Electron flow of biological H-2 production by sludge under simple thermal treatment: Kinetic study

By: Amin, MM (Amin, Mohammad Mehdi)[1,2]; Taheri, E (Taheri, Ensiyeh)[1,2,3]; Bina, B J (Bina, Biljan)[1,2]; van Ginkel, SW (van Ginkel, Steven W.)[4]; Ghasemian, M (Ghasemian, Mohammad)[1]; Puad, NIM (Puad, Noor Ili Mohamad)[5]; Fatehizadeh, A (Fatehizadeh, Ali)[1,2]

View Web of Science ResearcherID and ORCID

JOURNAL OF ENVIRONMENTAL MANAGEMENT
Volume: 250
Article Number: UNSP 109461
DOI: 10.1016/j.jenvman.2019.109461
Published: NOV 15 2019
Document Type: Article
View Journal Impact

Abstract

Mixed culture sludge has been widely used as a microbial consortium for biohydrogen production. Simple thermal treatment of sludge is usually required in order to eliminate any H-2-consuming bacteria that would reduce H-2 production. In this study, thermal treatment of sludge was carried out at various temperatures. Electron flow model was then applied in order to assess community structure in the sludge upon thermal treatment for biohydrogen production. Results show that the dominant electron sink was acetate (150-217 e(-) meq/mol glucose). The electron equivalent (e(-) eq) balances were within 0.8-18% for all experiments. Treatment at 100 degrees C attained the highest H-2 yield of 3.44 mol H-2/mol glucose from the stoichiometric reaction. As the treatment temperature increased from 80 to 100 degrees C, the computed acetyl-CoA and reduced form of ferredoxin (Fdred) concentrations increased from 13.01 to 17.34 e(-) eq (1.63-2.17 mol) and 1.34 to 4.18 e(-) eq (0.67-2.09 mol), respectively. The NADH(2) balance error varied from 3 to 10% and the term e(-) (Fd <-> NADH(2)) (m) in the NADH(2) balance was NADH(2) consumption (m = -1). The H-2 production was mainly via the Fd-hydrogenase system and this is supported with a good NADH(2) balance. Using the modified Gompertz model, the highest maximum H-2 production potential was 1194 mL whereas the maximum rate of H-2 production was 357 mL/h recorded at 100 degrees C of treatment.

Keywords

Author Keywords: Biohydrogen; Electron flow model; H-2 yield; Kinetic model; Stoichiometry

KeyWords Plus: BIOHYDROGEN PRODUCTION; HYDROGEN PRODUCTION; BIO-HYDROGEN; WASTE-WATER; ACID-PHASE; FERMENTATION; GLUCOSE; METABOLISM; BIODIESEL; METHANE

Author Information

Reprint Address: Fatehizadeh, A (reprint author)

+ Isfahan Univ Med Sci, Environm Res Ctr, Res Inst Primordial Prevent Noncommunicable Dis, Esfahan, Iran.

Addresses:

+ [1] Isfahan Univ Med Sci, Environm Res Ctr, Res Inst Primordial Prevent Noncommunicable Dis, Esfahan, Iran
+ [2] Isfahan Univ Med Sci, Sch Hlth, Dept Environm Hlth Engn, Esfahan, Iran
+ [3] Isfahan Univ Med Sci, Sch Hlth, Student Res Comm, Esfahan, Iran
+ [4] Georgia Inst Technol, Sch Civil & Environm Engn, 200 Bobby Dodd Way, Atlanta, GA 30332 USA
+ [5] Int Islamic Univ Malaysia, Dept Biotechnol Engn Kulliyyah Engn, Bioproc & Mol Engn Res Unit BPMERU, Kuala Lumpur, Malaysia

E-mail Addresses: A.Fatehizadeh@hlth.mui.ac.ir

Funding

Funding Agency	Grant Number
Isfahan University of Medical Sciences of Iran	393298

View funding text

Publisher

ACADEMIC PRESS LTD- ELSEVIER SCIENCE LTD, 24-28 OVAL RD, LONDON NW1 7DX, ENGLAND

Journal Information

Impact Factor: Journal Citation Reports

Categories / Classification

Research Areas: Environmental Sciences & Ecology

Web of Science Categories: Environmental Sciences

See more data fields