

Taking a close look at Foodborne Pathogens

Why details matter in observing pathogens with electron microscopes

Foodborne pathogens refer to microbes found in farm, zoo and pet animals and to microbes found in the environment (water, soil, air) that make human beings fall sick, irrespective of the infection path. Approximately 250 different types of bacteria, parasites, viruses, algae and molds make up the family of foodborne microbes. All of them are so small that they cannot be seen without a microscope.

Electron microscopy enables detailed examination of the morphology of foodborne pathogens; although for most species, an observation by light microscopy is possible. The inter-bacterial interactions, or the interactions between human cells and bacteria, can therefore be observed in more detail through electron microscopy. Such details are essential in order to understand the pathogen and help develop potential cures.

A few of the most common bacterial pathogens that can cause foodborne diseases, leading to more dangerous complications:

- Salmonella enterica
- Clostridium perfringens
- Campylobacter jejuni
- Shigella spp
- Listeria monocytogenes

Salmonella enterica

Salmonella enterica is a rod-shaped bacterium that infects humans and has a wide range of other animal hosts. Cattle and poultry are the most common hosts, but domestic pets such as hamsters and cats can also be infected by these bacteria. Pasteurization and proper cooking of food prior to consumption removes these pathogens. Salmonella enterica causes fever, diarrhea, abdominal cramps and vomiting for 12 to 72 hours after infection.

Clostridium perfringens

Another major cause of food poisoning is Clostridium perfringens. Symptoms appear more quickly (typically within six hours of the infection) than with Salmonella. It dwells in poorly cooked meat and poultry but is also found in well-cooked but improperly stored food. Abdominal cramps, diarrhea, vomiting and fever are the symptoms of this infection. If left untreated, food poisoning could result in C. perfringens settling in the intestine and secreting a necrotic toxin, which can cause fatal intestinal hemorrhaging.

Two common bacterial images captured by a Thermo Scientific™ Phenom Desktop scanning electron microscope (SEM) are given below:

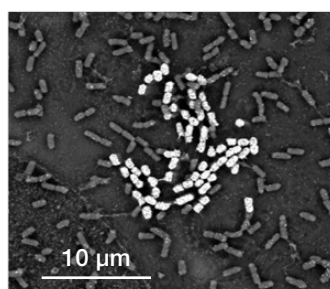


Figure 1.
SEM image of E-Coli bacterie.

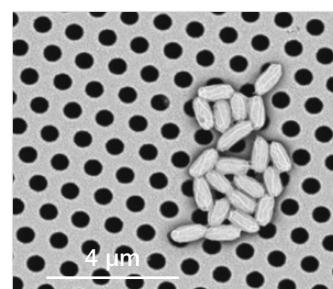


Figure 2.
SEM image of Bacillus Pumilus.

Campylobacter jejuni

Campylobacteriosis leads to an inflammatory, often bloody, dysentery or diarrhea accompanied by fever and abdominal cramps. *Campylobacter jejuni* is a comma-shaped, spiral bacterium usually seen in poultry and unpasteurized milk. The pathogen is also transmitted by sexual contact or by fecal-oral route.

Shigella spp

Shigella is a bacterium commonly found in gorillas and humans. It spreads through poor hygiene or uncooked food and causes Shigellosis, which can be prevented by frequent hand washing and thorough food cooking. It is characterized by delayed symptoms, which can last for weeks. Severe diarrhea, abdominal pain, vomiting and painful bowel movements are the some of the most common symptoms.

Listeria monocytogenes

A rod-shaped bacterium, *Listeria monocytogenes*, causes infections of the central nervous system together with Gastroenteritis. It is found everywhere and is resistant to very cold temperatures; therefore, storing food in the refrigerator will not prevent the infection. Symptoms include abdominal pain and diarrhea.

Fungal infections

Unlike fungi, which is commonly called mold, bacterial infection of food is not usually visible to the naked eye. Several thousands of known species of mold can grow on carpets, clothes, wood and leather. However, most importantly, molds can grow on food if placed in moist conditions. Many common types of mold reproduce by making spores. When the spores settle on a moist food source, they germinate and create a branching network of cells known as hyphae, which are visible. The impact on human health is dependent on the length of exposure and the nature of the fungi.

Figure 3 depicts *Aspergillus niger*, isolated from coffee. A common food contaminant, it is also known as black mold, as it is identified by its black spores, although the contaminant can be confused with other species. *A. niger* is less likely to cause human diseases than other *Aspergillus* species, but if present in large quantities, it can cause fungal ear infections.

Figure 4 depicts *Rhizopus stolonifer*, also called Black Bread Mold, isolated from bread. Resembling threads, it consumes nutrients from bread and damages the surface of its host. *R. stolonifer* is commonly found in cosmopolitan locations and can cause opportunistic infections of humans as well as infection in fruits and vegetables.

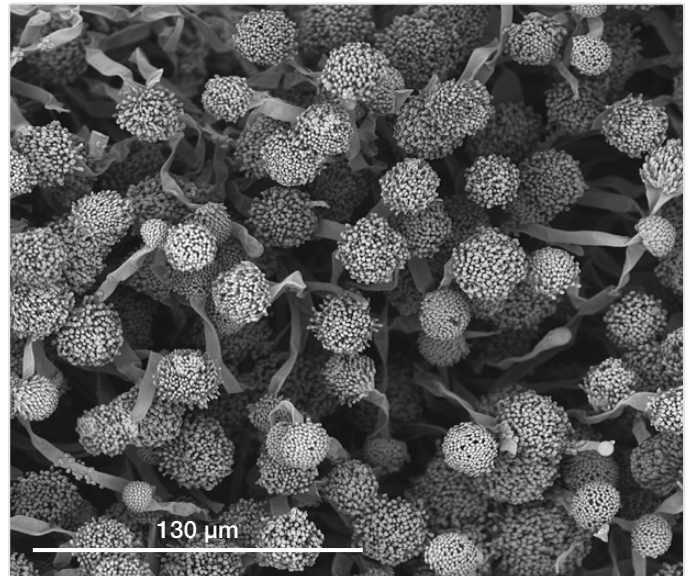


Figure 3. SEM image of *Aspergillus niger* spores found in coffee, captured by a Phenom Desktop SEM.

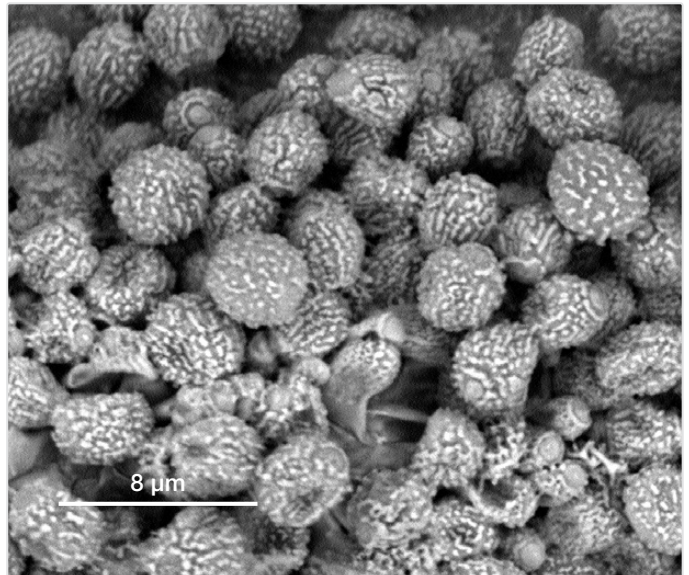


Figure 4. SEM image of *Rhizopus stolonifer* collected from bread, captured by a Phenom Desktop SEM.

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