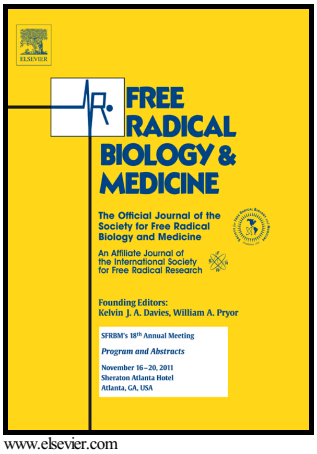

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Long-lived and short-lived reactive species produced by a cold atmospheric pressure plasma jet for the inactivation of *Pseudomonas aeruginosa* and *Staphylococcus aureus*

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Abstract

Different chemical pathways leading to the inactivation of *Pseudomonas aeruginosa* and *Staphylococcus aureus* by a cold atmospheric pressure plasma jet (APPJ) in buffered and non-buffered solutions are reported. As APPJs produce a complex mixture of reactive species in solution, a comprehensive set of diagnostics were used to assess the liquid phase chemistry. This includes absorption and electron paramagnetic resonance spectroscopy in addition to a scavenger study to assess the relative importance of the various plasma produced species involved in the inactivation of bacteria. Different modes of inactivation of bacteria were found for the same plasma source depending on the solution and the plasma feed gas. The inactivation of bacteria in saline is due to the production of short-lived species in the case of argon plasma when the plasma touches the liquid. Long-lived species (ClO^-) formed by the abundant amount of $O^\bullet$ radicals produced by the plasmas played a dominant role in the case of Ar + 1% O_2 and Ar + 1% air plasmas when the plasma is not in direct contact with the liquid. Inactivation of bacteria in distilled water was found to be due to the generation of short-lived species: $O^\bullet$ & $O_2^{\bullet-}$ for Ar + 1% O_2 plasma and $O_2^{\bullet-}$ (and $^\bullet OH$ in absence of saline) for Ar plasma.

Keywords: Atmospheric pressure plasma, electron spin resonance, plasma medicine, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, bacteria inactivation, $O^\bullet$, $O_2^{\bullet-}$, $^\bullet OH$, ClO^-

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