Pluronic F-127 and Chitosan hydrogel delivering nitric oxide with antibacterial effect and cytocompatibility

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Abstract

Nitric oxide (NO) is a small molecule involved in a wide range of physiological and pathophysiological processes, including vasodilatation, control of inflammatory pain, wound healing, and antibacterial activities. As NO is a free radical, the design of drugs that generates therapeutic amounts of NO in controlled spatial and time manners is still a challenge. In this study, the NO donor S-nitrosoglutathione (GSNO) was incorporated into the thermoresponsive Pluronic F-127 (PL) - chitosan (CS) hydrogel (Figure 1), in an easy and economically feasible methodology. CS is a polysaccharide with known antimicrobial and biocompatibility properties. Scanning electron microscopy, rheology and differential scanning calorimetry techniques were used for hydrogel characterization. The results demonstrated that the hydrogel has a smooth surface, thermoresponsive behavior, and good mechanical stability. The kinetics of NO release and GSNO diffusion from GSNO-containing PL/CS hydrogel demonstrated a sustained NO/GSNO release, in concentrations suitable for biomedical applications, at physiological and skin temperatures. The GSNO-PL/CS hydrogel demonstrated a concentration-dependent toxicity to Vero cells, and antimicrobial activity to Pseudomonas aeruginosa (minimum inhibitory concentration and minimum bactericidal concentration values of 0.5 µg·mL-1 of hydrogel, which correspondents to 1 mmol·L-1 of GSNO). Interesting, the concentration range in which the NO-releasing hydrogel demonstrated antibacterial effect was not found toxic to Vero mammalian cell. Thus, GSNO-PL/CS hydrogel is suitable biomaterial for topical NO delivery applications.

Image

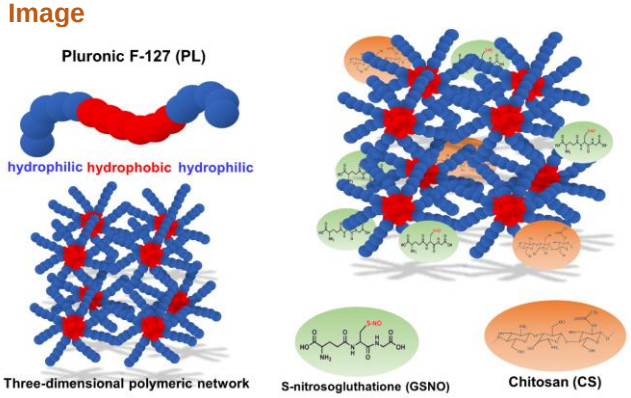
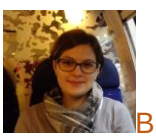


Figure 1: Schematic representation of the formation of three-dimensional polymeric network of Pluronic F-127 (PL) hydrogel structure containing chitosan (CS) and S-nitrosoglutathione (GSNO) to delivery NO.

Recent Publications

1. Pelegrino T Milena (2018) S-nitrosoglutathione-containing chitosan nanoparticles dispersed in Pluronic F-127 hydrogel: Potential uses in topical applications. Journal Of Drug Delivery Science And Technology 43:211-220.
2. Ferraz S Letícia (2018) Antitumor potential of S-nitrosothiol-containing polymeric nanoparticles against melanoma. Molecular Pharmaceutics 1:1.
3. Pelegrino T Mlena (2017) Nitric oxide-releasing nanoparticles: synthesis, characterization, and cytotoxicity to tumorigenic cells. Journal of Nanoparticle Research 19:1.
4. Pelegrino T Milena, Seabra B Amedea (2017) Chitosan-Based Nanomaterials for Skin Regeneration. AIMS Medical Science. 4:352-381.
5. Pelegrino T Milena (2016) Chitosan nanoparticles for nitric oxide delivery in human skin. MedChemComm 10:1-12.



Biography

Milena T Pelegrino has her expertise in synthesis and characterization of nanoscale and bulk polymeric materials for biomedical applications including drug delivery and tissue engineer. She has a Bachelor's Degree in Biological Sciences at the Federal University of Sao Paulo (UNIFESP) finished in 2014. In 2017, he held the sandwich master's degree at UNIFESP in the Sustainability Science and Technology program in conjunction with the University of Edinburgh (Scotland) with the support of Fapesp FAPESP: 2015 / 00393-8) and the Royal Society (Newton Advanced Fellowship - NA140046). She is currently a PhD student (Process FAPESP: 2017 / 05029-8) in the biosystems program of the Federal University of ABC (UFABC).

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