

## Abstract

The thesis deals with cold plasmas and plasma activated liquids and their applications in biomedicine and agriculture. Namely their use on various targets, such as biomolecules, bacteria, cells, seeds and plants. It consists of five scientific papers published in renowned journals preceded by a commentary including an introduction to all targets, associated plasma induced effects as reported in a literature, followed by our research objectives and a brief characteristic of achieved results. Various sources of cold plasmas of transient spark discharge, gliding arc discharge and He plasma jet are presented, and were used and operated in a contact with various water solutions. The plasma chemical effect and formation of gas phase species ( $\text{NO}_x$ ,  $\text{N}_2\text{O}$ ,  $\text{HNO}_2$ ,  $\text{O}_3$ ) and liquid phase species ( $\cdot\text{OH}$ ,  $\text{H}_2\text{O}_2$ ,  $\text{NO}_2^-$ ,  $\text{NO}_3^-$ ) generated by these discharges were identified by absorption and fluorescence spectroscopy. The effect of various parameters, such as  $\text{N}_2/\text{O}_2$  gas ratio or water activation time on reactive species formation and antibacterial efficiency of a model bacteria *Escherichia coli* are reported. Effects on bacterial inactivation by studied plasma sources was evaluated by standard plate count method. The strongest bactericidal effect was observed in non-buffered water solutions if discharge was generated in air-like mixture. The effect of the discharges on biomolecules, such as DNA or proteins as well as eukaryotic cells was also investigated. The results on HeLa and Vero mammalian cell viability, apoptosis and cell cycle indicate that cold plasma has a potential to selectively target cancerous cells. The effect of the plasma activated water on seed germination and plant growth stimulation was studied in *in vitro* and *in vivo* conditions. We observed improvement of wheat seed water uptake, germination, and early development of the seedlings. The increase of dry weight, photosynthetic pigments content, photosynthetic rate and suppress of antioxidant enzymes activity in wheat and lettuce plants were measured. The effect of plasma activated water was compared to  $\text{H}_2\text{O}_2$  and/or  $\text{NO}_3^-$  solutions of various concentrations and were assessed their individual and combined role in the process of plants stimulation by the plasma activated water.

**Key words:** cold plasma, transient spark discharge, gliding arc discharge, plasma jet, reactive oxygen and nitrogen species, plasma activated water, biomolecules, bacteria, mammalian cells, seeds, plants