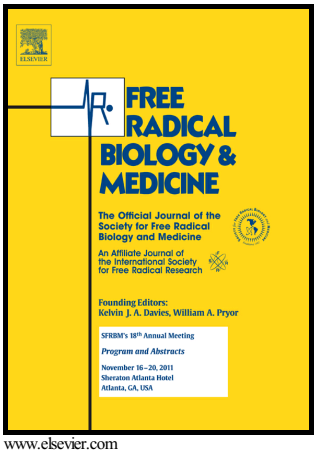
Selenophosphate synthetase 1 and its role in redox homeostasis, defense and proliferation

Jiwoon Na, Jisu Jung, Jeyoung Bang, Qiao Lu, Bradley A. Carlson, Xiong Guo, Vadim N. Gladyshev, Jinhong Kim, Dolph L. Hatfield, Byeong Jae Lee



www.elsevier.com

PII: S0891-5849(18)30770-6
DOI: https://doi.org/10.1016/j.freeradbiomed.2018.04.577
Reference: FRB13745

To appear in: *Free Radical Biology and Medicine*

Received date: 13 February 2018
Revised date: 24 April 2018
Accepted date: 26 April 2018

Cite this article as: Jiwoon Na, Jisu Jung, Jeyoung Bang, Qiao Lu, Bradley A. Carlson, Xiong Guo, Vadim N. Gladyshev, Jinhong Kim, Dolph L. Hatfield and Byeong Jae Lee, Selenophosphate synthetase 1 and its role in redox homeostasis, defense and proliferation, *Free Radical Biology and Medicine,* https://doi.org/10.1016/j.freeradbiomed.2018.04.577

Selenophosphate synthetase 1 and its role in redox homeostasis, defense and proliferation

Jiwoon Na[1#], Jisu Jung[1#], Jeyoung Bang[1], Qiao Lu[1], Bradley A. Carlson[2], Xiong Guo[3], Vadim N. Gladyshev[4], Jinhong Kim[1], Dolph L. Hatfield[2] and Byeong Jae Lee[1*]

1. School of Biological Sciences, Seoul National University, Seoul 08826, Korea
2. National Cancer Institute, National Institutes of Health, Bethesda, MD20892, USA
3. School of Public Health, Xi'an Jiaotong University, Xi'an 710061, PR of China
4. Division of Genetics, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School, Boston, MA 02115, U.S.A.

[#]These authors contributed equally

[*]Address correspondence to: Byeong Jae Lee, PhD, Professor, School of Biological Sciences, Interdisciplinary Program of Bioinformatics, Seoul National University, Building 504, Room 525, Seoul 151-742, Korea. Tel: +82-2-880-6775, Fax: +82-2-872-9019. E-mail: imbglmg@snu.ac.kr

Abstract

Selenophosphate synthetase (SEPHS) synthesizes selenophosphate, the active selenium donor, using ATP and selenide as substrates. SEPHS was initially identified and isolated from bacteria and has been characterized in many eukaryotes and archaea. Two SEPHS paralogues, SEPHS1 and SEPHS2, occur in various eukaryotes, while prokaryotes and archaea have only one form of SEPHS. Between the two isoforms in eukaryotes, only SEPHS2 shows catalytic activity during selenophosphate synthesis. Although SEPHS1 does not contain any significant selenophosphate synthesis activity, it has been reported to play an essential role in regulating cellular physiology. Prokaryotic SEPHS contains a cysteine or selenocysteine (Sec) at the catalytic domain. However, in eukaryotes, SEPHS1 contains other amino acids such as Thr, Arg, Gly, or Leu at the catalytic domain, and SEPHS2 contains only a Sec. Sequence comparisons, crystal structure analyses, and ATP hydrolysis assays suggest that selenophosphate synthesis occurs in two steps. In the first step, ATP is hydrolyzed to produce ADP and gamma-phosphate. In the second step, ADP is further hydrolyzed and selenophosphate is produced using gamma-phosphate and selenide. Both SEPHS1