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Reaction engineering of an unspecific peroxygenase towards kg production of KA-oil

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PURPOSE OF THE ABSTRACT
Unspecific peroxygenases (UPOs, EC 1.11.2.1) are H2O2-dependent, heme-thiolate enzymes catalysing oxyfunctionalisation reactions of typically hydrophobic substrates.[1] Their robustness, high activities and simple use make UPOs attractive biocatalysts for chemical production at a reasonable preparative scale.[2] However, to date, peroxygenases, among many other biocatalysts, have been mainly applied for syntheses of high value-added chiral products, whereas biocatalytic syntheses of bulk chemicals are scarce.[3] “KA-oil” consisting of cyclohexanol/cyclohexanone is an example of a highly demanded bulk chemical used for polymer production such as nylon on a billion kg-scale.[4]
With this contribution, we report the evaluation of reaction conditions that govern the use the recombinant unspecific peroxygenase from Agrocybe aegerita (rAaeUPO, PaDa-I variant) for the synthesis of KA-oil on a kg-scale (Figure 1).
Suitable conditions for a reaction system enabling high substrate loadings are identified and were used to screen process-relevant parameters including H2O2-feeding rate and enzyme concentration on a 100 mL scale. Transferring the optimal conditions to a 10 L scale enabled synthesis of KA-oil with promising productivities of 16.5 g *L-1* h-1 and 480 g of product. To the best of our knowledge, this is the first time UPOs have been used at this scale to produce oxyfunctionalized products.

FIGURES

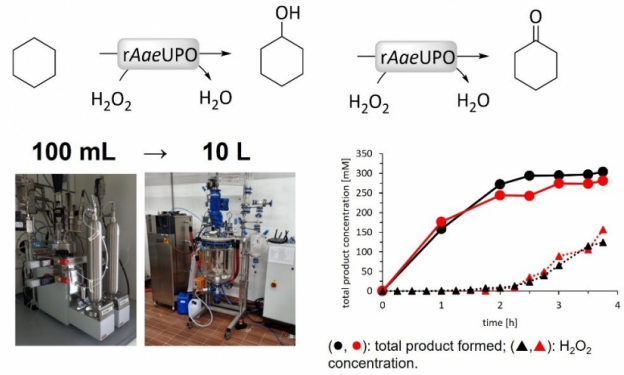

FIGURE 1

Figure 1

rAaeUPO-mediated oxidation of cyclohexane on a 10L-scale.

FIGURE 2

KEYWORDS

peroxygenase | cyclohexane | reaction engineering | upscaling

BIBLIOGRAPHY

[1] Hobisch M., Holtmann D., Gomez de Santos P., Alcalde M., Hollmann F., Kara S., Biotechnol. Adv. 2020, 107615.

[2] Xu X., Hilberath T., Hollmann F., Curr. Opin. Green Sustain. Chem. 2023, 39, 100745.

[3] Hanefeld,U., Hollmann F., Paul CE., Chem. Soc. Rev. 2022, 51.2, 594-627.

[4] Musser MT., Ullmann's Encyclopedia of Industrial Chemistry,2011.