Enhanced Poly(3-hydroxybutyrate) Production from Oil Palm Frond Juice by *Cupriavidus necator* NCIMB 11599

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Abstract

A substantial amount of renewable sugars can be obtained by simply pressing the oil palm frond (OPF) using sugarcane press machine. OPF juice can be utilized as a carbon source for the production of poly(3-hydroxybutyrate), P(3HB) by using a wild type strain of *Cupriavidus necator* CCUG 52238^T. Unfortunately, lesser amount of P(3HB) content *i.e.* 32 wt.% was obtained when 30% (v/v) of OPF juice was supplemented as the sole carbon source in shake flasks experiment. An attempt has been made to further enhanced the P(3HB) production using a mutant strain of *Cupriavidus necator* NCIMB 11599 in a 2L fed-batch bioreactor. The P(3HB) produced from this study was then characterized for its physical, thermal and mechanical properties. From the fed-batch experiment supplemented with concentrated OPF juice, we managed to obtain higher cell dry mass of 40 g/l with 75 wt.% of P(3HB) accumulation. Images of bacterial cells taken at 60 h of cultivation period with a Transmission Electron Microscope (TEM) showed the vast majority of microbial cells contained many P(3HB) granules with a few cells autolysis occurred, indicating the suitable time for cells harvesting. Number average molecular weight, mechanical and thermal properties of P(3HB) obtained from OPF juice showed an almost similar properties to those reported in the literature indicating that OPF juice can become viable low-cost substrate alternative in P(3HB) production.

Keywords : Oil palm frond juice, Renewable sugars, Poly(3-hydroxybutyrate), *Cupriavidus necator* NCIMB 11599

Objective

To improve P(3HB) production from OPF juice in 2 L fed-batch bioreactor by using *Cupriavidus necator* NCIMB11599 (mutant strain of *R. eutropha* H16)

Materials and Methods

Results & Discussion

A) Growth, P(3HB) production and sugars consumption profile

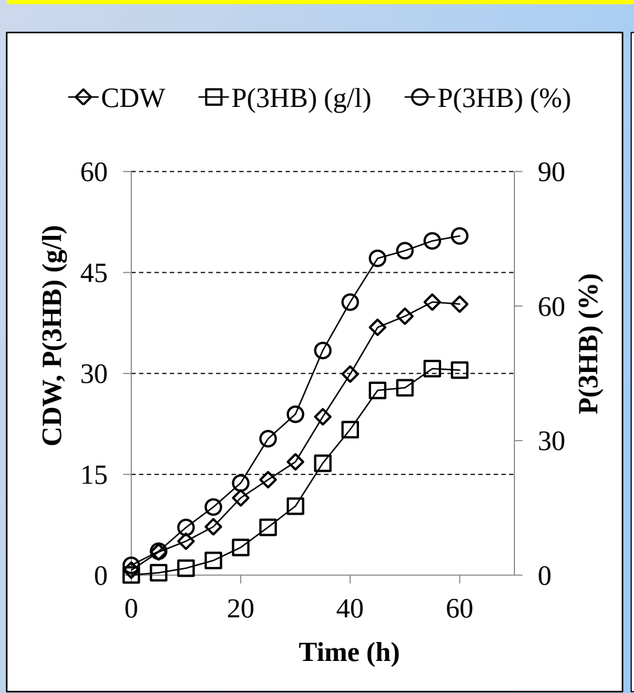

Fig. 1. (a) Time course of cell dry weight, P(3HB) (g/L) and P(3HB) content (wt.%) of *C. necator* NCIMB 11599 over time.

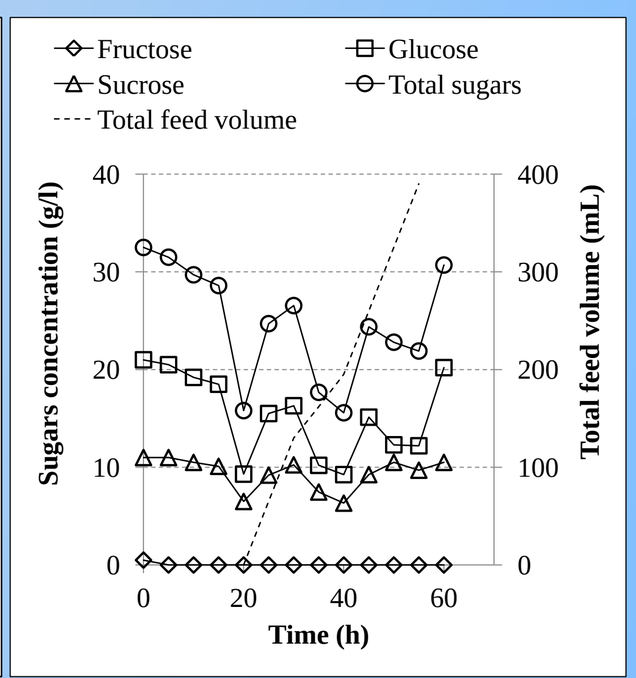

Fig. 1. (b) Total OPF juice added and sugars consumption profile of *C. necator* NCIMB 11599 over time during fed-batch culture supplemented with concentrated OPF juice.

B) TEM analysis

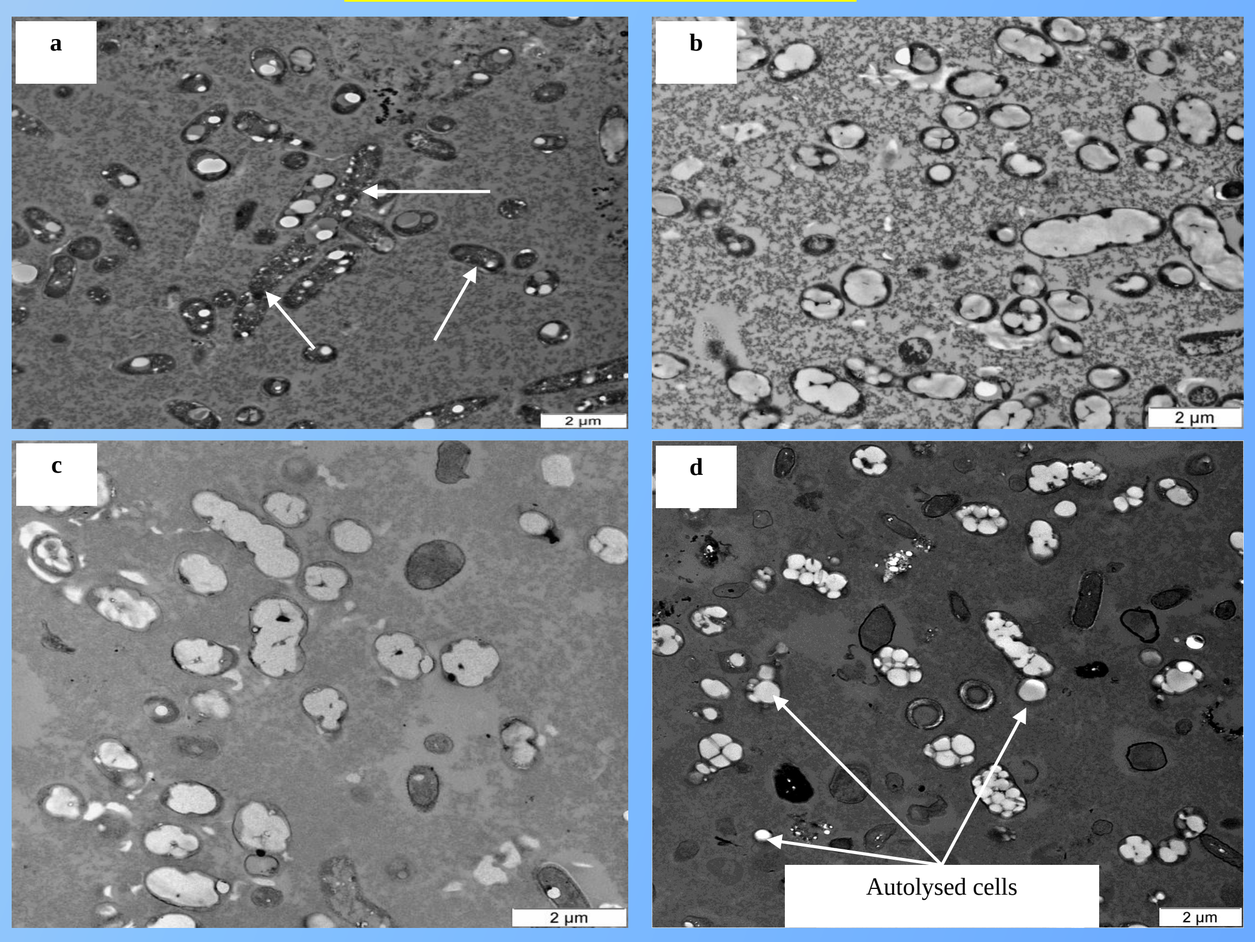

Fig. 2. TEM images of *C. necator* NCIMB 11599 in fed-batch fermentation (a) 10 h (b) 30 h, (c) 45 h (d) 60 h (Magnification a and d 8,000x; b and c 10,000x; bar = 2 µm)

Conclusions

1. P(3HB) production was further improved by culturing the mutant strain *i.e. C. necator* NCIMB 11599 under suitable cultivation condition in fed-batch bioreactor.
2. Final P(3HB) concentration recorded at 30.5 g/l, comprising of 75 wt.% of the biomass dry weight.
3. TEM analysis confirmed the vast majority of P(3HB) granules within the cell walls with a few cell autolysis occurred, indicating the suitable time for cells harvesting.

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