Statistical Optimization of Ethanol-Based Biodiesel Production from Sludge Palm Oil Using Locally Produced Candida cylindracea Lipase

By: Nasaruddin, RR (Nasaruddin, Ricca Rahman)[1]; Alam, MZ (Alam, Md Zahangir)[1]; Jami, MS (Jami, Mohammed Saedi)[1]; Salihu, A (Salihu, Aliyu)[1,2]

View ResearcherID and ORCID

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Abstract

Face centered central composite design was used to optimize the enzyme loading, reaction temperature and mixing speed of sludge palm oil (SPO) transesterification reaction using locally produced Candida cylindracea lipase. The developed quadratic model was found to be significant at $p < 0.05$. The highest biodiesel yield of 57.5 % (w/w SPO) and 15.22 % free fatty acids (FFA) conversion to biodiesel with coefficient of determination R-2 of 0.91 and 0.93, respectively were obtained at enzyme loading of 0.4 U/g SPO, 41 degrees C and 250 rpm mixing speed. Enzyme loading (U/g) gave little effect on the % FFA conversion to biodiesel and total biodiesel yield compared to temperature and mixing speed due to high FFA and water content, thus further studies are required for improvement. The study shows the low cost SPO and locally produced lipase have a promising potential in the utilization of waste for low cost biodiesel production.

Keywords

Author Keywords: Biodiesel; Free fatty acid; Lipase; Optimization; Sludge palm oil

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Author Information

Reprint Address: Alam, MZ (reprint author)

+ Int Islamic Univ Malaysia, Dept Biotechnol Engn, Fac Engn, BERC, Kuala Lumpur 50728, Malaysia.

Addresses:

+ [1] Int Islamic Univ Malaysia, Dept Biotechnol Engn, Fac Engn, BERC, Kuala Lumpur 50728, Malaysia

+ [2] Ahmadu Bello Univ, Dept Biochem, Zaria, Nigeria

E-mail Addresses: zahangir@iium.edu.my

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1. Title: [not available] — Times Cited: 2
By: Ainie, K.; Siew, W.L.; Tan, Y.A.; et al.
MPOB Test Methods Published: 2005
Publisher: Malaysian Palm Oil Board, Malaysia
[Show additional data]

2. High quality biodiesel obtained through membrane technology — Times Cited: 30
By: Atadashi, I. M.; Aroua, M. K.; Aziz, A. R. Abdul; et al.
JOURNAL OF MEMBRANE SCIENCE Volume: 421 Pages: 154-164 Published: DEC 1 2012

3. Biodiesel production through lipase catalyzed transesterification: An overview — Times Cited: 245
By: Bajaj, Akhil; Lohan, Purva; Jha, Prabhat N.; et al.
JOURNAL OF MOLECULAR CATALYSIS B-ENZYMATIC Volume: 62 Issue: 1 Pages: 9-14 Published: JAN 2 2010

4. Regeneration of immobilized Candida antarctica lipase for transesterification — Times Cited: 168
By: Chen, JW; Wu, WT
JOURNAL OF BIOSCIENCE AND BIOENGINEERING Volume: 95 Issue: 5 Pages: 466-469 Published: MAY 2003

5. Continuous esterification for biodiesel production from palm fatty acid distillate using economical process — Times Cited: 76
By: Chongkhong, S.; Tongurai, C.; Chetpattananondh, R.
RENEWABLE ENERGY Volume: 34 Issue: 4 Pages: 1059-1063 Published: APR 2009

6. Enzymatic biodiesel: Challenges and opportunities — Times Cited: 159
By: Christopher, Lew P.; Kumar, Hemanathan; Zambare, Vasudeo P.
APPLIED ENERGY Volume: 119 Pages: 497-520 Published: APR 15 2014

7. Study of biodiesel production from animal fats with high free fatty acid content — Times Cited: 83
By: Encinar, J. M.; Sanchez, N.; Martinez, G.; et al.
BIORESOURCE TECHNOLOGY Volume: 102 Issue: 23 Pages: 10907-10914 Published: DEC 2011

8. Production of biodiesel from waste frying oil — Times Cited: 317
By: Felizardo, P; Correia, MJN; Raposo, I; et al.
WASTE MANAGEMENT Volume: 26 Issue: 5 Pages: 487-494 Published: 2006

9. Biodiesel production from mahua (Madhuca indica) oil having high free fatty acids — Times Cited: 346
By: Ghadge, SV; Raheman, H
BIOMASS & BIOENERGY Volume: 28 Issue: 6 Pages: 601-605 Published: 2005

10. Extracellular enzymatic activity profiles in fungi isolated from oil-rich environments — Times Cited: 68
By: Gopinath, Subash C. B.; Anbu, Periasamy; Hilda, Azariah
Mycoscience Volume: 46 Issue: 2 Pages: 119-126 Published: APR 2005

11. Sludge palm oil as a renewable raw material for biodiesel production by two-step processes — Times Cited: 67
By: Hayyan, Adeeb; Alam, Md Zahangir; Mirghani, Mohamed E. S.; et al.
BIORESOURCE TECHNOLOGY Volume: 101 Issue: 20 Pages: 7804-7811 Published: OCT 2010

12. Reduction of high content of free fatty acid in sludge palm oil via acid catalyst for biodiesel production — Times Cited: 64
By: Hayyan, Adeeb; Alam, Md Zahangir; Mirghani, Mohamed E. S.; et al.
FUEL PROCESSING TECHNOLOGY Volume: 92 Issue: 5 Pages: 920-924 Published: MAY 2011