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Compared investigation of chronic effects of carbamazepine and cyprodinil on Daphniidae

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Nowadays, a big challenge for our aquatic environment is the entry of biologically active substances such as pharmaceuticals in the water body. These substances may have adverse effects on aquatic organisms. One example is carbamazepine, an anticonvulsant drug. Due to its high consumption volumes and low degradation in waste water treatment plants, carbamazepine is frequently detected in water bodies. In the literature there is no consensus whether carbamazepine affects Daphniidae. Therefore, our research question was whether there is a chronic effect of carbamazepine on Daphniidae. We examined potential chronic effects of carbamazepine with three different daphnid species (*Daphnia magna*, *D. pulex, Ceriodaphnia dubia*). Chronic reproduction tests with *D. magna* and *D. pulex* for 21 d and with *C. dubia* for 7 d were conducted. Observed endpoints were reproduction, day of first reproduction and growth. Cyprodinil, an active ingredient in fungicides which are still in use in Europe, was chosen as a positive control substance. It is also a contaminant in aquatic ecosystems. Additionally, the sensitivity of all three species to carbamazepine and cyprodinil was investigated. In our experiments, carbamazepine did not show any effect on any of the three test species up to a concentration of 10 mg/L. In contrast cyprodinil affected all three test species. The reproduction of *D. magna* and *C. dubia* was significantly reduced at a concentration of 32 µg cyprodinil/L while the reproduction of *D. pulex* was significantly decreased at 16 µg cyprodinil/L. Furthermore, the exposure to 32 µg cyprodinil/L resulted also in a delay of the first reproduction in *D. magna* and *C. dubia*. The growth of the Daphniidae was not affected by cyprodinil in the tested concentration range. The maximum measured concentration of carbamazepine in surface water is 6 µg/L. Because the concentrations in our tests were much higher than measured environmental concentrations, no chronic effects of carbamazepine as a single substance on Daphniidae are expected in the field. Further research should address the question if carbamazepine can be a relevant stressor for Daphniidae in combination with other contaminants. In addition, our experiments with cyprodinil show that in contrast to other studies *D. pulex* was more sensitive than *C. dubia*.

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Do antidepressants impair colour change and camouflage in two juvenile marine invertebrates, Sepia officinalis and Carcinus maenas?

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Prescriptions of antidepressants are still on the rise worldwide, and their excretion may result in a potential contamination of the aquatic compartments. Indeed, antidepressant residues such as fluoxetine (Prozac©) and venlafaxine (Effexor©) are currently detected at low concentrations, from ng.L^{-1} to µg.L^{-1}. Due to bioaccumulation, however, the toxicity of these micropollutants is not necessarily represented by their concentration in the water body. Furthermore, these compounds conceived to treat depressive or anxiety disorders are worrisome because they can trigger neurobiological changes through targeting the serotonergic system of non-target organisms, such as marine invertebrates. Indeed, juvenile shore crabs and cuttlefish, which are particularly vulnerable to predators, thrive in the intertidal zone and coastal water. These animals express cryptic patterns enabling them to hide from their predators by blending into their environment. The dynamic change of patterns and the intensity of colouration can be achieved very rapidly as in *S. officinalis*, or more slowly as in *C. maenas*, either being controlled nervously, or by neuropeptide hormones, respectively. Neuronal and neurohormonal control, in turn, is influenced by neurotransmitters, such as serotonin. To study the effects of antidepressants at environmental concentrations, juvenile cuttlefish and crabs were exposed during 30 days to fluoxetine alone or in mixture with venlafaxine (*i.e.* 2.5 ng.L^{-1} and 5 ng.L^{-1}). The animals passed several behavioural tests such as predation; colour change on opposite backgrounds, on grey medium or checkerboard background; sand-digging behaviour, to evaluate their camouflage and colour change efficiency each week. Juvenile cuttlefish exposed to low concentration of antidepressants showed a decrease in predation motivation and success, and modified colour change and camouflage in certain conditions. In young crabs low concentration of antidepressants seemed to elicit cuticule brightening as rapid and transient colour change.

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Mercury transfer through the food chain of the three-spined stickleback (Gasterosteus aculeatus)

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Mercury is considered as one of the top priority chemicals by the WHO and is a pollutant of global concern due to its capacity to travel long distances through the atmosphere. Nowadays, point sources of mercury pollution in Flanders are rare but certain regions are still contaminated as consequence of historical pollution. Microbes can convert inorganic mercury to a methylated form which is biomagnified through the food chain and has strong neurotoxic properties. The actual risk of transfer of environmental mercury to biota is highly dependent on physicochemical properties of the water and sediment since they influence methylation processes and bioavailability. Profound knowledge on the matter of bioavailability remains scarce due to the complexity of mercury speciation and sensitivity of mercury analysis. This study was setup to gain a better understanding of mercury bioavailability and the transfer through the food chain of the three-spined stickleback (*Gasterosteus aculeatus*). During a preliminary field study within the Scheldt and Maas basin of Flanders, 8 stickleback populations were identified by both high and low muscle mercury content. Subsequently, water-, sediment-, macroinvertebrate- and fish samples were collected and analyzed for total mercury concentration and additional physicochemical properties (water and sediment). Biota-sediment magnification factors (BSMFs) were calculated as a proxy for mercury bioavailability for benthic macroinvertebrates. Differences between populations in terms of bioaccumulation as a consequence of dietary mercury exposure was evaluated via estimated biomagnification factors (BMFs). The total mercury load within one specific river was positively correlated with organic matter content (R= 0.77) and smaller grain sizes (R=0.52), while samples with a higher percentage of sand had less mercury (R = 0.80). Organic matter content (R=0.67), a larger clay (R=0.62) and silt (R =0.57) fraction and higher acid volatile sulfide concentration (R=0.79) in the sediment did decrease the overall bioavailability of mercury for sediment dwelling invertebrates. The BMFs of the low-contaminated populations were close to or even below 1. On the contrary the biomagnification factors of highly polluted populations ranged from 2-4. The observed differences in mercury biomagnification between distinct populations of the same species is an interesting finding and possible explanations are currently being explored.