

## A multivariate consecutive extraction process of Pectin and Hesperidin from *Citrus aurantium* L.: Process optimization, Extract mechanism and Bio-activity Analysis

Peng Zhou<sup>1</sup>, Xiangzhou Li<sup>1,2\*</sup>, Jun Zhou<sup>1</sup>, Limin Qu<sup>1</sup>

1.College of Materials Science and Engineering, Central South University of Forestry and Technology, 410004, Changsha, P.R.China

2.Institute of Natural Products Processing and Utilization, Central South University of Forestry and Technology, 410004, Changsha, P.R.China

**Abstract:** 【Objective】 With the proposal of the Paris Climate Agreement and double carbon policy, production enterprise is now facing green and low-carbon transformation. To promote green and low-carbon development, optimizing the production process and improving utilization rate of raw materials for the reduction of production cost is an significant technological path for the food processing and manufacturing industry. Thus, the aim of this work was to develop a multivariate consecutive extraction process of pectin and hesperidin. 【Method】 The process parameters will be put forward through single-factor experiments, Plackett-Burman design and Box-Behnken design. At the same time, the multivariate consecutive extraction process mechanism was revealed with the plant tissue structure microscopic analysis and mathematical models. 【Result】 The experimental results showed that the multivariate consecutive extraction process was effective and feasible. Pectin with excellent properties was obtained, and the solid-liquid ratio of extraction process parameters of hesperidin was reduced to 1:8 (g: mL). The problems of environmental pollution and high energy consumption in traditional extraction could be solved. 【Conclusion】 The multivariate consecutive extraction process, an innovative, economic and environmental-friendly process, may be realized easily in industrial application. The preferential extraction of pectin was helpful for the destruction of cell structure and the exposure of hesperidin crystals, which can effectively reduce the internal resistance of the mass transfer and the activation energy of extraction process, therefore accelerating the penetration and wetting of the extractant into the raw material internally, improving the transfer of hesperidin from the inside to the surface of the raw material as well and thus can improve extraction efficiency of hesperidin. The purity of the obtained hesperidin was up to 91.7%, which can be further purified depending on application requirements. A large amount of pectin was obtained ( $23.3 \pm 0.5\%$  yield), and the pectin has superior gel-property, strong antioxidant activity and certain antibacterial activity. The pectin and hesperidin obtained will have better application prospects in food because of their unique characteristics. This work will provide a new way for industrial multivariate consecutive extraction process of pectin and hesperidin, and a promotion of green and efficient extraction of plants rich in hesperidin and pectin components may be realized.

**Key words:** *Citrus aurantium* L.; Pectin; Hesperidin; Multivariate consecutive extraction; Extract mechanism

\* This work is supported by the National Key Research and Development Program of China under Grant 2022YFD2200605, the China Guangxi Key Laboratory of Chemistry and Engineering of Forest Product under Grant GXFK2302 and the Central South University of Forestry and Technology Postgraduate Science and Technology Innovation Fund under Grant 2023CX01016.

E-mail address: rlxz@163.com (X.Z. Li)