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Introduction

Pharmaceutical compounds concentrations are detected worldwide in traces ranging from ng/L to mg/L. The absence of appropriate wastewater treatment specifically targeting their elimination, allow these compounds to be continuously discharged to ecosystems acting as persistent compounds and emerging pollutants with high risk to surface and groundwater ecosystems



Pharmaceutical compounds consumption

- 15g/y worldwide average per capita
- 50-150g/y in industrialized countries
- 100,000 tons/y worldwide

Pharmaceutical compounds - current knowledge

- Frequently present in complex mixtures
- Absence of environmental quality standards (EQS) in the FWD
- Some included in the EU FWD watch list (E.g. Diclofenac, antibiotics...)
- Ecotoxicological data:
 - Still being built on standard surface aquatic taxa
 - No information on subterranean aquatic taxa

Diclofenac

Diclofenac is a non-steroidal anti-inflammatory drug (NSAID) widely used in all the world as an analgesic

Application forms:

- Oral application (main form)
- Eye dropping
- Dermal applications
- Injection

Approximately 65% of the dosage is excreted through urine (six metabolites identified)

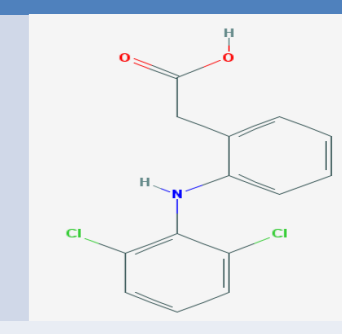
Elimination process:

- Wastewater treatment plants: poorly removed (mainly removal efficiency 21-40%)
- Environment: phototransformation (main process) and soil retention

Table 2: Diclofenac highest occurrences detected in aquatic environment from Ionappan et al., 2016.

Environmental medium	Concentration (ng L ⁻¹)	Country	Reference
River	4900	Pakistan	Scheurell et al. (2009)
River	1030	Germany	Heberer (2002a)
Lake	370	Switzerland	Buser et al. (1998)
Well	590	Germany	Sacher et al. (2001)
Drinking water tap	18	Spain	Carmona et al. (2014)

Table 1: Diclofenac chemical description:

Pharmaceutical compound	Diclofenac
Structure	
Formula	C ₁₄ H ₁₁ Cl ₂ NO ₂
CAS number	15307-86-5

Material and methods



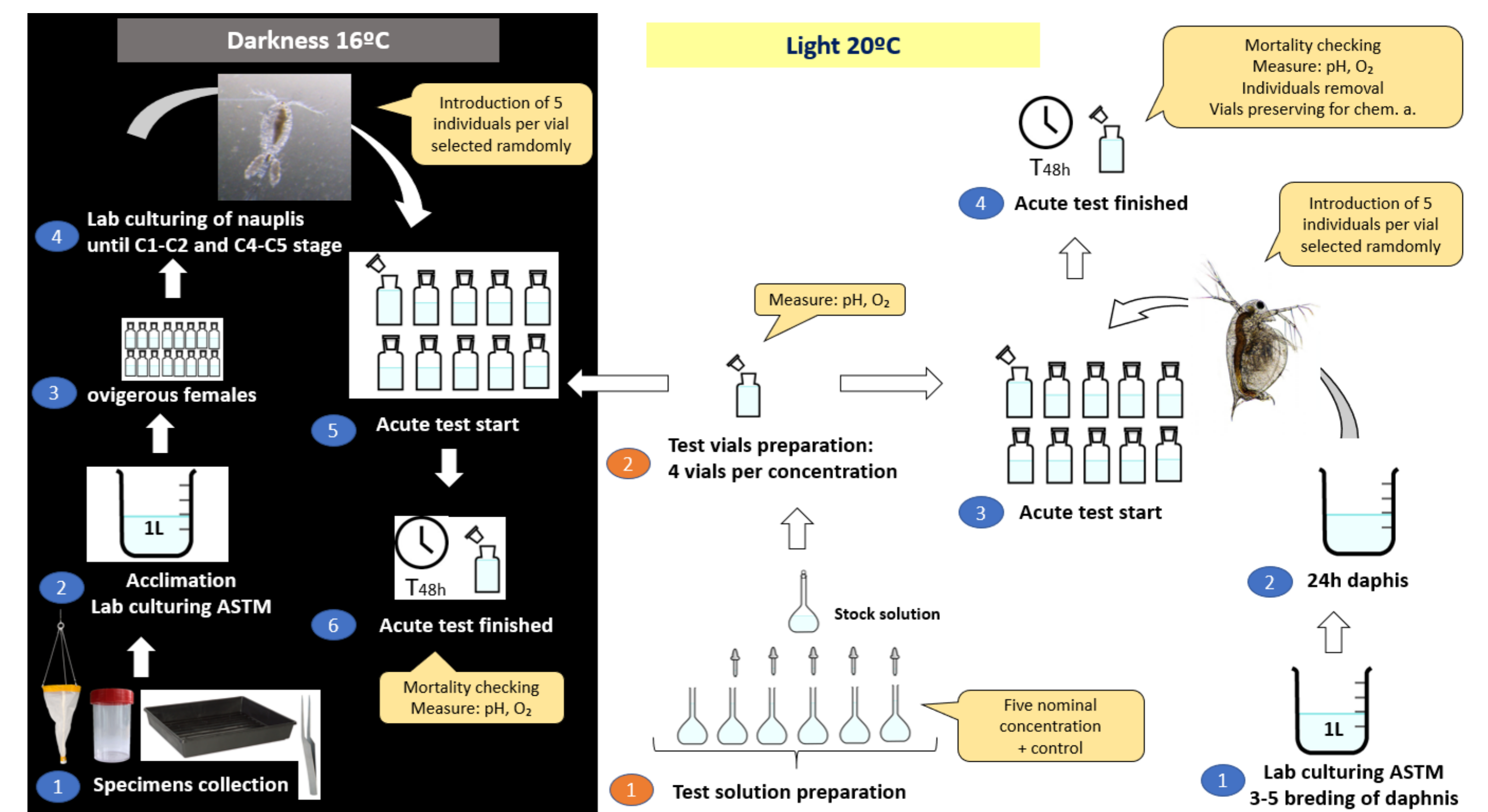
Daphnia magna Müller, 1785

- ☐ standard ecotoxicological testing species
- ☐ short life cycle
- ☐ ease of culturing
- ☐ wide database on ecotoxicological responses
- ☐ clone Beak



Diacyclops crassicaudis crassicaudis Sars, 1863

- ☐ cosmopolitan species present in freshwater and groundwater ecosystems
- ☐ short life cycle
- ☐ small size
- ☐ collected from a well in Madrid Community



Results

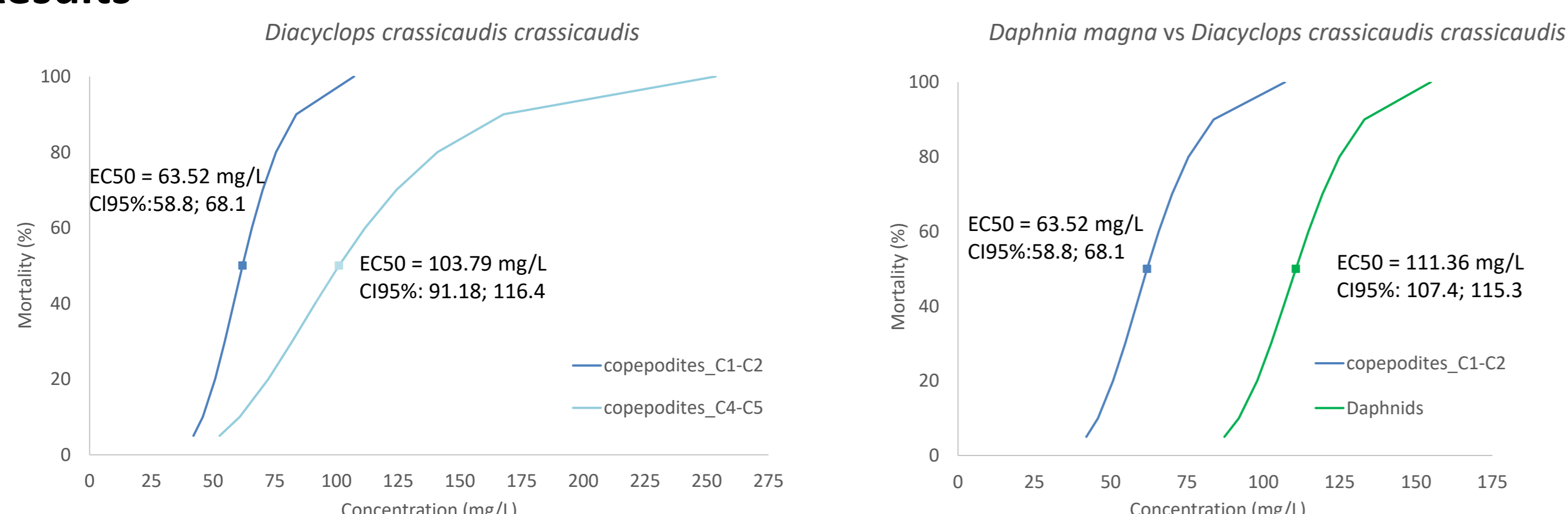


Figure 1: Diclofenac dose-response curve and half maximum effective concentration (EC50) for *Diacyclops crassicaudis crassicaudis* and *Daphnia magna*.

Table 3: Diclofenac Risk Quotient (RQ) estimation using the highest measured environmental concentration (MEC) observed in the literature, the half maximum effective concentration (EC50) obtained from this study and the assessment factor of 1000 (EMA, 2006).

Organisms	MEC – freshwater	PNEC	RQ
<i>Diacyclops crassicaudis crassicaudis</i>	0.0049 mg L ⁻¹	0.063 mg L ⁻¹	0.077
<i>Daphnia magna</i>	0.0049 mg L ⁻¹	0.111 mg L ⁻¹	0.044

Organisms	MEC - Groundwater	PNEC	RQ
<i>Diacyclops crassicaudis crassicaudis</i>	0.00059 mg L ⁻¹	0.063 mg L ⁻¹	0.009
<i>Daphnia magna</i>	0.00059 mg L ⁻¹	0.111 mg L ⁻¹	0.0053

Discussion

- Diclofenac was more toxic to the copepodites C1-C2 than to the neonates of *D. magna*
- Newborn copepodites of *Diacyclops crassicaudis crassicaudis* were more sensitive to diclofenac than higher stages of juvenils copepodites
- Diclofenac did not pose a risk to groundwater or freshwater ecosystems, at least based on the highest MEC of diclofenac to stimate the RQ

Conclusions

Further long-term toxicity testing at more environmentally relevant concentrations and the use of species with similar ecological features and more closely related are required for a better understanding of the potential of pharmaceutical compounds to harm the groundwater biota

References

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Acknowledgments

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