Photodynamic inactivation of multidrug-resistant bacteria in hospital wastewaters: influence of residual antibiotics

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Hospital wastewater has the potential to be a threat to public health as it can contain bacteria that may facilitate resistance transfer to other species within sewage treatment plants. Some pathogenic microorganisms are more concentrated in hospital wastewaters and some of these strains are resistant to antibiotics, such as vancomycin-resistant enterococci and methicillin-resistant *Staphylococcus aureus*.

Since these effluents are discharged as conventional urban effluents to the municipal sewage system without prior treatment, there is widespread contamination of natural waters with emerging contaminants.

The traditional methods used to reduce the content of enteric pathogens, including multidrug resistant (MDR) microorganisms, of residual waters are based in disinfection processes that are expensive, unsafe and not always effective. Consequently, new technologies are needed, especially for effluents treatment including hospital residual waters. The antimicrobial photodynamic inactivation (PDI) may represent a potential alternative.

PDI uses a nontoxic photosensitiser, in this case a cationic porphyrin, which absorbs energy from visible light and transfers it to other surrounding molecules, creating highly cytotoxic reactive oxygen species (ROS) that inactivate microbial cells.

FIGURE 1
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The researchers evaluated the potential of PDI for treating hospital effluent. The efficiency of PDI was assessed in a buffered solution and in hospital residual water for four MDR bacterial strains of vital clinical importance (*Staphylococcus aureus, Pseudomonas aeruginosa, Acinetobacter baumannii and Escherichia coli*). The synergistic effect of PDI and antibiotics (ampicillin and chloramphenicol) was also evaluated.

The results indicate that PDI can effectively inactivate MDR pathogenic bacteria in the buffered solution (reduction of 6–8 log). In wastewater, the inactivation of the four MDR bacteria was again efficient and the decrease in bacterial survival starts even sooner. A faster decrease in bacterial survival occurred when PDI was combined with the addition of antibiotics.

The researchers concluded that PDI has potential to be an effective alternative to the traditional methods for treating hospital effluent. The inactivation of MDR bacteria in hospital wastewaters is effective and the presence of antibiotics may enhance its effectiveness.

Although the study's findings are very positive, the researchers recognise that more experiments are needed to establish an inexpensive and environmentally friendly antimicrobial protocol. 'The next steps are to determine the efficiency of PDI in raw hospital wastewater, the use of sunlight as a low cost light source and the possibility of immobilising the photosensitiser on solid supports.

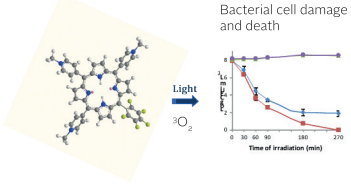

FIGURE 2
Representation of the interactions between the photosensitizer, light, oxygen, and the bacteria.