

Research Article

Microwave-assisted Extraction of Flavones from Bamboo Leaves

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Abstract: Flavones from bamboo leaves have special pharmacological effects and bioactivities. The extraction process was studied by microwave radiation technology through single factor test and orthogonal experiment design method to investigate the influence of experimental factors. The results indicated that optimum extraction conditions were concentration of ethanol 80% (v/v), weight ratio of solid/liquid 0.04 (w/w), extraction time 6 min, the extraction rate of flavones reaches maximum 3.2%.

Keywords: Bamboo leaves, extraction, flavones, microwave-assisted

INTRODUCTION

Bamboo is a kind of perennial herbs belonged to the grass family, which is an abundant and easily available plant, widely distributed in China. According to the traditional Chinese medicine dictionary, bamboo leaves have the effects of helping to promote the secretion of saliva, clear away heat and stop irritation as well as antibacterial, anti-inflammatory, anti-senility and anticancer due to a great deal of flavones in it (Colombo *et al.*, 2006). So flavones from bamboo leaves can be used in medicine to cure and prevent heart disease, tumor and caducity, etc., which are important resources of traditional Chinese medicine (Hartog *et al.*, 2007). And it would have a extensive application prospect in functional food.

Recently, there are a lot of researches on methods of the different extraction and separation processing of the total flavones from natural herbs. But there are few reports of extraction of flavones from bamboo leaves using microwave-assisted method (Pan *et al.*, 2012). It has been demonstrated that microwave-assisted method has the advantages of high efficiency, saving energy, less time and environment friendly compared with other traditional method as reflux extraction (Ganzler *et al.*, 1990; Jacob *et al.*, 1995). Thus, this method is utilized in this paper to extract flavones from bamboo leaves to find the optimum extraction conditions.

MATERIALS AND METHODS

Materials: The materials used were bamboo leaves (*Phyllostachys edulis*, collected in the local area and identified by a Botanist in the college of Biology Engineering, Zhoukou Normal University). Ethanol, sodium hydroxide and aluminum nitrate were purchased from Chemical Reagent Co. Ltd. (Tianjin,

China) and troxerutin was obtained from Halin Shengwu Co. Ltd. (Shanghai, China).

Preparation of sample powder of bamboo leaves: After collected, they were cleaned and dried to constant weight at 50°C for 24 h in an air-circulating oven, then ground to the particle size 40 mesh.

Preparation of sample solution: Ten gram sample powder and a certain amount of ethanol were added into a conical flask, the solution after extraction at 500 W in a microwave oven (MKX-J1A2, MKW Co. Ltd. Qingdao, China) for some time, was centrifuged at 4,000 r/min for 20 min at room temperature, then the supernatant was separated to obtain the sample solution.

Determination of the drawing of standard curve: Fifty milligram troxerutin was dissolved in ethanol (70%), then transferred into a 250 mL volumetric flask to calibrate, the standard solution was shake up and placed still. Afterwards take 0.0, 1.0, 2.0, 3.0, 4.0, 5.0, 8.0, 10 and 12 mL, respectively of the standard solution by measuring pipets to different 50 mL volumetric flasks, added 2.0 mL of sodium nitrite (5%) and 2.0 mL of aluminum nitrate (10%). Six minutes later, added 8.0 mL sodium hydroxide (5%), shake up and calibrated with ethanol (80%). Used reagent ethanol as a reference to measure its absorbance at 510 nm by UV-Vis Spectroscopy (Perkin Elmer, USA), thus obtained the standard curve under different concentrations (Pietta *et al.*, 1991). The equation between Absorbance (A) and concentration of troxerutin (X) was: $A = 13.1329X + 0.00406$, $R^2 = 0.9975$, showing a good linear relationship.

Measurement of total flavones in the sample solution: Two milliliter sample solution treated under different extraction conditions was transferred into 50

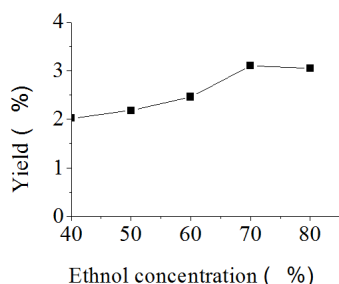


Fig. 1: Effect of ethanol concentration on the extraction yield of flavones

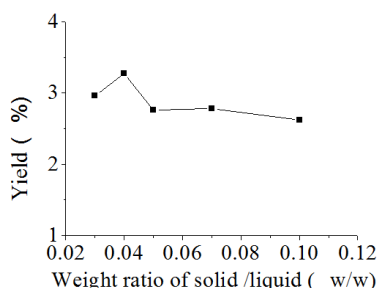


Fig. 2: Effect of weight ratio of solid/liquid on the extraction yield of flavones

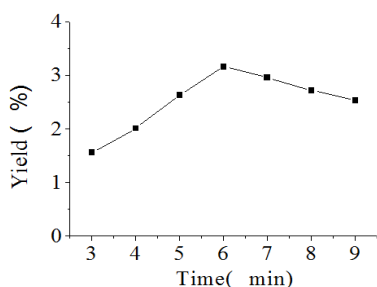


Fig. 3: Effect of time on the yield of flavones

mL volumetric flasks and then it was dealt with the same procedure mentioned above to measure its absorbance, furthermore, to calculate its mass.

RESULTS AND DISCUSSION

Effect of ethanol concentration on the extraction yield of flavones: Ten gram powders and 30 g ethanol of different concentration were added in a flask under microwave radiation for 10 min. The effect of ethanol concentration on the extraction yield of flavones is showed in Fig. 1. With the ethanol concentration ranging from 40 to 70%, the extraction yield of flavones increases when reaction time is 10 min and weight ratio of solid/liquid is 0.04, but the yield shows a slight variation from 70 to 80%.

Effect of weight ratio of solid/liquid on the extraction yield of flavones: Ten gram powders and 70% concentration of different mass of ethanol were

Table 1: Experimental factors and levels in orthogonal test

Level	Concentration (v/v)	Weight ratio of solid /liquid (w/w)	Time (min)
1	60	0.03	6
2	70	0.04	7
3	80	0.05	8

Table 2: Experimental results in orthogonal test of extraction

No.	Concentration (v/v)	Weight ratio of solid /liquid (w/w)	Time (min)	Yield (%)
1	1	1	1	1.46
2	1	2	2	2.23
3	1	3	3	2.51
4	2	1	2	2.34
5	2	2	3	2.72
6	2	3	1	3.02
7	3	1	3	1.80
8	3	2	1	3.22
9	3	3	2	3.05
x ₁	2.067	1.867	2.567	
x ₂	2.693	2.723	2.540	
x ₃	2.690	2.860	2.343	
R	0.626	0.993	0.224	

added in a flask under radiation for 10 min. As is shown in Fig. 2, the variation of yield is not obvious when the weight ratio of solid/liquid ranges from 0.02 to 0.10, the maximum value of yield is 3.28 corresponding to 0.04. Considering the cost of solution and the difficulty of separation, the best ratio 0.04 is chosen.

Effect of microwave radiation time on the extraction yield of flavones: Ten gram powders and 1000.0 g ethanol of 70% concentration were added into a flask followed by radiation for some time. The results (Fig. 3.) indicate that the yield of flavones is increasing with the time length varying from 3 to 6 min, whereas when the length continues to extend, the yield decreases. That is because too much radiation would raise temperature so violently that the solute would easily volatilize or flavones decompose.

The results of orthogonal test: According to the results of single factor tests, we chose concentration, weight ratio of solid/liquid and time as three factors to study the yield of flavones. Each factor has three levels (Table 1).

It can be concluded from results of Table 2 that the weight ratio of solid/liquid affected the yield the most significantly in the three factors, while time the least. Therefore, the optimum experimental conditions were 80% ethanol, the ratio of solid /liquid 0.04 and time 6 min to obtain the maximum yield 3.22%. Under the selected conditions, the mean yield was 3.1% by repeated 5 times.

CONCLUSION

Based on single-factor and orthogonal tests, it was investigated that the optimization of extraction of flavones from bamboo leaves using microwave

radiation method in this study. Under the optimum experimental conditions microwave power 500 W, 80% ethanol as extraction solvent, the ratio of solid/liquid 0.04 (w/w) and extraction time 6 min, the maximum extraction rate of flavones reaches 3.2%, which demonstrates it is an efficient, energy-saving and environmentally friendly extraction process.

REFERENCES

- Colombo, R., F.M. Lancas and J.H. Yariwake, 2006. Determination of flavonoids in cultivated sugarcane leaves, bagasse, juice and in transgenic sugarcane by liquid chromatography-UV detection [J]. *J. Chromatogr. A*, 1103(1): 118-124.
- Ganzler, K., I. Szinai and A. Salgo, 1990. Effective sample preparation method for extracting biologically active compounds from different matrices by a microwave technique [J]. *J. Chromatogr.*, 520: 257-262.
- Hartog, J.W.L., A.A. Voors, S.J.L. Bakker, A.J. Smit and D.J. van Veldhuisen, 2007. Advanced glycation end-products (AGEs) and heart failure: Pathophysiology and clinical implications [J]. *Eur. J. Heart Fail.*, 9: 1146-1155.
- Jacob, J., L.H.L. Chia and F.Y.C. Boey, 1995. Thermal and non-thermal interaction of microwave radiation with materials [J]. *J. Mater. Sci.*, 30: 5321-5327.
- Pan, J., S. Zhang, M. He *et al.*, 2012. Extracting process and anti-oxidation character of flavonoids from bamboo leaves [J]. *J. Chin. Inst. Food Sci. Technol.*, 12(3): 39-44.
- Pietta, P.G., P.L. Mauri, A. Rava and G. Sabbatini, 1991. Application of micellar electrokinetic capillary chromatography to the determination of flavonoid drugs [J]. *J. Chromatogr. A*, 549: 367-373.