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In-package cold plasma technologies

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Abstract

Cold plasma is an ideal antimicrobial agent with a gamut of reactive chemical species, that could be obtained from electrical discharges in atmospheric gases. The reactive species are effective against a range of microorganisms, including bacteria, fungi, spores and viruses, as well as pesticides and mycotoxins. Generation of cold plasma inside sealed packages allows to localise and extend the action time of reactive species on microorganisms, while preventing any post-process contamination. In this review, we present an examination of the design aspects of the in-package plasma systems, the packaging requirements, and discuss their efficacy with respect to microbiological and chemical safety of foods.

Keywords: electrical discharge; decontamination; food safety; *E. coli*; ozone

Introduction

Food processing technologies have come a long way with developments evolving from application/deprivation of heat, utilization of microorganisms, natural and chemical preservatives, and application of electromagnetic fields for preservation. Of the several food preservation processes that humankind has developed over the centuries, canning holds a distinct place. This technology has stood the test of times, supported humanity during times of peace as well as wars, and remains widely used in the food industry. With the revolution brought by introduction of polymers in the twentieth century, canning branched into retort pouch technology and gained even more popularity (Misra, et al., 2017). There are numerous reasons that were responsible for the success of canning and retort pouch technology. However, the simplest and quite intuitive design principle turns out to be the processing in a closed (hermetically sealed) environment that prevented post-processing contamination, thereby ensuring a long shelf-life.

Despite the popularity of thermal processing, it has its own widely known demerits, mainly the considerable loss in food quality (Holdsworth & Simpson, 2008). To address this issue, researchers spent the last four decades in exploring and developing nonthermal technologies. Among the nonthermal technologies developed, by far, only irradiation and high-pressure processing (HPP) have gained the most popularity and success in industry and for HPP, also among consumers (Misra, et al., 2017). It should be noted that HPP, (including high hydrostatic pressure) also involves (pressure) treatment inside sealed pouches, thus avoiding the likelihood of post-process contamination.