Nanofiber And Metal Organic Framework Based Entrapment Of An Alpha Amylase And Its Kinetic Studies

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INTRODUCTION

In yester years, immobilization of an enzyme has been presented as a tool for the enhancement of enzyme properties such as reusability and stability. On the other hand, type of material which is used, plays a vital role in the entire process of immobilization, because of powerful effect of support materials in the outcome of the catalytic system. For the purpose of entrapment of enzyme, two different methods are used, in which Nanofiber as well as metal organic framework are selected as support material. Nanofiber proved as a solid matrix for immobilization of enzymes because of their high surface area to volume ratio and less mass transfer resistance (Pesaran et al., 2015). Whereas, Metal organic framework is crystalline, porous material composed of organic linker and metal nodes (Li et al., 2016). This study provides the selection of appropriate background material for specific enzyme, and their kinetic properties

Method

Synthesis Of Nanofiber Immobilized Alpha Amylase

Alpha Amylase (enzyme) Amount	Polymer Amount, %	Solvent (5ml)	Flow Rate	Voltage	Drum Distance (cm)
0.5 gm (soluble)	PVA, 0.8 gm, 8%	Water	1 ml/hr	21.5 KV	16 cm
0.225 gm (insoluble)	PMMA, 0.225 gm, 4.5%	Dmf	0.5 ml/hr	10 KV	10 cm
0.3 gm (insoluble)	PVAC, 0.7 gm, 14%	Methanol	1 ml/hr	11.8 KV	12.5 cm

Amount of enzyme and polymer used in synthesis of nanofiber

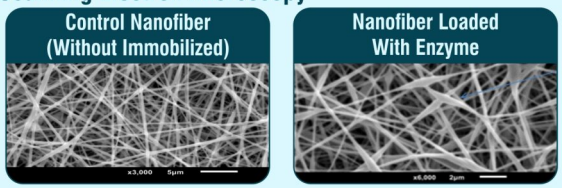
Electrospinning Unit

Synthesis Of Metal Organic Framework Entrapped Alpha Amylase

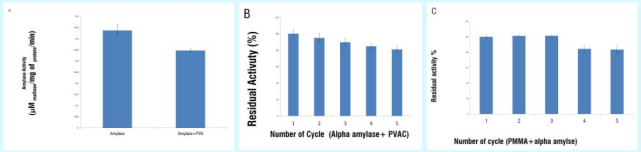
The support material was synthesized by three different solutions, Solution 1 (Trimesic acid + NaOH) + Solution 2 (Enzyme + distilled water) and Solution 3 (FeCl3) was added drop wise, then Allow the solution on magnetic stirrer for crystallization (30 min) and filter it with distilled water.

Result

Scanning Electron Microscopy

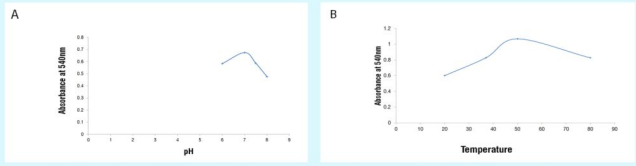


Alpha Amylase Enzyme Activity



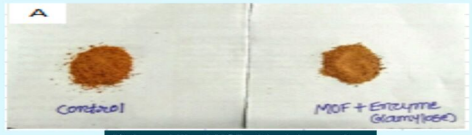
A) Comparison between free and immobilized alpha amylase in nanofiber B) Residual activity of PVAC + alpha amylase C) Residual activity of PMMA + alpha amylase.

Stability Of Nanofiber Entrapped Alpha Amylase



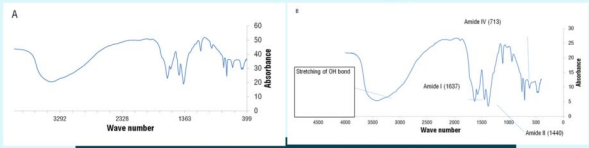
A) Effect of pH on immobilized alpha amylase in nanofiber B) Effect of temperature on immobilized alpha amylase in nanofiber.

Synthesis Of Metal Organic Framework



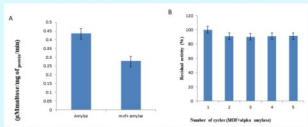
A) Immobilized MOF with alpha amylase

Fourier transform infrared spectroscopy



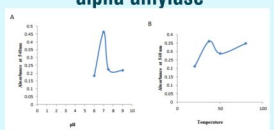
A) FTIR of Control MOF B) FTIR of MOF immobilized alpha amylase

MOF immobilized alpha amylase enzyme activity



A) Comparison of free and immobilized alpha amylase in MOF
B) Residual activity of MOF + alpha amylase.

Stability of MOF entrapped alpha amylase



A) Effect of pH on immobilized alpha amylase in MOF
B) Effect of temperature on immobilized alpha amylase in MOF.

Conclusion

Threw SEM image, it was confirmed that enzyme was entrapped successfully.Residual activity of Nanofiber (PVAC and PMMA) was the 81% after 5 cycles. In FTIR of MOF immobilized enzyme, same group gave the different wave number in immobilized alpha amylase compare to control MOF. While, MOF + alpha amylase gave 91% residual activity. At pH 7 MOF and Nanofiber shows maximum activity.Temperatures were different in case of Nanofiber at 50 ^{0}C and MOF 37 ^{0}C.

Reference

Pesaran, M., Amoabediny, G. and Yazdian, F., 2015. Effect of cultivation time and medium condition in production of bacterial cellulose nanofiber for urease immobilization. International Journal of Polymer Science, 2015.

Li, S.F., Chen, J.P. and Wu, W.T., 2007. Electrospun polyacrylonitrile nanofibrous membranes for lipase immobilization. Journal of Molecular Catalysis B: Enzymatic, 47(3-4), pp.117-124.