

PAPER • OPEN ACCESS

The 12th Congress of Indonesian Society for Biochemistry and Molecular Biology in Conjunction With The 2nd International Conference “Collaboration Seminar of Chemistry and Industry (CoSCI)” and AnMicro Workshop

To cite this article: 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **217** 011001

View the [article online](#) for updates and enhancements.

You may also like

- [Overcoming roadblocks in computational roadmaps to the future for safe nanotechnology](#)
Ceyda Oksel Karakus and David A Winkler
- [Targeted breath analysis: exogenous volatile organic compounds \(EVOC\) as metabolic pathway-specific probes](#)
Edoardo Gaude, Morad K Nakhleh, Stefano Patassini et al.
- [The effects of sample size on omics study: from the perspective of robustness and diagnostic accuracy](#)
Xiaoyu Zhang, Xuejiao Cui and Feng Zhu

Preface

Second International Conference “Collaboration Seminar of Chemistry and Industry (CoSCI 2018) in conjunction with 23rd Indonesian Society for Biochemistry and Molecular Biology (ISBMB) seminar was taken place at Universitas Airlangga, Surabaya-Indonesia on October 11-12, 2018. The event presented a theme” Recent Development of Omics Technology For Human Prosperity”.

"Omics is a general term for a broad discipline of science and engineering for analyzing the interactions of biological information objects in organism. The main focus is on: 1) mapping information objects such as genes, proteins, and ligands; 2) finding interaction relationships among the objects; 3) engineering the networks and objects to understand and manipulate the regulatory mechanisms; and 4) integrating various omes and omics subfields.

The event was held to facilitate for the scientists, scholars, engineers and students from universities, research institutes and industries to present ongoing research activities, especially in Biochemistry, Biology, Chemistry, Medicine and other in related fields. It was also to encourage future collaboration among all participants.

The conference of CoSCI and ISBMB created proceedings from the papers that were submitted by participants, after they were reviewed by committee members and international reviewers. This volume intends to provide readers with the recent advances in the Omics Technology such as Chemistry, Biochemistry and Molecular Biology, and Medicine field.

We would like to thank to all authors who contributed to the proceedings and also to the organizing committee, reviewers, speakers, sponsor, and all the conference participants for their supporting in the conference of CoSCI 2018 and 23rd Seminar of ISBMB.

Dr. Purkan, M.Si

Department of Chemistry, Faculty of Science and Technology, Universitas Airlangga,
Surabaya, Indonesia, Nov. 10, 2018



PAPER • OPEN ACCESS

Committee

To cite this article: 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **217** 011002

View the [article online](#) for updates and enhancements.

You may also like

- [Carbon Paste Electrode Modified Imprinted Zeolite as a Selective Sensor for Creatine Analysis by Potentiometry](#)
A. Athiroh, T Fadillah, D F Damayanti et al.
- [Hepato-Renal Protective Effects of Mangosteen \(*Garcinia mangostana* L.\) Pericarp Extract in Streptozotocin-induced Diabetic Mice](#)
Saikhu Akhmad Husen, Septian Hary Kaiqutny, Arif Nur Muhammad Ansori et al.
- [Effect of particle size on sensory attributes of sapodilla tea \(*Manilkara zapota*\) using E-tongue](#)
S Rahimah, R Arbaia, R Andoyo et al.

COMMITTEE

The Chairman

1. Dr. Purkan, M.Si, Chemistry Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia.
2. Dr. Sri Sumarsih, M.Si, Chemistry Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia

Steering Committee

1. Dr. Abdulloh, M.Si, Chemistry Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia
2. Dr. Alfinda Novi Kristanti, DEA (Chemistry Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia
3. Dr. Ni'matuzarroh, M.Si, Biology Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia
4. Satya Candra Wibawa Sakti, M.Sc, Ph.D, Chemistry Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia
5. Harsasi Setyawati, S.Si, M.Si, Chemistry Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia
6. Ahmadi Jaya Permana, S.Si, M.Si, Chemistry Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia
7. Kautsar UI Haq, S.Si, M.Si, Chemistry Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia
8. Dr. Rico Ramadhan, M.Sc, Chemistry Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia
9. Dr. Indeswati Diyatri, drg., M.S, Faculty of Dentistry, Universitas Airlangga
10. Dr. Dian Mulawarmanti, drg., M.S, Faculty of Dentistry, Hang Tuah University, Surabaya Indonesia

Scientific Committee

Editors:

1. Ali Rohman, M.Si, Ph.D, Chemistry Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia
2. M. Zakki Fahmi, M.Si, Ph.D, Chemistry Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia
3. Dr. Verawat Champreda, M.Sc, National Center for Genetic Engineering and Biotechnology (BIOTEC), Thailand
4. Dr. Sehanat Prasongsuk, Department of Botany, Chulangkorn Universty, Thailand



Reviewers :

1. Prof. Ni Nyoman Tri Puspaningsih, M.Si, Biochemistry Research Division, Faculty of Science and Technology, Universitas Airlangga, Indonesia
2. Prof. dr. Soetjipto, MS., Ph.D, Biochemistry Department, Faculty of Medicine, Universitas Airlangga
3. Prof. Seung Wook Kim, Dept of Chemical and Biological Eng, Korea University
4. Prof. Rendy Kartika, Chemistry Department, Louisiana State University, Baton Rouge, LA
5. Prof. Hunsa Punnapayak, Department of Botany, Chulalongkorn University, Thailand
6. Prof. Antonius Suwanto, Division of Microbiology, Institut Pertanian Bogor, Indonesia
7. Prof. Dessy Natalia, Biochemistry Research Division, Faculty of Mathematics and Natural Sciences, Institut Teknologi Bandung, Indonesia
8. Prof. Dr, Suraini Abdul Aziz, Faculty of Biotechnology and Biomolecular Sciences, University Putra Malaysia
9. Prof. Afaf Baktir, Biochemistry Research Division, Faculty of Science and Technology, Universitas Airlangga, Indonesia
10. Dr. Mulyadi Tanjung, M.Si, Natural Product Research Division, Faculty of Science and Technology, Universitas Airlangga, Indonesia
11. Tjitjik Srie Tjahjandarie, Ph.D, Natural Product Research Division, Faculty of Science and Technology, Universitas Airlangga, Indonesia
12. Prof Fedik Rantam, Stem Cell Research Division, Faculty of Veterinary, Universitas Airlangga, Indonesia
13. Prof. Yosephine Sri Wulan Manuhara, Biology Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia
14. Dr. Hery Suwito, M.Si (Chemistry Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia
15. Dr. Nanik Siti Aminah, M.Si, Chemistry Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia
16. Dr. rer. nat. Ganden Supriyanto, M.,Sc, Chemistry Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia
17. Dr. Pratiwi Pudjiastuti, M.Si, Chemistry Department, Faculty of Science and Technology, Universitas Airlangga, Indonesia

PAPER • OPEN ACCESS

Peer review statement

To cite this article: 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **217** 011004

View the [article online](#) for updates and enhancements.

You may also like

- [Peer review statement](#)

- [Peer review statement](#)

- [Peer review statement](#)

Peer review statement

All papers published in this volume of *IOP Conference Series: Earth and Environmental Science* have been peer reviewed through processes administered by the proceedings Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by IOP Publishing.



PAPER • OPEN ACCESS

Synthesis of Aldehyde-Silica Nanoparticle for Matrix Immobilization of Endo- β -1,4-D-xylanase

To cite this article: A A I Ratnadewi *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **217** 012047

View the [article online](#) for updates and enhancements.



IOP | ebooksTM

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the collection - download the first chapter of every title for free.

Synthesis of Aldehyde-Silica Nanoparticle for Matrix Immobilization of Endo- β -1,4-D-xylanase

A A I Ratnadewi^{1,2,3*}, S Trissa¹, Suwardiyanto¹, W Handayani¹, A B Santoso¹, and Sudarko^{1,3}

¹Department of Chemistry, Faculty of Mathematics and Natural Science, University of Jember, 68121, Jember, Indonesia

²Graduate School of Biotechnology, University of Jember, 68121, Jember, Indonesia

³Laboratory Center for Development of Advanced Sciences and Technology (CDAST), University of Jember, 68121, Indonesia

*istri_dewi.fmipa@unej.ac.id

Abstract. Synthesis of silica nanoparticles has been conducted by sol gel method using Tetraethylorthosilicate (TEOS) as precursor. Silica nanoparticle was prepared by varying the molar ratio of NH_3 and TEOS i.e. 0.03, 0.06 and 0.12. Mixture of TEOS, ethanol, distilled water and NH_3 as catalyst was stirred at temperature of $50 \pm 2^\circ \text{C}$ for 5 hours to produce sol. The sol was allowed to form gel for 48 hours. Gel of silica was kept at temperature of 70°C to evaporate the solvent resulting in white powder of silica followed by calcination at 400°C for 8 hours. Characterization by means SEM revealed that the silica particle size was governed by the molar ratio of NH_3 and TEOS. Higher NH_3 concentration gave a bigger particle size i.e. 88.48, 271.31 and 473.52 nm respectively. Modification of the silica surface with glutaraldehyde was aimed to make the silica as immobilization matrix of endo- β -1,4-D-xylanase. Percentage of immobilized protein enzyme on silica 88.48, 271.31 and 473.52 nm were 30.49%, 15.05%, and 10.56% respectively.

Keywords: xylanase, immobilization, aldehyde-silica nanoparticle

1. Introduction

Silica nanoparticle/silica in nano scale (10^{-9} m) recently has more industrial application. It has good stability and chemical inertness.[1] Nanomaterial such as silica nanoparticle as a raw material results in product with different properties and quality improvement as well.[2] One of silica nanoparticle utilization is as a matrix in enzyme immobilization process. Silica nanoparticle is a good matrix since it has large surface area and pore volume, uniform pore size, easiness for chemical modification, reusability and environment friendliness.[3]

Silica nanoparticle is usually synthesized by sol-gel, reverse micro emulsion ad solid state. Sol-gel is widely employed in producing pure silica as it can control the particle size, size distribution and morphology by systematic controlling the reaction parameters.[4] Sol-gel is a method of solid preparation at low temperature by involving transition of a system of microscopic particles dispersed in a liquid (sol) to a microscopic material containing liquid (gel) and result in hard material like glass as evaporated. Material obtained by this method is amorphous with not uniform pores. It is usually involving hydrolysis and condensation process.[5]

Enzyme endo-1,4 xylanase is an enzyme with ability to hydrolyze xylan producing oligosaccharide such as XOS which beneficial in health. The use of this enzyme in free form is not efficient as it cannot be reused. Hence it is observed to immobilized endo- β -1,4-D-xylanase onto silica nanoparticle. It is initiated by synthesis silica nanoparticle followed by enzyme immobilization and determine efficiency of immobilized enzyme protein.

2. Experimental Method

Synthesis of silica nanoparticle by sol-gel technique using Tetraethylorthosilicate (TEOS) as precursor is adopted from previous work.[6] [7] Mole ratio of H_2O : TEOS : EtOH is constant i.e. 4:1:8, with a variation in the amount of ammonia to control the particle size, the mole ratios of NH_3/TEOS are 0,03 ; 0,06 and 0,12. TEOS and ethanol 90% was mixed using a magnetic stirrer and dropwise of solution containing ammonia and water was added periodically. It was conducted for 5 hours at temperature of



50 ± 2 °C to produce sol. The mixture was left at room temperature to form a gel. The gel was evaporated at 70 °C leaving a fine white powder and it was calcined at 400 °C for 8 h.

Immobilization was conducted through a covalent bond. The bond was formed after a modification on the functional groups of silica using glutaraldehyde. This modification was adopted from previous work by washing the silica in water for twice and separated by centrifugation. Silica nanoparticle was mixed with 3 mL of glutaraldehyde and separated through a centrifugation (150 rpm) for 4 hours at room temperature.[8] [9]Silica nanoparticle was then washed three times using 30 mL of water to remove unreacted glutaraldehyde. Immobilization of endo-β -1,4-D-xylanase is through mixing the modified silica and enzyme in a shaker (150 rpm) at temperature of 25 °C for 36 h. The free enzyme was washed using 3 mL of water for three times.

The protein content of the enzyme solution before and after immobilization in washing buffer solution were determined by the Bradford method using bovine serum albumin as a standard protein [10]

The percentage of immobilization yield (YI) enzyme was calculated using formula of %YI= $\frac{P_i - P_w}{P_i} \times 100$. Where P_i is total protein in endo-β -1,4-D-xylanase, P_w is total protein left in washed solution, and P_s is total protein in supernatant after immobilization.

In addition, several analyses were conducted to support the present study, such as a Scanning Electron Microscope and a Fourier Transform Infra Red.

3. Results and Discussion

Figure 1 is SEM images of silica synthesized via sol-gel using TEOS as silicon precursor and ammonia as catalyst. Particle size of silica varies as a function of mole ratio of NH₃ : TEOS. The average of particle size of silica are 88.48, 271.31 and 473.52 nm respectively as mole ratio of NH₃ : TEOS of 0.03, 0.06 and 0.12.

Previous work has synthesized silica nanoparticle through sol-gel by varying mole of NH₃ catalyst with mole ratio NH₃ : TEOS 0.11 : 0.28 resulting in silica with particle size of 55 nm, whereas mole ratio of NH₃ 0,3 : TEOS 0,28 gave silica with particle size of 130 nm[11]. Another study have immobilized xylitol dehydrogenase through covalent bond onto silica with particle size of 15, 30, 80 and 3000 nm and reported that highest immobilization was shown by silica with particle size of 80 nm[12]. Immobilization of endo-β -1,4-D-xylanase onto silica nanoparticle was first confirmed by FTIR analysis. For this purpose, FTIR spectra of unmodified silica nanoparticle, glutaraldehyde-modified 20 nm silica nanoparticle, glutaraldehyde-modified 88.48 nm silica nanoparticle, glutaraldehyde-modified 271.31 nm silica nanoparticle, and glutaraldehyde-modified 473.52 nm silica nanoparticle were measured and compared.

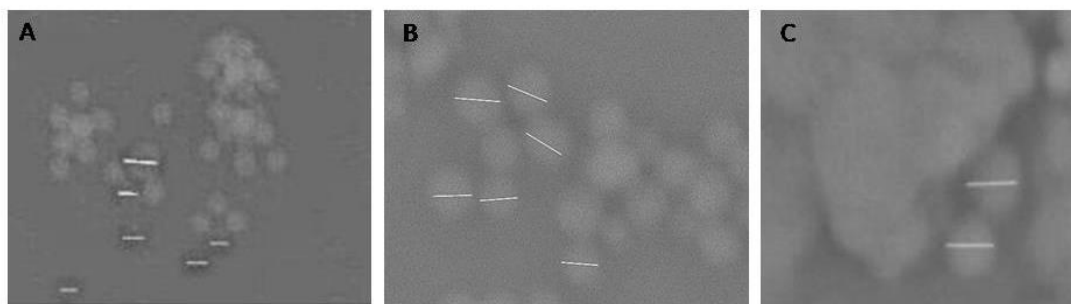


Figure 1. Particle size of silica of (a) mole ratio NH₃:TEOS 0,03, (b) mole ratio NH₃ :TEOS 0,06, (c) mole ratio NH₃:TEOS 0,12

Figure 2 (control) shows peaks unmodified silica nanoparticle at 800.49 cm⁻¹ are assigned to the Si-O symmetric stretching vibration, 958.65 cm⁻¹ are assigned to the Si-OH asymmetric stretching vibration, and peaks at 1091.75 cm⁻¹ are assigned to the Si-O asymmetric stretching vibration.[13] Modification of functionalized silica nanoparticle was treating the nanoparticles with glutaraldehyde. During the reaction, one of the aldehyde groups of glutaraldehyde conjugates to the silica nanoparticle while another aldehyde groups conjugates to the endo-β -1,4-D-xylanase through the amino group. Modification of functionalized silica nanoparticle was confirmed by FTIR analysis. FTIR analysis of modified silica nanoparticle revealed the presence of aldehyde groups on silica nanoparticle shown in

Figure 2 (A,B,C,D). There is two new peaks at 1710.92 – 1718.63 cm^{-1} are assigned to C=O bond of aldehyde group and peaks at 2928.04 – 2974.33 cm^{-1} are assigned to stretching vibration of C-H bond of glutaraldehyde. [14] [15]

Protein content of free endo- β -1,4-D-xylanase is 2.65 mg whereas the immobilized ones are 0.808, 0.399 and 0.280 mg in silica with particle size of 88.47, 271.31 and 473.52 nm respectively. In respect to the particle size of silica percentage yield of enzyme immobilization are 30.49, 15.05 and 10.56 %. It shows that silica with smaller particle size increases the amount of protein immobilized onto the silica.

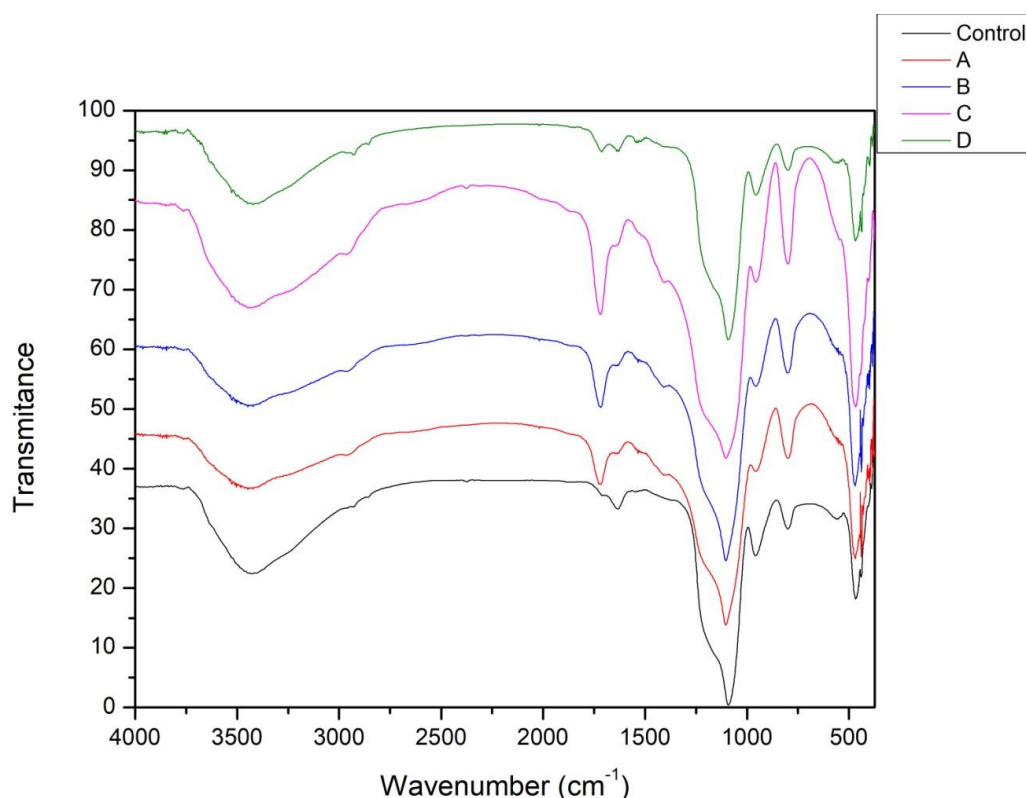


Figure 2. FTIR spectra of **control** unmodified silica nanoparticle, **(A)** glutaraldehyde-modified 88.48 nm silica nanoparticle, **(B)** glutaraldehyde-modified 271.31 nm silica nanoparticle, **(C)** glutaraldehyde-modified 473.52 nm silica nanoparticle, and **(D)** glutaraldehyde-modified 20 nm silica nanoparticle

4. Conclusion

Silica nanoparticle synthesized through sol-gel with mole ratio NH_3 : TEOS of 0.03; 0.06 and 0.12 result in silica with particle size of 88.48, 271.31 and 473.31 nm respectively. Silica-aldehyde was obtained on modification of silica surface with glutaraldehyde. Immobilization of endo- β -1,4-D-xylanase onto nanoparticle silica-aldehyde gave percentage of immobilized endo- β -1,4-D-xylanase protein of 30.49, 15.05 and 10.56 % in respect to the particle size of silica of 88.48; 271.31 and 473.52 nm.

References

- [1] Fernandez, B. R. 2012. Sintesis Nanopartikel SiO_2 Menggunakan Metoda Sol-gel Dan Aplikasinya Terhadap Aktifitas Sitotoksik Sel Dalam Review Jurnal Nanoteknologi. Review Jurnal Nanoteknologi. Padang: Jurusan Kimia, Program Pascasarjana Universitas Andalas.
- [2] Siswanto, M. Hamzah, Mahendra, and Fausiah. 2012. Perencanaan Nanosilika Berbahan Baku Silika Lokal Sebagai Filler Kompon Karet Rubber Air Bag Peluncur Kapal Dari Galangan. Prosiding INSINAS 2012. Jakarta: Badan Pengkajian dan Penerapan Teknologi.
- [3] Zhang. Y. W., Tiwari. M. K, Jeya. M, and Lee. J. K. 2011. Covalent immobilization of

- recombinant *Rhizobium etli* CFN42 xylitol dehydrogenase onto modified silica nanoparticles. *App Microbiol Biotechnol.* **90** 2 499-507.
- [4] Rahman, I. A., and V. Padavettan. 2012. Synthesis of Silica Nanoparticles by Sol- Gel: Size-Dependent Properties, Surface Modification, And Applications In Silica-Polymer Nanocomposites In Review. *Journal of Nanomaterials.* **12** 1 1-15.
- [5] Wijaya, K. 2010. *Nanomaterial Berlapis Dan Berpori: Sintesis, Karakterisasi Dan Perannya Sebagai Material Multi Fungsi.* Yogyakarta: UGM
- [6] Bracho, D., V.N. Dougnac, H. Palza, and R. Quijada. 2012. Functionalization of Silica Nanoparticles for Polypropylene Nanocomposite Applications. *Journal of Nanomaterials.* **20** **15** 1477- 1482.
- [7] Stoeber, W. Fink, A. 1968. Controlled Growth of Monodisperse Silica Spheres in the Micron Size Range. *Journal of Colloid and Interface Science.* **26** 1 69-68.
- [8] Singh, R, K., Zhang. Y. W, N. Nguye, M. Jeya, and J. K. Lee. 2010. Covalent immobilization of β -1,4-glucosidase from *Agaricus arvensis* onto Functionalized Silicon Oxide Nanoparticles. *Appl Microbiol Biotechnol.* **89** 2 337-344.
- [9] Dhiman, S., Jagtap. S. S, Jeya, M. Haw, J. R, Kang. Y. C, and Lee. J. K. 2011. Immobilization of *Pholiota adiposa* xylanase onto SiO₂ nanoparticles and its application for production of xilooligosaccharides. *Biotechnology.* **34** 7 1307-1313.
- [10] Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. Protein measurement with the Folin reagent. *J. Biol. Chem* 1951; 31:426–428.
- [11] Ibrahim, I.A.M., A.A.F, Zikry, and M.A. Sharaf. 2010. Preparation of Spherical Silica Nanoparticles: Stober Silica. *Journal Of American Science.* **6** 11 985-989.
- [12] [Zhang. Y. W., Tiwari. M. K, Jeya. M, and Lee. J. K. 2011. Covalent immobilization of recombinant *Rhizobium etli* CFN42 xylitol dehydrogenase onto modified silica nanoparticles. *App Microbiol Biotechnol.* **90** 2 499-507.
- [13] Beganskiene, A., Sirutkaitis, V., Kurtinaitiene, M., Juskenas, R., and Kareiva, A., 2004, FTIR, TEM and NMR Investigations of Stober Silica Nanoparticles, *Mater. Sci.*, 10 4 287-290
- [14] Shariat, S.Z.A.S, F.Borzouee,M.R.Mofid,J.Varshosaz.2018.Immobilization of lactoperoxidase on graphene oxide nanosheets with improved activity and stability. *Biotechnol Lett.*
- [15] Singh N, Srivastava G, Talat M, Raghubanshi H, Srivastava ON, and Kayastha AM.2014. Cicer a-galactosidase immobilization onto functionalized graphene nanosheets using response surface method and its applications. *Food Chem* **142** 1 430–438.

Acknowledgement

We acknowledged Hibah Kelompok Riset (KeRiS) (Grant: Dana Internal Universitas Jember 2018).