Evaluation of microfiber's effects on the physiology of the Pacific oyster Crassostrea gigas: the relevancy of using more realistic particles

Clémentine Labbé*[1], Camille Détrée[2], Ika Paul-Pont[1], Enora Prado[3], Maria El Rawke[3], Nicolas Delorme[4], Imogen Ellen Napper[5], Richard Thompson[5], and Arnaud Huvet[1]

[1]Laboratoire des Sciences de l'Environnement Marin (LEMAR) – UBO, CNRS, IFREMER, IRD – ZI de la Pointe du Diable, CS 10070, 29280 Plouzané, France

[2]Laboratoire de Biologie des Organismes et Ecosystèmes Aquatiques (BOREA) – Université de Caen-Normandie, MNHN, SU, UA, CNRS, IRD – Esplanade de la Paix, 14032 Caen, France

[3]Ifremer - Laboratoire Détection, Capteurs et Mesures (LDCM) – Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER) – Centre Bretagne, ZI de la Pointe du Diable, CS 10070, 29280 Plouzané, France

[4]Institut des Molécules et Matériaux Du Mans – UMR 6283 CNRS-Le Mans Université – Av. O. Messiaen, 72085, Le Mans Cedex 9, France

[5]School of Biological and Marine Sciences – University of Plymouth, Drake Circus, Plymouth PL4 8AA, United Kingdom

Abstract

The recent growth of fast-fashion and our daily use of fibrous materials over the years have led to the massive release of microfibers (MF) into the oceans. Although MF pollution is commonly linked to plastic pollution, a vast majority of the collected MF are made of natural components. We investigated the effects of a 96h-exposure to both natural and synthetic textile MF and their associated chemical additives on the physiology of C. gigas. Selected MF were either produced in the lab from six commercial yarns (acrylic, nylon and polyester (synthetic MF); wool, cotton and organic cotton (natural MF)) or originating from the laundering of jumpers made of polyester, cotton or a mix of MF (polyester/cotton/acrylic). Specifically, we evaluated oyster's capacity of ingesting MF of a given size and explored the effects of both MF and their leachates on a set of biomarkers representing key physiological functions. For both MF and leachates, two scenarios were considered: an environmentally relevant (10 MF.L-1) and a worst-case scenario (10000 MF.L-1). Overall, when comparing laboratory-produced and laundering MF, a distinctive response was observed. There was no effect of laboratory-produced MF exposure concentration on oyster's key physiological processes whereas a dose-dependent effect was observed in oysters exposed to MF from washing machines. In addition, the exposure to both laundering MF and leachates disturbed oysters' digestive function, and this, regardless the nature of MF, while a more contrasting response was observed in the case of laboratory-produced MF. Ingestion of natural calibrated MF led to a perturbation of oyster digestive functions, presumably due to their physical characteristics (roughness), while little effects of synthetic MF were observed on the selected endpoints. These results stress the need to consider realistic wastes in ecotoxicological studies, including natural and non-calibrated particles to thoroughly evaluate the impact of anthropogenic debris.

*Speaker

Keywords: textile microfibers, contamination, oysters, biomarkers, laundering