

Conclusions

This study provides the basic information on the mechanism of the conjugation in *Paramecium caudatum*. I revealed the role of microtubules and γ -tubulin during conjugation in *P. caudatum*. The new findings were summarized as follows.

1. The cytoplasmic microtubules play important roles at the two stages of nuclear migration, because the cytoplasmic microtubules develop extensively around the meiotic product and the migratory pronucleus in the paroral region. These nuclear migrations were inhibited by the injection of the anti- α -tubulin antibody into the cytoplasm. The injection may inhibit the polymerization of the cytoplasmic microtubules.
2. The intranuclear microtubules develop the direction of the pronuclear movement during the nuclear exchange. The nuclear exchange never results from amoeboid movement such as the previous reports suggested. The cooperative works of the cytoplasmic and the intranuclear microtubules may be involved in the pronuclear migration during the nuclear exchange.
3. The γ -tubulin accumulates around not only the meiotic products but also the migratory pronucleus in the paroral region at the stages of the nuclear migrations. Both transfers of the meiotic product and the migratory pronucleus to the paroral region were inhibited by the injection of anti- γ -tubulin antibody into the cytoplasm. The injection of the anti- γ -tubulin antibody into the cytoplasm was not inhibit the nuclear divisions. γ -tubulin located in the cytoplasm may work on the nucleation of the cytoplasmic microtubules responsible for the nuclear migrations.

4. The intranuclear microtubules of the migratory pronucleus extend from the cell junction to the extending tip of the migratory pronucleus, because γ -tubulin was densely accumulated at the end of or back side of the migratory pronucleus. The γ -tubulin located in the nucleus may be involved in the extension of the intranuclear microtubules responsible for the nuclear migration during nuclear exchange.

5. The existence of the germinal nucleus is indispensable for the accumulation of γ -tubulin and the assembly of the cytoplasmic microtubules around the paroral region, because accumulation of γ -tubulin and the assembly of the cytoplasmic microtubules did not appear around the paroral region in amiconucleate cells.