The novel use of carbon xerogels for the immobilization of L-asparaginase, an antileukemic drug

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Abstract

L-asparaginase (ASNase, EC 3.5.1.1) is an aminohydrolase enzyme, currently used in the pharmaceutical sector as an anticancer drug to treat acute lymphoblastic leukaemia (the most common type of cancer among children) and in the food industry for the mitigation of acrylamide production on starch-rich foods. Considering the importance of these applications, the continuous study and improvement of this enzyme's properties are required. The immobilization of ASNase is an exciting option for both industries, allowing a more straightforward recovery of the enzyme and the ability to reuse it. Besides, immobilization can reduce the side effects shown by some patients during the free-enzyme administration for the therapeutic sector. Properties such as high surface area and adsorption capacity, and the ability to precisely customize the porosity, makes carbon xerogels (CXs) promising materials for several potential applications, namely for ASNase immobilization. In this work, the influence of the contact time, pH, and enzyme concentration on the yield and relative recovered activity of the immobilized ASNase was studied using the Central Composite Design methodology. The results obtained for three different CXs (pore dimensions ranging from 4 to 30 nm) revealed a significant influence of the enzyme concentration on the immobilization process. The operational and thermal stabilities, as well as the stability at different pH values of the immobilized enzyme were also evaluated. The most promising results were obtained using a CX with an average pore size of 4 nm, reaching maximum immobilization yields and relative recovered activities above 100%. These results confirm the potential of CXs as support for ASNase immobilization. They are considered a step towards searching for a cost-effective and straightforward immobilization process for subsequent use in the therapeutic and food sectors.