Abstract

Food loss and waste are a significant problem from both social, economic and environmental perspectives. Preventing food loss requires efforts at all stages of the food supply chain, especially in reducing the transfer of pathogenic microorganisms from the environment to food products.

Low-temperature plasma is considered a promising alternative to conventional sterilization methods. In order to meet the growing attention to low-temperature plasma, the effectiveness of this method in inactivating fungi belonging to the genera *Fusarium*, *Alternaria* and *Botrytis* on materials commonly used in the agro-food industry was investigated.

The study showed that cold atmospheric plasma generates various reactive oxygen and nitrogen species, which have a biocidal effect on fungal cells by damaging the cell membrane and increasing its permeability. The inactivation effect on fungal cells increased with plasma treatment time and varied depending on the microorganism strain.

Safety assessments of this method have also been conducted, evaluating the risk of developing tolerance and adverse morphological and physiological changes after repeated exposure, potentially leading to increased pathogenicity towards plants in both *in vitro* and *in vivo* studies.

Observations included deformations in cell wall structure, changes in fungal growth rate and biomass production, altered susceptibility to antifungal agents and oxidative stress. Plasma also affected fungal pathogenic traits, including cell adhesion, biofilm formation, production of polysaccharide-degrading enzymes, and extracellular metabolite toxicity. Changes in pathogenicity were strain-dependent and influenced by the number of exposures to sublethal doses of low-temperature plasma.

In vivo experiments demonstrated that multiple treatments of fungal hyphae with low-temperature plasma reduced the pathogenicity of most tested fungal strains. The findings suggest that cold plasma technology could enhance food safety by reducing losses due to cross-contamination. However, individual adjustment of inactivation conditions is recommended for each specific application.