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Effects of reactive plasma particles to yeast cells using genetic mutants

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We investigated the mechanisms of interaction of low temperature (cold) plasma generated in atmospheric pressure air with eukaryotic cells of yeasts. The focus was on the yeast response to oxidative stress and the potential induction of yeast apoptosis by the cold plasma. Six mutants and corresponding wild type strains of yeast *Saccharomyces cerevisiae* were subjected to direct and indirect (via plasma activated deionized water, PAW) plasma treatment by the air transient spark discharge with water electrospray at a flow rate of 1 ml/min. The effects of plasma interactions with yeast cells were evaluated using the $\%_{survival}$ for both standard and mutant strains and both direct and indirect exposure to plasma in different incubation times post plasma treatment.

The results of $\%_{survival}$ show that direct exposure of the cells to the plasma or indirect exposure to the PAW results in their viability reduction, which increased with incubation time. Direct treatment effect was stronger than indirect (PAW). Mutant strains *Δsod1* and *Δsod2* defective in superoxide dismutase (SOD) were found more vulnerable to both direct and indirect plasma treatment. Since SOD plays an important role in protecting cells from oxidative damage and detoxification of superoxide radicalO_2^- (Fig. 1), this indicates that O_2^- plays an important role in the plasma inactivation of the cells [1]. The presence of O_2^- and other reactive oxygen and nitrogen species were confirmed by chemical analysis of the PAW [2].

Several *in vitro* and *in vivo* studies demonstrated plasma induced apoptosis in cells [3]. Mutants defective in enzymes employed in yeast apoptosis (*Δaif1*, *Δnuc1*, *Δyca1*, *Δybh3*) demonstrated very small changes of survival rate in comparison with standard strains. The apoptotic sequences induced by plasma in model cells were thus not confidently confirmed.

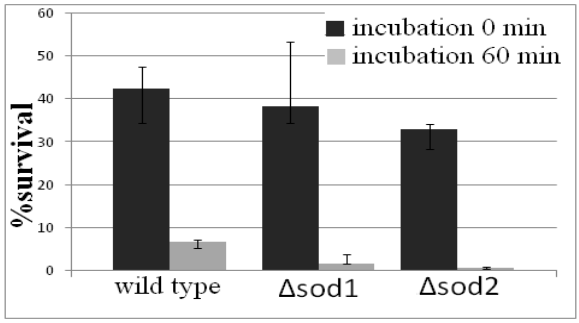

Fig. 1 Median $\%_{survival}$ of selected yeast strains in incubation times of 0 and 60 min post direct air plasma treatment.

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