The biological production of eco-friendly plastics from waste plastics for novel applications.

UNIVERSITY OF WOLVERHAMPTON

Brian Johnston*, David Hill, Marek Kowalczuk, Iza K. Radecka.
University of Wolverhampton, School of Sciences,
Faculty of Science and Engineering,
Wolverhampton, WV1 1SB, UK
B.Johnston@wlv.ac.uk*

Introduction

The world's oceans are being polluted by toxic, petrol-based plastics. **Polyhydroxyalkanoates (PHAs)** could be an alternative, non-toxic, **biodegradable, eco-friendly plastic** [1-2].

Figure 1: PHA structure (left) PHA granules within microbes (right) [3].

PHAs are **recyclable** bioplastics that can be produced by certain microbes like ***Cupriavidus necator*** [1]. This bacteria was selected for this study because:

- it is very **robust**,
- produces **high yields** of PHAs
- it **grows well at low temperatures** [1-4].

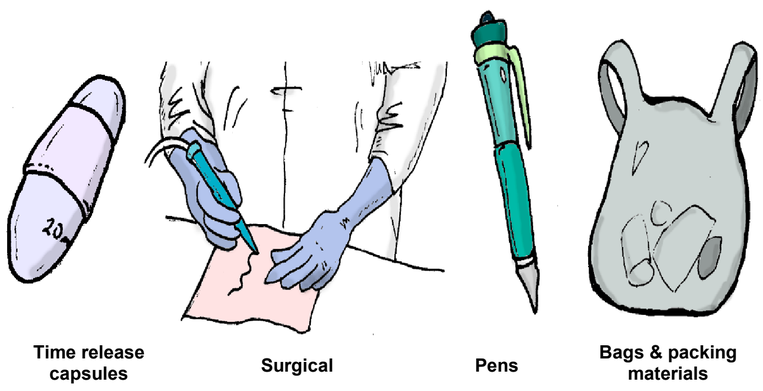


Figure 2: Applications of PHAs [1-4].

Factors currently **limiting the** use of PHAs are:

- **high cost** of the nutrient sources for biosynthesis
- expensive processing requirements to extract [1,4].

Project aims

- To use **waste polyethylene (PE) plastics** (in wax form) as a carbon source for bacteria to make bioplastics.
- To prove those bioplastics (PHAs) produced can be used for novel purposes.

Materials

- *Cupriavidus necator* formally *Ralsonia eutropha* H16 (NCIMB 10442, ATCC 17699).
- The Oxidised PE produced by The Department of Chemical Organic Technology and Petrochemistry, Silesian University, Poland.
- The Non-oxidised PE was supplied by Recycling Technologies Ltd, Swindon, UK.
- PHA-blend scaffolds produced at the Centre of Polymer and Carbon Materials, P.A.N., Zabrze, Poland.
- Chemicals used for this study were provided by Lab M Ltd, UK.

Method

Upstream: To prevent any impurities that could have a negative affect on the bacterial growth media, **no initiators or catalysts were used** in the production of the waxes, making the process more **eco-friendly.**

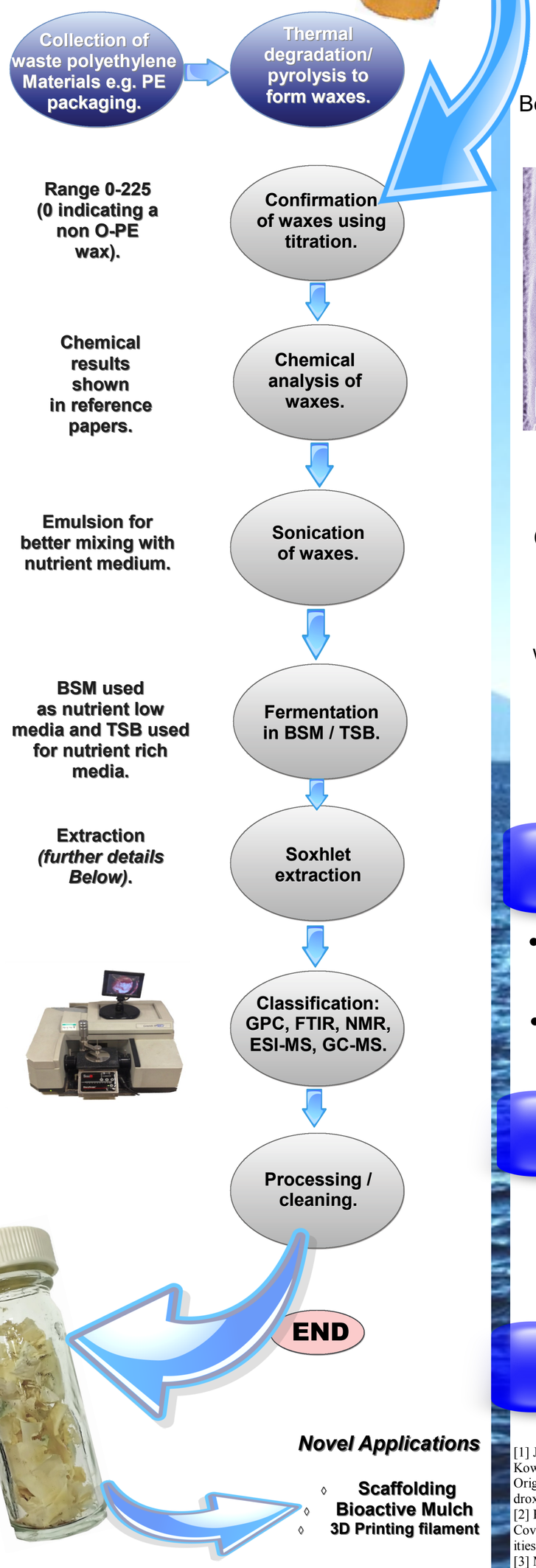


Figure 3: Summary of PHA production and analysis. (grey circles are processes investigated)

Downstream: PHA **extraction** was done after 48 hours of microbial growth. The biomass obtained was frozen and dried in a vacuum. PHAs were then separated from dry biomass.

Results

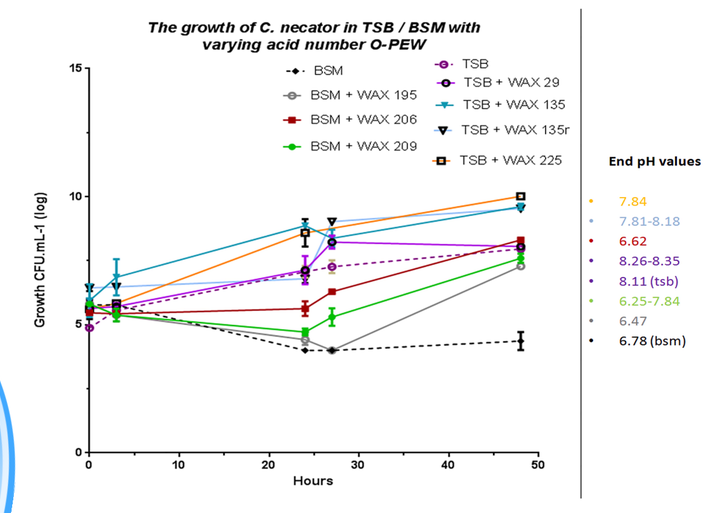
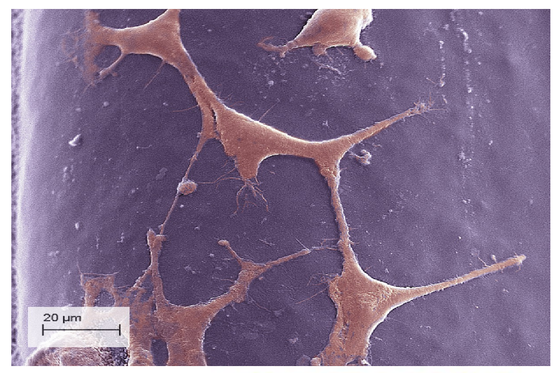


Figure 4: Microbial growth over 48 hours.

Better growth is observed with more oxidised PE waxes, **showing it is a viable carbon source additive** [1].



(a) Human cell growth shown on polymers [6]

(b) Bioactive compound released from mulch suppressed weed growth [7]

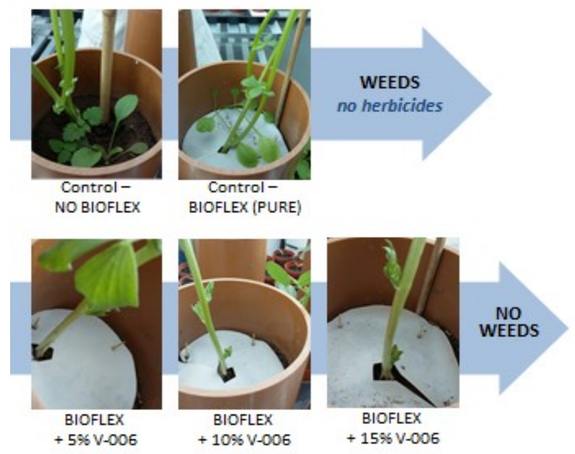


Figure 5: Applications of PHA-blends.

Conclusions

- PHAs were produced from PE wax, structures were confirmed using advanced chemical analysis [1,5,6].
- PHA-blends can be used for human cell scaffolding & bioactive mulch [6-7].

Future aims

- Investigation into **extraction techniques.**
- Improved wax **emulsifying methods**.
- **Wider range** of waste plastic for PHA process.

References

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