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# Extraction of Polyphenols from Jackfruit's Peel and Its Applications in Tobacco

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**Abstract.** In this paper, the parameters for the extraction of polyphenols from jackfruit's peel were optimized. The results showed that ethanol concentration of 30%, extraction temperature of 80°C, extraction duration of 1.5h and solid-liquid ratio of 1:30 were the optimal parameters for the extraction of polyphenols from jackfruit's peel. The effect of the extraction was also investigated to improve the inherent quality of tobacco. The extraction can improve the inherent quality of tobacco. It can enhance the aroma quality and make the smoke clean and smooth. Therefore, based on the effect of the extraction, it can be found numerous applications in the tobacco industry.

## 1. Introduction

Plant polyphenols (Phenolic compounds in plants) provide a natural sources of antioxidants using in nutraceuticals and foods [1]. Besides antioxidative, plant polyphenols also focus considerable attention for the treatment and prevention of many diseases such as anticancer, anti –inflammatory [2], anti-allergic [3] anti-arteriosclerosis [4] and anti-microbial [5-6] agents.

The tobacco polyphenol, mainly including tanning, coumarin, flavonoids and proanthocyanidins, is one of the most important category compounds in tobacco [7]. The concentration of polyphenols, to a certain extent, reflects the inherent quality of tobacco. In addition, it has an important contribution to the sensory quality. However, few studies have been reported on the applications of plant polyphenols in the tobacco industry. In the present study, we optimized the parameters for the extraction of polyphenols form jackfruit's peel and evaluated the effects of the extraction on tobacco.

## 2. Materials and Methods

### 2.1. Instruments and reagents

#### 2.1.1. Chemicals

Jackfruit's peel was purchased from Guangzhou.

All chemicals including ethanol, Folin-Ciocalteu's assay, aqueous Na<sub>2</sub>CO<sub>3</sub> and gallic acid were purchased from Guangzhou and at AR grade.

Water was provided by milli-Q system.



### 2.1.2. Apparatus

Electronic balance (BSA224S, Sartorius, Germany), UV spectrophotometer (U3010, HITACHI, Japan), water bath (B-220, Rongsheng, Shanghai), blender (HR2004, PHILIPS, Netherlands), shredder (QS-2A, GaTech, China), cigarette injection unit (Cijector, Burghart, Germany).

## 2.2. Methods

### 2.2.1. Extraction of polyphenols from Jackfruit's Peel

The fresh jackfruit's peel was milled into powder by a blender. According to the dissolution characteristics of polyphenols, ethanol was the extraction solvent of polyphenols from jackfruit's peel. The extraction parameters consist of ethanol concentration, extraction temperature, extraction duration and the ratio of solid to liquid (solid-liquid ratio) were optimized by using a L9 (34) orthogonal array, and evaluated according to the contents of the extracted polyphenols. The extraction was repeated in triplicates.

### 2.2.2. Determination of the contents of polyphenols

The content of polyphenols was tested using the Folin-Ciocalteu's assay, with slight modifications. The filtered sample was diluted with water to 50mL. Folin-Ciocalteu's phenol reagent was first diluted to 20%, and then 3.5mL of this very reagent was added to 1.5mL of the solution. Following by the addition of 4.0mL of the 7.5% aqueous Na<sub>2</sub>CO<sub>3</sub> solution and the mixture was incubated at room temperature for 40 min. The absorbance at 760nm was recorded. Using a standard curve of gallic acid, the final results were expressed as the content of gallic acid. All of the analysis was repeated in triplicates.

### 2.2.3. Sample collection and treatment

Twenty tobacco samples (4 varieties) were supplied by China Tobacco Guangdong Industrial Co., Ltd. Four types of tobacco in different locations: flue-cured tobacco (No.1-4 from China, No. 5-7 from Zimbabwe, Brazil and America), sun-cured tobacco (No.8-10 from China), burley (No.11-15 from China, No. 16 from Malawi), oriental tobacco (No.17-18 from China, No. 19-20 from Turkey). First, 50g of tobacco samples was cut into filamentous by shredder, and then 600mg of the cut tobacco was made into cigarette manually. The cigarettes were conditioned at the temperature of 22°C and the relative humidity of 65% for 48h. And 8  $\mu$  L of the extraction was injected by the cigarette injection unit. The injected samples were kept in sealed bags.

## 3. Results and Analysis

### 3.1. Optimal parameters for the extraction of polyphenols from Jackfruit's Peel

#### 3.1.1. Effect of extraction duration on the extraction of polyphenols from Jackfruit's Peel

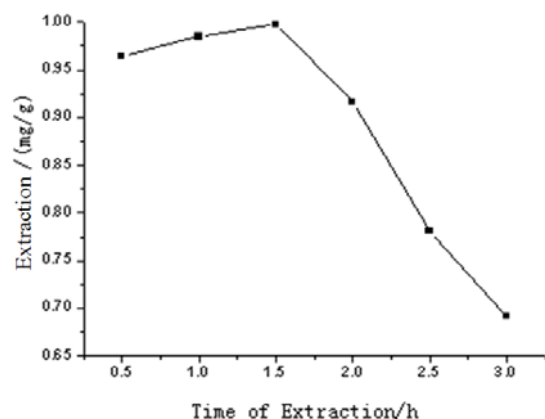
By using 40% ethanol as the extraction solvent, water bath temperature of 80°C and solid-liquid ratio of 1:25, the contents of polyphenols increased when the extraction duration is increasing. The content of polyphenols reached the maximum value when the extraction time was 1.5h (Fig.1). So, 1.5h was considered as the optimal extraction duration for the extraction of polyphenols from jackfruit's peel.

#### 3.1.2. Effect of solid-liquid ratio on the extraction of polyphenols from Jackfruit's Peel

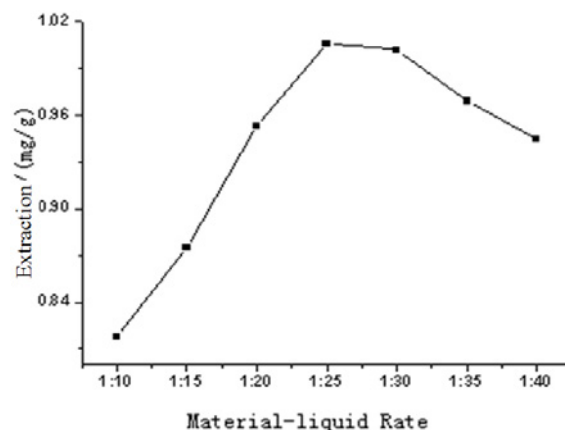
The solid-liquid ratio had a certain influence on the extraction. The content of polyphenols in extract first increased then decreased with the decrease of the solid-liquid ratio, and reached the maximum when the solid-liquid ratio was 1:25 (Fig.2). By considering the above result, 1:25 was determined as the optimal solid-liquid ratio for the extraction.

### 3.1.3. Effect of ethanol concentration on the extraction of polyphenols from Jackfruit's Peel

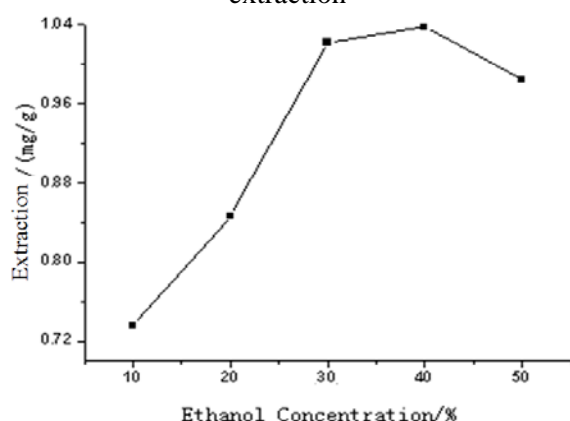
Ethanol concentration had a certain effect on the extraction of polyphenols from jackfruit's peel when the solid-liquid ratio was 1:25, water bath temperature was 80°C and extraction duration was 1.5h. The content of polyphenols reached the maximum level when the Ethanol concentration was 40% (Fig.3). Therefore, 40% was considered as the optimal ethanol concentration for the extraction.



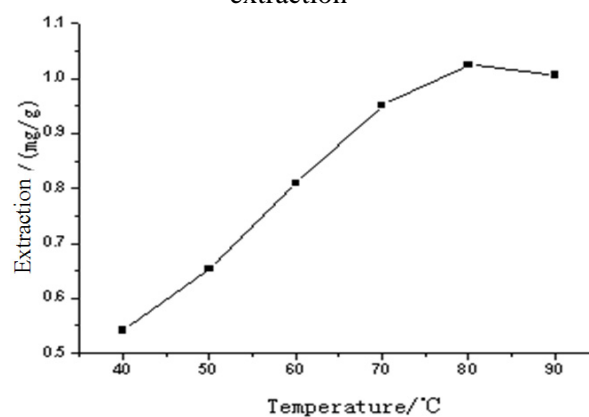
**Fig.1** Effect of extraction duration on the extraction



**Fig.2** Effect of solid-liquid ratio on the extraction



**Fig.3** Effect of ethanol concentration on the extraction



**Fig.4** Effect of extraction temperature on the extraction

### 3.1.4. Effect of extraction temperature on the extraction of polyphenols from Jackfruit's Peel

Under the condition of 40% ethanol, solid-liquid ratio of 1:25 and the extraction duration of 1.5h, water bath temperature had a certain effect on the extraction of polyphenols from jackfruit's peel. In detail, 80°C water bath was the most conducive to the extraction of polyphenols (Fig.4). So, 80°C was considered as the optimal temperature for the extraction of polyphenols.

### 3.1.5. Results of orthogonal test

The extraction parameters containing ethanol concentration, extraction temperature, extraction duration and the solid-liquid ratio were optimized by using a L9 (34) orthogonal array. As shown in Table 1 and Table 2, solid-liquid ratio was the most important factor influencing the content of polyphenols in the extract, followed in turn by extraction duration, extraction temperature and ethanol concentration. The optimal combination for the extraction of polyphenols was A2B3C1D2: extraction duration of 1.5h, solid-liquid ratio of 1:30, ethanol concentration of 30% and extraction temperature of 80°C.

**Table 1** Results of the orthogonal test

No.	Extraction duration (A)/h	Solid-liquid ratio (B)	Ethanol concentration (C)/%	Extraction temperature (D)/ °C	Concentration /(mg/g)
1	1.0	1:20	30	70	0.915
2	1.0	1:25	40	80	0.886
3	1.0	1:30	50	90	1.022
4	1.5	1:20	40	90	0.953
5	1.5	1:25	50	70	0.864
6	1.5	1:30	30	80	1.056
7	2.0	1:20	50	80	0.897
8	2.0	1:25	30	90	0.835
9	2.0	1:30	40	70	0.877
K <sub>1</sub>	2.822	2.764	2.806	2.655	8.304
K <sub>2</sub>	2.873	2.585	2.715	2.839	
K <sub>3</sub>	2.609	2.955	2.782	2.809	
R	0.264	0.370	0.091	0.184	

### 3.2. Effect of the extraction of polyphenols on the inherent quality of tobacco

Four varieties of twenty tobacco samples were collected and evaluated by at least seven assessors. As shown in Table 2, extraction of polyphenols from jackfruit's peel can improve the inherent quality of tobacco. It can enhance the aroma quality and make the smoke clean and smooth. Therefore, based on the effect of the extraction, it can be found numerous applications in the tobacco industry. The most obvious effect is on the sun-cured tobacco, followed in turn by flue-cured tobacco, oriental tobacco and burley.

**Table 2** Sample evaluation results

	Flue-cured tobacco		Sun-cured tobacco		Burley		Oriental tobacco	
	un-injected	injected	un-injected	injected	un-injected	injected	un-injected	injected
aroma quality	7.3	7.5	4.8	5.1	6.2	6.2	5.3	5.4
aroma amount	5.5	5.6	4.9	5.0	6.8	6.8	5.2	5.3
impact	5.2	5.1	4.6	4.6	5.9	5.8	4.7	4.7
concentration	6.5	6.6	5.0	5.2	7.1	7.0	5.4	5.4
irritancy	5.2	5.4	6.8	6.8	4.2	4.6	5.9	6.0
total	29.7	30.2	26.1	26.7	30.2	30.4	26.5	26.8

## 4. Conclusion

The parameters for the extraction of polyphenols from jackfruit's peel were optimized. The results showed that ethanol concentration of 30%, extraction temperature of 80°C, extraction duration of 1.5h and solid-liquid ratio of 1:30 were the optimal parameters for the extraction of polyphenols from jackfruit's peel.

The effect of the extraction was also investigated to improve the inherent quality of tobacco. The extraction can improve the inherent quality of tobacco. It can enhance the aroma quality and make the smoke clean and smooth. Therefore, based on the effect of the extraction, it can be found numerous applications in the tobacco industry.

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