RESEARCH ARTICLE

A facile approach for controlled synthesis of hydrophilic starch-based nanoparticles from native sago starch

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A facile approach for the preparation of hydrophilic starch-based spherical nanoparticles from native sago (*Metroxylon sagu*) starch using the drop-wise solvent exchange method was reported. Starch-maleate monoester (SM) was initially synthesized from native sago starch and maleic anhydride in an aqueous medium, and SM nanoparticles was subsequently precipitated in absolute ethanol under controlled conditions. The present study was focused mainly on modulating of the solvent and non-solvent systems to prepare SM nanoparticles of different morphologies. The pH of the solvent system and the nature of surfactants being added into the solvent system could influence the morphology of regenerated SM nanoparticles. SM nanoparticles of discrete and spherical shape were regenerated from a basic SM sample solution, or an acidic sample solution in the presence of an appropriate surfactant. SM nanoparticles with mean diameter of about 250 nm was obtained by precipitation in absolute ethanol in the presence of Brij 35 as the surfactant.

Keywords:
Controlled synthesis / Sago starch / Solvent exchange / Starch-maleate nanoparticles

1 Introduction

Starch is a natural biopolymer which is abundant, biocompatible, biodegradable and non-toxic. It has been studied extensively for various biomedical applications [1–5]. The hydrophilic nature of starch is mainly attributed to the presence of numerous hydroxyl groups in AM and AP as the major components of starch [2]. Such hydrophilicity of starch and its derivatives lead to the formation of non-covalent bonds with biological tissues [3]. Hence, starch-based nanoparticles can potentially be used as drug carriers in drug delivery systems such as in cancer therapy [4] and nasal absorption [5]. However, the presence of numerous hydroxyl groups on polysaccharide chains would lead to aggregation and eventually the collapse of starch nanoparticles [6]. As such, it is necessary to modify native starch hydrophobically in order to prepare discrete and stable starch-based nanoparticles.

Various types of starch-based nanoparticles have been prepared from hydrophobic oligomers of polysaccharides. For instance, hydrophobically modified dextran esters nanoparticles of mean size ranged from 90 to 520 nm has been synthesized [7]. Starch acetate nanoparticles of size ranged from 249 to 720 nm have been prepared by dropwise addition of non-solvent into starch acetate solution [8] Despite the inherent drawback of hydrophilic polysaccharide-based nanoparticles, encapsulation of sparingly water soluble drugs within these nanoparticles of tailored hydrophilicity could enhance their solubility. Besides, the amphiphilic nature of polysaccharide-based nanoparticles would enable their binding readily to the hydrophobic moiety of drugs [9].

Numerous approaches for the synthesis of polymeric nanoparticles that have been reported include solvent exchange, salting-out, emulsion–diffusion–evaporation,

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Abbreviations: CTAB, cetyl trimethylammonium bromide; **FTIR,** Fourier transformed infrared spectrometer; **SDBS,** sodium dodecyl benzene sulfonate; **SM,** starch-maleate monoester

