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Cold plasma reactive oxygen species generate oxidative stress but do not trigger apoptosis in yeast

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The mechanisms involved in cell killing by cold plasmas are to date not well understood and dissection of cellular pathways or structures affected by plasma using simple eukaryotic models is needed. We investigate the effects of interaction of cold air plasma with eukaryotic cells of yeasts by comparing several mutants and corresponding wild type strains of *Saccharomyces cerevisiae* in deionized water subjected to direct plasma and indirect plasma activated water (PAW) treatment by the transient spark discharge with water electrospray.

The cell survival measured by agar plate counts and propidium iodide (PI) staining showed that the cells subjected to direct plasma or to PAW lose their viability; increasing with incubation time. Direct plasma effect was stronger than indirect (PAW). Mutant strains (*Δsod1, Δsod2)* defective in superoxide dismutase (SOD) were more vulnerable, which indicates that O_2^- plays an important role in the cell inactivation (Fig. 1). On the contrary, catalase deficient mutants (*Δcct1, Δcta1*) did not show viability losses, indicating that low concentrations of H_2O_2 (~0.5 mM) in PAW [1] are not a key inactivation agent. Several *in vitro* and *in vivo* studies demonstrated plasma induced apoptosis in cells [2]. The survival of mutants defective in enzymes employed in yeast apoptosis (*Δybh3, Δaif1, Δyca1, Δnuc1*) did not significantly changes compared to the wild types. The apoptotic sequences induced by plasma in yeast cells were thus not confirmed.

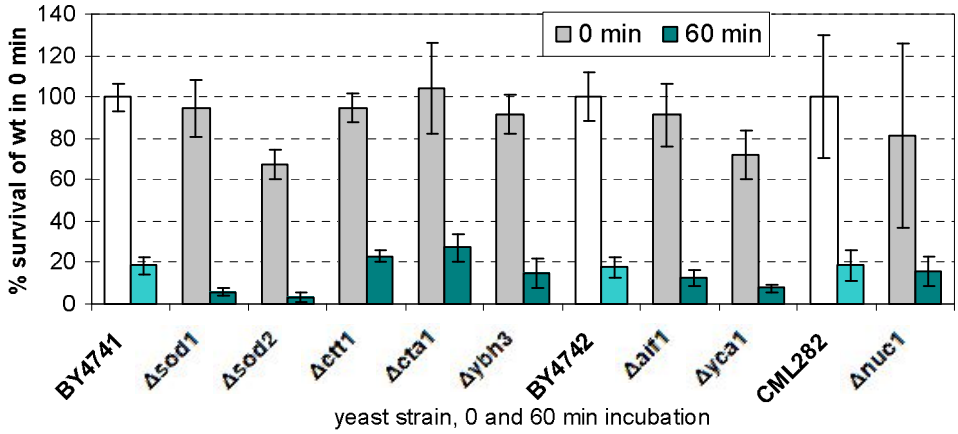

Fig. 1. Survival of yeast strains defective in superoxide dismutases, catalases or programmed cell death pathways in direct plasma treatment. Plotted values represent the survival of mutant strains relative to the survival of wild type (BY4741, BY4742 or CML282) 0 and 60 min post plasma treatment.

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[1] Z. Machala et al.: Plasma Process. Polym. 10, 649 (2013)
[2] R.N. Ma, H.Q.Feng et al., J. Phys. D: Appl. Phys. 46, 285401 (2013)