

[Home](#) [Applied Biochemistry and Microbiology](#) [Article](#)



A Solvent-tolerant Alkaline Lipase from *Bacillus* sp. DM9K3 and Its Potential Applications in Esterification and Polymer Degradation

Published: 06 December 2019

Volume 55, pages 603–614, (2019) [Cite this article](#)

Applied Biochemistry and
Microbiology

[Aims and scope](#)[Submit manuscript](#)



[P. Singh](#) , [V. Patel](#), [V. Shah](#) & [D. Madamwar](#) 

 171 Accesses  8 Citations [Explore all metrics](#) →

Abstract

Solvent-tolerant lipase produced by *Bacillus* sp. DM9K3 has been isolated from the hypersaline area, White Rann of Kachchh, Gujarat, India. The strain initially showed lipase activity of 11.1 U/mL in a basal medium which increased to 52.0 U/mL under optimized culture conditions. *Bacillus* sp. DM9K3 exhibited stability at 7% salinity, pH 9.0 and 50°C. The extracellular lipase was partially purified by acetone precipitation followed by DEAE-cellulose resulting in 39-fold purification with 40% yield. Metals ions such as Mg^{2+} , Ca^{2+} and K^+ showed enhanced enzyme activity. EDTA did not have a significant effect on activity suggesting that lipase is not metalloenzyme. The lipase under study showed the highest activity when palmitate (C16) was used as a substrate and was also

highly stable in organic solvents such as cyclooctane and benzene. The partially purified enzyme was immobilized for increasing the efficiency of the ethyl caprylate (an orange flavored ester) synthesis in the presence of cyclooctane. Additionally, lipase of *Bacillus* sp. DM9K3 was explored for biodegradation of polycaprolactone microspheres and showed promising results for potential applications in drug delivery system.

 This is a preview of subscription content, [log in via an institution](#)  to check access.

Access this article

[Log in via an institution](#)

[Buy article PDF 39,95 €](#)

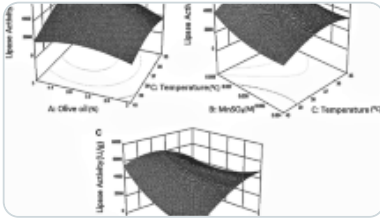
Price includes VAT (India)

Instant access to the full article PDF.

Rent this article via [DeepDyve](#) 

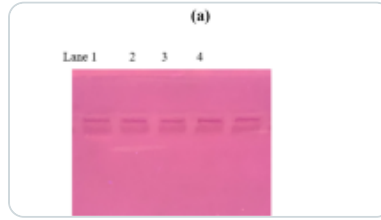
[Institutional subscriptions](#) →

Similar content being viewed by others



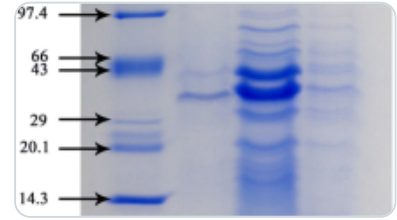
Production and purification of an alkaline lipase from *Bacillus* sp. for...

Article | 19 November 2018



Cloning, Overexpression and Application of Lipase from Thermotolerant *Bacill...*

Article | 20 June 2024



***Pseudomonas* sp. BUP6 produces a thermotolerant alkaline lipase with *trans*-...**

Article | 11 October 2017

REFERENCES

- 1 Kumar, A., Dhar, K., Kanwar, S.S., and Arora, P.K., *Biol. Proced. Online*, 2016, vol. 18, no. 2, pp. 1–11.

[Article](#) [Google Scholar](#)

- 2 Verma, N., Thakur, S. and Bhatt, A.K., *Int. Res. J. Biolog-ical Sci.*, 2012, vol. 1, no. 8, pp. 88–92.

[Google Scholar](#)

- 3 Bora, L., *J. Surfact. Deterg.*, 2014, vol. 17, no. 5, pp. 889–898.

[Article](#) [CAS](#) [Google Scholar](#)

- 4 Patel, V., Nambiar, S., and Madamwar, D., *Process Biochem.*, 2014, vol. 49, no. 10, pp. 1673–1681.

[Article](#) [CAS](#) [Google Scholar](#)

5 Mukherjee, J., Majumder, A.B., and Gupta, M.N., *Anal. Biochem.*, 2016, vol. 507, pp. 27–32.

[Article](#) [CAS](#) [Google Scholar](#)

6 Banerjee, A., Singh, V., Solanki, K., Mukherjee, J., and Gupta M.N., *Sustain. Chem. Process*, 2013, vol. 1:14.

[Article](#) [Google Scholar](#)

7 Jaeger, K.E. and Eggert, T., *Curr. Opin. Biotechnol.*, 2002, vol. 13, pp. 390–397.

[Article](#) [CAS](#) [Google Scholar](#)

8 Christopher, L.P., Zambare, V.P., Zambare, A., Kumar, H., and Malek, L., *J. Chem. Technol. Biotechnol.*, 2015, vol. 90, no. 11, pp. 2007–2016.

[Article](#) [CAS](#) [Google Scholar](#)

9 Balcao, V.M., Paiva, A.L., and Malcata, F.X., *Enzyme Microb. Technol.*, 1996, vol. 18, no. 6, pp. 392–416.

[Article](#) [CAS](#) [Google Scholar](#)

10 Perraud R. and Laboret, F., *Appl. Microbiol. Biotechnol.*, 1995, vol. 44, pp. 321–326.

[Article](#) [CAS](#) [Google Scholar](#)

11 Chen, B., Hu, J., Miller, E.M., Xie, W., Cai, M., and Gross, R.A., *Biomacromolecules*, 2008, vol. 9, no. 2, pp. 463–547.

[Article](#) [CAS](#) [Google Scholar](#)

12 Ganesh, M., Dave, N.R., L'Amoreaux, W., and Gross, A.R., *Macromolecules*, 2009, vol. 42, pp. 6836–6839.

[Article](#) [CAS](#) [Google Scholar](#)

13 Atkinson, P.J., Grimson, M.J., Heenan, R.K., Howe, A.M., and Robinson, B.H., *J. Chem. Soc. Chem. Commun.*, 1989, vol. 23, pp. 1807–1807.

[Article](#) [Google Scholar](#)

14 Dandavate, V. and Madamwar, D., *J. Microbiol. Biotechnol.*, 2008, vol. 18, no. 4, pp. 735–741.

[CAS](#) [PubMed](#) [Google Scholar](#)

15 Murray, E., Thompson, C.B., Sepidar, S., and Gordon, G.W. *Polym. Degrad. Stab.*, 2015, vol. 111, pp. 71–77.

[Article](#) [CAS](#) [Google Scholar](#)

16 Khan, I., Dutta, J.R., and Ganeshan, R., *Int. J. Biol. Macromol.*, 2017, vol. 95, pp. 126–131.

[Article](#) [CAS](#) [Google Scholar](#)

17 Patel, V., Gajera, H., Gupta, A., Manocha, L., and Madamwar, D., *Biochem. Eng. J.*, 2015, vol. 95, pp. 62–70.

[Article](#) [CAS](#) [Google Scholar](#)

18 Chen, D.R., Bei, J.Z., and Wang, S.G., *Polym. Degrad. Stab.*, 2000, vol. 67, pp. 455–459.

[Article](#) [CAS](#) [Google Scholar](#)

19 Ahmed, H.E, Ragvendra, T., and Madamwar, D., *Bioresour. Technol.*, 2010, vol. 101, no. 10, pp. 3628–3634.

[Article](#) [CAS](#) [Google Scholar](#)

20 Chauhan, M. and Garlapati, K. V., *Appl. Biochem. Biotechnol.*, 2013, vol. 171, no. 6, pp. 1429–1443.

[Article](#) [CAS](#) [Google Scholar](#)

21 Bora, L. and Bora, M., *Braz. J. Microbiol.*, 2012, vol. 43, no. 1, pp. 30–42.

[Article](#) [CAS](#) [Google Scholar](#)

22 Shariff, F.M., Leow, T.C., Mukred, A.D., Salleh, A.B., Basri, M., and Rahman, R.N.Z.R.A., *J. Basic Microbiol.*, 2007, vol. 47, no. 5, pp. 406–412.

[Article](#) [CAS](#) [Google Scholar](#)

23 Charoenpanich, J., Soongrung, T., Chinnasri, S., Suebchuea, N., Suppoontong, M., and Thiemsawait, S., *Biocatal. Agric. Biotechnol.*, 2018, vol. 13, pp. 116–122.

[Article](#) [Google Scholar](#)

24 Gulati, R., Isar, J., Kumar, V., Prasad, A.K., Parmar, V.S., and Saxena, R.K., *Pure Appl. Chem.*, 2005, vol. 77, no. 1, pp. 251–62.

[Article](#) [CAS](#) [Google Scholar](#)

25 Ameri, A., Shakibaie, M., Rostami, S.A., Ameri, A., Adeli-Sardou, M., Khazaeli, P., et al., *Biotechnology*, 2015, vol. 14, no. 4, pp. 154–164.

[Article](#) [CAS](#) [Google Scholar](#)

26 Bayoumi, A.R., El-Louboudey, S.S., Sidkey, M.N., and Abd-el-Rahman, A.M., *J. Appl. Sci. Res.*, 2007, vol. 3, no. 12, pp. 1752–1765.

[CAS](#) [Google Scholar](#)

27 Castro-Ochoa, L.D., Rodríguez-Gómez, C., Valerio-Alfaro, G., and Ros, R.O., *Enzyme Microb. Technol.*, 2005, vol. 37, no. 6, pp. 648–654.

[Article](#) [CAS](#) [Google Scholar](#)

28 Dharmsthiti, S. and Luchai, S., *FEMS Microbiol. Lett.*, 1999, vol. 179, no. 2, pp. 241–246.

[Article](#) [CAS](#) [Google Scholar](#)

29 Yanbing, Z., Hebin, L., Hui, N., Anfeng, X., Lijun, L., and Huinong, C., *World J. Microbiol. Biotechnol.*, 2015, vol. 31, pp. 295–306.

[Article](#) [Google Scholar](#)

30 Raghavendra, T., Vohra, U., Shah, A.R., and Madamwar, D., *Biotech. Prog.*, 2014, vol. 30, pp. 828–836.

[Article](#) [CAS](#) [Google Scholar](#)

31 Rashid F.A.A., Rahim R.A., Ibrahim D., Balan A., and Bakar N.M.A., *J. Pure Appl. Microbiol.*, 2013, vol. 7, no. 3, pp. 1635–1645.

[CAS](#) [Google Scholar](#)

32 Gupta, R., Gupta, N., Rathi, P., *Appl. Microbiol. Biotechnol.*, 2004, vol. 64, pp. 763–781.

[Article](#) [CAS](#) [Google Scholar](#)

33 Sujatha, K. and Dhandayuthapani, K., *Int. J. Pharm. Biol. Sci.*, 2013, pp. 645–652.

34 Peng, R., Lin, J., and Wei, D., *Appl. Biochem. Biotechnol.* 2010. vol. 162, pp. 733–743.

[Article](#) [CAS](#) [Google Scholar](#)

35 Rahman, R.N.Z.R.A., Bahrum, S.N., Salleh, A.B., and Basri, M., *J. Microbiol.*, 2006, vol. 44, pp. 583–590.

[PubMed](#) [Google Scholar](#)

ACKNOWLEDGMENTS

All authors are grateful to the Department of Biotechnology, New Delhi, India for financial support (BT/PR8218/BCE/8/1044/2013).

Author information

Authors and Affiliations

P.G. Department of Biosciences, UGC Centre of Advanced Study, Satellite Campus, Vadtal Road, Bakrol, 388 315 Sardar Patel University, Anand, Gujarat, India

P. Singh, V. Patel & D. Madamwar

School of Life Sciences, Faculty of Science, Atmiya University, Yogidham Gurukul, 360 005, Rajkot, Gujarat, India

V. Shah

Aanvik LifeSciences Pvt. Ltd., 380 013, Ahmedabad, Gujarat, India

V. Shah

Corresponding authors

Correspondence to [P. Singh](#) or [D. Madamwar](#).

Ethics declarations

COMPLIANCE WITH ETHICAL STANDARDS

The authors declare that they have no conflict of interest. This article does not contain any studies involving animals or human participants performed by any of the authors.

CONSENT FOR PUBLICATION

All the authors have consent for this manuscript publication.

AUTHOR CONTRIBUTIONS

P. Singh and V. Patel hold equal authorship for the paper.

Rights and permissions

[Reprints and permissions](#)

About this article

Cite this article

Singh, P., Patel, V., Shah, V. *et al.* A Solvent-tolerant Alkaline Lipase from *Bacillus* sp. DM9K3 and Its Potential Applications in Esterification and Polymer Degradation. *Appl Biochem Microbiol* 55, 603–614 (2019). <https://doi.org/10.1134/S0003683819060139>

Received

18 April 2019

Revised

30 May 2019

Accepted

20 June 2019

Published

06 December 2019

Issue Date

November 2019

DOI

<https://doi.org/10.1134/S0003683819060139>

Keywords:

[thermotolerant lipase](#)

[solvent-tolerant lipase](#)

[White Rann of Kachchh](#)

[esterification](#)

[reusability](#)

[biodegradation](#)