Analysis of Biotechnology in China's Food and Oil Industry

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Abstract. Since the foundation of People's Republic of China, China's biochemistry research-based foodstuffs production technology has become more mature. It not only improves quality and quantity of China's foodstuffs, but also ensures the safety of food supply. This paper takes soybean as the material and regards biotechnology as the basis of theory and practice to discuss the application of biotechnology in two foodstuffs industries: extracting soybean oil with microbial fermentation and producing soybean protein lactic acid bacteria beverage with enzymolysis technology. The results show the importance of biotechnology in foodstuffs production.

Introduction

China is a large country for producing, processing and consuming food and oil. The development of biotechnology can improve the utilization of grain crops as well as the quality of foodstuffs. Biotechnology covers a lot of fields, such as genetic engineering, cell engineering, fermentation engineering and enzyme engineering, etc. They are used in various fields. They can be used to create new types of grain crops with new functions, and also can be used to modify existing grain crops to make them meet people's eating habits and improve the benefits of foodstuffs production.

Analysis of extracting soybean oil with microbial fermentation

Employing microbial fermentation to extract soybean oil is a relatively mainstream production technology in foodstuffs industry. It uses mainly ultrasonic separation technology and enzymatic auxiliary technology. Compared with those traditional methods, it can extract soybean oil more thoroughly and improved oil extraction technology. In the soybean fermentation process, enzyme output and bacteria growth are simultaneous. It improves the separation efficiency of soybean oil and reduces product costs significantly. And this technology is quite simple and has few limitation factors. As long as the integrity of raw materials, temperature, cultivation time, substrate concentration and initial pH value are controlled well, the targets can be reached.

The introduction to the experiment method

In soybean, oil, seeds and protein are a combination. Current popular technology to extract soybean oil is to decompose soybean protein to get soybean oil. The enzyme microorganism can be used to ferment soybean to get soybean protein which can be decomposed to get soybean oil. In this operation, fermentation temperature, time and initial pH shall be improved in extracting oil with microorganism. And bacteria shall be used to perform molecular biological identification on experiment subjects.

The selection and configuration of medium

Employing microorganism fermentation technology to extract soybean oil needs agar slant medium and other materials, such as peptone 1.4%, beef extract 0.5%, agar 2.5% and sodium chloride 0.8%. The pH shall be in the range of 7.0 to 7.5. The agar slant medium shall be sterilized for 20 minutes under 125 ℃ and then be removed and put into slant for the use of experiment.

The test of oil extraction ratio

This paper uses continuous extraction (Soxhlet extractor method), which is a biotechnology to extract compounds from solid materials and also can be used for determining crude fat. First put

fermented soybean mixture in centrifuge, and perform centrifugation for over 15 minutes at 4000~4500r/min. Then add some ether (its volume shall be equal to soybean mixture) in the supernatant, and ether layer shall be extracted at room temperature. Put extracted ether layer into a dried constant weight Erlenmeyer flask. Then give a 35℃ water bath to the Erlenmeyer flask to evaporate ether from the ether layer, then dry the Erlenmeyer flask at 50℃ till it has a constant weight. Then the oil extraction ratio can be calculated. Repeat this experiment for three times to get the results, and then calculate the average value. According to the results, the calculation formula of soybean oil extraction ratio is as following:

$$W=(M1-M2)/M \times 100\%$$

In the above mentioned formula, W is the extraction ratio, M_1 and M_2 mean the weight of soybean in the flask and the weight of flask respectively. M is the total oil content.

The control optimization of soybean fermentation conditions—response surface experiment design

In the response experiment, the fermentation time, cultivation temperature and pH value are corresponding variables, and Minitab 15 software is used to design response surface, which can improve the microorganism fermentation oil extraction technology. As what has mentioned above, experiments shall be performed for three times or more. And the level and place of each experiment shall be different to achieve the goal of optimizing soybean fermentation conditions [1].

Table 1. Variable factors' data form in the response surface experiment

Level	Factors		
	A	B	C
	Time（h）	pH	Temperature（℃）
-1	17	4	34
0	20	6	36
1	23	8	38

The extraction method of genome in soybean mixture

Genome extraction is a process of combining bacteria and medium. It can extract genome from the soybean mixture quickly, analyze its DNA characteristics and help extract soybean oil. First bacterial cells cultured overnight shall be put into the centrifuge tube. Then the tube shall be given centrifugal rotation at 10000rpm and room temperature for 1-2 minutes. Then the bacteria and supernatant shall be collected.

Second adding 20mg/ml of lysozyme and 10mg/ml of 20 μL protease K solution in the medium. After shaking them till them mix well, give the medium a water bath for 30 minutes at 56 - 60℃ to let them lyse completely.

Third put the adsorption column in the adsorption tube, then use liquid moving machine to move the solution in the medium and translucent fibrous suspension into the adsorption column. Put them still for 2 minutes, and then give them centrifugation for at least 3 minutes in a centrifuge at room temperature and 12000rmp. Then discard the filtrate.

Fourth take out the adsorption column in the medium and put it into a 1.5 mL centrifugation tube. Add 50 μL eluate at 60℃ into this tube, then put them still for 3 minutes. Give them centrifugation for 1 minute at 10000rmp and then collect DNA solution. Now we can use downstream molecular experiment to test the characteristics of soybean genome.

The impacts of various factors on extracting soybean oil in microorganism fermentation

The impact of pH on extraction ratio

After crushing soybean and sifting them with 80 meshes, 10g crushed soybean powder could be taken out to mix with water to make 10% content mediums. Existing pH shall be changed as pH1,

pH3, pH5, pH7, pH9 and pH11. Cultivate them in table concentrator at 35 - 38℃ for 19-22 h. Its oil extraction results shall be as following graph 1:

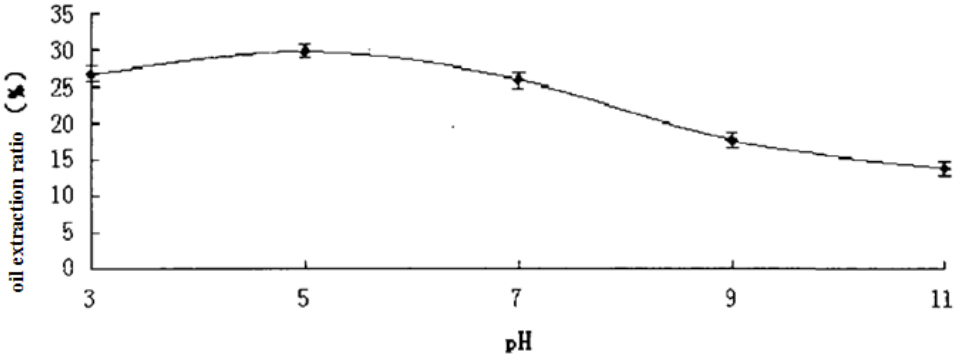

Fig. 1. The effect of pH on soybean oil extraction ratio

According to graph 1, protease produced by the bacteria in the culture dish and enzymatic effect of soybean powder shall be linked to the initial pH. As pH value may affect enzyme production of bacteria, it will affect soybean oil extraction ratio. Thus if pH value is controlled in the range of 1-3, oil extraction ratio may be improved greatly. If pH is in the range of 3-5, oil extraction ratio's growth will slow.

With the increase of pH value, oil extraction ratio reduces. Test results show that pH5 is the best initial fermentation value.

The effect of cultivation temperature on oil extraction ratio

After crushing soybean and sifting them, 10g soybean powder shall taken out to mix with water to make a 10% content medium. Maintain pH as 5, cultivate them in table concentrator at 32-40℃ for 19-22h. Its oil extraction ratios are as following:

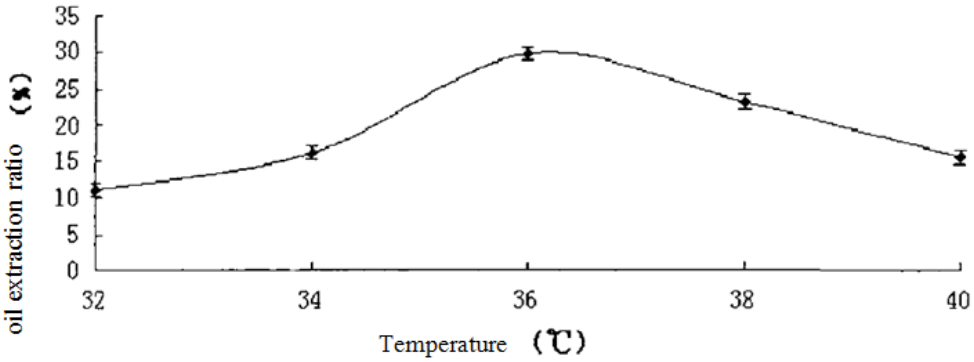

Fig. 2. The effect of temperature on oil extraction ratio

Temperature is one of the biggest factors that affects oil extraction ratio in microorganism. Higher or lower temperature will affect the enzyme production efficiency of microorganism and the effect of enzyme on oil extraction ratio. In regulating temperature, the temperature shall be increased from 32℃ to 36℃. Results show that oil extraction ratio increases gradually and the growth is obvious. When the temperature increases from 36℃ to 40℃, oil extraction ratio deduces. The reason is that when the temperature is over 36℃, some bacteria will lose activation or even die for they could not bear the high temperature. On the other hand, when the temperature increases, protease produced by microorganism will lose activation for they could not bear high temperature. Considering all these factors, 34~36℃ may be the best fermentation temperatures for microorganism fermentation technology [2].

Microorganism fermentation has a significant effect on oil extraction. But there are many factors to be considered, like controlling fermentation temperature, pH values and fermentation time. At the

same time, the response surface experiment has optimized soybean oil extraction. It has a broad application range and its results can be predicted. Thus it can provide precise variables and error information and plays a key role in oil extraction with microorganism fermentation technology.

Analysis of production research on enzymolysis technology-based soybean protein lactic acid bacteria beverage

Soybean contains rich and quality protein sources. If soybean protein is fermented by lactic acid bacteria to make soybean protein lactic acid bacteria beverage, this beverage could provide better probiotic effect. So the lactic acid bacteria are also called as probiotics. If humans intake of a certain amount of lactic acid bacteria, these bacteria can help maintain intestine's normal function, improve intestinal microenvironment, reduce humans' serum cholesterol and enhance humans' immunity. So the soybean protein lactic acid bacteria beverage has a strong healthcare function. The soybean protein lactic acid bacteria beverage is made by enzymolysis technology. This technology can reduce soybean peptide, improving soybean milk's taste. At the same time, the integration of lactic acid bacteria and soybean peptide can strengthen beverage's anti-oxygenation and helps improve lactic acid bacteria's activation.

The application of enzymolysis technology

In the enzymolysis process of soybean milk, trypsin, alkaline protease, neutral protease and papain are selected to perform enzymolysis to the soybean milk. The main goal of enzymolysis is to improve the taste and lactic acid bacteria's activation of lactic acid bacteria beverage. In the enzymolysis process, a 10% NaOH solution is mixed with soybean milk to regulate its pH value to 7.0. Then the enzymolysis is carried out. In this process, it does not need to regulate pH value. See graph 2.

Table 2. The enzymolysis effects of 4 kinds of proteases

No.	Protease	Temperature ℃	Enzyme content %	Time h
SH 0		0.5%~0.8%	55	4
SH 1	Alkaline protease	0.5%~0.8%	55	4
SH 2	Neutral protease	0.5%~0.8%	45	4
SH 3	Papain	0.5%~0.8%	55	4
SH 4	Trypsin	0.5%~0.8%	55	4

Analysis of enzymolysis effects on soybean protein lactic acid bacteria beverage taste

First enzymolysis technology has a significant influence on regulating soybean protein lactic acid bacteria beverage taste. It reduces the flavor of soybean beverage. This shows that enzymolysis could improve the flavor of soybean. Scientific experiments show that enzymolysis could decompose small peptides and amino acids in soubean protein, separate the beany flavor from protein. Thus the taste of soybean milk will be changed. Although the beany flavor has been reduced, the bitterness of enzymatic hydrolysate still exists. The bitterness is obvious especially in soybean milk decomposed by alkaline protease and neutral protease. The bitter is relatively lighter in enzymatic hydrolysate decomposed by papain and trypsin. Some experts think that this bitterness is from polypeptide of protease. After being hydrolyzed, the polypeptide will release some hydrophobic amino acid residues. This residue contains long chain aromatic amino acid residues; this is the source of bitterness. Generally speaking, hydrophobic group of papain is hidden in protease, thus its bitterness could not be tasted. Only when protein is hydrolyzed to become small peptides, its hydrophobic group can be shown, thus we can taste the bitterness [3].

Normally speaking, people will choose papain in making soybean protein lactic acid bacteria beverages, for papain has the best enzyme effect and people is easy to accept the flavor of its product. It will taste better after adding sugar, juice and essence. This show that in making beverages, peptidase of lactic acid bacteria will further hydrolyze the bitterness flavor peptide in protease to reduce the bitterness flavor from the beverage.

To sum up, when the soybean milk is pulped by 100℃ water, enzymolyzed by papain at 55℃ for 4 hours, and deactivate enzyme at 90℃ for 10 minutes. This can reach the inoculation and fermentation. The lactic acid bacteria beverages produced in this operation process has a good taste, and lactic acid bacteria survive long and have a large quantity (They can survive 30 days at 4℃ in storage environment). It is an relatively ideal enzymolysis technology for soybean products.

Conclusion: This paper mainly introduces microorganism-based fermentation soybean oil extraction technology and enzymolysis technology process of soybean protein lactic acid bacteria beverages. Both of them show the importance of biotechnology in foodstuffs production. Through applying these technologies and the achievements made by them, people realize the importance of biotechnology and its related industry in China's food and oil industry. Therefore China should fully study and take advantage of biotechnology, apply it in foodstuffs' deep processing and full application, extend it to all food production fields in order to exert its powerful efficacy and economy.

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