OPEN ACCESS

Scientific Letters

III 1H-TOXRUN
International Congress 2024
02-03 May, 2024 | Porto, Portugal

Oral Communication 4

Exploring the potential of combined natural photosensitizers, gentamycin, and colistin in antimicrobial photodynamic inactivation of *Pseudomonas aeruginosa* biofilms

Ariana S. C. Gonçalves [1,2], Manuel Simões [1,2,3] and Anabela Borges [1,2,3,*]

[1] LEPABE—Laboratory for Process Engineering, Environment, Biotechnology and Energy, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal
[2] ALiCE—Associate Laboratory for Innovation in Chemical Engineering, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, s/n, 4200-465 Porto, Portugal
[3] DEQ—Department of Chemical Engineering, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, s/n, 4200-465 Porto, Portugal

* Correspondence: apborges@fe.up.pt

Abstract

Background: The increasing prevalence of wound infections poses a growing threat to the healthcare system [1]. Compounding this challenge, the presence of biofilms significantly impairs both the healing process and the effectiveness of the treatment of wound infections [2]. Antimicrobial photodynamic inactivation (aPDI) has shown promising results in combating this global problem. However, its potential against Gram-negative bacteria such as *Pseudomonas aeruginosa* remains a major challenge [3]. **Objective:** The aim of this study is to investigate the effect of subinhibitory concentrations of colistin (CL) in conjugation with curcumin-gentamycin (Cur-Gen) dual combinations on boosting the aPDI of *P. aeruginosa* biofilms. **Methods:** The efficacy of CL in enhancing the photodynamic activity of Cur-Gen against biofilms was investigated using the strain *P. aeruginosa* ATCC 10145. Membrane permeability after CL treatment was assessed by flow cytometry. The synergistic concentrations of the triple combination Cur-Gen-CL were determined using the checkerboard assay. The efficacy of blue light (420 nm, 30 mW/cm^2, 10 min) to photoactivate Cur-Gen-CL and thus promote its ability to prevent and control biofilms was investigated. The total mass, metabolic activity and cell culturability of the *P. aeruginosa* biofilms were quantified by crystal violet, alamar blue and colony forming units (CFU), respectively. **Results:** Subinhibitory CL concentrations (4 µg/mL) increased the membrane permeability of *P. aeruginosa* by approximately 30%. This effect enhanced the efficacy of the photoactivated Cur-Gen-CL triple combination in preventing the formation of *P. aeruginosa* biofilms compared to Cur-Gen alone. In addition, the photoactivated Cur-Gen-CL combination achieved a complete reduction in the culturability (approximately 7 log CFU/cm^2) of preformed *P. aeruginosa* biofilms and a reduction in biomass and metabolic activity by over 60 and 90%, respectively. **Conclusions:** This study has shown that the use of CL is a promising strategy to enhance the aPDI effect of the Cur-Gen combination against *P. aeruginosa* biofilms.

Keywords: antibiotic combinations; antimicrobial photodynamic inactivation; colistin; natural photosensitizers; *P. aeruginosa* biofilms

Acknowledgments

This research was funded by national funds through FCT/MCTES (PIDDAC): LEPABE, UIDB/00511/2020 (DOI: 10.54499/UIDB/00511/2020) and UIDP/00511/2020 (DOI: 10.54499/UIDP/00511/2020) and ALiCE, LA/P/0045/2020 (DOI: 10.54499/LA/P/0045/2020). Ariana S.C. Gonçalves acknowledges individual PhD fellowships from FCT (2022.10913.BD).

References

1. Frykberg R. G., Banks, J. Challenges in the treatment of chronic wounds. Advances in Wound Care, 2015. 4(9):560-582.
2. Clinton, A. and T. Carter, Chronic wound biofilms: pathogenesis and potential therapies. Laboratory Medicine, 2015. 46(4):277-284.
3. Gonçalves, A.S.C., Leitão, M.M., Simões, M., Borges, A. The action of phytochemicals in biofilm control. Natural Product Reports, 2023. 40(3):595-627.