

Pathways for bioplastics production from microalgae

Technoeconomic framework

Sofia Chaudry | 2023

Australia's National Science Agency





Team

<u>Sofia Chaudry</u>, <u>Valentina Hurtado-McCormick</u>, <u>Ka Yu Cheng</u>, <u>Anusuya Willis</u>, <u>Robert Speight</u>, <u>Anna H Kaksonen</u>





Global plastic consumption



Generated using data obtained from: <u>OECD (2022)</u>, <u>"Global Plastics</u> <u>Outlook: Plastics use by polymer"</u>, <u>OECD Environment Statistics (database)</u>





How bioplastics are produced?

Direct extraction of natural polymers from biomass

Example:

starch, protein, cellulose Common biomass sources: potato, wheat, corn, wood

Bacterial production of polymers from biomass

Example:

polyhydroxyalkanoates (PHA) Common biomass sources:

sugars

Bacterial production of monomers followed by polymerization

Example:

polylactic acid Common biomass sources: sugars





Potential of microalgae for bioplastics

Diverse microbes with promising biotechnological potential

CO₂ fixation, fast-growth, adaptable, bioremediation

Image source: Australian National Algae Culture Collection (ANACC)

Proteins (20 - 60%)

Carbohydrates (starch, cellulose, hemi-cellulose) (10 -50%)

Lipids (15 - 60%)

Others (e.g. pigments, polyhydroxyalkanoates)



Pathways of bioplastic production from microalgae







Technoeconomic evaluation for suitable pathway identification

Technical aspects

- Fertilizer footprints
- Energy footprints
- Water footprints
- Integrated waste treatment (performance)
- By-product (possibility)
- CO₂ fixation (environmental aspect)

Economic aspects

- Cost of bioplastics
- Waste treatment credit
- By-product credit

Competing solutions



Suitable pathway



Technoeconomic framework to support research and development and industry

Screening

Exploring the potential of the process options

Screening of process options

Research and development support

Most promising pathway for bioplastics production

Most influencing parameters

Risk and uncertainty



Team work



Image sources: CSIRO science images/ Tardis Pixabay Valentina Hurtado-McCormick IWY-CERC Fellow | CSIRO Environment



Thank you

CSIRO Environment

Sofia Chaudry CERC Fellow Resource Sector Biotechnology

+61 8 9333 6029 sofia.chaudry@csiro.au