Cyclodextrins to control enzyme activity

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Cyclodextrins (CDs) are macrocyclic oligosugars, with a hydrophobic internal cavity and a hydrophilic outer surface. The great significance of CDs lies in their ability to form inclusion complexes with other molecules. Moreover, chemically modified CDs are synthesized in order to vary their solubility, to modify their complexation properties and/or to introduce certain specific functional groups. These characteristics facilitate the control of enzyme activity, not only by encapsulation of substrates or products but also by generating new micro-environments around the enzyme when modified CDs are used. We have previously developed a method, basically performed in water, to synthesize a new thiol-cyclodextrin. In this work the enzymatic browning, involving the oxidation of polyphenols by polyphenol oxidase (PPO), was selected as a model to study the effect of β-CD and thiol-CD on biocatalysis. The influence of PPO source, substrate’s structure and presence of thiol groups in the oligosaccharide were evaluated in order to demonstrate the versatility of CDs to control enzyme activity. Thus, apple enzyme was inhibited by β-CD while tomato PPO significantly increased its activity. Both β-CD and thiol-CD showed more affinity for chlorogenic acid than methylpyrocatechol, suggesting that interactions between host and hosted affect the encapsulation process. Finally, 1000-fold fewer µmoles of thiol-CD were needed to inhibit apple PPO than the required to achieve the same inhibition with β-CD.

Keywords: cyclodextrin, enzymatic browning, polyphenol oxidase.