

# The Mechanism of Endosymbiosis of the *Chlorella* Species within the Cell of a Ciliate *Paramecium Bursaria* by Adjusting the Surrounding pH and Overcoming Digestion

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It has been thought that intracellular symbiosis evolved chloroplast and mitochondria, and understanding the mechanism is one of the major issues in biological science. *Paramecium bursaria* is a ciliate in which the unicellular green alga of *Chlorella* sp. coexists symbiotically. Because this symbiosis between *Chlorella* and *Paramecium* can be reproduced experimentally, this system has been applied to elucidate the symbiosis. It is essential for *Chlorella* coexisting in *Paramecium* that *Chlorella* must survive in a strong acidic environment by acidosome when it is taken into the phagosome of *Paramecium*, and overcome digestive action as well. These two questions have been addressed in this study. When yeast cells stained with a pH-indicating dye was taken up into phagosomes together with *Chlorella* cells and placed under the light, the pH in phagosomes rose. This experiment clearly showed that *Chlorella* increased the surrounding pH under the light in relation to photosynthesis. The cell number of *Chlorella* after incorporating into *Paramecium* decreased in the dark but increased in the light, which suggested a possible involvement of some excreted photosynthetic product(s). Based on the findings of previous research indicating maltose of a major photosynthetic product excreted from *Chlorella*, the cell number of *Chlorella* greatly decreased when maltose is degraded by maltase treatment, whereas the cell number was restored when maltase was removed by rinsing. It was then suggested that maltose excretion prevented *Chlorella* digestion by lysosomes.