Axopodial degradation by arsenic ions and pH in the heliozoon *Raphidiophrys contractilis*

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SUMMARY

In this study, we have observed the effect of pH and arsenic ions on the heliozoon *Raphidiophrys contractilis.* In the presence of arsenic ions and pH variations, this heliozoon shows different sensitivities; axopodial degradation is one of these. Most organisms have adapted to life in water of a specific pH, and may die if the pH changes even slightly. At extremely high or low pH values the water becomes unsuitable for most organisms. The accumulation of trace elements, such as arsenic, in the environment is a potential risk to human health due to their transfer in aquatic systems. It is important to monitor and ensure the quality of our aquatic environments. The heliozoon *R. contractilis* might be used as a bio-indicator to monitor and assess water quality.

[Aim of Research]

Every organism has particular environmental requirements for it to be healthy and reproduce successfully. The presence or absence of healthy populations of organisms within their habitats is a sign of particular environmental characteristics. Many factors affect the chemical, physical and biological characteristics of a water body. To characterize the water quality in very convenient, time- and cost-effective ways, we used heliozoon *Raphidiophrys contractilis* as a model system to assess environmental toxicity in the aquatic environment due to heavy metal and pH variation. Heliozoons are cosmopolitan found in ma-

rine, brackish and fresh waters. Heliozoons possess long and thin tentacles called axopodia radiating from the spherical cell body, in which bundles of microtubules are present as supporting cytoskeleton (1, 2). The axopodia show frequent shortening and re-elongation, as their microtubules are highly sensitive to environmental factors including toxic chemical substances (3) and pH. Arsenic is ubiquitous in the environment, being naturally present in soil, air, water and food, and concentrations may be increased by anthropogenic contamination. We have examined the effect of various concentrations of As^{3+} and different pH solutions on the heliozoon *R. contractilis* and found that the length of axopodia decreased significantly comparing with the normal axopodial length in control cells. Detectable concentrations of As^{3+} using other protozoan species were higher than the regulation values and also than the detectable concentration by *R. contractilis*. From these observations, the heliozoon *R. contractilis* was found to be useful in toxicity assessment on the unicellular eukaryotic cells for metal pollutants and pH variation.

[Materials and Method]

The heliozoon *Raphidiophrys contractilis* was originally collected from a brackish pond in Shukkei-en Garden, Hiroshima City, Japan. Organisms were cultured monoxenically at 20 ± 1°C in a culture medium based on 10% artificial sea water and food flagellate *Chlorogonium elongatum* (4). *C. elongatum* was added to the culture medium as food source. Sub-culturing was carried out at intervals of about 7 to 10 days. Floating heliozoans were placed on a glass slide, and surrounded with rectangular mounting ridges of petroleum jelly. The slide was kept in a humid chamber and the cells were allowed to settle for10-15 minutes so that they might recover from axopodial disturbance caused by pipetting. Then metal ions or different pH solutions were added and cells were covered with a cover slip, observed under microscope (Nomarski differential interference optics) and recorded.

[Results and Discussion]

Effect of As^{3+}on the axopodia of the heliozoon *Raphidiophrys contractilis* was observed. Sixteen different concentration of As^{3+} between 10^{-11} and 10^{-2} M were used in this experiment. Axopodial length degraded gradually according to the severity of the As^{3+} effect. In the presence of high concentration of As^{3+}, all axopodia of all cells disappeared and the cells were disrupted quickly. The detectable concentration of As^{3+} using *R. contractilis* was 10^{-10}, whereas the WHO regulated value of As^{3+} in drinking water and sewage water are 1.3×10^{-7} and 6.7×10^{-7} M, respectively. The variation of pH in the aquatic environment is also significant for the survival of organism. *R. contractilis* can be used as a pH indicator; we could detect pH $\leq$ 6 or pH $\geq$ 8 and the axopodial length degraded at non-neutral pHs.

[References]

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