Journal of Biotechnology and Biomaterials

Mass scale production strategies for biodegradable polymer from glycerol

Ashok Kumar Srivastava

Indian Institute of Technology Delhi, India

Abstract

Biodegradable poly-hydroxy-butyrate (PHB) features properties similar to polypropylene which is inherently non degradable and is produced from depleting petroleum resources. High cost of the raw material and expensive downstream operations are the key reasons of its higher cost than petroleum derived plastics. The main focus of the present study was to develop economic and sustainable production protocols of biodegradable polymers. Thus the major objective of the present study was to optimize PHAs production using gram negative bacteria Cupriavidus necator which has a unique ability to grow on waste by-product (glycerol) of bio-fuel industry and accumulates PHB (up to 80% of biomass) in the growth phase The medium recipe for the cultivation of C. necatar was developed by statistical optimisation protocol. The batch kinetics of growth and biopolymer production was established in a 7-liter ADI Bioreactor which featured a biomass & PHB accumulations of 8.88 g/L & 6.76 g/L respectively. Culture growth inhibition by key substrates (carbon and nitrogen) was then assessed which invariably demonstrated a decrease in specific growth rate of culture and complete inhibition of growth at a glycerol & nitrogen concentration of 100 g/L & 13 g/L respectively.

A mathematical model was then developed for growth and PHB production to study the culture behaviour under different cultivation conditions and predict innovative fed-batch cultivation strategies. This was then used to design different carbon and nutrient feeding strategies in fed-batch cultivations to optimize the PHB production. The selected few optimized cultivation strategies (constant feed rate, decreasing feed rate, pseudo steady state of key substrate glycerol) were then implemented experimentally. It was observed that the highest PHB accumulation and productivity of 13.12 g/L and 0.27 g/L.h respectively was obtained in the fed-batch cultivation with maintenance of pseudo steady state with respect to key substrate glycerol.

Biography

Ashok Kumar Srivastava received his Ph.D. degree from the McGill University, Montreal in 1990 He has 41 years of Industrial - Research - Teaching experience in the area of Biochemical Engineering & Biotechnology. He has 110 International Journal papers, 162 International/ National presentations, 19 book chapters & three patents to his credit. He has supervised 16 Ph.Ds (5 continuing) & 76 Master's theses. His major interest is in Modelling Simulation, optimization and control of bioprocesses, Microbial / Plant cell / hairy root cultivations for important metabolite production (Bio/copolymer production, podophyllotoxin, azadirachtin, ajmalicine, shikimic acid etc) & novel bioreactor development. He has Developed Virtual Lab for "Bioreactor Modeling and Simulation" for UG/PG students of biochemical engineering & biotechnology http://vlab. co.in/broad-area-biotechnology-and-biomedical-engineering.

Publications

1. Publication I: Developing a green and sustainable process for enhanced PHB production by Azohydromonas australica
2. Publication II: Mass production of Ajmalicine by bioreactor cultivation of hairy roots of Catharanthus roseus
3. Publication III: A step towards the development of an economic sustainable technology for poly (β-hydroxybutyrate): A Green Plastic
4. Publication IV: Mass Scale Artemisinin Production in a Stirred Tank Bioreactor Using Hairy Roots of Artemisia Annua
5. Publication V: Bacterial Polysaccharides: An Overview

3rd International Conference on Industrial Biotechnology and Bioprocessing | Paris, France | February 17-18, 2020

Citation: Ashok Kumar Srivastava, Mass scale production strategies for biodegradable polymer from glycerol, Industrial Biotechnology 2020, 3rd International Conference on Industrial Biotechnoloy and Bioprocessing, Paris, February 17-18, 2020, 04