Ultra-low dietary exposure to 14C-labelled polystyrene: evidencing translocation of nanoplastics in fish

Nathaniel Clark*†[1], Astrid Fisher[2], Lee Durndell[3], and Richard Thompson[1]

[1]University of Plymouth – School of Biological and Marine Sciences, University of Plymouth, Drake Circus, Plymouth, United Kingdom

[2]University of Plymouth – School of Biological and Marine Sciences, University of Plymouth, Drake Circus, Plymouth, United Kingdom

[3]University of Plymouth – School of Geography, Earth and Environmental Sciences, University of Plymouth, Drake Circus, Plymouth, United Kingdom

Abstract

Assessing the dietary accumulation of nanoplastics in fish following ultra-low exposure concentrations is often restricted due to analytical limitations. Here, we have developed a method for synthesising C14-labelled polystyrene nanoplastics (14C-PS NPs), with a subsequent exposure in rainbow trout to determine dietary bioavailability at ultra-low concentrations (n = 5), equating 5.9 μg polystyrene kg-1 feed. Fish were fed this diet at a ration of 2% body weight per day for a period of two weeks. On day 3, 7 and 14, the fish were sampled for the mid intestine, hind intestine, kidney and liver, and measured for tissue radioactivity (determine by liquid scintillation counting). Some background activity was found in the control samples (1-31 Bq g-1, depending on the tissue with the kidney having the highest), as expected due to low level tissue autofluorescence. By the end of the experiment, the hind intestine and liver following 14C-PS NP exposure contained had significantly elevated radioactivity in the tissues (25.3 and 15.0 Bg g-1, respectively) compared to the controls (and in the liver, this equated to 1.8 μg polystyrene g-1 dry weight. In conclusion, even low μg kg-1 exposures can cause nanoplastics to accumulate into the body of a fish.

Keywords: Rainbow trout, uptake, accumulation, bioavailability, radiolabelling

*Speaker

†Corresponding author: nathaniel.clark@plymouth.ac.uk