OA1.4 - Utilization of light energy in novel phototrophic bacterium *Gemmatimonas phototrophica*

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The bacterium *Gemmatimonas phototrophica* was described in 2014 as the first phototrophic representative of the bacterial phylum Gemmatimonadetes. *G. phototrophica* contains small amount of type-2 purple bacterial reaction centers, but it does not contain any carbon fixation genes. Since the contribution of light-derived energy to its metabolism and growth was unclear, we decided to elucidate how light energy is utilized in its metabolism and how much it stimulates its growth. The light-harvesting capacity of *G. phototrophica* was first tested using infra-red variable fluorescence measurements. The obtained fluorescence induction kinetics documented that *G. phototrophica* has an approx. four times larger effective antenna cross-section when compared with *R. rubrum*.
To test how light exposure influences carbon metabolism we conducted metabolic assays using radiolabeled substrates such as leucine, glutamate, acetate, pyruvate, glucose and thymidine. The assimilation rates of leucine, thymidine and glucose were about 2.5-fold higher under light compared to the dark conditions. Acetate, pyruvate and glutamate were not utilized.
The ultimate evidence of functional photosynthesis is the direct stimulation of cell growth by light. The growth rate is typically measured in liquid cultures from the relative increase of biomass per unit of time. Unfortunately, this standard approach could not be used since *G. phototrophica* do not grow in liquid cultures. Therefore we attempted to approximate growth kinetics from the expansion of *G. phototrophica* colonies on agar plates. We used a custom made imaging system to follow the colony growth. During the 2 weeks of the experiment, the colonies exposed to light grew approx. 40% faster than the dark-incubated samples (0.32 d^{-1} v. 0.24 d^{-1}).
All the presented results document that *G. phototrophica* is a typical facultative photoheterotroph. It requires organic carbon substrates for its growth but it can supplement a large part of its metabolic needs using light-derived energy.