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Enzymes in the food industry

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Abstract

Enzymes are used in the food industry by making use of plants, animals and microorganisms. It is used not only in food but also in other industries. By utilizing the properties of enzymes, improvements in foods, that is, consumption conveniences, can be achieved. For example, softening the meat, delaying the staling of the bread, ripening the cheese, making the juices clearer. The purpose of using enzymes in this field is not only because of the feature, durability and activity of the enzyme, but also to obtain and price. In this proceeding review we will focus on the utilization of the enzymes in the food industry.

Introduction

Food products; they are multi-component products with complex structure and texture, the quality of which is determined by consumer demands [1]. It is defined as any processed, partially processed or unprocessed substance that is eaten, smoked or expected to be smoked by humans, excluding live animals, feed, medicinal products used for therapeutic purposes, unharvested plants, cosmetics, tobacco and tobacco products that are not directly offered for human consumption [2].

Enzymes are protein catalysts that increase the rate of a chemical reaction and are not consumed during the reaction [3] substrate; They are substances that react in a reaction catalyzed by an enzyme [4]. These molecules bind to a specific region of the enzyme [4]. This region is called the active region and catalysis takes place in this region [4]. The enzyme gets its specificity from the three-dimensional shape of an enzyme and the structure of its active region [4]. Only a few substances are compatible with the active site, but not with different shapes and functional groups [4]. Only a few substances are suitable for the active site; Carrying different shapes, different properties and functional groups does not show conformity [4]. Enzymes take their names according to their functions and often end with the suffix "az".[4] The activity of an enzyme, that is, how efficiently the enzyme exerts its effect, is affected by the parameters such as temperature and pH [5]. Each enzyme has a different set of efficiently working conditions; we call these optimum conditions [5]. Optimal conditions ensure that the enzyme molecule is most active [5]. Enzymes have an optimum temperature where the reaction rate is most active [5]. And this temperature enables the highest rate of molecular collisions and more efficient reactant conversion rate into the product molecules without denaturing the enzyme [5]. Enzymes have an optimum pH as well as an optimum temperature, although many enzymes have optimal pH values of 6-8, there are some exceptional cases [5].

Factors affecting enzyme activity in foods

Temperature

We mentioned earlier that enzymes are heat sensitive [6]. Heat treatments can cause the catalytic properties of enzymes to decrease or disappear [6]. Increasing the temperature increases the activity of enzymes, however, the rate of inactivation of enzymes increases at high temperatures [6].

pH

Enzymes work with different activities at different pH values [6]. Enzymes show activity in a limited pH range [6]. However, the pH-activity profile is not sufficient to define an enzyme [6]. Optimum pH value varies depending on different substrates [6].

Radiation

The radiation created by electromagnetic waves affects the enzyme and its activity. As a protection method, irradiation with ionizing radiation is used in food processes [7,8]. However, inactivation of enzymes requires the application of microorganisms in an inappropriately higher dose than the applied radiation [6].

Pressure

High hydrostatic pressure was applied on enzymes such as pectinesterase, lipase, polyphenol oxidase, lipoxygenase, peroxidase, phosphatase and catalase, and when the enzymes were examined, it was found that the enzymes were inactivated [9].

Humidity

Since the solid medium prevents the diffusion of the enzyme or substrate at low humidity levels, only the substrate, which is intertwined with the enzyme, is hydrolyzed, especially in hydrolytic reactions [10].

Enzymatic reactions in grains stored in a humidity environment of less than 16% depend only on the natural enzyme effect of the grains [11]. However, enzymes originating from molds formed on grains in high humidity environments are also important in hydrolytic reactions [11].

Use of enzymes in the food industry

α-Amylase

Bakery products are shown at the beginning of the important application areas [6]. Hydrolysis of starch granules and insoluble pentosans, which are fragmented with the help of α-amylase and pentosanase, improves bread quality [6].

Amyloglucosidase (Glucoamylase)

Further breakdown of dissolved starch molecules by α-amylase with amyloglucosidase [12]. The fungal-derived amyloglucosidase enzyme is used specifically in the brewing industry to break down dextrins left over, to flavor beer after fermentation, and in distilled products for saccharification purposes [12].

Pectinase

They are mixtures of fungal origin (Aspergillus niger) that contain several enzyme activities [13,14]. At the top of the application areas of these enzymes are the clarification of unclear fruit juices such as apple juice, the reduction of viscosity in concentrates and purees, the increase of fruit juice yield, the facilitation of the filtration function and the peeling of the fruit skin [13,14]. Pectin enzyme in wine production. It is also used to increase fruit juice yield, color extraction-purification- and clarification [6].

Cellulase

The most important microbial sources are Trichoderma viride and Aspergillus niger [15,16]. Production of glucose from the remaining residues containing cellulase is used in the processing of garlic and softening of mushrooms; these are some application areas of this enzyme [15,16].

Hemicellulase

Cellulase preparations also contain hemicellulase enzyme [17]. Hemicellulase is used to improve the quality of bread, especially since it prevents staling by breaking down the pentosan molecules present in wheat flour [17].

Invertase

Invertase hydrolyzes sucrose to glucose and fructose, this process provides the formation of natural sugar required for jam making [6]. Natural sugars prevent crystallization at higher concentrations, which crystallize at a lower rate than sucrose [6].

Lactase (β-galactosidase)

Lactose can be produced by mold, yeast and bacteria [18]. This enzyme hydrolyzes lactose to glucose and galactose, and as a result, it provides flavor to milk [18]. At the same time, this conversion of lactose is important for the health of individuals who cannot tolerate lactose [18]. Another important role is to prevent lactose crystallization, which may occur in ice cream, by breaking down lactose [6].

Protease

Papain and other plant-derived proteases (bromelain and ficin) have application areas such as tenderizing meat, preventing beer from being clear in the cold, and producing protein hydrolysates [19]. Fungal-derived ones are used to modify wheat gluten, especially in the bakery industry [19]. It is also used infrequently for tenderizing meat and obtaining protein hydrolysates [19]. Trypsin is mostly used in the production of protein hydrolysates, while rennin and its different source pepsin are used to precipitate casein in cheese making [19].

Another protease enzyme from Aspergillus Niger is used in the clarification of kiwi juice [19]. With this enzymatic method, better results were obtained in terms of clarity and quality than clarification using bentonite [19].

Although proteases, which are a source of bacteria, are not widely used in the food production process, they are used in the maturation of products such as cheese, sausage and sausage [6].

Papain

Its source is a herbal protease [20]. It is obtained by isolating the immature papaya fruit (Carica papaya) [20]. It has application areas such as ensuring the clarity of the beer and softening the meat [20]. Although its effect is low in raw meat, it is effective on collagen, muscle fibers and some elastin in pre-cooked meat [20]. It is used in the beer industry [20]. It is used together with proteases of fungal or bacterial origin to ensure the clarity of beer [20].

Trypsin and cymotrypsin

These enzymes are obtained from bovine pancreas [6]. They can be used for many purposes such as digestion, injury and fracture treatments [6]. Saymotrypsin is also used as an alternative treatment to surgery in the treatment of cataracts [6].

Pepsin

This enzyme is isolated from bovine gastric mucosa [6]. It is used for digestion purposes and for breaking down cereals (amylase + pepsin) and baby foods (trypsin + pepsin) [6]. In addition, pepsin ensures the clarity of beer and is also used in cheese making together with rennin [6].

Rennin

Raw rennin (rennet) has the property of coagulating milk [6]. It has an important place in the field of cheese production application [6].

Lipase

These enzymes can be obtained from different sources [21]. It is used for the formation of the desired taste and odor in processed chocolate and cheese, and it is applied for the rapid maturation of cheeses [21]. Lipases increase the foaming property of egg white by creating conditions that provide monoglyceride and diglyceride formation [21].

Glucosoxidase/Catalase

Glucosoxidase is of fungal origin [22] and in the presence of oxygen and water, it oxidizes glucose to gluconic acid and hydrogen peroxide [22].

Glucosoxidase and catalase enzymes function in the application of removing both glucose and oxygen from the environment in the food industry [22]. Beer, fruit juices, wine, dried foods, canned milk powders and mayonnaise can be among the foods that remove oxygen [22]. It is also seen in the production of gluconic acid, which has a low-calorie value and is used as a sweetener [22].

Lipoxidase

It is usually found in wheat germ [6]. During the milling of wheat, it is separated from the flour [6]. Lipoxidase added to soy flour acts as a whitening agent in bread making [6]. Its function is to remove the effect of carotene pigment in the presence of oxygen and linoleic acid [6]. It also causes oxidation of thiol components in gluten and thus improves bread quality positively [6].

Glucose isomerase

It is of bacterial or fungal origin [6]. It enables the conversion of glucose to fructose and enables the production of natural sugars from glucose [6]. Fructose sucrose, which is sweeter than glucose, is used as a sweetening option [6].

Enzyme sources

Enzyme production is generally carried out using fermentation techniques, mold, yeast and bacterial species [6]. However, some enzymes are obtained from animal tissues (rennin, pepsin, cymotrypsin, trypsin), plants (papain, bromelain, ficin) and microbial sources [6]. However, in most of these organisms, fluctuations can be observed due to various factors with slow growth rate and low production [23]. Therefore, researchers working on enzymes closely follow developments in fields such as molecular biology, genetics, and protein engineering in order to obtain more efficient ways to produce enzymes, to improve the properties of existing methods, and to make completely new enzymes [23].

Studies conducted in this direction have proven that recombinant DNA technology, together with other techniques of genetic engineering and biotechnology, has a significant potential for microbial production of genes encoding a specific enzyme with recombinant DNA techniques [23]. By selecting genetically modified and recombinant organisms, it increases the efficiency in enzyme production and enables the creation of more useful enzymes [6]. It is possible to increase the amount of enzyme produced by a particular microorganism by induction [6]. Enzymes found naturally in foods affect the processes of the products to be created with them in different ways [6].

The darkening reactions caused by the prophenol oxidase enzyme in fruits and vegetables, the degradation of lipase and peroxidase in wheat germ, or the gelling of peptic enzymes in citrus juices can be given as examples of how they affect food processes in different ways [6]. For this reason, it is necessary to inactivate these kinds of enzymes in foods by heat treatment or inactivation processes [6]. However, some naturally occurring enzymes can be considered beneficial [6]. For example, the amylase enzyme in potatoes can add flavor to fried products. The peptic enzymes in apples and grapes are important in clarifying fruit juices [6].

Conclusion

Protein encompasses most of the enzyme structure and contains an acid chain. The acid chain is present in all living cells. Therefore, enzymes are present in many different food industries. They have been in the food industry for years, such as bakery products, fruit juices, dairy products. It is increasing day by day in the production processes of the enzyme in the food industry. Biotechnology will spread to a wider spectrum with fields such as molecular biology and genetics.

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