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Beta-Cyclodextrin Inclusion Complexes for Antifungal Food Packaging Applications

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Abstract : The microbial contamination in fruits due to the presence of fungal is the most important cause of their deterioration and loss. The development of active food packaging materials with antifungal properties has been proposed as an innovative strategy in order to prevent this problem. In this way, natural compounds as the essential oils or their derivatives, also called volatile compounds (VC), can be incorporated in the food packaging materials to control the fungal growth during fruit packaging. However, if the VC is incorporated directly in the packaging material, it is released very fast due to VC high volatility. For this reason, the formation of inclusion complexes through the encapsulation of VC into beta-cyclodextrin (β-CD) and their incorporation in package materials is an alternative to maintain an antifungal atmosphere around the packaged fruits for longer times. In this context, the aim of this work was to develop inclusion complexes based in β-CD and VC (β-CD:VC) for further application in the antifungal food packaging materials development. β-CD:VC inclusion complexes were obtained with two different molar ratios 2:1 and 1:1, through co-precipitation method. The entrapment efficiency of β-CD:VC as well the release of antifungal compound from inclusion complexes exposed to different relative humidity (25, 50, and 97 %) to headspace were determined by gaseous chromatography (GC). Also, thermal and antimicrobial properties of β-CD:VC were determined through thermogravimetric analysis (TGA) and antifungal assays against Botrytis cinerea, respectively. GC results showed that β-CD:VC 2:1 had a higher entrapment efficiency than β-CD:VC 1:1, with values of 75.5 ± 3.71 % and 59.6 ± 1.51 %, respectively. It was probably because during the synthesis of β-CD:VC 1:1, there was less molecular space to the movement of VC molecules. Furthermore, the release of VC from β-CD:VC was directly related with the relative humidity. High amount of VC was released when the inclusion complexes were exposed to high humidity, possibly due to the interactions between the water molecules and the β-CD hydrophilic wall. On the other hand, a better thermal stability of VC in inclusion complexes allowed to verify its effective encapsulation into β-CD. Finally, antimicrobial assays showed that the inclusion complexes had a high antifungal activity at very low concentrations. Therefore, the results obtained in this work allow suggesting the β-CD:VC inclusion complexes as potential candidates to the development of fruit antifungal packaging materials, which activity is relative humidity dependent.

Keywords : Botrytis cinerea, fruit packaging, headspace release, volatile compounds
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