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The Extracting Technology of Polysaccharide from Tartary Buckwheat

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Abstract

Buckwheat (F. tartaricum Gaertn) has many functions of dietotherapy and health care, which are beneficial to the treatment of diabetes, hypertension, cardiovascular disease, anti-cancer and so on. Buckwheat polysaccharide is one of important functional ingredients of Buckwheat. In this paper, the extracting technologies of polysaccharide from Tartary buckwheat were investigated. The results showed that the optimum parameters for the extraction is solid to liquid ratio 1:20, temperature 85 ℃, duration 120min, extraction for 2 times, alcohol concentration 80%.

Keywords

tartary buckwheat, extraction, polysaccharide, orthogonal design

1. Introduction

Buckwheat (*F. tartaricum Gaertn*) has high nutritional value, containing various functional components which are beneficial to the treatment of diabetes, hypertension, cardiovascular disease, anti-cancer and so on (Li et al., 2010; Zhang et al., 2010; Wang et al., 2017). Buckwheat (*F. tartaricum Gaertn*) has many functions of dietotherapy and health care. Buckwheat polysaccharide is one of important functional ingredients of Buckwheat (Cao et al., 2008; Wu et al., 2010). There are few studies on buckwheat polysaccharides and the mechanism of buckwheat polysaccharides in the treatment of diseases is need to further study. Whether it has synergistic effects with flavonoids, inositol and protein in buckwheat should be further studied. Here, we analyzed the effects of the extraction conditions to tartary buckwheat polysaccharides and got the optimal preparing conditions for tartary buckwheat polysaccharides. The results of this work will lay the foundation of theory and application for the further study of tartary buckwheat polysaccharides.

2. Materials and Methods

2.1 Preparation of Buckwheat Flour

Tartary buckwheat (Chuanqiao No. 1) was purchased from Liangshan Yi Autonomous Prefecture. Buckwheat was grinded into flour using flour mill, then filtered using 200 mesh sieve.

2.2 Extraction Process of Tartary Buckwheat

Tartary buckwheat was grinded into flour using flour mill, then filtered using 200 mesh sieve. Polysaccharides were extracted from buckwheat flour using hot water, and then the liquid was centrifuged at 5000g for 10min, the supernatant was put into a new tube and added alcohol solution to precipitate the polysaccharides for 12h, then centrifuged at 5000g for 10min, discarded the alcohol solution and the precipitation washed using anhydrous ethanol and drying. The dried precipitation was dissolved in water for further analysis.

2.3 Determination of Polysaccharide Content (Zemnukhova et al., 2004; Lee et al., 1995)

Accurately prepare 0.1mg/mL glucose solution (glucose standard solution). Add 0.1mL, 0.2mL, 0.4mL, 0.6mL, 0.8mL, 1.0mL of glucose standard solution in the calibration tubes and add the ddH_2O volume up to 2.0mL, and then add the 2 mL phenol solution, Mix well. Finally, Drop concentrated sulfuric acid 10 ml slowly, mix well, boil 15 min in boiling water bath. After cooling, the absorbance value was measured at 490nm wavelength with a blank reagent as reference. The standard curve was made with glucose concentration X as abscissa and absorbance difference (Y) as ordinate. The regression equation was y=4.2586x-0.0038, and the correlation coefficient was r=0.9982 (Figure 1).

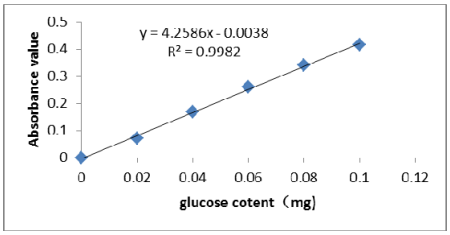

Figure 1. Standard Curve of Glucose

2.4 The Optimization of the Preparation Process of Buckwheat Polysaccharides

To optimize the preparation process of buckwheat polysaccharides, the major factors and their levels were determined according the effects of various factors (such as solid to liquid ratio (S/L), ethanol concentration, extraction temperature, extraction time, extraction times) on buckwheat polysaccharides content. The optimum preparation conditions of buckwheat polysaccharides were further determined using orthogonal test.

3. Results and Discussion

3.1 The Effects of Solid to Liquid Ratio on Buckwheat Polysaccharides Extraction

The buckwheat polysaccharides were extracted at different solid to liquid ratio for 60min with temperature was 60℃, ethanol precipitation concentration 60%. The buckwheat polysaccharides content was analyzed. The optimum solid to liquid ratio was 1:20 (Figure 2).

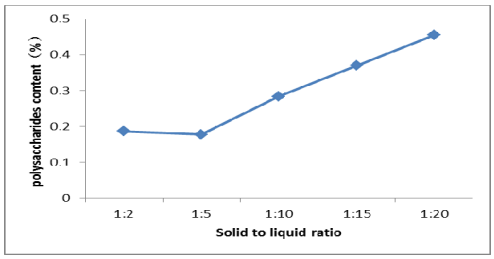

Figure 2. Effects of Solid to Liquid Ratio on Polysaccharides Extraction

3.2 The Effects of Ethanol Concentration on Buckwheat Polysaccharides Extraction

The buckwheat polysaccharides were extracted for 60min with temperature was 60℃, solid to liquid ratio was 1:10, using different ethanol concentration for precipitation. The buckwheat polysaccharides content was analyzed. The optimum ethanol precipitation concentration is 60% (Figure 3).

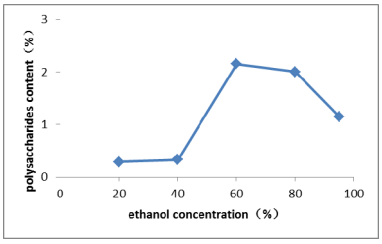

Figure 3. Effects of Ethanol Concentration on Polysaccharides Extraction

3.3 The Effects of Extraction Time on Buckwheat Polysaccharides Extraction

The buckwheat polysaccharides were extracted for different time with temperature was 60℃, solid to liquid ratio was 1:10, ethanol concentration was 50%. The buckwheat polysaccharides content was analyzed. The optimum *extracting time* is 120 min (Figure 4).

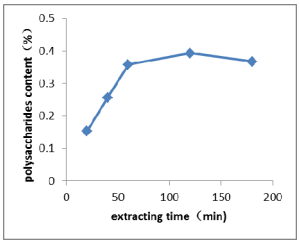

Figure 4. Effects of Extracting Time on Buckwheat Polysaccharides Extraction

3.4 The Effects of Extraction Temperature on Buckwheat Polysaccharides Extraction

The buckwheat polysaccharides were extracted for 60min at different temperature, with solid to liquid ratio was 1:10, ethanol concentration was 50%. The buckwheat polysaccharides content was analyzed. The optimum extraction temperature is 60℃ (Figure 5).

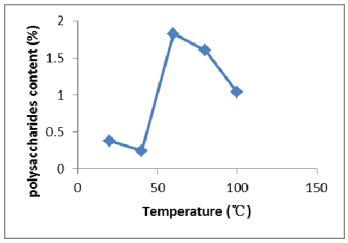

Figure 5. Effects of Extraction Temperature on Buckwheat Polysaccharides Extraction

3.5 The Effects of Extraction Times on Buckwheat Polysaccharides Extraction

The buckwheat polysaccharides were extracted for 60min at different extraction times, with solid to liquid ratio was 1:5, extraction temperature is 60℃, ethanol concentration was 50%. The buckwheat polysaccharides content was analyzed. The optimum extraction times is 2 (Figure 6).

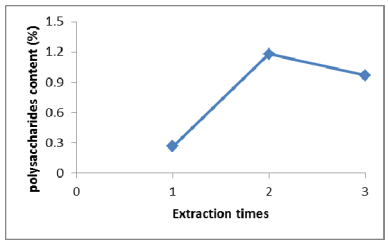

Figure 6. Effects of Extraction Times on Buckwheat Polysaccharides Extraction

3.6 Orthogonal Experiment of Buckwheat Ppolysaccharides Extraction

According the effects of individual factors on buckwheat polysaccharides extraction, orthogonal experiments were conducted using extraction times, Solid-to-Liquid ratio (S/L), temperature and ethanol concentration as factors and flavonoid content as index (Tables 1 and 2).

Table 1. Factor Level Table

Level	A (extraction times)	B (S/L)	C (temperature /℃)	D (ethanol concentration /%)
1	1	1:10	40	40
2	2	1:15	60	60
3	3	1:20	80	80

Table 2. $L_9(3^4)$ Polysaccharides Extracting Orthogonal Experiment Design and Results

No.	A (extraction times)	B (S/L)	C (temperature /℃)	D (ethanol concentration /%)	Extraction rate of Polysaccharides (%)
1	1	1 (1:10)	1(40)	1 (40)	0.234
2	1	2 (1:15)	2 (60)	2 (60)	0.716
3	1	3 (1:20)	3 (80)	3 (80)	1.05
4	2	1 (1:10)	2 (60)	3 (80)	1.237
5	2	2 (1:15)	3 (80)	1 (40)	0.762
6	2	3 (1:20)	1 (40)	2 (60)	0.583
7	3	1 (1:10)	3 (80)	2 (60)	0.767
8	3	2 (1:15)	1 (40)	3 (80)	0.577
9	3	3 (1:20)	2 (60)	1 (40)	0.636
K1	2.000	2.238	1.394	1.632	
K2	2.582	2.055	2.589	2.066	
K3	1.980	2.269	2.579	2.864	
R	0.201	0.071	0.398	0.411	

As the results shown in the Table 2, ethanol concentration had the largest effect on polysaccharide content. Temperature had the second largest effect on polysaccharide content. Extraction times had the third largest effect on polysaccharide content. Solid-to-liquid ratio had the fourth largest effect on polysaccharide content. The optimum parameters for producing technology of polysaccharides from buckwheat using hot water-ethanol method are $A_2B_3C_2D_3$, that is ethanol concentration 80%, temperature at 60℃, solid-liquid ratio 1:20, extraction times 2. The sequence of effects on polysaccharide content: D>C>A>B.

4. Conclusions

The main factors affecting the extraction of polysaccharides were ethanol concentration, temperature, solid-liquid ratio and extraction times. Through the analysis of single factor gradient experiment and orthogonal experiment, the optimum extraction conditions were obtained: ethanol concentration was 80%, temperature was 60℃, solid-liquid ratio was 1:20, exacting time 120min, extraction times was 2.

Acknowledgments

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References

Cao, W., Chen, W. J., Suo, Z. R., & Yao, Y. P. (2008). Protective effects of ethanolic extracts of buckwheat groats on DNA damage caused by hydroxyl radicals. *Food Res Int*, *41*, 924-929. https://doi.org/10.1016/j.foodres.2007.10.014

Lee, J. S., Ra, K. S., & Son, H. S. (1995). Extraction and Component Sugar Analysis of Polysaccharides from Buckwheat. *Korean Journal of Food Science and Technology*, *27*(6), 860-865.

Li, D., Li, X. L., & Ding, X. L. (2010). Composition and antioxidative properties of the flavonoid-rich fractions from tartary buckwheat grains. *Food Science and Biotechnology*, *19*, 711-716. https://doi.org/10.1007/s10068-010-0100-4

Wang, L. J., & Bai, X. (2017). The producing technology of Resistant Starch (RS) from buckwheat sing microwave treatment. *Sustainability in Environment*, *2*(3), 301-308. https://doi.org/10.22158/se.v2n3p301

Wu, S. C., & Lee, B. H. (2011). Buckwheat polysaccharide exerts antiproliferative effects in THP-1 human leukemia cells by inducing differentiation. *J Med Food*, *14*(1/2), 1-8. https://doi.org/10.1089/jmf.2010.1252

Zemnukhova, L. A., Tomshich, S. V., Shkorina, E. D., & Klykov, A. G. (2004). Polysaccharides from Buckwheat Production Wastes. *Russian Journal of Applied Chemistry*, *77*(7), 1178-1181. https://doi.org/10.1023/B:RJAC.0000044171.74713.d8

Zhang, M., Chen, H., Li, J., Pei, Y., & Liang, Y. (2010). Antioxidant properties of tartary buckwheat extracts as affected by different thermal processing methods. *LWT-Food Sci Technol*, *43*, 181-185.

Note

Note 1. [1,2] These authors contributed equally to this work.