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GENERAL BIOLOGY

On Studying the Hazards of Pollution of the Biosphere: Effects of Sodium Dodecylsulfate (SDS) on Planktonic Filter-Feeders

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Many species of planktonic and benthic invertebrates are active filter-feeders. The filtration activity of aquatic organisms is of great importance for the functioning of ecosystems [1–3]. It was shown earlier that surfactant sodium dodecylsulfate (SDS) inhibits the filtration activity of *Mytilus edulis, M. galloprovincialis*, and some other aquatic filter-feeders [4–15], which is manifested in a decreased removal of suspensions from water by these organisms. Similarly to other water pollutants, surfactants have a strong anthropogenic impact on ecosystems [14].

The goal of this study was to test whether SDS has an inhibitory effect on the ability of planktonic filter-feeders *Daphnia magna* to remove phytoplankton from water during their filtration activity. Experiments were performed with five-day-old *D. magna* approximately 1 mm in size at an age of five days. Before the beginning of the experiment, daphnia were kept under laboratory conditions in vessels and fed with phytoplankton (green algae *Scenedesmus quadricauda* (Turp.) Breb.) at a low concentration (at most 50 thousand cells/ml). At the beginning of the experiment, *S. quadricauda* cells were added at a higher concentration (400 thousand cells/ml). In the control variant, daphnia were incubated in an SDS-free medium. In the experimental variants, the incubation medium contained SDS at preliminarily selected concentrations (0.1, 0.5, 1, 5, and 10 mg/l). The concentration of *S. quadricauda* cells was determined in a Nageotte counting chamber at a depth of 0.5 mm 3, 6, 9, 12, and 24 h after the beginning of the experiment. Each vessel contained 50 ml of water medium and 25 daphnia. Incubation was performed at 24 ± 1.5°C. Each variant was performed in duplicate.

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The rate of food consumption (algae removal from water) by one daphnia (R) was calculated by conventional formula

$$R = \frac{V(K_0 - K_t)}{Nt}, \quad (1)$$

where R is the mean rate of algae removal from water by one daphnia in 1 h in the considered time interval; V is the vessel volume, ml; K_0 and K_t are the concentrations of algal cells at the beginning and end of experiment; N is the number of daphnia in vessel; and t is the duration of experiment, h.

The results of experiments showed that the concentration of *S. quadricauda* cells gradually decreased with time (table). This indicates that daphnia removed algal cells from water as a result of its filtration. The concentration of algal cells decreased both in the control and at certain SDS concentrations (0.1, 0.5, 1, 5, and 10 mg/l).

After incubation for 3 h in the presence of SDS at all concentrations studied (0.1 mg/l and higher), the number of algal cells was higher than in the control, indicating that the filtration rate and efficiency of algae removal from water decreased.

After filtration for 6–24 h in the presence of SDS at concentrations 5 and 10 mg/l, the abundance of *S. quadricauda* cells was higher than in the control. At lower SDS concentrations (0.1, 0.5, and 1 mg/l), differences in the abundance of algal cells relative to the control were observed after 3 h of incubation and disappeared after 6–24 h of incubation.

The calculation of the mean rate of algae removal by daphnia (R) showed that this parameter decreased in the first 3 h after the beginning of incubation in the presence of SDS. R calculated after incubation for 3 h in the control (0 mg/ml SDS) was 74.7×10^3 cells per one daphnia per 1 h; this value was taken as 100%. After incubation in the presence of 0.1 mg/l SDS, R decreased to 42.7×10^3 cells/ml (approximately

Concentration of algae *S. quadricauda* cells in vessels with daphnia *D. magna* containing different concentrations of sodium dodecylsulfate (mg/l)

Incubation time, h	Number of cells in 1 ml, $\times 10^6$					
	0 (control)	0.1	0.5	1	5	10
0	0.40	0.40	0.40	0.40	0.40	0.40
3	0.29	0.34	0.36	0.36	0.36	0.36
6	0.24	0.24	0.24	0.24	0.28	0.32
9	0.20	0.20	0.20	0.20	0.24	0.28
12	0.16	0.16	0.16	0.16	0.20	0.24
24	0.04	0.04	0.04	0.04	0.08	0.12

57.2% of the control). When SDS concentration was increased to 0.5 mg/l, *R* decreased by more than 60% relative to the control and reached 26.7×10^3 cells per one daphnia per 1 h (35.7%).

Importantly, we did not observe any increase in the mortality rate of daphnia within 3 days of incubation in the presence of SDS at the concentrations studied. Thus, the described effects were observed at sublethal concentrations of SDS.

The results of this study are consistent with data obtained for other filter-feeders, including the results of our earlier studies of the effect of SDS on the filtration activity of *M. edulis, M. galloprovincialis*, and other filter-feeders [5, 8, 14, 15].

The toxicological hazard of SDS is apparently determined by the membranotropic effect of this compound, which belongs to the group of anionic surfactants [14].

Thus, the results of our experiments demonstrated that SDS decreases the rate of water filtration by the planktonic crustaceans *D. magna*, which is expressed in a decrease in the consumption of food (phytoplankton) and algae removal from water.

The results of this study are important for understanding the hazard associated with anthropogenic disturbances of environmental processes essential for self-purification of water [6, 13] and biogeochemical fluxes of elements in aquatic ecosystems.

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