

How is Microwave Technology Used to Process Foods?

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Background

Microwave ovens are a staple in American homes. The same technology used in consumer household microwave ovens is also commonly used in food processing at the commercial level. Microwave technology is used to cook, thaw, melt, dry, render, and blanch foods (Fellows 2009).

How It Works

Microwave technology works by generating electromagnetic waves that vibrate specific molecules within food products. These quick vibrations generate heat that warms or cooks the product. The heating rate of food depends on its composition. For example, foods with a high water content, like fresh vegetables, cook faster than other foods (FSIS 2013). Other factors, such as the food's shape, size, fat content, sugar content, and physical state (e.g., frozen or liquid), also influence how quickly a food is heated (Fellows 2009).

Technology

Microwave ovens convert electric energy from a power source to produce short radio waves (microwaves) using a magnetron, a piece of equipment in all microwave devices. Contrary to popular belief, microwave technology does not cook food from the inside out. In fact, the electromagnetic waves only travel to a depth of about 1 to 1 ½ inches into the food; the remainder of the food is cooked by the heat generated as a result of reactions the electromagnetic waves have with the food (FSIS 2013).

The primary difference in home and commercial microwave technologies is the amount of power output by the machine. Home microwave technology generates enough power to process a small amount of food at one time. Information about a home microwave oven's energy output in wattage (watts or kilowatts, or W or KW) can

be found in the owner's manual or on a label inside or on the back of the device (figure 1). The higher the wattage, the more energy is delivered to the food and the faster it is cooked. Food applications typically use microwave frequencies of 916 MHz or 2,450 MHz.



Figure 1. Example of a label showing the energy output in megahertz and kilowatts on a home microwave oven. (Photo courtesy of Tommy Saunders, Virginia Tech.)

Commercial microwave technology is a process generating enough power to heat or cook larger quantities of food (Fellows 2009). Commercially, microwave technology can take different forms; it can look like a larger version of a home microwave oven or like a long tunnel. In continuous microwave systems (figure 2), a beam of microwave energy can be aligned to treat a particular path where food products and/or packaging travel (Fellows 2009).



Figure 2. A commercial microwave processing system developed by the food engineering team at North Carolina State University. (Photo courtesy of Josip Simunovic, Department of Food, Bioprocessing and Nutrition Sciences, NC State University.)

Efficacy

Foods heated using microwave technology often cook unevenly, leaving cold spots in the food. A food's components (water, fat, etc.) influence the evenness of the cooking. Uneven heating is seen more often in home microwave ovens. This may allow harmful bacteria to survive. Regularly stirring the product during cooking and checking end-point temperatures in multiple places can ensure the safety of the product. To ensure safety, cooking instructions on food labels should always be followed (figure 3). Additionally, all leftovers should be reheated to at least 165°F (FSIS 2013).

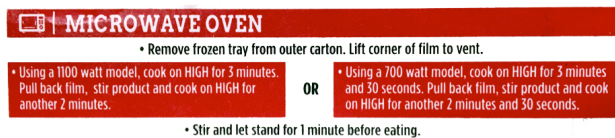


Figure 3. Microwave cooking instructions for a food product. (Photo courtesy of Lily Yang, Virginia Tech.)

Benefits

The use of microwave technology allows rapid heating of food products, typically without overheating one portion of the food. Microwave technology prevents surface and quality changes to food that can occur in other types of heating methods (e.g., browning of food surface when using direct heat in a frying pan) (Fellows 2009). Microwave heating is also energy efficient, preventing excessive use of energy that would be required by many other cooking processes (Fellows 2009).

Current Usage

Microwave technology is commonly used at home; it is a convenient way to prepare frozen and leftover meals. The food industry uses microwave technology to produce ready-to-heat and ready-to-eat meals, to bake items such as breakfast cereals, to blanch fruits and vegetables, and in other applications (Fellows 2009).

References

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