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Investigating the biodegradation potential of plastic by the microbiota in the digestive tracts of *Galleria mellonella* and *Tenebrio molitor*

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Introduction

Plastic waste has become a growing concern due to its impact on the environment and human health. While a fraction of collected plastic waste is recycled through physical-chemical treatments, a significant part ends up in landfills, is incinerated or dumped without control. Recent studies have shown that the larvae of *Tenebrio molitor* and *Galleria mellonella* insects can ingest plastic particles, and their gut microbiota plays a key role in their metabolism.
In this study, we characterized the plastic-degrading microbial population in the digestive tract of *T. molitor* and *G. mellonella* fed with plastic.

Experimental

The insects were fed with different types of microplastics (2mm) for 28 days, including both virgin (V) and recycled (R): polyethylene terephthalate (PET), linear low-density polyethylene (LLDPE), low-density polyethylene (LDPE), and polystyrene (PS). These plastics were introduced into the insect diet at different concentrations (50%, 90%, and 100%) and non-amended plastic diet was used as a control. The digestive system of the larvae was extracted under sterile conditions, and its content was inoculated on culture media for plate counts of total bacteria (Nutritive Agar) or fungi (Rose Bengal), as well as specific media such as media for polycaprolactone-degrading and ligninolytic degraders (medium with Remazol Brilliant Blue R dye). These latter activities are known to be linked to plastic biodegradation. After comparison, microorganisms appearing only in plastic-fed insect samples and absent in standard diet samples were isolated (Figure 1).

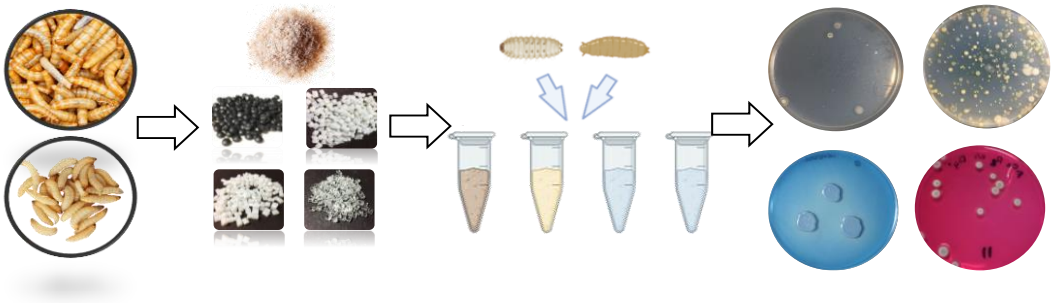

Figure 1. Experimental design workflow

Results and Discussion

The results revealed that microorganisms with ligninolytic and polycaprolactone-degrading capabilities reached higher levels in samples obtained from insects fed with plastic than in those from control specimens not fed with plastic. In the case of *G. mellonella*, 11 bacteria and 5 yeasts were isolated, while in the case of *T. molitor*, 7 bacteria and 1 fungus were isolated. These unique microorganisms represent themselves as potential candidates for use in biological techniques for the degradation of multiplastics.

Conclusions

In this study, the plastic-degrading microbial population in the digestive system of *T. molitor* and *G mellonella* was characterized. Plastic feeding causes pressure on the microbiota of the digestive system of these insects, promoting the proliferation of microorganisms capable of degrading plastic. The isolated microorganisms are candidates for the application of biological techniques aimed at multiplastic degradation.

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Biography

After obtaining his Bachelor's degree in Environmental Sciences and a Master's degree in Agroalimentary and Industrial Biotechnology, Jesús Salinas is currently pursuing a Ph.D. in Biotechnology at the University of Almeria (UAL). Over the past three years, he has been working as a researcher in the Microbiology Area at UAL, gaining specific expertise about bioremediation and plastic biodegradation by microbial consortia.