Scaling-up enzyme immobilization: efficiency and productivity of two model systems

V. Marchini[1], D. Roura Padrosa[1]*

[1]InSEIT AG, Gesellschaftsstrasse 42, 3012-CH, Bern

Enzymatic reactions have received increased attention over the years, owing to the incontrovertible necessity for sustainable processes [1]. Indeed, biocatalysts fulfil the demand for greener reactions thanks to their valuable properties, while providing simpler synthetic routes with higher selectivity than the traditional hazardous methods. In addition, enzyme immobilization onto solid supports is an essential tool to allow their reusability and to preserve stability over several operational cycles [2]. Nevertheless, immobilization of biocatalysts is usually considered a small-scale process at the research level, while larger scale is required in order to achieve considerable amounts of the desired product. Moreover, this technique is still very unpredictable, meaning that significant experimental effort is involved during the screening process, since it relies on a trial-and-error approach. To overcome this issue, bioinformatic tools, like the package CapiPy, allows scientists to rationalize the experimental design for more time and costs effective studies [3,4]. In this work, it has been demonstrated that scaling up is possible and efficient, without any major loss in terms of immobilization and productivity of the enzymatic reactions performed in batch and in continuous flow systems. For this proof of concept, two different enzymes were chosen together with two well-established reactions, previously reported in scientific publications. Consequently, two high-value compounds were obtained, starting from relatively cheap molecules. As further outcome, costs and profits were calculated to prove the efficiency of the biocatalytic scalability not only from the productivity perspective but also from a financial one.

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