Interaction of pulsed electrical discharge produced at gas-liquid interface with bacteria in water

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Bactericidal effects of non-thermal plasma produced by various types of electrical discharges in gas or liquid phase received considerable interest during recent years due to their potential utilization in various biomedical applications. Chemical effects induced by the reactive oxygen species (ROS) and reactive nitrogen species (RNS) are generally accepted to play the dominant role in the plasma interaction with living matter in the atmospheric air plasma systems. In underwater plasmas, physical processes, such as high electric field, UV radiation and shock waves, may significantly contribute to the biological effects in addition to the chemical effects that are largely attributed to OH radicals and H_2O_2. When the gas phase discharge is generated in close proximity to a liquid surface, chemical species produced by the discharge in the gas or at the gas-liquid interface can penetrate or dissolve into the liquid and initiate biocidal processes in water (such as OH radicals, O_3, H_2O_2, NO_3^-, NO_2^-). In addition to the production of ROS (such as OH radicals, O_3, H_2O_2), production of RNS produced by the discharge under atmospheric conditions with suitable nitrogen sources results into the formation of NO_2^- and NO_3^- in water and increased acidity of plasma treated water. There are also possible synergistic effects of the above mentioned processes, which lead, for example, to the formation of peroxynitrites in water [1-3].

In this paper we investigated chemical and biological effects induced in water by pulsed corona discharge produced at gas-liquid interface between a planar high voltage electrode made from reticulated vitreous carbon (RVC) and the water surface [4,5]. Formation of O_3, H_2O_2, NO_3^-, NO_2^- and $ONOO^-$ produced by the discharge was measured under various conditions and the bactericidal effects of the discharge were studied on inactivation of *Escherichia coli.* The mechanisms of bacterial inactivation and contribution of ROS and RNS was studied in dependence on the composition of the gas atmosphere (oxygen mixtures with nitrogen or with argon) and on the pH value of plasma treated water (controlled by buffers).

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