10th Central European Symposium on Plasma Chemistry
21st International Conference on Plasma Physics and Applications

Bucharest, Romania, 1-5 September 2025

Book of Abstracts

Edited by: Daniela Dobrin, Monica Magureanu, Bogdana Mitu, Veronica Satulu

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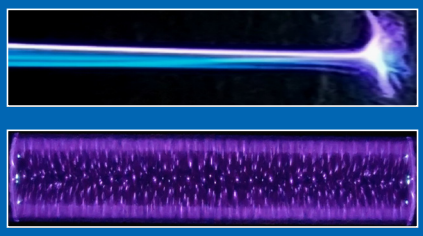

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Combining plasma-activated water with natural phenolics to mitigate yeast biofilm formation and adhesion

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Biofilm formation by yeasts presents significant challenges in food processing, healthcare, and industrial environments [1]. This study investigates the effects of 1 kHz transient spark (TS) discharge plasma-activated water (PAW) and two natural phenolic compounds—cinnamic acid and vanillin—on the biofilm formation and surface adhesion of four yeast species: *Schizosaccharomyces pombe* SZMC 1280, *Wickerhamomyces anomalus* SZMC 8061Mo, *Saccharomyces cerevisiae* SZMC 1279, and *Debaryomyces hansenii* SZMC 8045Mo. Yeast biofilms were cultivated on sterile microscope slides and incubated for 48 hours at 30°C under different treatment conditions: PAW alone, phenolics alone, a combination of PAW and phenolics, and an untreated control group. Fluorescence microscopy at 100× magnification was used to assess biofilm integrity.

Biofilms developed under control conditions exhibited dense, structured formations with substantial extracellular polymeric substances (EPS). Biofilms treated with either PAW or phenolics alone showed reduced EPS deposition. The PAW-phenolic combination biofilms appeared highly fragmented, with diminished biomass and weakened cell attachment. The observed antibiofilm effects can be attributed to the combined action of reactive oxygen and nitrogen species (RONS) including H_2O_2, O_3, NO_2^-, NO_3^- and OH radicals generated in PAW and the antimicrobial properties of phenolic compounds. The enhanced biofilm disruption observed with PAW-phenolic combined treatment likely results from multiple mechanisms: (1) oxidative degradation of EPS by RONS, reducing the protective barrier around yeast cells; (2) increased cell membrane permeability and metabolic disruption caused by phenolics, leading to cell detachment; and (3) interference with biofilm-associated gene expression, preventing biofilm maturation and persistence.

These findings highlight the potential of PAW-phenolic combinations as an effective approach to fungal biofilm control applicable in medical device sterilization, and industrial sanitation.

Keywords: Plasma-activated water, Yeast, Biofilms, Adhesion
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