

**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

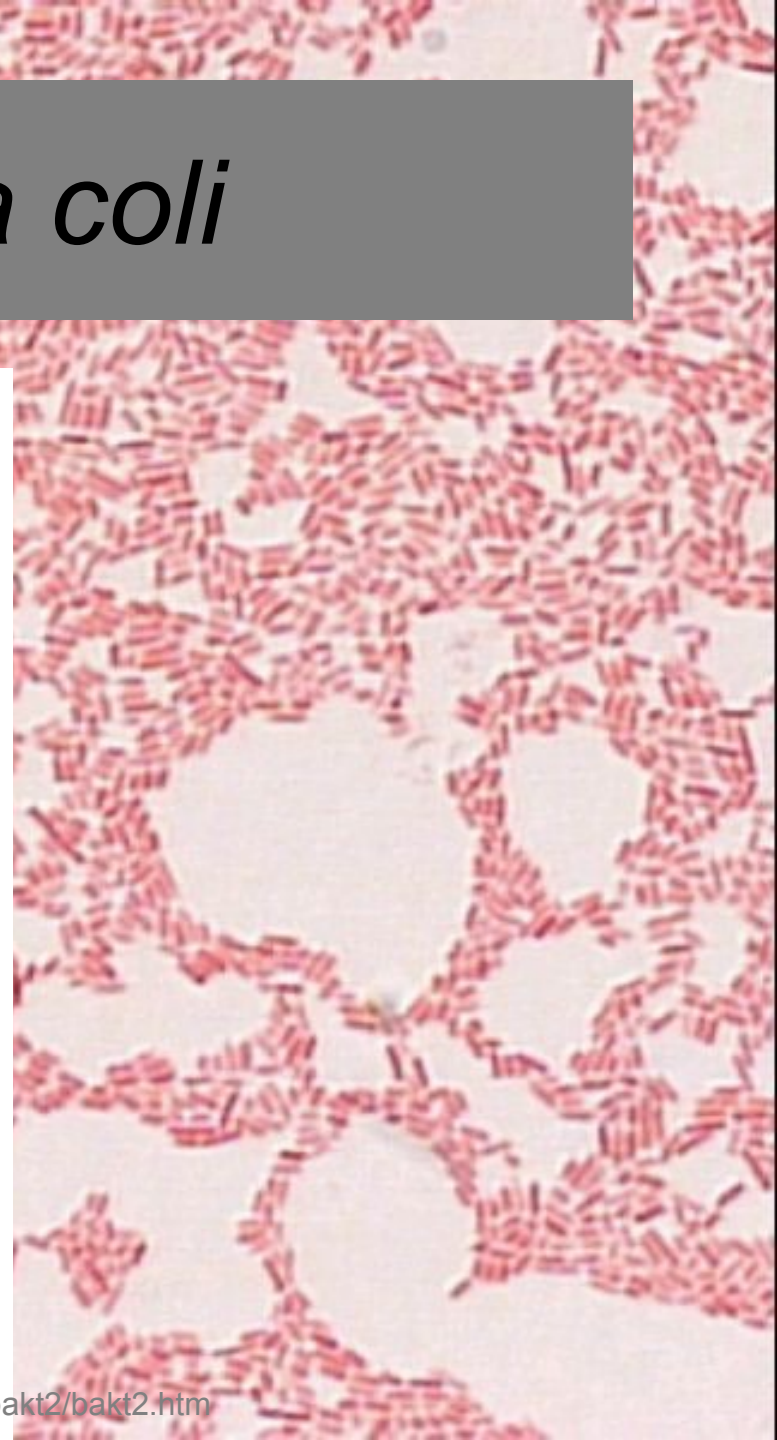
## *Escherichia coli*

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*



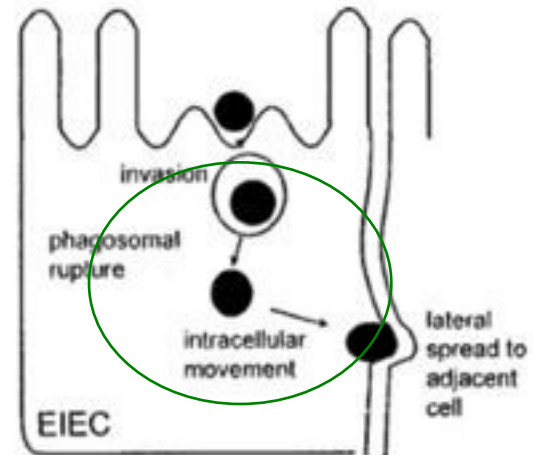
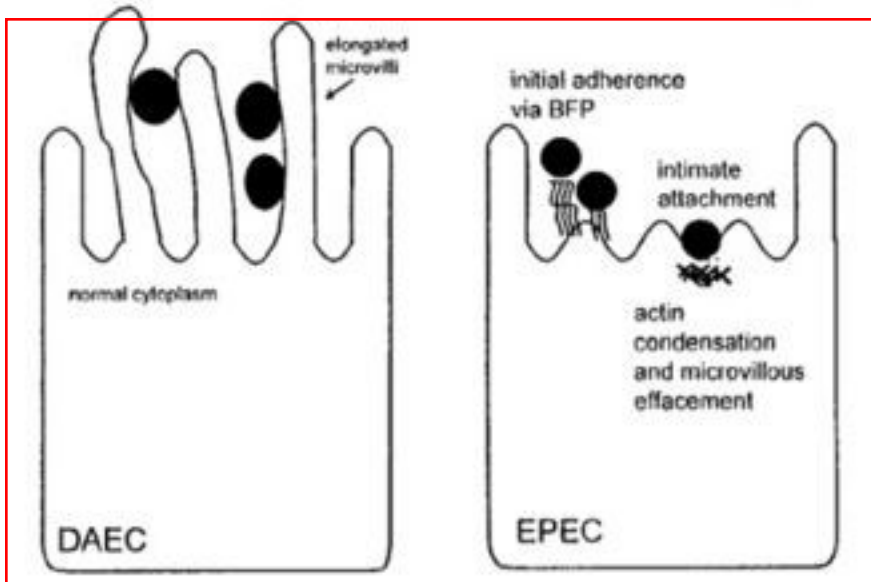
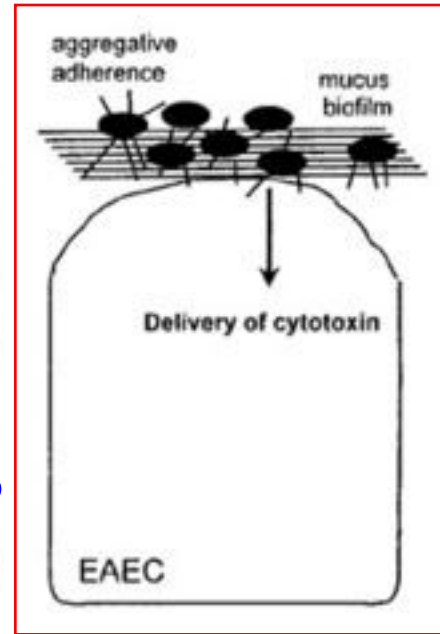
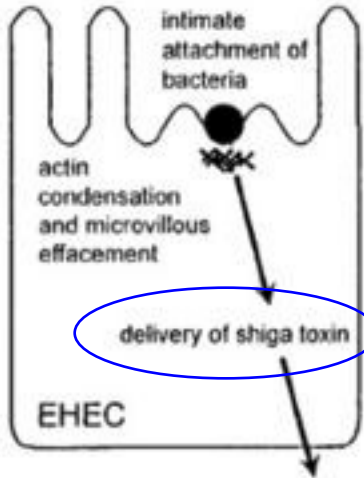
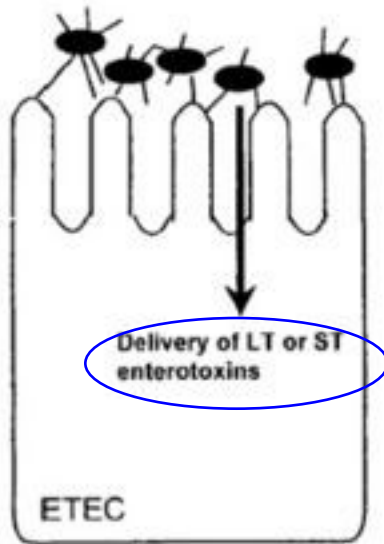
# Bacterial agents of diarrhea and dysentery – II

***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 Shiga toxins, 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

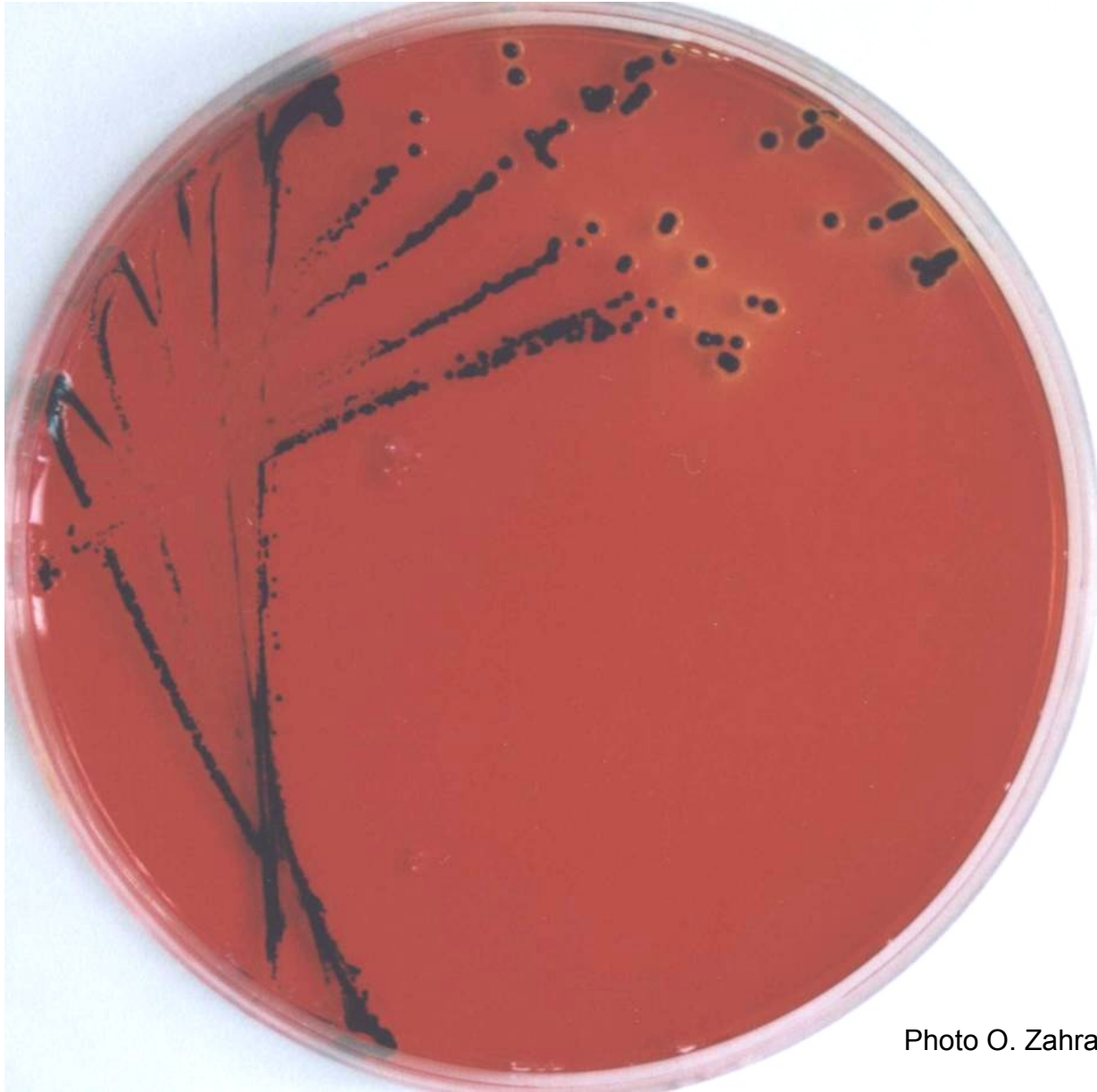


Photo O. Zahradníček.

# 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*

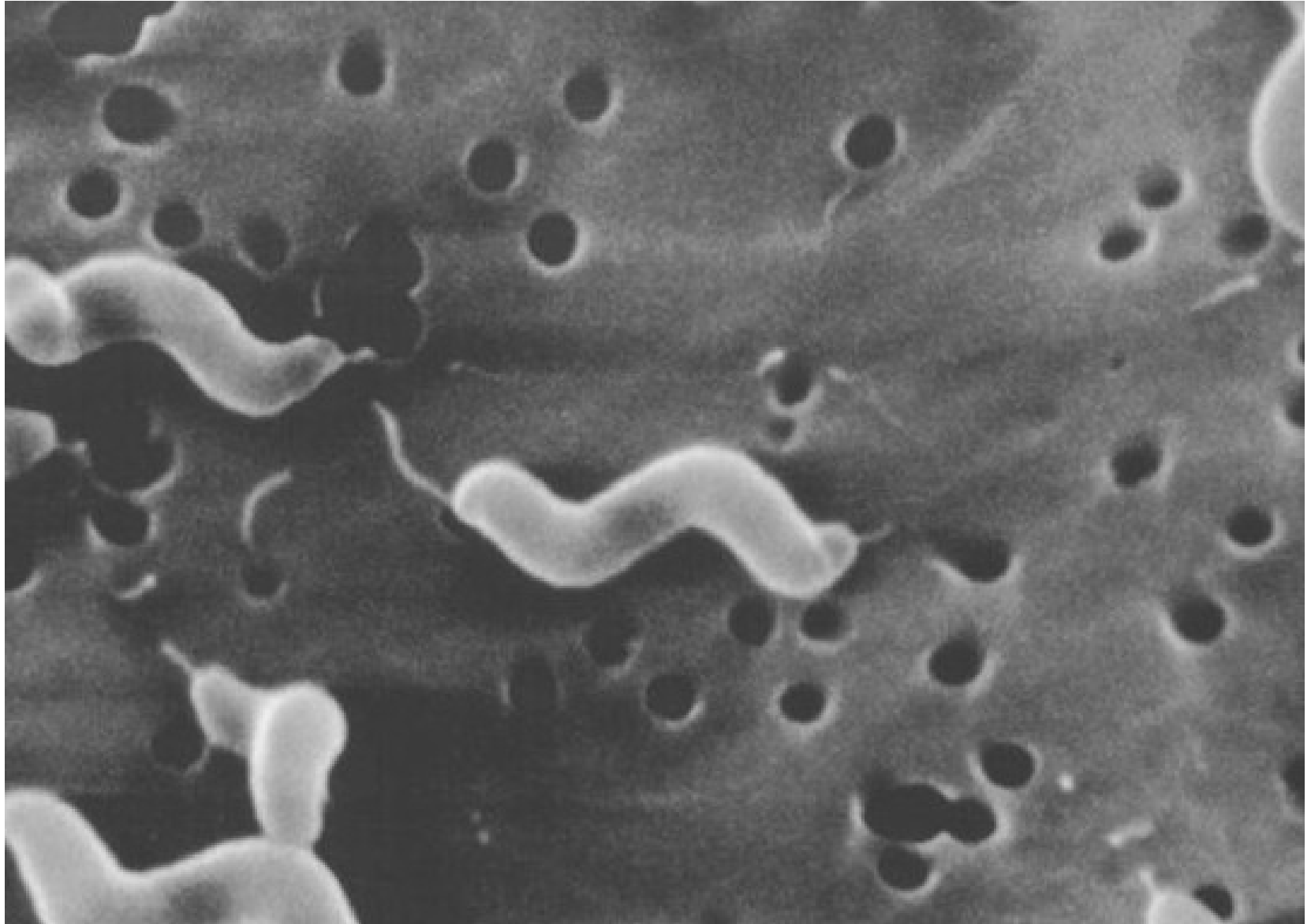
Very low infectious dose → epidemic outbreaks

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

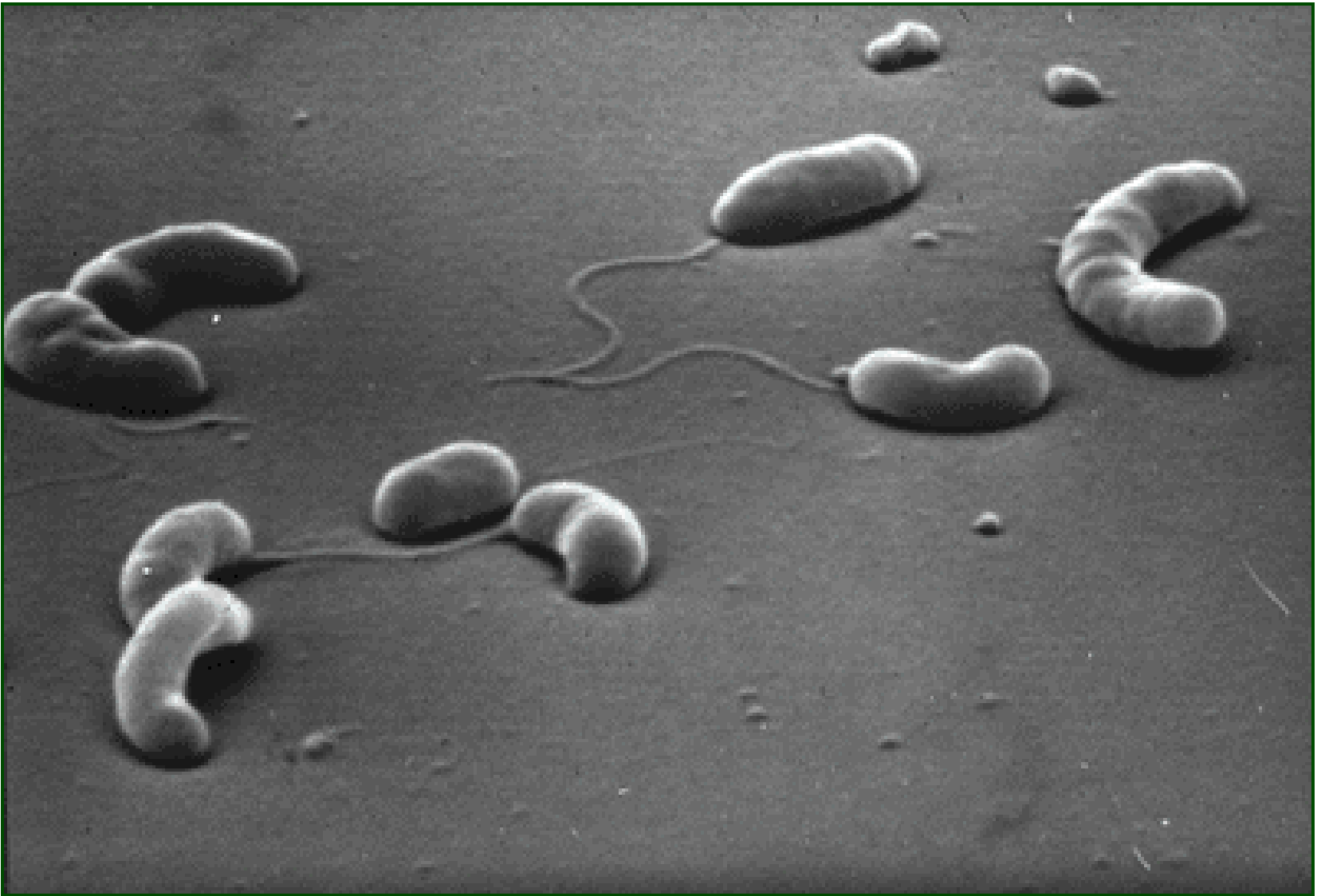
## *Vibrio cholerae*

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

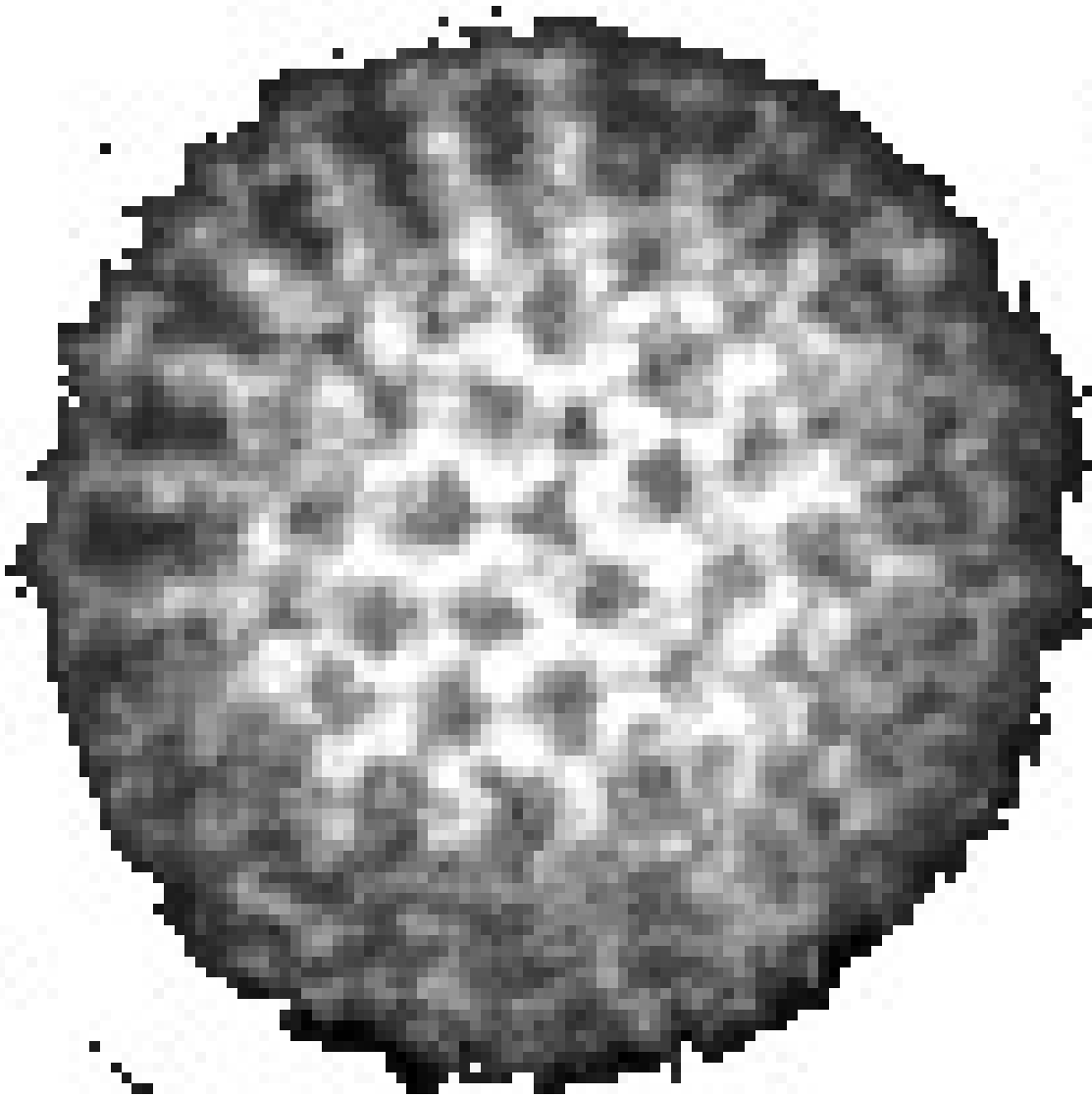
**Astroviruses** (star-shaped virions)

Adenoviruses type 40 and 41

Small, round gastroenteritis viruses



# Rotavirus



[http://web.uct.ac.za/depts/mmi/s\\_tannard/emimages.html](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*

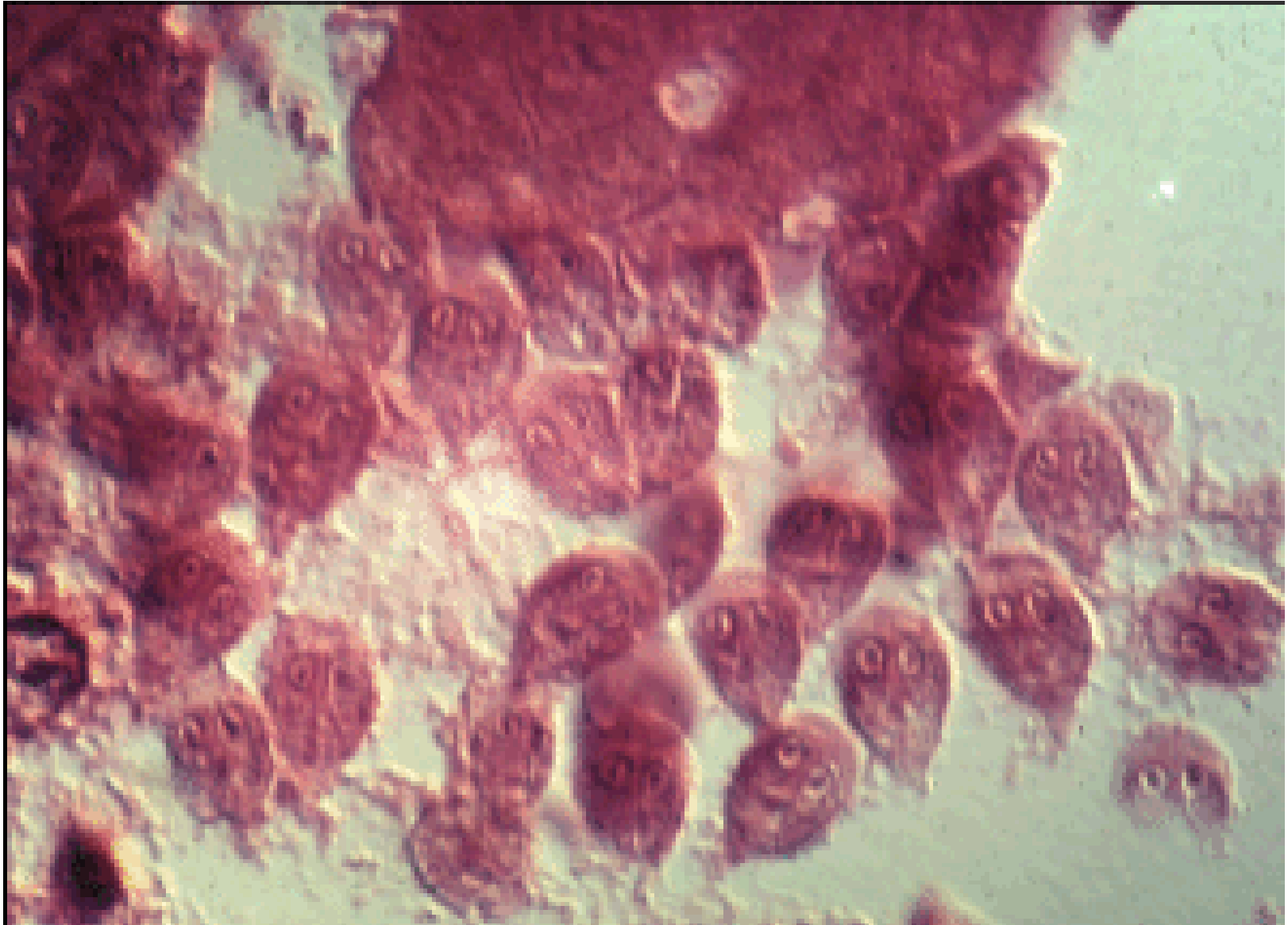
In AIDS also:

*Isospora belli* (coccidium)

*Enterocytozoon bieneusi* (microsporidium)

*Strongyloides stercoralis* hyperinfection  
(helminth)

# Lamblia



# 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

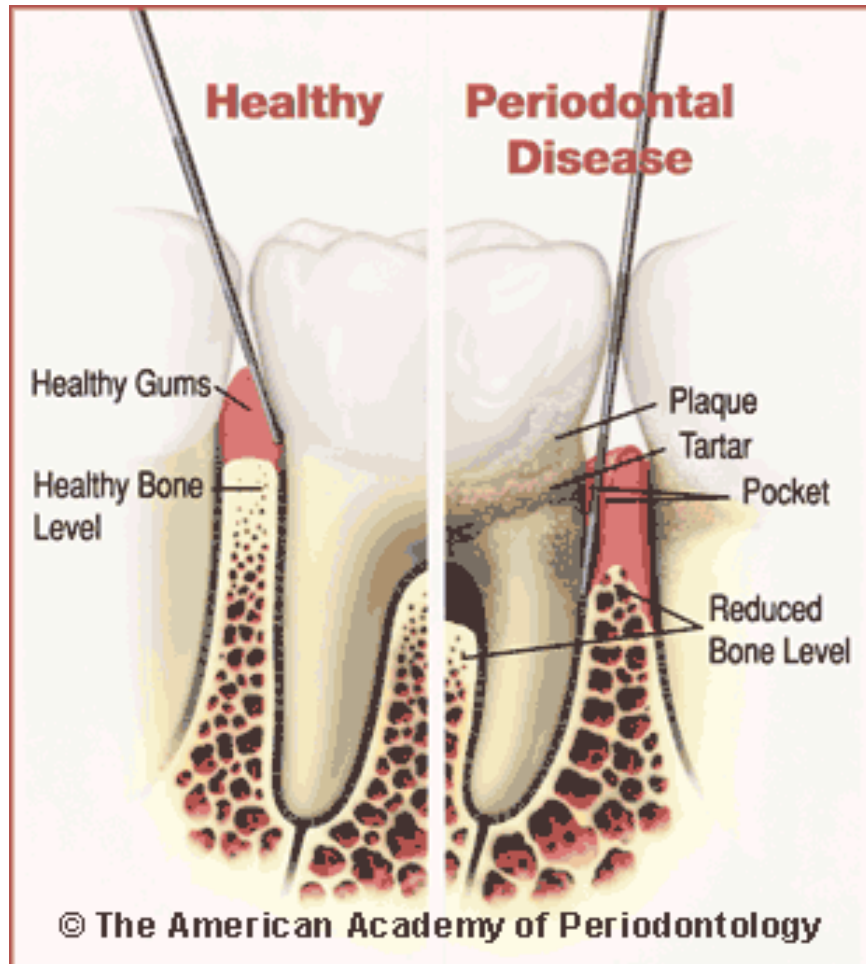
Hemoglobin converted to verdoglobulin

- 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?

