

Abstract

Application of Thiolated Silica Nanoparticles in Food Industries [†]

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This study demonstrates the synthesis of silica nanoparticles (Si-NPs) using the sol-gel method, followed by thiolation via mercaptopropyl tri-methoxy-silane, to encourage the covalent binding of *Aspergillus oryzae* β -galactosidase with the developed nanosupport. A higher yield of 89% for enzyme immobilization was obtained on the obtained surface functionalized nanobiocatalyst. The pH and temperature optima of the immobilized and soluble enzymes were found to be 50 °C and pH 4.5, respectively. Nevertheless, when compared to soluble β -galactosidase (S β G), β -galactosidase bound to thiolated Si-NPs (I β G) demonstrated a marked increase in activity under extreme temperature and pH variations. This was due to the improved tolerance towards harsh pH ranges and the limitation of the enzyme's thermal movement at higher temperatures. Furthermore, it was noted that even after an hour, I β G still retained 58% activity at 5% galactose concentration. However, S β G displayed 23% activity in similar experimental conditions. The immobilized enzyme was found to be reusable, retaining 63% of its activity even after six repeat uses. According to the batch reactor experiment, I β G showed 86% and 79% lactose hydrolysis at 50 °C and 60 °C, respectively, whereas the soluble enzyme showed 71% and 60% lactose hydrolysis under the same conditions after 8 h. Further investigation into the stability of the generated nanobiocatalyst will be necessary to produce lactose-free dairy products in continuous reactors and to produce galacto-oligosaccharides.

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