Is aquaculture production of bivalves affected by microplastic contamination?

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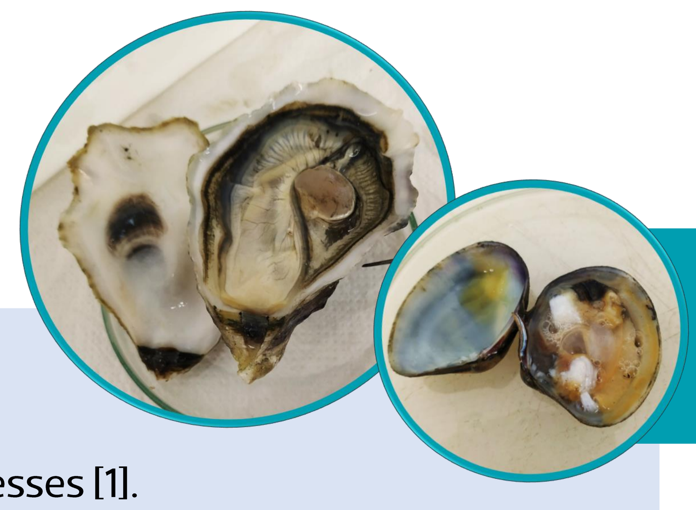


Introduction

Marine bivalves are an important group of invertebrates with a wide distribution that play important roles in trophic webs and in several ecosystem processes [1].

Bivalves have a good nutritional value, and some species are highly consumed and appreciated by humans. The global production of marine bivalves has been increasing worldwide over the past few decades, mainly because of the expansion of the aquaculture production that represents 92% of the total production of these organisms [2].

Aquaculture production of marine bivalves occur mainly in extensive open areas placed in transitional waters systems, that can be highly impacted by a vast number of pollutants, including microplastics (MPs). These plastic particles can be found in different environmental matrices, such as water, sediment and biota. These particles can be ingested by marine bivalves, posing a threat to them, to the entire marine food chain, and ultimately to humans [3].

Regarding the major concern of microplastic pollution and its implications to seafood quality and human health, this study aims to understand the occurrence and seasonal variation of microplastics in different tissues (visceral mass, digestive system, gills, muscle) of the marine bivalves Pacific cupped oyster, *Crassostrea gigas* (Thunberg, 1793), and Japanese carpet shell, *Ruditapes philippinarum* (Adams & Reeve,1850), produced in a Portuguese aquaculture for human consumption, and in the surrounding environmental matrices (water and sediment surfaces).

Materials and Methods

Water, sediment and bivalve samples were collected in December of 2019 and July of 2020 in a bivalve aquaculture located in the Ria de Aveiro coastal lagoon (Portugal).

Two sampling stations (white dots in the figure on the right) were defined according to where each bivalve species was produced.

Study Area

Water samples were pre-filtered through a set of sieves with different mesh sizes (5 mm and 38 μm) and the microplastics were extracted by wet peroxide oxidation (30% H_2O_2), density separation with $ZnCl_2$ and filtration [4].

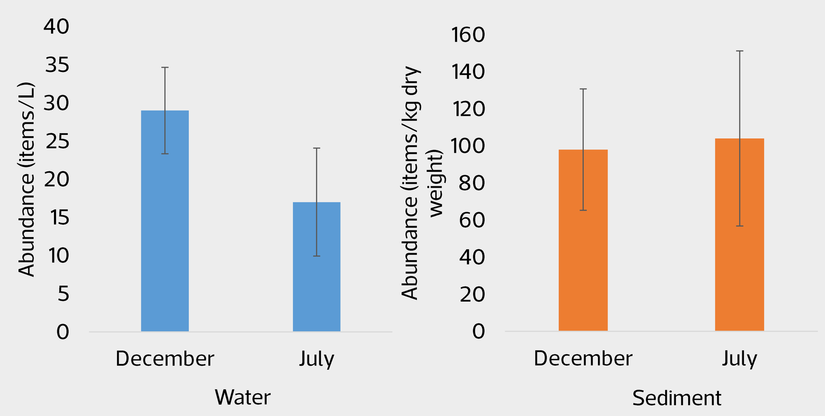
Sediment samples were submitted to an oxidation treatment (10% H_2O_2) prior to density separation with $ZnCl_2$ and filtration of microplastics [5].

Bivalve organisms were divided in the following tissues: visceral mass, digestive system, gills and muscle. Microplastics were extracted from bivalve tissues through digestion with 15% H_2O_2, followed by direct filtration [6,7].

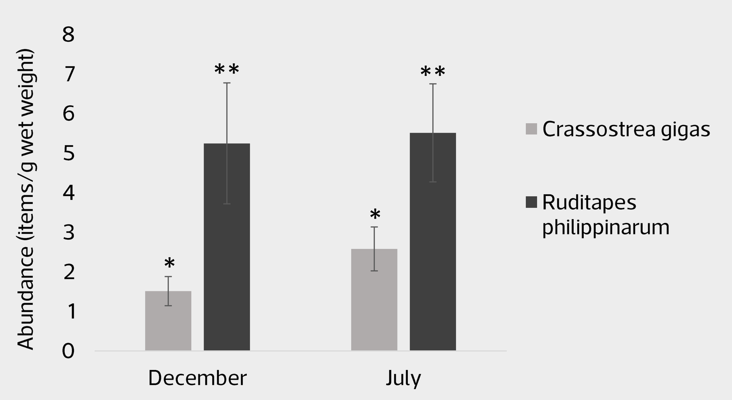
The filters (0,45 μm) containing the recovered samples from water, sediment and bivalve tissues were visually inspected for microplastics by stereomicroscopy. The number of microplastics found in each sample and their physical properties (type, size, color) were registered and analyzed.

Results

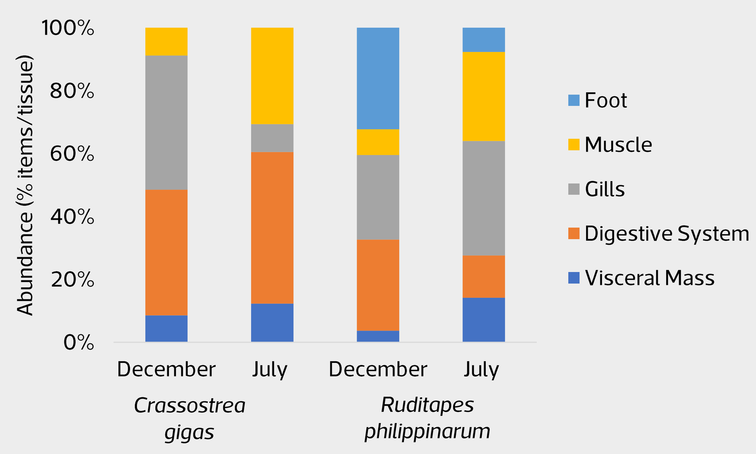
MP particles in water and sediment



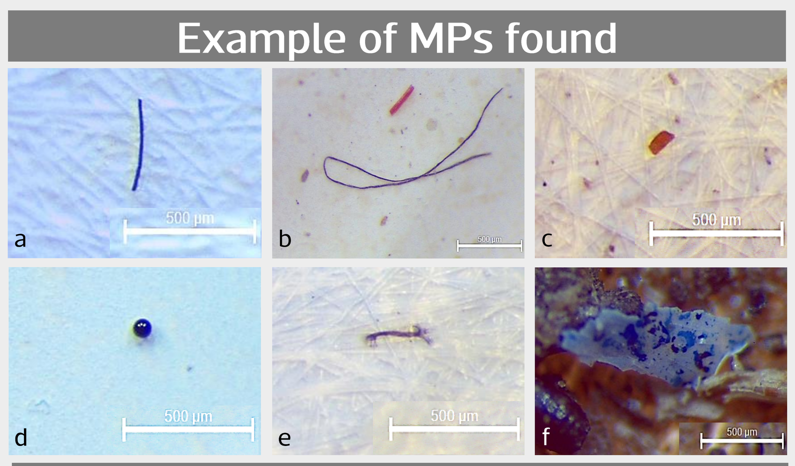
MP particles in bivalves



MP particles in bivalve tissues

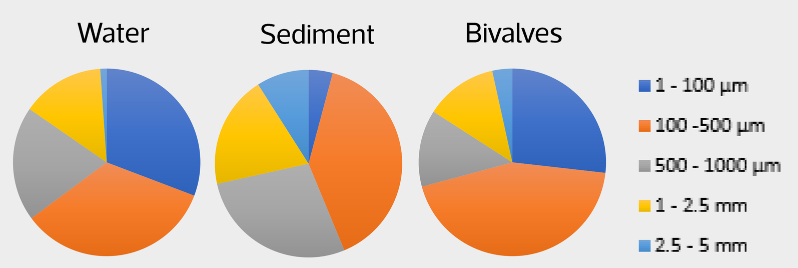


Example of MPs found

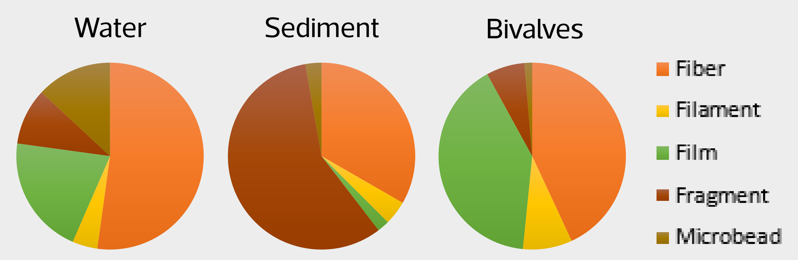


a) Blue fiber, b) purple fiber and pink fragment, c) Brown film, d) blue microbead, e) purple filaments and f) multicolor fragment.

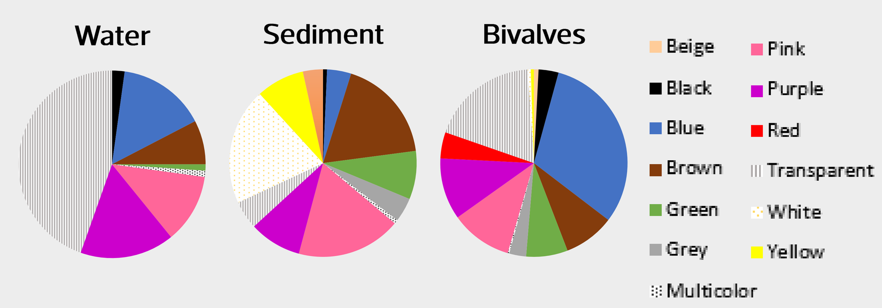
Size of MP particles



Type of MP particles



Color of MP particles



Conclusions

Microplastic pollution is affecting the aquaculture production of *C. gigas* and *R. philippinarum* intended for human consumption, since MP particles, mostly fibers, fragments and films, were found in both environmental matrices (water and sediments) and in the different tissues of the two bivalve species analyzed. No significant seasonal variation of MP abundance was observed in water, sediment or bivalve samples. MP abundances recorded for both environmental matrices were not significantly different from one another. In *C. gigas* the main tissues where MPs were found are the digestive system, gills and muscle, while in *R. philippinarum* are the digestive system, gills, muscle and foot. *R. philippinarum* showed a significantly higher MP abundance than *C. gigas*, which could translate to a higher risk for human health in case of consumption of contaminated bivalves.

Future Work

The next steps of this ongoing research will be the identification of the plastic polymers of the MPs found by Micro-Fourier Transformed Infrared spectroscopy (μ-FTIR), and the study of potential nutritional effects of MP acute exposure to the bivalve species by determining their biochemical composition (fatty acid, carbohydrate and protein contents).

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Acknowledgments

This study was supported by Fundação para a Ciência e a Tecnologia (FCT) through the strategic projects UIDB/04292/2020, granted to MARE – Marine and Environmental Sciences Centre and UIDP/50017/2020+UIDB/50017/2020 granted to CESAM – Centre for Environmental and Marine Studies. D. C. C. Silva thanks to FCT for the doctoral grant SFRH/BD/143686/2019 funded by National Funds and Community Funds through FSE.. A. M. M. Gonçalves acknowledges University of Coimbra for the contract IT057-18-7253.