

# **Sustainability in commercial laundering processes**

Module 6  
**Special aspects**

Chapter 2

## **Microorganisms in water**

# Content

---

- Contamination of laundry waters
- Microorganisms
  - Bacteria
    - Bacterial spores
    - Cocoid bacteria – round shaped bacteria
    - Bacilli - rod shaped bacteria
    - Other forms
  - Fungi
  - Viruses
  - Protozoa
- Pathogens in water
- Terms related to microbial decontamination

# Learning targets

---

After finishing this chapter, you will

- know and be able to explain the basic information on the types of microorganisms that exist
- know the main types of microorganisms that occur in waters
- be able to explain terms related to microbial decontamination

# Contamination of laundry waters

- all laundries are great consumers of water, while especially hospital laundries have microbiologically contaminated linen and thus contaminated process water
- different types of hospital textiles come into contact with human excrements and cause contamination of the water in the laundering process
- in order to reduce water consumption in the laundering process, some of the water is reused
- this enlarges the possibility of the linen contamination after the washing process, since the bio burden of the process water is increased



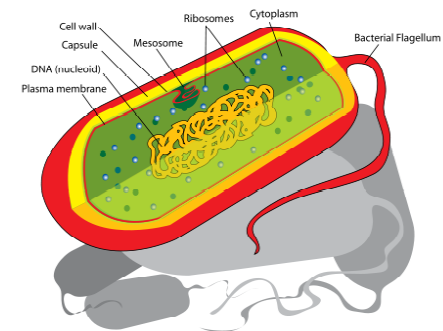
# Microorganisms

---

- the word microorganism originates from the Greek work micro and means small
- microorganisms are very small life form, they are so small that individual organisms can usually only be seen by magnification
- the major groups are: bacteria, fungi, viruses and protozoa
- microorganisms are widely distributed in nature
- all aquatic ecosystems such as: fresh water, ocean water, rainwater etc contain microorganisms

# Bacteria

- bacteria are the most abundant organism on earth and live almost everywhere: in the soil and water, in plants and animals
- only relatively few bacteria cause human disease and many benefit humans
- for example, many are important decomposers that assure the flow and recycling of nutrients through ecosystems
- others have important industrial and pharmaceutical uses
- on the other hand, pathogenic bacteria cause diseases
- Bacteria are divided according to their shape into coccoid, rod shaped and other forms

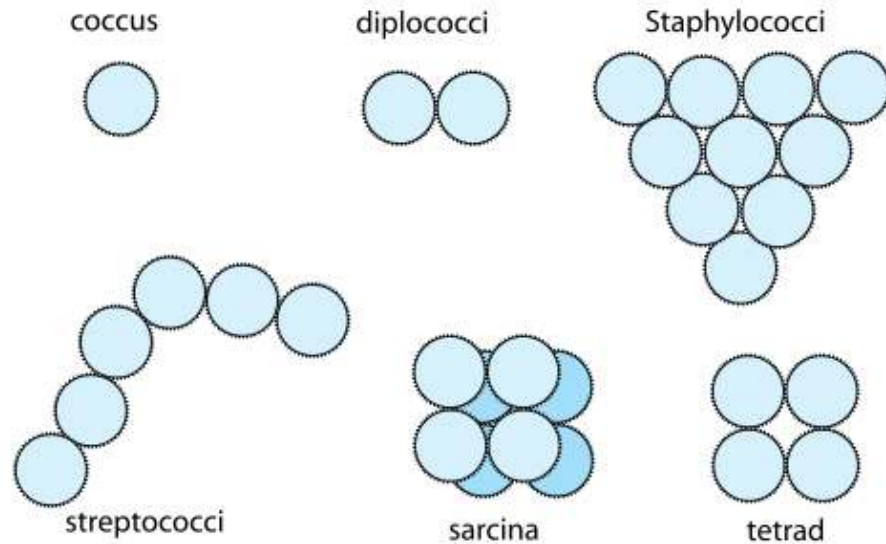


# Bacterial spores

- In a hostile environment many bacteria have the possibility to produce a vegetative form called SPORES
- The production of spores allow survival of the organism under severe nutrient deprivation and dehydration conditions
- Spores are even resistant to the actions of common antimicrobial agents and treatments
- The spore has a hard protective coating that enables the dormant bacterium to survive for weeks, even years, through drought, heat and even radiation
- When conditions become more favourable again the bacteria transform from a spore back to a cell

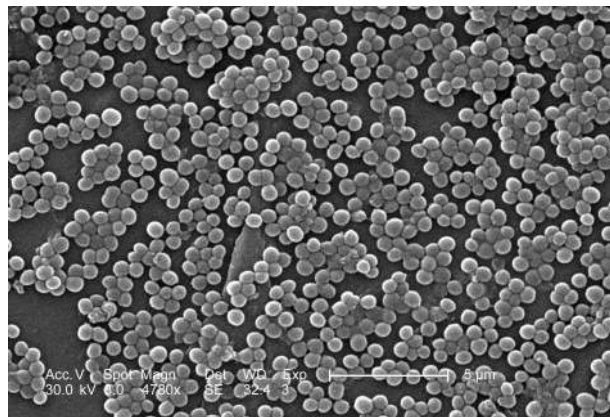


# Coccioid bacteria – round shaped bacteria



Some examples are:

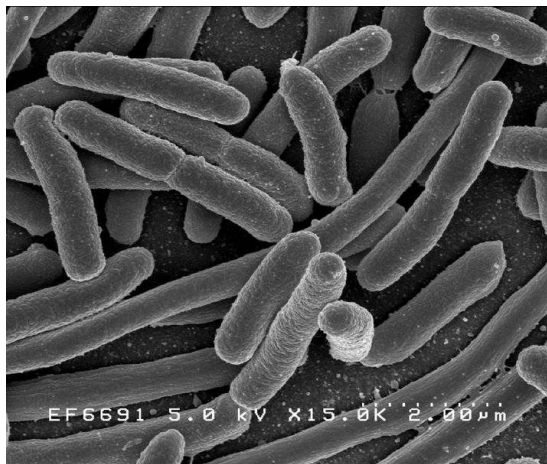
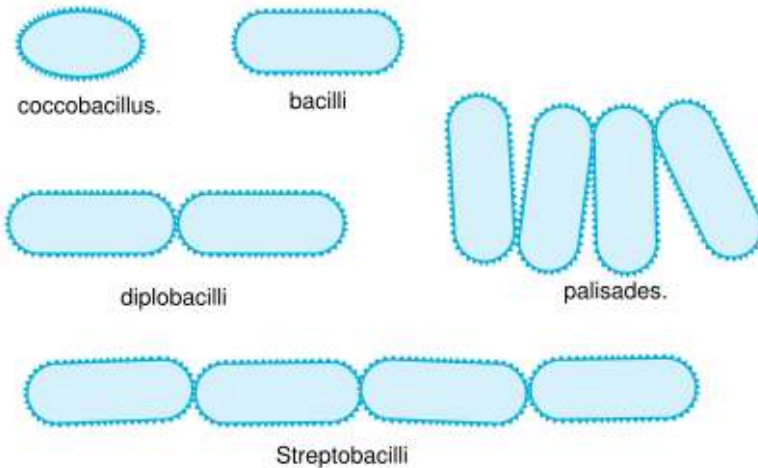
- *Escherichia coli*: coliform enterobacteria, causes food poisoning
- *Staphylococcus aureus*: leading cause of tissue infection (MRSA)
- *Enterococcus faecium* (pair): intestine bacteria, resistant to many antibiotics (VRE)
- *Streptococcus pneumoniae*: causes pneumonia, meningitis, otitis media etc
- *Micrococcus spp.* (tetrads): common skin contaminant, relatively harmless to humans



*Staphylococcus aureus*

Image credit: CDC/ Matthew J. Arduino, DRPH;  
Janice Carr (PHIL #6486)

# Bacilli - rod shaped bacteria



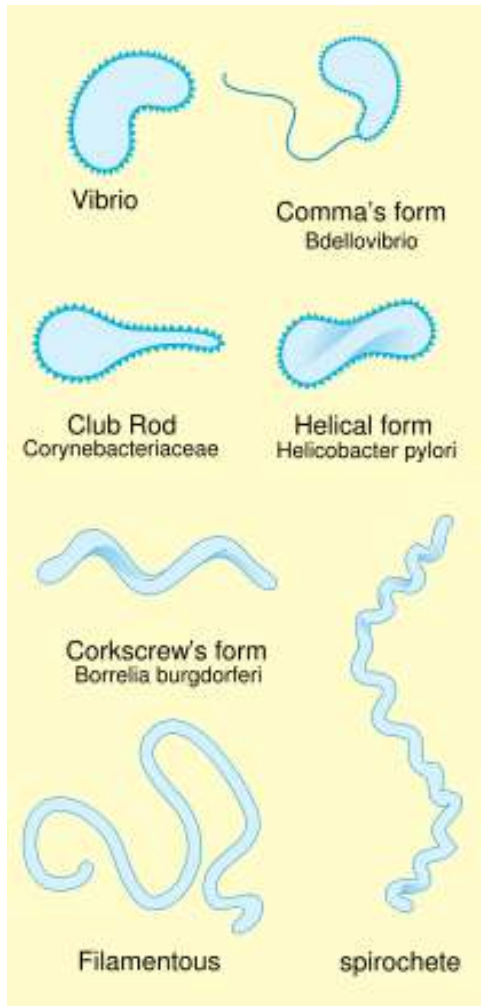
Some examples are:

- *Escherichia coli*: coliform bacteria, causes food poisoning
- *Pseudomonas aeruginosa*: often found in waters, resistant to antibiotics, often causes nosocomial infections
- *Mycobacterium tuberculosis*: causes TBC
- *Bacillus cereus*: causes dangerous infections in newborn infants
- *Lactobacillus acidophilus*: is considered a probiotic or "friendly" bacteria
- *Legionella pneumophila*: causes type of pneumonia, often from installations such as cooling towers or showers

*Escherichia coli*

Image credit: Rocky Mountain Laboratories, NIAID, NIH

# Other forms of bacteria



Some examples are:

- *Vibrio cholera* (vibrio): human pathogens that causes cholera (severe diarrhea)
- *Helicobacter pylori*: (vibrio): leading cause of peptic ulcers
- *Leptospira interrogans*: (spirochete): causes leptospirosis, an infectious disease that affects the liver and kidneys in humans and some animals
- *Borrelia burgdorferi* (spirillum): causes boreliosis.



*Borrelia burgdorferi*

Image credit: CDC (PHIL #6631), 1993

# Fungi

- Fungi are divided into yeasts and moulds
- Fungi are used by industry to produce a variety of useful products. They also cause spoilage of fruits, vegetables etc.
- YEASTS: are typical unicellular fungi, such as
  - *Saccharomyces cerevisiae* (for baking and brewing beer)
  - *Candida albicans*: common pathogen, causes vaginal infections
- Moulds: are described as filament-like, such as:
  - *Penicillium roqueforti* , used in cheese manufacture
  - *Penicillium notatum* , first antibiotic

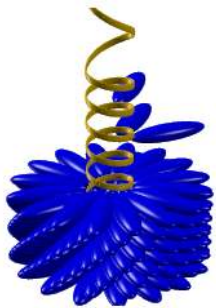


*Aspergillus fumigatus*

Image credit: CDC/Dr.  
Libero Ajello (PHIL #4297),  
1963

# Viruses

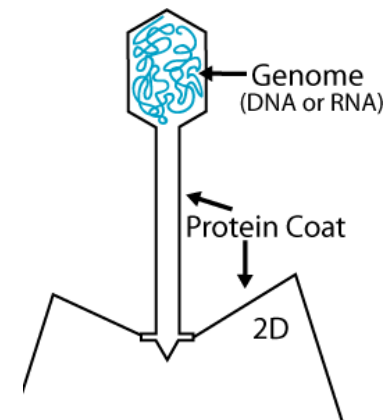
- Viruses are sub-microscopic small infectious agents that can infect animals, plants, and other microorganisms
- They can live only in living host cells where they replicate
- They possess DNA or RNA but never both
- 3 main shapes are: helical, icosahedral and complex
- Examples of viruses are: rotavirus, herpes simplex virus, hepatitis A virus, HIV



Tobacco mosaic virus  
(helical structure)



Rotavirus  
(icosahedral structure)



Structure of complex virus

# Protozoa

- protozoa are single-celled organisms that are ubiquitous in aqueous environments and the soil
- they are divided into four groups on the basis of their means of locomotion: flagellates, amoeboids, sporozoans and ciliates
- protozoans play an important role as herbivores and as consumers in the decomposer link of the food chain by controlling the bacteria population and biomass
- some protozoans can produce a cyst under certain adverse conditions
- some examples are: malaria parasites, trypanosomes, *Giardia lamblia*, *Cryptosporidium*



*Giardia lamblia*  
Content Provider(s):  
CDC/ Janice Carr

# Pathogens in water

---

- human pathogens in water supplies usually come from contamination of waters with faecal material;
- *Escherichia coli* is a typical indicator of faecal contamination of waters
- Other indicators of water contamination are: non specific coliforms and *Pseudomonas aeruginosa*
- Data from the early 90's (Wikipedia) indicate that the following waterborne diseases have been reported as follows:
  - caused by protozoa: amebiasis, cryptosporidiosis, giardiasis
  - caused by bacteria: cholera, botulism, typhoid, dysentery, legionellosis, leptospirosis
  - caused by viruses: hepatitis A, polio, rotaviruses, small round structured viruses, enteric viruses



- **STERILISATION**

is absolute, there are no degrees of sterilisation. Typical conditions are: moist heat: 121°C, 15 min, 2 bars or dry heat 170°C for 120 min

- **DISINFECTION**

is the destruction or removal of infective agents by chemical or physical means. A disinfectant is an agent (usually chemical) that kills the growing forms, but not necessarily resistant spores of disease-producing organisms. Disinfectants tend to reduce or inhibit growth, they usually not sterilize

- **DECONTAMINATION**

is the process of cleansing to remove contamination (pollution), or the possibility of contamination

- **PASTEURIZATION**

is a form of disinfection used for material, which may be altered or damaged by excessive heat (i.e. milk). Low heat is applied once or repeatedly to sensitive liquids to reduce the number of viable organisms

- **GERMICIDE**

(cide means kill) is a chemical agent that rapidly kills microbes, but not necessarily their spores. Bactericide kills bacteria, virucide kills viruses, fungicide kills fungi etc. sporicide kills bacterial spores

- **SANITIZATION**

the reduction of pathogens to safe public health levels by mechanical cleaning or by chemicals