

Liquid Food Sterilization Using Pulsed Electric Field

Authors : Tanmaya Pradhan, K. Midhun, M. Joy Thomas

Abstract : Increasing the shelf life and improving the quality are important objectives for the success of packaged liquid food industry. One of the methods by which this can be achieved is by deactivating the micro-organisms present in the liquid food through pasteurization. Pasteurization is done by heating, but some serious disadvantages such as the reduction in food quality, flavour, taste, colour, etc. were observed because of heat treatment, which leads to the development of newer methods instead of pasteurization such as treatment using UV radiation, high pressure, nuclear irradiation, pulsed electric field, etc. In recent years the use of the pulsed electric field (PEF) for inactivation of the microbial content in the food is gaining popularity. PEF uses a very high electric field for a short time for the inactivation of microorganisms, for which we require a high voltage pulsed power source. Pulsed power sources used for PEF treatments are usually in the range of 5kV to 50kV. Different pulse shapes are used, such as exponentially decaying and square wave pulses. Exponentially decaying pulses are generated by high power switches with only turn-on capacity and, therefore, discharge the total energy stored in the capacitor bank. These pulses have a sudden onset and, therefore, a high rate of rising but have a very slow decay, which yields extra heat, which is ineffective in microbial inactivation. Square pulses can be produced by an incomplete discharge of a capacitor with the help of a switch having both on/off control or by using a pulse forming network. In this work, a pulsed power-based system is designed with the help of high voltage capacitors and solid-state switches (IGBT) for the inactivation of pathogenic micro-organism in liquid food such as fruit juices. The high voltage generator is based on the Marx generator topology, which can produce variable amplitude, frequency, and pulse width according to the requirements. Liquid food is treated in a chamber where pulsed electric field is produced between stainless steel electrodes using the pulsed output voltage of the supply. Preliminary bacterial inactivation tests were performed by subjecting orange juice inoculated with Escherichia Coli bacteria. With the help of the developed pulsed power source and the chamber, the inoculated orange has been PEF treated. The voltage was varied to get a peak electric field up to 15kV/cm. For a total treatment time of 200 μ s, a 30% reduction in the bacterial count has been observed. The detailed results and analysis will be presented in the final paper.

Keywords : Escherichia coli bacteria, high voltage generator, microbial inactivation, pulsed electric field, pulsed forming line, solid-state switch

Conference Title : ICFSFPT 2021 : International Conference on Food Engineering and Food Processing Technology

Conference Location : Dubai, United Arab Emirates

Conference Dates : March 22-23, 2021