

Polyhydroxyalkanoates (PHAs): Biodegradable Polyesters from Agricultural Waste and Surplus Material

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Polyhydroxyalkanoates (PHAs) are biodegradable polyesters that are stored intracellular in granules when growth of the producing bacteria is limited by essential nutritional compounds like the nitrogen or phosphate source of the growth and production medium [1]. Under such conditions the PHA content in the cells can increase to more than 80% of the cell dry weight formed, and the quality of the polyesters stored can be influenced by feeding precursors for synthesis of copolyesters or terpolyesters. A drawback for this development is the fact that in most cases production costs for PHAs are still higher than costs for conventional resins. Biotechnological polymer production occurs in aerobic processes, therefore only about 50% of the main carbon sources, and even a lower percentage of the precursors used for production of co-polyesters end up in the products wanted. To overcome this problem, cheap carbon and nitrogen sources for microbial growth and PHA synthesis are needed to lower the production costs. Such sources are available as agricultural waste and surplus materials, for example lactose in cheese-whey or glycerol liquid phase (GLP) from the biodiesel production process to be used as a cheap carbon source (Fig. 1), or meat and bone meal (MBM) to be used as nitrogen source after hydrolysis [2]. Based on these renewable resources new technologies for polymer production can be developed, integrating the principles of “Cleaner Production” and “Life Cycle Analysis” into the strategies for process design [3].

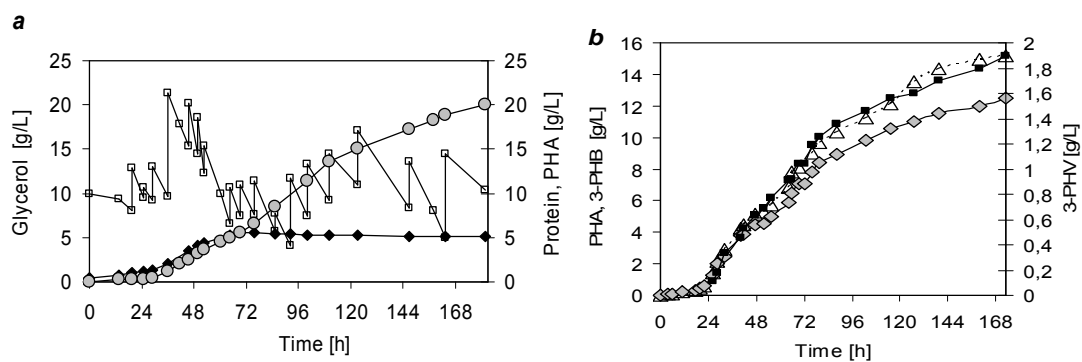


Figure 1: Production of poly-(3HB-co-3HV) from glycerol liquid phase (GLP) with *Haloferax mediterranei*. (a) Patterns of glycerol, protein and PHA; (b) polyester formation during the process

Keywords: polyhydroxyalkanoates; sustainable production; waste materials

[1] G. Braunegg, G. Lefebvre, K.F. Genser, *J. Biotechnol.* **65**, 127 (1998).

[2] M. Koller, G. Braunegg, R. Bona, C. Herrmann, P. Horvat, J. Martinz, J. Neto, L. Pereira, M. Kroutil, P. Varila, *Biomacromolecules* **6**, 561 (2005).

[3] G. Braunegg, R. Bona, M. Koller, *Polymer-Plastics Technology and Engineering* **43**, 1779 (2004).