inactivation of planctonic microorganisms and their consortiums by DC atmospheric pressure plasma jets

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Among a variety of plasma sources for biomedical applications a special attention is focused on the plasma jets [1] due to their possibility to treat objects of complex shapes and sizes outside the closed discharge volume. Moreover, there is transition observed in microbiology from traditionally considering microorganisms as single-celled organisms to viewing microbial communities as the integral structures that regulate the vital functions depending on the changes in environmental conditions. These factors should be considered in the development of microbial test objects to assess the impact of the plasma exposure [2].

This report presents experimental results for inactivation of planktonic microorganism test strains of *S. aureus, E. coli, P. aeruginosa*separately and in such consortiums *E. coli + P. aeruginosa* and *S. aureus + E. coli + P. aeruginosa*.The total initial concentration in each experiment is 105 CFU/ml. The DC atmospheric pressure air plasma jet at 30 mA [3, 4] is used for microorganisms inactivation. The efficiency of plasma exposure is estimated with a percentage of the survived cells in the strains. The temperature in Petri dish was controlled with a thermal imager FLIR E4 and did not exceed 30 °C.

Fig. 1, *a* shows Petri dish with a control sample of monoculture *P. aeruginosa.*Fig.1, b shows Petri cup with the same monoculture after 10 mintreatment. In this case plasma has eliminated most of the microorganisms. Fig. 1, c and Fig. 1, d demonstrate 10 min treatment results on respective consortia of two and three monocultures. Even though plasma appears to be less effective on consortia compared to monoculture, there is no visible difference in inactivation effect between the two consortia.



Fig. 1. Inactivation of microorganisms: *а)* control, *b) P. aeruginosa, c) E. coli*+*P. aeruginosa,*

*d) S. aureus*+*E. coli+P. aeruginosa*

The obtained characteristic D-times are rather different for the planktonic microorganisms as monocultures and in consortia, namely, for monocultures of *S. aureus*, *E. coli*, *P. aeruginosa* the characteristic D-times are practically the same and are around 3 min, while for the consortia these are 5 min.

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References

1. А M. Laroussi and V. Puech, *Plasma Sourc. Sci. Techn*., **Volume** 2, 034005 (2012).
2. Dudchik N.V. *Hygiene and sanitation*, **Volume** 5, Pages 82-84(2012).
3. A.A. Kirillov, A.V. Paulava, L.V. Simonchik, *22thInternational symposium of plasma chemistry*, 5–10 July 2015, Antwerpen, Belgium, Pages 5, P-II-11-7 (2015).