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„The impact of acyl-CoA:lysophosphatidylcholine acyltransferases (LPCATs) on Arabidopsis thaliana growth and development under standard and abiotic stress conditions"

Membranes are a key structural cell components of all living organisms. They serve as flexible barriers that separate cell's internal and external environment, control the movement of molecules and participate in intercellular communication. In plant, proper membrane structure is critical for homeostasis of the entire plant and play a fundamental role in the survival and adaptation of plants to adverse growth conditions.

Cell membranes consist of a lipid bilayer composed of phospholipids, which are made up of a polar head and two nonpolar fatty acid tails. Among them, phosphatidylcholine (PC) is the predominant component, playing a crucial role in maintaining the proper structure of membranes. The control of its content, fatty acids composition and overall PC metabolisms is regulated by the enzymes called acyl-CoA:**l**yso**p**hosphatidyl**c**holine **a**cyl**t**ransferase (LPCATs).

The biochemical role of LPCATs in the plant is well-established and is primarily associated with the process of remodeling cellular membrane composition. This function is assigned to these enzymes as they can function bidirectionally not only synthesizing PC from lysophosphatidylcholine (LPC) and acyl-CoA (fatty acid linked to coenzyme A) but also breaking it down into appropriate acyl-CoA and LPC. Lysophosphatidylcholine can be re-acylated with a different fatty acid (a process known as PC remodeling) or serve as another essential component of cellular membrane structure. Nevertheless, the physiological function of LPCATs still remains unclear, hence the primary goal of this project is to deepen our understanding in this area Due to the fact that LPCATs are crucial enzymes responsible for phosphatidylcholine metabolism, the primary phospholipid of cellular membranes, we assume that any disruption in their activity, will result in changes in plant development and their adaptation to adverse conditions.

Our preliminary studies conducted on *Arabidopsis thaliana* lines with declined LPCATs activity revealed substantial alterations in phenotype, including reduced roots development, biomass increments and disrupted tolerance to long-term temperature stress. These observations support the presumption that LPCATs play a critical role in plant physiological and can be crucial for adaptation plant to unfavorable environmental conditions. Our hypothesis suggests that the primary cause of these effects is the modification of PC and LPC content through the disruption of their metabolism regulated by LPCATs, consequently impacting membrane structure and disrupting proper plant growth.

To fully elucidate the role of LPCATs in plant growth and development, we plan to extend our study by investigation the correlation of these enzyme with the other enzyme called **p**hospholid:**d**iacylglycerol **a**cyl**t**ransferase (PDAT). PDAT is primarily involved in triacylglycerol synthesis, but it also indirectly participates in the metabolism of PC and LPC, serving as a substrate and a byproduct of its activity, respectively. So far, we have observed significant phenotypic changes in *A. thaliana* lines with increased PDAT activity and additionally we detected elevated LPCAT activity in these lines, indicating potential interplay between these enzymes.

In natural environment, plants are constantly exposed to various stress factors, both biotic (e.g., virus, bacteria) an abiotic (e.g., extreme temperature, drought, humidity). Their susceptibility to these stressors can lead numerous detrimental effects, including growth limitations, reduced yields, or even the demise of individual organs or entire plants. One of the crucial factor affecting plant adaptability is membrane structure adjustment and, in this context, the most important can be modification of both PC and LPC content, as well as the appropriate alteration of their fatty acid compositions. In this project , we plan to determine the role of LPCAT enzymes and their interaction with the PDAT enzyme concerning the adaptive abilities of plants to four of the most significant threats arising from climate change: high and low temperatures, drought, and flooding.

Conducted research will involve comprehensive analysis of *A. thaliana* lines with increased or decreased activity of LPCATs and PDAT as well as their combinations. The analyses will focus on macroscopic, biochemical and molecular level. The special emphasis will be placed on investigating changes in lipid metabolism as well as other lipid-related process.

The obtained results will significantly expand our knowledge regarding the role of enzymes influencing the composition of membrane lipids in growth and development of plant and adaptation of plants to adverse conditions. In the future, this knowledge may be used as a valuable tool in plant biotechnology to develop plant varieties resistant to unfavorable environmental conditions.