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Development of immobilized lipases for the production of 2nd generation biodiesel

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PURPOSE OF THE ABSTRACT

The production of biofuels has gained significant attention in recent years due to the increasing demand for renewable and sustainable energy sources. Among them, biodiesel has emerged as a promising alternative to fossil fuels (Lv et al., 2021). Lipases, enzymes that catalyze the breakdown of fats and oils, have been widely used in the production of biodiesel. However, the high cost and limited stability of free lipases pose significant challenges in large-scale production (Martínez Gil et al., 2022). Immobilization has been explored as a solution to overcome these challenges (Arana-Peña et al., 2020). The objective of the present work is to develop robust biocatalysts for the production of 2nd generation biodiesel, utilizing industrial sunflower and acid oil.

In this research, we investigated the potential of four biocatalysts for the production of 2nd generation biodiesel. These biocatalysts include Rhizopus oryzae lipase (Biolipasa-R, Biocon®-Spain), immobilized Candida antarctica lipase B (Novozym® 435), LIP2 lipase from Yarrowia lipolytica, and whole cells of Y. lipolytica after surface display of the LIPL2. Specifically, recombinant Y. lipolytica strains have been constructed using vectors bearing the strong promoters, i.e., Histone 3 and Exp1, and two LIP2 gene copies, in order to enhance the LIP2 secretion in the culture medium (Georgiadis et al., 2023). The presence of two LIP2 copies improved the specific activity of the enzyme approximately 55 times (418 U/mg) in comparison to the wild type strain (7.69 U/mg), making it an attractive candidate for biocatalyst development. In addition, Y. lipolytica cells were employed as whole-cell biocatalyst after surface engineering with the cell wall protein YlPIR1. Biodiesel production has been tested with this whole-cell biocatalyst and the results so far have shown up to 5 % conversion. Apart from the recombinant strains, biodiesel production has been tested with R. oryzae lipase and C. antarctica lipase B and the results have shown up to 100 % conversion.

In this study, we compared the efficiency of these four biocatalysts in terms of biodiesel yield/conversion, reaction time, stability under different conditions, and immobilization efficiency. To attain the desired productivity, lipases were immobilized on Diatomaceous earth, an affordable and environmentally friendly silicon dioxide-based material, as well as on commercial supports like Purolite® methacrylate resins. Immobilization efficiency reached 100 % for Biolipasa-R and 81 % for the engineered secreted LIP2, using the commercial resins. The findings of this study aim to provide useful insights into the development of efficient and cost-effective biocatalysts for the production of biodiesel.

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FIGURES

FIGURE 1

Co-finance

Co-finance

FIGURE 2

KEYWORDS

Biodiesel | Lipases | Immobilization | Biocatalysis

BIBLIOGRAPHY

[1] Liangliang, Lv., et al. Processes, 2021, 9(2), 1-10.

[2] Martinez, Gil., et al. ACS Omega, 2022, 7(46), 41882-41904.

[3] Arana-Pena, S., et al. Frontiers in Bioengineering and Biotechnology, 2020, 8.

[4] Georgiadis, I., et al. Microorganisms, 2023, accepted.