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The Extraction Technology of Flavonoids from Buckwheat

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Abstract

Buckwheat (*Fagopyrum esculentum*) is a kind of medicinal and edible crops with high Flavonoid content. Flavonoids from tartary buckwheat have significant therapeutic effects on vascular diseases, diabetes and obesity. In this paper, the extracting technologies of flavonoids from buckwheat were investigated. The results showed that the optimum parameters for the extraction is temperature 60℃, alcohol concentration 60%, solid to liquid ratio 1:20, pH=2, duration 120 min.

Keywords: Buckwheat; Flavonoid; Extraction; Orthogonal design

Introduction

Flavonoids have anti-inflammatory, antiallergic, diuretic, antispasmodic, antitussive and hypolipidemic effects, and have significant therapeutic effects on vascular diseases, diabetes and obesity [1,2]. Buckwheat (*Fagopyrum esculentum*) is a kind of medicinal and edible crops. The content of flavonoids in Tartary buckwheat is particularly rich, and the effect is the most remarkable [3,4]. We analyzed the effects of the extraction conditions to tartary buckwheat flavonoids and got the optimal preparing conditions for Tartary buckwheat flavonoids. The results of this work will lay the foundation of theory and application for the further study of Tartary buckwheat flavonoids.

Materials and Methods

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.

Determination of flavonoid content

Accurately prepare 0.1 mg/mL rutin methanol solution (rutin standard solution). Add 0.1 mL, 0.2 mL, 0.4 mL, 1.0 mL, 0.6 mL, 0.8 mL of rutin standard liquid in the calibration tubes and add the 100% methanol solution volume up to 1.0 mL, and then add the 2 mL 0.1 mol/L and 3 mL 1 mol/L acetic acid potassium chloride. Finally, add 30% ethanol up to 10 mL, after resting 30 min, the absorbance was measured at 420 nm. The standard curve was made with rutin concentration X as abscissa and absorbance difference (Y) as ordinate. The regression equation was y=8.0068x, and the correlation coefficient was r=0.9996 (Figure 1) [5,6].

The optimization of the preparation process of buckwheat flavonoids

To optimize the preparation process of buckwheat flavonoids, 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, pH value) on buckwheat flavonoid content. The optimum preparation conditions of buckwheat flavonoids were further determined using orthogonal test.

Results and Discussion

The effects of solid to liquid ratio on buckwheat flavonoid

The buckwheat flavonoids were extracted at different solid to liquid ratio for 60 min with ethanol concentration is 50% and temperature is 30℃. The buckwheat flavonoids content was analyzed. The optimum solid to liquid ratio is 1:20 (Figure 2).

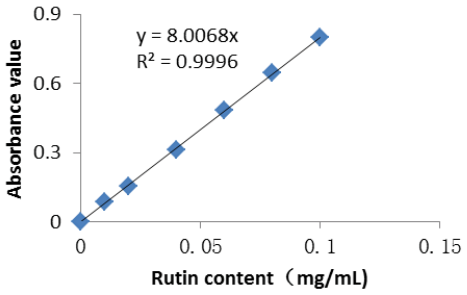

Figure 1: Standard curve of rutin.

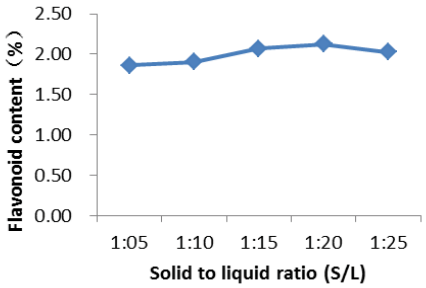

Figure 2: Effects of solid to liquid ratio on flavonoid extraction.

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Effects of ethanol concentration on buckwheat flavonoid extraction

The buckwheat flavonoids were extracted at different ethanol concentration for 60 min with solid to liquid ratio is 1:10 and temperature is 25℃. The buckwheat flavonoids content was analyzed. The optimum ethanol concentration is 60% (Figure 3).

Effects of extracting time on buckwheat flavonoid extraction

The buckwheat flavonoids were extracted at different extracting time with solid to liquid ratio is 1:20, pH 5, ethanol concentration is 50% and temperature is 50℃. The buckwheat flavonoids content was analyzed. The optimum extracting time is 160 min (Figure 4).

Effects of temperature on buckwheat flavonoid extraction

The buckwheat flavonoids were extracted at different temperature with solid to liquid ratio is 1:20, pH 5, ethanol concentration is 50% and extracting time is 60 min. The buckwheat flavonoids content was analyzed. The optimum extracting temperature is 70℃ (Figure 5).

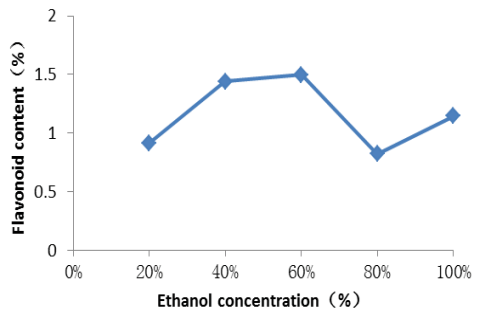

Figure 3: Effects of ethanol concentration on flavonoid extraction.

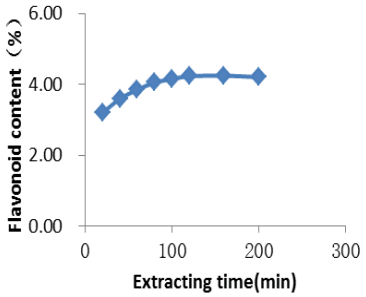

Figure 4: Effects of extracting time on flavonoid extraction.

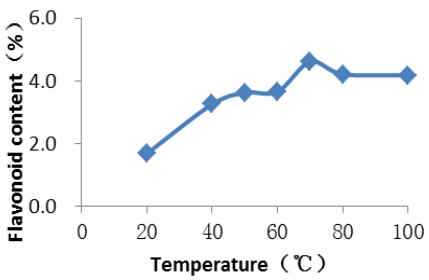

Figure 5: Effects of temperature on flavonoid extraction.

Effects of pH values on buckwheat flavonoid extraction

The buckwheat flavonoids were extracted at different pH values with solid to liquid ratio is 1:20, ethanol concentration is 50%, temperature is 50℃ and extracting time is 60 min. The buckwheat flavonoids content was analyzed. The optimum pH is 2 (Figure 6).

Orthogonal experiment of buckwheat flavonoid extraction

According the effects of individual factors on buckwheat flavonoid extraction, orthogonal experiments were conducted using extracting time, temperature, solid-to-liquid ratio (S/L) and pH as factors and flavonoid content as index (Tables 1 and 2).

As the results shown in the Table 2, solid-to-liquid ratio had the largest effect on flavonoid content. The pH Value had the second largest effect on flavonoid content. Temperature had the third largest effect on flavonoid content. Exacting time had the fourth largest effect on flavonoid content. The optimum parameters for producing technology of flavonoids from buckwheat using ethanol solvent are A1B2C2D1, that is exacting time 120 min, temperature at 60℃, solid-liquid ratio 1:20, pH 2. The sequence of effects on flavonoid content: C>D>B>A.

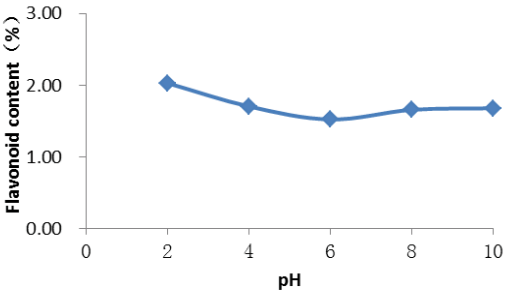

Figure 6: Effects of pH on flavonoid extraction.

Level	A (Extracting time/min)	B (Temperature/°C)	C (Solid-liquid ratio)	D (pH)
1	120	50	01:15	2
2	160	60	01:20	6
3	180	70	01:25	10

Table 1: Factor level table.

S. No.	A (Extracting time/min)	B (Temperature/℃)	C (Solid-liquid ratio)	D (pH)	Flavonoid Content (%)
1	1 (120 min)	1 (50℃)	1 (1:15)	1 (2)	3.895
2	1 (120 min)	2 (60℃)	2 (1:20)	2 (6)	4.017
3	1 (120 min)	3 (70℃)	3 (1:25)	3 (10)	2.26
4	2 (160 min)	1 (50℃)	2 (1:20)	3 (10)	3.59
5	2 (160 min)	2 (60℃)	3 (1:25)	1 (2)	2.576
6	2 (160 min)	3 (70℃)	1 (1:15)	2 (6)	3.973
7	3 (180 min)	1 (50℃)	3 (1:25)	2 (6)	2.027
8	3 (180 min)	2 (60℃)	1 (1:15)	3 (10)	3.872
9	3 (180 min)	3 (70℃)	2 (1:20)	1 (2)	4.214
K1	10.172	9.512	11.74	10.685	-
K2	10.139	10.465	11.821	10.017	-
K3	10.113	10.447	6.863	9.722	-
R	0.02	0.317667	1.652667	0.321	-

Table 2: $L_9(3^4)$ flavonoid extracting orthogonal experiment design and results.

Conclusion

The main factors affecting the extraction of flavonoids were solid-liquid ratio, pH value, and extraction temperature and extraction time. Through the analysis of single factor gradient experiment and orthogonal experiment, the optimum extraction conditions were obtained: the extraction temperature was 60℃, the concentration of ethanol was 60%, the ratio of material to liquid was 1:20, and pH was 2.

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