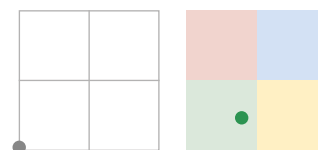




Biocatalysis and biosynthesis

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The terms biocatalysis and biosynthesis refer to the use of enzymes (natural catalysts) or microorganisms to sustainably manufacture products in addition to classic chemical synthesis: biodegradable biocatalysts can be tailored by means of directed enzyme evolution for many areas of application that are still a challenge for traditional chemistry. Biocatalysis or biosynthesis are already being used in many industries, for example in the production of fine chemicals, in the flavour and fragrance industry or in the production of active agents. Much hope is placed on biocatalysis and biosynthesis for the utilisation of renewable resources as they foster a greater independence from fossil energy sources.

The situation today

Significant advances have been made in recent years. In 2018, the Nobel Prize in chemistry was awarded to Frances Arnold for inventing directed enzyme evolution. Further enzyme families have been made industrially usable and applied in the production of pharmaceuticals, and trend-setting industrial processes have been developed in which several enzymes are arranged in consecutive series to produce complex products. However, regulatory provisions, e.g. regarding using enzymes as adjuvants in food technology processes, and also possible restrictions concerning the open access to bioinformatic data, could prevent the industrial use of biocatalysis and biosynthesis. Many opportunities for sustainable developments based on such data could remain untapped.

Large Swiss companies like *Nestlé* and *Novartis* are expanding their capacities in biocatalysis, biosynthesis and enzyme design and are harnessing the technology to manufacture products with high added value. SMEs are not fully seizing the opportunities offered by biocatalysis and biosynthesis. In Switzerland, new courses of studies and continuing education programmes are being developed in order to overcome the limited availability of trained personnel.

Future prospects

Improved processes for directed enzyme evolution and the increased use of artificial intelligence enable to industrially exploit additional classes of enzymes and to reduce the time-to-market of components produced by biocatalysis. Miniaturisation and automation are further drivers in this process. New biocatalytic processes pave the way for innovations in the area of new active agents. Biocatalysis and biosynthesis can become a game changer in the sustainable production of chemicals derived from non-petroleum based raw materials and also in the degradation of plastic waste.

The corona crisis has clearly shown that Switzerland is not self-sufficient with regard to the production of essential drugs. The active ingredients and the corresponding primary products have to be sourced in particular from Asia. Switzerland should be able to produce at least small amounts of essential medicines needed for emergency care. In this context, biocatalysis and biosynthesis could also play a role. The dialogue between industrial and academic partners is essential to increase the success of biocatalysis and biosynthesis. Switzerland could financially support networking projects that promote the exchange between key partners. Companies interested in incorporating biocatalysis and biosynthesis in their processes should focus on developing knowledge by means of collaborations, of continuous staff training and of specific requirement profiles for new staff members.