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Opinion

Controlling microorganisms using physical methods

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DESCRIPTION

Humans have utilised numerous physical methods of microbial control for food preservation for thousands of years. High temperatures, radiation, filtration, and desiccation (drying) are only a few of the common control approaches. Many of these approaches kill cells without killing them directly by disrupting membranes, increasing membrane permeability, or causing denaturation, degradation, or chemical alteration of proteins and nucleic acids. This section discusses various physical approaches for microbial control.

One of the most common and oldest methods of germ control is heating. It's utilised in simple cooking and canning processes. Microbes can be killed by heat because it changes their membranes and denaturates proteins. A microorganism's thermal death point (TDP) is the lowest temperature at which all microorganisms die in a 10-minute exposure. Different microorganisms react to high temperatures in different ways, with some (e.g., endospore-formers like *C. botulinum*) being more heat tolerant than others. The thermal death time (TDT) is a comparable parameter that measures how long it takes to kill all microorganisms in a sample at a certain temperature. These terms are frequently used to describe sterilising methods that involve a lot of heat, such as autoclaving. Boiling is one of the oldest methods for controlling germs with wet heat, and it is usually highly successful at killing vegetative cells and some viruses. Boiling, on the other hand, is less successful at killing endospores; some endospores can withstand boiling for up to 20 hours. Boiling may also be less successful at higher altitudes, because the boiling point of water is lower and so the boiling time required to kill germs is longer. Boiling is not regarded a viable sterilising procedure in the laboratory or clinical context for these reasons.

Moisture-heat sterilisation is used in autoclaves. They are used to sterilise goods such as surgical equipment without destroying them by raising temperatures over the boiling point of water to kill vegetative cells, viruses, and notably endospores, which are known to resist boiling temperatures. While working in Louis Pasteur's laboratory in 1879, Charles Chamberland (1851–1908) created the modern autoclave. The autoclave is still thought to be the most effective sterilisation technology. Large industrial autoclaves known as retorts enable for large-scale moist-heat sterilising outside of laboratory and clinical settings.

Although complete sterilisation is preferable for many medical uses, it is not always feasible for other applications and may compromise product quality. Boiling and autoclaving are not good methods for controlling microbial development in many meals because they can compromise the food's consistency and other organoleptic (sensory) properties. Pasteurization is a method of microbial management for food that involves the use of heat but does not result in the food being sterile. While retaining food quality, traditional pasteurisation destroys pathogens and lowers the amount of spoilage-causing bacteria. Louis Pasteur invented pasteurisation in the 1860s as a way to keep beer and wine from spoiling. Pasteurization is now the most popular method for killing heat-sensitive microorganisms in milk and other foods (such as apple juice and honey). Pasteurized foods, on the other hand, are not sterile and will eventually spoil.

Except for psychrophiles, which prefer cold temperatures, exposing bacteria to low temperatures can be a simple and effective microbial control approach (see Temperature and Microbial Growth). Refrigerators preserve temperatures between 0 and 7 degrees Celsius in households and labs. This temperature range inhibits microbial metabolism, reducing microorganism development and extending the shelf life of refrigerated items such as food and medical supplies. Certain types of laboratory cultures can be stored for subsequent use using refrigeration.

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With the exception of psychrophiles, which favour cold temperatures, exposing bacteria to low temperatures can also be a simple and effective technique of microbial control (see Temperature and Microbial Growth). Refrigerators in homes and laboratories keep temperatures between 0 and 7 degrees Celsius. This temperature range suppresses microbial metabolism, dramatically decreasing microorganism growth and extending the shelf life of refrigerated products including groceries and medical supplies. Refrigeration can be used to store certain types of laboratory cultures for later use.

Microbial development can be slowed or even killed by freezing below 2 degrees Celsius. The only safe ways to thaw frozen items, according to the US Department of Agriculture (USDA), are in the refrigerator, immersed in cold water changed every 30 minutes, or in the microwave, at temperatures that are not conducive to bacterial growth. 3 Furthermore, frozen goods should be treated as fresh perishables because interrupted bacterial development can restart.

Bacterial cultures and medical specimens that require long-term preservation or transportation are frequently frozen at temperatures as low as 70°C. Specimens can be kept at these ultra-low temperatures by storing them on dry ice in an ultra-low freezer or in dedicated liquid nitrogen tanks with temperatures below 196°C.