

**Institute for Microbiology, Medical Faculty of Masaryk University
and St. Anna Faculty Hospital in Brno**

Agents of digestive system infections – II

Bacterial agents of diarrhea and dysentery – I

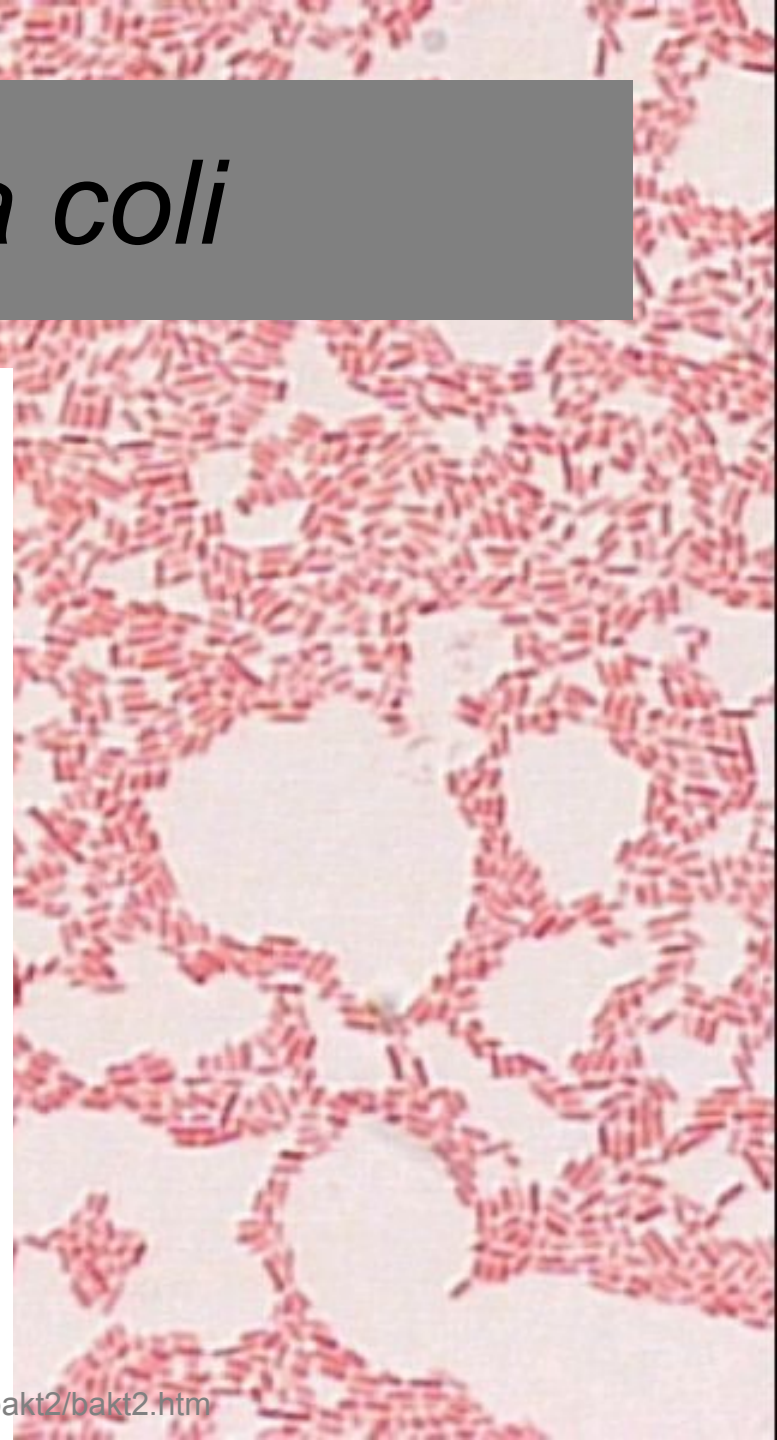
Escherichia coli

Most *E. coli* strains are component (approx. 1 %) of normal intestinal flora

- important
- essential
- beneficial
- non-pathogenic in the intestine

Only some *E. coli* strains are pathogenic even in the intestine

Escherichia coli



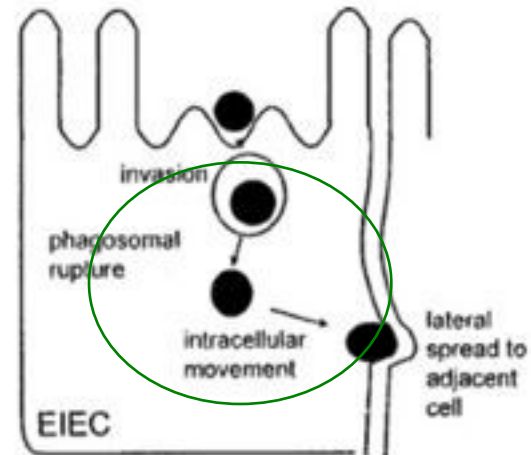
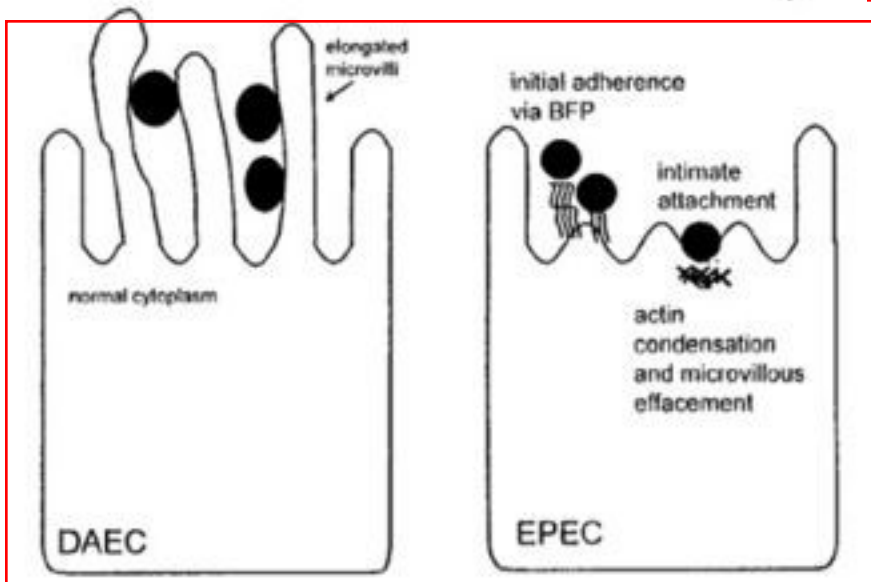
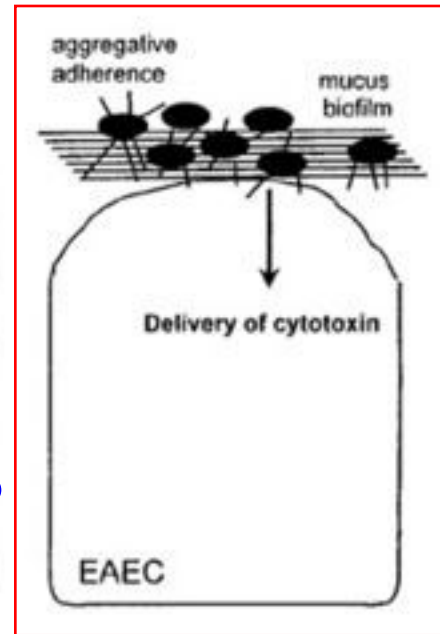
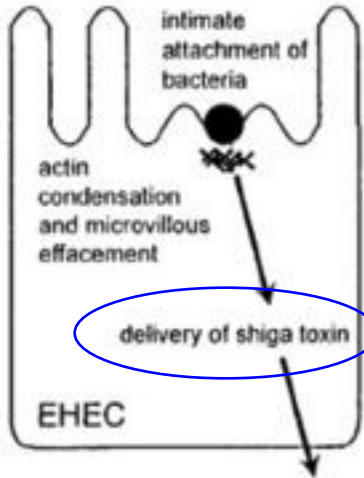
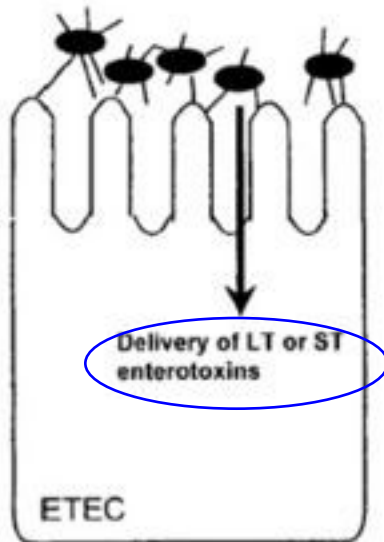
Bacterial agents of diarrhea and dysentery – II

Escherichia coli strains causing diarrheal disease:

- **ETEC** (enterotoxigenic *E. coli*): children in developing countries, traveller's diarrhea; 2 enterotoxins (heat-labile and heat-stable)
- **EPEC** (enteropathogenic *E. coli*): O55, O111; small infants; disruption of microvillus structure
- **EIEC** (enteroinvasive *E. coli*): similar to *Shigella*; invasion of colonic cells
- **EHEC** (enterohaemorrhagic *E. coli*): O157:H7; 2 cytotoxic Shigatoxins, destruction of microvilli; hemorrhagic colitis & hemolytic-uremic syndrome

E. coli types

<http://microbewiki.kenyon.edu/index.php/Escherichia>



Bacterial agents of diarrhea and dysentery – III

Salmonella

Taxonomical remarks:

There are **>4.000 salmonella** serotypes

Official names of them are **inconvenient**:

- The most frequent salmonella:

Salmonella enterica subspecies *enterica* serotype *enteritidis*

- The most important salmonella:

Salmonella enterica subspecies *enterica* serotype *typhi*

Instead of them we can use more useful names:

- **Salmonella Enteritidis**
- **Salmonella Typhi**

Salmonella - MAL agar

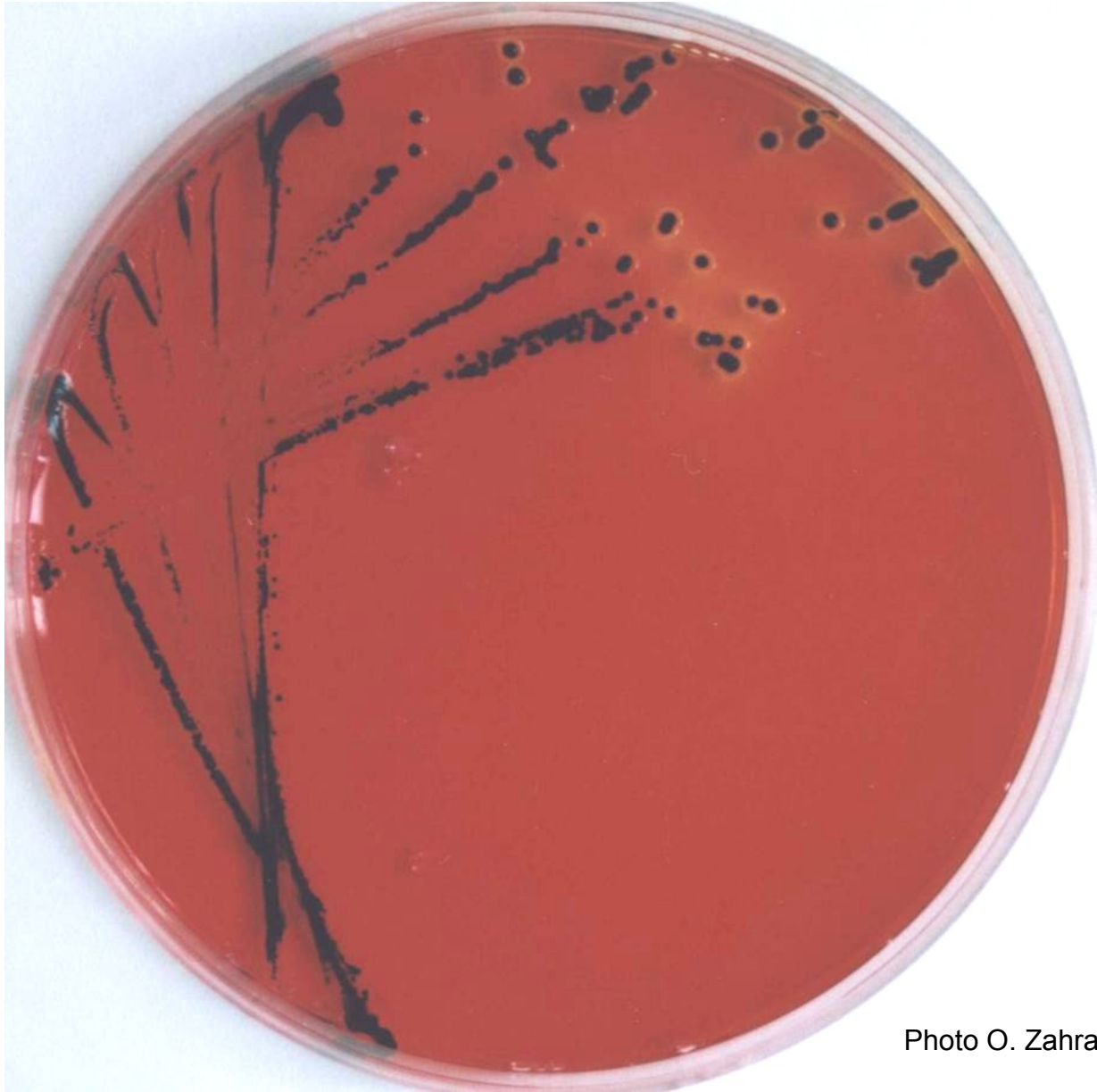


Photo O. Zahradníček.

Bacterial agents of diarrhea and dysentery – IV

Two types of salmonella infections:

- 1) **Systemic** infections (enteric fever): S. Typhi, S. Paratyphi A – C
- 2) **Gastroenteritis** (salmonellosis): remaining >4.000 serotypes

Pathogenesis of both starts with the invasion of intestinal epithelia

- In 1) invasion continues and **infection becomes generalized** → little or no diarrhea, but pronounced **fever** & other general symptoms
- In 2) **infection is localized** to ileocaecal region → **diarrhea**, nausea & vomiting, abdominal pain, temperature may be elevated

Bacterial agents of diarrhea and dysentery – V

Diagnosis & treatment of salmonella infections:

1) Enteric fever (reservoir: human beings only):

Detection of salmonellae in **blood, urine and stool** (on special media), later detection of antibodies (**Widal** reaction), in suspected carriers examination of duodenal fluid

Treatment: **antibiotics** (chloramphenicol, fluoroquinolones, ampicillin, cotrimoxazol)

2) Gastroenteritis (reservoir: poultry & animals):

Examination of **stool only**

Treatment: symptomatic only, **no antibiotics**

Bacterial agents of diarrhea and dysentery – VI

Campylobacter jejuni

As common as salmonella (or even more); invades jejunal epithelium ; reservoir: poultry

Cultured on a special medium, in an atmosphere of reduced oxygen, at 42 C

Shigella sonnei, S.flexneri, S.boydii, S.dysenteriae

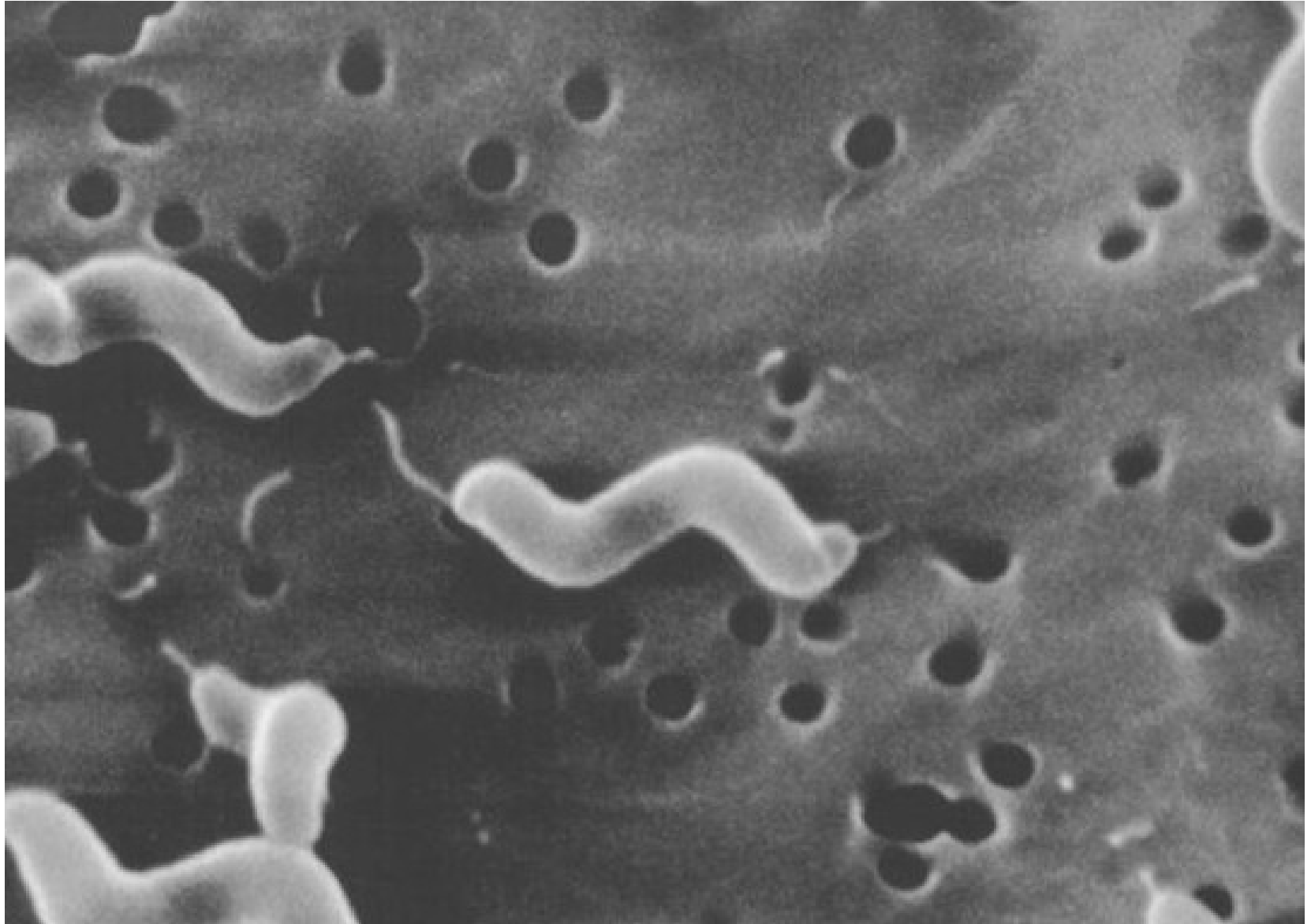
Very low infectious dose → epidemic outbreaks

Transmitted only among human beings

Invasion of cells of colon and rectum

The disease is called **bacterial dysentery**

Campylobacter jejuni



Bacterial agents of diarrhea and dysentery – VII

Yersinia enterocolitica

gastroenteritis, in children also mesenterial lymphadenitis (mimicking acute appendicitis)

vector: contaminated food

multiplies in refrigerator even at 4 °C

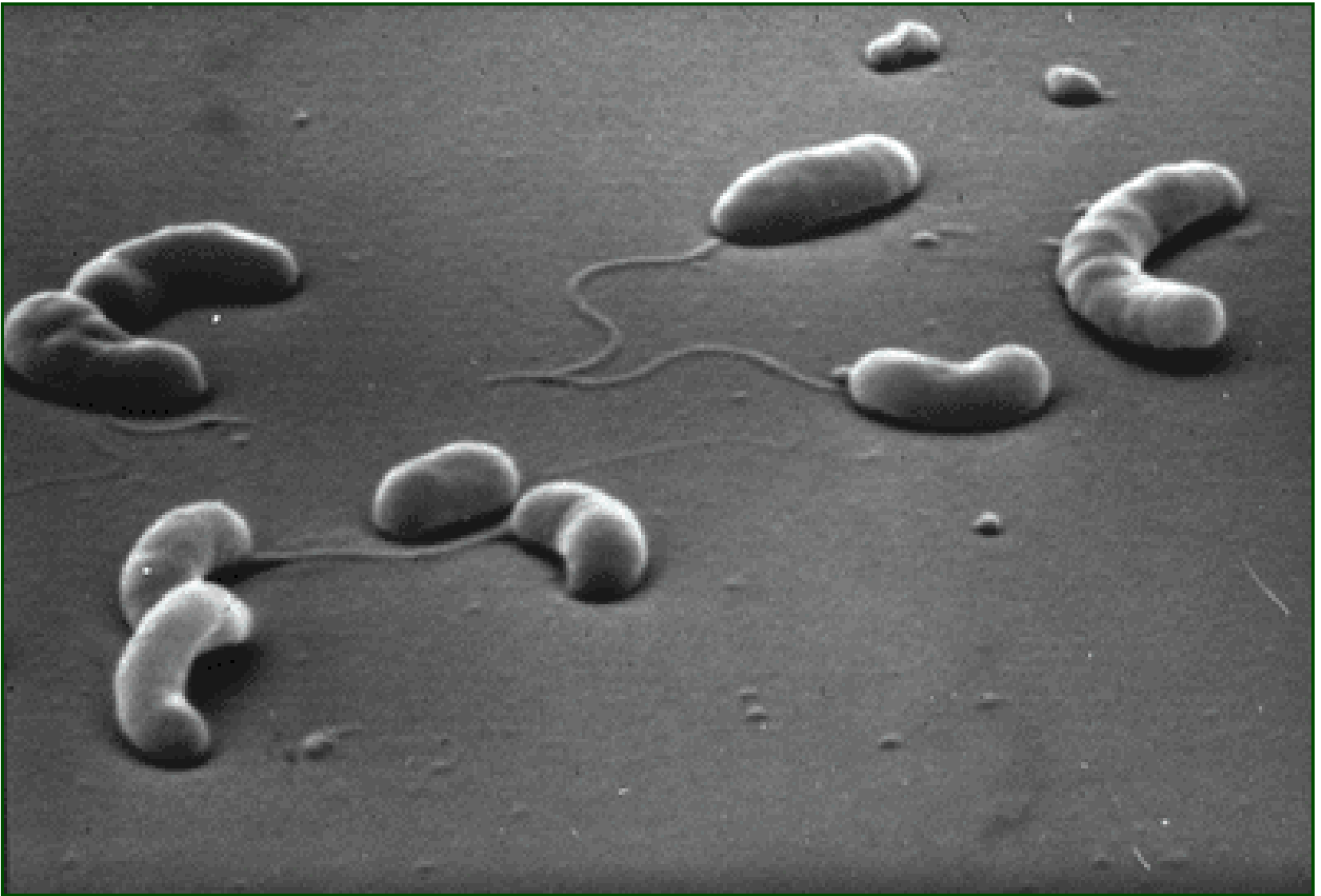
Vibrio cholerae

Cholera toxin activates adenylate cyclase → hypersecretion of water & electrolytes → death by dehydration and electrolyte abnormalities

V. cholerae flourishes in water & causes epidemics

Vibrio parahaemolyticus: from raw fish & shell-fish

Vibrio cholerae



Diarrhea during antibiotic therapy

Common after **tetracyclines**; from excessively multiplied *Staphylococcus aureus*, *Pseudomonas aeruginosa* or ***Candida albicans*** (the only example of diarrhea of mycotic origin)

After **lincomycin or clindamycin** (but even after other ATB) → dangerous **pseudomembranous colitis** caused by ***Clostridium difficile***

Patients contaminate the hospital environment with resistant spores

Colitis can be treated by metronidazol

Direct proof of the **toxin A** as an antigen is **essential** because *C. difficile* can be found in healthy people



Proof of the toxin A in *C. difficile*. Photo: MÚ archive

Viral agents of diarrhea

Generally: small, acid- and bile-resistant non-enveloped viruses

Rotaviruses (*Reoviridae* family)

serious diarrhea of young children, epidemics in winter

Noroviruses and **sapoviruses** (formerly agents Norwalk and Sapporo, *Caliciviridae* family)

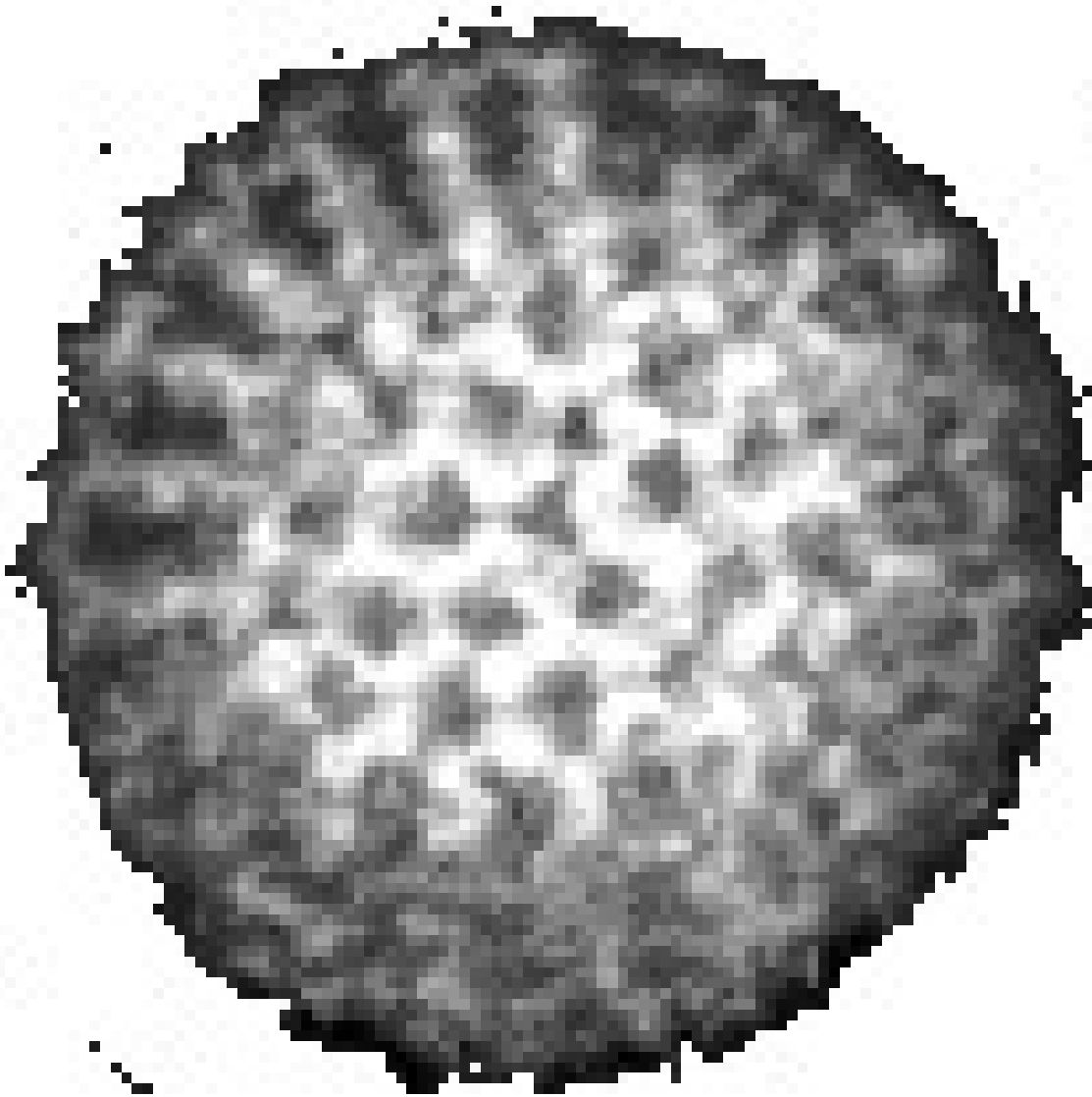
epidemics in children and adults, too

Astroviruses (star-shaped virions)

Adenoviruses type 40 and 41

Small, round gastroenteritis viruses

Rotavirus



http://web.uct.ac.za/depts/mmi/s_tannard/emimages.html

Parasitic agents of diarrhea

In previously healthy individuals:

Entamoeba histolytica: amoebic dysentery

Giardia lamblia: giardiasis

Cryptosporidium parvum: cryptosporidiosis

Cyclospora cayetanensis

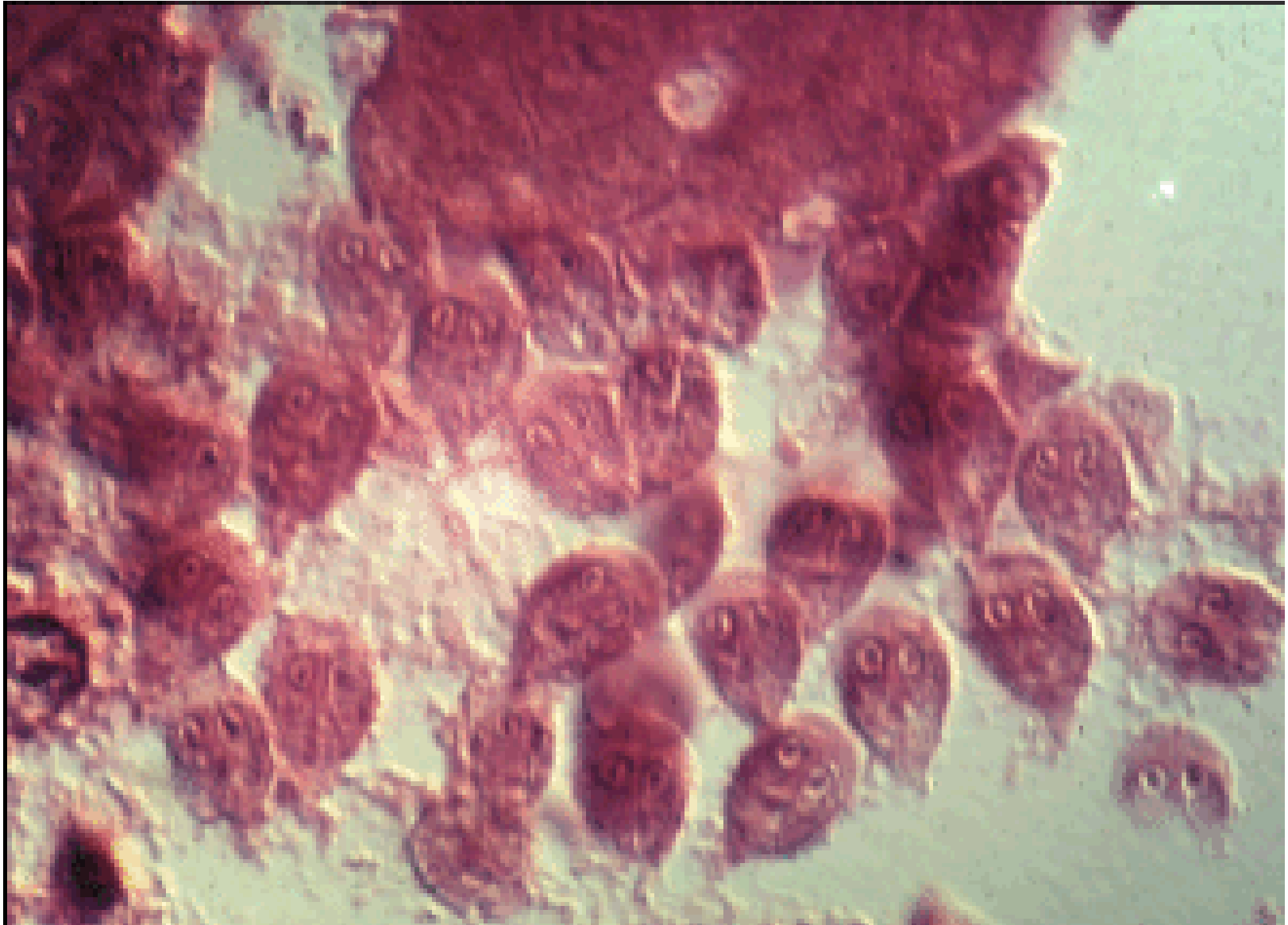
In AIDS also:

Isospora belli (coccidium)

Enterocytozoon bieneusi (microsporidium)

Strongyloides stercoralis hyperinfection
(helminth)

Lambli



Other intestinal parasites (helminths)

Small intestine:

Ascaris lumbricoides (human roundworm)

Ancylostoma duodenale (Old World hookworm)

Necator americanus (New World hookworm)

Strongyloides stercoralis (threadworm)

Fasciolopsis buski (giant intestinal fluke)

Taenia saginata (beef tapeworm)

Taenia solium (pork tapeworm)

Hymenolepis nana (dwarf tapeworm)

Diphyllobothrium latum (fish tapeworm)

Large intestine:

Enterobius vermicularis (pinworm)

Trichuris trichiura (whipworm)

Ascaris lumbricoides egg

Egg



Fertile egg (wet mount 400X)

Food poisoning

1. Intoxication due to a toxin preformed in the food

Staphylococcus aureus: heat-stable enterotoxin

Clostridium perfringens: heat-labile enterotoxin

Bacillus cereus: heat-stable enterotoxin and vomiting toxin (mostly in rice)

Clostridium botulinum: heat-labile neurotoxin

2. Intoxication due to invasive microorganisms

Salmonella gastroenteritis

ETEC and EHEC

Listeria monocytogenes

Thank you



Q1: Alpha-hemolysis

- Murray:

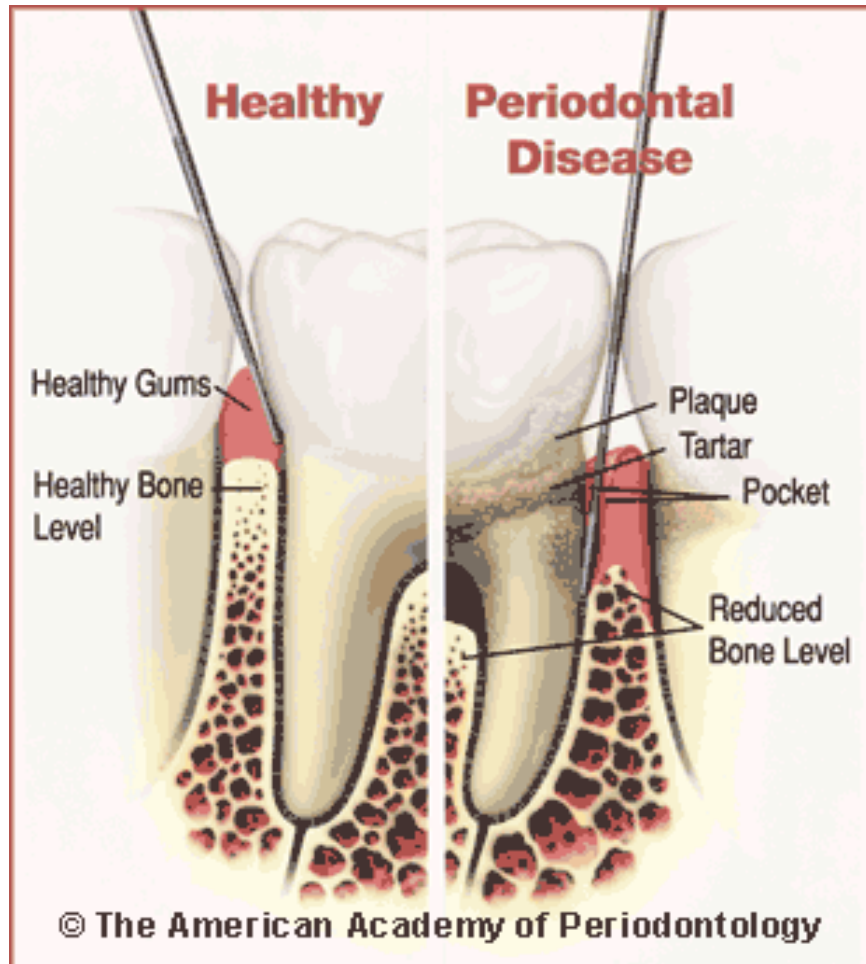
Alpha-hemolysis = viridation = incomplete hemolysis

Hemoglobin converted to verdoglobin

- Votava:

Incomplete hemolysis = a type of beta hemolysis

Q2: Anaerobes



Colonizing bacteria – a key factor in development of parodontal diseases, **anaerobic environment**

Homework 1 – solution

Harmenszoon Rembrandt van Rijn (1606-1669)

Anatomy Lecture of Doctor Tulp (1632)



Homework 2

Who is the author of this drawing and what is its name?

