Development of chitosan membranes with cationic porphyrins incorporated to eliminate microbial contaminants in water supply

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Methods of water disinfection are intended to inactivate pathogens in order to minimize the risk of waterborne disease. Such methods include filtration of various types, treatment with ultraviolet light and a chemical process. However, modern analytical methods reveal that this standard method of water disinfection may lead to the formation of products that are toxic and potentially carcinogenic. The Photodynamic Inactivation could be an alternative process to inactivate microorganisms in water by the combined action of visible light, oxygen, and a photosensitizer. Nevertheless, the photosensitizer can not remain free as a contaminant in this kind of application. So, in this study, chitosan membranes with incorporated photosensitizers were developed aiming photoinactivation of bacteria in drinking water. The phtosensitizers used were *meso*-tetra (***N***-methyl-4-pyridyl)-porphyrin (0,29% w/w) and 5,10,15,20-tetrakis(*p*-aminophenyl)-porphyrin (0,15% w/w). *Escherichia coli* was used as a model in photoinactivation of bacteria in suspension ($1x10^7$ cells mL^{-1}). Results showed that there was a significant bactericidal effect in the presence of chitosan/porphyrin membranes under irradiation with a 590 nm LED (4 log of reduction) compared to the control test (chitosan membranes under light and chitosan/porphyrin membranes in the dark). The more effective system was chitosan/5,10,15,20-tetrakis(*p*-aminophenyl)-porphyrin since it caused the same cellular reduction with less photosensitizer incorporated . These results suggest the effectiveness of the process of photoinactivation when photosensitizers are casted into a polymeric support, and that this system has the potential to eliminate microbial contaminants in water.
Keywords: chitosan membrane, porphyrin, photoinactivation, disinfection of water.

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[1] S. N. Kulshreshtha, *Water Resour. Manag.* **12**, 167-184 (1998).
[2]A. Acher, E. Fischer, R. Turnheim, Y. Manor, *Water Res.* **31**, 1398-1404 (1997).
[3] A. Dabrowska, J. Nawrocki, *Water Res.* **43**, 2201-2208 (2009).
[4] T. N. Demidova, M. R. Hamblin, *Antimicrob. Agents Chemother.* **49**, 2329-2335 (2005).
[5]T. Maisch, *Laser Med. Sci.* **22**, 83-91 (2007).
[6] T. Maisch, J. Baier, B. Franz, M. Maier, M. Landthaler, R. M. Szeimies, W. Bäumler, *PNAS* **104**, 7223-7228 (2007).
[7] M. R. Hamblin, T. Hasan, *Photochem. Photobiol. Sci.* **3**, 436-450 (2004).
[8] T. Maisch, *Mini Rev. Med. Chem.* **9**, 947-983 (2009).
[9] R. Bonnet, M. A. Krysteva, I. G. Lalov, S. V. Artarsky, *Water Res.* **40**, 1269-1275 (2006).
[10] H. M.Tang, M. R. Hamblin, C. M. Yow, *J. Infect. Chemother.* **13**, 87-91 (2007).
[11] A. K. Benabbou, C. Guillard, S. Pigeot-Rémy, C. Cantau, T. Pigot, P. Lejeune, Z. Derriche, S. Lacombe, *J. Photochem. Photobiol., A.* **219**, 101-108 (2011).
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