

APPLICATION OF ENZYMES IN FOOD INDUSTRY

4. LACTASE (β -GALACTOSIDASE)

- a) Hydrolysis of lactose is an important biotechnological process in food industry. The enzyme β -galactosidase catalyzes the hydrolysis of lactose. It belongs to the family of hydrolases.
- b) β -Galactosidase can be obtained from numerous biological systems including plants, animals and microorganisms.
- c) It is required for the digestion of whole milk
- d) Used in production of lactose free milk
- e) Also used in production of ice cream and sweetened flavored and condensed milks
- f) Cheap source of lactose for the production of lactic acid by fermentation.
- g) Lactase is used with milk and milk-based products to reduce lactose intolerance in people.
- h) The scoopability and creaminess of ice creams improved significantly after the hydrolysis of lactose with lactase.
- i) Additional advantage of hydrolyzing lactose into monomers is the reduction requirement of sweeteners as they could improve the sweetness of the products.
- j) Another major application of lactase is the lactose hydrolysis in whey. Whey is a byproduct of cheese production and its main components are lactose, proteins and minerals.

5. PROTEASE

- a) Proteases are enzymes which catalyze the hydrolysis of peptide bonds present in proteins and polypeptides. They represent 60% of industrial enzymes on the market.
- b) The major sources of protease enzymes are animals, plant and microorganisms (both bacterial and fungal).
- c) Proteases are divided into two groups: exopeptidases and endopeptidases, based on the site of action on polypeptide chains.
- d) Plant proteases such as bromelain, ficin and papain are widely used in food industry for various applications such as brewing, tenderization of meat, coagulation of milk and as a digestive aid.

- e) In addition, proteases are also used to improve the flavour, nutritional value, solubility and digestibility of food proteins as well as to modify their functional properties including coagulation and emulsification.
- f) Proteases are widely used in baking industry for the production of bread, baked foods, crackers and waffles.
- g) Acidic fungal proteases are used in improving fermentation of beer as they are efficient even at low pH by balancing the amino acid profile of beer.
- h) Another major application of proteases is associated with dairy industry. Naturally occurring proteases contribute significantly to the flavor characteristics of cheese. They are used for the acceleration of cheese ripening, to modify the functional properties and reduce the allergenic properties of milk products.

6. LIPASES

- a) Lipases are enzymes which catalyze the hydrolysis of long chain triglycerides.
- b) They are naturally present in the stomach and pancreas of humans and other animal species in order to digest fats and lipids.
- c) Microbial lipases are produced by bacteria, fungi and yeast. Microbial enzymes contribute to approx. 90% of global lipase market.
- d) In the food and beverage industry, lipases find major application in dairy, baking, fruit juice, beer and wine industries.
- e) Commercial lipases are mainly used for flavor development in dairy products and processing of other foods containing fat.
- f) They can improve the characteristic flavor of cheese by acting on the milk fats to produce free fatty acids after hydrolysis.
- g) Lipases are also used as flavor development agents in butter and margarine, also to prolong the shelf life of various baking products.
- h) In alcoholic beverages such as wine, the aroma can be modified using lipase.
- i) In addition to this, lipase could also be used in the processing of different waste streams that are released from food industries.

7. CELLULASES

- a) Cellulases are enzymes that act on polymeric cellulose and hydrolyze β -1,4 linkages to liberate glucose units. The three major classes of cellulases are endo-(1,4)- β -d-glucanase, exo-(1,4)- β -d-glucanase and β -glucosidases.
- b) The industrial making of cellulases is mainly from microbial sources, bacteria and fungi, and these microorganisms can be diverse in their habitat.
- c) Cellulases from fungi (*Aspergillus* and *Trichoderma*) and bacteria (*Bacillus* and *Paenibacillus*) are potentially used in the production of food.
- d) In juice industry, cellulases are applied in combination with other macerating enzymes for increasing process performance and yield, improving the extraction methods, clarification and stabilization of juices.
- e) They can also reduce the viscosity of nectar and puree from fruits such as apricot, mango, plum, papaya, pear and peach, and are used for the extraction of flavonoids from flowers and seeds.
- f) They are also reported to reduce bitterness of citrus fruit and improve aroma and taste.
- g) Cellulases are used with other enzymes for efficient olive oil extraction.