

Bacteria

Man and bacteria

A textile dealer discovers bacteria

The first scientist to have studied and described bacteria was Anton van Leeuwenhoek (1632-1723). He was a textile dealer who lived in Holland and used magnifying glasses to assess the quality of fabrics. In 1668, during a business trip to England, he bought some very powerful magnifying glasses with which he built a rudimentary microscope. His curiosity led him to observe a bit of everything and this is how he happened to see microbes for the very first time. In his writings, van Leeuwenhoek described bacteria as strange round-shaped beings. At first, there were many problems classing these new organisms since they were so peculiar they could not be included in either group of the living kingdoms: the vegetal and the animal kingdom. One century after van Leeuwenhoek, Carolus Linnaeus designed a new kingdom to include all the known micro-organisms that he called chaos.

The discovery of fermented bacteria

One of the main pioneers of microbiology was the French Louis Pasteur, who in 1854 was urged by spirit-makers to study fermentation. Pasteur proved that micro-organisms play an essential role in fermentation processes. In addition, he found that the unwanted reproduction of some substances, such as lactic acid or acetic acid, in spirits, is due to the presence of different kinds of micro-organisms, including bacteria. These discoveries helped develop the first effective systems to destroy harmful micro-organisms. The term "microbe" was coined in 1878 by Charles Emmanuel Sédillot who, at the French Academy of Sciences, proposed that all microscopic organisms should be called microbes.

Bacteria, diseases and antibiotics

Not all bacteria are useful or harmless; some of them transmit diseases, even very serious ones, that especially in the past caused great epidemics. The bacterial origin of some pathologies, such as the plague, cholera, pneumonia or meningitis, has been only recently discovered. In the past, when the existence of bacteria was not known, these diseases were thought to be caused by sorcery, curses or the influence of the stars. The discovery of the existence of pathogenic micro-organisms led research to find ways to fight them.

In 1929, Alexander Fleming, a Scottish doctor who conducted researches at St. Mary's Hospital in London, discovered penicillin: the very first antibiotic substance ever known and studied. Penicillin was discovered by chance during some research on staphylococci. Fleming prepared some containers (plates) where he grew colonies of this micro-organism. To be observed, the plates had to be opened, exposing the bacterial cultures to the air, letting other micro-organisms in. So, some mildews started growing amongst the colonies of staphylococci. The scientist noticed that around the mildew the colonies grew more and more transparent until they disappeared, so he assumed that the mildew produced a substance that could wipe out the bacteria. Fleming extensively studied this substance and, since it was produced by the mildews of the genus *Penicillium*, he called it penicillin. The discovery of antibiotics has eradicated or remarkably reduced very many of the most dangerous diseases. But defeating bacteria is no easy feat. These micro-organisms can generate resistant strains, i.e. genetic variants that spontaneously evolve from one species and can survive even in the presence of antibiotic substances. This is why research must keep developing new antibiotics.

Bacteria and food

Man has been using bacteria for thousands of years, but he has only recently become aware of such uses. Very many foods are made with the aid of bacteria. These micro-organisms modify raw foods and transform them into new products with different chemical, physical, sensory and nutritional characteristics. In addition, these foods have a longer shelf life

and sometimes they are even safer to use. Cheese, yoghurt, bread, wine, even dressed pork products and preserves are made with the aid of different species of bacteria.

Dairy farming

Milk bacteria, such as *Streptococcus thermophilus* and *Lactobacillus bulgaricus*, are the micro-organisms most commonly used in dairy farming. These bacteria, which come in the form of bacilli or cocci, are anaerobic (they do not need oxygen to survive) and transform simple sugars (glucose and lactose) into lactic acid through a metabolic process which is known as fermentation. Lactic acid alters the chemical and physical features of milk, transforming it into something else: yoghurt. Butter-making also needs the aid of some micro-organisms: the typical taste of this product is due to the presence of diacetyl, a substance released by the milk bacteria that develop as the milk cream ages. Some bacteria can produce substances, such as bacteriocins and nisins, that have an antibiotic effect, i.e. they fight the harmful bacteria that could contaminate cheese.

Special bacteria, known as "proponic", develop in some types of cheese, such as Emmenthal and Gruyère, and produce large amounts of carbon dioxide. The gas forms gaps in the cheese paste which when aged exhibits the famous "holes".

Bacteria with a good taste

Milk bacteria are also used to make many baked products, such as brioches, cakes and biscuits. With the aid of bacteria, these foods acquire a better flavour and taste.

Wine, especially red wine submitted to ageing processes, is also made with the aid of some bacteria that, by transforming malic acid into lactic acid, improve the taste of wine.

Dressed pork products are made with the aid of some bacteria of the genera *Lactobacillus*, *Pediococcus* and *Micrococcus*. These micro-organisms produce antibacterial substances that give these products a longer shelf life and release molecules that improve their taste. Micrococci in particular transform the fats and cure the pork meat.

Pasteurization

The presence of bacteria in some foods is undesirable since it speeds up decomposition and could be dangerous for human health. The oldest method developed to control the concentration of bacteria in food was invented by Louis Pasteur in the late 19th century, and this is why it is known as pasteurisation. It is a process that reduces the amount of bacteria without altering the nutritional and sensory features of the food. This process consists in heating the product for a few minutes at 55C° to 70C°. In this way, a large part of the bacteria die, thus making the food more hygienic. Today, milk, sauces, creams, preserves and beer are commonly pasteurised before being sold.

Let's cure ourselves with bacteria

Bacteria are used to make a high number of pharmacologically important substances. *Actinomycetes*, for instance, are thread-like bacteria that morphologically resemble mildews. They are among the most important producers of antibiotics, such as streptomycin and tetracycline.

Vitamin B12 (cobalamin) is also produced in laboratory by bacteria.

Some special bacterial strains are used as test micro-organisms to determine the antibiotic and vitamin content of some foods or drugs. Microbial strain means a bacterium that, although belonging to a given species, has distinctive morphological and metabolic features, such as, for instance, specific resistance to antibiotics, production of some substances or resistance to specific environmental conditions. A bacterial colony is instead a cluster of cells that is visible to the naked eye, mostly round in shape, and is originated by the proliferation of strains. A colony consists therefore of a very high number of bacteria from the same strain.

Biotechnology

Through biotechnology, segments of DNA can be introduced in the genetic inheritance of a bacterium. Human DNA supplies bacterial cells with instructions to synthesise proteins that the bacteria usually do not synthesise. This has led to the production of proteins that are very important to treat some diseases. Nowadays, substances that in the past used to be extracted from natural sources and often available in limited amounts can be obtained from bacteria in large amounts and at low costs. The protein molecules of bacterial origin that are useful in medicine include insulin for diabetes, interferon for viral infections and the growth hormone.