TRACKING NANO- AND MICRO PLASTICS IN LIVING ORGANISMS TO ASSESS HUMAN HEALTH RISKS

ACRONYM: TRACTION

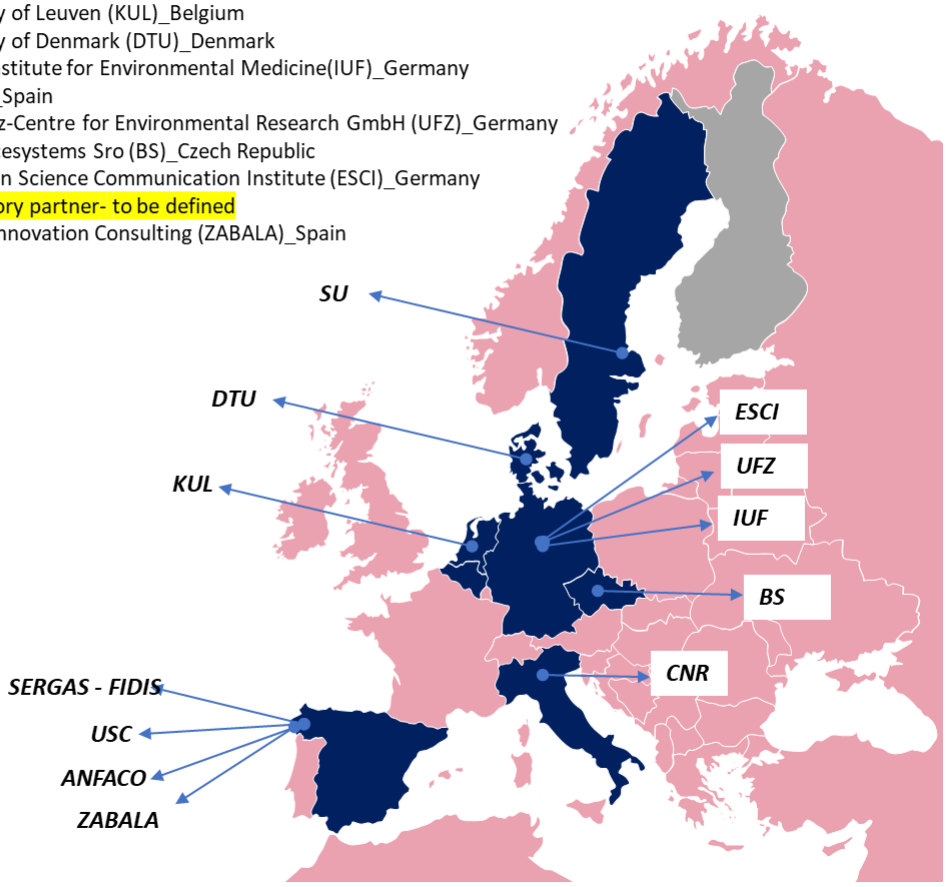
EU CALL: BHC-36-2020. Micro- and nano-plastics in our environment: Understanding exposures and impacts on human health.

ACTION: RIA (100% grant)

CONSORTIUM:

PARTNER		COUNTRY	ENTITY TYPE
SERGAS & FIDIS	Servicio Galego de Saude	ES	UNIV
USC	University Santiago de Compostela	ES	UNIV
CNR	Consiglio Nazionale delle Ricerche	IT	RTD CENTRE
SU	Stockholm University	SE	UNIV
KUL	KU Leuven	BE	UNIV
DTU	Technical University of Denmark	DK	UNIV
IUF	Leibniz-Institute for Environmental Medicine	DE	RTD
ANFACO	Asociación Nacional de Fabricantes de Conservas de Pescados	ES	RTD CENTRE
UFZ	Helmholtz-Centre for Environmental Research GmbH	DE	RTD CENTRE
BS	Biodevice Systems	CZ	SME
ESCI	European Science Communication Institute	DE	NPO
INTEK	Intertek		SME
ZABALA	Zabala Innovation Consulting	ES	SME

Partner 1: SERGAS&FIDIS_Spain
Partner 2: University of Santiago (USC)_Spain
Partner 3: Consiglio Nazionale delle Ricerche (CNR)_Italy
Partner 4: Stockholm University (SU)_Sweden
Partner 5: University of Leuven (KUL)_Belgium
Partner 6: University of Denmark (DTU)_Denmark
Partner 7: Leibniz-Institute for Environmental Medicine(IUF)_Germany
Partner 8: ANFACO_Spain
Partner 9: Helmholtz-Centre for Environmental Research GmbH (UFZ)_Germany
Partner 10: Biodevicesystems Sro (BS)_Czech Republic
Partner 11: European Science Communication Institute (ESCI)_Germany
Partner 12: Regulatory partner- to be defined
Partner 13: Zabala Innovation Consulting (ZABALA)_Spain



TOPIC CHALLENGE:

Global plastic production has increased exponentially for decades. A significant proportion of the plastic produced is not disposed of properly and persists in the environment, especially the marine environment. Plastic products can be slowly degraded into smaller pieces (micro- or even nanoplastics). Furthermore, micro-plastics are intentionally added to, for example, toothpaste and beauty products (referred to as microbeads) or are a secondary by-product of rubber from, e.g. textiles, tyre wear or artificial turf.

Plastic debris is associated with a "cocktail of contaminants" made up of chemical ingredients present originally in the plastic and chemical pollutants adsorbed to the plastic from the environment, including metals and other persistent contaminants such as polychlorinated biphenyls (PCBs) and flame retardants. The debris is filtered into marine species' gastrointestinal tract mechanically or it may look like food to some species, thus entering the food chain, with unknown effects.

Risk assessments and reviews carried out in recent years have concluded that there is evidence that humans are exposed to micro- and nano-plastics through their diet, drinking water or inhalation. However, our understanding of the fate and toxicity of these plastic particles in humans constitutes a major knowledge gap, rendering it difficult to carry out proper science-based risk assessment and management.

GENERAL SCOPE:

Proposals should use innovative approaches to provide policy relevant scientific data in support of improved human health hazard and risk assessment of micro and/or nano-plastics.

IMPACT

- *Better understanding of health impacts of exposure to micro- and/or nano-plastics, including preliminary investigations into long-term impacts.*
- *Innovation in human health hazard and risk assessment methodologies of micro- and/or nano-plastics.*
- *Contribution to the health-relevant aims of the European Strategy for Plastics in a Circular Economy and of the Bioeconomy Strategy*

NEED:

Plastics are highly versatile materials that have brought huge societal benefits. They can be manufactured at low cost and their lightweight and adaptable nature has a myriad of applications in all aspects of everyday life, including food packaging, consumer products, medical devices and construction. This plastic dependent lifestyle involved that in 2050, it is anticipated that an extra 33 billion tonnes of plastic will be added to the planet. Indeed, plastic demand in the European Union alone for 2010 was estimated at 46.4 million tonnes, consisting of two main types: plastics used for packaging of food and consumer items, with the second group constituting plastics used in the construction industry (PlasticsEurope 2013).

Given that most currently used plastic polymers are highly resistant to degradation, this influx of persistent, complex materials is a risk to human. Continuous daily interaction with plastic items allows oral, dermal and inhalation exposure to chemical components, leading to the widespread presence in the human body of chemicals associated with plastics. Indiscriminate disposal places a huge burden on waste management systems, allowing plastic wastes to infiltrate ecosystems, with the potential to contaminate the food chain. Of particular concern has been the reported presence of microscopic plastic debris, or microplastics (debris ≤1 mm in size), in aquatic, terrestrial and marine habitats. Yet, the potential for microplastics and nanoplastics of environmental origin to cause harm to human health remains understudied (*Marine Anthropogenic Litter pp 343-366*).

One way around this problem is to determine what chemicals are actually present in the human body. Human biomonitoring involves measuring the concentrations of environmental contaminants and/or their metabolites in human tissues or body fluids, such as blood, breast milk, saliva or urine. Biomonitoring is considered a gold standard in assessing the health risks of environmental exposures because it can provide an integrated measure of an individual's exposure to contaminants from multiple sources (*Sexton, K., Needham, L., & Pickles, J. (2004). Human biomonitoring of environmental chemicals. American Science, 92, 38–45.*). This approach has shown that chemicals used in the manufacture of plastics are certainly present in the human population. For some chemicals, their widespread presence in the general population at concentrations capable of causing harm in animal models has raised public health concerns (*Melzer, D., & Galloway, T. S. (2010). Burden of proof. New Scientist, October 2010, pp. 26–27*). Indeed, the National Health and Nutrition Examination Survey (NHANES), a program designed to assess the health and nutritional status of adults and children in the United States (http://www.cdc.gov/nchs/nhanes.htm), reported that on several chemicals associated with the use or production of plastics such as bisphenol A, phthalates, styrene, acrylamide, triclosan and brominated flame retardants were present in the general population.

In addition to the well-known toxicity effect of the plastic additives, concern has been raised that microscopic plastic debris (microplastic <1 mm) may also be detrimental to the human health. Microplastics have been studied mostly in the context of the marine environment, and have been found to be a major constituent of anthropogenic marine debris. They consist of small plastic items, such as exfoliates in cosmetics, or fragments from larger plastic debris, including polyester fibres from fabrics, polyethylene fragments from plastic bags and polystyrene particles from buoys and floats (*Cole, M., Lindeque, P., Halsband-Lenk, C., & Galloway, T. S. (2011). Microplastic as a contaminant in the marine environment: a review. Marine Pollution Bulletin, 62, 2588–2597.*).

In terms of human health risks, microplastics as contaminants in the wider environment represent a concern because it has been shown that they can be ingested by a wide range of aquatic organisms, both marine and freshwater, and thus have the potential to contaminate the entire food chain. The majority of studies have documented microplastics in the guts of organisms, an organ that is not generally consumed directly by humans. Exceptions to this include shellfish such as mussels, clams and some shrimps that are eaten whole or with their gut. The risk of ingesting microplastics contained within other tissues depends on the degree to which uptake of microplastics and translocation and redistribution and retention within other body tissues occurs.

PROJECT OBJECTIVES

Micro- and Nanoplastics have become a critical pollutant in the environment both because of degradation of plastic waste reduced into smaller fragments and because of commercial application of nanoplastics. The small particle size and low density enable microplastics to escape wastewater treatment process and enter in the environment. From there these tiny particles can be ingested and accumulated by various organism and, along the food chain, enter into the human body. Despite strong evidences show that nanoplastics not only accumulate but have also adverse effects on organisms there are no technologies or methodologies for their detection in vivo especially for the investigation of low dosage and/or long-term exposure needed to understand the impact on human health of environmental exposure.

TRACTION is a multidisciplinary proposal, which aims to compile a precise map of the distribution of nanoplastic in living organisms to assess the related risk on humans and inform legislation on human health hazard. TRACTION will investigate the contamination of animals and humans by plastic micro- and nano-particles (PMNP) by employing the development and fabrication of natural and artificial nano-and micro-plastic objects easily detectable by common diagnostic techniques, such as MRI, PET, CT and fluorescence confocal microscopy, by the labelling with magnetic contrast agents, radiotracers or fluorescent moieties.

WORK PACKAGES