DESCRIPTION FOR THE GENERAL PUBLIC

The ubiquitin-proteasome system (UPS) is a major proteolytic system in eukaryotes. It acts by tagging targets with ubiquitin protein(s) was identified in many eukaryotic organelles but was thought to be missing in plastids. However, most recent findings show that UPS is indeed present in chloroplast, i.e. the organelle where photosynthesis takes place. Photosynthesis appeared for the first time in ancestors of modern prokaryotic photosynthetic organisms, cyanobacteria. According to the endosymbiotic theory they were engulfed by other cells about one billion years ago and now exist as chloroplasts of multicellular organisms. Interestingly, ubiquitination is not present in prokaryotes, thus it is intriguing to understand the role of ubiquitination in chloroplasts. Originally, ubiquitinated proteins were shown to be degraded by proteasome but now we know that ubiquitination may also affect protein localization within the cell, inhibit or stimulate protein-protein interactions, alter enzymes activity or regulate histones modifications. Current project focuses on identification of ubiquitin-tagged proteins in model plant organism, *Arabidopsis thaliana*. We will study multidomain proteins SPL1 and SPL2 embedded in outer membrane of chloroplast. The sequence of their cytosol domains suggests that SPL1 and SPL2 might ubiquitinate other proteins present in this compartment. And their central domains localized in the intermembrane space may interact with other protein partners. By applying various molecular biology and biochemical techniques we want to identify both SPL1/2 substrates and their protein partners to elucidate the precise role of these proteins.

We propose basic research on the *Arabidopsis* model plant in an area of profound biological importance with great potential to yield results of economical or societal significance. Chloroplasts are the site of photosynthesis in plants, algae and some protists, and so mediate much of the world's primary productivity. As photosynthesis is the only significant mechanism of energy input into the biosphere, chloroplasts are essential for plants and animals alike; thus, agriculture is wholly dependent on chloroplast biogenesis. Chloroplasts or other plastids also mediate many biosynthesis (starch, amino acids, fatty acids). Many of these products are vital in mammalian diets, and knowledge on plastid biogenesis may enable improvements in their quantity or quality. Since plastids are so integral to cellular metabolism, plastid biogenesis defects can cause plants to die during (pre)embryonic development. Chloroplasts contain ~3000 proteins but only ~100 are encoded by the plastome. Thus >90% of plastid proteins are nucleus encoded and cytosolically synthesized, so that chloroplast biogenesis is dependent on efficient operation of the TOC/TIC import machinery. Because of chloroplasts' uniquely important role in the biosphere, we are all dependent upon proper chloroplast development (including protein import) for survival. This emphasizes the importance of knowledge on chloroplast protein import.

Plastids offer many opportunities for agricultural or industrial exploitation. Depletion of fossil fuels and environmental effects of their use demand that renewable materials are used by the chemical and fuel industries. Biofuels have attracted much attention recently, and will likely become more significant as cost and efficiency issues are resolved. As raw materials for biofuel production are derived largely via chloroplast processes, improved understanding of plastid biogenesis will aid development of this important technology. As chloroplasts may contain >50% of total leaf protein, foreign proteins can be expressed to extremely high levels in plastids. Plastid manipulation may also enable accumulation of foreign proteins that would be harmful elsewhere in the cell. Plastids are inherited maternally and so (in relation to transplastomics) the possibility for transgene outcrossing is minimized. Knowledge on plastids may have medical or veterinary applications, as apicomplexan parasites (malaria, toxoplasmosis) contain a relict plastid. Moreover, our work on SPL1/2 may shed light on related processes in mitochondrial biogenesis; significantly, mitochondria and the ubiquitin proteasome system have both been implicated in ageing and neurodegenerative diseases.