Aptitude of Mayflies as Test-organisms in Bioassays

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Introduction

Various biotests are used in the assessment of surface waters, which however do neither reflect the spectrum of species of stream organisms nor their ecological demands. The sensitivity of **mayflies** (Ephemeroptera) as typical stream organisms against toxical and endocrine acting compounds are nearly unknown. Mayflies are widespread, the greatest diversity and abundance is found in streams. They belong to the merolimnic, hemimetabolic insects, passing through a complex life cycle (Fig. 1). The stage "subimago" is unique in the world of insects and represents an additional developmental stage. Especially endocrine disrupters are expeceted to affect these organisms during the hormonal changes in this developmental phase. Toxic effects were conducted under presence of **3,4-dichloroaniline**. The effects on larval development and emergence were studied using **bisphenol A**, known as an ecdyson antagonist (1).

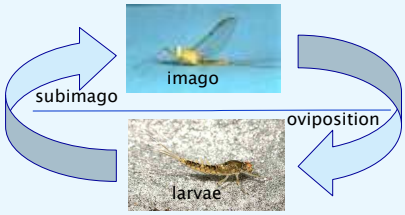


Fig. 1: Life cycle of mayflies

Materials and methods

Experimental design:

Climatic exposure cabinet: light/dark cycle: 16/8 h (Fig. 2)
Medium: M4-medium (Elendt)
Steady supply of oxygen

Long-term tests:
Semi-static in small aquaria
Food: stones with aufwuchs
Duration: untill emergence

Acute toxicity tests I:
100ml vessels
Food: no
Duration: 96 h

Acute toxicity tests II:
Small aquaria
Food: stones with Aufwuchs
Duration: 96 h

Test organisms (elder larvae):
Haprophlebia ignita
Serratella ignita

Test organism (young larvae):
Haproleptoides confusa

Test organism (young larvae):
Epeorus assimilis

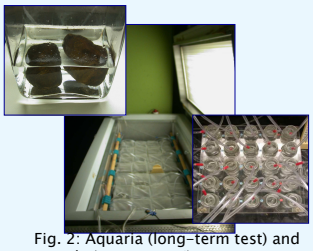
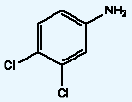
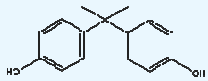


Fig. 2: Aquaria (long-term test) and vessels (acute tests I)



3,4-dichloroaniline



bisphenol A

Preliminary investigations:

Experiments lasting until emergence of the various mayfly-species to establish the experimental design

⇨ No difference in mortality and success of emergence between streamwater and the artificial medium M4

Comparative tests:

Acute Immobilisation Test (*Daphnia magna*, 48h, OECD 202) with media (BPA/DCA) from the tests with mayflies

Results

1. Long-term tests (elder larvae)

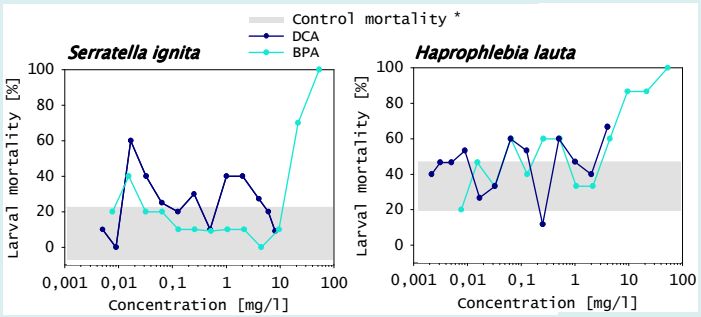


Fig. 3: Larval mortality dependent on DCA and BPA

DCA: No effects on mortality in both tested species

BPA: Concentration-depent mortality in both tested species

***S. ignita*:** Low control mortality (7,5%) higher recovery (93%)
BPA: LC_{50}(26d) 17,31mg/l

***H. lauta*:** High control mortality (33%), low recovery (78%)
BPA: LC_{50}(58d) 11,14 mg/

⇨ **Effects on both tested species comparable**

⇨ ***Serratella ignita* easier to handle, because of compact body and larger size**

2. Acute toxicity tests (young larvae)

DCA: Mortality depends on concentration, in contrast to tests with older larvae

BPA: Mortality depends on concentration in both tested species

E. assimilis: More sensitive to BPA than *D. magna*

LC_{50} [mg/l]	DCA	BPA
D. magna (48h)	0,4	14,3
H. confusa (72h)	5,0	30,1
E. assimilis (72h)	-	7,9

*: mean+standard deviation (n=4)

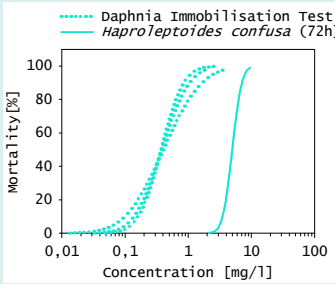


Fig. 4: Dose-response-curve DCA (Probitanalysis)

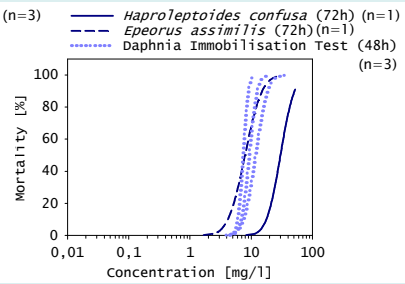


Fig. 5: Dose-response-curve BPA (Probitanalysis)

Conclusion

⇨ It is possible to handle mayflies semi-statically with artificial medium M4

⇨ Long term-tests with elder larvae show mortality only regarding BPA, probably only due to uptake via food (DCA log Kow: 2,69, BPA log Kow: 3,32)

⇨ Basically mayflies are suitable as test organisms in long-term tests (*S. ignita* easier to handle)

⇨ Young larvae are more sensitive than older ones, probably due to uptake via body surface

⇨ Young larvae are suitable as test organisms in acute toxicity tests

Literatur: 1.Dinan et al (2001): Environ. Toxicology chem. 20, 2038-2046