# A critical review of microbiological colonisation of nano- and microplastics (NMPs) and their significance to the food chain

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## Background

Microplastics are extremely small mixed shaped plastic debris in the environment. These plastics are manufactured (primary microplastics) or formed from the breakdown of larger plastics once they enter the terrestrial, freshwater and marine environments (secondary microplastics). Over time, a combination of physical, photochemical and biological processes can reduce the structural integrity of plastic debris to produce microplastics and even further to produce nanoplastics.

NMPs have been detected in both the aquatic and terrestrial environments and can be easily spread by water, soil and air and can be ingested by a wide range of organisms. For example, NMPs have been found in the guts of fish and bivalve shellfish. Microplastics have also been detected in food and in human faeces. Therefore, NMPs are not only found in the environment, but they may contaminate the food supply chain and be ingested by consumers. There is evidence suggesting that microorganisms are able to colonise the surfaces of microplastics and aggregates of nanoplastics. However, the risk to consumers posed by NMPs colonised with microorganisms (including those that are AMR) which enter the food supply chain is currently unknown.

## Objective and Approach

To address this evidence gap, the FSA has commissioned Cefas, with support from University of Exeter and Fera, to carry out a critical review of the scientific literature (both peer-review and grey literature sources) concerning the diversity of microorganism that colonise microplastics and aggregates of nanoplastics, outline the key pathways that these microbiologically contaminated plastics are able to enter the food chain from environmental sources (e.g. from water, soil and air) and the associated risks these may pose to human health. We will also focus on areas of particular concerns such as the role of NMPs in the spread of AMR in the food chain.

To achieve this, the project will be split into a series of work packages (WP), each of which will create part of the literature review and will be led by one of the partner organisations:

- WP1 will focus on providing an overview of NMPs in the environment

- WP2 will focus on the interaction of NMP and microorganisms
- WP3 will focus on the pathways which microbiologically colonised NMPs enter the food chain
- WP4 is on NMP specific microbial risk to consumers
- WP5 will bring together the information gathered throughout WP1 and 4, to deliver a full, critical review of the subject.

It is hoped that this review will allow the FSA to form a position on this issue and, if necessary, highlight further research required to address significant evidence gaps.

## Results and conclusions

This review considers both peer-review published and grey literature from between 1st January 1980 and 3rd February 2020. Around 305 relevant papers were identified and included in this review. The review found that:

- The scale of NMP in the environment has been shown to be a large and growing problem with the majority of studies focussing on marine and aquatic systems.
- Association between NMP and pathogenic organisms (such as Vibrio spp., Pseudoalteromonas spp. and Aeromonas salmonicida) has been demonstrated in research but the amount of data is low and there is a lack of data comparing association with similarly sized, non-plastic particles (such as sediments).
- There is a general lack of papers on potential pathways by which NMP can enter the food chain. From limited data available, it can be inferred that pathogens in association with NMP could potentially reach the human food chain. However, the consequence of this and comparison to non-plastic vectors have been insufficiently studied to create a clear picture of the risk posed to public health.
- Research quantifying the dietary NMP intake is not available for most food and drink categories. From the identified studies involving foods, most have been carried out on fish and shellfish, with a very few considering food at retail sale or point of consumption.
- Currently, it is difficult to assess the impact of microbiological contaminated NMPs in the food chain due to significant data gaps and lack of research in this area.

Research report
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