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Vincent Salis, Jean-Chrisologue Totozafy, Carine C. Deruyffelaere, Isabelle Bouchez, Fabien Chardon, et al.. Deciphering the function of Arabidopsis LDAP1 in lipid droplet turnover induced by heat stress. Colloque GRAINES 2023, Nov 2023, VERSAILLES, France. 2023. hal-04518493

HAL Id: hal-04518493 https://hal.science/hal-04518493

Submitted on 27 Mar 2024

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Colloque Graines 2023 – IJPB Versailles

Deciphering the function of Arabidopsis LDAP1 in lipid droplet turnover induced by heat stress

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Background : Lipid droplets (LDs) are lipid storage organelles composed of a neutral core of triacylglycerols (TAGs) and sterol esters surrounded by a monolayer of phospholipids with associated proteins, including structural proteins of the Lipid Droplet Associated Protein (LDAP) family. Heat stress (HS) was shown to trigger the expression of LDAP1, one of the 3 LDAP in Arabidopsis thaliana [1], and to induce TAG accumulation [2], leading to the formation of LDs which are subsequently remobilized during the recovery phase. How the stress-induced LDs are degraded and contribute to cell homeostasis after returning to normal growth conditions remains completely unknown.

Objectives : Deciphering the role of LDAP1 in LD dynamics in response to HS and during the recovery phase ; assessing LDAP1 function in plant tolerance to HS.



Model					2 Lipidome dynamics during HS and recovery		
15 conditions	Unstressed 22°C	Heat Stress 37°C ; 3h	Recovery 22°C		ColO	ldap1-1	
5 replicates)* 🔆			Lipid profile	TAG	-	







Col 0

ldap1/pLDAP1-LDAP1-GFP

- Idap1-1
- Better survival of *Idap1-1* plantlets to high HS compared to wt ones.
- The wt phenotype is restored by complementation



- Transient accumulation of Polyunsaturated fatty acid (PUFA)-containing TAGs during HS.
- Slight modification of the dynamics of some lipid species in *Idap1-1*.

Conclusion : TAGs and LDAP1 accumulate during HS and are degraded upon return to normal growth conditions. TAGs show a higher degradation rate than LDAP1 during the recovery phase. In-depth analysis of lipidome adaptation during and after HS confirms previous observation such as the accumulation of PUFA-containing TAGs and a decreased in the unsaturation index of membrane lipids [3]. Furthermore, LDAP1 deficiency is associated with a slower degradation rate of some lipid species during the recovery phase, without blocking TAG accumulation or degradation.

ldap1-

[1] Gidda, S.K., Park, S., Pyc, M., Yurchenko, O., Cai, Y., Wu, P., Andrews, D.W., Chapman, K.D., Dyer, J.M., and Mullen, R.T. (2016). Lipid Droplet-Associated [2] Mueller, S.P., Unger, M., Guender, L., Fekete, A., and Mueller, M.J. (2017). Phospholipid: Diacylglycerol Acyltransferase-Mediated Triacylglyerol Synthesis Proteins (LDAPs) Are Required for the Dynamic Regulation of Neutral Lipid Compartmentation in Plant Cells. Plant Physiol. 170: 2052–2071. Augments Basal Thermotolerance. Plant Physiol. 175: 486–497.

[3] Shiva, S. et al. (2020). Leaf Lipid Alterations in Response to Heat Stress of Arabidopsis thaliana. Plants 9: 845.

