulation of milk by starter culture bacteria
- sharp, acidic taste, smooth texture
- flavor – acetaldehyde (aroma; primary flavor - 90% of taste), lactate (tart taste), diacetyl and acetate

Batch process of yoghurt production

1. Mix ingredients, standardize (water, milk solids etc.)
2. pasteurization to:
   - kill off pathogens and reduce microorganisms that would compete with starter culture
   - destroys enzymes and immunoglobulins that may interfere with fermentation
   - improves gel formation/texture (denatures whey proteins)
   - releases nutrients favorable to starter culture bacteria
3. homogenize – break fat globules down to smaller, more consistent size → smoother/creamier product (even distribution of lipid)

4. add **starter culture** at 44-46 degrees (43 gives good acid and flavor; above or below favors growth of one or the other)
5. 6 hours incubation to pH 4.8, measure lactic acid levels
6. Rapidly cool to 29 degrees to stop further fermentation
7. Packaged and cooled to 4.4 degrees and stored 24 hours to pH 4.3