Nanomedicine & Biotherapeutic Discovery

Extended Abstract

The Release Property of Amoxicillin Nanoparticle and their Antibacterial Activity

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Abstract

Early efforts have been made in an attempt to reduce the adverse side effect of multiple drug resistance organisms, and new classes of antimicrobial nanoparticles (NPs) and nanosized carriers for antibiotics delivery were developed. PURPOSE: This study was focused on the assessment of the physiochemical characterization, In vitro drug release, biofilm formation and antimicrobial properties of amoxicillin encapsulated within the Poly (ε-caprolactone) (PCL) nanoparticles. Methods: amoxicillin (AMX) nanoparticles were prepared using the emulsion solvent evaporation method with different concentrations of polycaprolactone (PCL) and Poly Vinyl Alcohol (PVA). These nanoparticles were subsequently characterized and evaluated for their antibacterial activity and biofilm inhibition activity using mean and standard error for Data analysis. Results: It was found that increased PCL concentration resulted in an increase in entrapment efficiency (EE%) to 83.3%. Meanwhile, an increase in the PVA concentration led to a decrease in the EE% and an increase in nanoparticle size. Enhancements in the percentage of practical yield to 80.2% as the polymer concentration rose. Fourier transform infrared spectra data for the MNPs, CS-coated AMX, and AMX-PCL-NPs nanoparticles were compared, which confirmed the PCL coating on the AMX and the AMX-PCL-NPs loaded nanoparticles. In addition, the antimicrobial activity of the nanoparticles was determined using agar diffusion and growth inhibition assays against both gram-positive Staphylococcus aureus, gram-negative Pseudomonas aeruginosa and Proteus mirabilis bacteria. Furthermore, 10 µg/ml was the minimum inhibitory concentration of the AMX-PCL-NPs nanoparticle which inhibited biofilm formation in Staphylococcus aureus bacteria. Conclusion: Thus, this study presents a novel ß-lactam antibacterial-nanocarrier system that can reduce and inhibit bacterial growth showing it to be a promising tool for numerous medical applications. There is a growing interest among material scientists to provide antimicrobial properties to implantable biomaterials in order to reduce the adverse side effects of the traditional oral antibiotic therapy and the associated Surgical Site Infections (SSIs) when bio-implants are involved. Therefore, in addition to serving its primary function, the implant will also help prevent the formation of bacterial biofilms and the released antimicrobial agent will kill or inhibit the growth of bacteria, thereby reducing the potential of SSIs. This will help overcome the failure of a single antibiotic therapy that may contribute to poor stability of the drug in the acidic pH of the stomach, poor permeability of antibiotics across the mucus layer, or due to the availability of sub-therapeutic antibiotic concentrations at the infection site after oral administration in a conventional capsule or tablet dosage form. All these problems encourage scientific researchers through addition surface modifications to the nanoparticles by preparation an antibiotic delivery system which is able to localize the drug at the infection site and to achieve bactericidal concentrations that are desirable. Optimal modifications to some physicochemical properties of polymeric nanoparticles, such as size and surface characteristics, make it possible to modulate their bio distribution parameters. When designing nanoparticles for a drug delivery system, which can give a large bio distribution of the drug and can allow the reaching of particular sites that are different from reticuloendothelial cells, it is necessary to avoid the removal of drug-loaded nanoparticles from the blood by the endocytic uptake of Kupfer cells or other phagocytic cell populations within the Mononuclear Phagocyte System (MPS). Moreover, more effort was focused on Polymeric Nanoparticles (NPs) in order to increase their capacity for intracellular drug delivery and therapeutic effects by enhancing stability and sustaining release, especially for drugs that act via

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intracytoplasmic receptors. For example, Sahoo et al. Reported that NPs enhanced the paclitaxel efficacy on the breast cancer cell line via sustained intracellular delivery. Another study also presented the improvement of the indomethacin cytotoxic effects on the glioma cell line when it was nano-encapsulated. Besides these examples, the nanoparticle-based delivery system can also be designed to target specific tissues, cells and/or intracellular compartments. Biodegradable polymeric NPs are highlighted areas of drug delivery research; they are used to modify the release and distribution profile of antibiotics, allowing effective delivery to be improved and toxic effects to be lowered.

The biodegradable antimicrobial-based polymers in which antimicrobial drugs, namely ampicillin, and amoxicillin, were chemically incorporated into -anhydride and amide bonds backbone of poly (anhydride-amides) by solution polymerization were designed to locally prevent infections associated, e.g., with medical devices or by controlled hydrolytic degradation.

The in vitro degradation of the polymer into bioactive products were measured and the antibacterial properties examined using gram-negative (Escherichia coli) and gram-positive (Staphylococcus aureus) bacteria. The objective of this study was to focus on the testing the antibacterial activity of amoxicillin antibiotic encapsulated with PCL polymer, which is widely used as a biodegradable polymer for biomedical applications, such as surgical sutures and drug delivery devices, and polyvinyl alcohol as an emulsifier capping agent in the analysis of an in vitro drug release analysis.

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