Occurrence of microplastics in bivalves: can a systematic literature review support risk assessment?

Alice Giusti (1), Lisa Guardone (1), Marco Diano (1), Francesca Susini (2), Andrea Armani (1)

(1) FishLab, Dipartimento di Scienze Veterinarie, Università di Pisa (2) Istituto Zooprofilattico Sperimentale del Lazio e della Toscana

Corresponding author: Alice Giusti (alice.giusti183@outlook.it)

Microplastics (MPs) are a global environmental issue, particularly affecting the aquatic ecosystem. Due to their small size (<5 mm), MPs can be absorbed or ingested by aquatic organisms, and transferred through food webs. Toxic effects due to the ingestion of MPs, alone or contaminated with additives or pollutants, have been hypothesized. Human exposure is inevitable, also following accumulation in the food chain. Seafood, especially bivalves, being filter feeders and consumed as whole, are an important potential pathway. The scientific interest in the topic is rising, and several narrative reviews on MPs in food, including seafood, have been published since the publication of a statement on the presence of MPs and nanoplastics in food by EFSA in 2016 (1), highlighting a scarcity of data on MPs occurrence.

The aim of this review was to systematically revise scientific papers (SPs) to assess the occurrence of MPs in different categories of bivalves (mussels, clams, oysters and scallop) worldwide. A double-step filtration was used, applying increasingly stricter quality criteria. Data on MPs abundance were first discussed focusing on all the investigated species and geographical areas. Then, a subset of SPs selected in the second filtering step was used to calculate the weighted MPs mean abundance and the human exposure per serving size.

In the first filtering process 87 SPs, published between 2014 and 2020 in 30 different scientific journals, were retained. Overall, 67 species, 6 genera and 1 family of bivalves were analysed. Mussels were the most analysed (61 SPs), followed by clams (55 SPs), oysters (31 SPs), and scallops (7 SPs). Mytilus edulis and *M. galloprovincialis* were the most investigated species, followed *by P. viridis, Mytilus sp., R. philippinarum* and *C. gigas*. All these are commercial species, globally farmed and distributed. Marine FAO areas 61 and 27 were most investigated. Overall, MPs mean abundance was variably reported, as well as the use of different methods and procedural controls. Therefore, in this study, the weighted MPs mean abundance was calculated only including data from a subset of SPs (n=32; 37%). The overall weighted MPs mean abundance including data from all FAO areas was 1.19 MPs/g ww. The highest value was observed in FAO area 61 (2.33 MPs/g ww), while values <1 MPs/g ww were observed in FAO areas 27 and 57. Among bivalve categories, the highest weighted MPs mean abundance (overall FAO areas) was observed for scallops (1.99 MPs/g ww), followed by mussels (1.71 MPs/g ww), clams (0.84 MPs/g ww) and oysters (0.65 MPs/g ww). Thus, the consumption of standard portions of each bivalve category determines the ingestion of a different number of MPs depending on the FAO area; the highest value (~645 MPs) would be ingested with a portion of mussels from FAO area 61.

Our findings confirmed the existence of quality issues and the lack of analytical standardization. A disparity among investigated species and geographical areas was observed, and only three studies addressed processed products. These aspects affect the outcome of systematic reviews to support risk assessment; future studies should explore the issue of MPs adopting an interdisciplinary perspective, integrating different technical and scientific competences to collect evidences for risk assessment and management.

[1] EFSA. Presence of microplastics and nanoplastics in food, with particular focus on seafood. EFSA Journal, 14(6):4501, 2016.