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Cold plasma in food processing

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Irving Langmuir coined the term “cold plasma” in 1928 to describe a partially ionised gas containing ions, electrons, ultraviolet photons, and reactive neutrals, such as radicals, excited and ground-state molecules. Cold plasma is a novel, non-thermal and disruptive technology that has shown tremendous promise for food processing applications. It is an eco-friendly method used to preserve food and has been employed for numerous operations in the food industry, such as food decontamination, enzyme inactivation, degradation of toxins, quality improvement, the extension of shelf-life, packaging alteration, etc. It is produced when an electrical energy source is applied to a gas such as helium, neon, or argon resulting in the creation of the reactive species described above. Dielectric barrier discharge (DBD) and jet plasma are commonly used for this purpose. Cold plasma operates under ambient or partial vacuum and produces high energy at low temperature by generating excited species in an electric discharge, thus creating reaction products that interact with the pathogen’s cellular organic compounds. These reaction products break covalent bonds and create recombination products with cellular nitrogen, hydrogen and oxygen, causing surface modification and pathogenic microorganism inactivation. Various contributing factors determine the success of the operation, such as plasma reactor design and structure, gas composition, plasma energy, pulse form, and duration of input. It also depends on the water activity, fat and protein content, spore formations, and the number of microorganisms present. Major challenges faced are approval from the regulatory authorities, construction of appropriate plasma source, and controlling reaction chemistry of cold plasma with the article to be treated. Cold plasma has an appeal with its low carbon footprint sustainable procedure along with its non-thermal and economic characteristics making it unique when compared to conventional processing technologies. However, cold plasma processing is still in its infancy and requires further research in order to utilise its maximum potential.

Keywords: Cold plasma, Disruptive technology, Decontamination, Enzyme inactivation, Sustainable, Shelf life, Food Processing, Food packaging

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