



Original Article

A sensory evaluation on the formulation optimization of the herbal tea from honeysuckle and rose by single factor and orthogonal tests

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Abstract: The objective of this study was to produce an innovative type of optimized formulation of the herbal tea. The study utilized honeysuckle (*Lonicera japonica* Thunb.) and rose (*Rosa rugosa* Thunb.) as raw materials, along with white granulated sugar and citric acid. The optimal formula of the herbal tea was determined through single factor and orthogonal tests based on the sensory score. The results demonstrated that the combination of 7.5% of honeysuckle concentrate, 2.5% of rose concentrate, 14% of white granulated sugar, and 0.08% of citric acid was the optimal formula of the herbal tea. The beverage yielded by this formula boasted a bright color, moderate sourness and sweetness, and an appealing fragrance from honeysuckle and rose. In addition to having a distinctive flavor, it also serves as a healthy and nutritious form of herbal tea. Furthermore, this formula provides a new avenue for the development and utilization of honeysuckle and rose.

Keywords: honeysuckle; rose; herbal tea; orthogonal tests; sensory evaluation

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Introduction

Liver disease is a prevalent cause of illness and death on a global scale.^[1] What's alarming is that unhealthy living styles and bad dietary habits of human beings contribute to an increase in the global burden of the liver disease. Accordingly, it is indispensable to note that the liver not only exerts a significant role in metabolism and detoxification but also serves as a pivotal and frontline immune tissue.^[2] In view of this nature, prioritizing liver

protection should be a top concern for individuals and healthcare professionals. Interestingly, the popularity of traditional Chinese medicine (TCM) in the treatment of liver disease is on the rise due to its proven safety and effectiveness. As a traditional herb with hepatoprotective properties, whether honeysuckle extract or various monomer components of honeysuckle both have been demonstrated to exhibit potent

hepatoprotective benefits in a variety of liver disease models.^[3-6] Analogously, rose may have the ability to protect the liver.^[7] Currently, as two kinds of flower herbs of homology of medicine and food, researchers have developed several health care products and herbal flower tea containing honeysuckle or rose.^[8] Nonetheless, the combination of honeysuckle and rose has not been reported. One herb may contain several active medicinal ingredients,^[9] consequently, combining several herbs with semblable effects not only minimizes the dosage of a single drug but also exerts more efficient pharmacological effects. In addition, through literature investigation and practical cases, we realized that the combination of these two flower herbs is highly safe at normal doses, and there is no mutual restraint and antagonism situation in the compatibility theory of traditional Chinese medicine. Based on that, we have designed a work to formulate a polyherbal tea for the prevention and treatment of the liver disease. For the formulation, we have selected honeysuckle and rose, both the selected plants have been reported to have potential hepatoprotective effects. In this paper, we present the results of a preliminary investigation into the work, which aimed to investigate the best formulation ratio of the herbal tea through single factor and orthogonal tests, so as to produce a healthy and nutrient-rich herbal tea with transparent color, strong aroma, and delicious taste, with possible hepatoprotective potential as well.

Materials and methods

1. Materials and instruments

a. Materials

Honeysuckle (LOT: 2201070) and rose (LOT: 2205075) were purchased from Sichuan New Lotus Traditional Chinese Medicine Slices Co., Ltd. White granulated sugar was

purchased from the local supermarket. Citric acid was purchased from Shandong Yingxuan Industrial Co., LTD.

b. Instruments

Electronic analytical balance (BP-211D, Sartorius Corporate, Germany), thermostat water bath (DZKW-4, Beijing Zhongxing Weiye Instrument Co., LTD), induction cooker, pot, beaker, a glass rod, measuring cylinder, press cloth.

2. Methods

2.1 Technological process

The technological process of the herbal tea is shown in Figure 1.

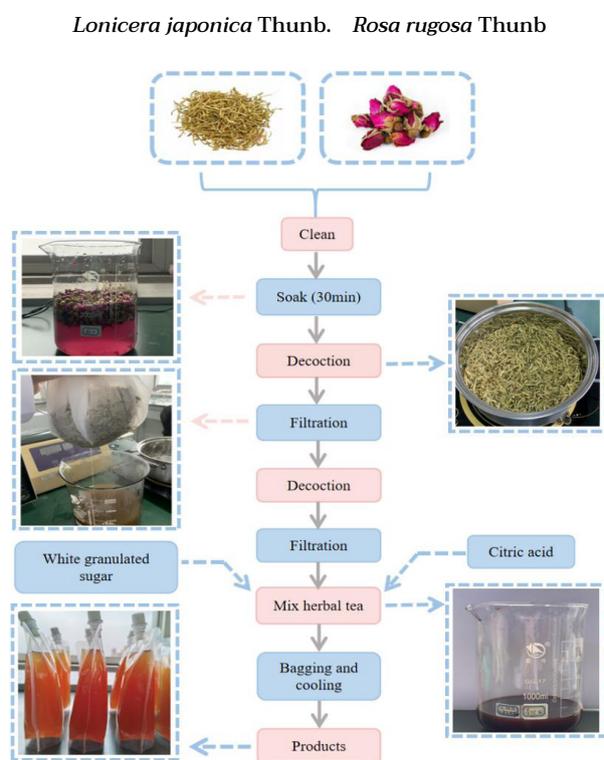


Figure 1 Technological process of the herbal tea

2.2 Operating points

(1) Preparation of honeysuckle concentrate: the herb was cleaned up, then it was submerged in a certain amount of drinking water for 30 minutes. Subsequently, the decoction was carried out, and 15 times drinking water was added for the initial decoction before it was

filtered while hot. After that, a second decoction was made with 10 times drinking water and filtered once more. In this process, the liquid was initially decocted with a martial fire (about 200°C) until it boils, and then it was decocted steadily with a gentle fire (around 100 °C). Ultimately, the second filtrate was combined with the first before it was concentrated into 1 g of medicinal materials in every 5 mL of concentrate in a thermostatic water bath at 60 °C.

(2) Preparation of rose concentrate: the herb was washed initially, afterward it was immersed in a certain amount of drinking water for 30 minutes. Whereafter, the decoction was performed, and 12 times drinking water was added for the first decoction before it was filtered while hot. In this process, the liquid is initially decocted with a martial fire (about 200°C) until it boils, and then it is decocted steadily with a gentle fire (around 100 °C). The next step was that the second decoction was put into effect with 10 times of drinking water, then it was filtered immediately. In the end, the filtrate of the second one was combined with the first one before they were concentrated into 1g of medicinal materials per 5 mL of concentrate in a thermostatic water bath at 60 °C.^[10]

(3) Mixing and formula optimization: the optimal formulation of the herbal tea was obtained by single factor and orthogonal tests, with honeysuckle concentrate, rose concentrate, white granulated sugar, and citric acid as factors, and the sensory score as the index.

(4) Bagging: the optimized herbal tea was poured into a sterilized food-grade transparent sub-packing bag.

2.3 Single factor test

Based on the results of the preliminary experiment, the amounts of honeysuckle concentrate (2.5%, 5%, 7.5%, 10%, and 12.5%),

rose concentrate (2.5%, 5%, 7.5%, 10%, and 12.5%), white granulated sugar (10%, 12%, 14%, 16%, and 18%), and citric acid (0.04%, 0.06%, 0.08%, 0.10%, and 0.12%) were selected to address the effects of the supplemental levels of them on the sensory score of the herbal tea.

2.4 Orthogonal test

Based upon the single factor test, 3 levels were selected for each of the 4 factors, including the amount of honeysuckle concentrate (factor A), the amount of rose concentrate (factor B), the amount of white granulated sugar (factor C), and the amount of citric acid (factor D). Afterward, the $L_9(3^4)$ orthogonal test was implemented to determine the optimal formula of the herbal tea. The orthogonal test design is displayed in Table 1.

Table 1 Levels of the factors of the orthogonal test

Levels	Factors			
	A%	B%	C%	D%
1	2.5	2.5	12	0.06
2	5	5	14	0.08
3	7.5	7.5	16	0.10

2.5 Sensory score of the herbal tea

The quality of the herbal tea was assessed using the sensory scoring criteria based on flavor, odor, color, and organizational state. Using the percentage system scoring method, 10 volunteers (5 men and 5 women) without taste preferences aged from 20 to 40 were invited to conduct comprehensive scores according to the sensory evaluation criteria to determine the optimal formula ratio of the beverage. The sensory scoring criteria are shown in Table 2.

Table 2 The sensory scoring criteria

Sensory Items	Scoring Criteria	Scores
Flavor (30 scores)	Moderate sweet and sour, with no bitterness	21-30
	Slightly sour/sweet/thin, slightly bitter	11-20
	It's sour/sweet/thin and bitter	0-10
Odor (30 scores)	The fragrance is suitable and soft	21-30
	Inconspicuous scent	11-20
	Almost fragrance-free	0-10
Color (20 scores)	Light yellow/orange/red, uniform and transparent	11-20
	The color is dark, uneven, and opaque	0-10
Organizational Status (20 scores)	Uniform, no suspended substance or impurities, no stratification, no visible precipitates	11-20
	There are suspended solids or impurities, layers, and visible precipitates	0-10

2.6 Statistics and analysis

All the data were analyzed and plotted by Graph Pad Prism software and expressed by mean±SD. One-way ANOVA was used for comparison between multiple groups, and differences were considered to be statistically significant if p<0.05.

Results and analysis

1. Single factor test

1.1 Effect of the amount of honeysuckle concentrate on the sensory score

With 5% rose concentrate, 14% white granulated sugar, and 0.08% citric acid as the invariant, 2.5%, 5%, 7.5%, 10%, and 12.5% honeysuckle concentrate were selected for the single factor test. In accordance with the sensory score, the ideal amount of

honeysuckle concentrate was determined, as can be noticed in Figure 2 below.

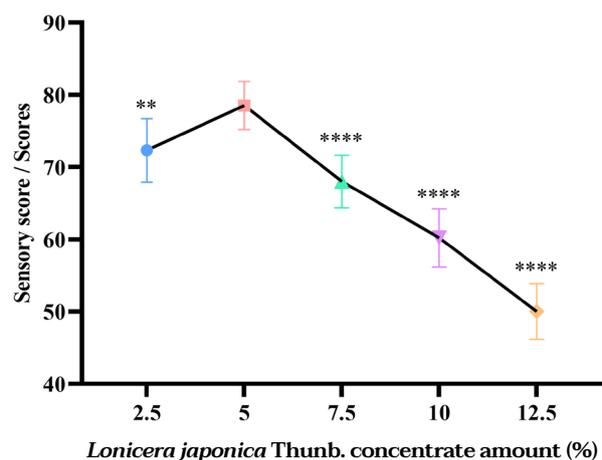


Figure 2 Effects of the amount of honeysuckle concentrate added on the sensory score

Results are presented as mean±SD. **p<0.01 and ****p<0.0001 (vs. 5%).

As demonstrated in Figure 2, the sensory score of the herbal tea increased initially before drastically declining as the concentration of honeysuckle increased. The beverage had little flavor to drink when the content of honeysuckle concentrate was less than 5%. Nevertheless, when the amount of honeysuckle concentrate exceeded 5%, the bitter taste of the plant was overpowering, which resulted in a dramatic fall in the sensory score. Hence, the amount of honeysuckle concentrate was determined to be 5%, and

the product had the optimal taste under this condition.

1.2 Effects of the amount of rose concentrate on the sensory score

With 5% of honeysuckle concentrate, 14% of white granulated sugar, and 0.08% of citric acid as a fixed value, 2.5%, 5%, 7.5%, 10%, and 12.5% of rose concentrate were chosen for single factor test and the optimal amount of rose concentrate was determined in conformity with the sensory score, as shown in Figure 3 below.

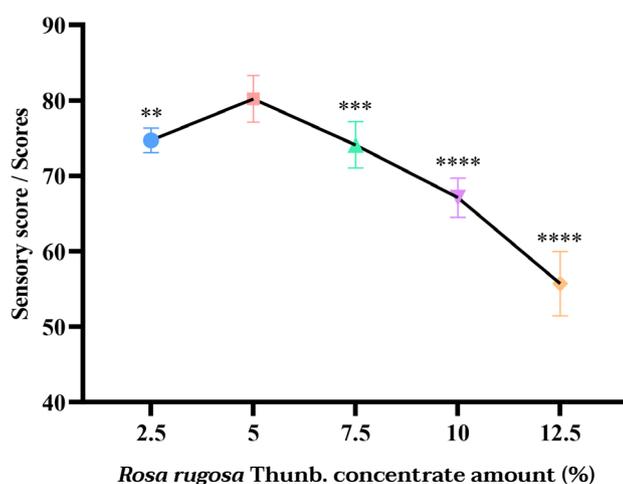


Figure 3 Effects of the amount of rose concentrate on the sensory score

Results are presented as mean±SD. **p<0.01, ***p<0.001 and ****p<0.0001 (vs. 5%).

As manifested in Figure 3, with the increase in the concentration of rose, the sensory score of the herbal tea showed a tendency of minor increase initially and decreased subsequently with the increase of rose concentrate. The product tasted the most pleasant and had an appropriate balance of sweet and sour when the rose concentrate was added at a content of 5%. Whereas, when the amount of rose concentrate was smaller than 5%, the product lacked the distinctive fragrance of rose. On the contrary, if too much rose concentrate was added, the taste of the herbal

tea will be astringent and the smell will be disharmonious, affecting the overall quality of the product.

1.3 Effects of the amount of white granulated sugar on the sensory score

White granulated sugar in the percentages of 10%, 12%, 14%, 16%, and 18% were chosen, whereas 5% of honeysuckle concentrate, 5% of rose concentrate, and 0.08% of citric acid as constant values, to carry out a single factor test. The optimal amount of white granulated sugar was determined according to the sensory score, as shown in Figure 4.

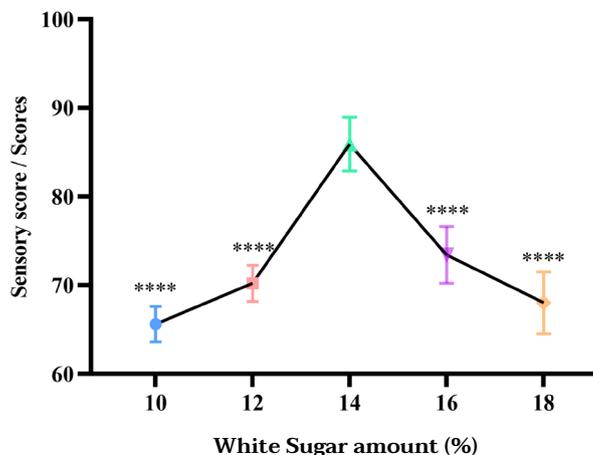


Figure 4 Effects of the amount of white granulated sugar on the sensory score

Results are presented as mean±SD. ****p<0.0001 (vs. 14%).

As can be observed in Figure 4, the sensory score steadily rose as the amount of white granulated sugar increased. The sensory score peaked at 14% white granulated sugar, at which point the product's flavor, sweet, sour, and taste coordination were at their optimum. When the amount of white granulated sugar was increased, the sensory score would decrease, and the sweetness of the product was overwhelming, making the overall taste of the product not satisfactory. When the amount of white granulated sugar was insufficient, the product lacked sweetness, and the flavor was negatively

impacted by the bitterness of honeysuckle and the astringency of rose. Thus, 14% was the recommended level of the amount of white granulated sugar.

1.4 Effects of the amount of citric acid on the sensory score

With 5% of honeysuckle concentrate, 5% of rose concentrate and 14% of white granulated sugar as invariant values, citric acid was selected as 0.04%, 0.06%, 0.08%, 0.10%, and 0.12% for the single factor test, and the optimal addition of citric acid was determined corresponding to the sensory score, as exhibited in the following Figure 5.

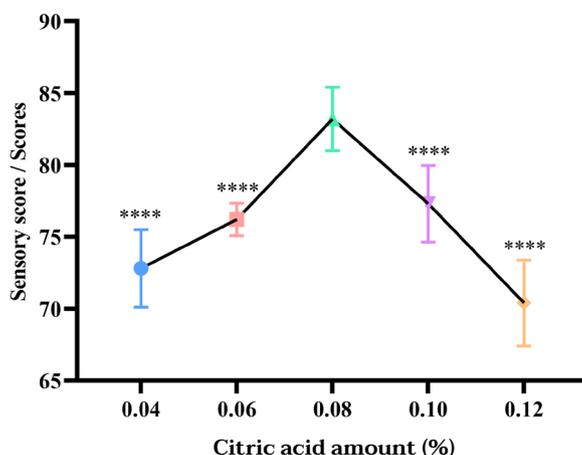


Figure 5 Effects of the amount of citric acid on the sensory score

Results are presented as mean±SD. ****p<0.0001 (vs. 0.08%).

As illustrated in Figure 5, with the increase in the amount of citric acid, the sensory score of the herbal tea revealed a tendency of initially increased and then fell off with the rise of citric acid. While the amount of citric acid was less than 0.08%, the sour taste of the product was insufficient. On the contrary, As the amount of citric acid was higher than 0.08%, the sour taste of the product was excessively strong, which covered the taste of

the raw materials of the beverage, and the sensory score will decrease as demonstrated. In conclusion, the appropriate amount of citric acid was determined to be 0.08%, which not only could boost appetite but also enhanced the taste of the herbal tea.

2. Orthogonal test

The orthogonal test results of the herbal tea are shown in table 3.

Table 3 The orthogonal test results of the herbal tea

Test Number	A	B	C	D	Sensory Score/scores
	Honeysuckle Concentrate/%	Rose Concentrate /%	White Granulated Sugar /%	Citric Acid /%	
1	1	1	1	1	76.0
2	1	2	2	2	71.8
3	1	3	3	3	67.8
4	2	1	2	3	90.1
5	2	2	3	1	72.3
6	2	3	1	2	75.5
7	3	1	3	2	88.7
8	3	2	1	3	77.1
9	3	3	2	1	75.6
K1	215.6	254.8	228.6	223.9	
K2	237.9	221.2	237.5	236.0	
K3	241.4	218.9	228.8	235.0	
k_1	71.9	84.9	76.2	74.6	
k_2	79.3	73.7	79.2	78.7	
k_3	80.5	73.0	76.3	78.3	
R	8.6	11.9	3.0	4.1	

As reflected in Table 3, the importance ranking of the four factors affecting the sensory score of the herbal tea was in the order of $B > A > D > C$, what's meaning that, the amount of rose concentrate followed by honeysuckle concentrate, citric acid, and white granulated sugar. The amount of rose concentrate had the greatest influence on the sensory score of the herbal tea, followed by the amount of honeysuckle concentrate, whereas the amount of citric acid and white granulated sugar had relatively little influence. $A_3B_1C_2D_2$ was the best formula combination of the herbal tea in the light of the value of K. Nevertheless, the highest sensory score of the product in the table was test group 4,

that was, the sensory score allocation scheme was $A_2B_1C_2D_3$.

3. Confirmation of optimal formulation

On account of the optimal formulation was not obtained from the 9 products we made, subsequently, we mixed and blended the plan generated by the value of K and carried out a sensory score. As implied in Table 4, the final sensory score was compared with that obtained from test group 4 in the table, and the results indicated that the sensory score of the beverage produced according to the K value plan (91.4 points) was superior to that of experiment 4 (90.1 points). To sum up, $A_3B_1C_2D_2$ was chosen as the best allocation scheme in this experiment.

Table 4 Confirmation of optimal formulation

Test Number	Sensory Score/scores	Average score
1	91.8	
2	92.1	91.4
3	90.3	

Discussion

Analogously, honeysuckle has the effect of protecting the liver and promoting gallbladder, and rose has the effect of soothing the liver and regulating qi, the combination of them has a potential beneficial action on the liver undoubtedly. Naturally, the homology of medicine and food TCM with synergistic effects should be further considered for the development of health products. In this study, single factor and orthogonal tests were conducted to investigate the formula of the herbal tea. 7.5% of honeysuckle concentrate, 2.5% of rose concentrate, 14% of white granulated sugar, and 0.08% of citric acid were found to be the ideal proportions for

the herbal tea. With this ratio, the herbal tea was uniform, transparent, and orange-yellow in color. It also had an overtly distinctive fragrance of honeysuckle and rose, which was smooth and refreshing, moderately sweet and sour, and rich in nutrition. In terms of the choice of excipients, white granulated sugar is the most commonly used excipient in polyherbal tea, which could improve the bitter taste of traditional Chinese medicine and thus keep the taste of herbal tea good. Combined with the formula of wanglaoji herbal tea, thus we chose white granulated sugar as an excipient of the herbal tea. Additionally, citric acid is also a familiar food additive, which can not only adjust the acidity, and neutralize the sweetness

of white granulated sugar, but also has the effect of preservative and fresh-keeping, so we chose citric acid as another excipient of the herbal tea. An innovative polyherbal tea is required to make sure that people take pleasure in its tastes before it is permitted to go on the market and into the lives of individuals. The formula in the current study that obtained the best sensory score featured better flavor which could promote the compliance or use of this herbal tea. The development of a new herbal tea product not only offers a novel approach to fully utilize honeysuckle and rose, but also promotes public health development. In the future, this study could supply a few recommendations for the production of polyherbal tea and we will also conduct research on the hepatoprotective effect of this polyherbal tea in the future.

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นิพนธ์ต้นฉบับ

การประเมินคุณภาพทางประสาทสัมผัสในการพัฒนาสูตรชาสมุนไพรดอกสายน้ำผึ้งและดอกกุหลาบที่เหมาะสมด้วยวิธีทดสอบแบบปัจจัยเดียวและการทดสอบ orthogonal

เหยา อวี๋ซิน, ก้าว อี้หลิง, จ้าว ชิงเถา, หลี่ หยุนเสี๋ย, เฝิง เฉิง

ห้องปฏิบัติการหลักประจำมณฑลด้านทรัพยากรยาแผนจีนภาคตะวันตกเฉียงใต้ มหาวิทยาลัยการแพทย์แผนจีนเฉิงตู

บทคัดย่อ: การศึกษานี้มีวัตถุประสงค์เพื่อพัฒนาสูตรชาสมุนไพรใหม่ที่มีความเหมาะสม วัตถุดิบที่ใช้คือ ดอกสายน้ำผึ้ง (*Lonicera japonica* Thunb.) และดอกกุหลาบ (*Rosa rugosa* Thunb.) ร่วมกับน้ำตาลทรายขาวและกรดซิตริก โดยอิงจากคะแนนทางประสาทสัมผัส และกำหนดสูตรที่เหมาะสมสำหรับชาสมุนไพรโดยวิธีการทดสอบปัจจัยเดียวและการทดสอบ orthogonal ผลการศึกษาพบว่า ดอกสายน้ำผึ้งเข้มข้น 7.5% ดอกกุหลาบเข้มข้น 2.5% น้ำตาลทรายขาว 14% และกรดซิตริก 0.08% เป็นสูตรที่มีความเหมาะสมมากที่สุด ซึ่งชาสูตรนี้มีกลิ่นสดใสรสชาติหวานอมเปรี้ยวกลมกล่อม และมีกลิ่นหอมสดชื่นจากดอกสายน้ำผึ้งและดอกกุหลาบ นอกจากนี้จะมีรสชาติที่โดดเด่นแล้ว ยังดีต่อสุขภาพและมีคุณค่าทางโภชนาการอีกด้วย การพัฒนาชาสูตรนี้ยังเป็นแนวทางในการพัฒนาและใช้ประโยชน์จากสายน้ำผึ้งและดอกกุหลาบอีกด้วย

คำสำคัญ: ดอกสายน้ำผึ้ง; ดอกกุหลาบ; ชาสมุนไพร; การทดสอบ orthogonal; การประเมินคุณภาพทางประสาทสัมผัส

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原创论文

通过单因素和正交试验对金银玫瑰双花凉茶的配方优化进行感官评价

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摘要: 本研究的目的是研制出一种新型的优化配方的凉茶。该研究以金银花 (*Lonicera japonica* Thunb.) 和玫瑰花 (*Rosa rugosa* Thunb.) 为原料, 辅料为白砂糖和柠檬酸。以感官评分为基础, 通过单因素试验和正交试验确定了凉茶的最佳配方。结果表明, 金银花浓缩液 7.5%、玫瑰花浓缩液 2.5%、白砂糖 14%、柠檬酸 0.08% 为该凉茶的最佳配方。用这种配方制成的饮料颜色鲜艳透亮, 酸甜适中, 具有沁人心脾的金银花和玫瑰花的香味。除了其独特的风味, 它还是一种健康丰富和营养的凉茶。该凉茶的研制为金银花和玫瑰花的开发利用提供了新的途径

关键词: 金银花; 玫瑰花; 凉茶; 正交试验; 感官评价

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