

ASSESSMENT OF MICROPLASTIC CONCENTRATIONS IN HUMAN STOOL FINAL RESULTS OF A PROSPECTIVE STUDY

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Do microplastics reach the human gut?

The microplastics literature provides evidence that tiny plastic particles are accumulating in the marine food chain. Scientists have also detected microplastics in food intended for human consumption such as salt or bottled drinks. It has been long suspected that humans are orally exposed to microplastics via their diet. This pilot study was conducted with eight participants from across the globe. Each person kept a food diary in the week leading up to their stool sampling. This first study of its kind did confirm that plastics are unintentionally ingested and ultimately reach the human gut.

Participants



- 8 healthy male and female participants from AT, FI, UK, IT, JP, NL, PL and RU
- Exclusion criteria: diagnosed gastrointestinal disease, recent dental treatment, medical diets, alcohol abuse and intake of drugs affecting stool frequency, consistency or resorption.

Data collection and sampling

- Food log to track 6-7 days prior to sampling
- Questionnaires on plastic exposure, alcohol consumption, chewing gum consumption, cosmetics, drinking habits from PET bottles
- Sampling of ~50 g stool



Final Results

DESCRIPTIVE STATISTICS

- 3 male and 5 female participants, aged 33-65 yrs
- 0/8 vegetarians
- 2/8 daily chewing gum users
- 6/8 ingested sea food during observation period
- 8/8 contact with plastic-wrapped food
- ~ 750 ml/day beverage consumption from PET

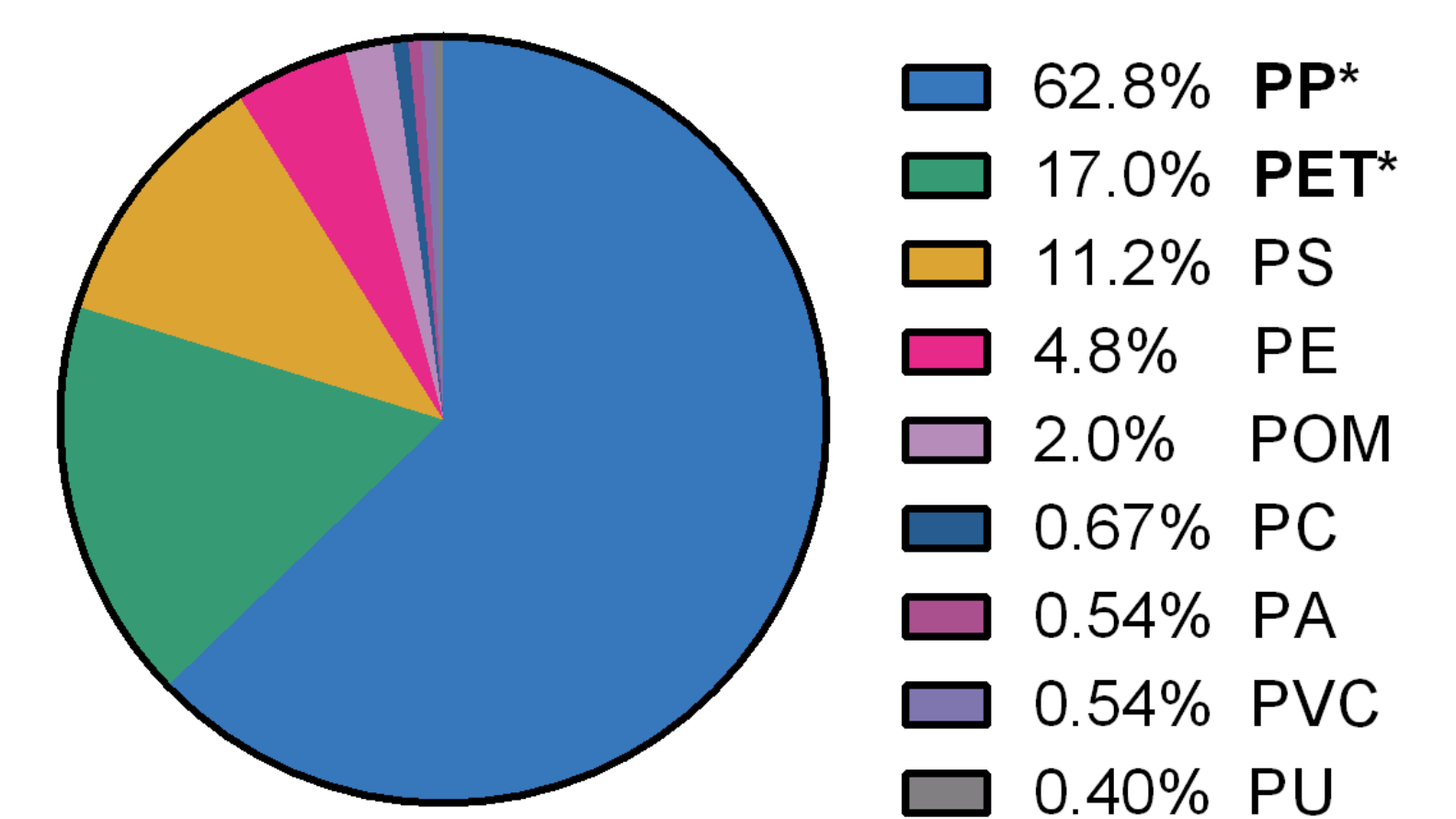
STOOL ANALYSIS

20 microplastic particles/10 g stool (median)
(Q1-Q3: 18-172)
of size 50-500 µm

- 8/8 samples tested positive for microplastics
- 9/10 plastic types detected overall
- 3-7 different plastic types per sample
- 7 g stool analysed (median) (Q1-Q3: 3-11)

Assessment of contamination caused by lab: No microplastic particles > 50 µm (10 plastic materials listed above) detected in blank sample.

RELATIVE FREQUENCIES OF MICROPLASTIC TYPES



- PP and PET were found in 100% of samples (*)
- PP, PET, PS and PE were found in >95% of samples

Pre-Treatment of Human Stool Samples

SAMPLE PRE-TREATMENT



Stool samples and blanks before (above) and after 2 weeks (below) of H₂O₂ (hydrogen peroxide) treatment.

- Aims at reducing the amount of natural stool constituents.
- After 2 weeks, still a fair amount of solids was left.
- Separation of solids into fractions 0.05-0.5 and > 0.5 mm



STOOL RESIDUES FOR ANALYSIS



Coarse fraction of pre-treated stool (> 0.5 mm) with seeds, fibres, fluff and thin-layered fragments remaining.

⇒ ATR-FTIR measurements, no > 0.5 mm plastics detected



Fine fraction of pre-treated stool (0.05-0.5 mm) with small particles, fibres and fluff remaining.

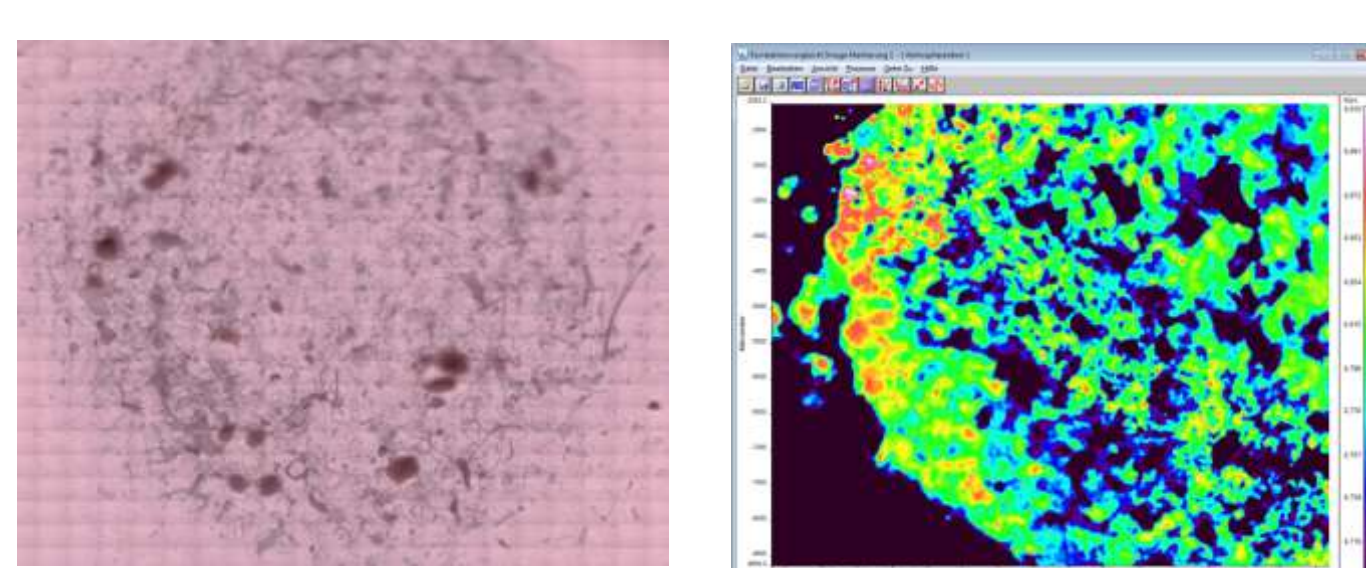
⇒ FTIR measurements in transmission with imaging

NEXT STEP: IDENTIFY MATERIAL OF SOLID REMAINS AND TEST FOR THE PRESENCE OF MICROPLASTICS:

Polyethylene (PE), Polypropylene (PP), Polyamide (PA), Polyvinylchloride (PVC), Polystyrene (PS), Polyethylenterephthalate (PET), Polyurethane (PU), Polymethylmethacrylate (PMMA), Polycarbonate (PC), Polyoxymethylene (POM).

Detection of Microplastics by FT-IR Spectroscopy and Imaging

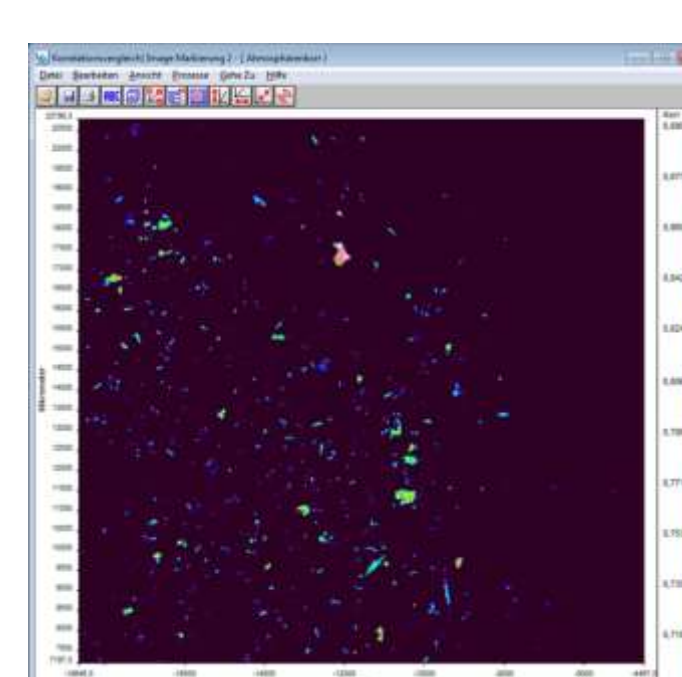
FT-IR IMAGING EXAMPLE



Stool residues of size 0.05-0.5 mm

- Left: Photograph of analytical sample
- Right: FT-IR transmission images
 - correlation R² with plastics is color-coded;
 - here: Polyethylene, R² = 0.7-0.9.
- Too many false positives for microplastics caused by interfering biological material that was still remaining after pre-treatment.

ADVANCED SAMPLE PREPARATION MADE QUANTIFICATION POSSIBLE!



1 particle identified as Polyethylene.

- Successful reduction of biological matrix so that the masking effect is diminished considerably.
- Automated FT-IR image analysis results in fewer false positives.
- Additional expert check of each particle's IR spectra is crucial for setting reasonable correlation thresholds.

Conclusion & Outlook

- Microplastics reach the human gut and are (partly?) excreted with the stool.
- The present pilot study included only a small sample size for first screening in humans.
- The analytical procedures are now available for human stool screening.
- Expand work to a study with a larger number of participants.
- Refine study design for investigating plastic exposure and medical implications.
- Plan for analytical validation experiments using microplastic reference material.