

STORAGE CELLS AND THEIR ROLE IN TARDIGRADE PHYSIOLOGY

Abstract

Tardigrades possess remarkable tolerance to numerous stress conditions (e.g. almost complete desiccation, exposure to very low sub-zero temperature, heat stress and even exposure to space in low Earth orbit). Indeed, they are among the most radiation-resistant multi-cellular organisms. The body cavity of tardigrades is filled with the storage cells (SC). Their role in anhydrobiosis has been discussed. The main objectives of this work were to analyse (i) the occurrence of mitosis in SC, (ii) the factors constraining anhydrobiotic survival, and (iii) the general ultrastructure of SC and their ultrastructure concerning the stress conditions. Our model species, *R. cf. coronifer* is one of the most extensively studied tardigrades concerning anhydrobiosis. Comprehensive histochemical techniques were used in combination with SEM, TEM, and confocal microscopy. First, mitotic divisions of tardigrade SC occur with a higher frequency in juveniles than in adults and correlate with animal growth. Mitosis is more frequent in moulting tardigrades, but the overall mitotic index is low. Furthermore, tardigrades of *R. cf. coronifer* can survive the maximum of 6 repeated desiccation cycles with significantly declining survival rate with repeated desiccations and significantly lower number of SC and more incorrectly formed tuns ("semi-tuns") after the fifth desiccation cycle. Tardigrades of *R. cf. coronifer* survive 6 months of desiccation. Heat stress, however, decreases the survival rate of desiccated tardigrades. Only a few ultrastructural changes were observed concerning to desiccation: (i) change in pigmentation in epidermal cells, (ii) overall cellular shrinkage, (iii) increments of heterochromatin in SC, (iv) change in density and contents of reserve material in SC, (v) partially loss of nucleoli. The SC of active specimens contain a large nucleus, distinct nucleolus, ribosomes, mitochondria, RER, GA, large autophagosomes. Lipids and polysaccharides are the main stored material in SC. Finally, two cell-types with different ultrastructure were defined in tardigrades of *R. cf. coronifer*: (i) type I cells are metabolically active and store nutrients in form of reserve spheres and type II cells that might represent undifferentiated stem-cell-like cells.

Key words: storage cells, coelomocytes, mitosis, tardigrades, anhydrobiosis, tun formation, cryptobiosis, Tardigrada, Richtersius coronifer

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