

Enzyme assays and new processes and products by targeted enzyme catalysis

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Seaweeds, plant biomass, and many agro-industrial co-processing streams are rich in complex polysaccharides and thus valuable sources of beneficial bioactive substances such as 'prebiotic' dietary fibers, functional food ingredients, and cellulose that can be used in new recyclable materials. The selectivity of microbial enzymes is suitable to reap structurally intact, functional components from these raw materials. The research quest is to understand how the enzymes work regarding sequence-structure-function and enzyme-substrate interaction. In addition, the provision of the quantitative foundation of the enzyme kinetics is critical. Usually, the enzyme kinetics of these reactions do not obey classic Michaelis-Menten enzyme kinetics; this is because the substrates are often both polymeric and partially insoluble, meaning that the enzymes attack a solid-liquid interface as well as multiple chemical bonds in the substrate, in addition, the macroscopic properties such as viscosity of the system changes during reaction. Quantitative assessment of the enzyme activity of oxidative and hydrolytic enzymes acting on natural polymeric substrates is thus notoriously difficult, but Fourier Transform Infrared (FTIR) combined with multiway analysis has turned out to be a universally applicable approach for rapid assessment of enzyme activity on complex biopolymers. Rather than monitoring the change in intensity of a single, specific peak in the FTIR spectrum, continuous time-resolved monitoring of the full spectral fingerprint in the mid-infrared range enables measurement of multiple spectral changes occurring simultaneously in both substrate and products during an enzymatic reaction. The development of effective, cell free, enzyme assisted processes on plant biomass and seaweed substrates indeed rests on detailed kinetic characterizations of the enzyme reactions. In conclusion, the message is that the applied enzyme technology research can provide new knowledge on how enzymes work and in turn pave the way for novel enzyme discoveries and applications.