Preparation, Physicochemical and Film-Forming Properties of Carboxymethyl/Hydroxypropyl Dual-Modified Tapioca Starches

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ABSTRACT

Water-soluble, dual-modified tapioca starches were prepared via carboxymethylation and hydroxypropylation reactions. The effects of modification sequence on physicochemical and film-forming properties of the modified starches were investigated. The reactions were carried out on the native tapioca starch in specific orders to yield either carboxymethylhydroxypropyl starch (CMHPS) or hydroxypropylcarboxymethyl starch (HPCMS). The degree of carboxymethyl substitution (DS) and molar hydroxypropyl substitution (MS) of dual-modified starches were 0.39 and 0.02 for CMHPS and 0.26 and 0.02 for HPCMS, respectively. Both CMHPS and HPCMS were soluble in water, a 1%w/v solution of which yielded pH of 8.0 and 6.8 and the viscosities of 89.3±0.6 and 82.0±1.4 mPa s at shear rate 500 s^{-1}. SEM images revealed marked differences in the granule surface between the native and modified starches, while XRD showed a decrease in the degree of crystallinity in the modified starches compared to their native starches. The film-formation test by Petri dish method showed that CMHPS and HPCMS formed clear films with good strength and fair flexibility. The addition of plasticizers, PEG 6000 and glycerol, and a crosslinking agent – citric acid – at suitable amount, further improved the texture and flexibility of the films. CMHPS film showed a significant improvement on the water vapor transmission rate (WVTR) compared to CMS and HPCMS and can be developed as new aqueous-based, film-coating agents for pharmaceutical tablets.

Key words: Tapioca starch, Hydroxypropylation, Carboxymethylation, Film-coating agent, CMHPS, HPCMS

INTRODUCTION

Starch is one of the most versatile biopolymers used in pharmaceutical industry as it has been utilized as many types of excipient, including filler/diluent, disintegrant, and, in a paste form, binder. However, some inherent physicochemical properties such as the insolubility in water (Krogar et al., 2002), poor flowability, opacity of cooked paste, etc. have limited applications of native starch in many cases. Modification of starch represents an effective way to utilize starch to its maximum potential.