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Designing an enzyme for sustainable propylene production

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PURPOSE OF THE ABSTRACT
Repsol is a global multi-energy provider. We strive to drive the evolution towards a decarbonization energy model, and with this ambition in mind we have set ourselves the goal of reaching a net zero emissions company by 2050.
Accordingly, Repsol have initiated a transformation process that will enable us to turn our businesses into multi-energy hubs, which in the short term will be able to process alternative feedstocks to generate fuels and materials with a low carbon footprint.
Thinking about this, we have explored new renewable raw materials that allow us to obtain more sustainable polymers. Hereby, an alternative route for the synthesis of propylene has been designed. Propylene would be polymerized to polypropylene. This polymer belongs to the group of polyolefins and is used in a vast variety of applications including food packaging, textiles, laboratory equipment, automotive components and transparent films.
Volatile fatty acids (VFAs) from controlled anaerobic digestion were identified as a potential renewable raw material. From these VFAs, a potential enzymatic route that allows the decarboxylation of butyric acid to obtain propylene has been identified. After performing a screening of several enzymes, we have chosen one of them, which showed very low enzyme activity (1%). Thus, a directed evolution pathway was designed to improve its activity.
Firstly, a computational study was accomplished to identify promising positions into the sequence. Afterwards, an experimental study was carried out to implement them in the laboratory, leading to improvements in the enzyme activity, although we are still far away from an industrial application. Nevertheless, we will show other Repsol's circular economy initiatives nearly industrial.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

sustainable polymers | propylene | enzyme directed evolution | volatile fatty acids

BIBLIOGRAPHY