LIPASE IMMOBILIZATION ON FIBERS GRAFTED WITH POLYGLYCIDYL METHACHRYLATE

By: Alkhatib, MFR (Alkhatib, Ma'an Fahmi Rashid)[1,2]; Bahrudin, NA (Bahrudin, Nik Adlin)[1,2]; Salleh, HM (Salleh, Hamzah Mohd)[3,4]; Nasef, MME (Nasef, Mohamed Mahmoud Elsayed)[5]; Ting, TM (Ting, Teo Ming)[6]

IIUM ENGINEERING JOURNAL
Volume: 20 **Issue:** 1 **Pages:** 12-23
DOI: 10.31436/iiumej.v20i1.1002
Published: 2019
Document Type: Article

Abstract

Lipase enzyme originated from wheat germ was immobilized on nylon -6-grafted with polyglycidyl methachrylate (PGMA). The immobilization of enzyme experiments were designed and studied using face centred central composite design (FCCCD) under response surface methodology (RSM). Prior to immobilization, the polymer was activated with diethyl amine/ethanol to introduce an amine functional group to facilitate covalent bonding with the enzyme. The immobilized and free enzymes were characterized for effect of temperature and pH on enzyme activity, stability, storage and reusability as well as kinetics studies. ANOVA revealed that optimum lipase activity of 0.287 U/ml was achieved at immobilization time of 5 h, pH of 6 and 1.0 mg/ml for enzyme concentration. The optimum temperatures and pH for immobilized and free enzymes were 45 degrees C and 35 degrees C, and 8 and 7, respectively. The immobilized enzyme showed higher stability compared to free enzyme. The immobilized enzyme retained 18% of its activity after being recycled 8 times. In a storage stability test, immobilized lipase was able to retain 70% of its activity after being stored for 30 days, while free enzyme activity dropped to 15 % after 20 days of storage.

Keywords

Author Keywords: immobilization; enzyme; lipase; optimization; FCCCD; RSM; fibers; nylon; stability; reusability; kinetics study
KeyWords Plus: CANDIDA-RUGOSA LIPASE; HYDROLYSIS

Author Information

Reprint Address: Alkhatib, MFR (reprint author)

+ Int Islamic Univ Malaysia, Fac Engn, Dept Biotechnol Engn, POB 10, Kuala Lumpur 59728, Malaysia.

Reprint Address: Alkhatib, MFR (reprint author)

+ Int Islamic Univ Malaysia, Fac Engn, Dept Biotechnol Engn, POB 10, Gombak 53100, Selangor, Malaysia.

Addresses:

+ [1] Int Islamic Univ Malaysia, Fac Engn, Dept Biotechnol Engn, POB 10, Kuala Lumpur 59728, Malaysia
+ [2] Int Islamic Univ Malaysia, Fac Engn, Dept Biotechnol Engn, POB 10, Gombak 53100, Selangor, Malaysia
+ [3] Int Islamic Univ Malaysia, Int Inst Halal Res & Training INHART, POB 10, Kuala Lumpur 59728, Malaysia
+ [4] Int Islamic Univ Malaysia, Int Inst Halal Res & Training INHART, POB 10, Gombak 53100, Selangor, Malaysia
+ [5] Univ Tecknol Petronas, Chem Engn Dept, Seri Iskandar 32610, Perak, Malaysia
+ [6] Agensi Nuklear Malaysia, Radiat Proc Technol Div, Kajang 43000, Selangor, Malaysia

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

Funding

Funding Agency	Grant Number
Fundamental Research Grants Scheme, Ministry of Higher Education (MOHE), Malaysia	FRGS 14-162-0403

View funding text

Publisher

KULLIYYAH ENGINEERING, INT ISLAMIC UNIV MALAYSIA, JALAN GOMBAK, 53100, MALAYSIA

Categories / Classification

Research Areas: Engineering
Web of Science Categories: Engineering, Multidisciplinary

See more data fields

Cited References: 25

Showing 25 of 25 **View All in Cited References page** *(from Web of Science Core Collection)*

1. **Statistical modelling optimisation of cellulase enzyme immobilisation on functionalised multi-walled carbon nanotubes for empty fruit bunches degradation.** Times Cited: 8
By: Alkhatib, M. F.; M. d. Zahangir Alam; Rasha Mohammed
Australian Journal of Basic and Applied Sciences Volume: 6 Issue: 1 Pages: 30-38 Published: 2012

2. **Enzymatic hydrolysis of oil palm empty fruit bunch using immobilized cellulase enzyme** Times Cited: 5
By: Alkhatib, Ma'an; Abd, Rasha Mohammed; Alam, Md Zahangir; et al.
AFRICAN JOURNAL OF BIOTECHNOLOGY Volume: 10 Issue: 81 Special Issue: SI Pages: 18811-18815 Published: DEC 16 2011

3. **ANALYTICAL-CHEMISTRY** Times Cited: 32
By: BOWERS, LD; CARR, PW
ANALYTICAL CHEMISTRY Volume: 48 Issue: 7 Pages: A545-& Published: 1976

4. **RAPID AND SENSITIVE METHOD FOR QUANTITATION OF MICROGRAM QUANTITIES OF PROTEIN UTILIZING PRINCIPLE OF PROTEIN-DYE BINDING** Times Cited: 210,166
By: BRADFORD, MM
ANALYTICAL BIOCHEMISTRY Volume: 72 Issue: 1-2 Pages: 248-254 Published: 1976

5. **Immobilization of Candida rugosa lipase on chitosan with activation of the hydroxyl groups** Times Cited: 283
By: Chiou, SH; Wu, WT
BIOMATERIALS Volume: 25 Issue: 2 Pages: 197-204 Published: JAN 2004

6. **Immobilization of Burkholderia sp lipase on a ferric silica nanocomposite for biodiesel production** Times Cited: 79
By: Dang-Thuan Tran; Chen, Ching-Lung; Chang, Jo-Shu
JOURNAL OF BIOTECHNOLOGY Volume: 158 Issue: 3 Pages: 112-119 Published: APR 15 2012

7. **Immobilization, stability and esterification studies of a lipase from a Bacillus sp.** Times Cited: 63
By: Dosanjh, NS; Kaur, J
BIOTECHNOLOGY AND APPLIED BIOCHEMISTRY Volume: 36 Pages: 7-12 Part: 1 Published: AUG 2002

8. **Solid state fermentation with recovery of Amyloglucosidase from extract by direct immobilization in cross linked enzyme aggregate for starch hydrolysis** Times Cited: 12
By: Gupta, Kapish; Jana, Asim Kumar; Kumar, Sandeep; et al.
BIOCATALYSIS AND AGRICULTURAL BIOTECHNOLOGY Volume: 4 Issue: 4 Pages: 486-492 Published: OCT 2015

9. **Immobilization of Candida rugosa lipase on electrospun cellulose nanofiber membrane** Times Cited: 104
By: Huang, Xiao-Jun; Chen, Peng-Cheng; Huang, Fu; et al.
JOURNAL OF MOLECULAR CATALYSIS B-ENZYMATIC Volume: 70 Issue: 3-4 Pages: 95-100 Published: JUL 2011

10. **Binary immobilization of Candida rugosa lipase on chitosan** Times Cited: 136
By: Hung, TC; Giridhar, R; Chiou, SH; et al.
JOURNAL OF MOLECULAR CATALYSIS B-ENZYMATIC Volume: 26 Issue: 1-2 Pages: 69-78 Published: NOV 3 2003

11. **Characterization of Burkholderia lipase immobilized on celite carriers** Times Cited: 31
By: Liu, Chien-Hung; Lin, Yen-Hao; Chen, Chun-Yen; et al.
JOURNAL OF THE TAIWAN INSTITUTE OF CHEMICAL ENGINEERS Volume: 40 Issue: 4 Pages: 359-363 Published: JUL 2009

12. **Crystalline morphology and polymorphic phase transitions in electrospun nylon-6 nanofibers** Times Cited: 144
By: Liu, Yi; Cui, Li; Guan, Fangxiao; et al.
MACROMOLECULES Volume: 40 Issue: 17 Pages: 6283-6290 Published: AUG 21 2007

13. **Organic Polymer Supports for Synthesis and for Reagent and Catalyst Immobilization** Times Cited: 470
By: Lu, Jinni; Toy, Patrick H.
CHEMICAL REVIEWS Volume: 109 Issue: 2 Pages: 815-838 Published: FEB 2009

14. **Immobilization of lipases on hydrophobic supports involves the open form of the enzyme** Times Cited: 204
By: Manoel, Evelin A.; dos Santos, Jose C. S.; Freire, Denise M. G.; et al.
ENZYME AND MICROBIAL TECHNOLOGY Volume: 71 Pages: 53-57 Published: APR 2015

15. **Radiation-grafted copolymers for separation and purification purposes: Status, challenges and future directions** Times Cited: 126
By: Nasef, Mohamed Mahmoud; Guven, Olgun
PROGRESS IN POLYMER SCIENCE Volume: 37 Issue: 12 Pages: 1597-1656 Published: DEC 2012

16. **New CO2 adsorbent containing aminated poly(glycidyl methacrylate) grafted onto irradiated PE-PP nonwoven sheet** Times Cited: 13
By: Nasef, Mohamed Mahmoud; Abbasi, Ali; Ting, T. M.
RADIATION PHYSICS AND CHEMISTRY Volume: 103 Pages: 72-74 Published: OCT 2014

17. **Glutaraldehyde activation of polymer Nylon-6 for lipase immobilization: Enzyme characteristics and stability** Times Cited: 1
By: Pahujani, S; Kanwar, SS; Chauhan, G; et al.

Bioresour Published: 2008
[Show additional data]

18. **Immobilization of lipase from Candida rugosa on Sepabeads(A (R)): the effect of lipase oxidation by periodates** Times Cited: 23
By: Prlainovic, Nevena Z.; Knezevic-Jugovic, Zorica D.; Mijin, Dusan Z.; et al.
BIOPROCESS AND BIOSYSTEMS ENGINEERING Volume: 34 Issue: 7 Pages: 803-810 Published: SEP 2011

19. **Production of lipase in a fermentor using a mutant strain of Corynebacterium species: Its partial purification and immobilization.** Times Cited: 8
By: Roy, Nityananda; Ray, Lalitagauri; Chattopadhyay, Parimal
Indian Journal of Experimental Biology Volume: 42 Issue: 2 Pages: 202-207 Published: February 2004

20. Title: [not available] Times Cited: 12
By: Singh, B.
Biotechnology Expanding Horizons. Published: 2009
Publisher: Kalyani Publishers, India

21. **Immobilization of lipase by ultrafiltration and cross-linking onto the polysulfone membrane surface** Times Cited: 39
By: Wang Yujun; Jian, Xu; Luo Guangsheng; et al.
BIORESOURCE TECHNOLOGY Volume: 99 Issue: 7 Pages: 2299-2303 Published: MAY 2008

22. **Optimization of lipase entrapment in Ca-alginate gel heads** Times Cited: 181
By: Won, K; Kim, S; Kima, KJ; et al.
PROCESS BIOCHEMISTRY Volume: 40 Issue: 6 Pages: 2149-2154 Published: MAY 2005

23. **Cross-linked enzyme aggregates of Mung bean epoxide hydrolases: A highly active, stable and recyclable biocatalyst for asymmetric hydrolysis of epoxides** Times Cited: 38
By: Yu, Chun-Yang; Li, Xiao-Feng; Lou, Wen-Yong; et al.
JOURNAL OF BIOTECHNOLOGY Volume: 166 Issue: 1-2 Pages: 12-19 Published: JUN 20 2013

24. **Preparation and characterization of sol-gel hybrid coating films for covalent immobilization of lipase enzyme** Times Cited: 20
By: Yuce-Dursun, Basak; Cigil, Asli Beyler; Dongez, Dilek; et al.
JOURNAL OF MOLECULAR CATALYSIS B-ENZYMATIC Volume: 127 Pages: 18-25 Published: MAY 2016

25. **Lipase immobilization on glutaraldehyde-activated nanofibrous membranes for improved enzyme stabilities and activities** Times Cited: 57
By: Zhu, Jing; Sun, Gang
REACTIVE & FUNCTIONAL POLYMERS Volume: 72 Issue: 11 Pages: 839-845 Published: NOV 2012

Showing 25 of 25 **View All in Cited References page**