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PepTrap™

Enzyme immobilization technology : Application energy and food/beverage industries

RESEARCH FOR IMPACT

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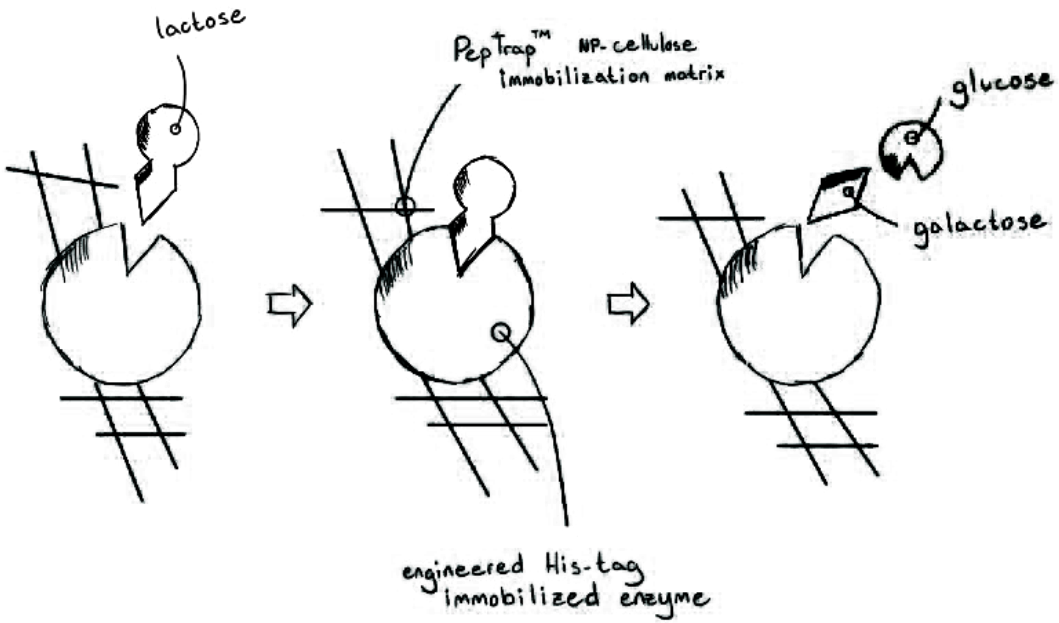
Industrial scale enzyme immobilization using PepTrap™

- Genetically tagged enzymes are functionalized immobilized on nanoparticle coated cellulose matrices
- The cellulose matrix provides an inert and porous super-structure that permits high mass transfer rate, while providing a large surface area for interaction between the immobilized enzyme and its substrate



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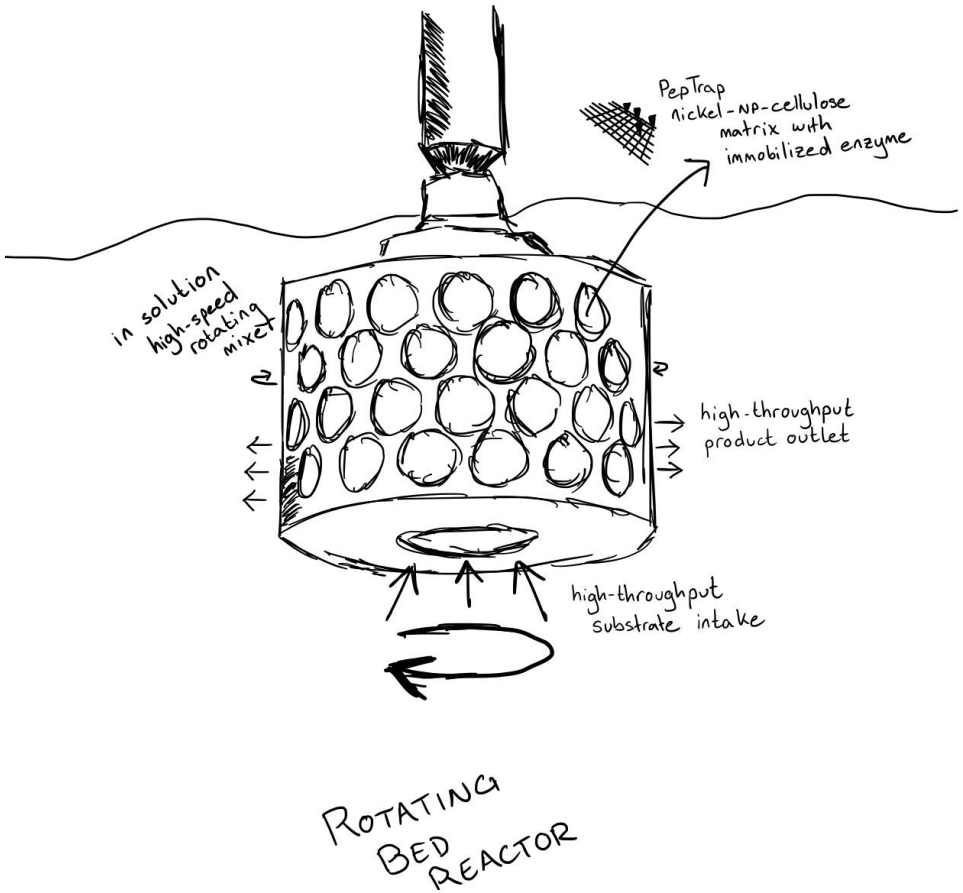
Industrial scale enzyme immobilization

- The cellulose matrix is housed within a rotating bed reactor to increase the efficiency of catalysis in large scale industrial settings
- The centrifugal forces generated with the rotation of the reactor pulls the substrate through the matrix



Enzyme mediated carbon capture for power plants

- Anthropogenic activities have resulted in the drastic increase in the release of greenhouse gases in the past century (400ppm of CO_2 surpassed in 2016)
- Energy production is responsible for 27% of all CO_2 emissions globally
- Carbonic anhydrases (CA) are zinc-containing enzymes that catalyze the reversible hydration of carbon dioxide in a two-step mechanism in which the nucleophilic attack of a zinc-bound hydroxide ion on carbon dioxide, followed by the regeneration of an active site by ionization of the zinc-bound water molecule and removal of a proton from the active site.
- Carbon dioxide can be sequestered from the flue gas released by fossil fueled power plants

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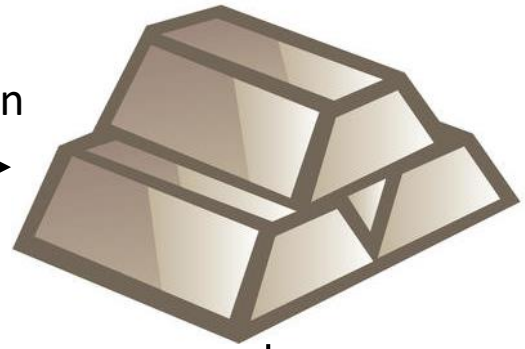
Flue gas

CO_2 capture

Rotating bed reactor

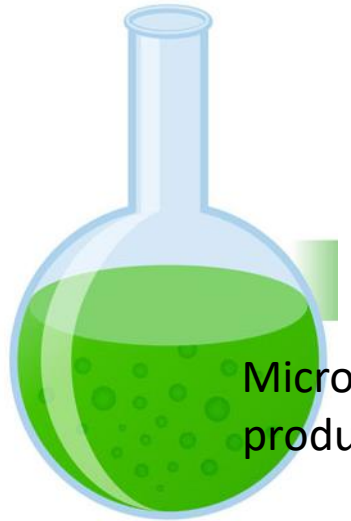
(Immobilized carbonic anhydrase)

Mineralization



$NaHCO_3$

Carbon source



Microalgae production

Fuel alternatives

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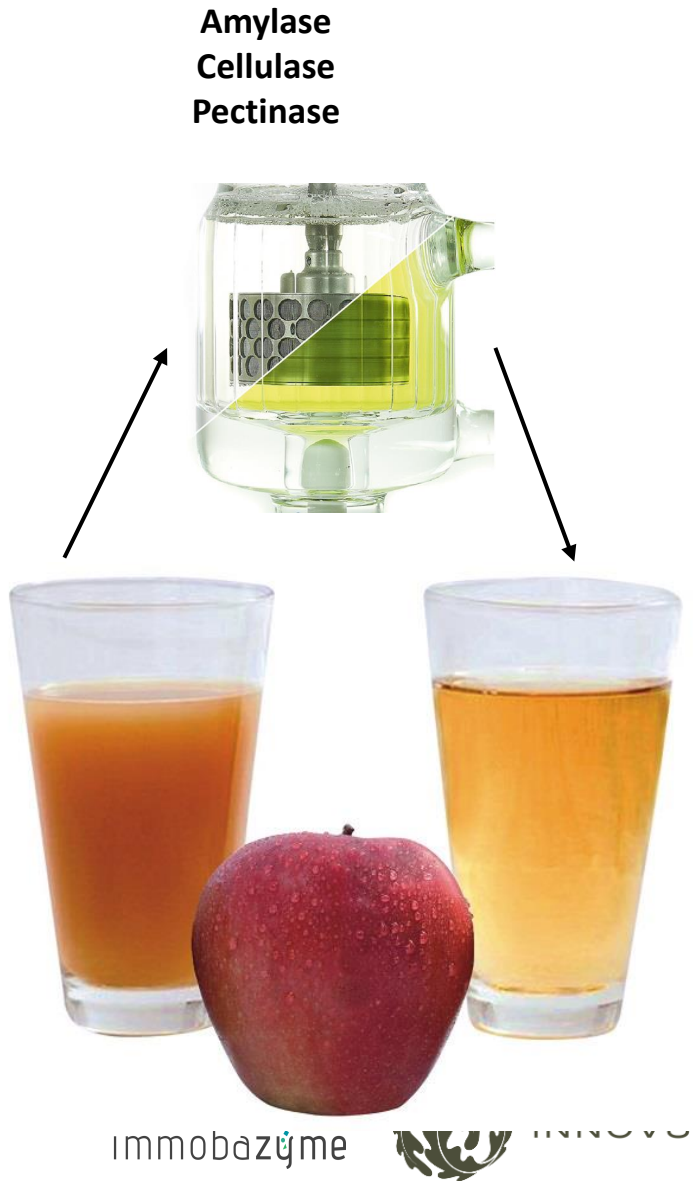
Improvements to the food and beverage industry

- Enhance fruit juice production
- Production of high fructose corn syrups
- Removal of lactose from milk
- Removal of the contaminant, dextran, in the sugar milling industry

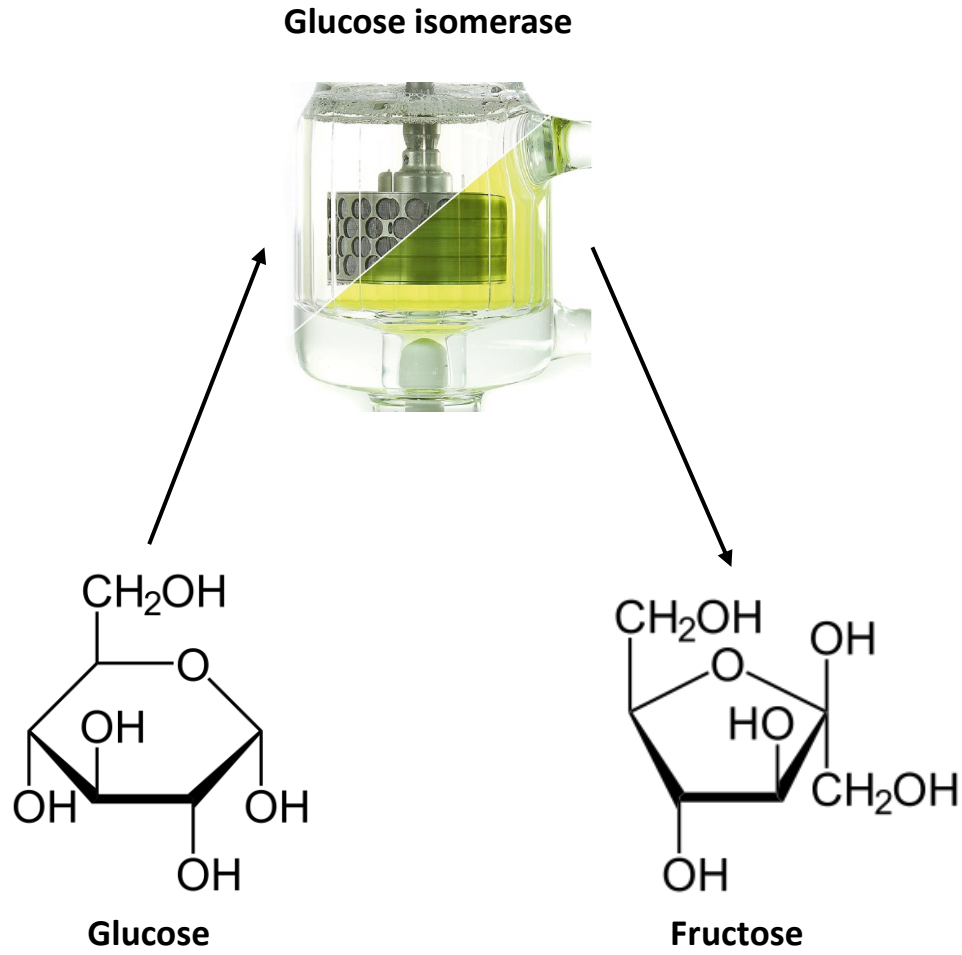
Enhance fruit juice production

- The fruit juice industry applies a variety of enzymes to maximize their yields and reduce their overheads
- Enzymes such as amylases, cellulases and pectinases are used to break down cell walls, and release liquids and sugars from insoluble fractions
- These enzymes breakdown the insoluble fractions, clarifying and releasing sugars into the juice to produce a more desirable final product
- Immobilized enzymes perform these reactions faster, more efficiently and at a lower cost than traditional applications



Production of high fructose corn syrups

- Fructose is a monosaccharide widely used for food, pharmaceutical, and medical applications.
- Such ubiquity can be ascribed to its various superior technical properties over the conventional sugar, sucrose, and many beneficial roles in the human body.
- High fructose syrup (HFS) can be synthesized from starch or inulin using enzymatic/chemical methods.
- A typical approach is the hydrolysis of starch using amylolytic enzymes and the subsequent isomerization glucose to fructose.
- Immobilized enzymes perform these reactions faster, more efficiently and at a lower cost than traditional applications



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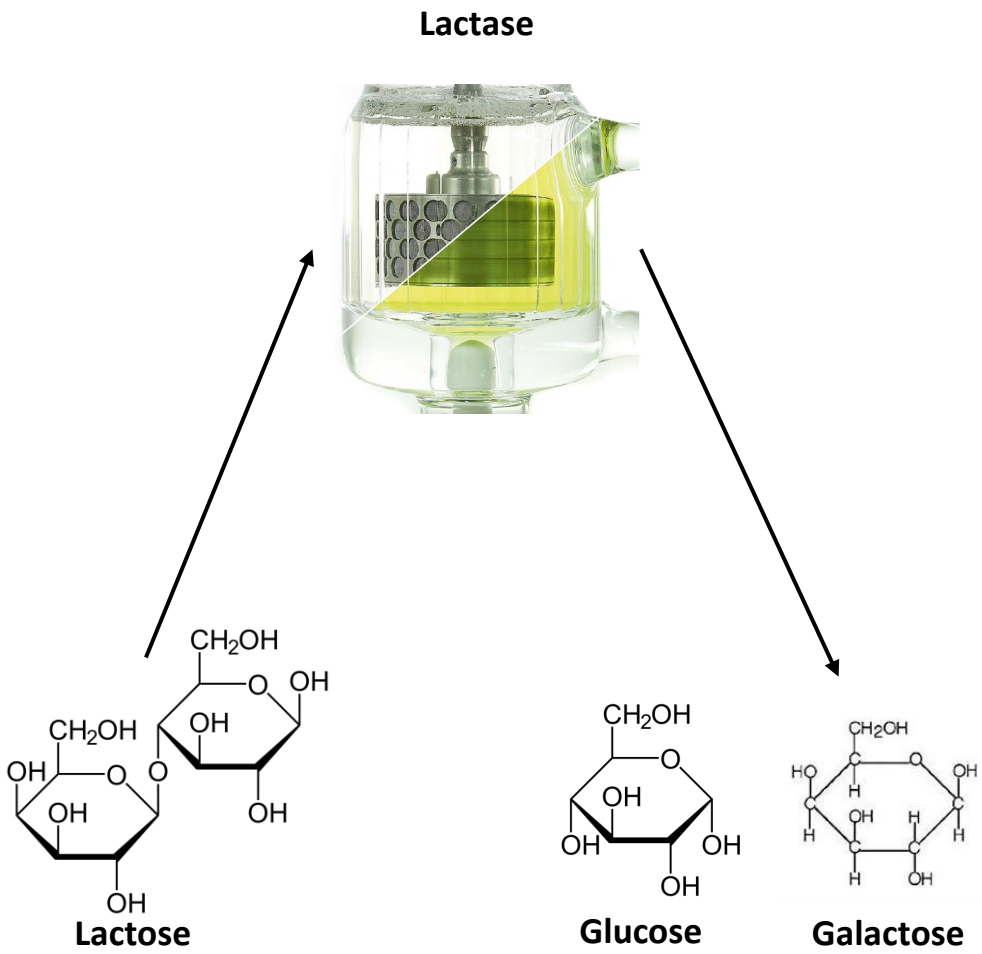
Removal of lactose from milk

- Lactose is a disaccharide sugar consumed predominantly in dairy products.
- However the majority of the global population is incapable of digesting lactose resulting in unpleasant gastrointestinal symptoms.
- A conventional approach to removing lactose from dairy products is the addition of the enzyme lactase, which hydrolyzes lactose to the monosaccharide sugars glucose and galactose.
- Immobilized lactase hydrolyzes lactose faster, more efficiently and at a lower cost than traditional applications.



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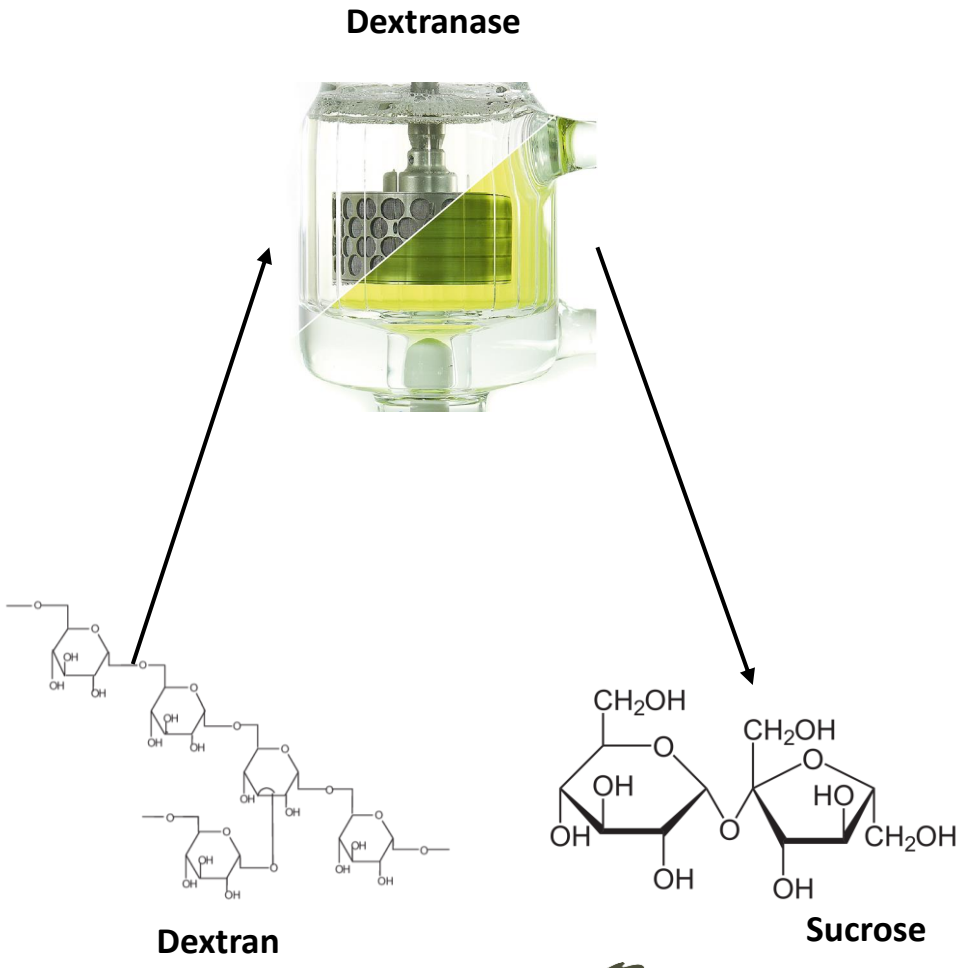
Removal of the contaminant, dextran, in the sugar milling industry

- Dextrans are undesirable gummy compounds synthesized from sucrose by contaminating microorganisms introduced during the harvesting of the sugar cane.
- The presence of dextran increases the viscosity of process streams leading to a decreased factory capacity, poor clarification, increased boiling times, a decrease in sucrose crystallization rates, a loss of sucrose in the final molasses, formation of needle shaped crystals and a transfer of dextran to the raw sugar, lowering the quality of the sugar product.
- These negative effects are estimated to result in R1.6 billion per annum in lost revenue.
- The enzyme dextranase efficiently hydrolyzes dextran back into the desirable sugar, sucrose.
- However, the application of dextranase as a free enzyme solution is too costly to be applied to large scale industrial processes.
- Immobilized dextranase allows for the enzyme catalysed removal of dextrans in sugar milling processing streams.



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