

Module 2: Microbiology

Contents:

Basic microbiology terminology and microbiology specific to laundries and textile services to ensure a correct implementation of EN 14065 (RABC-System) with regard to hygiene.

What are microorganisms?

- **Microorganisms are** microscopically small creatures (plants or animals), which cannot be seen with the naked eye.
- They are only visible for the eye when they appear in large amounts as a colony (culture). Otherwise they are only to be observed with the help of an enlarging instrument as for instance a microscope
- Most microorganisms are unicellular.
- Examples: bacteria, many fungi such as yeasts and algae.
- Viruses excluded! – they cannot increase their number by themselves
- **!!!Not all microorganisms are human pathogenic (able to make humans ill) –e.g. bacteria in yoghurts!!!**

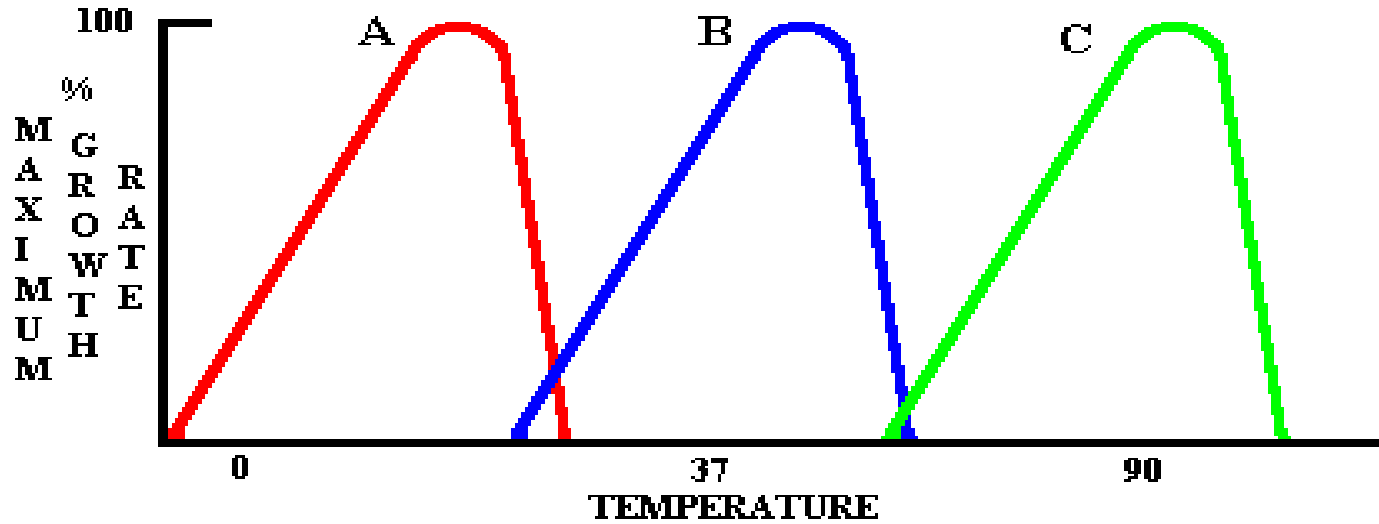
The life of microorganisms

- Each life-form needs:
 - an **energy source** (light, inorganic substances such as sulphur, carbon monoxide or ammoniac as well as organic matters as sugar, proteins or fat)
 - a **nitrogen-source** (nitrogen-gas, ammoniac, nitrate/nitrite) or organic nitrogen components as protein or nucleic acid
 - a **carbon-source** (carbon dioxide or –monoxide, methane or complex organic matters)
 - an **oxygen-source** (all cells use oxygen in a bounded way, lots of them need oxygen in the form of gas (air), but for many microbes oxygen is fatal)
 - a **phosphor- sulphur- magnesium- potassium- and sodium-source**
 - a **calcium-source** (mostly highly concentrated but some microbes only need traces!)
 - **water**
 - **trace elements** (necessary for many enzymes)

This means for a laundry or textile service enterprise:

- Without nourishment the number of microorganisms cannot be increased
- Microorganisms appear in large amounts when dirt and humidity offer a nutrient source.
- After carrying out a successful cleaning and disinfection, a surface remains poor in germs for a longer time;
as soon as dirt gets to the surface again the basis for re-growth is given
- Keep the environment clean!

living conditions I

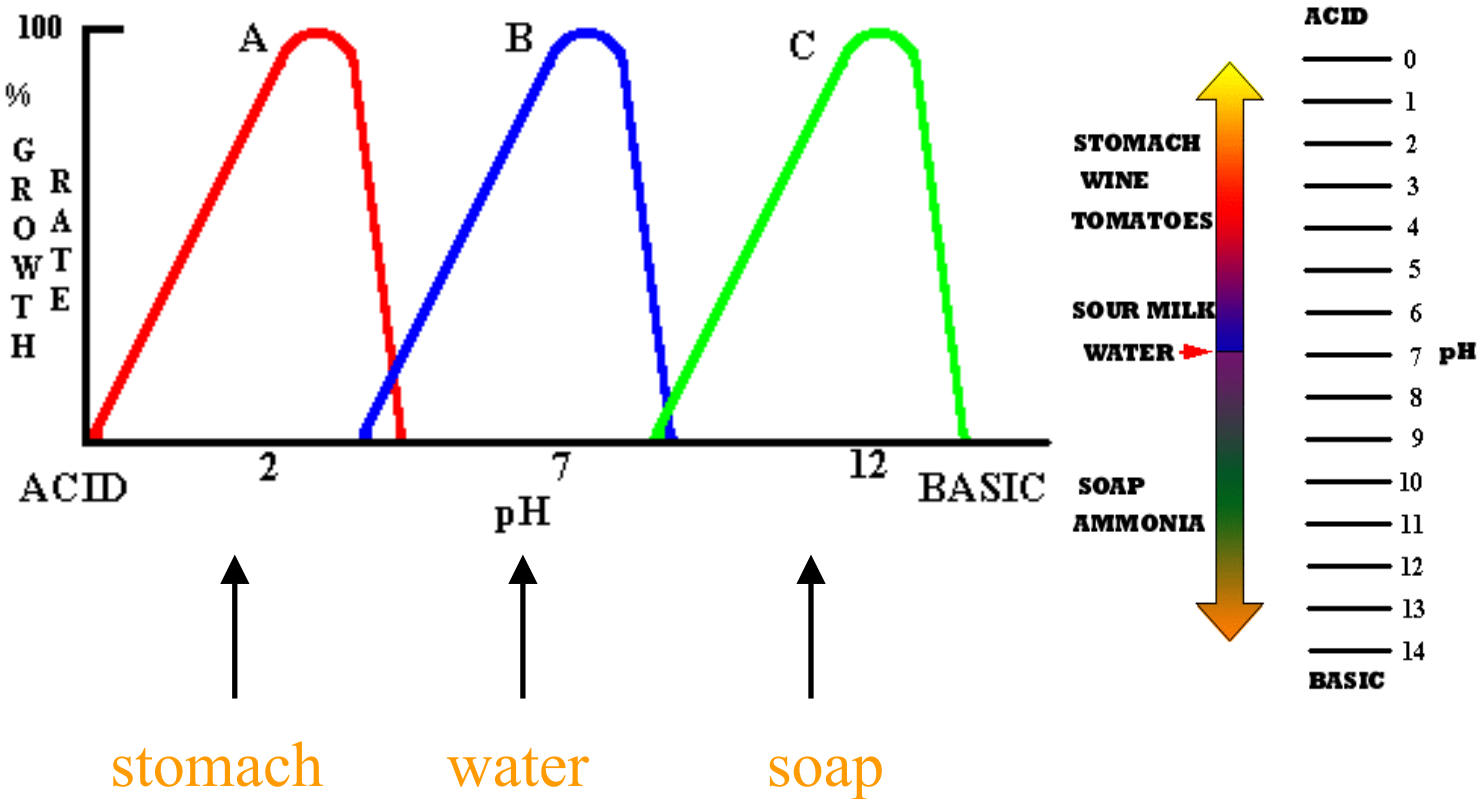


↑
Cold
e.g. refrigerator

↑
„normal“-
area



living conditions II

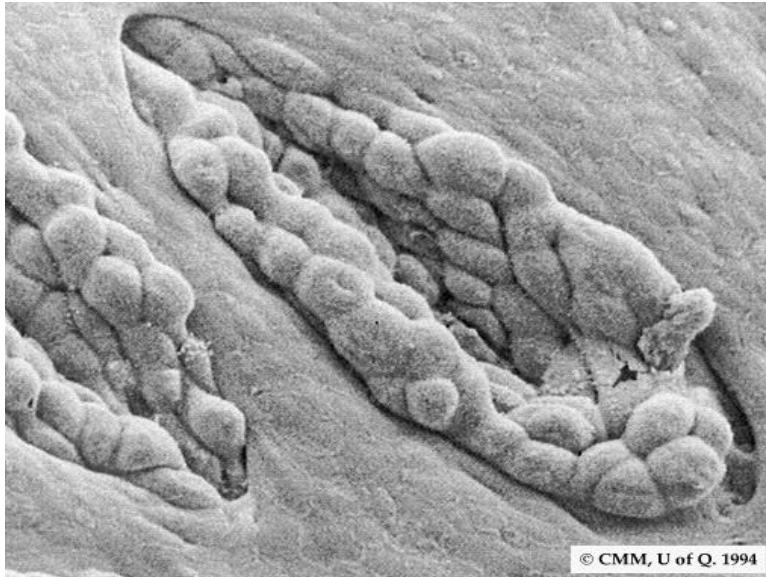


(the Archaeobakterium *Picrophilus torridus* will grow by pH 0,7)!!!

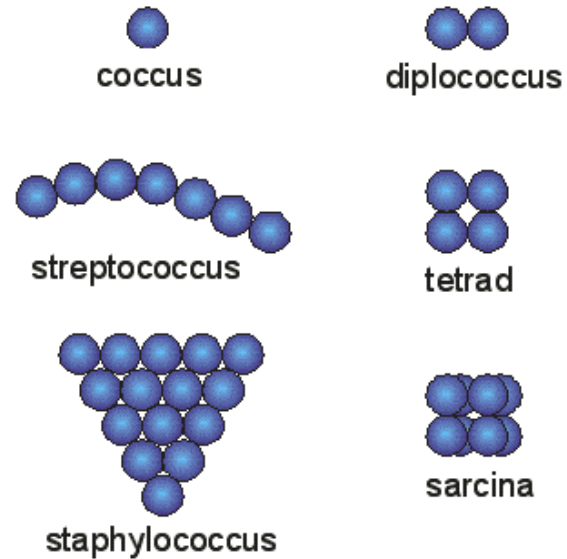
This means for a laundry or textile service enterprise:

- Even under extreme conditions and enormous pH-value-fluctuation some microorganisms can survive.
- For the validation of disinfecting washing procedures extreme heat- and disinfection-resistant germs are used to exclude that other (less resistant) germs can survive.
- Test-germs in Germany and most other countries: *Staphylococcus aureus* and *Enterococcus faecium*.

Cocoid bacteria:



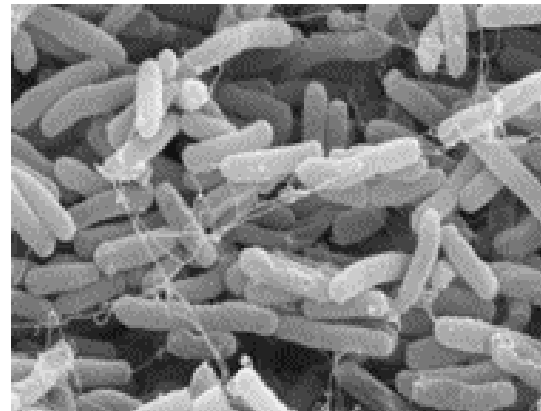
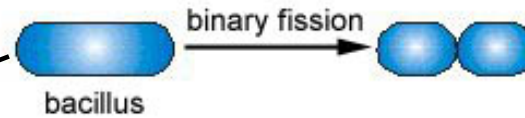
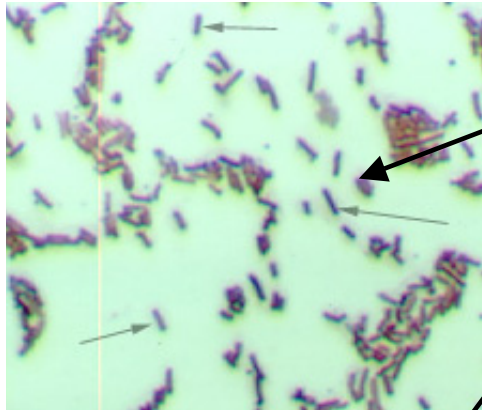
Staphylococcus infected intestine
Magnification x1000



coccus $\hat{=}$ round (globular bacteria)

Coccus ranks among the most resistant bacterium within a laundry!

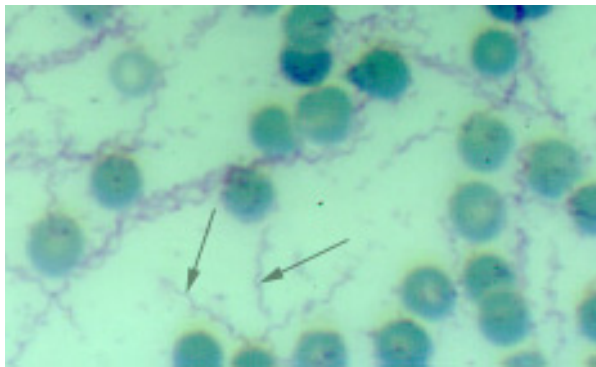
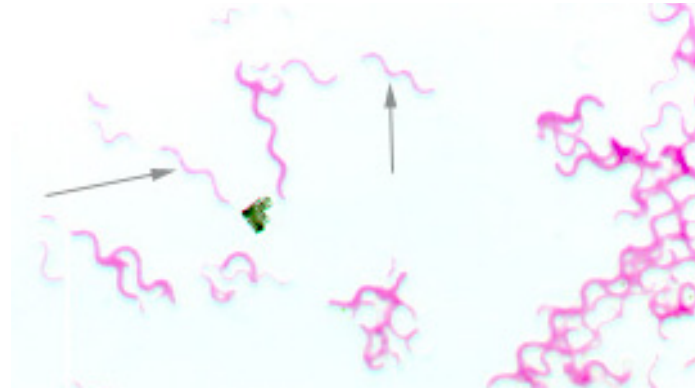
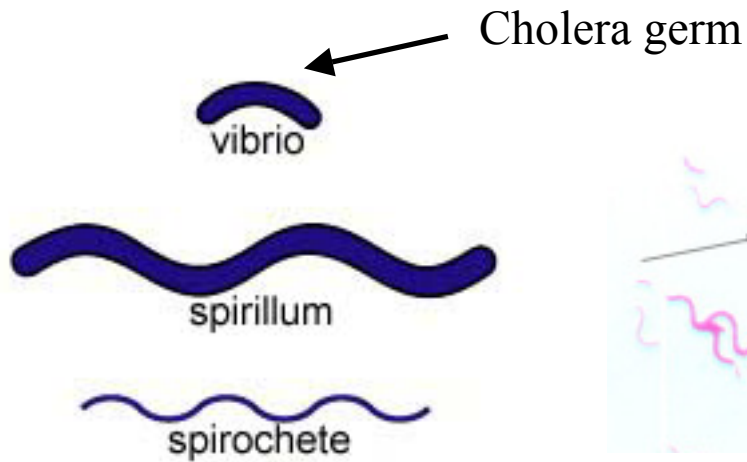
rod shaped bacteria:



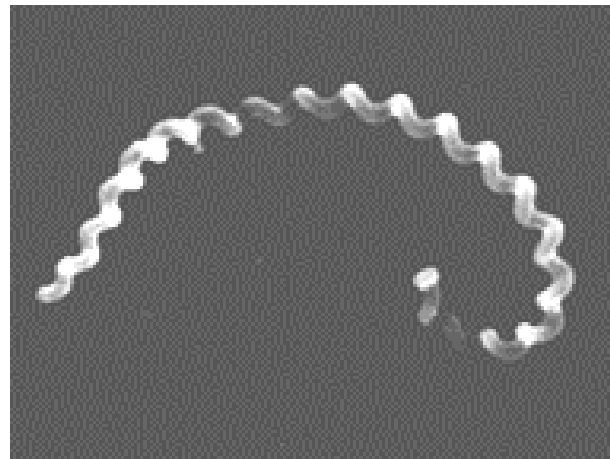
Escherichia coli

The detection of coliform bacteria resp. *E. coli* points out to faecal contamination!

helical bacteria:



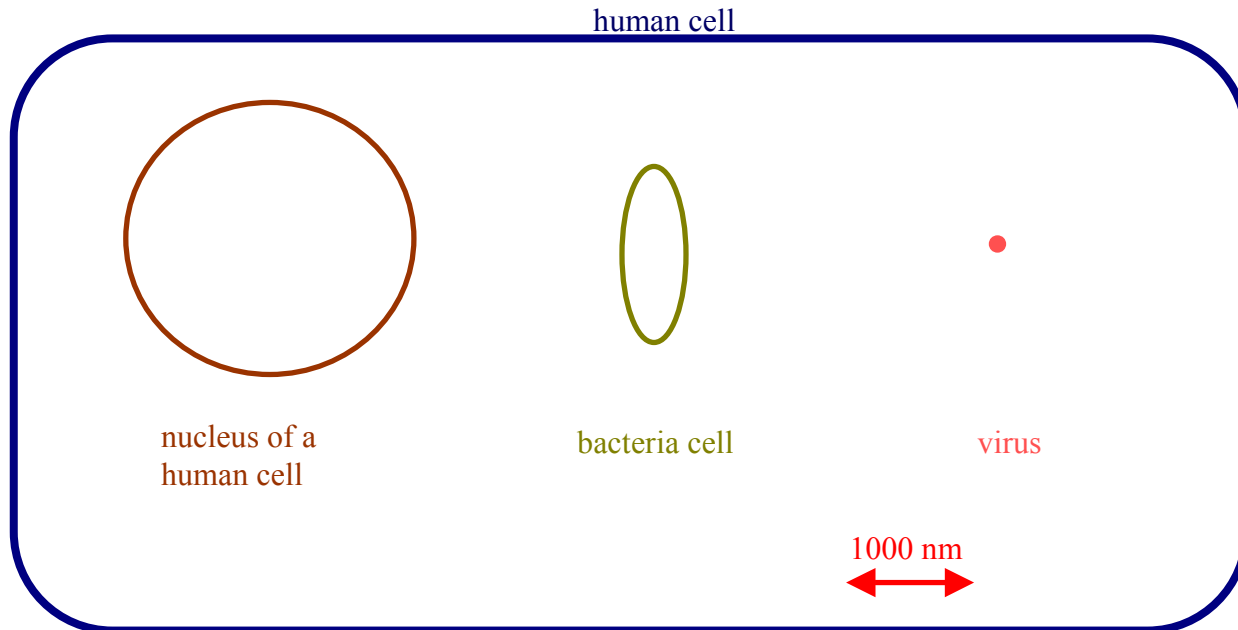
Borrelia



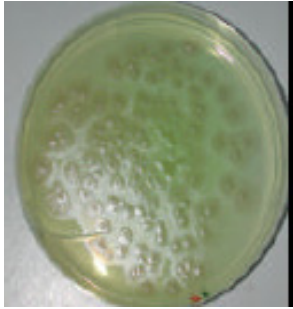
Leptospira interrogans

Sizes

- **proportion**



example spectrum of germs in laundries



Pseudomonas aeruginosa



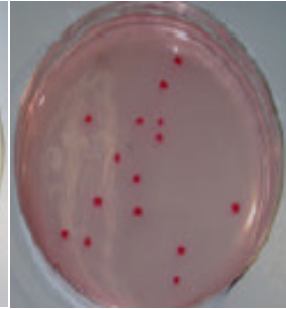
Bacillus subtilis



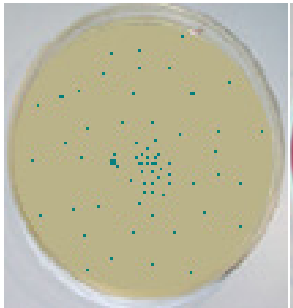
Candida albicans



Staphylococcus aureus



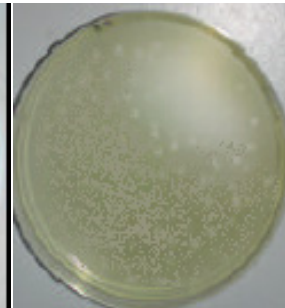
Salmonella spp.



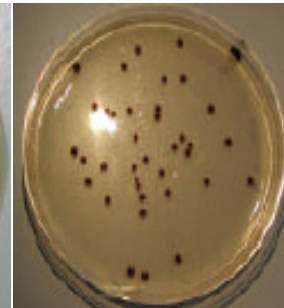
Listeria spp.



Escherichia coli



Aspergillus niger



Enterococcus faecium



Staphylococcus epidermidis

inclusive soiled laundry-area!!!

Sick by germs? Do I have to worry?

- **Fortunately** a multitude of germs or toxins have to be taken to cause a sickening effect!!!
- **Danger:** little amounts of germs are enough to start a reproduction in the food-product at the customers
- **If you let an *E. coli* bacterium grow for 48 hours with unlimited food and space, the mass would weigh 4000 times as much as the globe !!!**

Foodstuff sector

- Certain bacteria cause illness by spoiling food more often than others.
- **The grocer for instance should be able to ensure, that his delivered goods are free of :**
 - Staphylococcus aureus,*
 - Salmonella spp.,*
 - Listeria monocytogenes* and
 - Campylobacter spp.*
- When carrying out microbiological hygiene investigations it is recommended to also check the absence of these bacteria

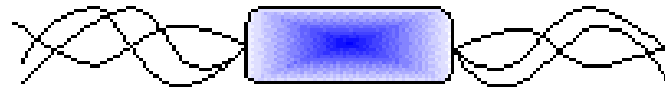
Locomotion by flagella



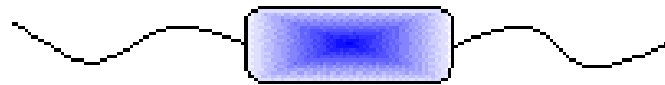
locomotion



monotric



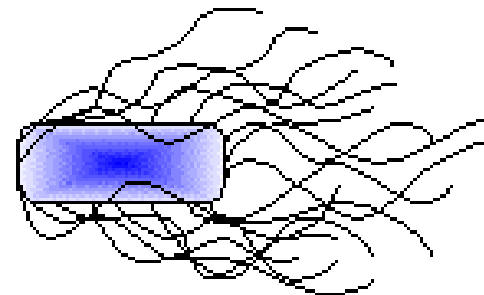
lophotric



amphitric

Salmonella spp.

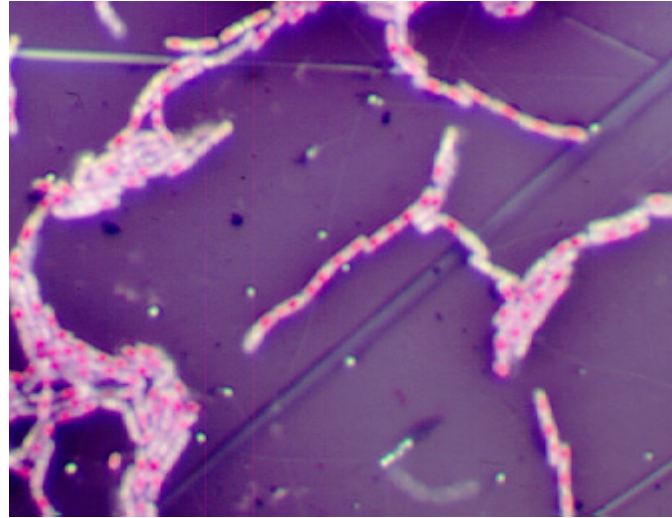
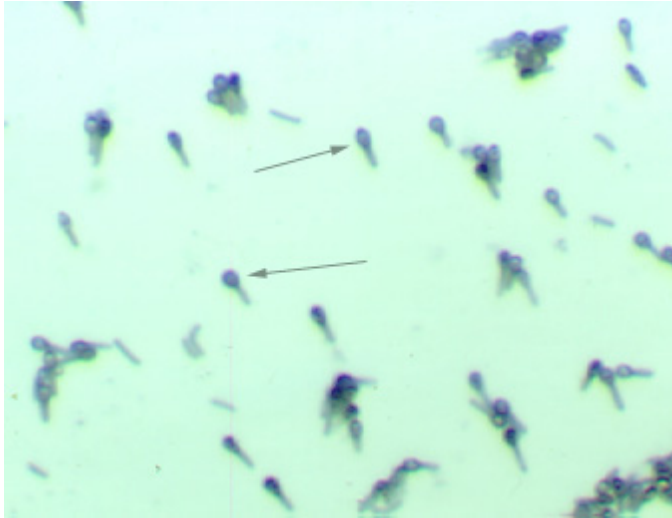
peritric



Microorganisms are very fast!

Compared to his length a human should have to run as fast as a sports car (ca. 200 km/h or 124 mi/h).

Endospores I

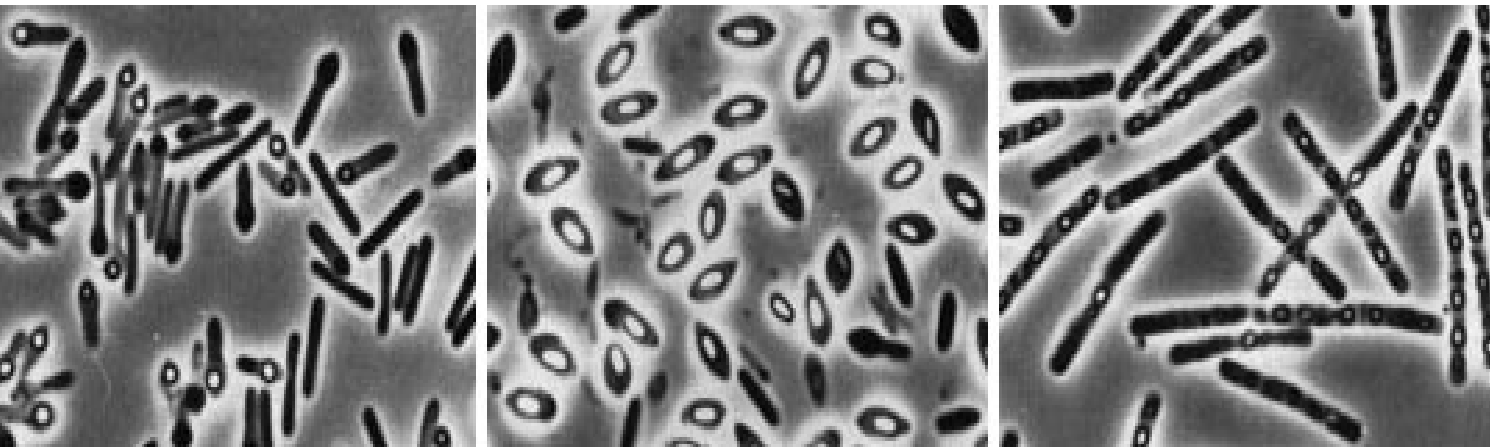


Endospores are resting life-forms, which can only be produced by *Bacillus* (Anthrax-germ), *Clostridium* (Tetanus-germ) and a few others.

Endospores are extremely heat-resistant and cannot be destroyed by conventional (disinfecting) washing procedures!!

Endospores II

Endospores -forming Bacilli (phase contrast photo)



terminal

central

sub terminal

Module 2, Microbiology

Temperatures of more than 100 °C or several decades of drought cannot touch those permanent forms of life!!!

Bacteria-Toxins

- toxins which cause the disintegration of cells

LIPASES

(*C. perfringens* α -Toxin)

PORES-BUILDING TOXINS

(*S. aureus* α -Toxin, Streptolysin O)

- protein synthesis-inhibiting toxins (diphtheria toxin)
- pharmacological active toxins (cholera toxin)
- neurotoxins (tetanospasmin, *C. botulinum* toxin – BOTOX)
- endotoxins (LipoPolySaccharide)

Besides: Viruses

Definition: viruses are sub-microscopic small nucleic acid-protein-complexes, with a distinctive particle structure, which are augmented/accommodated in living cells.

- viruses are inactivated resp. killed by chemo-thermal washing procedures of **sphere A and B**.
- sphere A and B are achieved by applying a method which is listed at the Robert-Koch-Institute (in case of doubt, please ask your detergent supplier).
- sphere A and B especially are especially suited for hospital textiles (infectious laundry).

Fungi as cause of disease

- **toxin (poison) producers (e.g. Amanitin, Ergotamin, Aflatoxins acute toxicity + carcinogenic characteristics)**
- **allergenic**
 - a) **by aerogen-spread spores (pollinosis, farmer-lung)**
 - b) **by antigen diffusion (e.g. mycosis)**
- **deterioration of foodstuffs**
moulds are often responsible for spoiled food.

Yeast: *Candida albicans*

- Cause of 80 – 90 % of all fungus infections
- *C. albicans* responsible for 60 – 80 % of all *Candida*-Infections; *C. glabrata* for 15 – 30 % of adults- *C. parapsilosis* f. 20 – 30 % of newborns
- Optimum growth temperature (25°C -) 37°C, visible growth in 1 - 2 days
- Drying resistant! Are often found in laundries on dry linen
- Transmitted by personnel (pay attention to hand hygiene resp. disinfection!)

End of Module 2. (Microbiology)

*„Though I know a lot, I want to know
everything.“*

J. W. v. Goethe (1748 – 1832)

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Further on with module 3!