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Research Progress of Comprehensive Utilization of High Added Value of Yunnan Coffea Arabica Peel

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Abstract

This paper focused on the comprehensive utilization of high added value of Yunnan Coffea Arabica peel, reviewed the research progress of extracting pectin and anthocyanin from Yunnan Coffea Arabica peel; the research status of fermentation preparation of enzymes, yogurt and process ethanol; it introduced the research survey of preparation of peel wine, fruit tea, and soluble dietary fiber, analyzed the problems in the comprehensive utilization of high added value of coffee peel, and predicted research hotspots and directions based on the actual situation.

Keywords

Coffea Arabica; Coffee peel; Extraction; Fermentation; High added value; Research progress.

1. INTRODUCTION

Coffee is a perennial evergreen shrub, which is mainly native to Africa, Coffea Liberica, Coffea Canephora and Coffea Arabica are predominant, the tropical plateau or high-altitude mountainous area are mainly planted with Coffea Arabica, the coffee planting bases in China are mainly distributed in Hainan Province and Yunnan Province, while Coffea Canephora is mainly planted in Hainan Province. Yunnan belongs to high-latitude region, due to its unique geographical and climatic conditions, sunshine and climate are very suitable for coffee plant, the four major producing regions of Coffea Arabica in Yunnan are mainly Dehong, Pu'er, Lincang and Baoshan, the coffee quality is excellent, acidity and fragrance are moderate. Due to rural revitalization and poverty alleviation, the Yunnan provincial government attaches great importance to the plant and development of the coffee industry, and its productive planting production has developed rapidly, which become the main coffee-growing area in China [1-3]. Coffea Arabica is mainly processed by wet processing, dry processing and semi-wet processing, coffee peel is a by-product of primary coffee processing, wet processing is the main processing method of Coffea Arabica in Yunnan, wet processing will produce a large amount of coffee peel, the Coffea Arabica growing area in Yunnan produces a huge amount of coffee peel, about 39.68 tons [4]. A large amount of coffee peel is discarded as waste, which pollutes the environment and wastes resources.

This paper summarized the extraction process, fermentation process and other utilization aspects of Yunnan Coffea Arabica peel in recent years, analyzed the comprehensive utilization value of coffee peel, and looks forward to the research direction of comprehensive utilization of Yunnan Coffea Arabica peel, which provides a reference for further research on coffee peel.

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2. EXTRACTION PROCESS OF COFFEE PEEL

2.1. Extracting Pectin from Coffee Peel

Pectin is a natural food additive, which is a soluble heteropolysaccharide and widespread in plant cells, the production sources are mainly citrus peel, apple pomace, beet pulp, watermelon, papaya and watermelon, etc., it has anti-inflammatory, immunomodulatory and antibacterial functions [5].

The pectin content of coffee peel is high, and it is the main product extracted from coffee peel. Lin Shan et al. [6] extracted pectin from coffee peel and conducted research in detail, the results showed that when the solid-liquid ratio was 1:30, the pH value was 1.5, the extraction temperature was 50 °C, and the extraction time was 100 minutes, the average yield of pectin is about 10%; Li Xiaojiao et al. [3] extracted pectin by ultrasonic-assisted method, hydrochloric acid extraction method and microwave-assisted method respectively, it was found that the yields of pectin obtained by the two methods were different, and the GalA content of the acid-alkali modified pectin was higher; Li Xiaojiao, Fu Wenxiang, et al. [8] showed that when the solid-liquid ratio, pH value, extraction temperature, and extraction time were optimized, the yield of coffee peel pectin could reach 15.13%, and all physical and chemical indexes conformed to international standard.

2.2. Extracting Anthocyanins from Coffee Peel

Anthocyanin is widespread in cherries, purple sweet potatoes, eggplant peel, blood oranges, hawthorn peel, blueberries, morning glory, perilla and other plants, they are rich in anthocyanins and are pure natural water-soluble pigment, because it has strong antioxidant, anti-aging, anti-inflammatory, antibacterial, liver protection, metabolic regulation, vision improvement, prevention of cardiovascular disease functions, etc., and can reduce the important role of thrombosis caused by metabolic syndrome, it is widely used in food additives, food nutrition fortifiers and cosmetics, its utilization value is getting higher and higher [9-10], and its extraction process is more and more valued as well. The methods of extracting anthocyanins from plants mainly include microwave-ultrasonic synergistic extraction method, supercritical extraction method, microwave-assisted extraction method, ultrasonic-assisted extraction method, and solid-liquid extraction method, etc.[11].

The peel of Yunnan coffee is usually green when it is immature, it turns dark red or reddish-purple after mature, so the peel of Yunnan Coffea Arabica is rich in anthocyanins. Zhang Yunhe, Fu Xiaoping, et al. [12-13] used organic solvents to extract the peel of Yunnan Coffea Arabica, determined that coffee peel extract contains cyanidin-3-glucoside and cyanidin-3-rutinoside, determined the contents of two anthocyanins, which were 3.35 mg/100 g and 11.2 mg/100 g, respectively. Liu Li, Lin Shan et al. [14] studied the method of stably extracting pigment from coffee peel, and tested the stability of pigment, the results showed that coffee peel pigment has strong stability and is not easy to fade. Luo Yating, Cui Xianliang, etc. [15] used the response surface method to optimize the extraction process of procyanidins in coffee peel, and used the relationship between the multivariate quadratic regression equation and the response value for analysis, so that obtain the best process parameters, and provided data support for improving the extraction rate of procyanidins from coffee peel.

3. FERMENTATION PROCESS OF COFFEE PEEL

3.1. Preparing Ferment by Fermenting Coffee Peel

Plant ferment is also known called plant fermentation broth, the raw materials are mainly apples, green vegetables, brown rice and herbal plants for medicine and food, after adding single or multiple probiotics, microbial fermented product is formed after low-temperature and

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long-term fermentation. It can be used to make ferment foods such as ferment drinks, jelly and meal replacement powder, as well as ferment health products, medicines, cosmetics, etc. [16].

The ferment is prepared from coffee peels by fermentation, it is also one of the aspects of the comprehensive utilization of traditional coffee peels by humans, Chen Xiaowei, Fan Haoan et al[17] carried out full and in-depth research on the transformation of fermentation metabolites of traditional coffee peel plant ferment and its antioxidant properties, and through the research the association between plant metabolites and antioxidant indexes, the analysis and evaluation of the comprehensive indexes of coffee peel ferment in different time periods, thus obtaining that the appropriate extension of the fermentation time is more conducive to improve the maturity of coffee peel ferment.

3.2. Fermenting Yogurt with Coffee Peel Powder

In recent years, people's living standards have been improving day by day, and the types of yogurts have become more and more diversified, by adding natural medicinal and edible plants, yogurt with unique flavor and rich nutrition can be made to meet people's individual needs. Quan Fan, Zhu Wenxiu et al. [18] used quinoa and fresh milk as the main raw materials to make yogurt, which has a unique grain flavor and is rich in nutrients, the sensory score is 90.7. Xu Zeqi, Zhou Fang [19], etc. used milk and soymilk as the main raw materials, and used steviol glycosides to replace part of sucrose, fermented yogurt, it had better taste, smell, color and higher nutritional value.

Yin Xiong, Li Zelin et al. [20] added Yunnan Coffea Arabica peel powder into fresh milk, and added leaven for fermentation, and the sensory quality of the obtained yogurt was high, reaching 91 points.

3.3. Preparing Ethanol by Fermenting Coffee Peel

The cellulosic plants are used as raw materials to prepare and produce fuel ethanol, the price is cheap, and it can also help alleviate problems such as energy crisis, food shortage, pollution, etc., and provide guarantee for the sustainable development of human economy and society.

Chen Xuan, et al. [21] found the optimal process conditions for preparing ethanol by fermenting coffee peels, at this time, the volume fraction of process ethanol reached 3.42%. However, this output rate is still very low, it has also become a bottleneck problem in the production of ethanol by fermenting coffee peel at present, which needs to be further solved.

4. OTHER USES OF COFFEE PEEL

He Hongyan, et al. [22] studied the coffee peel technology, found that the coffee peel was added with sugar, acid and dried, and the tea soup was yellow and bright, and the taste and flavor were excellent. Wen Zhihua, et al. [23] focused on the detailed processing flow of coffee peel tea, and evaluated the quality of coffee peel tea. Hu Rongsuo, et al. [24-26] took coffee peel as raw material, brewed coffee fruit wine with unique flavor, extracted soluble dietary fiber, and the extraction rate reached 9.72%, conducted a more comprehensive study on its extraction process and functional properties, studies confirmed the operability of extracting soluble dietary fiber with coffee peel as raw materials, moreover, the functional features of the extracted soluble dietary fiber were excellent. Wang Dandan, et al. [27] used coffee peel as raw material, extracted soluble dietary fiber by using shear emulsification-assisted enzymatic method, and optimized the production process conditions.

5. SUMMARY AND OUTLOOK

Coffee peel is rich in ingredients, mainly containing protein, medium sugar, cellulose, alkaloids, polyphenols, etc. Scholars at home and abroad have paid great attention to improving

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the added value of the comprehensive utilization of coffee peel. There are many studies on the comprehensive utilization of coffee peel abroad, but the studies on the utilization of coffee by-products in China is still at a relatively low level, most by-products are gathered together or used as crop fertilizers, etc., however, a few scholars have carried out research on the comprehensive utilization of coffee peel, in order to find high value-added products, such as extracting pectin from coffee peel, extracting anthocyanins, preparing ferment and yogurt by fermentation, preparing coffee peel tea, fruit wine and soluble cellulose, etc., but most of them stay in theoretical research, and there is fewer studies on the technological production of coffee peel, it forms a contradiction for the high value-added processing of large quantities of coffee peels every year, therefore, new research directions of coffee peel can be predicted:

1) According to the feature of a large amount of peel and residues produced by the processing of coffee peels in Yunnan coffee-growing areas over the years, the research directions of the high value-added utilization rate of coffee peel are actively expanded and promote them.

2)The extraction and fermentation process conditions of coffee peel is optimized, the yield of extraction and fermentation products are improved, and simulation software is used to carry out large-scale production and research on coffee peel extraction and fermentation process, so as to provide theoretical basis for the realization of batch industrial production.

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