# 参叶补益方的提取工艺优选Δ

吴延娆[1,2,3]*，于明明[4]，牛晓静[1,2,3]，段晓颖[1,2,3]#（1.河南中医药大学第一附属医院药学部，郑州 450003；2.河南省中药临床应用、评价与转化工程研究中心，郑州 450003；3.河南省中药临床药学中医药重点实验室，郑州 450003；4.江苏康缘药业股份有限公司，江苏 连云港 222001）

**中图分类号** R917；R284.2 **文献标志码** A **文章编号** 1001-0408（2026）12-1573-06
**DOI** 10.6039/j.issn.1001-0408.2026.12.09

**摘 要 目的** 优选参叶补益方的提取工艺。**方法** 基于质量源于设计理念，选择芦丁、荷叶碱、芥子碱硫氰酸盐、甘草苷、甘草酸单铵盐含量和出膏率为参叶补益方提取工艺的关键质量属性（CQAs）；采用鱼骨图结合失效模型和效应分析法确定加水量、提取时间和提取次数为关键工艺参数（CPPs）。采用高效液相色谱法检测芦丁、荷叶碱、芥子碱硫氰酸盐、甘草苷、甘草酸单铵盐含量；采用层次分析-熵权法对芦丁等5种成分的含量及出膏率进行综合赋权。采用Box-Behnken响应面法拟合CQAs与CPPs数学模型，筛选提取工艺的操作空间并进行验证。**结果** 优选提取工艺的操作空间为加水量9.5～12倍、提取时间1～1.7 h、提取次数3次。经验证，操作空间内优选提取工艺的综合评分分别为89.79、84.93分。**结论** 所得参叶补益方的提取工艺可用于其颗粒剂的开发与生产。

**关键词** 参叶补益方；工艺优选；关键工艺参数；关键质量属性；层次分析-熵权法；Box-Behnken响应面法

## Optimization of the extraction process of Shenye buyi formula

WU Yanrao[1,2,3], YU Mingming[4], NIU Xiaojing[1,2,3], DUAN Xiaoying[1,2,3] (1. Dept. of Pharmacy, the First Affiliated Hospital of Henan University of Chinese Medicine, Zhengzhou 450003, China; 2. Henan Provincial Research Center for Clinical Application, Evaluation and Translation Engineering of Traditional Chinese Medicines, Zhengzhou 450003, China; 3. Henan Provincial Key Laboratory of Traditional Chinese Medicines and Clinical Pharmacy, Zhengzhou 450003, China; 4. Jiangsu Kanion Pharmaceutical Co., Ltd., Jiangsu Lianyungang 222001, China)

**ABSTRACT OBJECTIVE** To optimize the extraction process of Shenye buyi formula. **METHODS** Based on the quality by design (QbD) concept, the contents of rutin, nuciferine, sinapine thiocyanate, liquiritin, and glycyrrhizic acid ammonium salt, as well as the extract yield, were selected as the critical quality attributes (CQAs) for the extraction process of Shenye buyi formula. The fishbone diagram combined with the failure model and effect analysis method was adopted to determine the water addition, extraction time and extraction times as critical process parameters (CPPs). High-performance liquid chromatography was employed to detect the contents of rutin, nuciferine, sinapine thiocyanate, liquiritin, and glycyrrhizic acid ammonium salt. The analytic hierarchy process-entropy weight method was used to comprehensively assign weights to the content of the five components including rutin and the extract yield. The Box-Behnken response surface method was employed to fit the mathematical model between CQAs and CPPs, screen the operational space of the extraction process, and validate it. **RESULTS** The optimal operational space of the extraction process was 9.5 to 12 times the amount of water added, the extraction time was 1 to 1.7 hours, and the extraction times were 3. Upon verification, the comprehensive scores of the optimal extraction process within the operational space were 89.79 and 84.93, respectively. **CONCLUSIONS** The extraction process of the Shenye buyi formula can be applied to the development and production of its granule preparations.

**KEYWORDS** Shenye buyi formula; process optimization; CPPs; CQAs; AHP-EWM; Box-Behnken response surface method

Δ**基金项目** 国家中医药管理局科技项目（No.GZY-KJS-2022-046-2）；河南省国家中医药传承创新中心科研专项（No.2023ZXZX1048）；河南省中医药科学研究专项课题（No.2024ZY2021）

* **第一作者** 主管药师，硕士。研究方向：中药制剂及质量控制。E-mail：wuyan19890212@126.com

# **通信作者** 主任药师，硕士。研究方向：中药新技术新剂型与新药研发。E-mail：dxy1378@163.com

参叶补益方为河南中医药大学第一附属医院的临床经验方，由人参、桑叶、荷叶、黄芥子、甘草等10味中药组成，具有健脾补元、益肺、散风清热的功效。方中，人参、桑叶和荷叶均为君药，人参具有改善造血功能、提高免疫力等作用[1-2]；桑叶中的芦丁具有抗氧化活性[3]；荷