Surfactant-free β-galactosidase micromotors for "on-the-move" lactose hydrolysis

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Lactose is the most abundant disaccharide in milk and essential for the nourishment of newborn infants. Lack of the enzyme lactase in the small intestine resulted in heavy digestions and stomachache. Enzymatic hydrolysis using the enzyme β-galactosidase has proven to be a convenient way to broke lactose into glucose and galactose, which can be easily absorbed by the intestinal tract, avoiding such milk intolerance. Biocatalysts immobilization onto nanosupports possess several advantages over traditional chemical technologies such as higher specificity, facile product separation and the possibility to work in continuous operation. Herein we describe the use of surfactant-free carbon nanomaterial catalytic micromotors as moving nanosupports for the immobilization of β-galactosidase towards highly efficient lactose hydrolysis in continuous mode.
Self-propelled micromotors hold considerable promise as "dynamic supports" for the immobilization of enzymes for a myriad of applications. Indeed, micromotors presents several advantages compared to traditional materials employed in immobilized biocatalysts due to their capability to move in the reaction media eliminating substrate diffusion necessity. The concept is illustrated in Figure 1. The micromotors are prepared by template electrodeposition using multiwalled carbon nanotubes (MW) as outer layer for further functionalization and Ni-PtNPs for inner layer that allows efficient self-propulsion in milk an easy recovery from sample by magnetic separation. Enzyme β-galactosidase is immobilized by covalent chemistry leading to functional structure with potential to eliminate lactose in raw milk samples. The micromotors can propel in skimmed milk without the aid of any surfactant, opening new avenues for its application in food applications. The immobilized β-galactosidase activity and stability are evaluated under different temperature and pH conditions. Immobilized biocatalyst micromotors reusability by magnetic separation from sample and their performance in real skimmed milk are studied towards efficient operation in food industry.[1]

References

[1] R. Maria-Hormigos, B. Jurado-Sánchez, A. Escarpa. Advanced Functional Materials. DOI: 10.1002/adfm.201704256

Figures

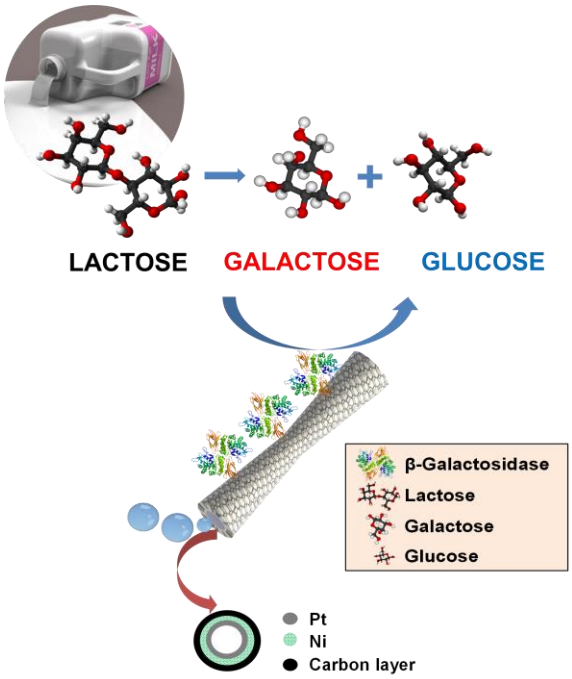

Figure 1: Surfactant free β-galactosidase micromotors for lactose removal from milk.