Use of immobilized enzymes in food industry

Summary

Enzymes have been exploited by humans for thousands of years. Traditional foods and beverages like cheese, yoghurt and kefir, bread, beer, vinegar, wine and other fermented drinks, as well as paper and textiles, were produced with the help of enzymes which were present in starting materials as early as 6000 BC. Food applications of enzymes represent a wide and highly diverse field including baking, dairy, juice, vegetable processing and meat. The enzymes are used to obtain a number of benefits, like more efficient processes, leading to reduced use of raw materials, improved or consistent quality, replacement of chemical food additives and avoidance of potential harmful by-products in the food. Enzymes accelerate different chemical reactions with high specificity and are not permanently modified by their participation in reactions. But enzymes are costlier than chemical catalysts, in general, and cost effectiveness of enzyme-based processes could be reached by the repeated use of enzymes. However, enzymes remain in solution with products and it is not possible to recover them easily from the reaction mixture. If they are made insoluble or stationary in active forms, repeated use of an enzyme becomes possible. Immobilization is the process by which an enzyme is made insoluble or stationary with the retention of full or substantial activity. So, Immobilization is the localization or confinement of enzymes during a process, which permits separation of the enzyme from substrate and product for its repeated use.

In the immobilization of an enzyme, it is most important to select the method of attachment, which will not affect or interfere with the substrate-binding site of the enzyme. Considerable knowledge of the active site of the enzyme is essential and any possible interaction with binding site is avoided. Enzyme as biocatalyst can be immobilized using either purified/semi-purified enzyme (without undesired contaminant activities) or whole cells or sub-cellular components. Most of the enzymes used in industry are microbial extracellular enzymes, which can be isolated more easily from fermented broth as crude enzyme. Extra cellular enzymes are generally more stable than intracellular enzymes against environmental stress. The cost of enzyme is kept low by the development of fermentation with high enzyme. Three industrial enzymes have been chosen for immobilization due to their industrial importance in the production of low-cost foods and drugs namely, galactosdiase, inulinase and penicillin acylase. Galactosidase will solve 70% of the worldwide population suffering from lactose intolerance, as well as, protecting the environment by converting wastes, as whey, to lactose free syrup; inulinase produces fructose, which is 4 times sweeter than glucose and has, additionally, the advantage of being recommended to diabetics and people on a diet. Penicillin acylase produces 6-aminopenicillanic acid (6-APA), which is the precursor for the production of 19% of the worldwide antibiotics, such as Ampicillin and Amoxicillin. Immobilization of enzymes on natural biopolymers, such as grafted carrageenan, chitosan and alginate will,

practically, enable the separation and reusability of the enzymes for tens of times, which will, consequently, reduce both the enzyme and the product costs. Accordingly, we are expecting the prices of foods and drugs to be significantly reduced. One of the major advantages of the immobilization of enzymes, that we have achieved, is the improvement of the enzyme's thermal, as well as, operational stabilities.