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Structural and thermodynamic factors on the adsorption process of phenolic compounds onto polyvinylpolypyrrolidone

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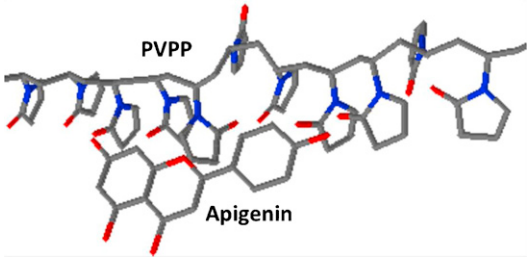
HIGHLIGHTS

- Adsorption depends on the PC molecular size, number and availability of its OH groups.
- The adsorption onto PVPP of some pure PC corresponds to a physisorption process.
- Adsorption process was spontaneous and enthalpically-driven for C.
- The adsorption processes were spontaneous and entropically-driven for EGCG and GA.
- These results implicate potential uses of selective-adsorption of PC.

GRAPHICAL ABSTRACT



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ABSTRACT

In this study we find the possible structural factors that can determine the adsorption process of some pure phenolic compounds (PC) onto polyvinylpolypyrrolidone (PVPP), analyzing their adsorption isotherms by using the Langmuir and the Freundlich theories. In this perspective, the adsorption capacity of short size PC would depend on the number and availability of its hydroxyl groups. To intermediate molecular size PC, the improvement in the adsorption capacity presumably depends on its resemblance with the resveratrol molecule. To large size PC, the adsorption capacity was considerably high due to hydroxyl groups disposed in different spatial orientations with respect to the plane. Thermodynamic analyses showed that adsorption onto PVPP of some pure PC correspond to a physisorption process that was spontaneous and enthalpically-driven for PC like catechin (C) and entropically-driven for PC like epigallocatechin gallate (EGCG) and gallic acid (GA). These results implicate potential selective adsorption uses of PVPP.

1. Introduction

Compared to porous inorganic materials, polymeric adsorbents generally exhibit a higher stability and selectivity, and are easier to be regenerated. They are also of adjustable functionality, surface area and porosity. Consequently polymeric adsorbents have been used extensively in the rare precious metal recovery, in the extraction of natural products and in waste water treatment [1,2]. Nevertheless, due to the complexity of the adsorption phenomena occurring at the liquid/solid interfaces, the literature based on aspects related to polymeric adsorbents is still limited [3,4].

Among its several potential applications, polymeric adsorbents have been widely used to adsorb phenolic compounds (PC). The latter use is of relevance to scientists in the fields of chemistry, chemical engineering, botany and pharmacy.

Although many methods and techniques can be employed to isolate and purify PC from natural extracts, including foods, the adsorption based on polymeric adsorbents is the most prominent

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