FOOD STANDARDS AGENCY: INFORMATION RELEASED UNDER THE FREEDOM OF INFORMATION ACT

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Request

I would like to request the following information under the Freedom of Information Act.

1. *A copy of the latest assessment of the impacts of microplastics on human health, as referred to in the response to this parliamentary question:*

http://www.parliament.uk/business/publications/written-questions-answers-statements/written-question/Commons/2017-06-26/1230/

2. *Correspondence between members of the science directorate and the Department of Health relating to the preparation of this assessment.*

3. *A list of information sources consulted in the preparation of this assessment.*

Response

1. The FSA agrees with, and supports, the European Food Safety Authority (EFSA) statement - *Presence of microplastics and nanoplastics in food, with particular focus on seafood* (https://www.efsa.europa.eu/en/efsajournal/pub/4501), published in 2016. In the meantime, the FSA has continued to monitor emerging scientific information concerning microplastics in seafood.

2. EFSA, rather than the FSA, carried out the risk assessment on microplastics in food, so there was no correspondence between the FSA and the Department of Health on this subject.

3. EFSA's 2016 statement - *Presence of microplastics and nanoplastics in food, with particular focus on seafood* - contains a comprehensive list of references for all the sources of information that EFSA considered in their assessment.

Additional informal information concerning the FSA's position on microplastics

The FSA's top lines on microplastics in seafood are:

• The FSA has been monitoring the scientific evidence concerning the occurrence and effects of microplastic particles in seafood and other food products for several years.

• On the basis of available information, the FSA considers that it is unlikely that the presence of the reported low levels of microplastic particles in certain types of seafood, such as mussels, would cause harm to consumers.

• Micro- and nanoplastics can bind various environmental pollutants and could therefore contribute to the uptake of these chemicals by filter feeding shellfish. However, these chemicals also bind to naturally occurring sediment particles, which are ingested by filter feeders, and which are vastly more abundant than microplastics in the environment.

• The FSA agrees with European Food Safety Authority's (EFSA) recommendation that further information regarding the occurrence and the possible toxic effects of micro- and nanoplastics in seafood is required.

• Regulatory limits for certain environmental chemical contaminants, such as polycyclic aromatic hydrocarbons, in shellfish and fish, irrespective of the source of these contaminants, would prevent consumers from being exposed to shellfish containing elevated levels of these regulated contaminants.

EFSA's 2016 statement on micro- and nanoplastics in food is the predominant and most authoritative source of information concerning potential dietary exposure and possible health risks to humans from micro- and nanoplastic particles in food. Although some further peer-reviewed scientific information regarding the occurrence and behaviour of microplastic particles in the marine environment and food chain has emerged in the meantime, none of this new information qualitatively changes the preliminary health risk assessment provided in EFSA's 2016 statement. Although EFSA's statement on micro- and nanoplastics did not identify specific risks associated with consumption of seafood contaminated with microplastics, there is still insufficient data on the occurrence of microplastics and nanoplastics, and a lack of toxicological and toxicokinetic data, for a comprehensive human risk assessment, particularly for any possible toxic effects of the micro- and nanoplastic particles themselves.

Much of the new information that has become available concerns analysis and monitoring of microplastics, in various environmental media and biota, and the role that microplastic particles could play as vectors for the transfer of certain hydrophobic environmental contaminants to marine invertebrates, fish and birds. However, whilst improving our knowledge and reducing uncertainty, they do not provide any qualitatively new information that would change the assessment based on the available information concerning micro- and nanoplastics in seafood that was provided by EFSA in 2016
The following paragraphs provide a concise overview of some of this research which, in addition to the information provided in EFSA's 2016 statement on microplastics, the FSA has used to develop its position on microplastics in food. However, this extra information, that I am providing in addition to my formal response to your request for information under the Freedom of Information Act, is not intended to be a comprehensive review or a formal risk assessment.

Analytical standards and methods

Hermsen *et al* (2017) reported much lower levels of microplastics >20 μm in fish from the North Sea than had been reported in previous studies, which did not use such strict quality assurance standards for their analysis. On the basis of their own study, and other studies that adhere to strict quality assurance criteria, Hemsen *et al* (2017) suggest that microplastic ingestion by fish may occur at a lower incidence than previously thought. FTIR spectroscopy has been used to identify particular types of plastic present in microparticles isolated from fish (*e.g.* Hermsen *et al*, 2017) or mussels (Jang *et al,* 2016). Micro-Raman Spectroscopy is also being used more widely to characterising the composition of plastic microparticles found in fish (*e.g.* Karami *et al*, 2018) or in other media such as water (*e.g.* Schymanski *et al* 2018). Incidentally, Karami *et al* (2018) investigated, microplastics in whole canned sardines and sprats and reported very low numbers of particles which could have been present in fish tissues due to improper gutting or, possibly, translocation of particles across the gut. However, Karami *et al* (2018) concluded that consumers would only ingest between 1 and 5 microplastic particles per annum from consumption of the canned fish products that they tested. New more straightforward analytical methods have been introduced for the detection of microplastics in environmental and biological samples to improve the efficiency and reliability of environmental monitoring data. For example, Erni-Cassola *et al* (2017) demonstrated the effectiveness of Nile Red dye for the quantification of polyethylene, polypropylene, polystyrene, and nylon-6 particles, >20 μm, which frequently occur in the water column. However, they highlighted the importance of carrying out appropriate chemical digestion of the isolated microparticles to avoid potential false positives which can occur due to the ability of Nile Red to also bind to some types of natural microparticulate materials such as lignin or chitin, as well as plastic microparticles.

Are microplastics vectors for toxic chemicals?

Persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs) or polybrominated diphenyl ethers (PBDEs), which have extremely low solubility in water, can be adsorbed to the surface of microplastic particles. Consequently, it has been suggested that microplastics could be vectors for the transfer of POPs to marine invertebrates or fish that ingest the particles. Wardrop *et al* (2016) provided evidence that this can occur in a laboratory setting by showing that PBDEs can efficiently adsorb to polyethylene microbeads and that ingestion of the PBDE-coated microbeads by rainbow fish reared in clean water (*i.e.* with no other particulate material other than food) resulted in the transfer of most, but not all, PBDE congeners to the fish tissues. However, this is a rather artificial scenario that does not reflect the natural environment. In the field, various naturally occurring materials that are much more abundant than micro- or nanoplastic particles also bind hydrophobic organic contaminants.
Marine worms have been used a test system to investigate the impact of microplastic particles on the transfer and uptake of POPs from sediment. Beckingham *et al* (2017) examined the effects of polypropylene microbeads on the uptake of PCBs by worms and reported that the presence of microplastics in sediments reduced the bioavailability of PCBs to the worms and that natural organic and inorganic materials in sediment, rather than microplastics, would be dominant as vectors for the uptake of PCBs. Similar findings were reported by Besseling *et al* (2017) who investigated the effects of polyethylene microbeads on the transfer and uptake, from sediment, of PCBs by marine lugworms. This study showed that the presence of polyethylene microbeads in the sediment had a negligible impact on the uptake and bioaccumulation of PCBs by the worms.

Food contaminated with POPs is also likely to be a much more abundant and bioaccessible source of these contaminants than microplastic particles, which are inert and not biodegradable in the gut in marine organisms. Koelmans *et al* (2016) carried out a critical review of scientific literature concerning the role of microplastic particles play in the transfer and uptake of POPs from the marine environment into marine organisms. They estimated that microplastic particles only accounted for about 0.01% of POPs associated with various environmental media in oceans, other than water, with substantially higher proportions being associated with dissolved organic matter, colloids, detritus, phytoplankton, bacteria and zooplankton. They concluded that the overall flux of POPs from ingestion of natural prey is the dominant source of exposure of organisms to these chemicals in the marine environment.

Lohmann (2017) reviewed whether microplastics act as vectors for persistent organic pollutants in the marine environment and the marine food chain. He concluded that whilst there is evidence that microplastics can accumulate these types of chemical, that does not mean that they are important as vectors for the transfer of POPs (with the possible exception of some flame retardant chemicals) to marine animals. He did, however, conclude that microplastics should, themselves, perhaps be regarded as POPs.

Polystyrene foam can be a source of hexabromocyclododecanes (HBCDs), which are flame retardants, and polystyrene microparticles in the marine environment as demonstrated by Jang *et al* (2016) who reported increased levels of polystyrene microbeads and HBCDs in mussels cultured on polystyrene buoys. However, in this case the chemical contaminant is actually part of the plastic formulation and not adsorbed onto the plastic microparticles from the aquatic environment.

Marine birds such as northern fulmars have been used as sentinels for monitoring exposure to ingested microplastic particles from the sea and it has been suggested that retention of microplastics in their gizzards could result in increased accumulation of POPs in their muscles and livers. Herzke *et al* (2016) found that there was no correlation between levels of PCBs, DDT or PBDEs in muscle or liver from northern fulmars and the quantities of microplastics present in their digestive system. This suggests that microplastic particles did not act as vectors for the transfer of these POPs and that natural prey was probably the dominant source of these contaminants in the birds.

The need for laboratory investigations to be environmentally realistic.

Sometimes experimental scenarios used to investigate the ecotoxicological effects of microplastics can be rather unrealistic. As previously mentioned, experimental exposure of fish to plastic microbeads coated with POPs in sediment-free water does not reflect the natural environment where fish would be exposed to dissolved and particulate organic matter as well as to microplastic particles. Laboratory studies on the effects of microplastics in aquatic organisms should also be quantitatively realistic. Lenz *et al* (2016) have highlighted the fact that many investigations into the ecotoxicological effects of microplastics have used experimental exposure concentrations that are up to seven orders of magnitude higher than reported environmental levels. Consequently, Lenz *et al* (2016) have called for future studies on the impact of microplastics on marine ecosystems to at least include concentrations of microplastics that are environmentally relevant.

Phoung *et al* (2016) have also highlighted that most laboratory experiments on microplastics have been carried out at concentrations, or with quantities, that greatly exceed those found in marine organisms and natural ecosystems. Furthermore, most experiments are carried out with only one type of microbead and/or hydrophobic chemical whereas in the field, there would be complex mixtures of microplastics, other microscopic particles, of various shapes and sizes, as well as a complex cocktail of chemicals. Microplastics in the environment are also likely to coated with natural hydrophobic chemicals or to be colonised by various micro-organisms which could alter the adsorption properties for toxic anthropogenic chemicals in the environment in a manner that would be difficult to replicate in the laboratory.

Atmospheric deposition of microplastics

In addition to contamination of water and the marine environment by microplastics from sources such as waste water, run-off from land into rivers, or degradation of macroscopic plastic in the marine environment, there is also increasing evidence for atmospheric contamination and deposition. For example, Dris *et al* (2016) has reported atmospheric deposition of up to about 100 particles/m^2/day for synthetic fibres in Paris. Cai *et al* (2017) reported atmospheric deposition of 175 to 313 microplastic particles/m^2/day, in Dongguan City, most of which were polyethylene, polypropylene or polystyrene, and which had diverse forms including fibres, foam, fragments and film. Obviously, such atmospheric deposition could provide an additional pathway for marine contamination and contamination of seafood, but could also have an impact on terrestrial food sources or even food during preparation for consumption.

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