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The Role and Future Prospects of Microorganisms in Fermented Food Production

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Abstract. Microbes have been used in the production of fermented food for a long time. Through the use of microorganisms, food fermentation can not only improve the flavor of food, but also improve the nutritional value of food. With the progress of modern fermentation technology, the microbial cultivation technology is becoming more and more mature, and more and more fermented or semi-fermented products such as artificial meat, bean paste, yogurt and liquor appear on the market. In the perspective of the whole food industry, microorganisms in the processing of food production fermented food in the future also has a huge development space, using genetic engineering, molecular biology and other frontier biotechnology microbial research, explore the mechanism of microbial fermentation raw materials and the connection between microorganisms, so as to realize in the process of fermentation to microorganisms more scientific and reasonable regulation, and improve the quality of fermented food. This paper makes a detailed summary of the role of microorganisms in food processing and the application status of microorganisms, and provides suggestions on the future development prospects of microorganisms, and provides reference for the development of microbial fermentation technology in the food field.

Keywords: Fermented foods; microbial fermentation technology; application.

1. Introduction

Fermented food refers to a kind of food that people process and make by using beneficial microorganisms. In the production process of fermented food, microorganisms are used to treat the raw materials, and the enzymes secreted by the microorganisms decompose the cell wall, changing the texture of the food and improving its taste. At the same time, the flavor substances produced during the fermentation process give the food a unique flavor, such as yogurt, wine, soy sauce, and pickled vegetables. From the perspective of food preservation, usually the original food is not easy to preserve, and it is easy to appear food corruption phenomenon, while the food fermented by microorganisms such as pickled vegetables and cheese can be preserved for a longer time. From the perspective of human nutrition intake, the microorganisms, minerals, and other nutrients in the food after microbial fermentation, as well as proteins that are decomposed into small molecular amino acids and peptides by microorganisms, are more easily absorbed by the human body. In addition, microorganisms consume a large amount of carbohydrates and fats in food raw materials during the fermentation process, effectively reducing calories intake during ingestion, meanwhile, in the process of transportation, microorganisms often produce vitamins that are not contained in food raw materials, so the food after microbial fermentation has higher nutritional value. In general, the significance of studying microorganisms in fermented foods lies in improving food quality and flavor, enhancing food nutritional value, extending the shelf life of food and promoting healthy eating. Nowadays, as people pay more attention to food's taste and calories consumed, fermented foods are becoming more and more popular, and there are more fermented foods with varying degrees on the market. In the traditional processing process, due to the technical limitations, the production process is generally complex process, long production cycle problems. To improve fermented foods and enhance production efficiency, modern fermentation engineering adopts high-throughput screening (HTS) technology, metabolic engineering, genetic engineering, and other technologies to improve microbial

strains, and then improves the taste and nutritional value of food through single microbial culture and mixed microbial systems.

At the same time, after eating the microbial fermented food, many microorganisms will enter the human body, and the beneficial microorganisms can play a positive role in the metabolism of the human body. These research results not only help to promote the development of food science but also help to improve people's quality of life and standards.

2. Role of Microorganisms in Food Processing

2.1. Enhance the Taste of Food

First, when using microorganisms to process food, microorganisms can decompose the macromolecular substances in food such as carbohydrate, cellulose, protein, fat, etc., forming small molecular substances that can stimulate human smell and taste, and making the food taste more rich. Second, microorganisms can secrete a variety of enzymes, which break down the cell wall, so that the structure of food changes, combined with the processing of fermentation, food can get a better taste [1]. Third, microbial fermentation can remove the fishy smell, odor and other adverse factors that are not conducive to the production, processing and sales of food. After the combined fermentation of Pichia amenthionina Y and lactobacillus XPL-1 in soybean milk, the sample analysis by GC-MS showed that the characteristic components of fishy aldol basically disappeared, and the aroma characteristics of alcohol and esters such as ethyl acetate and phenylethanol were prominent. This shows that the soybean milk fermented by Pichia amenthionina Y and lactic acid bacteria has better quality compared with that before treatment [2].

2.2. Improve the Nutritional Value of Food, Strengthen the Human Absorption Effect

When microorganisms ferment food, they produce metabolites that are beneficial to humans. Microbial polysaccharides can effectively regulate the intestinal flora and improve the gastrointestinal health. Microbial fermentation of food can produce a variety of human essential amino acids. Li analyzed the ∑EAA/∑NEAA and AAS values, and found that the fermented mandarin fish had a large increase in free fatty acids and essential fatty acids compared with the fresh mandarin fish [3]. In the process of fermenting food, microorganisms decompose macromolecular substances in food such as protein, carbohydrate, fat and form small molecular compounds and other amino acids, which is more conducive to the absorption of the stomach and stomach. In mixed bacteria fermentation, Bacillus subtilis, Bacillus cereus, lactobacillus and yeast are in a certain proportion. In the material to water ratio of 1:1 and fermentation for 24h, the removal rate of phytic acid under pH natural conditions is as high as 86.71% [4].

In addition, microorganisms can significantly reduce cereals, beans and other foods contain phytic acid, phytic acid and calcium, magnesium, iron, zinc and other metal ions form complexes, these complexes to gastrointestinal absorption of minerals, and microbial fermentation food significantly reduce the content of phytic acid such as nutrients, promote the human body to the absorption of minerals.

2.3. Health Care Function

Many food products, after fermentation by microorganisms, will produce some biological active substances that the food itself does not have [5]. For example, the enzymes produced by probiotics fermentation from animals, plants and bacteria have biological activities such as increasing antioxidant activity, regulating blood pressure, relieving alcohol and protecting liver. In addition, lactobacillus such as lactic acid bacteria and Bifidobacillus are currently eaten as probiotics and colonized in the stomach and intestines, which can effectively inhibit the proliferation of harmful bacteria such as E. coli and Salmonella, while probiotics can help regulate intestinal pH, promote gastrointestinal peristalsis, prevent or improve diarrhea and other symptoms.

3. Current Status of Microorganisms in Food Fermentation

3.1. Single Cell Protein

Single cell protein (SCP), also known as microbial protein (MP), is a microbial body cultured on industrial and agricultural waste and petroleum waste. At present, mold mainly uses mold, Yeah, Fungi, or Alga to produce SCP. SCP is a new source of protein rich in nutrition, protein content up to 40%~80%, and contains a variety of vitamins, minerals and a variety of biological active substances such as coenzyme Q, glutathione, etc. Bacterial proteins are rich in protein, amino acids and other nutrients, and their essential amino acids and overall nutritive value even exceed fishmeal [6]. At the same time, natural gas-based SCP also has the potential to serve as a feed protein. The SCP production process can be summarized as expanding the strains for sterilization, and then putting the bacteria into the fermenter, and then controlling the fermentation conditions. After the fermentation, the finished products are obtained after separation, filtration and drying.

SCP has huge market potential because of its rich nutrition, wide raw material sources, short cultivation cycle, high production efficiency and industrial production.

3.2. Condiment

Microorganisms are widely used in the production of condiments, such as vinegar, soy sauce, MSG and other seasonings. In the fermentation process, microorganisms can improve the taste of food, enhance the taste of food to varying degrees, and produce special flavor. After boiling beans and beans, beans were inoculated with Aspergillus rice, and then cultivated and fermented to produce a bean paste with rich bean flavor. In the production of vinegar, molds, yeast and other starch saccharification to produce small molecular sugar, and then yeast and lactic acid bacteria in the anaerobic environment to produce ethanol. In this process, yeast can also promote the generation of organic acids, amino acids, pyrazines and other flavor substances. Finally, lactic acid bacteria and acetic acid bacteria are selected to ferment alcohol substrates such as ethanol and sugar alcohol to produce organic acids such as acetic acid and lactic acid, and to promote the formation of some ketones and aldehydes of flavor substances [7].

3.3. Alcoholic Beverages

With the development of modern industry, the wine industry has become an important part of the national economy. In the process of wine making, microorganisms secrete enzymes in the growth and reproduction, and large molecules such as protein, sugar and fat in the raw materials are decomposed to form small molecule compounds such as amino acids, oligosaccharides and fatty acids. At the same time, the vitamins, amino acids and other substances produced by microorganisms in the growth and reproduction process not only promote the growth and reproduction of other microorganisms, but also can participate in the chemical changes in the process of brewing, generating ethyl hexanate, lactic acid and other fragrance substances. In order to reveal the flavor function microorganisms in the fermentation process of barley wine, Liu et al. adopted HS-SPME-GC-MS to analyze the flavor substances produced in the fermentation process of barley wine, and then selected 17 dominant microbial genera to calculate the Spearman correlation coefficient between them and the flavor substances (ρ). This study showed that Aspergillus, Saccharomyces and other bacteria were the main flavor function microbial flora, and Saccharomyces was shown to be significantly positively associated with alcohols and Komagataella with esters [8].

Microorganisms are currently widely used in the research and production of fermented foods such as condiments, wine and products such as single-cell proteins. Microorganisms can not only be used to improve food taste and nutritional value, but also to produce special fermented flavors.

4. Prospect of Microorganisms in Fermented Foods

Most of the microorganisms in traditional food fermentation are mixed bacteria fermentation system, while in modern fermentation industry, pure seed fermentation occupies a large proportion, but in fact, products such as Luzhou-flavor liquor and bean paste can only be mixed fermentation with multiple strains, and it is difficult to obtain the above products only through pure seed fermentation. Traditional fermentation process is limited by production conditions. The microorganisms in the fermentation process not only come from curved species, but also from raw materials, fermentation environment, production tools, etc., and the microbial community is complex and diverse [9]. In the long-term culture of specific fermentation environment, a mixed system with the core flora for fermentation was formed. Under the mixed bacteria system, each microorganism maintains its independence and is associated with each other. However, this traditional mixed bacteria system often has some problems, such as low raw material conversion rate, adverse by-products, and low efficiency of flavor generation.

Modern fermentation industry often uses qPCR technology and high throughput sequencing technology such as traditional mixed system rapid quantitative detection, and further combined with the composition of fermentation process of real-time monitoring to analyze the flora structure and succession, and then select the flavor contribution strains, not cultured functional microorganisms, etc., at the same time resolve the connection between microorganisms, finally through artificial restructuring bacteria, artificial control flora and synthetic technology to optimize the quality of fermented food [10].

5. Conclusion

Microbial fermentation technology is of great significance to the food processing industry. After the fermentation treatment of cereals, beans, milk and other raw materials, it can improve the food flavor, improve the nutritional value of food, and produce active substances beneficial to human body. The progress of microbial fermentation technology will also provide strong technical support for the research and development of fermented food and the improvement of processing technology. This paper analyzes the recent application progress of existing microbial foods and finds that traditional food fermentation exists in the production efficiency of low, low raw material conversion rate, modern fermentation technology, through microbial single culture, artificial recombinant bacteria, artificial deployment, optimization of fermentation system, by solid fermentation, mixed fermentation system, pure-red fermentation technology to optimize the quality of fermented food, microbial now widely used in wine, condiments, dairy products and other fermented food and single cell protein, microbial polysaccharide product production, development potential is huge. In the future, the fermented food industry can use more advanced sequencing technology and analysis technologies such as flow cell technology, EMA/PMA-qPCR technology to study the community composition of microorganisms and the mechanism of microorganisms producing flavor substances, which is conducive to promoting the progress of the food industry.

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