Harpacticoid copepods in a DEB framework: Investigating pharmaceutical effects on Nitocra spinipes

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Introduction

- Copepods are an ideal test system in ecotoxicology studies:
  - Largest animal biomass on earth (estimate)
  - Small size
  - Easy lab culture and handling
- Dynamic Energy Budget (DEB) theory can help to identify a stressor’s mode of action (MoA) on energy allocation
- The copepod life cycle deviates from standard DEB:
  - Complete metamorphosis after 6th molt
  - Abrupt stop in growth at adult stage
- Copepods need further investigation for use in a DEB framework

Materials & Methods

Life cycle experiments

- Experimental setups were based on the OECD guidance document [1] for harpacticoid copepod life cycle testing

Test species: Nitocra spinipes

- Brackish water species
- Worldwide distribution
- Test species since 70s

Test compound: Citalopram

- Selective serotonin re-uptake inhibitor (antidepressant)

Identification of DEB-MoA

- Observed effects at 100 and 1000 µg/L were simulated in the DEBKiss model by means of the stress factor s
- A slope parameter a was introduced to the stress function to accurately cover the concentration dependent magnitude of effects

\[ s = \frac{1}{c_T} \max(0, c_V - c_0)^a \]

- Observed effects could be explained by the presence of two individual MoAs:
  (a) Increase in growth costs
  (b) Decrease in reproduction costs
- The stress function could be calibrated with just one set of parameters to describe both effects (instead of using separate fits for each MoA)

Results & Discussion

Development and reproduction test

- The N. spinipes life cycle could be captured well by just slight modifications of the DEBKiss model structure
- Effects of citalopram on development (inhibition) and reproduction (stimulation) of N. spinipes were explained by MoAs on energetic costs for growth and reproduction

Conclusions

- Slight developmental delay at 100 ng/L and stronger delay at and above 100 µg/L
- Brood stimulation at and above 100 µg/L

References