Chemistry Congress 2019 Enzymatic Degradation Comparison of Silk Fibroin Hydrogel (SFH), Silk Xanthan Hydrogel (SXH) and Silk Silver-Nanoparticles Hydrogel (SSH) for Drug Delivery Systems (DDS) Applications

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Abstract

Drug delivery systems (DDS) reduces side effects as oppose to conventional by targeting and releasing its dosage at specific site in the body. Successful DDS application requires a stable drug delivery mechanism of the drug carrier. Hydrogel based biomaterial has been used over the years to demonstrate successful biomedical application in vitro. This is due to their high biocompatibility and less cytotoxicity. Silk fibroin (SF) has proven to be an excellent choice of hydrogel based biomedical application, its three-dimensional stable network of polymers allows its swelling in large amount of water. In addition, it also degrades continuously overtime which makes it highly suitable as a smart drug vehicle. In an attempt to optimize the properties of silk fibroin, several methodological approaches to silk fibroin hydrogel preparation was adopted and evaluated. The approach here was to regenerate silk fibroin solution, process it by crosslinking with silver nanoparticles (AgNPs) and xanthan solution respectively. Silk Fibroin solution stored at 4°C was dried at room temperature for 3 days to obtain Silk Fibroin Hydrogel (SFH). Silk fibroin was cross-linked with Xanthan to obtain a stable hydrogel (SXH) at its optimum pH and temperature. Lastly, AgNPs was crosslinked with SF to produce SSN. All Hydrogels samples were freeze-dried into scaffolds, Essential Biomaterial Characterization and Enzymatic degradation analysis was carried out on all hydrogels at α=0.05 level.

Introduction

Drugs have been used extensively to improve health care. Health care technology has shii to the practice of drug delivery systems (DDS) in the past few decades to directly deliver treatment at specific targeted while also minimizing side eو ect as oppose the conventional. His great advancement has been implemented to several treatment therapy and even greater changes are anticipated in the near future. Biomedical engineers have contributed greatly to the understanding of the biochemical mechanism of invaded tissue cells with its corresponding physiological barriers to eطciently deliver drug at this site. He biosynthesis of smart drug delivery using diو erent biosynthetic techniques, polymer manipulation to form a stable hydrogel has picked the interest of several researchers in the field. DDS monitors and controls drug release dosage at specific site location. Silk fibroin obtained from Bombyx mori has been studied over the decades for hydrogel due to its excellent biocompatibility in vitro biomedical applications [1,2]. Its protein polymeric structures allows for its excellent biocompatibility with tissue cells. His polymeric network known as SILK I or SILK II possesses great mechanical quality excellent for bearing load which makes silk adequate for as a drug carrier, this diverse range of properties allows are broader span of silk fibroin as potential biomaterial. Xanthan is inhumane to a wide scope of temperature, pH and electrolyte fixations [3,4]. It likewise shows high shear steadiness across this physiological conditions. He presence of silver nanoparticles in silk fibroin hydrogel has been demonstrated in vivo to reduce bacterial contamination. He study therefore aims to determine the optimum processing condition for a silk-induced hydrogel for drug delivery system.

Silk fibroin preparation

Silk was degummed by carefully cutting its cocoons into pieces (Figure 1). Hese pieces were put inside an aqueous solution of sodium carbonate (Na2CO3) under heating at 100°C and agitation for 75 minutes. He gotten silk was washed with distilled and dried for 24 hours. He dried silk was dissolved in a mixture of solvents known as ternary solvent consisting of 1 mole of Calcium Chloride, 2 mole of Ethanol and 8 mole of water (1:2:8 molar ratio) at 75°C for 90 minutes. Dialysis and filtration was carried out using purified water and dialysis bag (purchased from sigma) respectively for 3 consecutive days at 25°C [5]. and dried at 65°C overnight. He dried samples were weighed and decided as dry weight aier degradation (Wt) and the percentage of the remaining weight was calculated [9].

% Weight remained=Wt/Wo × 100

Green synthesis of silver nanoparticles

For purification, all glasswares were sterilized with 70% Ethanol solution. Olive leaves were air-dried in a shaded environment overnight. 20 g of dried olive leaf was grounded into powder form, and immersed in 20 mL Ethanol to begin extract. He solution was immersed in water bath at 30°C, 100 rpm for 3 days allowing the extraction of the olive oil [7]. He solution was later filtered using filter paper and dehumidify at room temperature. Aqueous solution of AgNO3 of 0.034 gram was added to about 5 ml of Olive leaf extract to fix up the solution

up to 1 x 10-3 M of silver nanoparticles [8].

Preparation of hydrogels Silk Fibroin Hydrogel (SFH) Silk Xanthan Hydrogel (SXH) Silk Silver Nanoparticle Hydrogel (SSH) The silk fibroin solution was stored at 4°C and was dried for 3 days to produce Silk Fibroin Hydrogel (SFH) Crosslinking silk fibroin with xanthan to form Silk Xanthan Hydrogel (SXH). Crosslinking silk fibroin with silver nanoparticles to form Silk Silver Nanoparticle Hydrogel (SSH).

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