



How is Cold Plasma Used to Process Food?



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Background

Cold plasma, or CP, is a food processing method in which plasma, a reactive state of gas, is used to kill bacteria (pathogens) on foods. It has the potential to be used to process fruits, vegetables, meats, poultry, and nuts. The term “cold” is used because this process does not require heat.

How It Works

CP reactions take place in the air above the food. Reactive particles are created when high-voltage electricity is passed through the air or through another type of gas, such as oxygen, nitrogen, or helium. The electricity energizes the gas particles, which then come in contact with the bacterial cells on the food and break the chemical bonds holding together the bacteria’s protective cell wall. As the cell wall becomes damaged, the particles penetrate the bacteria and break apart the cell’s interior organs, including DNA and proteins, killing the bacteria. While this method is powerful against bacterial cells, the type of cells that make up foods are barely affected.

Technology

Many different technologies produce CP. They are defined by how closely the CP comes into contact with the food product (figures 1-3). The specific technology is normally chosen based upon the food being treated.

Efficacy

With CP technologies, harmful pathogens such as *Salmonella*, *E. coli* O157:H7, *Listeria monocytogenes*, and *Staphylococcus aureus* can be reduced by over 99.999 percent (a 5-log reduction). CP effectiveness is influenced by a number of factors,

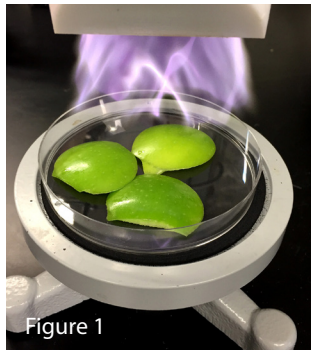


Figure 1



Figure 2

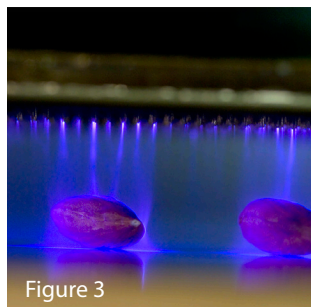


Figure 3

Figures 1-3. The cold plasma process being applied to apples, blueberries, and almonds. (Photos courtesy of Brendan Niemira, U.S. Department of Agriculture, Agricultural Research Service, Eastern Regional Research Center.)

including application method, time, gas(es) used, flow rate, moisture, and temperature. The success of the method also depends on the type of food being treated and the pathogen being killed.

Benefits

CP does not use water or chemicals, nor does it negatively affect the quality of the food. CP could replace some commonly used methods that use lots of water, generate expensive waste, and are not as effective. This technology has the potential to significantly benefit the environment.

Current Usage

While CP is effective in the laboratory, more research must be conducted to determine the effect on foods’ taste and texture and on its efficiency and cost-effectiveness at a larger scale. As of spring 2019, CP is not yet approved by the U.S. Food and Drug Administration for commercial use.

Resources

The information in this publication was modified, with permission, from:

Niemira, B. A. 2012. “Cold Plasma Decontamination of Foods.” Annual Review of Food Science and Technology. 3:125-42.

Acknowledgements

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