simCAT: A Mobile Aid to Recombinant Enzyme Production and Whole-cell Biocatalysis using Microorganisms

Verena Looser, Roland Gassmann (ZHAW, Wädenswil)

Project

Summary

The rapidly developing field of industrial biocatalysis relies on chemists, biologists, technologists or engineers who have extensive training at the interface of chemistry and biology, as well as in the fundamentals of engineering. At present, particularly for Swiss chemistry-related SMEs, there is a shortage of such skill combinations. Engineering courses in Switzerland still comprise only a minor proportion of biology/life science topics or applications, and life science courses typically lack engineering. To advance in the field of biocatalysis, integrated skills in life sciences, chemistry and engineering are particularly important. This project addresses this need and aims to improve academic curricula by designing and implementing an innovative mobile application appropriate as an integrated educational tool as well as for use in laboratory or industrial practice. In addition, the sim-CAT-tool under development will enable Swiss universities to up-date, harmonise and share their specific teaching contents, as well as giving the students opportunities for individual practice and accommodating student access to continuously up-dated expert knowledge.

The simCAT mobile application will provide a novel tool to efficiently and effectively convey relationships between theory (e.g. use of mathematical formulas, differential equations, numerical computation methods) and practical experimentation, where appropriate planning and hands-on performance are required to carry out a specific biological experiment. This tool will comprise specific teaching materials and experience, to be shared between different courses and universities and to complement traditional teaching with expert knowledge from academia and industry. The primary focus will be specifically on the field of microbial cultivation as the foundation of biocatalysis. In doing so, students will acquire a better understanding of essentials such as conversion kinetics (biomass growth, substrate utilisation and product formation) and influencing factors, as well as gaining a sense of typical time courses for monitored variables, values and parameters for different microorganisms. As the mobile application aims to provide standardised data structures, it will also facilitate data sharing, which is currently seldom achieved in the fields of bioprocessing and biocatalysis.

Features of the simCAT-application will cover the following three modes for use in the production of biocatalysts (i.e. recombinant or natural enzymes and whole-cell systems): (i) design and planning of a laboratory experiment, (ii) data collection and basic analysis, and (iii) interpretation of process data. The first mode provides the user with the means to predict the relevant state variables during the time course of an experiment, while the second mode allows the user to collect measured data and continuously adapt and compare them with simulations. Standardised determinations of physiological parameters from measured data and visual controls, as well as comparisons with typical data from the literature or previous experiments will be offered in the third mode.

simCAT is not only a mobile application for future-oriented innovative didactics in university education and continuous training, but will also seamlessly combine the technical advantages of an intelligent (expert) system with daily work routines in bioprocessing and biocatalysis. Therefore, we envisage that former students will continue to use simCAT in their future professions in academic or industrial research or in industrial manufacturing. As a result, this mobile application, owned by CCBIO and ZHAW, may facilitate a paradigm change in prevailing manufacturing procedures from chemical synthesis to biocatalysis.