論文の内容の要旨

Studies on organelle dynamics during spermiogenesis in *Marchantia polymorpha*
（ゼニゴケ精子変態過程におけるオルガネラ動態の研究）

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Sexual reproduction is a fundamental event in many eukaryotes, whose processes have been diversified during evolution. In land plants, while male gametes of angiosperms and some gymnosperms are immotile and delivered to female gametes through pollen tubes, other plants utilize motile flagellated male gametes called spermatozoids. During spermiogenesis, a process of transformation from immotile spermatids to motile spermatozoids, dynamic and complex reorganization of organelles take place. Although this process has been intensively examined by transmission electron microscopy, organelle dynamics during spermiogenesis and molecular mechanisms of spermiogenesis remain obscure. To understand how each organelle is reorganized during spermiogenesis, I took advantage of the liverwort *Marchantia polymorpha*, because genetic and cell biological techniques are applicable to this model plant that produce spermatozoids.

In Chapter 1, I generated transgenic plants expressing fluorescent protein-tagged organelle markers and observed reorganization of each organelle by confocal microscopy. I found that the shape and number of each organelle change drastically during spermiogenesis, and each of organelles and

organelle proteins are deformed and/or removed at different stages during spermiogenesis. I also found through detailed observation of mitochondria that mitochondrial fission frequently occurs at an early stage of spermiogenesis and most of resultant mitochondria are removed. Furthermore, I found that the posterior mitochondrion is generated by fission of the anterior mitochondrion.

In Chapter 2, I attempted to reveal how cytoplasmic components is removed during spermiogenesis, especially focusing on autophagy, a system for degradation of cytoplasmic components in the vacuole, because autophagic activity is highly elevated during spermiogenesis in *M. polymorpha*. Reverse genetic analyses using autophagy-defective mutants demonstrated that autophagy is responsible for degradation of various organelles during spermiogenesis. I also found that mitochondria are selectively degraded by autophagy at an early stage of spermiogenesis and later autophagic degradation of the cytosol and other organelles such as peroxisomes take place. I further found that some organelle proteins are degraded in the vacuole in an autophagy-independent manner. These results indicated that each cytoplasmic component is degraded in the vacuole in a distinctive and cell-autonomous manner during spermiogenesis in *M. polymorpha*, different from metazoan spermiogenesis in which unnecessary cytoplasmic components are removed by the phagocytic activity of neighboring cells.