

Evaluation of ecotoxic effects of PFOS, PFOA, and their mixture on aquatic organisms.

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INTRODUCTION & AIM

Per- and polyfluoroalkyl substances (PFAS) are man-made chemicals with high persistence, that are utilized in numerous consumer and industrial applications. The most well-known substances of this group are perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA). They have been used in various products such as non-stick cookware, textiles, paint, firefighting foams, surfactants, food packaging, and personal care items. Due to their extensive usage, they are frequently detected in water sources globally, with PFOS's reported concentrations reaching 187 and PFOA's 1371 ng L⁻¹ (1). PFOS and PFOA have been also reported in all levels of aquatic life. Indicatively, PFOS has been found in *Crassostrea virginica* in concentrations up to 1225 ng g⁻¹ (dw) and PFOA in *Sebastes mentella* 5.3 ng g⁻¹ (dw) (1). As PFAS are widely detected in the environment they may induce toxic effects on a variety of aquatic organisms, their investigation is crucial. The present study aimed to investigate the potential toxic effects of PFOS and PFOA (individually), as well as their mixture on a saltwater microalgae and a bacterium.

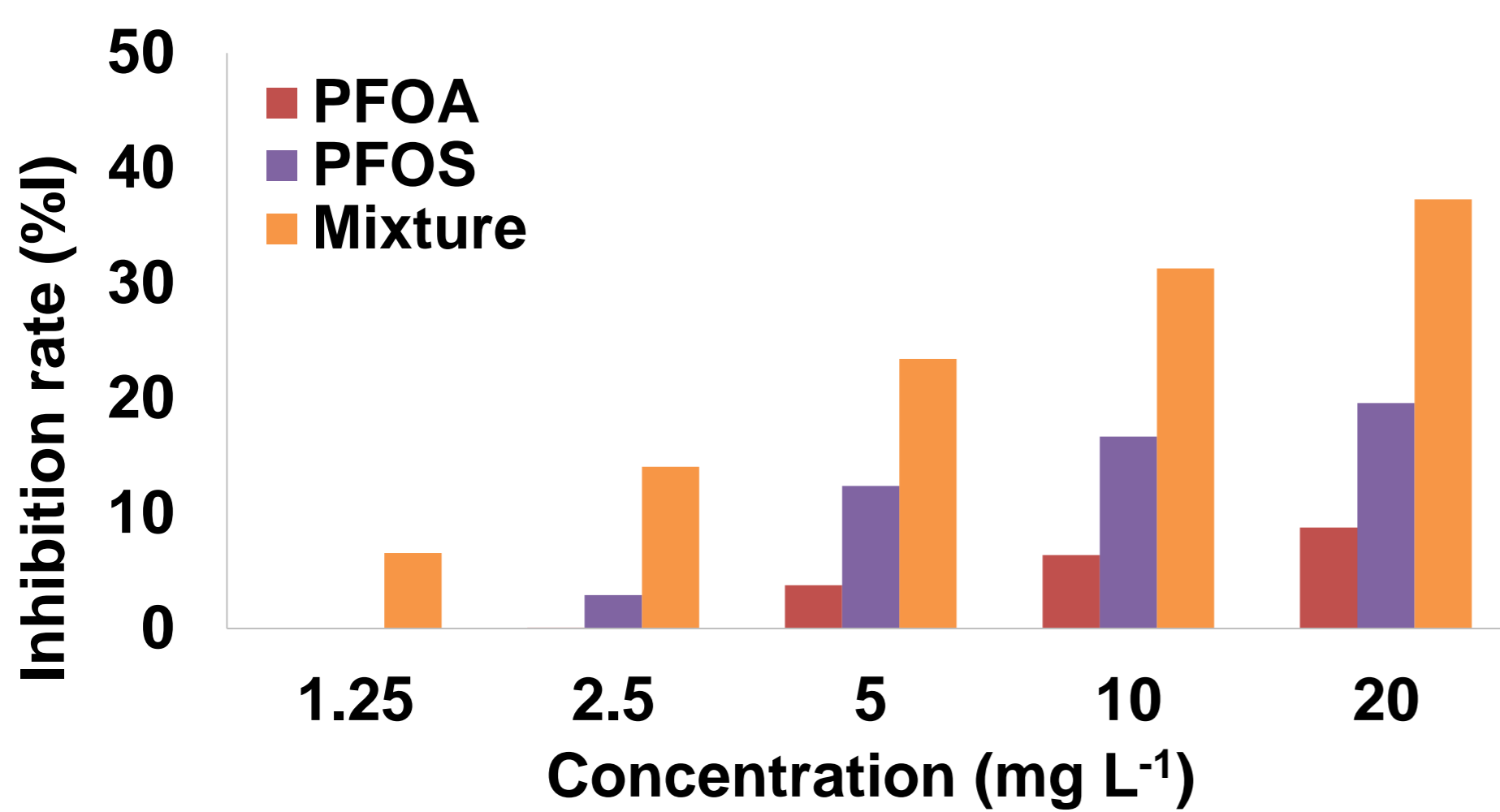


Figure 1: Bioluminescence inhibition percentage of *Aliivibrio fischeri* after 15 minutes of exposure to PFOA, PFOS and their mixture in different concentrations (1.25, 2.5, 5, 10, 20 mg L⁻¹).

METHOD

The potential toxic effects of the individual compounds (PFOA and PFOS), as well as their mixture were studied in:

- the bacterium *Alliivibrio fischeri*, using the Bioluminescence Inhibition Test.
- the saltwater microalgae *Dunaliella tertiolecta*, using the Algae Growth Inhibition Test.

Table 1: IC₅₀ (mg L⁻¹) values of PFOA, PFOS and their mixture for *Aliivibrio fischeri* and *Dunaliella tertiolecta*.

Microorganism/ Exposure period	IC ₅₀ (mg L ⁻¹)		
	PFOA	PFOS	Mixture
<i>Aliivibrio fischeri</i> /15min	1.98*10 ⁵	0.76*10 ⁵	0.39*10 ⁵
<i>Dunaliella tertiolecta</i> /72h	0.74	1.38*10 ²⁴	58.56

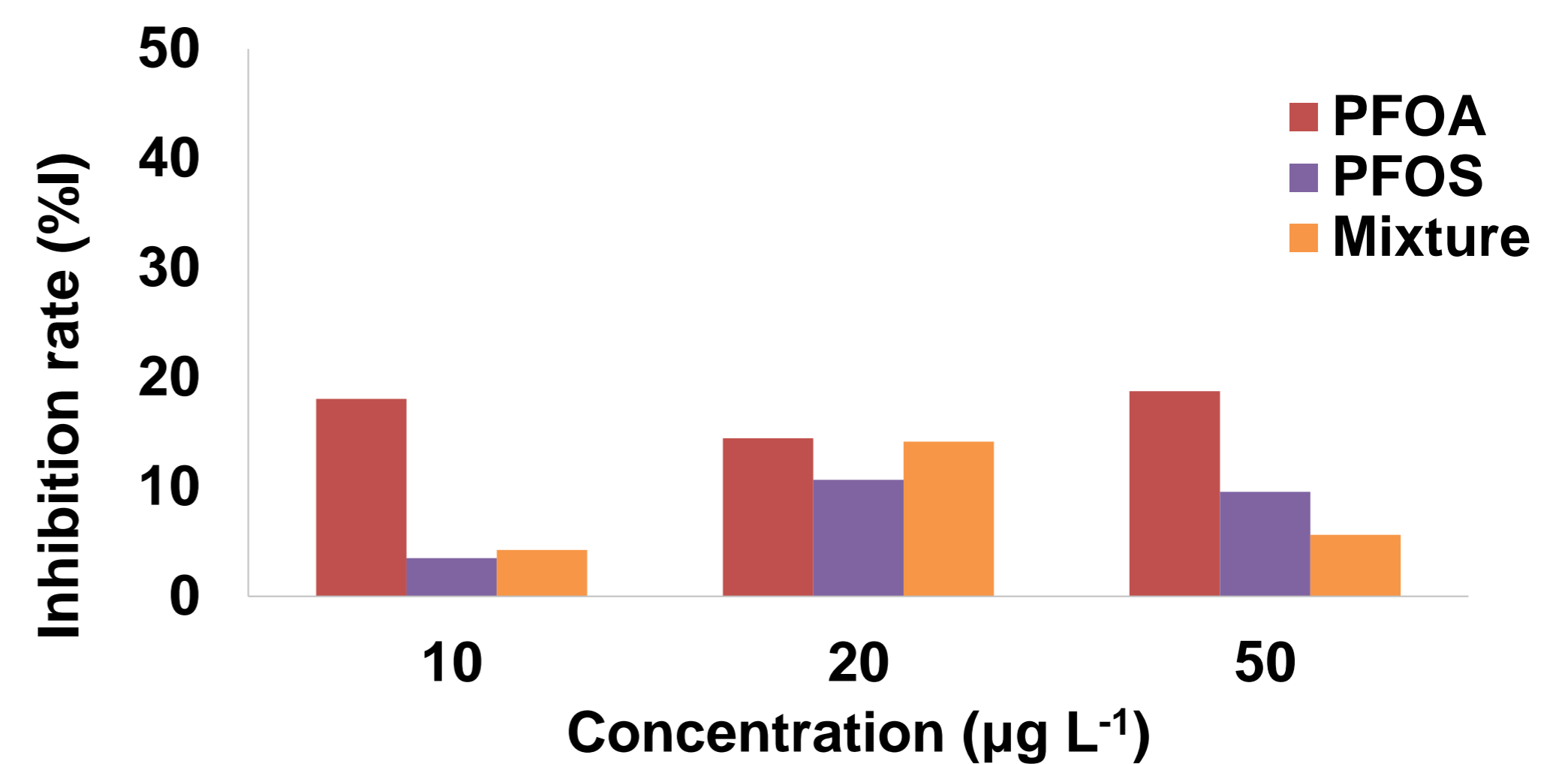


Figure 2: Growth inhibition percentage of *Dunaliella tertiolecta* after 72 hours of exposure to PFOA, PFOS and their mixture in different concentrations (10, 20, 50 µg L⁻¹).

RESULTS

- In the highest tested concentrations, the mixture of the studied compounds caused a noticeable effect at the bacterium *Alliivibrio fischeri*, with the bioluminescence inhibition percentage reaching 37%.
- Significant growth inhibition was observed when the microalgae *Dunaliella Tertiolecta* was exposed to PFOA for 72 hours (IC₅₀=0.74 mg L⁻¹).

CONCLUSIONS

- The studied mixture presented higher effects at the bacterium *Aliivibrio fischeri*, indicating possible synergistic effects of PFOA and PFOS.
- Taking into consideration the IC₅₀ values, PFOA is classified as very toxic for the microalgae *Dunaliella Tertiolecta* and the mixture of the studied compounds as harmful.
- The microorganisms presented different sensitivity to the studied compounds.

REFERENCES

1. Antonopoulou M, Spyrou A, Tzamarina A, Efthimiou I, Triantafyllidis V. Current state of knowledge of environmental occurrence, toxic effects, and advanced treatment of PFOS and PFOA. Science of The Total Environment. 2024 Feb 25;913:169332.