

Research Progress of Extraction of Anthocyanin from *Passiflora Edulis* Peel

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Abstract

This paper focused on the extraction of anthocyanin from *Passiflora edulis* peel, reviewed the extraction process of anthocyanin in natural plants, explored the extraction processes of anthocyanin from *Passiflora edulis* peel, summarized the single factor method and response surface methodology in the conventional process analysis and optimization methods, looked forward to the extraction processes and the optimization analysis direction of anthocyanin in the Yunnan *Passiflora edulis* peel, and provided reference for the extraction optimization and high value-added utilization of anthocyanin from *Passiflora edulis* peel.

Keywords

Passiflora edulis peel; extraction; anthocyanin; response surface methodology.

1. Introduction

Passiflora edulis is a kind of aromatic and delicious fruit, which is native to Brazil and is planted throughout South America, South Africa, Southeast Asian countries, Australia and the South Pacific, in China, it is mainly distributed in places like Guangxi, Jiangxi, Sichuan, Yunnan, it is an important tropical fruit in our country, it has the reputation of "King of Juice" and is planted in places like Mangshi, Longling in Yunnan. *Passiflora edulis* peel is the main by-product of *Passiflora edulis* juice processing. *Passiflora edulis* contains more than 135 kinds of aromatic substances, and is rich in 17 kinds of essential amino acids, various vitamins and trace elements and other beneficial ingredients. *Passiflora edulis* peel accounts for 45% to 55% of the whole fruit weight, the peel is rich in pectin, dietary fiber, flavonoids and anthocyanin, but the utilization rate is very low, a large number of peel by-products in the processing of *Passiflora edulis* juice have caused great waste of resources and environmental burden, therefore, in recent years, the high value-added utilization of *Passiflora edulis* peel has also greeted with an avalanche of publicity [1-2].

Anthocyanin is a type of compound which combines anthocyanin and sugar by glycosidic bonds, it is widespread in the cytosolic of flowers, fruits, stems, leaves and root organs of plants, makes them appear in different colors from red, purple to blue, etc. Anthocyanin is flavonoid-a group of substance based on flavonoid core and a family of compound that present red. Due to its unique functionality, it has been used to scavenge free radicals in the body, proliferate lutein, anti-tumor, anti-cancer, anti-inflammatory, lose weight, protect eyesight, etc., it is widely used in food and pharmaceutical industries, etc. *Passiflora edulis* peel contains anthocyanin, if high-purity anthocyanin can be efficiently extracted from *Passiflora edulis* peel to meet the demand for natural anthocyanin in domestic and foreign markets, the high value-added utilization rate of *Passiflora edulis* can be greatly improved.

This paper summed up the extraction process of anthocyanin in natural plants in recent years, summarized the extraction methods and optimization methods of extracting anthocyanin from *Passiflora edulis* peel as raw materials, and looked forward to the extraction process of

anthocyanin from *Passiflora edulis* peel, and it provided references for the efficient extraction of anthocyanin from *Passiflora edulis* peel.

2. Extraction Method of Anthocyanin from Natural Plants

The extraction processes of anthocyanin include ultrasonic-assisted method, microwave-assisted method, enzymolysis method, supercritical fluid extraction method, solvent extraction method, etc. [4-5]. The solvent extraction method uses volatile organic solvents to transfer some components in the raw materials into the solvent phase, and then recovering the organic solvents by means of evaporation, distillation, etc., and obtain the desired relatively pure extraction components. Yang Xiaona, Chen Zihong et al. [6] and Li Na, Ji Xinxin et al. [7] used solvent extraction to extract anthocyanin in Chinese redbud flower petals and *Lycium chinensis*, respectively, and optimized the extraction conditions like extraction time and solid-liquid ratio; The ultrasonic-assisted extraction method uses ultrasonic waves to destroy the plant cells and make the solvent enter the interior of the plant cells, thereby promoting the dissolution of anthocyanin and improving the extraction efficiency. Zhou Xinyu, Lv Chongning et al. [8] and Zhang Yan, Zhao Zunle et al. [9] used ultrasonic-assisted extraction to extract anthocyanin from rose hips and grape skin residue, respectively, and optimized the extraction conditions, and the effect was good; microwave extraction method uses microwave technology to destroy plant cell walls, thereby accelerating the extraction yield of anthocyanin in plant. Jin Limei, Bai Jing et al. [10] used microwave-assisted extract anthocyanin in seed coat of read adzuki bean, analyzed and studied its stability; enzymatic extraction method used enzymatic reaction to destroy cellulose, hemicellulose, pectin in plant cells etc. and improved the extraction rate of anthocyanin. Tang Gong [11] and Ma Yuting et al. [12] explored the extraction process of anthocyanin in grape peel and *Lycium ruthenicum* wine residue flowers by enzymatic hydrolysis, respectively; the methods of extracting anthocyanin from natural plants also included combined extraction methods like ultrasound-microwave [13-14] and ultrasound-assisted enzyme technology [15], because the use of anthocyanin is becoming more and more extensive, the research on its extraction methods is more and more valued, and new extraction methods and new processes also tend to develop rapidly.

3. Extraction and Separation Method of Anthocyanin from *Passiflora Edulis* Peel

The extraction processes of anthocyanin have their own advantages and disadvantages, but the extraction methods of anthocyanin from *Passiflora edulis* peel are less studied, and the most commonly used methods are solvent extraction and ultrasonic extraction at present.

3.1. Extraction of Anthocyanin by Solvent Extraction

Solvent extraction method, due to simple and easy operation, water, alcohol, and acid solution are selected as solvents, and different extraction methods like immersion method, reflux extraction method, and Soxhlet extraction method are used for extraction, therefore, it is widely used [16]. In recent years, there have been many reports on the extraction of anthocyanin by solvent extraction from *Passiflora edulis* peel. Ding Lei, He Chuanbo et al. [17] extracted anthocyanin from *Passiflora edulis* peel as raw material, and used ethanol solution acidified by citric acid to extract anthocyanin, they used the response surface optimization experiment to determine the optimal extraction conditions of anthocyanin from *Passiflora edulis* peel. The optimal extraction conditions of anthocyanin from *Passiflora edulis* peel were 74.41% ethanol volume fraction, 2.21% citric acid content, and 1:25.3 solid-liquid ratio(g/mL), The theoretical extraction amount of anthocyanin was 7.726 mg/g. Zeng Shaoxiao, Peng Bin et al. [18] extracted anthocyanin from *Passiflora edulis* peel with extraction rate of 13.7236 mg/g.

3.2. Separation of Anthocyanin by Macroporous Adsorption Resin

The macroporous adsorption resin method is to separate organic macromolecules with certain polarity according to the principle of adsorption and molecular sieve, this method has the advantages of good adsorption selectivity, large processing capacity, simple regeneration, and low cost [19-21]. Zhang Wenli et al. [22] used macroporous resin purification method to separate and extract anthocyanin from *Passiflora edulis* peel, and explored the technological conditions of separating and purifying anthocyanin from *Passiflora edulis* peel.

4. Analysis Methods of Parameter Optimization of Extraction Process of Anthocyanin from *Passiflora Edulis* Peel

The single factor method and the response surface methodology are commonly used in the optimization analysis method of extraction process of natural product. Univariate analysis is the analysis of a variable at one point in time. In the analysis experiment, if there is only one influencing factor or only one factor that has the greatest influence on the index, and other factors remain unchanged as much as possible, it is a single-factor experiment. In the actual analysis process, in order to achieve the purpose of high quality, high yield and low consumption, the process conditions need to be optimized, the usual practice is to reasonably arrange the experimental points, reduce the number of experiments, and quickly find the best point. The response surface methodology is a statistical method which uses reasonable experimental design method and obtains certain data through experiments, uses multiple quadratic regression equation to fit the functional relationship between the factors and the response value, and seeks the optimal process parameters through the analysis of the regression equation, and solve the multivariate problems. The response surface methodology is used for analysis, firstly, the experimental design should be carried out on the analysis object, and the appropriate mathematical model should be built through the measurement data; secondly, the experimental data should be obtained and the corresponding regression equation should be calculated; finally, the response surface should be obtained, and analyze the response surface to get the required analysis results. The response surface analysis method can predict the influence of different conditions on the response value, and its key is to examine the reliability of the fitting equation, so it is widely used in the optimization of extraction process parameters of natural products.

Zhao Chengping, Chen Shengping et al. [23] extracted flavonoids in hawthorn pulp, and optimized each extraction parameter by response surface methodology, and obtained the optimal extraction time, ethanol concentration, liquid-material ratio and total flavonoid extraction rate, which were broadly in line with the experimental results; Yang Yichen, Wang Erhuan et al. [24] used response surface methodology to optimize the design the experiment, which was broadly in line with the optimal volatile oil extraction process parameters obtained after fitting with the Design Expert 11 software and the experimental results; Ning Zhixue, Zhu Libin et al. [25] optimized the extraction process parameters of polyphenols in blackcurrant fruit through response surface experiment design, it is basically consistent in comparison with the actual experimental results. Therefore, the regression equation optimized and designed by the response surface method can better reflect the interaction among various factors, and it is widely used in the optimization of multi-factor process parameters.

5. Summary and Outlook

Passiflora edulis peel is rich in components, and the peel is rich in pectin, dietary fiber, flavonoid compound and anthocyanin. Scholars at home and abroad are seriously concerned about improving the comprehensive utilization of *Passiflora edulis* peel, but the studies on the high

value-added utilization of *Passiflora edulis* peel is still at a relatively low level, most of which are crop fertilizer, etc., in recent years, there are few studies on the comprehensive utilization of *Passiflora edulis* peel, only a few scholars studied the comprehensive utilization of *Passiflora edulis* peel, in order to find high value-added products, such as extracting pectin, anthocyanin and flavonoid with *Passiflora edulis* peel, but there are few studies on the extraction of anthocyanin, a few studies are still in theoretical research, and there are few studies on the technological production of *Passiflora edulis* peel, it is contradictory to the high value-added treatment of large quantities of *Passiflora edulis* peel every year, from this, new research directions of *Passiflora edulis* peel can be predicted:

- (1) The research directions of the high value-added utilization rate of *Passiflora edulis* peel were actively expanded by processing *Passiflora edulis* peel and peel produced by the processing, broadened the utilization directions, and promoted them, served the local economy and rural revitalization.
- (2) The new extraction processes of anthocyanin of *Passiflora edulis* peel were explored, and the studies on the combined extraction process of anthocyanin were actively innovated, in order to improve the extraction rate of anthocyanin. The single factor analysis method and response surface analysis software were used to optimize the extraction process conditions of *Passiflora edulis* peel, and the optimal conditions of extraction and separation were found, in order to increase and accelerate the high utilization rate of *Passiflora edulis* peel.
- (3) The chemical process simulation software was used to conduct simulation research and preliminary exploration on the industrial production process of anthocyanin extraction from *Passiflora edulis* peel, which provide theoretical basis for the industrial production of anthocyanin extraction from *Passiflora edulis* peel, and accelerate the comprehensive utilization of *Passiflora edulis* peel to realize the process of batch industrial production.

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