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AUTOMATED DETECTION AND IDENTIFICATION OF MICROPLASTICS IN BIOTA USING NILE RED AND MACHINE LEARNING

Validation of an innovative, cost-effective approach.

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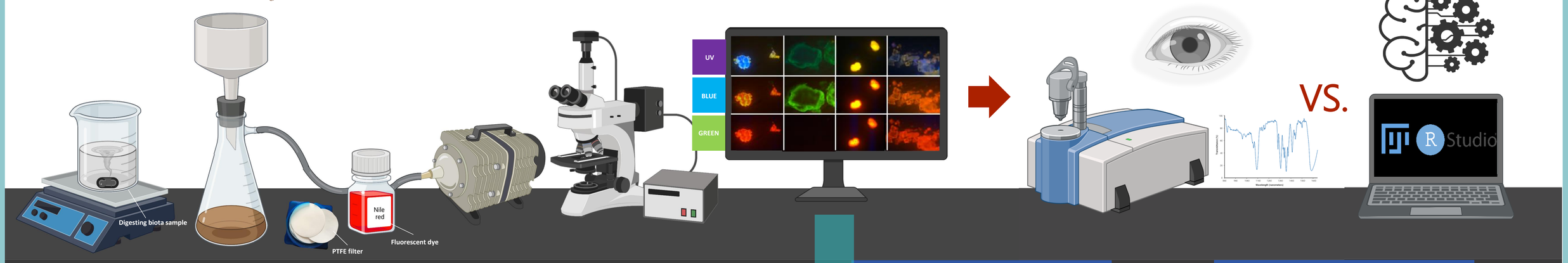
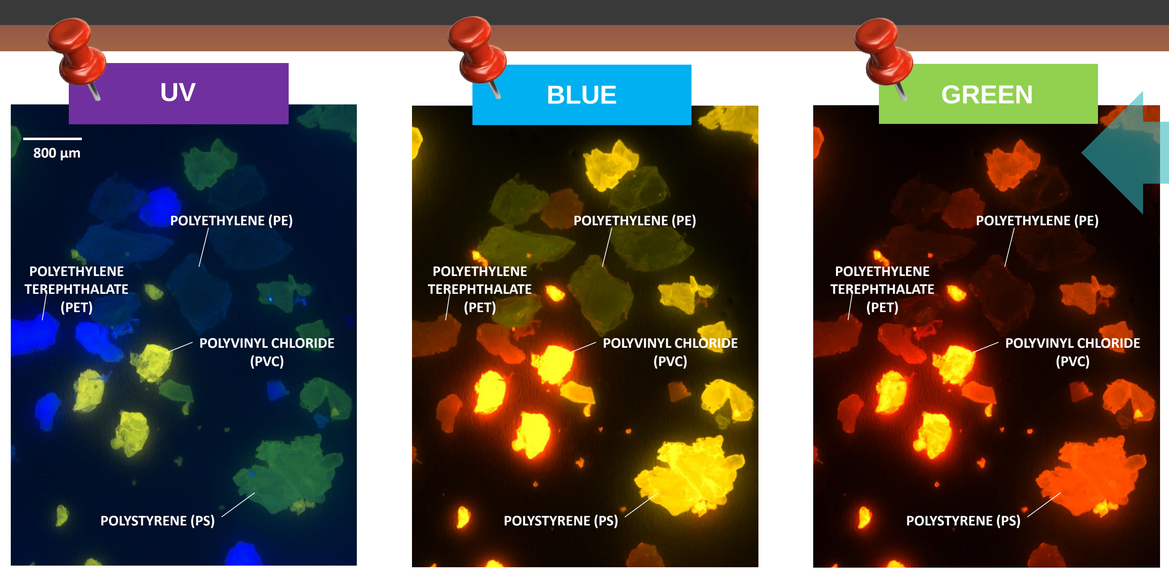
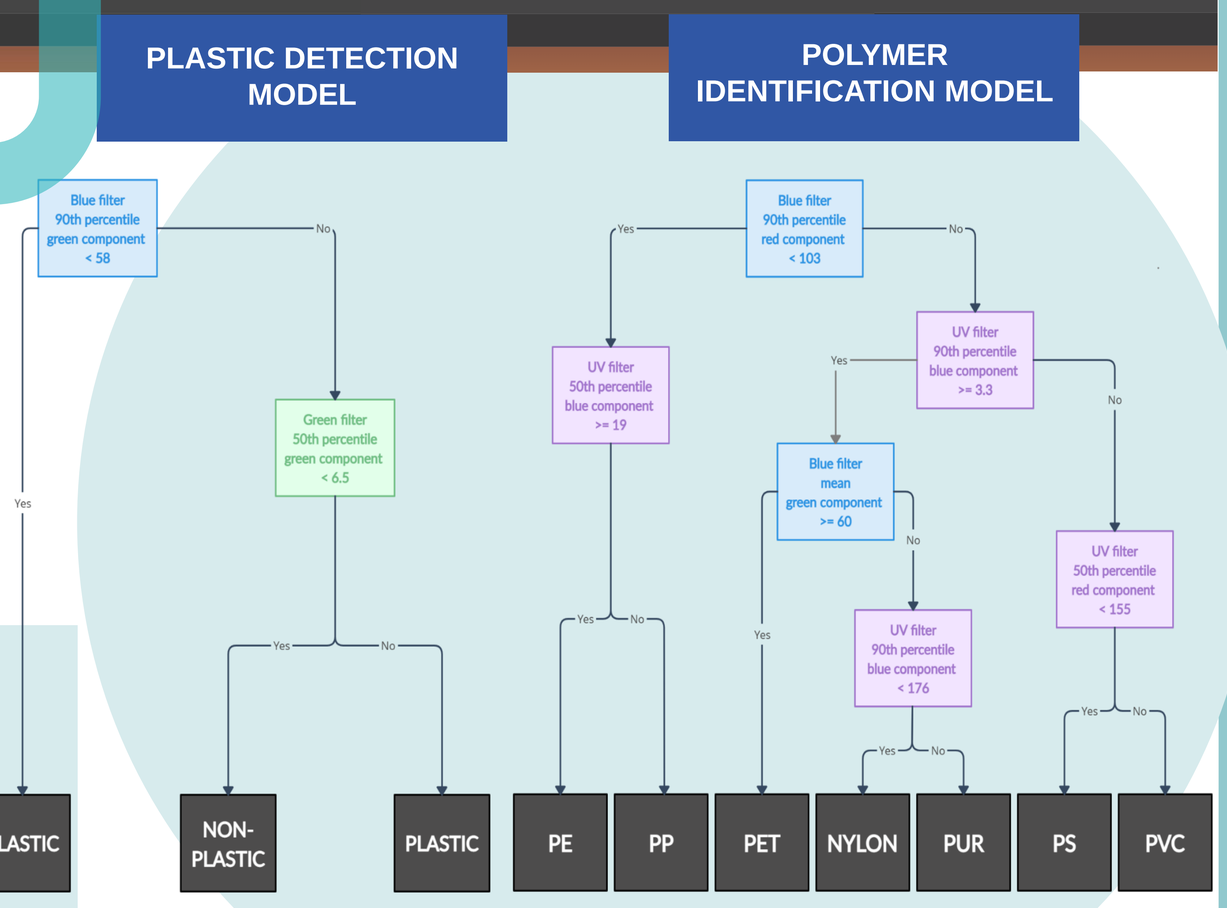
INTRODUCTION | MATERIAL & METHODS

We combined the advantages of both high-throughput screening and automation and developed an innovative approach for microplastics (MP) analysis in biota which is both cost- and time-effective. MP detection and identification of the polymer types is done using two machine learning decision models. We compared their performance for MP analysis with visual detection using fluorescence microscopy combined with µFTIR-based MP identification. Diluted along with non-diluted commercial and non-commercial mussels as well as gastrointestinal tracts (GITs) of various fish species were used as biota samples and were spiked with MPs varying in polymer type, size and shape. Samples were processed appropriately and photographed under a fluorescence stereomicroscope. Next, MP recovery per polymer type was determined using both techniques.







RESULTS

Mean recovery of all microplastics was above 80% for mussels and fish GIT samples for both techniques, which means that almost all visually recognisable plastics were also detected using the Plastic Detection Model (respectively 98.31% and 100%).

76.06% of the recovered MPs in all mussel samples and 83% in all fish GIT samples were correctly identified by the Polymer Identification Model. All polymer types of the analysed subsample (10%) were correctly identified using µ-FTIR spectroscopy.

The automated analysis was performed over <u>ten</u> times faster per sample. While both techniques performed well in terms of MP detection and identification, analysis of a filter with 20 particles using the ML models was much faster compared to the other technique.

The automated technique is also more cost-effective as no expensive equipment is needed, in contrast to the other technique.

The '<u>Plastic Detection Model</u>' predicts with high accuracy whether a particle is plastic or of natural origin, while the '<u>Polymer Identification Model</u>' allows to identify plastic polymer types. The model classifies unknown particles using simple decisions rules (yes/no answers). These rules are based on RGB colour data, extracted from Nile red-stained particles photographed under a fluorescence stereomicroscope.

CONCLUSION: Based on our findings, these models enable a cost-effective approach for routine analysis of MPs in mussels and fish GITs in a simple, yet reliable way.