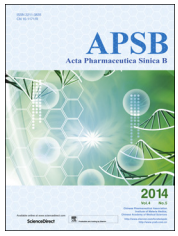
Acta Pharmaceutica Sinica B 2014;4(5):384–393

HOSTED BY

Chinese Pharmaceutical Association
Institute of Materia Medica, Chinese Academy of Medical Sciences

Acta Pharmaceutica Sinica B

www.elsevier.com/locate/apsb
www.sciencedirect.com



ORIGINAL ARTICLE

Simultaneous determination of nineteen major components in Qi She Pill by ultra-high-performance liquid chromatography–tandem mass spectrometry

Zhongliang Zhang[a], Qiang Li[a], Qiufen Li[a], Simiao Du[a], Yongquan Zhou[a], Chunming Lv[a], Yan Zhao[a], Yongjun Wang[b,*], Ning Zhang[a,*]

[a]*Experimental Center for Science and Technology, Shanghai University of Traditional Chinese Medicine, Shanghai 201203, China*
[b]*Institute of Spine, Shanghai University of Traditional Chinese Medicine, Shanghai 200032, China*

Received 7 January 2014; revised 26 April 2014; accepted 20 May 2014

KEY WORDS

UHPLC–MS/MS;
Active components;
Traditional Chinese medicine;
Qi She Pill (QSP)

Abstract Qi She Pill (QSP) is a traditional Chinese medicine (TCM) prescription that has been used in treating cervical spondylosis radiculopathy for many years. In this study, a simple and sensitive method using ultra-high-performance liquid chromatography–tandem mass spectrometry (UHPLC–MS/MS) on a reverse-phase C18 column was developed for the simultaneous determination of the 19 major components in QSP. We found that the optimum mobile phase for gradient elution was 0.1% formic acid and methanol. The correlation coefficients of all calibration curves were greater than 0.99. Recoveries measured at three concentration levels varied from 95.43% to 102.35%. Relative standard deviations of intra- and inter-day precisions were less than 4.45%. After successfully validating our method, we then applied it to the quantification of 19 components in QSP products to show that this method provides a new standard in quality assessment of TCM prescriptions containing multiple bioactive components.

© 2014 Chinese Pharmaceutical Association and Institute of Materia Medica, Chinese Academy of Medical Sciences. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Abbreviations: AST-III, astragaloside III; AST-IV, astragaloside IV; BER, berberine; CA, cholic acid; CCS, calycosin; CCSG, calycosin-7-*O*-*β*-D-glucoside; CE, collision energy; CSR, cervical spondylosis radiculopathy; DAI, daidzein; FAN, fangchinoline; FOR, formononetin; GA, gallic acid; 5-*O*-M, 5-*O*-methylvisammioside; ONO, ononin; PAL, palmatine; QSP, Qi She Pill; RA, rheumatoid arthritis; SEA, senkyunolide A; SEI, senkyunolide I; SIN, sinomenine; SRM, selective reaction monitoring; TCM, traditional Chinese medicine; TET, (+)-tetrandrine; THP, tetrahydropalmatine; THPB, tetrahydroepiberberine

*Corresponding authors. Tel.: +86 21 51322388; fax: +86 21 51322686.
E-mail addresses: yjwang88@hotmail.com (Yongjun Wang), ningzh18@126.com (Ning Zhang).

Peer review under responsibility of Institute of Materia Medica, Chinese Academy of Medical Sciences and Chinese Pharmaceutical Association.

http://dx.doi.org/10.1016/j.apsb.2014.05.003

2211-3835 © 2014 Chinese Pharmaceutical Association and Institute of Materia Medica, Chinese Academy of Medical Sciences. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

1. Introduction

Cervical spondylosis radiculopathy (CSR) is a chronic degenerative condition of the cervical spine that affects the vertebral bodies and intervertebral disks of the neck, as well as the components of the spinal canal. People with CSR may experience stiffness and pain or tingling in their necks, shoulders, or arms, leading to an impaired ability to work and a general decrease in their quality of life[1–4]. Currently, few drugs can effectively control CSR. However, Qi She Pill (QSP), a traditional Chinese medicine prescription, have been used in the clinical management of CSR for more than 40 years. QSP inhibit inflammation in CSR patients, and published reports have shown their beneficial effects on cervical intervertebral disc degeneration (New drug clinical trial documents number: China State Drug Administration 2003L04416)[5–7].

QSP is composed of six medicinals (Radix Astragali, Rhizoma Chuanxiong, Caulis Sinomenii, Radix Stephaniae Tetrandrae, Artificial Moschus, and Artificial Bovis Calculus). However, little is known about the exact components of QSP; therefore, many potential components may be responsible for their beneficial effects. Our previous quality control study of QSP suggested that the pills are composed of astragaloside, alkaloids and flavonoids, as well as other compounds, that have antiviral and antioxidant actions[8–15] and that have been clinically used in the therapeutic treatment of rheumatoid arthritis (RA) because of their remarkable anti-inflammatory properties.

In Chinese medicines, some active components are regarded as indices of quality control in prescriptions. Currently, only astragaloside IV and sinomenine are used as indices for quality control in the preparation of QSP[16]. However, it is well known that analysis of just a single or even a few marker compounds is not enough for good quality control of complex herbal products. Thus, an accurate and reliable method that assesses the multiple constituents of QSP is urgently needed to maintain safety by accurately monitoring quality control of QSP, as well as to enhance the efficacy of QSP in CSR control.

Thus, in this study, a simple, accurate and reliable UHPLC/MS method was developed for the simultaneous determination of the following 19 active components of QSP: (**1**) gallic acid (GA), (**2**) sinomenine (SIN), (**3**) calycosin (CCS), (**4**) calycosin-7-*O*-*β*-D-glucoside (CCSG), (**5**) tetrahydroepiberberine (THPB), (**6**) (+)-tetrandrine (TET), (**7**) tetrahydropalmatine (THP), (**8**) fangchinoline (FAN), (**9**) berberine (BER), (**10**) palmatine (PAL), (**11**) senkyunolide I (SEI), (**12**) ononin (ONO), (**13**) 5-*O*-methylvisammioside (5-*O*-M), (**14**) daidzein (DAI), (**15**) formononetin (FOR), (**16**) senkyunolide A (SEA), (**17**) astragaloside III (AST-III), (**18**) astragaloside IV (AST-IV), and (**19**) cholic acid (CA) (Fig. 1). Five batches of prescription extracts were used in this study. Our results indicate that the method proposed by us is particularly suitable for the routine analysis and quality control of QSP. Furthermore, we suggest that our established method would be applicable for quality control in the study of other compounds in TCM.

2. Materials and methods

2.1. Materials and reagents

The herbal portions of QSP, including, Radix Astragali, Rhizoma Chuanxiong, Caulis Sinomenii, Radix Stephaniae Tetrandrae, Artificial Moschus, and Artificial Bovis Calculus were purchased from Shanghai Kangqiao Pharmaceutical Co., Ltd. Standards of GA (110831-201003, >98%), SIN (110774-200507, >98%), TET (110711-200708, >98%), FAN (110793-200605, >98%), BER-HCl (110713-200911, >98%), PAL-HCl (110732-200907, >86%), AST-IV (110781-200613, >98%), and CA (100078-200414, >98%) were provided by the Chinese National Institute for the Control of Pharmaceutical and Biological Products (Beijing, China). Standards of CCS (120628, >98%), CCSG (121219, >97%), SEI (120728, >96%), ONO (120531, >98%), 5-*O*-M (120620, >98%), DAI (120829, >98%), FOR (120227, >98%), SEA (120828, >96%), and AST-III (120615, >98%) were purchased from Sichuan Weikeqi Biotech Co., Ltd. (Sichuan, China). Standards for THPB (10421-201207, >98%), TET (110711-200708, >98%), and THP (20302-201204, >98%) were purchased from Nanchang Beta Biotech Co., Ltd. (Nan chang, China).

HPLC-grade methanol was obtained from Dikma Technologies Inc. (USA). Formic acid (HPLC-grade) was purchased from CNW Technologies GmbH (Düsseldorf, Germany). Deionized water was purified using the Milli-Q Reagent Water System (Millipore, Bedford, MA, USA). All other reagents were of analytical grade.

2.2. Chromatographic and mass spectrometric conditions

The Dionex 3000 UHPLC system equipped with Thermo TSQ quantum Access MAX triple quadruple mass spectrometry was used for the chromatographic analysis. All separations were carried out on a Waters Acquity UPLC BEH C18 column (50 mm × 2.1 mm, 1.7 μm). The mobile phase consisted of (A) methanol and (B) aqueous formic acid (0.1%, *v*/*v*) using the following gradient elution: 20% A at 0–1 min, 20%–100% A at 1–8 min, 100% A at 8–12 min, 20% A at 12.1–16 min. The re-equilibration time was 4 min. The temperature of the column oven was 40 °C. The solvent flow rate was 0.3 mL/min. Nitrogen was used as the sheath and auxiliary gas, and Argon was used as the damping and collision gas. Ion spray voltage was set at 3.5 kV(+) and 2.5 kV(−), tube lens offset at 184 V(+) and 141 V(−), sheath gas rate at 35 psi, and auxiliary gas flow rate at 1.5 L/min.

2.3. Standard preparation

Nineteen stock solutions were prepared by dissolving 1.0 mg of each standard in 10 mL of methanol. Appropriate volumes of each stock solution were mixed together. Then, the mixture was diluted serially to prepare the reference working solutions.

2.4. Sample solution preparation

Twenty QS pills of each batch (five batches, 701, 702, 703, 704, 801, are from the same Shanghai Huanghai Pharmaceutical Co., Ltd.) were ground into powder by using a pestle and mortar, and 0.10 g of the powder was ultrasonically extracted with 50 mL of 100% (*v*/*v*) methanol for 20 min at 30 °C, and cooled at room temperature. The supernatant was subsequently filtered through a 0.22 μm membrane. An aliquot of 2 μL of the solution was injected into the UHPLC–MS/MS system for analysis.

2.5. Method validation

2.5.1. Linearity and sensitivity

A series of working solutions for all the standard substances were prepared by serial dilutions with methanol. Linearity was assessed

Download English Version:

https://daneshyari.com/en/article/2474736

Download Persian Version:

https://daneshyari.com/article/2474736

Daneshyari.com