QUANTIFICATION OF TITANIUM AND SILVER BY ICP-MS IN FARMED TURBOT AFTER CONTROLLED EXPOSURE TO NANOPARTICLES

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INTRODUCTION

Turbot (Scophthalmus maximus) is a flat fish highly appreciated due to its flavour and white, low-fat meat. It is commercially valuable, with the main aquaculture production of the European Union taking place in Galicia (northwest Spain), Portugal, Denmark, Germany, Iceland, Ireland, Italy, Norway and Wales. In this study, farmed turbot specimens were exposed to silver or titanium in the form of nanoparticles (NPs) to evaluate the possible impact of these emerging environmental pollutants in aquaculture fish products.

METHODOLOGY

Juvenile turbots were exposed to feed spiked with equivalent doses of 0, 0.25, 0.75 and 1.5 mg/Kg per fish per day of silver nanoparticles (PVP Ag NPs of 15 nm) or titanium dioxide NPs of 25 nm. These experiments were performed in triplicate (a total of 12 tanks for growing the fish). Samples were taken at the beginning of the experiment and then every 15 days for three months. The total concentrations of the elements found in muscle, kidney and liver tissue were investigated by inductively coupled plasma mass spectrometry (ICP-MS) after a microwave digestion. Some of the tissue samples were submitted to an enzymatic extraction to separate nanoparticles for quantification and characterisation in size by single-particle ICP-MS.

RESULTS

Titanium concentrations found in muscle samples were low and close to the detection limit of the technique (range of concentrations in the tanks: <0.002-0.098 µg/g). Ti concentrations in the liver were higher, ranging from <0.002-0.65 µg/g, while the element was not detected in most of the kidney samples (concentrations <0.075 µg/g). However, the concentration of titanium increased in faeces with the equivalent dose, with concentrations ranging from 1.6 (at equivalent dose 0) to approximately 40 µg/g (at equivalent doses 0.75 and 1.5 mg/Kg per fish per day). Silver concentrations found in muscle samples were very low, and in many cases close to or lower than the limit of detection of the procedure (1.36

ng/g). The measured concentrations in the tanks ranged from <1.36 ng/g to 27 ng/g in muscle, from 0.019 to 9.45 µg/g in liver, and from 0.0056 to 0.38 µg/g in kidney. Due to the low concentrations of accumulated elements, nanoparticles could not be analysed in the samples studied by single-particle ICP-MS.

DISCUSSION

Titanium was scarcely accumulated in the edible part of the animal (muscle). No relationship was observed between the equivalent dose added (or sampling time) and the concentration of Ti present in muscle, kidney or liver samples. Titanium was found mainly in the liver, but it seems that most of the element was excreted in faeces. The concentration of Ti in faeces increased with the equivalent dose and stabilised at approximately 40 µg/g at the equivalent dose of 0.75 mg/Kg per fish per day. We also did not observe a growing concentration of silver in muscle tissue. This metal accumulated in the liver and kidneys, showing an increase with sampling time and equivalent dose.