



Identification of negative influence of pharmaceuticals on the biodiversity of freshwater ecosystems with focus to water plant communities

Guido Gonsior, Theresa Graf, Waldemar Kiel, Rabea Christmann, Marcel Kahlke, Maren Dill

GG BioTech Design GmbH, Homberg (Ohm), Germany

The interaction of several species in the ecosystem prevents the risk of biological collapse. Aquatic plants are able to stabilise freshwater ecosystems in a significant way. Further, it is now very evident that climate change is significantly affecting most ecosystems, leading to potentially dramatic changes in food webs. All photosynthetic organisms that can store carbon from the atmosphere therefore have a central role to play.

It is therefore important to identify potentially toxic substances on aquatic plants and to clarify the effects under laboratory conditions.

We are currently working on the identification of stressors for macrophytes. It is becoming clear that even pharmaceuticals that have not been tested for their effect on rooted macrophytes could reduce plant communities.

Here we present some data to clarify the impact of pharmaceuticals on aquatic plants. The focus was on the OECD guideline 239 on aquatic plants in a water-sediment system with the standard species *Myriophyllum spicatum*.

Material & Methods

Test design: based on OECD 239
Test duration: 14 days (OECD 239)
Test plant: *Myriophyllum spicatum*
Test item: Diclofenac (1), Valsartan (2)
Concentrations: 0.1 mg/L; 1 mg/L; 10 mg/L
Validity criteria: OECD 239
- CV (Yield Fresh Weight) $\leq 35.0\%$
- Growth Factor (Fresh Weight) ≥ 2.0
- Growth Factor (Total Shoot Length)

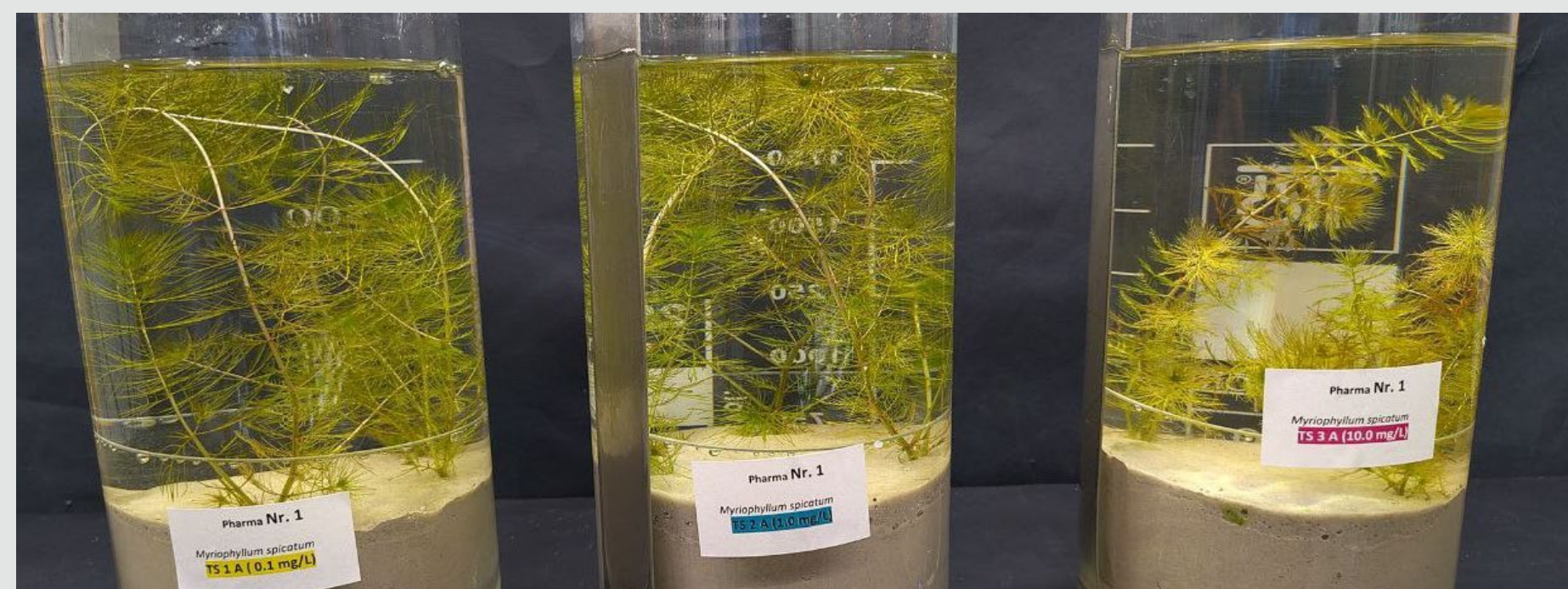
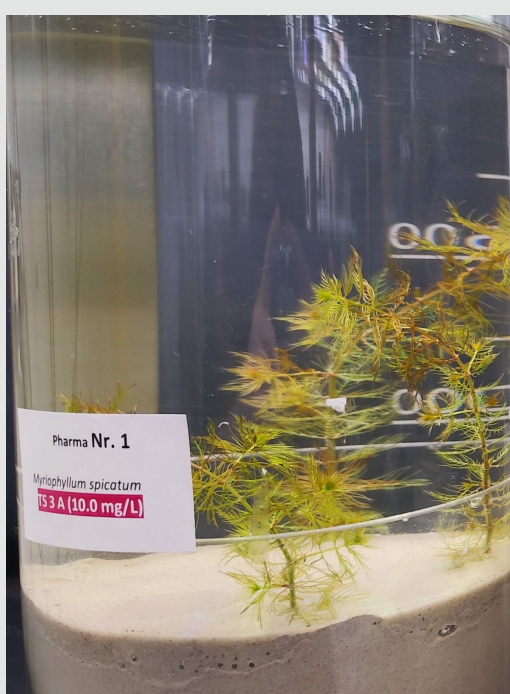
Selection of test item

The selected test substances valsartan and diclofenac were tested because they were found in high concentrations in wastewater and also in drinking and surface water compared to others. Like many other pharmaceuticals, they are persistent and mobile, which means that they remain in the environment for a long time and can spread quickly. In wastewater treatment plants pharmaceuticals are only partially removed so that residues can enter the water and accumulate in the environment.



Results

Day 7

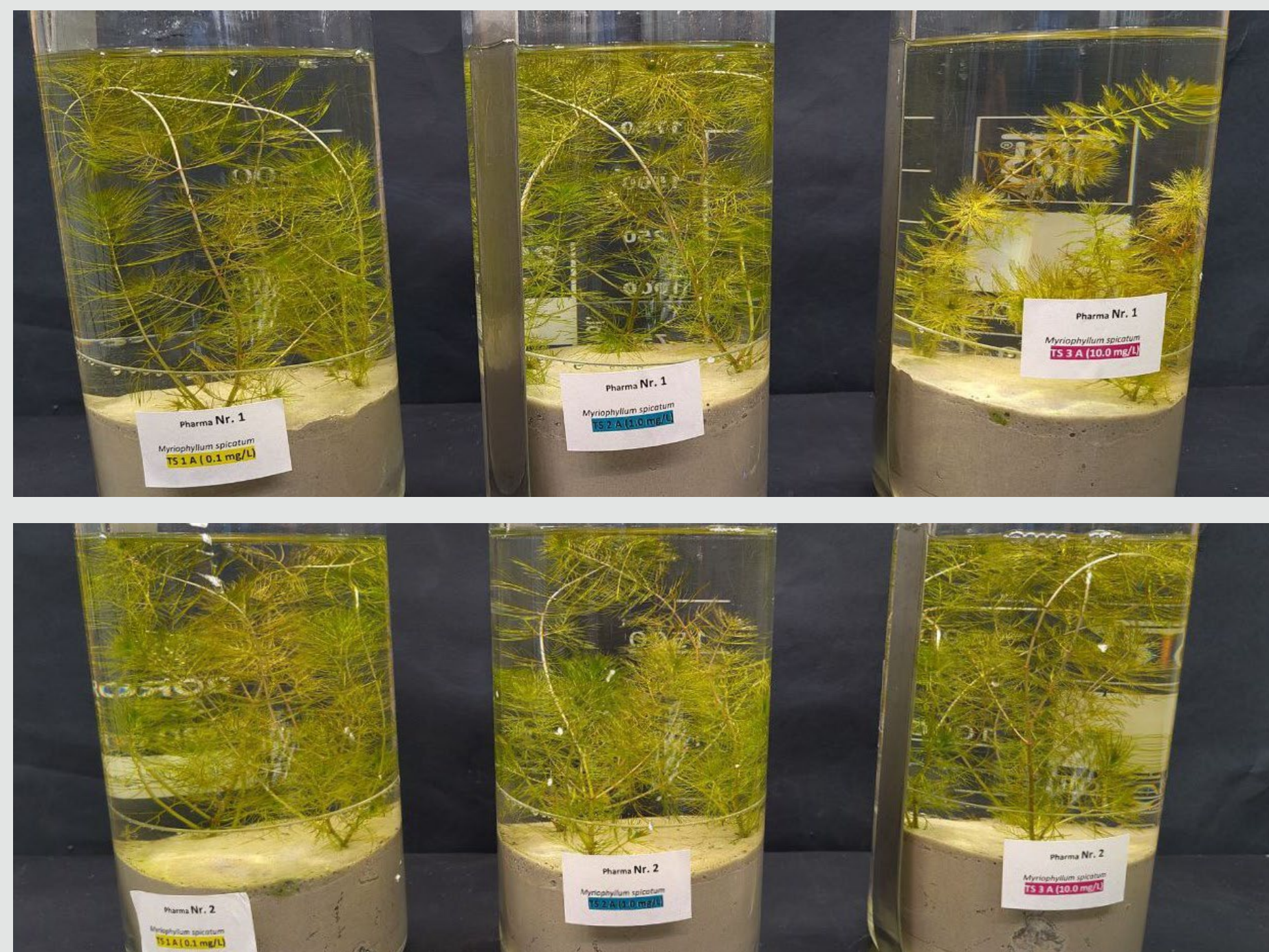
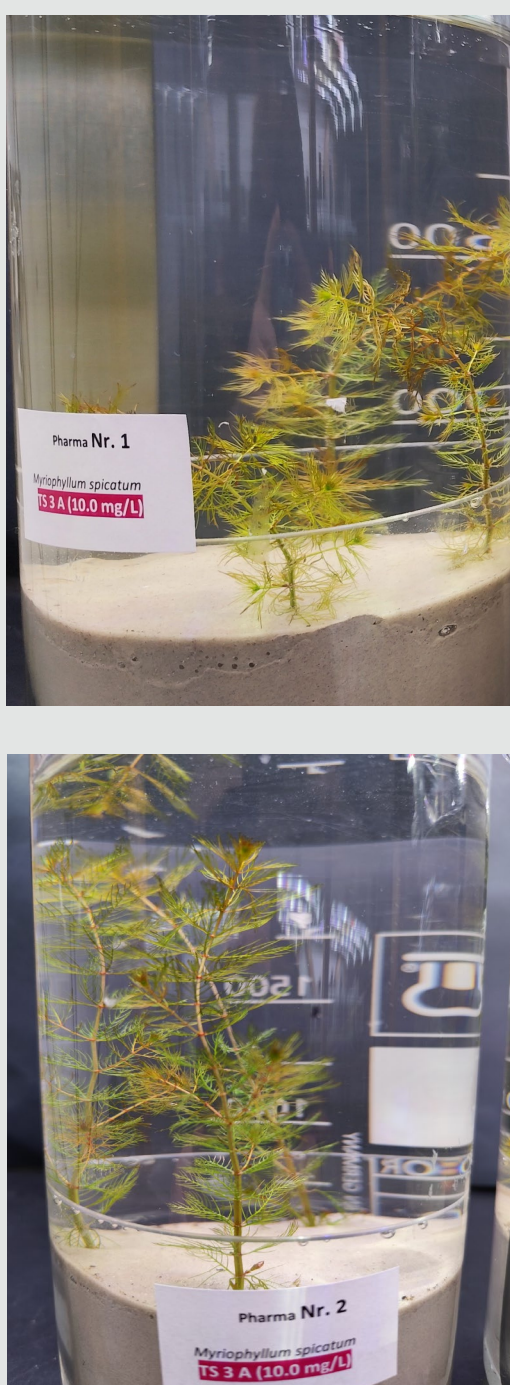


Diclofenac is a drug used to treat pain and inflammatory diseases. Showed effects like necrosis and chlorosis at day 7 till test end in the highest concentration level of 10 mg/L.



Valsartan is a medication used to treat high blood pressure, heart failure, and diabetic kidney disease. Showed no effects at the tested concentration levels.

Day 14



No effects could be observed over the test period of 14 days for valsartan. Based on these findings it could be assumed that no or only slight toxic effects occurred on by valsartan. No conclusion can be given for long term effects. In case of diclofenac clear effects could be observed resulting in the lowest calculated EC_{50} of 10.1 mg/L for yield total shoot length.

EC_{50} of Yield and Growth Rate (GR) of Total Shoot Length (TSL), Fresh (FW) and Dry Weight (DW) in mg/L

Pharmac.	TSL		FW		DW	
	Yield	GR	Yield	GR	Yield	GR
Diclofenac	10.1	33.0	13.3	31.5	20.7	38.0
Valsartan	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

Results of the probit analysis with yield TSL at 14.0 d: Selected effective concentrations (EC_x) of the test item and their 95%-confidence limits (according to Fieller's theorem).

Toxicity Metric	EC10	EC20	EC50
Value [mg/L]	1.293	2.623	10.145
lower 95%-cl	0.184	0.750	6.964
upper 95%-cl	2.551	4.249	17.930

Discussion

Especially in regions with a higher human population density, a higher exposure to chemicals can be assumed and long-term effects from persistent compounds cannot be ruled out. This should be investigated further, particularly in the case of pharmaceuticals with high persistence and mobility. Initial studies indicate that the risk of acute toxicity is given, and possible long-term effects should be considered. Aquatic plants play an important role in our ecosystem. Whether pharmaceuticals play a significant role to affect these ecosystems remains to be clarified. The selected test substances valsartan and diclofenac were tested because they were found in high concentrations in wastewater and also in drinking and surface. It can be assumed that other human and veterinary pharmaceuticals have an impact on the coral ecosystem. A general screening should be carried out to identify possible risks to one of the most endangered ecosystems. On the basis of this initial screening, it can be assumed that there is an acute risk to photosynthetic active organisms from medicinal products. Further long-term effects of pharmaceuticals could not be ruled out and require further clarification.