Microcystin-LR, -LW, and -LF on microplastics: toxic compounds adsorbed by six plastics

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This study aimed to evaluate the effect of microcystin hydrophobicity on the adsorption by different microplastic types.

Introduction

The presence of cyanobacterial blooms is an indicator of poor water quality. The hepatotoxin family of microcystins (MC) are the most common group of cyanotoxins reported in freshwater. There is an emerging concern that microplastics (size < 5 mm) can act as a vector for micropollutants when they co-exist in the same environment (**Fig 1**).

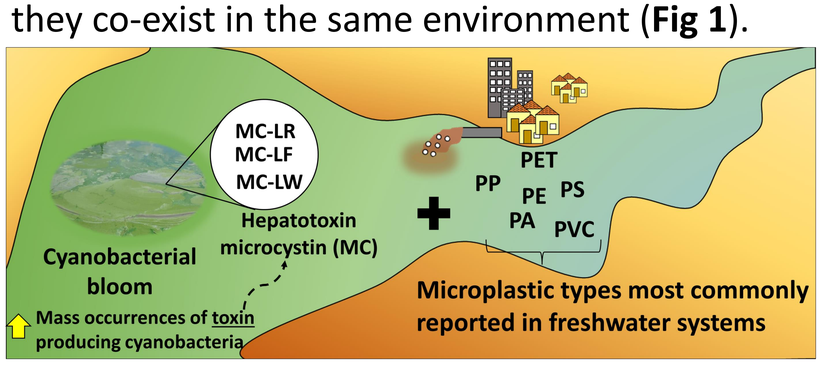

Fig 1. Interaction of co-occurrence of micropollutants, such as microplastics and microcystins, in the aquatic environment. Polypropylene (PP), polyethylene (PE), polyethylene terephthalate (PET), polyamide (PA), polystyrene (PS), and polyvinyl chloride (PVC).

Microcystin variants have been reported to adsorb on microplastics.

Scan here for: Potentially Poisonous Plastic Particles: Microplastics as a Vector for Cyanobacterial Toxins Microcystin-LR and Microcystin-LF.

Scan here for: Adsorption of cyanotoxins on polypropylene and polyethylene terephthalate: Microplastics as vector of eight microcystin analogues.

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Methods

A mixture of three microcystins (1 µg/mL each) was placed in contact with microparticles of polypropylene (PP), polyethylene (PE), polyethylene terephthalate (PET), polyamide (PA), polystyrene (PS), and polyvinyl chloride (PVC, **Fig 2**).

The samples were constantly horizontally agitated for 48 hours in the dark.

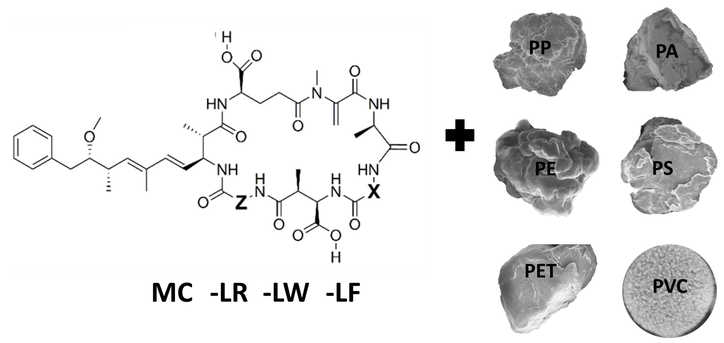

Fig 2. Mixture of MC-LR, -LW, and -LF were placed in contact with six microplastic types (scanning electron microscopic images).

The microplastic particles were characterised and shown to have average particle sizes of 5-45 µm (**Fig 3**).

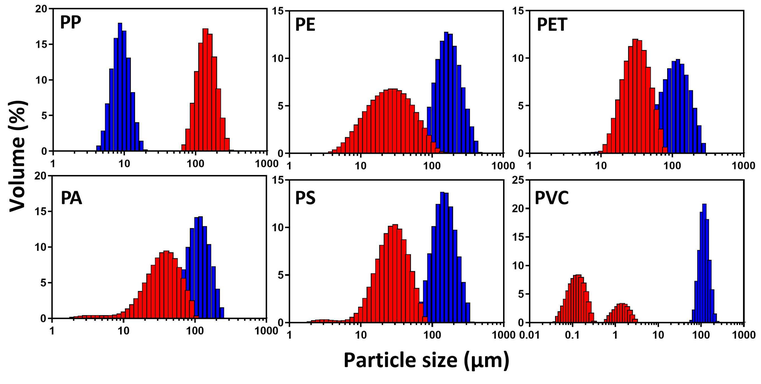

Fig 3. Particle size distribution of the microplastics as analysed by laser diffraction analysis. (see Methods text for abbreviations).

Results

- PP, PS, PVC, and PE adsorbed all MC variants.
- PET only adsorbed MC-LW.
- No adsorption was observed for PA.
- PP showed the greatest adsorption of the MC variants, adsorbing from 80% (MC-LR) to 100% (MC-LW/LF).
- The largest concentration adsorbed onto microplastics was observed for MC-LW, followed by -LF, and finally MC-LR (**Fig 4**).

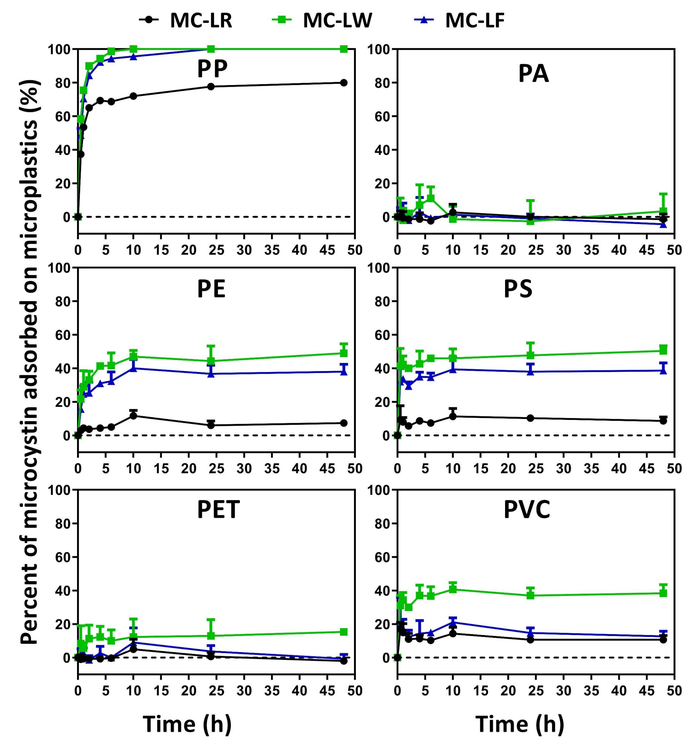

Fig 4. Percent adsorption of microcystin(MC)-LR, -LW, and -LF on a range of microplastics.

Conclusion

The hydrophobicity of the MC variants and the type of microplastics were the driven factor regarding the adsorption of MC on microplastics.