

Title

Molecular interaction between endosymbiotic green algae and host protozoans such as *Paramecium bursaria* and *Stentor pyriformis*

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Abstract (200-400 words)

Some eukaryotes accommodate endosymbiotic algae in their cytoplasm; however, the mechanisms involved in the interaction between the host and the symbiont remain largely unexplained. Recently, electron microscopy analyses and three-dimensional reconstructions were used to examine the ultrastructure of symbiotic algal cells (*Chlorella variabilis* Kb1) and their interactions with organelles in the host ciliate, *Paramecium bursaria* Pb-Kb1 β . In cryofixed *P. bursaria* specimens, the perialgal vacuole membrane (PVM), which surrounds the symbiotic algae, was found to be closely associated with the cell wall of the symbiotic algae. However, the distance between these structures was markedly expanded in chemically fixed samples, suggesting that the procedures involved in chemical fixation introduce artefacts¹. Structural connections between the host endoplasmic reticulum-mitochondria network and the symbiotic algae or its surrounding perialgal vacuole membrane were also identified, thereby suggesting additional mechanisms involved in the interaction between intracellular symbiotic algae and their eukaryotic hosts. The PVM prevents digestion of the symbionts in the host's cytoplasm and controls the mutual exchange of various substances between the two partners, indicating that the presence of the PVM is essential for their successful mutual endosymbiosis^{2,3}. Combined analysis of transcriptome and proteome data was employed to identify proteins that are associated with the PVM, and the results were compared with those obtained from the digestive vacuole membrane. The PVM fraction was found to contain various proteins, including amino acid and lipid transporters and a V-type H⁺-ATPase, which are considered to be closely related to the functions of the PVM. Many mitochondria-specific proteins were also identified as constituents of the PVM fraction, further strengthening the view that the PVM is tightly associated with mitochondria. Our observations propose a new endosymbiotic systems between the host eukaryotes and the symbionts where the benefiting symbiosis is performed through intimate interactions and an active structural modification in the host organelles.

1) Song, C. and Suzaki, T. 2013. J. Electr. Microsc. Technol. Med. Biol., 27: 1-8.

2) Song, C., Murata, K. and Suzaki, T. 2017. Sci. Rep., 7: 1221 (DOI:10.1038/s41598-017-01331-0).

3) Hoshina, R., Hayakawa, M. M., Kobayashi, M., Higuchi, R. and Suzaki, T. 2020. Sci. Rep., 10: 628 (DOI:10.1038/s41598-020-57423-x).



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