

## EFFECT OF CADMIUM TOXICITY ON SURVIVAL AND PHOTOTACTIC BEHAVIOUR OF *DAPHNIA MAGNA*

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### ABSTRACT

Change in the phototactic behaviour of a positively *Daphnia magna* clone C<sub>1</sub> 34 was used as indicator of toxic stress. The phototactic behaviour was quantified using an experimental set-up which was described in a previous study. In flow-through experiments, animals exposed to 0.03 mg l<sup>-1</sup> Cd<sup>2+</sup> exhibited a significant effect of cadmium on the phototactic behaviour within a period of 1 h, either with starved or fed animals by approximately 2x10<sup>5</sup> *Scenedesmus acutus* cell.ml<sup>-1</sup>. The results suggest also that cadmium can be adsorbed for 3- h exposure and became desorbed after 4.5 h period. Continuous flow-through protocol was described for measuring survival of strain of *D. magna*, using juveniles that have been exposed to 1 mg l<sup>-1</sup> Cd<sup>2+</sup> for: 0.25; 0.5; 1; 2; 4 and 6 h. In these experiments a significant reduction in survival was demonstrated and the effect was shown to be significant within the first 30 min of the test. It was also found that the inhibition rate I<sub>n</sub> of survival can be estimated by a logarithmic expression as a function of time: I<sub>n</sub> (%) = 26.348 Ln 54.352 x t.

Keywords: Adsorption, algae, cadmium, continuous biomonitoring, *Daphnia magna*, ecotoxicology, phototactic behaviour

### INTRODUCTION

*Daphnia* is used as an aquatic test organism in a great number of standardized bioassays and screening tests [1- 3].

The present study was undertaken to determine the effect of continuous exposure of *D. magna* to cadmium that may be contained in water. The parameters used to determine the effect of cadmium on *D. magna* were, phototactic behaviour and survival. For this purpose biomonitoring systems were described.

The proposals of these ecotoxicity tests using continuous monitoring method have been suggested by several authors [4 - 8].

In recent years numerous efforts have been made in the development of biological monitoring methods using organisms of different trophic levels. The development of *D. magna* monitor manufactured by BBE Moldaenke is based on swimming behaviour (altitude, turns and circling movements), growth observation and number of *Daphnia* [9]. An automated biomonitoring system for early warning of pollutants in aquatic environments has been described and characterized [10] in which sublethal changes in the movement behaviour of the flagellate *Euglena gracilis* are used. The Multispecies Freshwater Biomonitor (MFB) has been used as a bioassay and biomonitor in aquatic ecotoxicology with a variety of test species, crustaceans, fish and insects [11]. Long-term monitoring with *Grammarus pulex* and *D. magna* in the

MFB has been used. The validity of using an automated online biomonitoring MFB with the physiological and behavioural activities of three spinet stickleback *Gasterosteus aculeatus* has been demonstrated [12]. The use of phototactic behaviour of *Daphnia* for testing the potential toxicity of compounds has been suggested [13, 14]. The monitor has been developed so far to use changes in phototactic behaviour of *D. magna* [15].

More recently, the positively phototactic *D. magna* clone C<sub>1</sub>34 was used [16] and it was suggested that the behavioural criteria may be more sensitive and be a rapid indicator of cadmium stress. In this study we have shown that the sublethal concentration of cadmium (0.06 mg l<sup>-1</sup>) obtained previously [16] can be reduced under the same experimental conditions. For the behavioural test we have examined the effect of the algal food, present in the experimental medium, on the cadmium stress. The survival of a strain of *D. magna* was used for quantifying the cadmium toxicity using a flow-through continuous system.

### MATERIALS AND METHODS

#### Phototactic Experiments

All experiments were carried out as described previously [16]. The clone C<sub>1</sub> 34 of *D. magna* was isolated from a fishless city pond in Gent (Belgium). The experimental