A Study on Increasing Solubility of Soy—protein by Ultrasonic Waves*

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Abstract To increase the recovery rate and protein's content of soybean products through refined processing, we use the ultrasonic waves to treat the mixture of soy milk and soy pulp after wet—grinding, thus producing the effect of ultrasonic hole, which increases the solubility rate of soybean protein and decreases the remnants of soybean protein in soy pulp. The results show that ultrasonic waves can improve the solubility of soy protein. As a result, the content of soy milk protein and the dry weight of soy milk relatively increased by 6.6% and 11.6% respectively. This technique can improve the content of protein and the recovery rate in terms of traditional soy products and modern—processed soybean products including soy milk, instant soy powder, isolated soy protein, concentrated soy protein and so on.

Key words Ultrasonic waves; Soy protein; Solubility
中图分类号 S565.1 文献标识码 A 文章编号 1000—9841(2001)02—0102—03

The protein in traditional soy products and modern—processed soybean products belongs to the water—soluble protein existed in crude soybean, but the water—insoluble protein, part of lipoprotein, glycoprotein and the protein adhered to cellulose are insoluble. The content of protein remained in soy pulp amounts to about 20—29% (according to weight of dry basis). So the soybean pulp can only be used as forage or fertilizer, thus causing the waste of resources and increasing the cost of soybean products.

According to the records, ultrasonic waves can make biological macromolecule degrade, which possess such functions as emulsifying, sterilizing, deactivation of enzyme and rinsing. Nowadays, cell grinding machines, emulsification—homogenization machines and washers by means of ultrasonic waves have been put into practice.

The ultrasonic extraction technology, with which Yang Yanqiu makes highly purified powder lecithin, has been applied for patent.

In soybean protein—extraction technology, the ultrasonic waves produced effect of hole in liquid—the instant—high pressure (as high as several ten—thousand atmospheric pressures) grinds the macromolecules, at the same time, makes the protein adhering to the cellulose drop and makes parts of lipoprotein and glycoprotein free. Thus increasing the solubility of soybean protein.

In view of the above theories, we carried out the study on increasing soy—protein's solubility by ultrasonic waves. After repeatedly tests, we obtain the following results.

1 Materials and Methods

1.1 Materials

Soybeans from market

1.2 Equipment

* 收稿日期: 2000—08—21
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Model JY92—Ⅱ ultrasonic cell grinding machine made by XinZhi Research Institute for Scientific Equipment, in Ningbo.

1.3 Test methods

1.3.1 Check group

Select soybeans and grind them, when the grinded fineness reaches 60 mesh/in, put a 40g—smple into a 500ml—container with 240ml water. After soaking 3 hours, stir for 30 minutes with 120rpm. Then the milk and pulp separation is made through a meshed sieve of 100 mesh/in. This kind of soybean milk and soy pulp is the samples of check group.

1.3.2 Ultrasonic extraction group

Stirring is achieved though ultrasonic waves which is different from the check group (parameters in ultrasonic extraction group: power: 500W、frequency: 25KHz、processing time: 15min). This kind of soybean milk and soy pulp is the test sample.

1.4 Calculation method

Relative increased value =

$$\frac{\text{test group} - \text{check group}}{\text{Check group}} \times 100\%$$

Relative decreased value =

$$\frac{\text{check group} - \text{test group}}{\text{Check group}} \times 100\%$$

2 Results

In terms of State Standard GB5511—85 and other related stipulations, the samples have been examined. The results are as follows:

2.1 Compared with the check group, the content of soy milk protein relatively increased by 6.6% in the ultrasonic extraction group.

Table 1 The ratio of soybean milk protein (dry basis) between check group and ultrasonic extraction group

Names	Check group	Ultrasonic extraction group 1	2	3	4
Contents of soy milk protein (dry basis) %	39.4	42.4	41.4	42.2	42.3
Average %	39.4		42.0		

2.2 Compared with check group, the content of protein in soy pulp relatively decreased by 18.5% in the ultrasonic extraction group.

Table 2 The ratio of protein content in soy pulp (dry basis) between check group and ultrasonic extraction group

Names	Check group	Ultrasonic extraction group 1	2	3	4
Contents of protein in soy pulp (dry basis) %	23.8	19.0	20.2	19.2	19.1
Average %	23.8		19.4		

2.3 Compared with check group, the weight of dry materials in soy milk relatively increased by 11.6% in the ultrasonic extraction group

Table 3 The ratio of dry materials in soy milk between ultrasonic extraction group and check group

Names	Check group	Ultrasonic extraction group 1	2	3	4
Dry materials in soy milk g	22.4	25.2	24.8	25.0	25.1
Average g	22.4		25.0		

2.4 Compared with check group, the weight of soy pulp dry basis relatively decreased by 18.9% in ultrasonic extraction group

Table 4 The ratio of dry basis in soy pulp between ultrasonic extraction group and check group

Names	Check group	Ultrasonic extraction group 1	2	3	4
Dry basis in soy pulp g	15.0	11.4	12.8	12.0	12.4
Average g	15.0		12.2		

3 Conclusion and analysis

The results of the test show that ultrasonic extraction technology can relatively increase the content of soy milk protein and dry materials in soy milk by 6.6% and 11.6% respectively.

The reason why ultrasonic extraction technology can increase the recovery rate of products is that ultrasonic waves produce the effect of ultrasonic hole—instant—high pressure, which degrades the water—insoluble protein, makes the protein adhered to the cellulose drop, makes parts of lipoprotein and glycoprotein free and decreases the remnants of soybean protein in soy pulp, thus increasing the recovery rate

of the refined processing on soybean.

Ultrasonic extraction technology can not only be used in traditional processing of soybean products and soybean milk, but also be used in such technological processing as the making of instant soy powder and the soybean separation in soybean processing.

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超声波对大豆蛋白增溶作用的研究

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摘要 为了提高大豆深加工产品的得率和蛋白质含量，利用超声波处理大豆经湿磨后的浆渣混合液态物，产生超声空化效应，提高大豆蛋白的溶出率，减少大豆蛋白在豆渣中的残留。试验表明：超声提取技术能提高大豆蛋白的溶出率，从而使豆乳蛋白含量相对提高 6.6%，豆乳干物质重量相对提高 11.6%。该技术对于传统大豆制品及现代大豆加工新产品如豆奶、速溶豆粉及分离蛋白、浓缩蛋白等产品的生产均具有提高蛋白含量、增加得率的效用。

关键词 超声波；大豆蛋白；溶出率