Chemical digestion methods: What are the impacts on microplastics?

Alexandra M. Gulizia [a,b], **Eve Brodie** [a], **Marina MF. Santana** [a,b,c], **Sarah B. Bloom** [a], **Renee Daunmuller** [a], **Tayla Corbett** [a], **Cherie A. Motti** [a,b,c], **George Vamvounis*** [a,b,c]

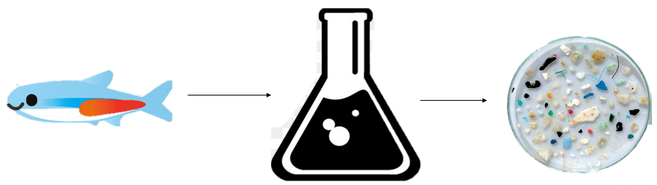
[a] College of Science and Engineering, James Cook University, Australia

[b] AIMS@JCU, Division of Research and Innovation, James Cook University, Australia

[c] Australian Institute of Marine Science (AIMS), Australia

1. Introduction

Chemical digestion methods allow plastics to be extracted and quantified from animal biota during field collection and exposure studies. However, to efficiently remove biomass, these methods often utilise harsh chemical conditions which can damage the plastic polymer.



pngwing.com; favpng.com; sci360.org

To ensure accurate quantification and classification of plastics in the environment, suitable chemical digestion methods need to be implemented.

2. Methods

Prepared polystyrene microplastics (300 µm – 1 mm) were exposed to the following digestion conditions in the table below

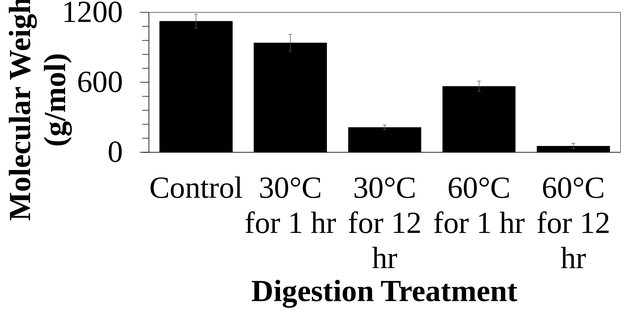
Reagent	Time (hours)	Temperature (°C)
KOH	12, 24, 48	30, 60, 90
NaOH		
H_2O_2		
HNO_3	1, 2, 12	30, 60

For more information contact: alexandra.gulizia@my.jcu.edu.au or george.vamvounis@jcu.edu.au

3. Results and Discussion

❑ Treatments with **HNO_3 resulted in a significant decrease in polymer chain length (e.g. molecular weight)**, **changes to signature peak environments** in the FT-IR spectra and **severe mechanical damages** indicating polymer degradation.

(a)



(b)

Digestive reagent at 60°C	Infrared spectral similarity (%) to control plastics
KOH	94
NaOH	86
H_2O_2	86
HNO_3	75

(c)

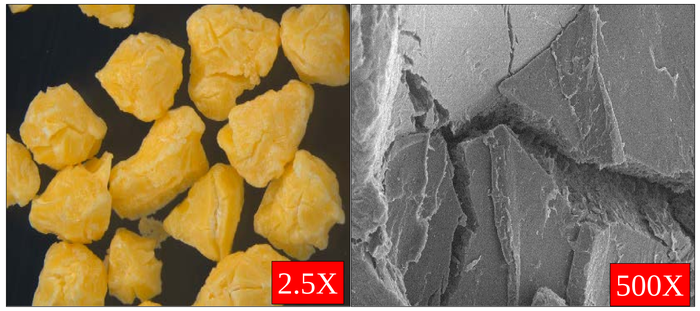


Figure 1. Chemical and physical analyses revealed (a) polymer degradation, (b) infrared spectral dissimilarity and (c) fragment discolouration and deep surface cracking associated with high temperature HNO_3 treatments

❑ There was significant **swelling and pitting after all 90°C KOH, NaOH and H_2O_2 digestions**. This indicated that microplastics may be more sensitive to digestion conditions given their manufacturing origins and/or environmental histories.

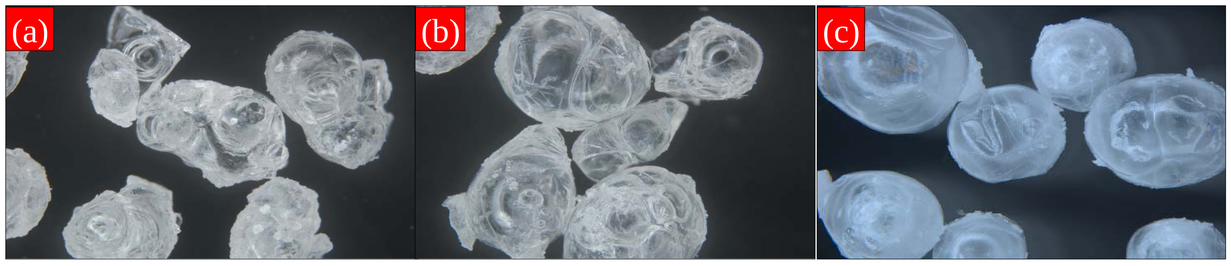


Figure 2. Microplastics swollen and pitted after 48-hour, 90°C digestions with (a) KOH, (b) NaOH and (c) H_2O_2 at 2.5X magnification

4. Conclusions

❑ Surface morphology may impact fragment reactivity during digestion.

❑ High temperatures digestions are associated with enhanced reagent reactivity, polymer and fragment degradation.

❑ HNO_3 digestions above 60°C may not be suitable for microplastic extractions

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