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Invited paper

The photophysical studies of Pluronic F127/P123 micelle mixture system loaded with metal free and Zn 5,10,15,20-tetrakis[4-(benzyloxy) phenyl]porphyrins

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ABSTRACT

Binary mixtures of Pluronics are studied as drug nanocarriers in this work. H_2 and Zn 5,10,15,20-tetrakis [4-(benzyloxy) phenyl] porphyrin were encapsulated onto binary micelle mixture of Pluronic F127/P123. The fluorescence and singlet oxygen generating behaviour of the porphyrins were investigated following incorporation. The fluorescence quantum yield for H_2TBnOPP ($\Phi_F = 0.034$) was higher than that of ZnTBnOPP ($\Phi_F = 0.023$) and decreased when ZnTBnOPP or H_2TBnOPP when in the presence of Pluronic F127/P123 binary mixtures. The k_q values were 2.8×10^8 and 3.7×10^8 M^{-1} s^{-1}, for H_2TBnOPP + Pluronic F127/P123 and ZnTBnOPP + Pluronic F127/P123 in water, respectively. The binding constants (K_b) were 1.58×10^5 M^{-1} and 1.02×10^5 M^{-1} for ZnTBnOPP + Pluronic F127/P123 and H_2TBnOPP + Pluronic F127/P123, respectively.

1. Introduction

Improving essential drug properties such as adsorption, distribution, metabolism, and excretion is essential in developing more effect drug therapies. It has been reported that, almost half of newly synthesized drug candidates often fail due to poor solubility in water, lack of bioavailability, and unfavourable metabolism [1]. Therefore, drug delivery research is essential in the translation of newly discovered molecules into potent drug candidates.

Many nanomedicines such as polymer-based ones are constructed using self-assembly principles including spontaneous formation of micelles used for drug delivery [2]. Polymer-based drug delivery systems have captured the attention of researchers since the end of the 20th century as a promising therapeutic strategy [1,3,4]. Several Pluronics have been approved by Food and Drug Administration (FDA) for oral or intravenous administration because they are widely employed as solubilizers, emulsifiers or coating agents due to their biocompatibility and high drug loading ability [2,5]. Polymeric micelles have been evaluated in several clinical trials as carriers for anti-cancer drugs [6–9].

Pluronic F127 and P123 triblock-copolymer micelles consist of poly(ethylene oxide)–poly(propylene oxide)–poly(ethylene oxide) (PEO–PPO–PEO) copolymers where the micelles have a terminal PEO segment acting as a hydrophilic corona and PPO as a hydrophobic core. They are one of the most studied biocompatible polymer nano-carriers for *in vivo* photodynamic therapy (PDT) studies [10]. These triblock copolymers have similar length of hydrophobic block F127 (PEO_{106}–PPO_{70}–PEO_{106}) and P123 (PEO_{20}–PPO_{70}–PEO_{20}), but different hydrophilic length [11,12]. Their biocompatibility and relatively small size help to prevent the micelles being recognized by proteins and macrophages therefore allowing a greater circulation time [13]. Pluronic micelles have been considered as a powerful and promising vehicle for the delivery of PDT photosensitizers such as porphyrins, chlorins, phthalocyanines, chlorophylls and xanthenes derivatives [3,2,14,15]. The interest in this work will be the mixture micelles of Pluronic F127 and P123 triblock-copolymer. Since Pluronic F127 and P123 have identical hydrophobic blocks, they have been reported to be able to comicellize [16]. It was previously demonstrated that a proper selection of Pluronics enables development of a tailor-made drug delivery system [17–20]. Pluronics hinder photosensitiser aggregation through encapsulation. Lee et al. [21] demonstrated that binary mixture systems may compensate for drawbacks of a mono system.

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