عنوان مقاله:

A New Amphotericin B-loaded Trimethyl Chitosan Nanoparticles as a Drug Delivery System and Antifungal Activity on Candida albicans Biofilm

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خلاصه مقاله:

Amphotericin B (AmB) is an effective antifungal agent; however, the application of AmB is associated with a number of drawbacks. Application of nanoparticles (NPs) is known to improve the efficiency of drug delivery to the target tissues, compared to the traditional methods. In this study, a novel method of NPs preparation was developed. The trimethyl chitosan (TMC) was synthesized using low molecular weight chitosan and was used for the preparation of TMC-NPs through ionic gelation method. Afterward, AmB-loaded TMC-NPs (TMC-NPs/AmB) were prepared and their drug delivery potential was testes. The TMC-NPs and TMC-NPs/AmB were characterized for their structure, particle size, Zeta potential, polydispersity index, morphology, loading efficiency, loading capacity, in vitro release profile, release kinetic, and entrapped AmB potency. The cytotoxicity and antifungal activity of TMC-NPs/AmB against Candida albicans biofilm were evaluated. The quaternization of TMC was estimated to be ۳۶.۴%. The mean particle size of TMC-NPs and TMC NPs/AmB were ۲۱۰±۱۵ and ۳۶۵±۱۰ nm, respectively, with a PDI of ۰.۳۰ and ۰.۴, ZP of +۳۴±۰.۵ and +۲۸±۰.۵ mV, respectively. Electron microscopy analysis indicated uniform spherical shapes with smooth surfaces. The TMC-NPs/AmB indicated LE of ۷۶% and LC of ۷۴.۰۴ % with a potency of ۱۱۰%. The release profile of TMC-NPs/AmB was best explained by the Higuchi model. The initial release after ۱۰ h was obtained at ۳۸%, and the rates of release after ۳۶ and ۸۴ h were determined at ۶۷% and ۷۶% respectively, which was significantly different (P<۰.۰۵) from previous time points. The minimum inhibitory concentration (MIC) (۵۰%) of NPs/AmB and AmB were ۰.۶۵ and ۱.۷۵ µg/mL, and the MIC ۸۰% were determined at ۱.۹۵ and ۷.۷۵ µg/mL, respectively, demonstrating a significant improvement in antifungal activity. The half-maximal inhibitory concentration for TMC-NPs/AmB and AmB were estimated at ۸۶ and ۱۰۵ µg/mL, respectively, indicating a significant reduction in cytotoxicity and the adverse effect. This study could successfully introduce a practical method to synthesize TMC-NPs. The encapsulation process was efficient and significantly improved the antifungal activity of AmB. The developed method can be applied to improve the feasibility of oral delivery while reducing the adverse effects associated with traditional methods.

کلمات کلیدی:
Amphotericin B, Nanoparticles, Trimethyl Chitosan, Candida albicans, biofilm