Environmental degradation due to pollution has become a huge health and social threat to worldwide countries. The “European Green Deal" commits to a zero-pollution economy for a toxic-free environment, and it specifically mentions the need to rapidly address the risks posed by very persistent chemicals, such as plastic. Micro- and nanoplastics (MP and NP) already heavily contaminate the environment, in particular the oceans, and, by contaminating environmental species, they enter the food chain. Human exposure to MP and NP mostly occurs through contaminated food. We ingest on average five grams of plastic per week (the equivalent of a credit card) and the implications for our health are not yet known, either as direct effects or as carriers of microorganisms and toxic chemicals. Moreover, whether they are ingested in micro or nano form, they can also lead to the intake of viruses, bacteria and toxic contaminants inside organisms. So, improving our knowledge on the interactions between MP and NP and the immune system has become extremely important.

The immunology group of IBBC is addressing the interaction of MP/NP with the immune system, from marine invertebrates to human beings, as the knowledge basis required for understanding the MP/NP impact on environmental and human health. The group is examining the interaction of MP/NP with microorganisms, the effects on marine invertebrates in vivo and the cellular and molecular mechanisms underpinning the onset of immune reactions to MP and NP in marine species (vertebrates and invertebrates) and in humans, through in vitro models aimed at realistic scenarios of exposure, using human primary cell/tissue systems and gut biopsies. In particular we are studying:

1. the immunological mechanisms of adaptation of polar fishes to MP/NP;
2. the immunological response to MP/NP in marine invertebrates, such as Ciona robusta;
3. the predictive value of the human health hazard posed by MP/NP, using human primary cell-based in vitro models of innate immune/inflammatory response and innate memory (i.e., monocytes, macrophages, DC);
4. the interaction between MP/NP with viruses (e.g., SARS-CoV-2 pseudovirus), to assess changes in pathogenicity and carrier effects;
5. the interaction of ingested MP/NP with the human gastro-intestinal tract (in vitro advanced models and biopsies from healthy subjects and coeliac disease patients) for effects on healthy vs. inflamed/pathological gut mucosa.

The overall aim is to exploit the commonalities and specificities of immune defensive responses throughout living species for a realistic prediction of the health and environmental hazard of MP/NP, including possible indirect effects caused by fine modulation of innate memory, carrier-dependent changes of the kinetics and dynamics of chemical compounds, allergens and microorganisms. As practical goal, we aim at developing simplified assays for a realistic and personalized prediction of MP/NP hazard for human health that consider the variability of immune competence within the human population (chronic diseases, inflammaging, immunobiography).

References:


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