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From agro-industrial waste to polyhydroxyalkanoates (PHA): submerged fermentation using mixed and pure bacterial cultures

Dora Bramberger[1],Viktoria Bačić[1], Karlo Grgurević[1], Laura Jaklenec[1], Vesna Ocelić Bulatović[1], Marinko Markić[1], Anja Rakas[1], Lidija Furač[1], Matija Cvetnić[1], Tomislav Bolanča[1], Šime Ukić[1†], Stela Jokić[2], Krunoslav Aladić[2], Ivica Strelec[2], Jasmina Ranilović[3], Dajana Kučić Grgić[1]

[1]*University of Zagreb, Faculty of Chemical Engineering and Technology, Trg Marka Marulića 19, 10 000 Zagreb, Croatia*

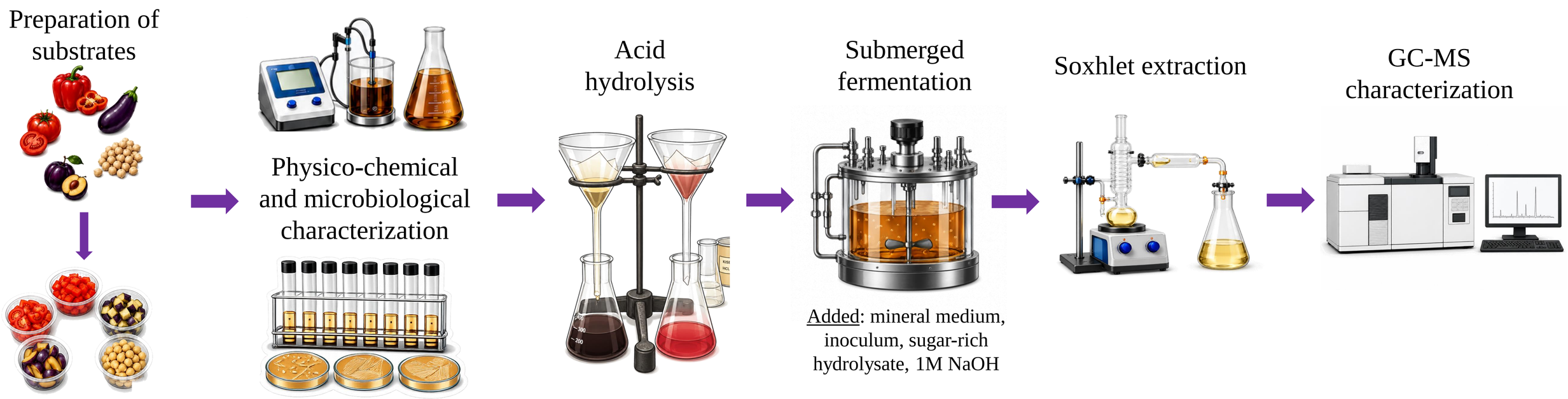
[2]*University of Osijek, Faculty of Food and Technology Osijek, Ulica Franje Kuhača 18, 31 000 Osijek, Croatia*

[3]*Podravka d.d., Ulica Ante Starčevića 32, 48 000 Koprivnica, Croatia*

INTRODUCTION

Polyhydroxyalkanoates (PHA) are biodegradable polymers synthesized by microorganisms as intracellular carbon and energy storage compounds. Due to their biodegradability and similar properties to conventional plastics, PHA represent a promising sustainable alternative for various applications. This study explored the production of poly(3-hydroxybutyrate)/poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHB/PHBV) from agro-industrial waste (chickpeas, plums, eggplants, peppers, and tomatoes) using acid hydrolysis and submerged fermentation. The fermentation process was performed in a bioreactor with pure culture *Pseudomonas putida* and mixed bacterial cultures *Cupriavidus necator* and *Pseudomonas putida*. During fermentation, optical density, pH value, dissolved oxygen concentration, and reducing sugar concentration were monitored.

METHODOLOGY



RESULTS

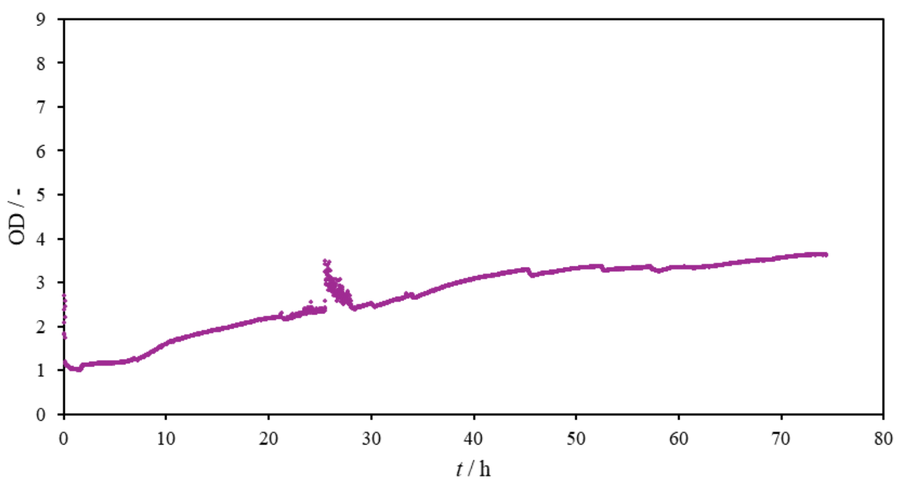


Fig 1. Change in optical density during fermentation with *Pseudomonas putida*.

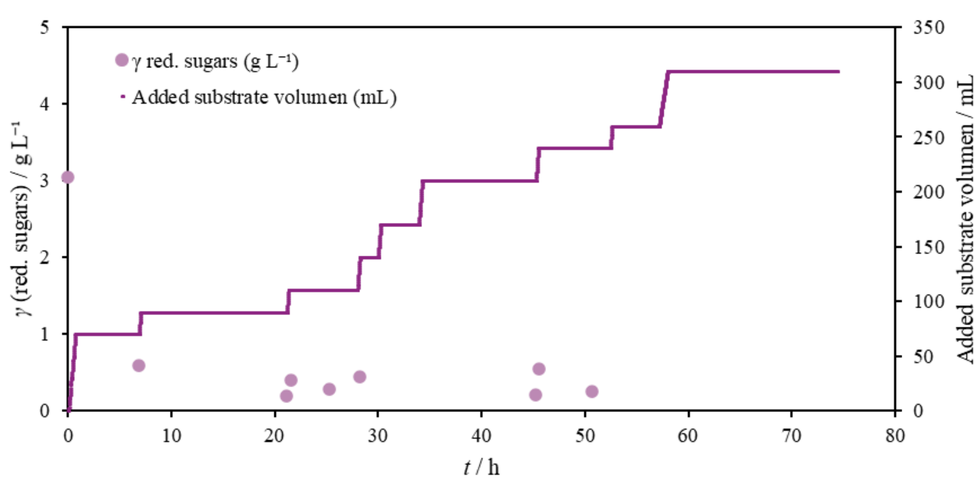


Fig 2. Change in reducing sugars concenctration during fermentation with *Pseudomonas putida*.

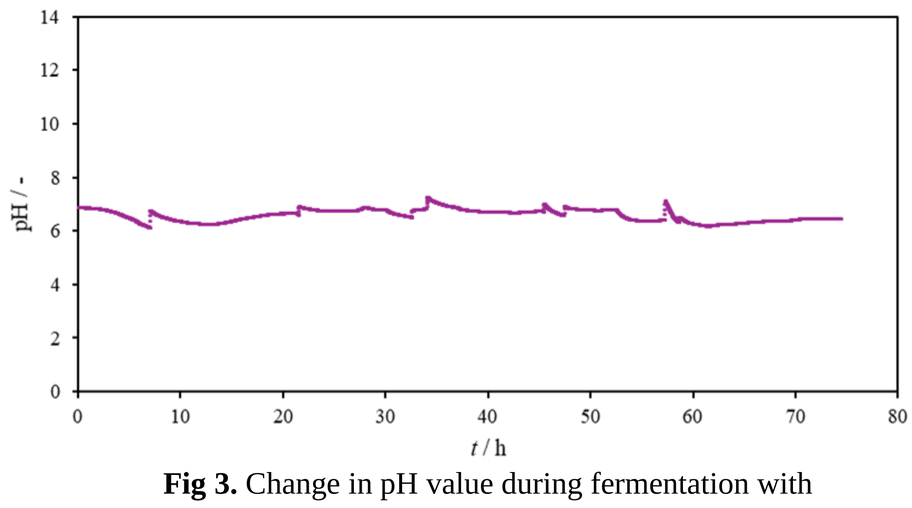


Fig 3. Change in pH value during fermentation with *Pseudomonas putida*.

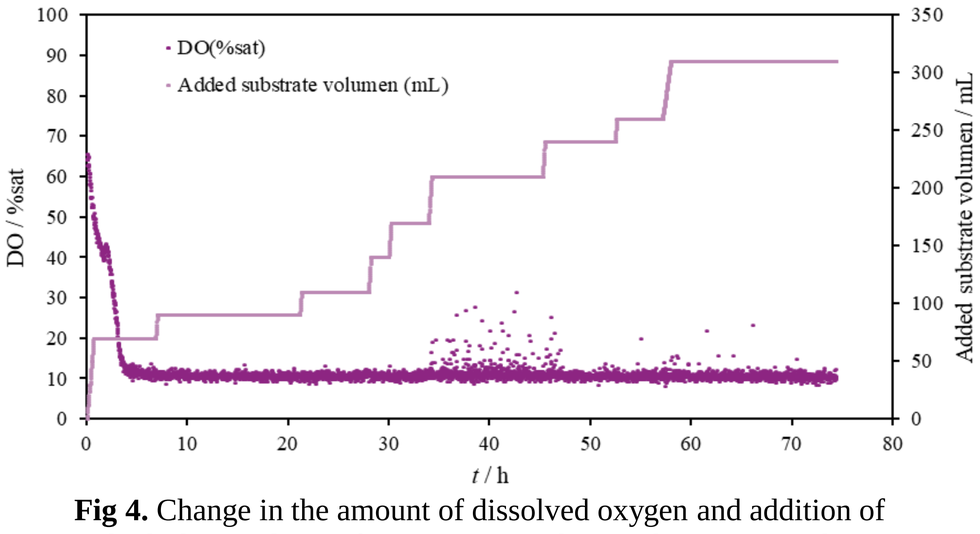


Fig 4. Change in the amount of dissolved oxygen and addition of hydrolyzate during fermentation with *Pseudomonas putida*.

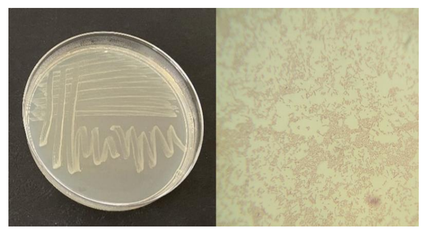


Fig 5. Colonies of the bacterial culture *C. necator* on nutrient agar and micrographs of Gram-stained bacterial cells.

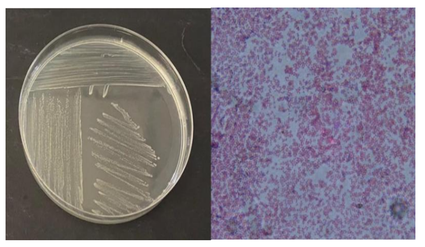


Fig 6. Colonies of the bacterial culture *P. putida* on nutrient agar and micrographs of Gram-stained bacterial cells.

Table 1. Results of PHA extraction from mixed and pure bacterial cultures.

	PHA extraction yield / %
Pure culture	39.44
Mixed culture	**40.53**

CONCLUSION

- ✓ Submerged fermentation was successfully carried out using both pure and mixed bacterial cultures for the production of PHA biopolymers from agro-industrial waste.
- ✓ The mixed culture showed a slightly higher PHA yield (40.53 %) compared to the pure culture (39.44 %).
- ✓ GC-MS characterization confirmed that the produced biopolymer corresponds to the PHBV copolymer.

https://bio-pha-com-f-pack.eu/

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