



## Investigation on ultrasound-assisted extraction of salvianolic acid B from *Salvia miltiorrhiza* root

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### ABSTRACT

It is reported that salvianolic acid B, a bioactive phenolic compound contained in the root of *Salvia miltiorrhiza*, exhibits a much stronger activity in free radical scavenging and antioxidance than those of vitamin E. When a conventional refluxing method is adopted to extract salvianolic acid B from the root, in which the materials are subjected to higher temperature and longer time, the yield of this phenolic compound is lower due to the possibility of its hydrolysis to tanshinol. However, a higher extraction yield can be achieved over a shorter time period and lower temperature when an ultrasound-assisted extraction method is used. This paper investigated the parameters influencing the extraction of salvianolic acid B. Factors such as extraction time, frequency of the ultrasound, the ratio of solvent to material, and types of extraction solvent were examined. A comparison was also conducted between conventional refluxing and ultrasound-assisted extraction. Results showed that the optimal parameters to extract salvianolic acid B from the root of *S. miltiorrhiza* were as follows: ultrasonic frequency: 45 Hz; solvent: 60% aqueous ethanol; extraction temperature: 30 °C; extraction time duration: 25 min.; ratio of solvent to material: 20:1 (v/w, ml/g). Under these conditions, the yield of salvianolic acid B was 5.17 mg/g (33.93 mg/g) higher than those with conventional refluxing method (28.76 mg/g), indicating that the efficiency and the yield of ultrasound-assisted extraction method are higher than reflux method, and the hydrolysis of salvianolic acid B to tanshinol is effectively avoided.

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### 1. Introduction

*Salvia miltiorrhiza* Bunge belongs to family Lamiaceae. Its root and rhizome have been traditional Chinese herbal drugs. The root of the plant is used for the treatment of thoracic-abdominal stinging syndrome, heat type arthralgia, ulcers, swelling and pain, insomnia, hepatosplenomegaly, and angina pectoris [1]. Phenolic compounds contained in the root of *S. miltiorrhiza*, such as salvianolic acid B, exhibits antithrombotic effect; it may prevent brain injury from cerebral ischemia-reperfusion [2]. Furthermore, salvianolic acid B also shows strong activities in free radical scavenging and antioxidance, stronger than those of vitamin E [3]. When a conventional refluxing method is adopted to extract salvianolic acid B from the root, in which the materials are subjected to higher temperature for a longer time, the yield of this phenolic compound is lower due to the possibility of its hydrolysis to tanshinol [4] (Fig. 1). Many investigations have reported that higher

extraction yields could be achieved within shorter time period and/or lower temperature when an ultrasound-assisted extraction method was adopted on other plant species [5–11]. No reports were found on the extraction of salvianolic acid B by ultrasound-assisted method. This paper investigates the best technological parameters influencing the extraction of salvianolic acid B. Factors such as extraction time, frequency of the ultrasound, the ratio of solvent to material, and types of solvent were systematically examined. A comparison was also conducted between a conventional refluxing extraction method and ultrasound-assisted extraction.

Ultrasound-assisted extraction is a novel method to effectively extract chemical constituents from plant materials [5,6]. High-intensity shock waves generates intense pressures, shear forces and temperature gradient due to the bubble of cavitation inducing the majority of ultrasonic effects within a material, which can produce physical, chemical and mechanical effects [7], making the chemical constituents dissolve in the solvent without heating. Ultrasound can also facilitate the solvation of plant materials by causing cell swelling and enlargement of the pores of the cell wall. Better swelling will improve the rate of mass transfer, and result in the increased extraction efficiency and/or reduced extraction time [8]. The main advantages of this new method are that the ultrasound

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