Bioresource Technology 129 (2013) 680–685

Contents lists available at SciVerse ScienceDirect

Bioresource Technology

journal homepage: www.elsevier.com/locate/biortech

Short Communication

Continuous butanol fermentation from inexpensive sugar-based feedstocks by *Clostridium saccharobutylicum* DSM 13864

Ye Ni *, Ziyi Xia, Yun Wang, Zhihao Sun

The Key Laboratory of Industrial Biotechnology, Ministry of Education, School of Biotechnology, Jiangnan University, 1800 Lihu Rd., Wuxi 214122, China

HIGHLIGHTS

- Butanol can be produced from cane molasses and corn stover hydrolysate by *C. saccharobutylicum*.
- A four-stage continuous butanol fermentation using CSH was steadily operated for 220 h.
- A high solvent productivity of 0.429 g/L/h and solvent titer of 11.43 g/L were attained.

ARTICLE INFO

Article history:
Received 30 July 2012
Received in revised form 21 November 2012
Accepted 23 November 2012
Available online 8 December 2012

Keywords:
Butanol
Continuous fermentation
Corn stover hydrolysate (CSH)
Cane molasses
Dilution rate

ABSTRACT

Corn stover hydrolysate (CSH) and cane molasses were studied for butanol fermentation by *Clostridium saccharobutylicum* DSM 13864 in continuous fermentation. Using cane molasses as substrate, solvent of 13.75 g/L (butanol 8.65 g/L) and productivity of 0.439 g/L/h were achieved in a four-stage continuous fermentation at a gradient dilution mode of 0.15–0.15–0.125–0.1 h^{-1}. In continuous fermentation using CSH as substrate, total solvent titer of 11.43 g/L (butanol 7.81 g/L) and productivity of 0.429 g/L/h were reached at a dilution rate of 0.15 h^{-1}, and the steady process was continuously operated for 220 h without compromise in solvent titer.

1. Introduction

With an ever-growing global depletion of natural oil and gas resources, and various environmental issues resulting from the rapid consumption of petroleum fuels, the development of alternative fuel resources has been getting significant attentions for decades (Bankar et al., 2012). Butanol, an important C4 platform compounds, is considered as one of the most promising biofuels. Compared with traditional biofuel ethanol, butanol provides many advantages such as higher energy content, less hygroscopy, less volatile, less hazardous to handle, and lower vapor pressure (Qureshi and Ezeji, 2008). In addition, this chemical is also an excellent fuel extender as it contains 22% oxygen (Qureshi et al., 2010). Importantly, butanol can be used directly or blended with gasoline or diesel at any ratio without retrofit of vehicle engines, and can be supplied and stored through the existing gasoline pipeline (Ni and Sun, 2009).

Butanol is a main product of acetone-butanol-ethanol (ABE) fermentation by *Clostridia* under anaerobic conditions, which was one of the largest industrial fermentation processes in the early 20th century. Compared with continuous fermentation, the commercial development of batch ABE fermentation has been hampered by a number of deficiencies including lower productivity, and stronger end-product inhibition, etc. The productivity of a traditional ABE batch fermentation, usually less than 0.5 g/L/h, is obviously undesirable for industrial production (Qureshi and Ezeji, 2008). While in continuous fermentation, the solvent productivity could be enhanced to 0.5–1.0 g/L/h (Maddox, 1989) . An average overall solvent concentration of 15 g/L and an overall solvent productivity of 0.27 g/L/h were achieved using a two-stage continuous cultivation with *Clostridium beijerinckii* NRRL B592 (Mutschlechner et al., 2000). Furthermore, higher solvent productivity and concentration could also be achieved in single-stage continuous process. In a single-stage continuous fermentation with wood pulp as a cell holding material, maximum solvent productivity of 13.66 g/L/h was obtained at a dilution rate of 1.9 h^{-1} (Survase et al., 2012). Recently, using a cell recycling continuous fermentation with glycerol as substrate, a solvent productivity of 8.3 g/L/h was reached at a dilution rate of 0.9 h^{-1} (Malaviya et al., 2012). Although a number of studies on continuous ABE fermentation have been carried out,

* Corresponding author. Tel./fax: +86 510 85329265.
E-mail address: yni@jiangnan.edu.cn (Y. Ni).

0960-8524/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.biortech.2012.11.142