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# BIODEGRADATION OF POLYLACTIC ACID-BASED POLYMERS

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## INTRODUCTION

According to the regulation adopted by the European Parliament in 2019 (Directive 2019/904), the use of petroleum-based plastics in the European Union must be phased out starting from 2021 and to be replaced by the use of alternative biodegradable plastics in order to reduce pollution. Such an alternative and eco-friendly solution can be to switch to the use of bioplastic made of biological resources (renewable energy sources) and biodegradable materials, like the PLA (polylactic acid), which is a heat tolerant biopolymer, from lactic acid made with poliestherfication in industrial conditions. According to certain studies the degradation of natural polymers are coherent with proteolytic and lipolytic enzyme activity properties of certain microorganisms.

The aim of the research was to map the applied microorganism's PLA depolymerase enzyme profile and the biodegradation efficiency.

## RESULTS

### STRAIN SELECTION

The strain selection (45°C, 3 days) was performed from 9 thermophilic microorganisms (*Bacillus, Sphingobacterium, Thermobifida, Sphingobium, Thermus* from NCAIM Budapest) by using screening method. The lactic acid utilization was carried out on 0,1% lactic acid agar plate (Fig. 1a and 2a). For the proteolityc enzyme activity testing (Fig 1b and 2b) the used media was a casein agar plate (Radha *et al.,* 2012) and for the lipolityc enzyme activity (Fig.1c and 2c) it was the Tween 80 agar plate (Rhiani *et al.,* 2018). The most promising results were selected to create microbial consortium and were used for biodegradation modelling.

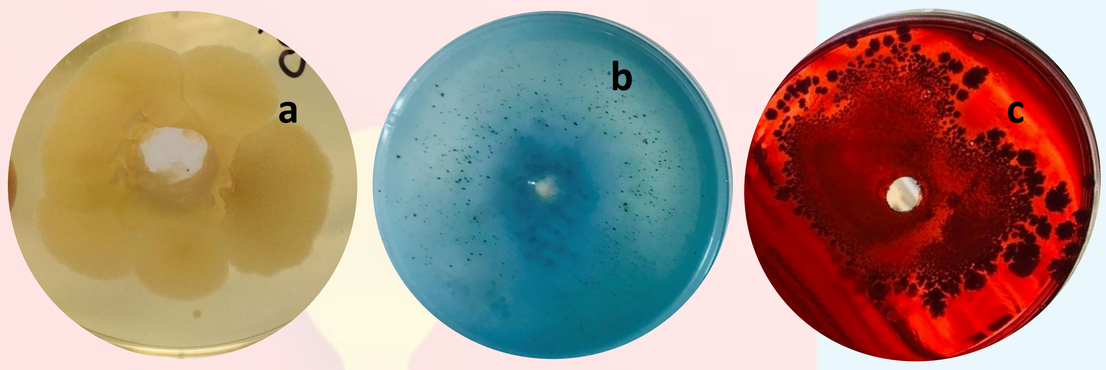


**Fig.1** *Thermobifida cellulosilytica* B1997 strain selection

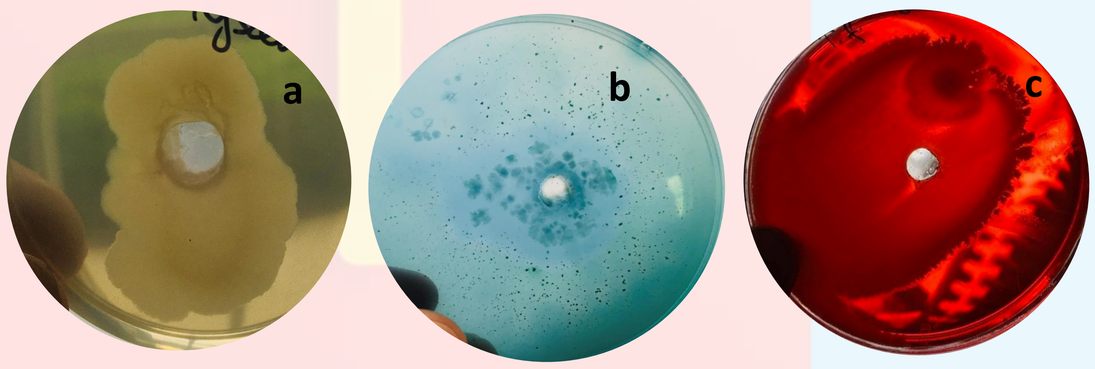


**Fig.2** *Thermobifida fusca* B2355 strain selection

### PLA BIODEGRADATION MODELLING

The shredded (0,2 x 0,2 cm, Fig. 4B) and cleaned PLA based cutlery (knives, Fig. 4A) was examined (150 RPM, 45°C, 21 days) in a submerged (TPY) environment (Fig. 4C) for biodegradation and the inoculation rate of the pre-cultured bacteria strains were 5 (w/w) %.

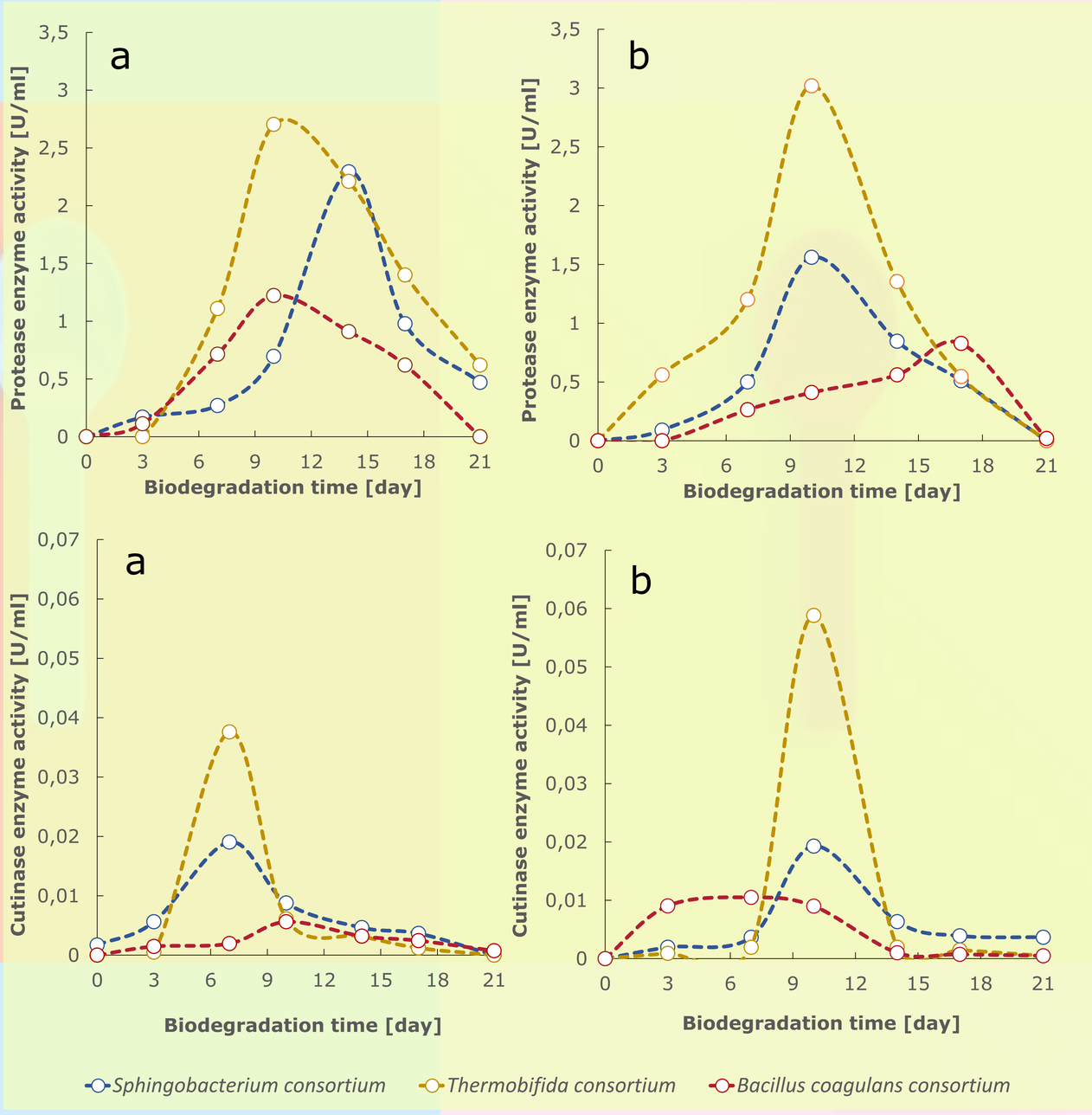


**Fig.3** Effects of PLA depolymerase enzyme activity on 0,5% glucose supplemented TPY (a) and 0,5% gelatin supplemented TPY (b)

During the experiment on 0,5% gelatin supplemented TPY medium the *Thermobifida* consortium synthetized **protease** and **cutinase** enzyme activity amount was higher than on the 0,5% glucose supplemented medium. At the end of the experiment this enzyme amount means 4 % PLA mass degradation (Fig. 4D). This result presents a good opportunity to apply further microorganism consortium and inductors for the effective biodegradation.

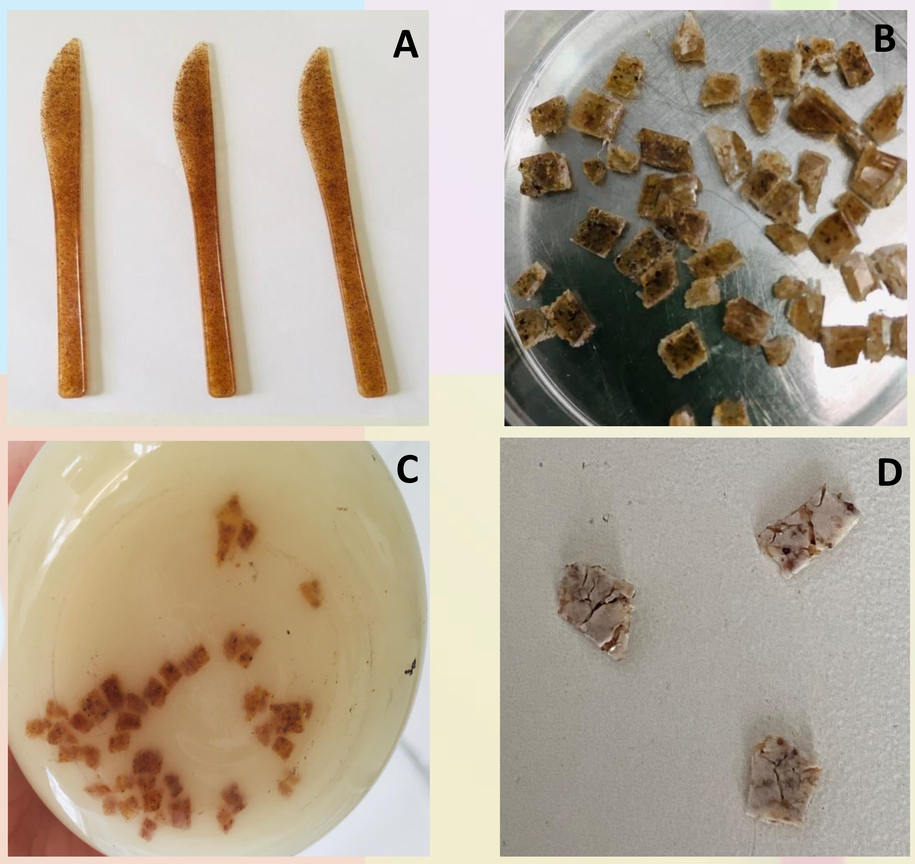


**Fig.4** PLA life cycle during the biodegradation modelling

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