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Whole Cell Based Biotransformation: An Effective Approach for Synthesis of valuable Compounds

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COLUMN ARTICLE

"Reduction of the impact of Chemistry on the Environment by preventing the pollution at its source level and avoiding the use of toxic/ hazardous reagents is what we call as Green Chemistry".

Biocatalysis these days has attained much attention as a green and sustainable alternative for the synthesis of biologically valuable compounds replacing the well-established chemical synthesis reactions [1-4]. Chemical synthesis pathways suffer from serious disadvantages such as; the use of toxic catalysts, harsh reaction conditions, side product formation, mixture of stereoisomer products, lesser yields and most importantly generation of toxic fumes/ solvents/chemicals which are hazardous to environment. Hence, greener alternatives for the synthesis of valuable compounds are in much demand and is a field of interest for many researchers [5,6]. Biocatalysis can often be performed by either purified enzymes or whole cell systems.

Among the broad variety of enzymes produced by microorganisms; hydrolases (63%), isomerases (25%) and lyases (5%) are the most commonly used purified enzymes in industrial production of compounds [7]. There are wide variety of reports available for synthesis of valuable compounds making use of purified isolated enzymes [8,9]. However, recently, many researchers have opted for the use of whole cells for biocatalytic reactions [2,6,10-12]. Whole cell based biotransformation is a new and upcoming tool for synthesis reactions. It is a much preferable route of synthesis especially where co-factor regeneration is required and in the cases where multi-enzyme cascades is required [4]. Additionally whole cell based biotransformation have other advantages over purified enzymes such as; (a) they provide a native environment to the enzyme like that of a bag; the enzyme is protected from harsh pH etc.; (b) whole cell based systems are cost-effective as opposed to purified enzymes wherein purification of enzymes, co-factor addition, intermediate addition etc. is required which further adds to the cost.

Now the question arises, how to get an efficient whole-cell biocatalyst? Bioprospecting is necessary for synthesis of the desired compound [13]. There can be two ways to find an efficient biocatalyst; (a) Pre-existing library- this consist of a set of organism that has been previously characterized to some degree or mentioned in the literature but their detailed enzymatic activity is unknown; (b) Randomly-generated library- here the researchers screen various samples such as soil, rotten piece of fruit etc. for the detection of desired activity of microbe.

For whole cell based biotransformation, host cell is of much importance. An ideal host should have following prop-

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erties; genetically amenable, grow in a cheaper media, grow fast, allow easy conversion into products, allow synthesis in bi-phasic media, and is compatible to various downstream processing methods. *E. coli* is a popular choice as host due to the ease of genetic manipulation and production of enzyme in high levels. Nature is still largely unexplored and is the most valuable source of new microorganisms capable of biotransformation. Recently, many researchers are particularly interested in the extremophiles such as psychrophiles, halophiles, acidophiles and thermophiles extremophiles as a valuable source of new enzymes and metabolites [14-16].

Although Nature is the best source for finding novel biocatalysts but still many of the microorganisms lack in terms stability, availability and productivity. Hence, new techniques such as recombinant DNA technology, metabolic engineering and combinatorial biosynthesis allow the improvement in terms of productivity and yield of the compound. In one such report, β-galactosidase was fused with spore coat protein (cot G) of *Bacillus* and was displayed on the surface of *Bacillus subtilis* spores. The recombinant spores were then used for transgalactosylation studies [17].

CONCLUSION

Thus, the whole cell approach can be considered as an efficient tool for synthesizing valuable compounds. Many research groups are interested in this field of whole cell biocatalyst but still this approach needs to be explored more so that they can be safely and comfortably used at industrial levels. High throughput screening is the most crucial factor required for selecting the microbe for biotransformation assay. Fast screening procedures, genetic modification (so as to lead high productivity), and well-designed bioprocess methodology can be aimed at so as to improve biocatalyst performance.

BIBLIOGRAPHY

1. de Carvalho CCCR. "Enzymatic and whole cell catalysis: finding new strategies for old processes". *Biotechnology Advances* 29.1 (2011): 75-83.

2. Ojha S., *et al*. "Synthesis of hexyl α-glucoside and α-polyglucosides by a novel Microbacterium isolate". *Applied Microbiology and Biotechnology* 97.12 (2013): 5293-5301.

3. Turner NJ and Truppo MD. "Biocatalysis enters a new era". *Current Opinion in Chemical Biology* 17.2 (2013): 212-214.

4. Sigrist R., *et al*. "Nature-inspired enzymatic cascades to build valuable cascades". *Biotechnology Advances* 33.5 (2015): 394-411.

5. Oroz-Guinea E and Garcia-Junceda. "Enzyme catalysed tandem reactions". *Current Opinion in Chemical Biology* 17.2 (2013): 236-249.

6. Ojha S., *et al*. "Production of isomalto-oligosaccharides by cell bound α-glucosidase of Microbacterium sp". *LWT-Food Science and Technology* 60.1 (2015): 486-494.

7. Johannes T. "Biocatalysis". London (UK). Taylor and Francis. Encyclopedia of Chemical Proceeding (2006): 101-110.

8. Milosavic NV., *et al*. "A simple and efficient one-step, regioselective, enzymatic glucosylation of arbutin by α-glucosidase". *Tetrahedron Letters* 48.40 (2007): 7222-7224.

9. Fernandez-Arrojo L., *et al*. "Transformation of maltose into prebiotic isomaltooligosaccharides by a novel α-glucosidase from Xanthophyllomyces dendrorhous". *Process Biochemistry* 42 (2007): 1530-1536.

10. das-Bradoo S., *et al*. "Synthesis of alkylgalactosides using whole cells of Bacillus pseudofirmus species as catalysts". *Journal of Biotechnology* 110.3 (2004): 273-286.

11. Rather MY., *et al*. "β-Glucosidase catalyzed synthesis of octyl-β-D-glucopyranoside using whole cells of Pichia etchellsii in micro-aqueous media". *Journal of Biotechnology* 150.4 (2010): 490-496.

12. Dahiya S., *et al*. "Biotransformation of sucrose into hexyl-α-D-glucopyranoside and-polyglucosides by whole cells of Microbacterium paraoxydans". *Biotechnology Letters* 37.7 (2015): 1431-1437.

13. de Carvalho CCCR. "Whole cell biocatalysts: Essential workers from Nature to the Industry". *Microbial Biotechnology* 10.2 (2017): 250-263.

14. Oren A. "Industrial and environmental applications of

halophilic microorganisms". *Environment Technology* 31.8-9 (2010): 825-834.

15. Elleuche S., *et al*. "Exploration of extremophiles for high temperature biotechnological processes". *Current Opinion in Microbiology* 25 (2015): 113-119.

16. Leal Dalmaso GZ., *et al*. "Marine extremophiles: a source of hydrolases for biotechnological applications". *Marine Drugs* 13.4 (2015): 1925-1965.

17. Kwon SJ., *et al*. "Transglycosylation a water-solvent biphasic reaction system with β-galactosidase displayed on the surfaces of Bacillus subtilis spores". *Applied and Environmental Microbiology* 73.7 (2007): 2251-2256.