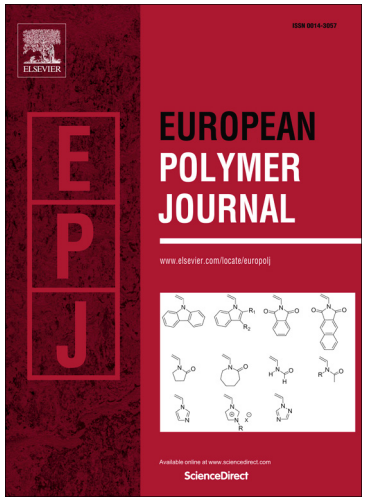

Cross-linked cationic starch derivatives for immobilization of chlorogenic acid

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Cross-linked cationic starch derivatives for immobilization of chlorogenic acid

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Abstract

Cationic cross-linked starches having quaternary ammonium groups (CCS) and tertiary amine groups (CTAS) were used for equilibrium adsorption of chlorogenic acid (CGA) from aqueous solution. The parameters of the Langmuir, Freundlich and Dubinin-Radushkevich adsorption models showed that driving forces of adsorption were interactions between cationic groups of starches and carboxylic group of acid. The values of parameters of both adsorption models and thermodynamic parameters showed that CGA has higher affinity to CTAS than CCS, the adsorption proceeds more favourably with higher exothermic effect and bigger changes in the systems order. Immobilization of CGA on CTAS and especially on CCS prevented the rapid loss of antioxidant activity. CGA adsorbed on CTAS and CCS exhibited the prolonged radical scavenging activity which could be related to gradual CGA desorption from cationic starch microgranules.

Keywords: chlorogenic acid, cross-linked starch, equilibrium adsorption, antioxidant activity

1. Introduction

Starch is inexpensive, widely available natural polymer that can be highly cross-linked with epichlorohydrin (EPCH), modified with various reagents and yield ionic products for adsorption of anionic substances. The cross-linked starches have a tree-dimensional structure and can swell in aqueous medium without dissolution. For instance, cross-linked starches can be cationized with 2,3-epoxypropyltrimethyammonium chloride with high reaction efficiency [1]. One of the advantages of cationic starch derivatives with quaternary ammonium groups (CCS) is that their sorption capacity is independent of pH value of adsorption medium [2]. Meanwhile, the addition of ammonium hydroxide into reaction mixture during starch cross-linking with EPCH is a convenient and an inexpensive way to introduce weakly basic cationic groups in to polymer substrate [3]. Obtained cross-linked cationic starch derivatives with predominantly tertiary amino groups (CTAS) have been characterized using IR techniques [4], and they sorption properties have been evaluated [5]. However, effectiveness of adsorption on CTAS was related to pH of solution, i.e. with ionization of tertiary amino groups.