DESCRIPTION FOR THE GENERAL PUBLIC

Cellular membranes are mainly considered as flat lamella built of lipids and proteins. However, in specific conditions, they can also bend into unique spatial periodic arrangements called cubic membranes. Such membrane configurations were observed already in many organisms from protozoa to mammals. Moreover, there is also great variability in membrane types which can fold into cubic shapes e.g. endoplasmic reticulum or mitochondria and plastid inner membranes. However, there is still a big paucity in the data regarding factors responsible for the formation of cubic membranes in natural systems, as well as potential biological role of such configuration. In this project we will focus on arguably most important membrane system in nature – main energy conversion center in plants i.e. thylakoid membranes. In general, thylakoid membranes form a lamella-based network of stacked membranes called grana and loosely arranged stroma thylakoids. However, during preliminary studies we discovered that particular *Arabidopsis thaliana* mutants are capable to form cubically shaped thylakoids.

Cubic arrangements are observed not only in biological membranes but they are one of the main forms of liquid lyotropic mesophases that could be obtained artificially. Because the role of artificially obtained cubic phases is described or proposed in different economically and socially relevant fields (e.g. drug delivery, control release of flavor in food industry, generation of advanced materials, spatial control of chemical reactions) it makes natural cubic membranes an obvious next target for investigations. It will be especially relevant to expand the potential role of mesophases, which cannot be obtained in case of e.g. small length-scales of artificial amphiphilic cubic phases. Naturally occurring bicontinuous phases deserve particular consideration, not only because their potential system-specific evolutionary purpose and function remains in the overwhelming majority of cases vague, but also due to the fact that they possess potential functional flexibility exceeding that of the synthetic phases.

This research project will focus on clarification of the structural and molecular basis of cubic membrane formation using a newly discovered model of dark-adapted thylakoids of fully developed chloroplasts of *Arabidopsis thaliana stn7* mutant. Moreover, an attempt will be made to decipher the biological function of cubic membranes in the studied model.

Detailed ultrastructural 2D and 3D analysis of the cubic membrane formation and its on-light transformation into lamellar arrangement will be performed. Structural analysis will be followed by the complex analysis of lamellar/cubic membranes composition using different complementary biochemical and biophysical techniques. Finally, selected biochemical methods will be used to test different work hypotheses on the role of cubic membrane appearance in studied model.

Obtained results will be the first complex analysis of the cubic membranes transformation both at the structural and composition level. We expect that knowledge on the crucial factors responsible for the formation of ordered cubic structure with large length-scales will be an important next step to obtain new artificial mesophases of expanded functionalities. Moreover, searching for the biological meaning of cubic phases appearance on studied model could bring more general answers on the role of ordered structures in the regulation of cells metabolism.