

**Institute for Microbiology, Medical Faculty of Masaryk University
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Agents of digestive system infections

Digestive system

- Its both ends are the „buggiest“ parts of the body
- Normal colonic flora: 99 % anaerobes (*Bacteroides*, *Fusobacterium*, *Clostridium*, *Peptostreptococcus*), only 1 % enteric bacteria (mostly *E. coli*) & enterococci

Mouth cavity – I

Normal flora:

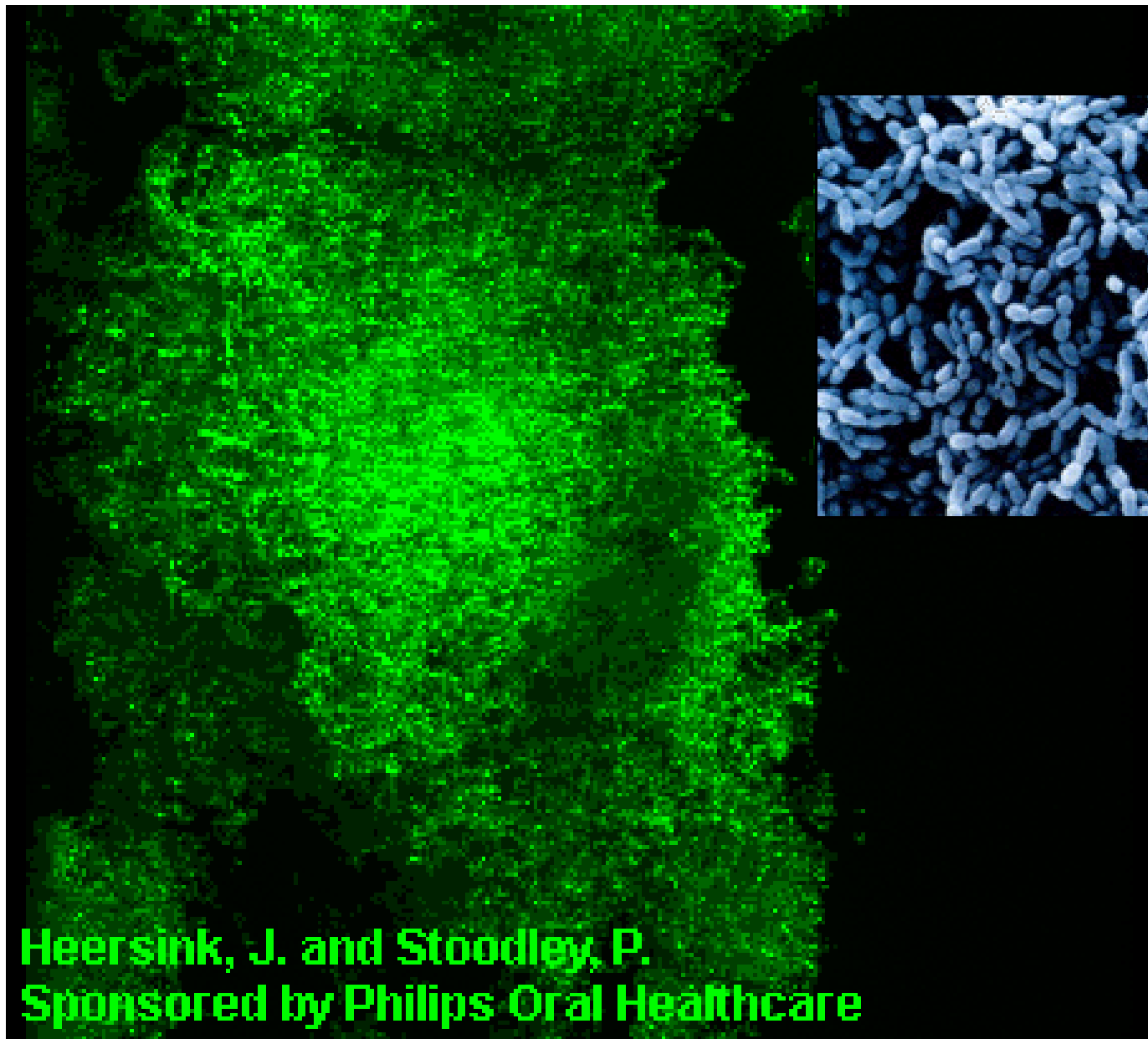
- viridans (= α -haemolytic) streptococci (e.g. *Streptococcus salivarius*)
- oral neisseriae (e.g. *Neisseria subflava*)
- haemophilli of low pathogenity (e.g. *Haemophilus parainfluenzae*)

Dental plaque: adherent microbial layer made up from living and dead bacteria and their products together with components from the saliva

In essence, **dental plaque is a biofilm**

It cannot be washed off, only mechanically removed.

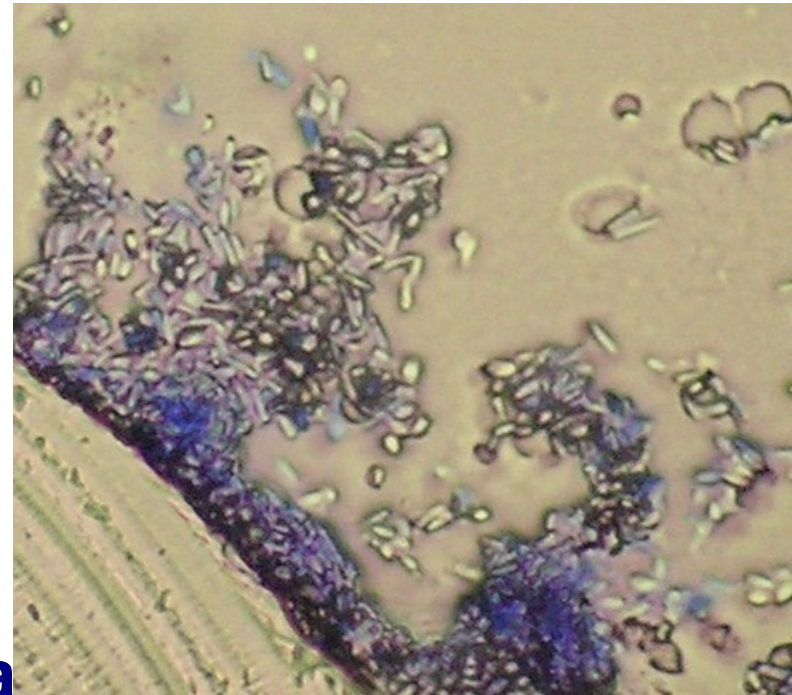




**Heersink, J. and Stoodley, P.
Sponsored by Philips Oral Healthcare**

Biofilm

- **Bacteria regulates the quantity of their population by regulative compounds**
- **Process – quorum sensing**
- **More resistant to**
 - **desinfectants**
 - **antibiotics**
 - **immune reaction**
- **The product of normal flora (which is positive) and pathogens as well**



Mouth cavity – II

Dental caries: chronic infections caused by normal oral flora → localized destruction of tooth tissue

Etiology: mouth microbes (mostly *Strept. mutans*) making acids from sucrose in food

Thrush (in Latin soor): *Candida albicans*
It occurs mostly in newborns

Herpetic stomatitis: primary infection with **HSV 1**

Ludwig s angina: polymicrobial **anaerobic** infection of sublingual and submandibular spaces (*Porphyromonas, Prevotella* etc.)

Herpetic stomatitis



Thrush



http://www.mydochub.com/images/oral_thrush.jpg

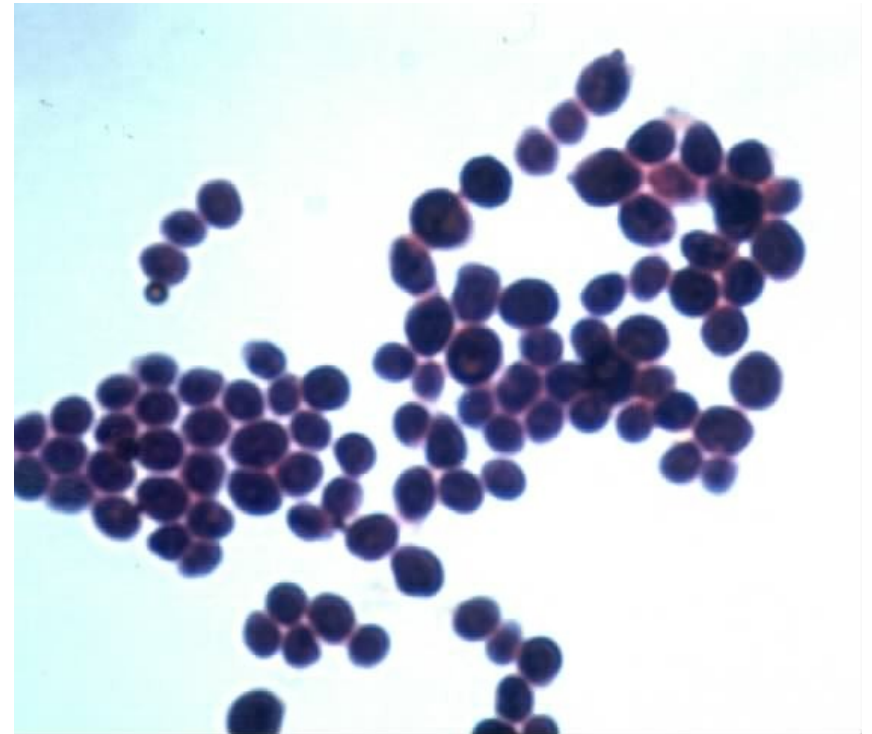
Oral thrush



 ADAM.

<http://www.clarian.org/ADAM/doc/graphics/images/en/17284.jpg>

C.albicans



www.medmicro.info

Oesophagus

Infections **never** in previously healthy individuals

Only in severely immunocompromised persons (AIDS):

- *Candida albicans*
- Cytomegalovirus (CMV)

Stomach

Stomach = sterile, killing by means of HCl most of swallowed microbes

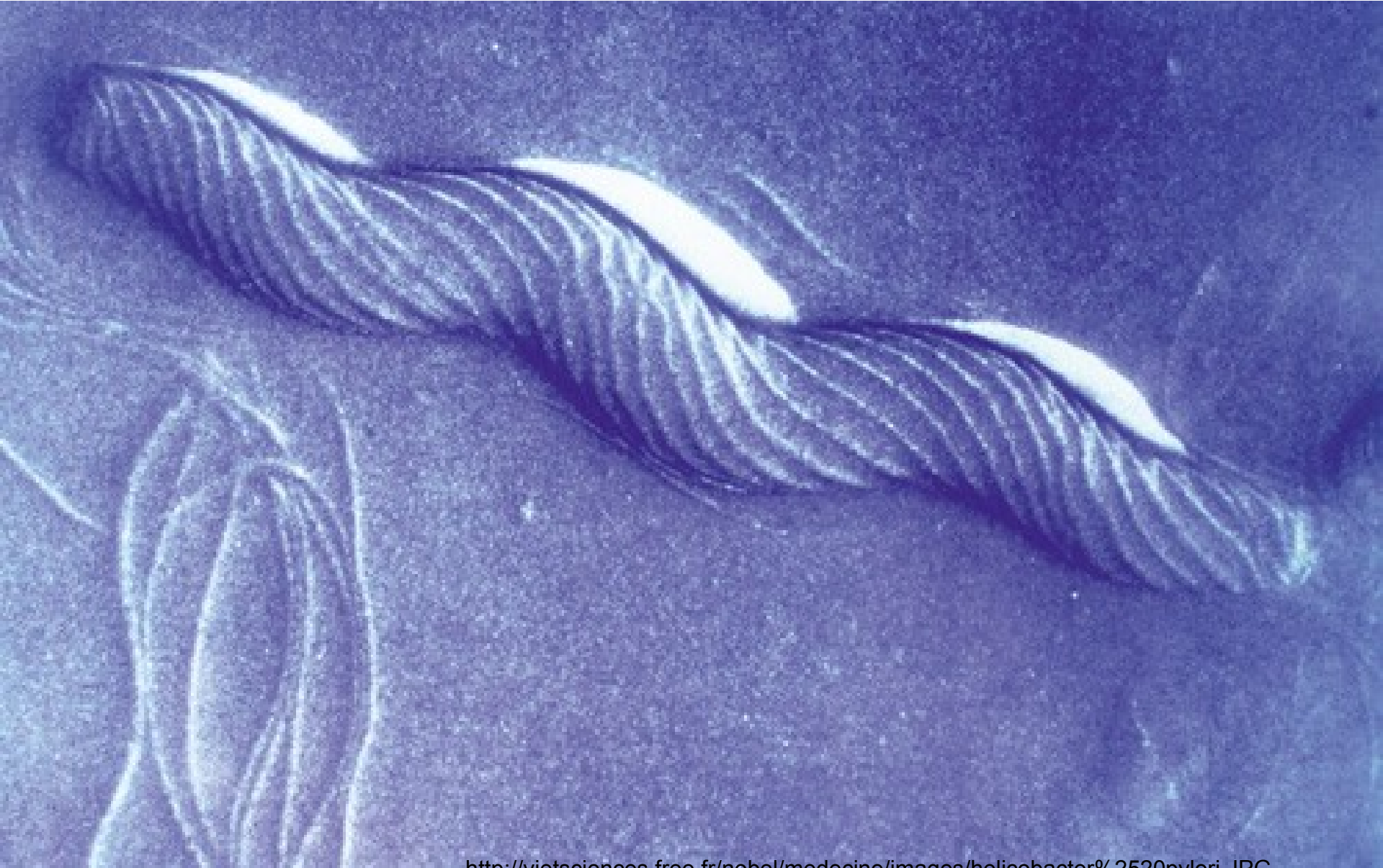
Helicobacter pylori

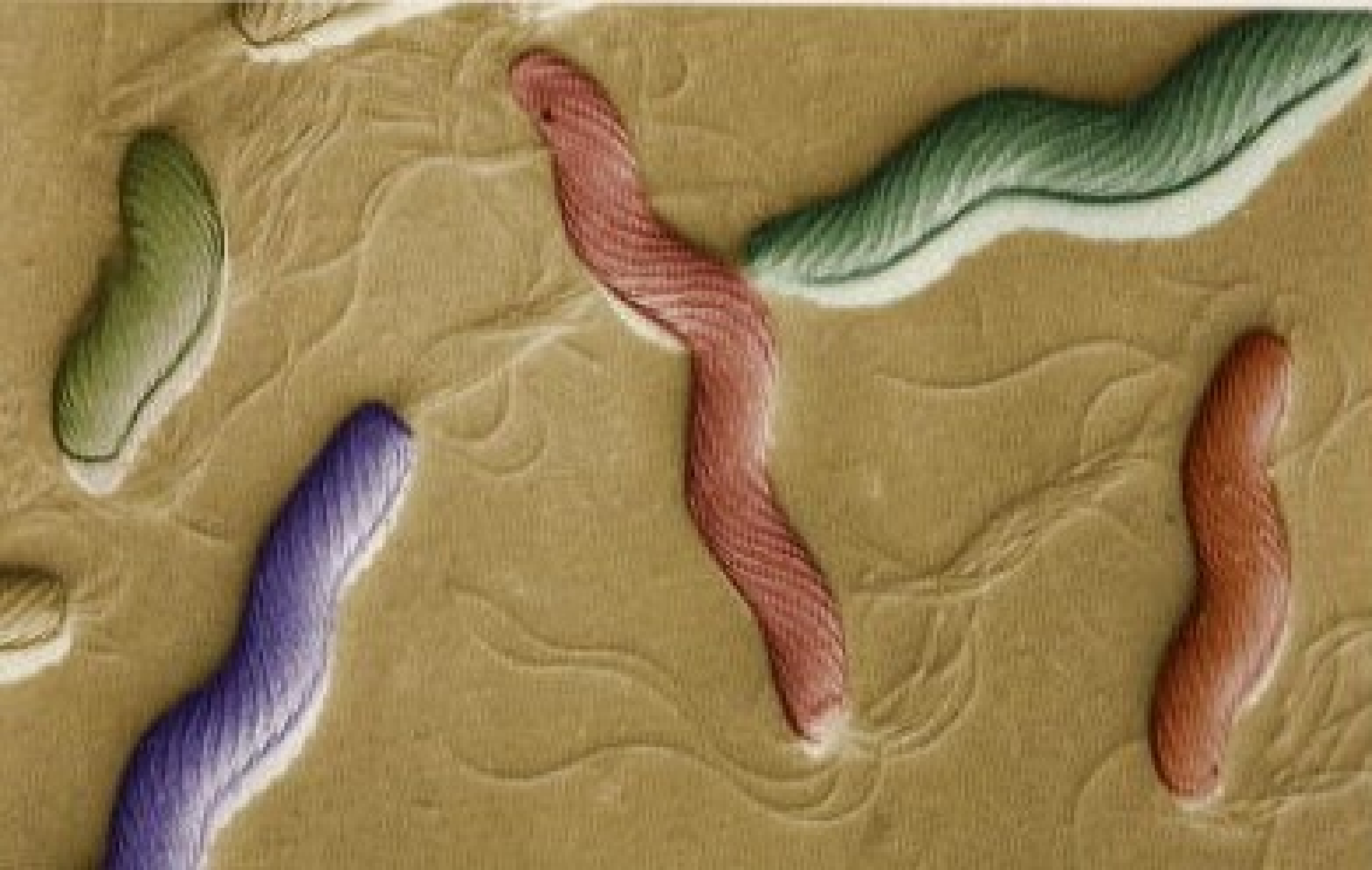
produces a potent **urease and by splitting tissue urea it increases pH around itself (1 molecule of urea \rightarrow 1 CO₂ + 2 NH₃)**

***H. pylori* causes**

- chronic gastritis**
- peptic ulcers**

Helicobacter pylori





www.univie.ac.at/hygiene-aktuell/helicobacter.jpg

Biliary tree & the liver

Acute cholecystitis (colic, jaundice, fever): obstruction due to gallstones

Etiology: intestinal bacteria (*E. coli* etc.)

Complication: **ascending cholangitis**

Chronic cholecystitis: the most important is *Salmonella Typhi* (carriers of typhoid fever)

Granulomatous hepatitis: Q fever, tbc, brucellosis

Parasitic infections of the liver: **amoebiasis** (*Entamoeba histolytica*: liver abscess), **malaria** (the very first, clinically silent part of the plasmodial life cycle), **leishmaniasis** (*Leishmania donovani*: kala-azar), **schistosomiasis** (eggs of *Schistosoma japonicum*)

Systemic infections which start in the digestive tract

Enteric fever (typhoid fever and
paratyphoid fever): *Salmonella* Typhi,
Salmonella Paratyphi A, B and C

Listeriosis: *Listeria monocytogenes*

Peritonitis: colonic flora

Viral hepatitis: HAV, HBV, HCV, HDV, HEV

Bacterial agents of diarrhea – I

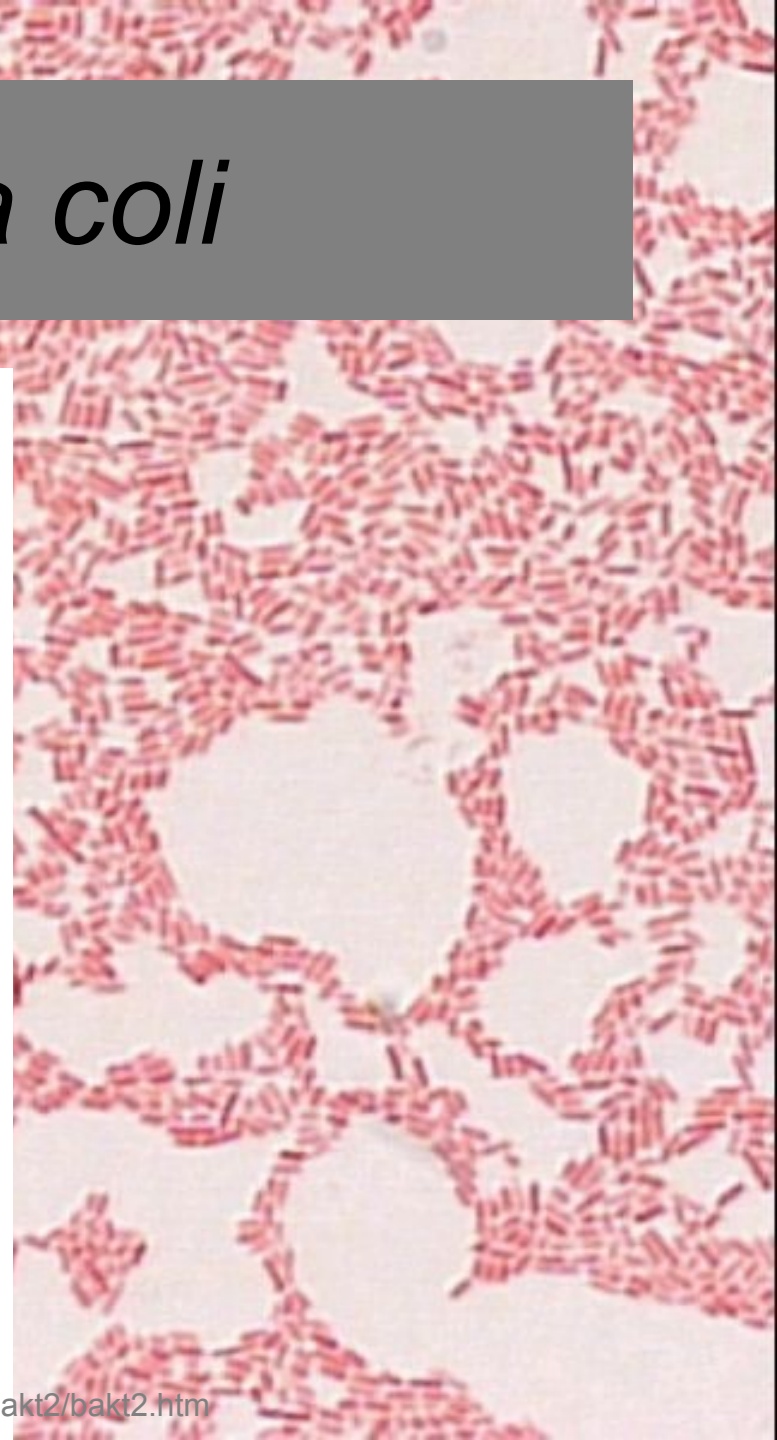
Escherichia coli

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

- beneficial
- non-pathogenic in the intestine

Some *E. coli* strains pathogenic in GIT

Escherichia coli



Bacterial agents of diarrhea – II

Escherichia coli strains causing diarrhea:

- **ETEC** (enterotoxigenic *E. coli*): children in developing countries, traveller's diarrhea, toxins
- **EPEC** (enteropathogenic *E. coli*): O55, O111; infants; disruption of microvillus structure
- **EIEC** (enteroinvasive *E. coli*): invasion of colonic cells
- **EHEC** (enterohaemorrhagic *E. coli*): O157:H7; 2 cytotoxic Shigatoxins, hemorrhagic colitis & hemolytic-uremic syndrome

Salmonella - MAL agar

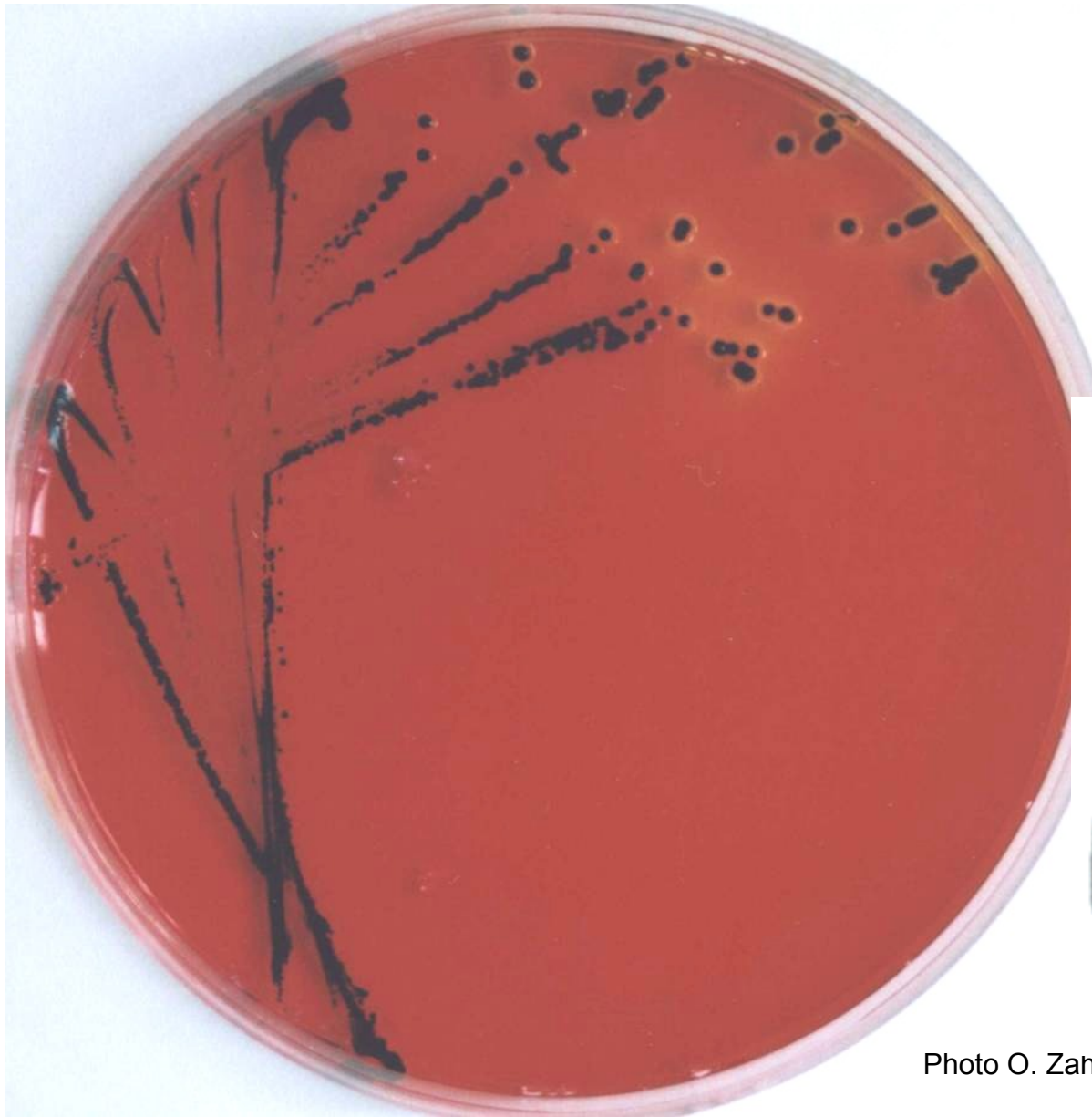


Photo O. Zahradníček.

Bacterial agents of diarrhea – III

A) **Salmonella systemic infections (enteric fever):**

S. Typhi, S. Paratyphi A – C (humans)

Gut invasion and **infection becomes generalized** → no diarrhea, pronounced **fever**, detection in **blood, urine and stool**, in susp. carriers in duodenal fluid, antibiotics

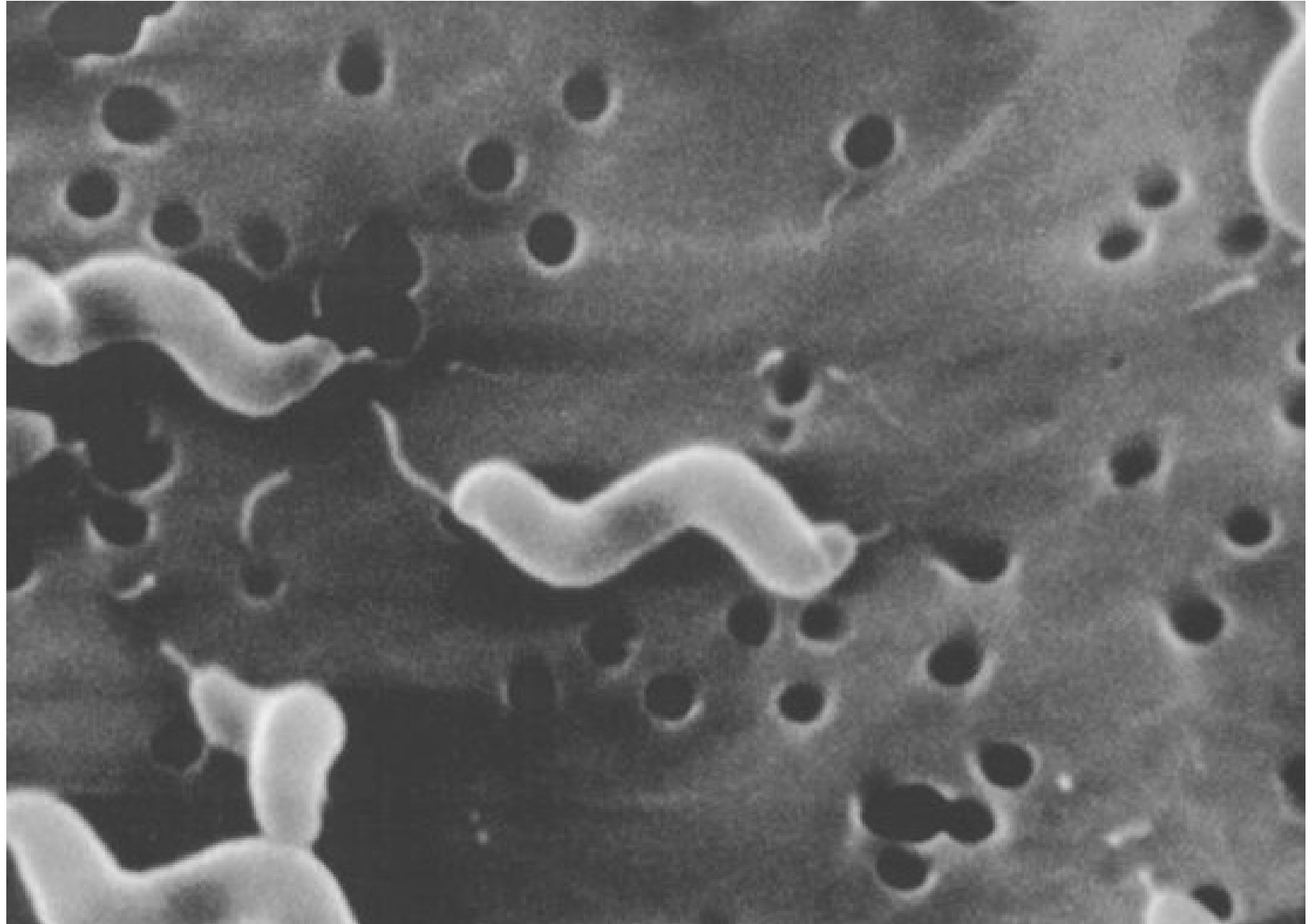
B) **Salmonella gastroenteritis (salmonellosis, reservoir: poultry & animals):**

>4.000 serotypes – e.g. S. Enteritidis

Localized in ileocaecal region → **diarrhea**, nausea & vomiting, abdominal pain, temperature, examination of **stool only**

Treatment: symptomatic, **no antibiotics**

Campylobacter jejuni



Bacterial agents of diarrhea – IV

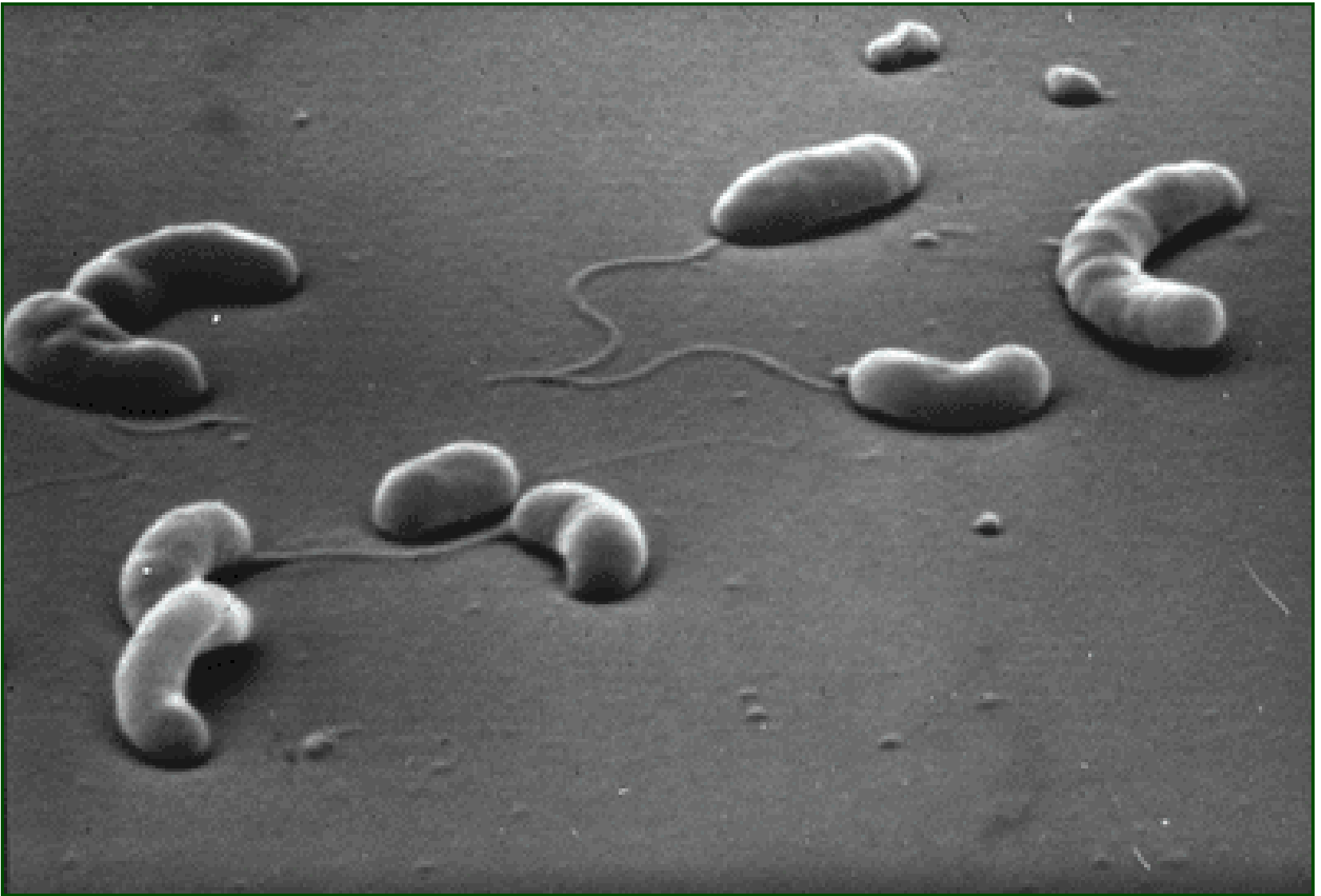
Campylobacter jejuni

invades jejunal epithelium, reservoir: poultry,
cultured on a special medium, in 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 - cells of colon and rectum
- **bacterial dysentery**

Vibrio cholerae



Bacterial agents of diarrhea – V

Yersinia enterocolitica

- gastroenteritis, in children also mesenteric lymphadenitis (mimicking acute appendicitis)
- vector: contaminated food, multiplies at 4 °C

Vibrio cholerae

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

V. cholerae flourishes in water & causes epidemics

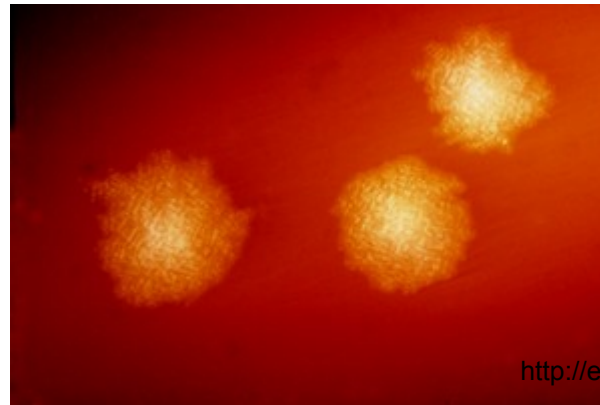
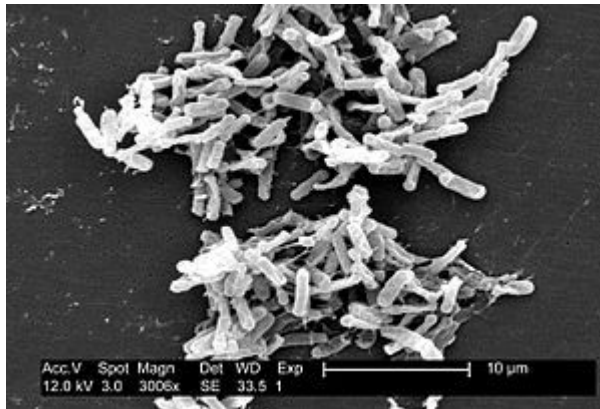
Diarrhoea during antibiotic therapy

Clostridium difficile:

pseudomembranous colitis frequently after **clindamycin, cephalosporines** (virtually after every ATB), hypervirulent serotype O27

Patients contaminate the hospital environment with resistant spores.

Treated with **metronidazol** or **vancomycin**

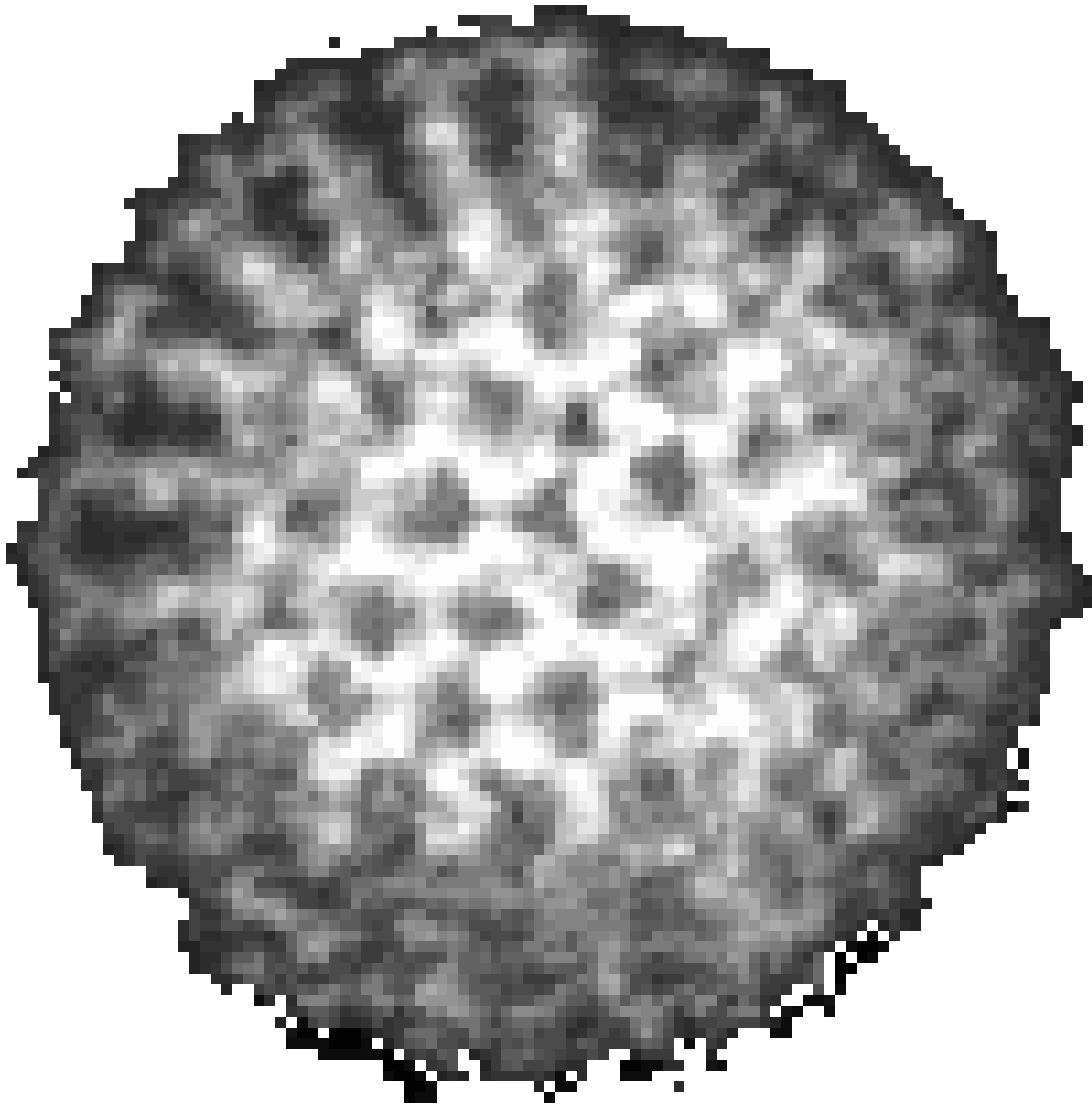


Direct proof of the **Cdiff toxins essential**, *C. difficile* can be found in healthy people



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

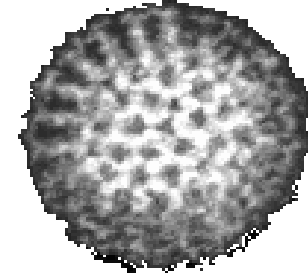
Rotavirus



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

Viral agents of diarrhea

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



Rotaviruses (*Reoviridae* family)

serious diarrhea of young children, epidemics in winter, vaccination

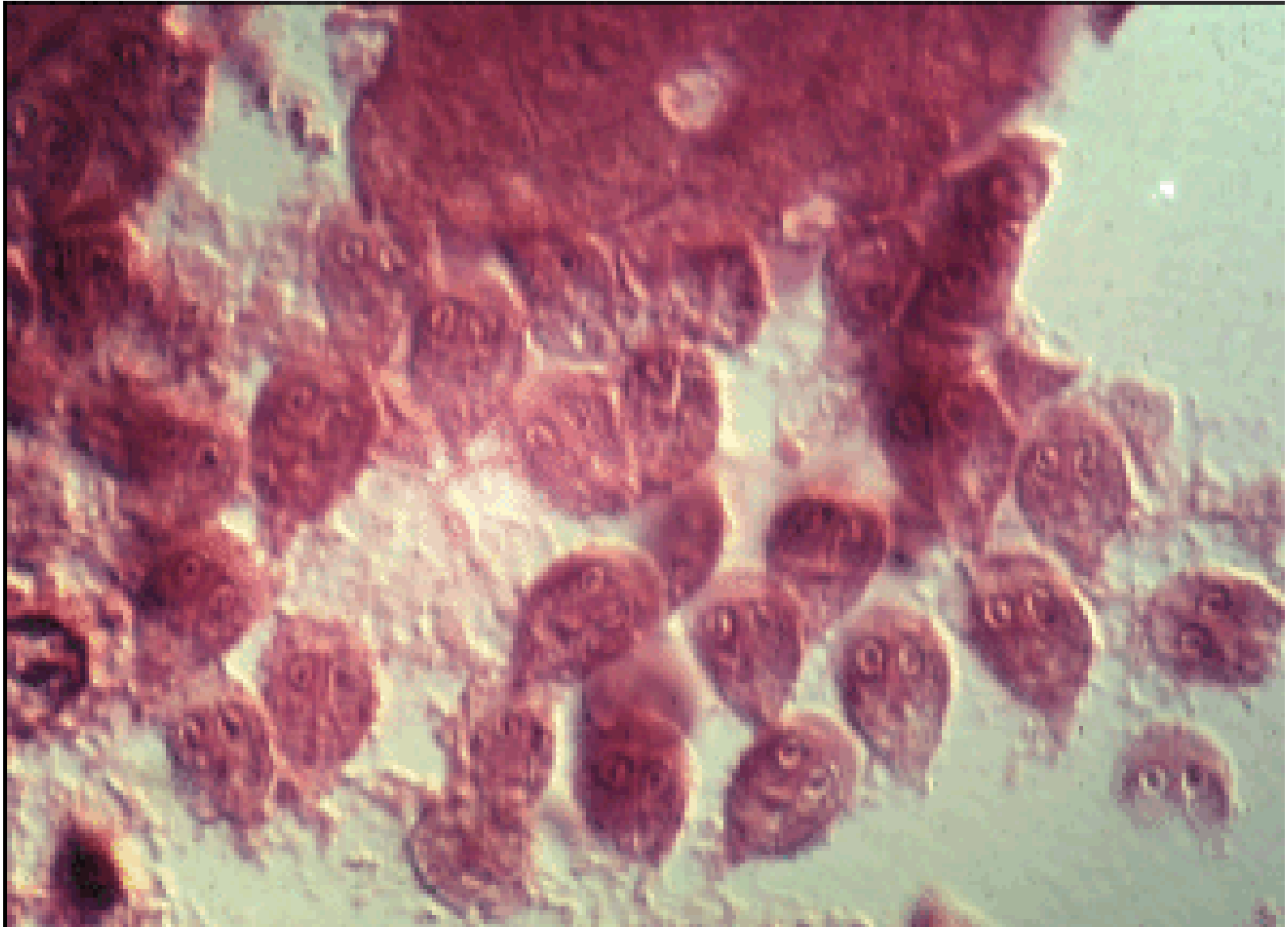
Noroviruses and **sapoviruses** (formerly agents Norwalk and Sapporo, *Caliciviridae* family)

epidemics in children and adults, in hospitals

Astroviruses (star-shaped virions)

Adenoviruses type 40 and 41

Lamblia



Ascaris lumbricoides egg

Egg



Fertile egg (wet mount 400X)

Parasitic agents of diarrhea

Protozoa:

Entamoeba histolytica: amoebic dysentery

Giardia lamblia: giardiasis

Cryptosporidium parvum: cryptosporidiosis

Helminths in the small intestine:

Ascaris lumbricoides (human roundworm)

Strongyloides stercoralis (threadworm)

Taenia saginata (beef tapeworm), *T. solium* (pork tapeworm)

Hymenolepis nana (dwarf tapeworm)

.....in the large intestine:

Enterobius vermicularis (pinworm)

Trichuris trichiura (whipworm)

Food poisoning

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



**Harmenszoon Rembrandt van Rijn (1606-1669)
Anatomy Lecture of Doctor Tulp (1632)**

