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Effect of Silicon nano particles on Immobilization of Glucoamylase on Nano-Support Materials

Abstract:

The immobilization of glucoamylase enzymes on nano-support materials enhances their stability, reusability, and catalytic efficiency, making them highly suitable for industrial bioprocesses. In this study, glucoamylase from Aspergillus oryzae was immobilized using calcium alginate beads, with and without silica nanoparticle (SNP) coating, to evaluate their functional stability and performance. The optimal enzyme entrapment was achieved using 5% alginate beads, and further reinforcement with 1% SNP significantly improved mechanical strength and reusability. Characterization studies demonstrated that SNP-coated alginate beads exhibited higher activation energy (48.34 kJ mol^{-1} vs. 37.69 kJ mol^{-1}) and improved resistance to thermal inactivation compared to non-coated beads. The immobilized enzyme maintained catalytic activity over a broad pH range (4.5–8.0) with an optimal pH of 6.0. Kinetic analysis revealed enhanced substrate affinity and turnover rates for the SNP-modified beads, indicating their potential for efficient starch hydrolysis. The scanning electron microscopy confirmed the structural integrity of the SNP-coated beads, showcasing their smooth and uniform morphology, which facilitated enhanced enzymatic hydrolysis. The results underscore the potential of nano-engineered enzyme immobilization strategies for improving biocatalytic processes, particularly in industrial starch hydrolysis applications. The enhanced stability and reusability of the immobilized enzyme reduce processing costs, minimize enzyme loss, and improve efficiency in large-scale biocatalysis applications. Furthermore, the use of silica nanoparticles enhances enzyme performance under industrial conditions, making it a promising approach for sustainable and high-yield food processing technologies.

Biography

Anam Saqib has completed his PhD at the age of 34 years from National Institute for Biotechnology and Genetic Engineering (NIBGE), Pakistan and fellowship program at Denmark's Technical University (DTU), Denmark. She is the Head of the Department (HOD)/ Principal Scientist at Quintech Centre for Applied Sciences (QCAS), Lahore, a sister organization and Research Centre for industrial & Fermentation Biotechnology. She has published more than 15 papers in reputed journals and has been nominated as professional trainer for international interns training program under OIC-COMSTECH.