Carbohydrate Polymers 86 (2011) 1817–1819

Contents lists available at ScienceDirect

Carbohydrate Polymers

journal homepage: www.elsevier.com/locate/carbpol

Short communication

Size controlled synthesis of starch nanoparticles by a simple nanoprecipitation method

Suk Fun Chin*, Suh Cem Pang, Soon Hiang Tay

Department of Chemistry, Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, 94300, Kota Samarahan, Sarawak, Malaysia

ARTICLE INFO

Article history:
Received 8 April 2011
Received in revised form 30 May 2011
Accepted 8 July 2011
Available online 19 July 2011

Keywords:
Sago starch
Nanoparticles
Nanoprecipitation
Particle size control

ABSTRACT

Starch nanoparticles of particle size range between 300 nm and 400 nm were synthesized by a simple nanoprecipitation method from native sago starch (*Metroxylon sagu*). Starch nanoparticles were formed by controlled precipitation through drop-wise addition of dissolved native starch solution to excess absolute ethanol. The size and shape of starch nanoparticles were modulated varying the synthesis parameters including the use of appropriate surfactant. Starch nanoparticles with mean diameter of about 150 nm were obtained in the presence of surfactants during precipitation. Both solvent and non-solvent systems used in the synthesis method were aqueous-based and the method was facile, and easy to perform as compared to other synthesis approaches previously reported.

1. Introduction

Starch is one of the natural occurring polymers which is biocompatible, biodegradable and shows bio-adhesion property. It is a polysaccharide that contains amylose and amylopectin (Pang, Chin, Tay, & Tchong, 2011). Due to its biodegradability, abundance and low cost, starch has been widely used in various applications such as water-soluble pouches for insecticides (Frederiksen, Hansen, Borggaard, & Pedersen, 2002), tissue engineering scaffolds (Gomes, Godinho, Tchalamov, Chunha, & Reis, 2002), excipients for tabletting and drug delivery carriers (Mahkam, 2010). Nano-sized starch particles have attracted much attention due to their unique properties that are different significantly from their bulk materials. Various synthesis methods have been attempted to prepare starch or starch derivatives nanoparticles. Starch nanoparticles with particles sizes of around 20–50 nm were synthesized by complex formation of starch–butanol followed by enzymatic hydrolysis of these starch–butanol complexes (Kim & Lim, 2009). However, due to the significant loss (85–90%) of the initial starch complex during hydrolysis process, the overall yield of the resulting starch nanoparticles was very low. Liu et al. reported the use of a high pressure homogenization method to prepare corn starch nanoparticles with yield of almost 100%. However, their synthesis method did not allow proper control of particle sizes (Liu, Wu, Chen, & Chang, 2009).

Due to its simplicity and reproducibility, the nanoprecipitation technique has been explored for the preparation of synthetic polymer nanoparticles such as poly(lactic acid) (PLA) and poly(lactic-co-glycolic acid) (PLGA) nanoparticles (Bilati, Allemann, & Doelker, 2005). In this paper, we have reported on the synthesis of starch nanoparticles with controllable particle sizes from native sago starch using the nanoprecipitation method. Starch nanoparticles were formed instantaneously in this one-step precipitation process. Starch nanoparticles of controllable particle size and shape were obtained by optimizing the precipitation conditions such as the rate of precipitation and the use of surfactants during precipitation.

2. Materials and methods

All chemicals were of reagent grade and were used without further purification. Ultrapure water (~18.2 MΩ, 25 °C) was obtained from a Water Purifying System (ELGA, Model Ultra Genetic). Sodium hydroxide and Tween 80 were purchased from Merck. Cetyl trimethylammonium bromide was obtained from J.T. Baker. Native sago starch powder was obtained from a local grocery store.

2.1. Preparation of sago starch nanoparticles

Starch nanoparticles were obtained by addition of starch solution into excess absolute ethanol under controlled conditions. In this study, the NaOH/urea (NU) (0.8:1 wt%) solution mixture was used as a solvent system for the dissolution of native sago starch. Generally 1 wt% of native sago starch solution was prepared by dissolving native sago starch powder in the NU solvent at ambient conditions. An aliquot of sago starch solution (1 mL) was added drop-wise into a fixed quantity of absolute ethanol (10 mL, 15 mL and 20 mL) which was continually stirred using a magnetic stirrer at

* Corresponding author. Tel.: +60 82 582999; fax: +60 82 583160.
E-mail address: sukfunchin@gmail.com (S.F. Chin).

0144-8617/$ – see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.carbpol.2011.07.012