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Production Technology of Lactase and Its Application in Food Industry Application

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Abstract

Lactase, also known as β-galactosidase, is widely used in industrial production. This paper reviews the lactase by its source, its nature, basic research and application.

Keywords

Lactase, Immobilization, Application

1. Introduction

Milk is the ideal natural food for all kinds of mammals to feed their cubs. It is rich in high quality protein, milk fat, lactose and other nutrients and calcium, phosphorus, potassium and other minerals and a variety of vitamins, but also contains a variety of immune substances, enzymes, hormones and other physiological activity of the biological activity of regulatory substances.

2. The Source and Characteristics of Lactase

1.1 Lactase

Lactase, also known as β-galactosidase, or β-D-galactoside galactose hydrolase, its role is in the specific conditions of hydrolysis of β-D-galactoside bond, the lactose hydrolysis into α- D-glucose and β-D-galactose, lactase also has the role of galactosyl transfer, galactose can be connected to the lactose, the formation of *Galactooligo saccharides*, as a probiotic factor for functional Food development. Lactase is a white powder, odorless, tasteless, dissolved after a light brown liquid, is a non-toxic side effect of biological enzyme preparation [1].

1.2 The Source of Lactase

The natural source of lactase: lactase (β-galactoside hydrolase; E C3.2 1. 23), a lactose hydrolase, is mainly found in young animal gut, plants, fungi, yeasts and bacteria. Many microorganisms can produce lactase, bacteria in lactic acid bacteria, bud bacillus, Escherichia coli, Lactobacillus oleracea, etc. [1]; fungi are Aspergillus oryzae, Aspergillus niger, Aspergillus sphaericus; yeasts have crisp Kluyveromyces, Lactic acid Kluyveromyces, lactic acid yeast, etc ; actinomycetes *Streptococcus sp*.

2. Lactase Production Technology

2.1 Application of Gene Engineering Technology in Lactase Production

For the production of lactase, gene engineering technology can lead lactase genes into microorganisms that are easy to culture and grow rapidly. Thus, the cost is greatly reduced. For example, Domingues constructed recombinant strains using the lacA gene encoding extracellular lactase produced by flocculent Saccharomyces cerevisiae and Aspergillus niger, enabling recombinant *Saccharomyces cerevisiae* strains to secrete lactase. Moreover, the lactase can efficiently utilize lactose. In order to improve the yield and quality of enzymes, site directed mutagenesis, protoplast fusion and DNA recombination technology were used to [2].

2.2 Immobilization Technology of Lactase

Compared with free enzymes, immobilized enzymes have many advantages. For example, the immobilized enzyme is easily separated from the substrate and product. The utility model can be used repeatedly and can undergo repeated batch catalytic reactions in a long time. The utility model has certain mechanical strength and can be used continuously in column reactors, and is suitable for large-scale industrial production. It not only reduces the catalytic cost, but also greatly reduces the waste discharge and operation pollution in the process of biocatalyst manufacturing. Immobilized enzyme saves energy and resources, reduces cost, protects environment, and makes production automatic and continuous. Enzyme immobilization methods include encapsulation, adsorption and covalent binding.

Embedding Method

The study found that adding carboxymethyl cellulose in alginate gel could improve the yield and enzyme activity of lactase. The reason may be that the addition of carboxymethyl cellulose reduces the loss of protein and increases the specific surface area of alginate beads during immobilization. When the mass ratio of carboxymethyl cellulose and alginic acid was 1.0:1.5, the immobilization yield was 58.2%, which was 14.2% higher than that of alginate alone [3].

Adsorption Method

Gurdas was immobilized on ion exchange resin A568 by adsorption method. The results showed that the immobilized enzyme showed higher activity than the free enzyme at all temperatures. The immobilized optimum pH was deviated from 0.5 to 6 in alkaline direction compared with free enzyme [4].

Covalent Binding

Joey and Talbert found that the higher the concentration of carboxylic acid, the smaller the enzyme activity after the covalent binding of lactase with microspheres. However, the activity of immobilized enzyme can be significantly improved by glucosamine modification (Joey Talbert et al., 2012). Wong, Dana, E, etc., covalently attached lactase to low-density polyethylene (LDPE) to obtain active packaging components. Through the assembly of polyethyleneimine, glutaraldehyde (GL) and lactase, the total protein amount, i.e. lactase activity, was increased and used in the production and packaging of lactose free dairy products [6].

Other Collaborative Methods

Qian Tingting[7] obtained modified magnetic chitosan microspheres by reverse suspension polymerization, using (HE-MA) and (GMA) as monomers and ammonium persulfate as initiator. Furthermore, the modified magnetic chitosan microspheres were used as carriers, and the lactase was immobilized by three methods of adsorption, covalent binding and glutaraldehyde cross-linking reaction. The factors affecting the immobilization were optimized, and the final immobilized lactase activity was 685 U/g carrier, and the recovery rate of enzyme activity was 34.3%. The pH stability and thermal stability of immobilized lactase were higher than those of free enzyme. After 10 times of continuous operation, the immobilized enzyme remained above 70% and had good operation stability.

3. Application of Lactase in Food Industry

3.1 Application in Dairy Products

In the fermentation process, only about 20% of the total yogurt is decomposed lactose, and if the use of neutral lactase to hydrolysis lactose, up to 90% of lactose is decomposed. Under the same conditions, the yogurt made from lactase hydrolysis milk can shorten the time of milk coagulation, 35-40%, and the product has higher viscosity, stronger milk flavor and better taste.

3.2 Production of Oligo Ggalactose

The galactose galactose (galactose) is used to produce galactose and glucose from lactose in milk, and the galactosidase bond is catalyzed by beta galactosidase. In addition, the hydrolyzed galactose is polymerized to the glucose end by forming the galactose, resulting in the formation of oligosaccharides with different degrees of polymerization. And it can improve constipation, cancer prevention and allergy [8].

Galactooligo saccharides has acid resistance and heat resistance. In the process, it does not lose its original characteristics because of high temperature and human gastric acid. Moreover, it can be effectively used by Bifidobacterium B bacteria and lactic acid rods A bacteria simultaneously with [9].

From the industrial production point of view, it is mainly concentrated lactose syrup as raw material. It uses lactase to produce oligomeric galactose by enzymatic reaction to achieve its commercial production. And the lactase concentration can reach 20-40g/100g, such a high concentration of enzyme may be a refined lactose or concentrated whey permeate [8].

4. Conclusion

This article examines the nature and origin of lactase. The application of lactase in food industry was introduced. At present, the methods of preparing lactase are mainly genetic engineering and immobilization technology. Both methods have high yield and purity, and are easy to use. At present, domestic and foreign research mainly from the following aspects. From the aspect of industrial fermentation, it is mainly the optimization of culture medium, inducer addition and fermentation mode, conditions and optimization of extraction technique of separation and purification; screening of high yield strains, mutation breeding; get high quality milk enzyme through in-depth study of gene engineering and the immobilized enzyme; modified enzyme; gene expression study on the mechanism of primary lactose intolerance. With the increasing awareness of the nutritional value of dairy products and the deepening of lactase research, I believe that in the near future, lactose intolerance will no longer become a problem, and milk will be more widely used.

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