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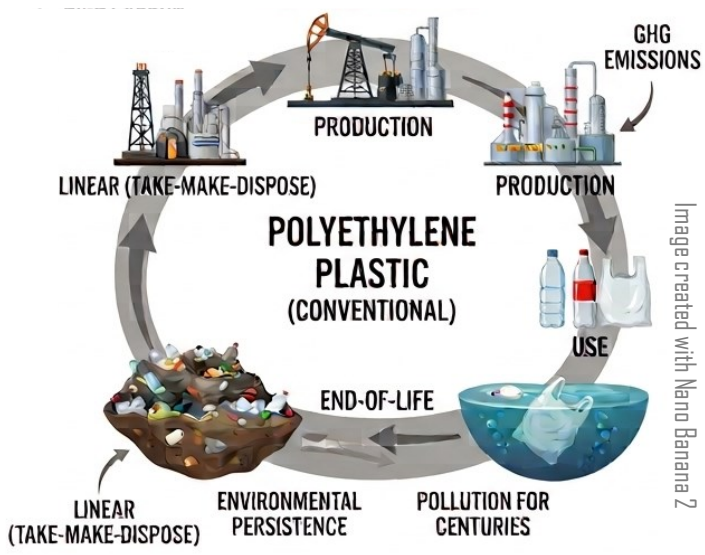
CARBON FOOTPRINT ANALYSIS OF BIODEGRADABLE PLASTICS PRODUCED FROM CITRUS PECTIN

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INTRODUCTION

CURRENT SCENARIO



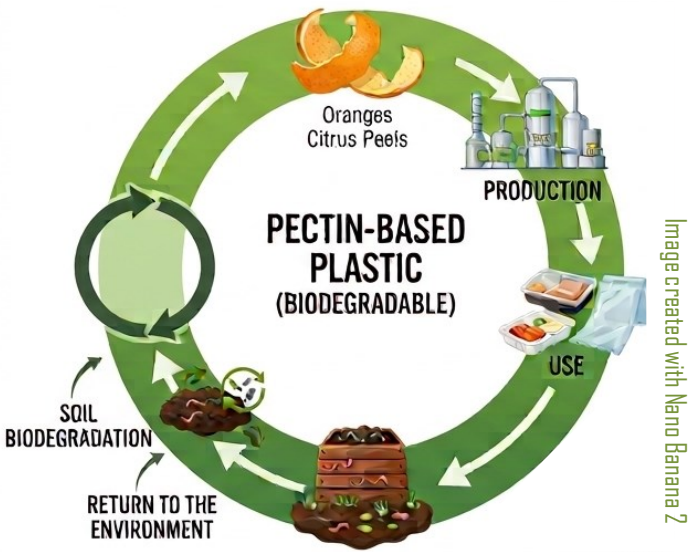
Technological transition

CENTRAL QUESTIONS

✓ Is pectin eco-friendlier than polyethylene?

LIFE CYCLE ASSESSMENT

PROPOSED SCENARIO



OBJECTIVE

The carbon footprints of citrus PEC and LDPE plastics were compared by life cycle assessment (LCA), as recommended by ISO 14040 [1], considering the main damage to ecosystems.

MATERIALS AND METHODS

GOAL AND SCOPE DEFINITION

Product model: plastic packaging – 11.7 g.

System boundary: cradle-to-grave (open dump for LDPE; Industrial composting for pectin.

LIFE CYCLE INVENTORY

Pectin extraction from orange peels [2,3].

Fossil-based LDPE and soybean-derived glycerol datasets from database Ecoinvent 3.7.2.

LIFE CYCLE IMPACT ASSESSMENT

Impact indicators were calculated using the IPCC 2021 method (ISO 14067).

RESULTS AND DISCUSSION

Table 1 – Cradle-to-grave impact results of biodegradable PEC plastics and LDPE plastics determined by the IPCC 2021 method.

Impact Indicator	LDPE	PEC
Aircraft (kg CO_2 eq)	1,79E-08	2,25E-08
Biogenic Emissions (kg CO_2 eq)	7,89E-04	1,95E-02
Biogenic Removals (kg CO_2 eq)	1,68E-03	5,87E-02
Fossil fuels (kg CO_2 eq)	3,83E-02	4,14E-02
Land use and land use change (kg CO_2 eq)	2,95E-05	1,24E-02
Total	3,75E-02	1,46E-02

CONCLUSIONS

PEC could reduce the climate change impacts of plastic packaging by compared with LDPE. The reduction was largely attributed to the biogenic carbon uptake associated with its plant feedstock, namely, the peel waste from the orange juice industry, as revealed by the LCA modelling. Overall, this study indicates that PEC plastic represents a promising lower-carbon alternative to conventional LDPE in packaging applications. Nevertheless, the results also highlight the importance of considering individual life-cycle stages and emission sources when evaluating biodegradable plastic performance.

REFERENCES

[1] INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, Environmental Management — Life Cycle Assessment — Requirements and Guidelines. ISO 14044:2006(E). 2006

[2] NADAR, C. G.; ARORA, A.; SHASTRI, Y. Sustainability Challenges and Opportunities in Pectin Extraction from Fruit Waste. *ACS Engineering Au*, v. 2, p. 61–74, 2022.

[3] GARCIA-GARCIA, G. et al. Life-Cycle Assessment of Microwave-Assisted Pectin Extraction at Pilot Scale. *ACS Sustainable Chemistry & Engineering*, v. 7, p. 5167–5175, 2019.

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