REVIEW ARTICLE

Immobilisation of fungal Beta-galactosidase – Review

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ABSTRACT

Beta-galactosidase enzyme catalyses conversion of lactose to its monosaccharides. The importance and use of fungal Beta-gaalctosidase is mentioned in this review article. Immobilisation of Beta-galactosidase using convanalin A, chitosan, calcium alginate, starch alginate, barium alginate and cobalt alginate entrapment beads were discussed here. For all these immobilisation techniques enzyme activity and stability of the immobilised enzyme complexes were reported by the researches. Along with this, therapeutic effect of the Concanavalin A, calcium-starch alginate enzyme complex is studied and reported by researchers. The hydrolysis of milk and whey using immobilised Beta-galactosidase are also reported and the maximum concentration of glucose after enzyme treatment was around 1404 mg/decilitre after 15 minutes of enzyme treatment.

Keywords: Beta-galactosidase, Immobilisation, Concanavalin A, Hydrolysis

INTRODUCTION

Beta-galactosidase is a member of hydrolase family that brings about the cleavage of glycosidic bond present between carbohydrates. Enzyme Beta-galactosidase converts lactose, a disaccharide to its monosaccharides, galactose and glucose by breaking of the beta-galactosidic bond present within them and provides various health benefits like providing a healthy alternative for lactose intolerance individuals (Parmjit *et al*., 2016). Beta-galactosidase is naturally present in animal organs e.g. Placenta and brain and also present in plants like peaches, apicoats and almonds (Soares *et al*., 2001). Along with plants and animals, microbes are also considered as important & naturally occurring sources of Beta-galactosidase. Microbes can give high yield of enzyme and reduces the cost production by growing on agro-waste (Holsinger *et al*., 1991). Synthesis of potential prebiotic with different nutritional health benefits is a result of transgalactosylation reaction catalyst by Beta-galactosidase enzymes which adds on to the industrial application of Beta-

galactosidase (Pernosil *et al*., 1987). The prebiotics synthesised are lactulose and galactooligosaccharides (GOS). Various microorganisms have been screened for high amount production of Beta-galactosidase. Effect of temperature and pH for optimal activity of the enzyme will differ from source to source. Amongst all the microbes, fungi are the most preferred source of Beta-galactosidase as it synthesises thermostable and extracellular enzyme. The optimum pH of fungal Beta-galactosidase is reported to be around 2.5-4.5 and optimum pH for bacterial Beta-galactosidase is around 6-7. The variation in optimum pH makes the enzyme suitable for their specific applications such as whey as hydrolysis of sweet whey and milk. The fungal Beta-galactosidase can be used for acidic whey hydrolysis. It was found that lactic acid bacteria isolated from various dairy products are the major source of this enzyme. Use of soluble enzyme in industries has many disadvantages like high sensitivity to several denaturing agents, non-reusability and presence of some inhibitory molecules in reaction mixture or samples. These obstacles can be overcome by using immobilised form of enzymes. Various immobilisation techniques are used to immobilise enzymes. These are Entrapment, Covalent Bonding, Membrane confinement and Adsorption.

MATERIALS AND METHODS

Immobilisation of beta-galactosidase using concanavalin A was done by using jack bean extract was done and further this complex was crosslinked with gluteraldehyde (Toshiba *et al*., 2007). Calcium alginate entrapped enzyme was used in packed bed reactor and stirred batch process for the hydrolysis of lactose in milk / whey (Toshiba *et al*., 2009). A novel technique was used as a therapeutic agent. In this technique, a concanvaline layered calcium alginate – starch beads were developed (Toshiba *et al*., 2008). Another novel method of Beta-galactosidase immobilisation was carried out by using starch alginate beads preparations (Ates *et al*., 1997). Stability of gluteraldehyde - activated chitosan in hydrolysis of lactose and in galactooligosaccharrides synthesis was performed (Manuela *et al*., 2013). The enzyme was also immobilised on chitosan a naturally occurring polysaccharides (Carlos *et al*., 1994). For all these enzyme preparations optimum enzyme activity was studied.

RESULTS AND DISCUSSION

The enzyme activity of Concanavalin A –Beta galactosidase complex was 92% and the same complex when crosslinked with gluteraldehyde showed decrease in its enzyme activity which was around 88%. The Vmax value of the calcium alginate entrapped enzyme used in whey hydrolysis was around 4.2 X $10^{-4.}$ Beads prepared were spherical in shape. The area and volume of the calcium –starch alginate beads were calculated and was found to be 341.94 X 10^{-3} and 18.80 X 10^{-3} respectively. Immobilised enzyme shows enzyme activity in wide range of pH, which is not seen in case of soluble enzyme preparations. Immobilized β- galactosidase maintain around 84% and 95% enzyme activity at pH 3.0 and 5.0, respectively. In case of soluble enzyme, activity retained is around 52% and 78% of the initial enzyme activity under similar conditions of pH 3.0 and 5.0 respectively. The results obtained indicates no of effect of prolonged inucation on the enzyme activity of the immobilised enzyme. (Toshiba *et al*., 2008; 2009). In this method, entrapment of Beta-galactosidase in cobalt alginate beads were performed. The relative enzyme activity of cobalt alginate beads was found to be 83%. The study to get the effect of pH and temperature on immobilised and free enzyme was performed. The pH range used for the study was 4 - 9.2 and the maximum activity was observed in range of 4 - 4.9 for both forms of enzyme. The maximum productivity obtained was 212 mg/decilitre/min at a residence time of r = 1.4 min. The highest concentration of glucose obtained was 1404 mg/decilitre when the treatment of immobilised enzyme was given for 25 minutes (Ates *et al*., 1997). The GOS productivity of chitosan immobilised enzyme in the PBR related to the operational flow rate indicates that the maximum of 484.5 g L^{-1} h^{-1} at 15 mL min^{-1} of GOS production can be achieved. Immobilisation technique of β-galactosidase using chitosan Allows researchers to fix the enzyme with the possibility of holding more than 75 % of the initial activity during 183 days at a half-life of 108.9 h (Carlos *et al*., 1994). There were number of studies conducted on stability and enzyme activity of immobilised enzyme by researchers.

REFERENCES

Carlos Carran and Amelia Rubiolo (1994) *Immobilisation of β-galactosidase on Chitosin.* Biotechnological Progress, Page No. 220-224.

Soares I, Tavora Z, Barcelos RP and Baroni S (2001) "*Microorganism produced enzymes in food industry." Journal of Agriculture & Biological Science.* Volume – 488, Page No. 83-94.

Manuela P Kleina, Lucas P Fallavena, Jéssie da N. Schöffer, Marco AZ Ayub, Rafael C Rodrigues, Jorge L Ninow, Plinho F Hertz (2013) *High stability of immobilized Beta- galactosidase for lactose hydrolysis and galactooligosaccharides synthesis.* Carbohydrate Polymers, Page No. 465– 470.

Parmjit S Panesar, Shweta Kumari, and Reeba Panesar (2010) *Potential Applications of Immobilized β-Galactosidase in Food Processing Industries.* SAGE-Hindawi Access to Research Enzyme Research, Volume 2010, page 16.

Prenosil JE, Stuker E and Bourne JR (1987) *Formation Of oligosaccharides during enzymatic lactose hydrolysis. Part I: State of art.* Biotechnol. Bioeng. 30:1019–1025.

Ates S and Mehmetoglu U (1997) *A new method for immobilisation of β-galactosidase and its utilization in plug flow reactor*. Process Biochemistry, Volume 32, Issue No. 5, Page No. 433-436.

Toshiba Haider, Qayyum Husain (2008) *Concanavalin A layered calcium alginate–starch beads immobilized galactosidase as a therapeutic agent for lactose intolerant patients.* International Journal of Pharmaceutics, Page No.1-6.

Toshiba Haider, Qayyum Husain (2007) *Calcium alginate entrapped preparations of Aspergillus oryzae galactosidase: Its stability and applications in the hydrolysis of lactose.* International Journal of Biological Macromolecules, Page No.72-80.

Toshiba Haider, Qayyum Husain (2009) *Hydrolysis of milk/whey lactose by β-galactosidase : A comparative study of stirred batch process and packed bed reactor prepared with calcium alginate entrapped enzyme.* Chemical Engineering and Processing: Process Intensification, Page No. 576-580.

Holsinger VH, Kligerman AE (1991)*Application of lactase in dairy foods and other foods containing lactose".* Food and Technology, Volume -167, Page No. 1938-1953.