Method development to extract microplastic particles from fishmeal

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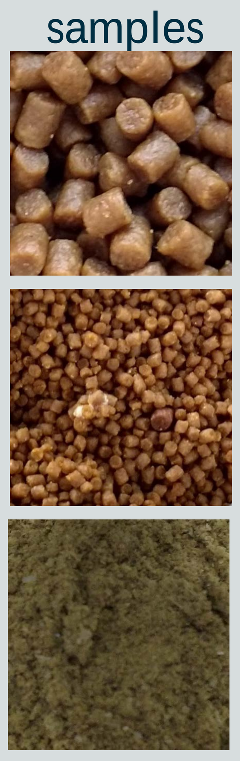
Background

- There is increasing concern of microplastic pollution entering human food chain, e.g. commercially available bivalves contain 2.2 particles (mean items per g of tissue)(1-4). Harmful chemicals adsorbed onto microplastics may become bioavailable in the digestive system. Pollutants in fishmeal may enter the human food chain indirectly through feed for poultry, pigs and aquaculture(5,6).
- Assessments of gastrointestinal (GI) tracts show that marine fish contain 1.0 to 4.9 items (mean items per individual)(7-11), other body parts have not been assessed. Fish and their by-products, including GI tracts, are used for fishmeal production(5,6).
- Microplastic extractions from fish GI tracts are often conducted with potassium hydroxide (KOH)(12-14). KOH has also been shown to be suitable for digestions of muscle and skin tissue of fish(15).
- Initial trials found that fishmeal digests with 10 % KOH could not be filtered, possible due to very fine bone fragments warranting a new protocol for extracting particles from fishmeal. The suitability of density separation using brine solutions is assessed.

Methods and results

Workflow and results of method development to extract microplastics from fishmeal samples:

Fishmeal samples



Treatment 1

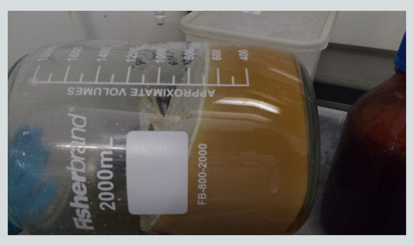
10 % KOH (3 x volume of sample) overnight at 60° C

→ Filtration **NOT** possible (pore size 0.45 to 20 µm)

→ Digestion at room temperature for 2 weeks → Filtration **NOT** possible (pore size 0.45 to 20 µm)

Treatment 2

10 % KOH (3 x volume of sample) overnight at 60° C → Density separation with Sodium chloride (NaCl) → Filtration **NOT** possible (pore size 20 µm) [sample turned into jelly]

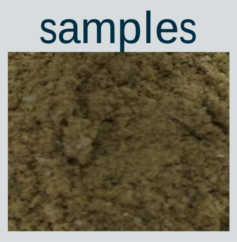


Treatment 3

Density separation with NaCl → Filtration of supernatant (pore size 20 µm) [pellets did not dissolve completely]

Workflow and results of recovery rate of microplastic particles from spiked fishmeal samples:

Fishmeal samples



→ Addition of microfragments (respective relative densities in brackets)

- Transparent PP - Polypropylene (c. 0.85 g cm^{-3})
- White PS – Polystyrene (c. 1.06 g cm^{-3})
- Green PET - Polyethylene terephthalate (c. 1.37 g cm^{-3})

→ **Treatment 3**

- Add 50 ml NaCl solution, soak overnight
- Add further 150 ml and decant top 50 ml & repeat this step once
- Filter supernatant

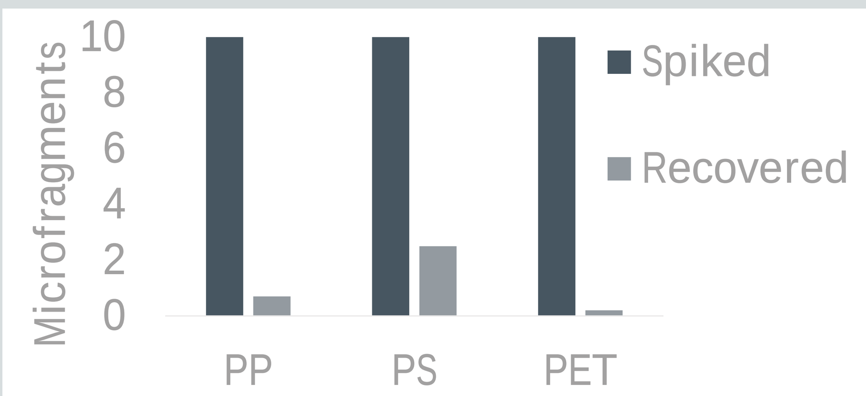


Fig. 1 – Mean recovery per polymer and sample

Table – Recovery of particles according to density (sample mean)

	Spiked	% recovered
Fragments (relative density <1.2)	20	17.8
Fragments (relative density >1.2)	10	2.2

Fig. 2 – PS fragments (red circles) remaining on sample surface

Comments

Use this space and post-it notes provided for your comments on the method section. Please leave your name and contact email with your feedback.

Discussion and conclusion

Density separation with a brine solution appears to be a suitable method for extracting microplastics from fishmeal. Brine solutions are commonly used to extract microplastics from sediments(1,16-20). Using a brine solution of NaCl of approximate density 1.21 g cm^{-3}, it was not expected to recover particles of a relative density above this value (table). Using Zinc chloride (density >1.7 g cm^{-3}) instead of NaCl should result in improved recovery of microplastics of relative densities above 1.21 g cm^{-3} (20) .

Interestingly, 27.8 % of polystyrene fragments were recovered, but only 7.8 % of polypropylene fragments (Fig. 1). An underestimation of polypropylene fragments may have occurred due to the similarity of clear polypropylene and bone fragments when using a low magnification microscope. However, general low recovery rates of polypropylene and polystyrene were likely due to the lack of transfer of microfragments when decanting the supernatant. A large number of white polystyrene fragments were still visible on the solution surface of the sample after the removal of the supernatant (Fig. 2). Removing the top layer in a more controlled manner using a separating funnel, pipette or an overflow method is suggested.

References

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