Synthesis of Optically Active Alcohols Using Photocatalytic Oxidative Cleavage of Alkenes Followed by Carbonyl Stereoselective Bioreduction

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Oxidative cleavage of alkenes to obtain carbonyl compounds has traditionally been carried out by ozonolysis, which relies on the *in situ* generation of ozone as a final oxidant. However, the risks related to the disposal of ozonides and peroxides, large amounts of hazardous waste, demand for using specialized equipment, and lack of selectivity of this reaction enforced chemists to discover safer and more sustainable synthetic protocols [1].

In the last decade, photobiocatalysis has gained considerable attention as an efficient synthetic tool in asymmetric organic synthesis. This stems from the fact that merging both of the aforementioned catalytic strategies brings many benefits for particular processes in terms of desired reactivity, selectivity, and ecological feasibility. So far, photobiocatalytic methods for obtaining optically active alcohols consist of deracemization of racemic alcohols combining photocatalytic oxidation and enzyme-catalyzed bioreduction [2,3], photocatalytic asymmetric C–H bond oxyfunctionalization of activated alkanes (i.e., ethylbenzene) followed by carbonyl stereoselective bioreduction [4] or selective activation of C−H bonds in a photo-biocatalytic cascade process [5].

In this study, we report on a one-pot, two-step sequential photo-biocatalytic synthetic procedure for the preparation of optically active alcohols from terminal alkenes.

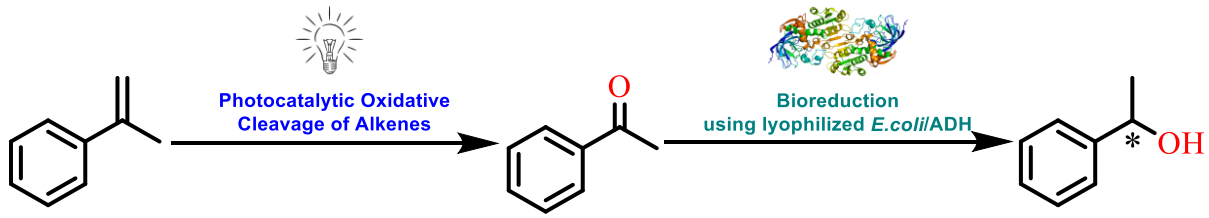

Figure 1 Synthesis of optically active alcohols using photo-biocatalytic cascade reaction.

References

[1] S. G. Van Ornum, R. M. Champeau, R. Pariza, *Chem. Rev.*, *106* (2006), *2990–3001*; DOI: 10.1021/cr040682z

[2] J. Wang, Y. Peng, J. Xu, Q. Wu, *Org. Biomol. Chem*., *20* (2022), *7765−7769*, DOI: 10.1039/D2OB01386J
[3] A. Rudzka, N. Antos, T. Reiter, W. Kroutil, P. Borowiecki, *ACS Catalysis, 14* (2024), *1808-1823*, DOI: 10.1021/acscatal.3c05100
[4] W. Zhang, E. F. Fueyo, F. Hollmann, L. L. Martin, M. Pesic, R. Wardenga, M. Höhne, S. Schmidt, *Eur. J. Org. Chem.,* 2019, *80−84*, DOI: 10.1002/ejoc.201801692
[5] W. Zhang, B.O. Burek, E. Fernandez-Fueyo, M. Alcalde, J.Z. Bloh, F. Hollmann, *Angew. Chem., Int. Ed. Engl.*, *56* (2017), *15451– 15455*, DOI: 10.1002/anie.201708668

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