Solanum lycopersicum (tomato) possesses mitochondrial and plastidial lipoyl synthases capable of increasing lipoylation levels when expressed in bacteria

By: Araya-Flores, J (Araya-Flores, Jorge)[1]; Miranda, S (Miranda, Simon)[1]; Covarrubias, MP (Paz Covarrubias, Maria)[1]; Stange, C (Stange, Claudia)[1]; Handford, M (Handford, Michael)[1]

PLANT PHYSIOLOGY AND BIOCHEMISTRY
Volume: 151
Pages: 264-270
DOI: 10.1016/j.plaphy.2020.03.031
Published: JUN 2020
Document Type: Article
View Journal Impact

Abstract

Lipoic acid (LA) and its reduced form (dihydrolipoic acid, DHLA) have unique antioxidant properties among such molecules. Moreover, after a process termed lipoylation, LA is an essential prosthetic group covalently-attached to several key multi-subunit enzymatic complexes involved in primary metabolism, including E2 subunits of pyruvate dehydrogenase (PDH). The metabolic pathway of lipoylation has been extensively studied in Escherichia coll. and Arabidopsis thaliana in which protein modification occurs via two routes: de novo synthesis and salvage. Common to both pathways, lipoyl synthase (LIP1 in plants, LipA in bacteria, EC 2.8.1.8) inserts sulphur atoms into the molecule in a final, activating step. However, despite the detection of LA and DHLA in other plant species, including tomato (Solanum lycopersicum), no plant LIP1s have been characterised to date from species other than Arabidopsis. In this work, we present the identification and characterisation of two LIPs from tomato, S1LIP1 and S1LIP1p. Consistent with in silico data, both are widely-expressed, particularly in reproductive organs. In line with bioinformatic predictions, we determine that yellow fluorescent protein tagged versions of S1LIP1 and S1LIP1p are mitochondrially- and plastidially-localised, respectively. Both possess the molecular hallmarks and domains of well-characterised bacterial LipAs. When heterologously-expressed in an E. coli lipA mutant, both are capable of complementing specific growth phenotypes and increasing lipoylation levels of E2 subunits of PDH in vivo, demonstrating that they do indeed function as lipoyl synthases.

Keywords

Author Keywords: Heterologous complementation; LIP1; Lipoic acid; Lipoyl synthase; Lipoylation; Pyruvate dehydrogenase; Solanum lycopersicum
KeyWords Plus: LIPOATE-PROTEIN LIGASE; ESCHERICHIA-COLI; ACID METABOLISM; REDOX STATUS; MOLECULAR-CLONING; SULFUR INSERTION; DILUTED SEAWATER; FATTY-ACID; ARABIDOPSIS; BIOSYNTHESIS

Author Information

Reprint Address: Handford, M (reprint author)

+ Univ Chile, Fac Sci, Dept Biol, Las Palmeras 3425, Santiago, Chile.

Addresses:

+ [1] Univ Chile, Fac Sci, Ctr Biol Mol Vegetal CBMV, Dept Biol, Santiago, Chile

E-mail Addresses:mhandfor@uchile.cl

Funding

Funding AgencyShow details	Grant Number
Comision Nacional de Investigacion Cientifica y Tecnologica (CONICYT) CONICYT FONDECYT	1181198
Comision Nacional de Investigacion Cientifica y Tecnologica (CONICYT)	PIA ACT192073
CONICYT Beca de Magister Nacional	22151178
CONICYT Beca de Doctorado Nacional	21160916
Fundacion Maria Ghilardi Venegas	
Fundacion Maria Ghilardi Venegas scholarship	
Faculty of Sciences, Universidad de Chile	

View funding text

Publisher

ELSEVIER FRANCE-EDITIONS SCIENTIFIQUES MEDICALES ELSEVIER, 65 RUE CAMILLE DESMOULINS, CS50083, 92442 ISSY-LES-MOULINEAUX, FRANCE

Journal Information

- **Impact Factor:** Journal Citation Reports

Categories / Classification

Research Areas: Plant Sciences
Web of Science Categories: Plant Sciences

Document Information

Language: English
Accession Number: WOS:000531096600025
PubMed ID: 32244096
ISSN: 0981-9428