Virginia Cooperative Extension
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Publication FST-357

How Is Pulsed-Light Used To Process Foods?

Authored by Nicole Arnold, Doctoral Student, Food Science and Technology, Virginia Tech; Lily Yang, Postdoctoral Researcher, Food Science and Technology, Virginia Tech; and Renee Boyer, Professor, Food Science and Technology, Virginia Tech

Background

Pulsed light (PL) is a food processing technology in which intense, short-duration pulses of white light are used to kill bacteria on food, food contact surfaces, and packaging. The term "pulsed light" is short for and synonymous with "high-intensity broad-spectrum pulsed light," "pulsed UV light," and "pulsed white light." This technology is often used in the cosmetics industry also.

How It Works

PL uses light frequencies from the electromagnetic spectrum (ultraviolet, visible, and infrared; fig. 1), ranging from about 200 to 1,000 nanometers (John and Ramaswamy 2018). Because visible light is a component of PL technology, humans are able to see it working. PL can be delivered in different ways: a single pulse of light, a burst of pulses, continuous pulses, or random sequences (John and Ramaswamy 2018). The radiation from the UV light damages the bacterial DNA (genetic makeup); (Nicorescu et al. 2013. Bacteria and other pathogens can also overheat and be destroyed by absorbing UV light (Elmnasser et al. 2007).

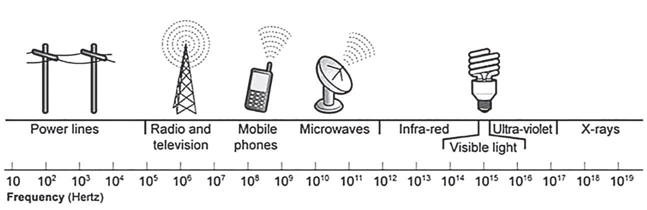

Figure 1. The infrared, visible, and ultraviolet light that make up pulsed light can be seen on the electromagnetic spectrum. (Photo courtesy of U.S. Government Accountability Office.)

Technology

PL systems are generally made up of three major components: (1) the power supply, (2) a pulse-producing device, and (3) a lamp. Stored energy is released into the lamp, which is then converted into an intense pulse of light onto the food being treated (Elmnasser et al. 2007). Additionally, water used in water-assisted PL (fig. 2) can also be used to cool treated produce while ensuring uniform exposure of all produce surfaces to the light (Huang et al. 2015).

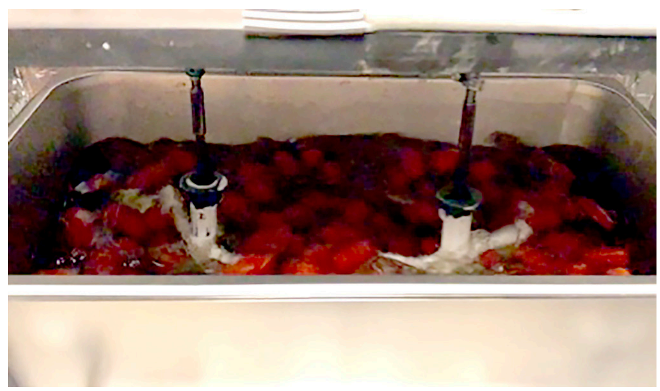

Figure 2. This is an example of pulsed light being used while strawberries are washed in water. (Photo courtesy of Haiqiang Chen, University of Delaware.)

Efficacy

PL does not penetrate foods well and therefore is often only used for surface decontamination. The technology reduces pathogenic *E. coli* and *Salmonella* on raspberries by approximately 99.99% (a 4-log reduction); (Xu and Wu 2016). Factors contributing to the effectiveness of PL include light intensity, number of light pulses, and the pattern of the pulses. Particle size, transparency (i.e., opaqueness), and food composition are all factors of a food product that can also affect efficacy. For example, PL does not work well on high-

Produced by Virginia Cooperative Extension, Virginia Tech, 2020

VT/0320/FST-357

protein or oily foods because the proteins and oils absorb the radiation from the UV light, which interferes with killing pathogens (Elmnasser et al. 2007).

Benefits

In addition to its food safety implications, PL can reduce allergens and extend shelf life while still maintaining product quality (John and Ramaswamy 2018). PL can preserve food quality attributes better than continuous light; because the pulsing prevents constant light exposure, resulting in lower temperatures and, therefore, less heat damage (Krishnamurthy, Demirci, and Irudayaraj 2004).

Current Usage

The U.S. Food and Drug Administration (2018) approved PL for food processing in 1996. While PL is effective in laboratory settings, more research must be done to determine its effect on taste and texture when applied directly to foods. Currently, PL is used commercially to sterilize packaging materials (e.g., bottle caps) in the beverage industry.

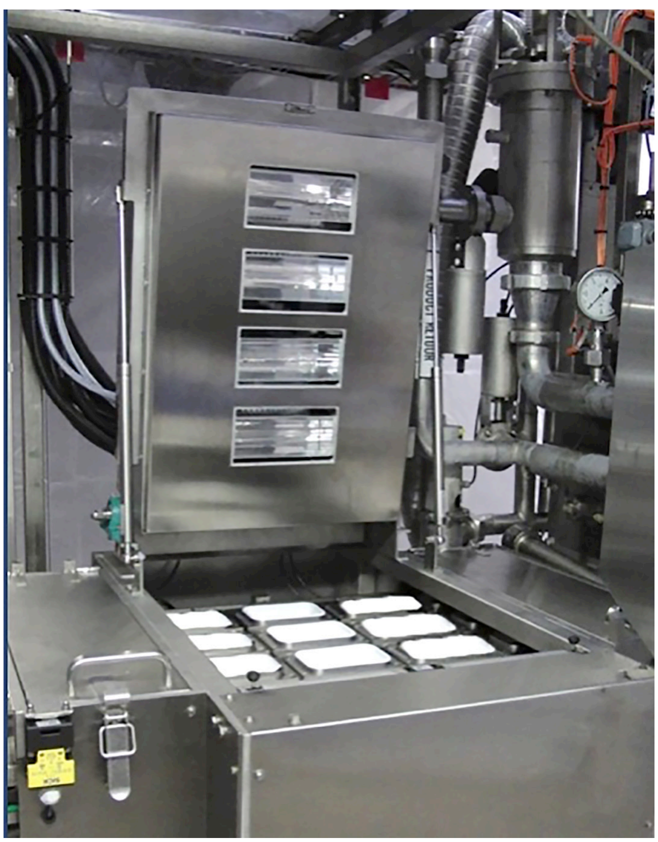

Figure 3. Margarine containers ready for sterilization using pulsed light. (Photo courtesy of Claranor LC.)

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Acknowledgements

This work is supported by the Agriculture and Food Research Initiative competitive grant program A4131 (grant No. 2015-69003-23410/project accession No. 1005440, “Enhancing the Safety and Quality of Fresh Produce and Low-Moisture Foods by Waterless Non-thermal Technologies”) from the USDA National Institute of Food and Agriculture.