Bioresource Technology 119 (2012) 355–361

Contents lists available at SciVerse ScienceDirect

Bioresource Technology

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

Effect of temperature on continuous fermentative lactic acid (LA) production and bacterial community, and development of LA-producing UASB reactor

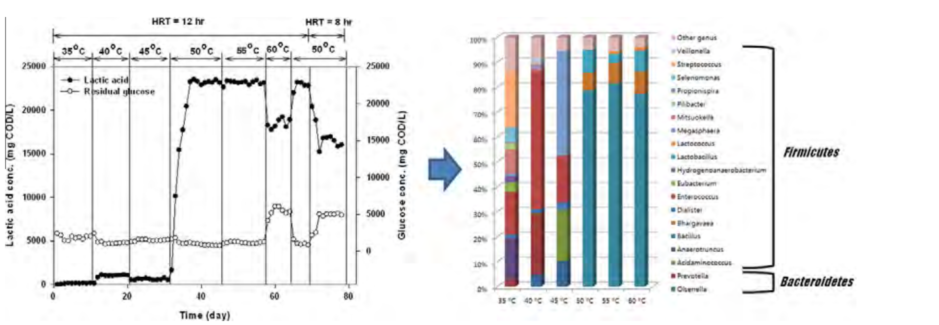
Dong-Hoon Kim [a], Wan-Taek Lim [b], Mo-Kwon Lee [a], Mi-Sun Kim [a,c,*]

[a] *Clean Fuel Department, Korea Institute of Energy Research, 102 Gajeong-ro, Yuseong-gu, Daejeon 305-343, Republic of Korea*
[b] *KAIST Institute for Biocenter, Korea Advanced Institute of Science and Technology, 373-1, Guseong-dong, Yuseong-gu, Daejeon 305-701, Republic of Korea*
[c] *Division of Renewable Energy Engineering, University of Science and Technology, 217 Gajeong-ro, Yuseong-gu, Daejeon 305-350, Republic of Korea*

HIGHLIGHTS

- ▶ Continuous lactic acid (LA) production by mixed cultures.
- ▶ Effect of temperature on LA production and bacterial community.
- ▶ Significant increase of LA production from 50 °C, over 90% LA conversion efficiency.
- ▶ Pyrosequencing analysis showed a drastic change of bacterial community.
- ▶ LA-producing UASBr enhanced the productivity up to 4.8 gLA/L/h.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 21 March 2012
Received in revised form 7 May 2012
Accepted 8 May 2012
Available online 23 May 2012

Keywords:
Lactic acid
Temperature
Pyrosequencing
Bacterial community
Upflow anaerobic sludge blanket reactor (UASBr)

ABSTRACT

A frequently used fermentation manner in lactic acid (LA) production, batch fermentation by pure cultures, has a limited practicability: low volumetric productivity and high energy consumption. In this study, continuous LA fermentation was performed in a completely stirred tank reactor at 12 h HRT, inoculated with anaerobic digester sludge. Glucose (25 g COD/L) was used as a feedstock and temperature was increased from 35 to 60 °C. LA production significantly increased from 50 °C, which was negligible up to 45 °C, with obvious bacterial community change. At 50 and 55 °C, LA production was maximized, reaching 23 g COD/L, corresponding to 92% LA conversion efficiency. Pyrosequencing analysis showed that microbial diversity was simplified at 50–60 °C, and the sequences closely related with *Bacillus coagulans* became predominant, followed by *Lactobacillus fermentum*. An LA-producing upflow ananerobic sludge blanket reactor was successfully developed, which enhanced the productivity up to 4.8 gLA/L/h by shortening HRT to 4 h.

1. Introduction

Lactic acid (LA) is widely used by the pharmaceutical, biomaterial, detergent, leather, and textile industries, and over the past few years it has received increasing attention as a building block for biodegradable plastics such as polylactic acid and polylactic-co-glycolic acid (Secchi et al., 2012). LA can be manufactured either by chemical synthesis or microbial fermentation, but the latter offers several advantages such as low cost of substrates and less energy consumption, and therefore, 90% of the worldwide LA production derives from the fermentation using lactic acid bacteria (LAB) (John et al., 2009).

Batch fermentation using pure cultures has been the most frequently used method for LA production to achieve higher concentration and yield (Akao et al., 2007; Hidaka et al., 2010). However, low volumetric productivity was the obvious disadvantage of the fermentation manner, since the culture periods in the batch

* Corresponding author at: Clean Fuel Department, Korea Institute of Energy Research, 102 Gajeong-ro, Yuseong-gu, Daejeon 305-343, Republic of Korea. Tel.: +82 42 860 3707; fax: +82 42 860 3739.

E-mail address: bmmskim@kier.re.kr (M.-S. Kim).

0960-8524/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.biortech.2012.05.027