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Food processing applications of enzymes

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Abstract
Enzymes have always been important to food technology because of their ability to act as catalysts, transforming raw materials into improved food products. Food processing enzymes are used as food additives to modify food properties. Food processing enzymes are used in starch processing, meat processing, dairy industry, wine industry and in manufacture of pre-digested foods. The present article reviews the applications of enzymes in food industry.

Keywords: Enzymes, applications, food industries

1. Introduction

Enzymes are proteins, that increase the rate of an immense and diverse set of chemical reactions required for life. In other words, they are highly specific biological catalysts (Hunter, 1995) [8]. Enzymes are commonly named in accordance with the reaction they carry out. Typically, the suffix 'ase' is added to the name of the substrate (e.g. glucose oxidase, an enzyme which oxidizes glucose) or the type of reaction (e.g. a polymerase or is omerase for a polymearization or isomerization reaction). The exceptions to this rule are some of the enzymes, such as pepsin, rennin and trypsin. The International Union Biochemistry (IUB) initiated standards of enzyme nomenclature which recommend that enzymes names indicate both substrates acted upon and the type of reaction catalyzed (IUB Homepage) [9]. Enzymes have been exploited by human for thousands of years. Rennet is an example of a natural enzyme mixture from the stomach of calves or other domestic animals that has been used in cheese making for centuries. Yeast enzymes have been used from centuries to ferment grape juice to make wine (Shinde *et al*. 2015) [15].

2. Enzymes in food processing

Enzymes have found widespread applications in food processing as they can modify and improve the functional, nutritional and sensory properties of ingredients and products. Food technologist selects those enzymes which can improve one particular unit operation of food production. These improvements involve substituting fish protein hydro lysates for milk in calf feed (Diazcastaneda and Brisson, 1989) [5], saving energy and money in production processes (Christiensen, 1989) [3] and modifying the functional properties of proteins (Adler-Nissen *et al*., 1983) [1].

2.1 Amylases

Alpha Amylases are extracellular enzymes that catalyze the hydrolysis of alpha 1,4-glycosidic linkages in starch to release glucose and are important as industrial starch conversion enzymes in the food industry. Amylolytic enzymes have numerous applications, such as the production of glucose syrups, high fructose corn syrups, maltose syrup, reduction of viscosity of sugar syrups, reduction of turbidity to produce clarified fruit juice for longer shelf-life, solubilisation and saccharification of starch and delay the staling of baked products (Neelima and Mayur 2015). Amylases can be made from various microorganisms especially from Bacillus, Pseudomonas and Clostridium family. Potential bacteria that are recently used to produce amylases in industrial scale are *Bacillus licheniformis* and *B. stearothermophilus* (Shinde *et al*. 2015) [15].

2.2 Catalases

Catalases can be obtained from bovine liver or microbial sources. They are used in the breakdown of hydrogen peroxide to water and oxygen. The source for industrial purpose is mostly fruit or vegetable source. This enzyme is used to cast off hydrogen peroxide from milk prior to cheese production (Tamara, 2011) [16].

Another use is in food wrappers to prevent food from oxidatioin. Catalase is also used in the elimination of glucose from egg white prior to drying for the use in baking industry. It controls the perishability of the food (Hunter, 1995) [8].

2.3 Lipases

A lipase is a water soluble enzyme that catalyzes the hydrolysis of ester bonds in water-insoluble, lipid substrates. Lipases are crucial flavouring agents and prolongs shelf life (Neelima and Mayur 2015) [11]. Microbial source of lipases are *Pseudomonas aeruginosa*, *Serratia marcescens*, *Staphylocococcus aureus* and *Bacillus subtilis*. Lipase is used as bio-catalyst to produce free fatty acid, glycerol and various esters, part of glycerides and fat that is modified or esterified from cheap substrate i.e. palm oil. Those products are considerably utilized in pharmacy, chemical and food industry (Shinde *et al*. 2015) [15].

2.4 Proteases

Proteases cleave the peptidic linkages in proteins. The number of industrially used proteases of plant origin is small (Aehle, 2004) [2] and some cysteine proteases (CPs) such as papain, bromelain, and ficin are nonetheless being used in a various processes. Papain and bromelain are also used to fabricate different sauces (Díaz *et al*. 1996) [4] and dry cured ham (Scannell *et al*. 2004) [12]. One of the principal applications of proteases is for the production of cheese. Due to the shortage of traditional rennet (enzymes derived from the stomachs of calves, lambs, or goats), other coagulant proteases have been investigated as substitutes for animal rennet. Microbial rennet has two hydrolytic action on casein: the first coagulant activity is represented by specific proteolysis, or the ability to recognize specific amino acid in the chain, breaking the κ-casein specifically between the units Phe (105) and Met (106); the second refers to nonspecific proteolytic activity, which hydrolyzes the κ-casein between other units of amino acids, leading to a reduction in yield and poor flavor development in some types of cheese.

2.5 Glucose oxidase

This enzyme catalyzes the breakdown of glucose to gluconic acid in the presence of dissolved oxygen (Muller 1928) [10]. The largely used species for this enzyme is *Aspergillus niger* and their strains are capable of producing exceptional amount of glucose oxidase (Shazia, 2008) [13]. It is used in the food industry to remove small amounts of oxygen from food products or glucose from diabetic drinks. It also imparts color flavour and texture to a number of food products and also increases their shelf life (Shazia, 2008) [13].

2.6 Pectinases

They are one of the most vital enzymes particulary in fruit juice industry as they help in obtaining well clarified and stable juices with higher yields (Dupaigne,1974) [6]. Pectinases reduces the viscosity of the fruit juices, removes the press ability of the pulp, breaks down the jelly structure and gives the higher yield of fruit juice. The pectin lytic enzymes are also used in canning of orange segments. Additionaly they are also used in sugar extraction process from date fruits. Other important processes where pectic enzymes are utilized are: in the preparation of hydrolysed products of pectin, in the refinement of vegetable fibres during starch manufacture, in the curing of coffee, in cocoa and tobacco and so forth.

2.7 Immobilized enzymes

Immobilized enzymes are of great value in the processing of food samples and its analysis. Immobilization typically reduces the enzyme‘s activity and the enzymes are subject to mass transfer limitations. Immobilization may be done with the aid of several strategies, namely, entrapment/ microencapsulation, binding to a solid carrier, and cross-linking of enzyme aggregates, resulting in carrier-free macromolecules (Sheldon, 2007) [14]. The extent of lactose hydrolysis whey processing, skimmed milk production and so forth has been greatly improved by using respective enzymes as immobilized forms. The manufacturing of high fructose corn syrup has been significantly facilitated with the aid of using immobilized glucose isomerase. An enormously new concept is the use of a single matrix for immobilizing more than one enzyme to enhance food processing. Two of the most successful examples of immobilized enzymes are the production of high-fructose corn syrup and the enzymatic modification of oils. Immobilized lipases are used as alternatives to hydrogenation and non-specific chemical esterification of oils to produce transfat free margarines and shortening, cocoa butter equivalents, medium chain triacylglycerols, diacylglycerols, fatty acid esters, and tailored fat products (Gangadharan *et al*., 2009) [7].

3. Conclusion

Enzymes are currently used in several different food products and processes and new regions of application are continuously being introduced. Evidence clearly shows that dedicated research efforts are consistently being made as to make this application of biological agents more effective and diversified. Immobilization of enzymes has been a key supporting tool for rendering proteins fit for food application, while simultaneously allowing the improvement of their catalytic capabilities. In a world with a rapidly increasing population and approaching exhaustion of many natural resources, enzyme technology offer a great potential for many food industries to help meet the challenges they will face in years to come.

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