Hydrodynamic functionality of the lorica in choanoflagellates

Choanoflagellates are unicellular eukaryotes that are ubiquitous in aquatic habitats. They have a single flagellum that creates a flow toward a collar filter composed of filter strands that extend from the cell. In one common group, the loricate choanoflagellates, the cell is suspended in an elaborate basket-like structure, the lorica, the function of which remains unknown. Here, we use Computational Fluid Dynamics to explore the possible hydrodynamic function of the lorica. We use the choanoflagellate Diaphanoeca grandis as a model organism. It has been hypothesized that the function of the lorica is to prevent refiltration (flow recirculation) and to increase the drag and, hence, increase the feeding rate and reduce the swimming speed. We find no support for these hypotheses. On the contrary, motile prey are encountered at a much lower rate by the loricate organism. The presence of the lorica does not affect the average swimming speed, but it suppresses the lateral motion and rotation of the cell. Without the lorica, the cell jiggles from side to side while swimming. The unsteady flow generated by the beating flagellum causes reversed flow through the collar filter that may wash away captured prey while it is being transported to the cell body for engulfment. The lorica substantially decreases such flow, hence it potentially increases the capture efficiency. This may be the main adaptive value of the lorica.

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