Summary of Research

We proposed the experiment to investigate the effects of microgravity exerted on the life span of clone generation of the ciliate *Paramecium*. For the purpose of the investigation on the fluctuation of the biologically relevant time during the long stay in space, the conformity of the experiment in the microgravity environment onboard Space Station has been examined. We so far developed the equipment model having the function of the cultivation of paramecia in a closed system, in which cells are grown in a small vessel with a wall of gas-permeable membrane, and the density of the cell is monitored, without invasion to the closed culture, by optical slice imaging and computer-aided image analysis. In this research we verified, following the scenarios of space experiment, the experimental procedures and the peripheral devices to the culture vessel, such as the method of the transportation to the orbit, a cell culture system using the developed equipment model, cell accumulator to induce autogamy under starvation and the long term and bubble-free preservation of culture medium.

Finally a test-bed model was developed which includes the all components so far tested (A in the figure). This model was able to grow and dilute cells independently in separate vessels with optically monitoring the density. Percent autogamy was measured from cells sampled at the dilution and maintained afterward for couple of days. As a result we could obtain the data of the changes in autogamy percent as a function of mean fission age (B) and absolute time (C), which are essential for the research on the fluctuation of clonal life span of *Paramecium* in space.

In addition to the development of the experimental hardware, gravity dependent phenomena of the cell growth in *Paramecium*. Several papers have reported that the proliferation rate of *Paramecium* became slower when cultured under hypergravity. Since they were based on the experiments on the bacterized culture, the possibility could not be excluded that the results reflect the slower proliferation of bacteria but not that of *Paramecium*. In order to investigate the direct effect of hypergravity solely on *Paramecium*, cells were axenically cultured under the hypergravity (1−20 g).

Cells cultured in 20 g attained the stationary phase with the same time as control culture but had lower density (about 2/3) at stationary phase. This lowered proliferation rate continued as long as cells were exposed to hypergravity (>one month). Hypergravity also changed the morphology of *Paramecium*, the long axis of the cells became shorter and the short axis became longer than those of control cells. However it did not change the length of autogamy immaturity measured by mean fission age. The reduced proliferation rate under hypergravity, as a result, prolonged it measured by absolute time. Previous space experiments denoted that the proliferation rate of *Paramecium* became
faster under microgravity. If we assume the symmetrical effect of gravity on the maturation process of Paramecium, microgravity in space might reduce the length of immaturity period of Paramecium in absolute time with maintaining the fission age unchanged.

List of Publication

Journal Articles

Proceedings of Oral Presentation