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A study on the Process of Containing Tablets from the Rind of Small-Grain Coffee in Yunnan, China

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ABSTRACT

An innovative Yunnan small-grain coffee pericarp tablet was developed by using high-speed grinding technology to convert Yunnan small-grain coffee pericarp into dry powder, and then combining other main and auxiliary ingredients. The quality of the product was evaluated by sensory scores, and a one-way test was applied to select the appropriate ratio of ingredients and formulation, and an orthogonal test was used to optimize the formulation of the tablets. The results showed that the optimal formulation for the production of Yunnan small-grain coffee pericarp tablets included 45.69% of Yunnan small-grain coffee pericarp powder, 19.58% of dextrin, 15.66% of mannitol, 15.66% of microcrystalline cellulose, 2.61% of magnesium stearate, 0.52% of calcium sulphate and 0.26% of sodium saccharin. Under this formula, the tablets had a unique taste, consistent color, smooth appearance, delicate texture and sensory score of 95. Its physical and chemical indexes and microbiological indexes meet the corresponding food safety standards, and it is a new product, which is of great significance to promote the food development of Yunnan small-grain coffee peel resources.

KEYWORDS

Yunnan small-grain coffee pericarp; Tablet; Orthogonal experiment

1. INTRODUCTION

In recent years, Yunnan Coffea arabica is popular in domestic and foreign markets, which has significantly promoted the economic growth of Yunnan Province. However, the deep processing technology and sales of coffee are mostly occupied by foreign markets [1] The Yunnan Province is the main coffee growing area in China. Yunnan Province is the main coffee growing area in China, and the main varieties grown are small-grain coffee, also known as Yunnan small-grain coffee [2][3] The topography of Yunnan Province is undulating, mostly mountainous. Due to the large topography of Yunnan Province, mostly mountainous terrain, air humidity, long hours of sunshine, large temperature differences between day and night, these natural conditions make Yunnan Province one of the best areas for growing small-grain coffee, small-grain coffee planted with moderate acidity, rich and mellow aroma [4][5].

For Yunnan Province, it is very likely that the coffee industry will become the pillar industry of Yunnan Province in the future, therefore, the scale of coffee cultivation in Yunnan Province should be further expanded [6] In addition, a sound coffee marketing system should be established, leading local coffee enterprises should be nurtured, and unified production, processing, sales and cultivation standards should be formulated to promote the development of the coffee industry. In addition, a sound coffee marketing system should be established, leading local coffee enterprises should be

nurtured, and unified standards for production, processing, sales and cultivation should be formulated in order to promote the development of the coffee industry in a comprehensive manner [7][8][9].

The results of the study show that coffee wastes are rich in organic nutrients and mineral nutrients and have a high value and a wide range of applications in the production of wine, alcohol, animal feed, biogas, fuel charcoal briquettes, organic fertilizers and medicinal chemicals [10] At present, the comprehensive utilization of coffee peel is mainly reflected in beverage manufacturing, feed, composting and so on. At present, the comprehensive utilization of coffee peels is mainly reflected in the manufacture of beverages, feed, composting, etc., but the low utilization rate has resulted in the waste of resources and environmental pollution [11] In pharmacological terms, the skin and flesh of the coffee fruit contain a variety of biologically active compounds, such as chlorogenic acid, rutin, fenugreek and anthocyanin. From a pharmacological point of view, the skin and flesh of the coffee fruit contain a variety of biologically active compounds, such as chlorogenic acid, rutin, mangiferin, fenugreek and anthocyanin. In addition, the skin and pulp of the coffee fruit contain components that can be combined with drugs to produce substances that are beneficial for liver protection, fat reduction, and lowering blood pressure. Many studies have been conducted on the use of coffee pulp and rind in food processing operations [12][13] In the process of coffee production, most manufacturers treat coffee peels as waste. In the process of coffee production, most manufacturers treat coffee rinds as waste when making coffee, which is not only unfavorable to the environment, but also a waste of resources. Therefore, it is an urgent task to explore the potential use of coffee peels to enhance the economic and social value of coffee [14][15].

Through chemical examination of the organic and mineral composition of the outer skin and husk of the coffee fruit, it has been found that these by-products are rich in a variety of organic nutrients and minerals. They are therefore of great value and have diverse potential for use in areas such as brewing, alcohol production, fodder farming, biogas generation, fuel rods, organic fertilizers, pharmaceuticals and chemical products [16][17].

The main components of coffee pericarp include cellulose, total sugar, protein and lignin, and the proportions of these components in the pericarp are: cellulose accounts for 17.704% to 18.585%, and total sugar accounts for 16.984% to 19.315%. It is worth noting that the sugars in the pericarp are mainly reducing sugars. Although the pericarp also contains caffeine, chlorogenic acid and fenugreek, which are unique to the coffee bean, their contents are significantly lower than those in raw coffee beans [18].

Tablets are a specialized type of tablet that can be used for a variety of purposes, such as anti-inflammatory, antiseptic, wound austerity, pain relief or local anesthesia. There are various methods of making tablets, including wet granulation and compression, dry granulation and compression, and direct powder compression, each of which has its own characteristics and is suitable for different drugs and production requirements [13].

The study found that the amount of caffeine contained in Coffea arabica beans was 15.56g/kg, while the concentration of caffeine in the peel reached 21.19g/kg, compared with 13.62g/kg in other parts [19] Currently, there are fewer studies and applications of coffee peel in food, mostly for the production of coffee peel tea and coffee peel wine. Currently for the coffee peel in the edible research and application of less, most are used to make coffee peel tea and coffee peel wine, although the raw material innovation, the coffee peel for the utilization, but its caffeine content and other factors are difficult to be strictly controlled, so more simple to eat and the amount of active control of the coffee peel tablets will not be underestimated the innovation and development of coffee peel tablets.

2. EXPERIMENTAL MATERIALS AND METHODS

2.1. Experimental Materials and Experimental Apparatus

The experimental materials are shown in Table 1.

Table 1. Table of sources of experimental materials

Ingredients	Level	Source
Yunnan small grain coffee pericarp	Food grade	Yunnan Pu'er
Mannitol	Food grade	Zhejiang Tianhe Food Bio
Dextrin	Food grade	Zhejiang Tianhe Food Bio
Microcrystalline cellulose	Food grade	Zhejiang Tianhe Food Bio
calcium sulfate	Food grade	Henan Zhongchen Biotechnology
Magnesium stearate	Food grade	mei wing food
Saccharin sodium	Food grade	Zhejiang Tianhe Food Bio

The experimental apparatus is shown in Table 2.

Table 2. Table of sources of experimental apparatus

Name	Model	Source
High-speed pulverizer	FW100	Tianjin Tester Instrument Co
Single punch tablet presses	THDP-6	Shanghai Tian Helu Machinery Equipment Co
Electrically heated blast drying oven	DHG-9240A	Shanghai Pious Jun Scientific Instrument Co

2.2. Process Flow

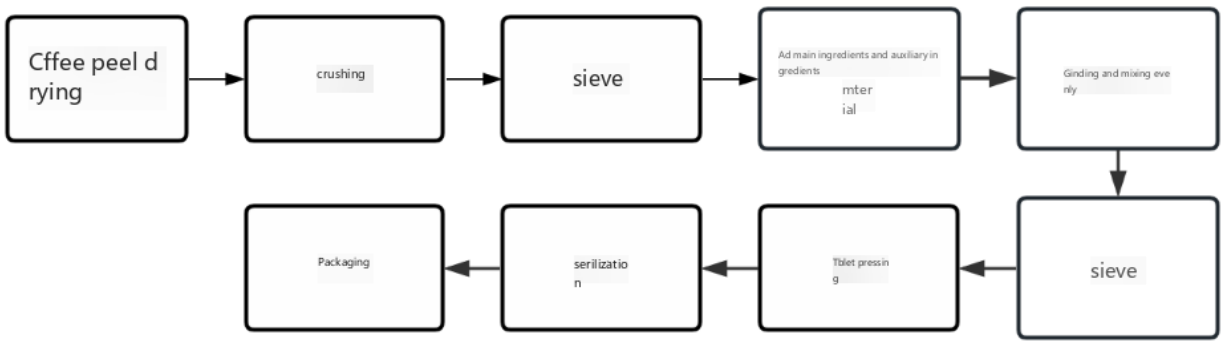

Figure 1. Flow chart of Yunnan Small coffee peel

Key Points.

a. The raw material treatment is to first clean the fresh Yunnan coffea arabica, and then bake the peel to dryness after peeling, with a strong aroma of coffee peel (do not clean the pectin to make it more flavorful).

b. The raw material treatment is to dry the dried small coffee peel, break it into powder, pass the 80 mesh sieve for standby, and prevent the granulation of the lozenges.

c. The purpose of drying is to keep the mixture dry, otherwise it will be difficult to form.

d. Sieving is to control the fineness of materials and reduce the particle feeling

3. ONE-WAY, ORTHOGONAL EXPERIMENTS THAT

3.1. One-way Experimental Setup for the Main Ingredient of Yunnan Small-Grain Coffee Pericarp Containing Tablets, the

The effects of the three additives, namely, Yunnan small-grain coffee pericarp powder, mannitol and dextrin, on the quality of Yunnan small-grain coffee pericarp tablets were screened. In order to ensure the quality of the tablets, the additives were set with reference to the relevant national standards and literatures, and the optimal composition of the formulations was determined by using the texture and the tissue state as the evaluation criteria. While keeping the auxiliary ingredients sorbitol, lactose, microcrystalline cellulose and magnesium stearate unchanged, suitable additions of Yunnan small-grain coffee pericarp powder (ranging from 26.1% to 52.21%), mannitol (ranging from 10.44% to 20.88%), and dextrin (ranging from 6.52% to 32.63%) were investigated with reference to the organoleptic scores, so as to determine the optimal composition of the tablets. The sensory quality of Yunnan small-grain coffee pericarp tablets was optimized.

3.1.1. One-way experimental setup for coffee pericarp powder addition

Taking the 76.6g Yunnan coffea arabica pericarp buccal tablet content as the standard condition, and keeping the addition amount of the main ingredients mannitol, dextrin, auxiliary ingredients sorbitol, lactose, microcrystalline cellulose and magnesium stearate unchanged, set the addition amount gradient of Yunnan coffea arabica pericarp at 26.1%, 32.63%, 39.16%, 45.69% and 52.21% to conduct a single factor experiment. Three parallel experiments were conducted in each group, With reference to the sensory evaluation scores, this study explored the influence of the addition amount of Yunnan coffea arabica pericarp on the Yunnan coffea arabica pericarp buccal tablets.

3.1.2. One-way experiment on mannitol addition

With 76.6g Yunnan coffea arabica pericarp buccal tablet content as the standard condition, while keeping the addition amount of the main ingredient of coffea arabica arabica pericarp, dextrin, auxiliary ingredients sorbitol, lactose, microcrystalline cellulose and magnesium stearate unchanged, set the mannitol addition gradient of 10.44%, 13.05%, 15.66%, 18.27% and 20.88% to conduct a single factor experiment. Three parallel experiments were conducted in each group, The effect of mannitol addition on Yunnan Coffea arabica pericarp buccal tablets was explored by referring to the sensory evaluation scores.

3.1.3. One-way experiment on dextrin addition

Under the standard condition of 76.6g Yunnan Coffea arabica pericarp buccal tablet content, while keeping the addition amount of the main ingredient, such as Yunnan Coffea arabica pericarp, mannitol, and auxiliary ingredients, such as sorbitol, lactose, microcrystalline cellulose, and magnesium stearate unchanged, five groups of dextrin addition gradients of 6.52%, 13.05%, 19.58%, 26.10%, and 32.63% were set to conduct a single factor experiment. Three parallel experiments were conducted in each group, The effect of dextrin addition on Yunnan Coffea arabica pericarp buccal tablets was explored by referring to the sensory evaluation scores.

3.2. One-way Experiment on the Excipients of Yunnan Small-Grain Coffee Pericarp Containing Tablets

The types and amounts of flavoring agents, fillers and binders in Yunnan small-grain coffee pericarp tablets were screened, and the additives were set with reference to the relevant national standards and literatures in order to improve the taste and tissue state, and to determine the optimal ratio of the ingredients. The effects of different concentrations of flavoring agents (0.13% to 0.65%), fillers (0.13% to 0.65%) and binders (7.63% to 18.27%) on the organoleptic quality of the tablets were evaluated

by sensory scoring, while keeping the main raw materials, namely, Yunnan small-grain coffee pericarp powder, mannitol, dextrin and magnesium stearate, unchanged.

3.2.1. One-way experiment for screening of flavoring agents

Sugar powder, sorbitol, saccharin sodium and menthol are selected as the auxiliary ingredients of flavor modifier, and the 76.6g Yunnan Coffea arabica pericarp buccal tablet content is taken as the standard condition. Under the condition that the main ingredient, Yunnan Coffea arabica pericarp, mannitol, dextrin, and the auxiliary ingredients, lactose, microcrystalline cellulose and magnesium stearate, are kept constant, the flavor modifier type addition experiment is set as sugar powder, sorbitol, saccharin sodium The single factor experiment of four groups of flavoring agent types with the addition amount of menthol of 0.39% was conducted. Three parallel experiments were conducted in each group. The effect of flavoring agent types on Yunnan Coffea arabica pericarp buccal tablets was explored by referring to the sensory evaluation scores.

After obtaining the best flavor modifier, take the 76.6g Yunnan coffea arabica pericarp buccal tablet content as the standard condition, and under the condition of keeping the addition amount of the main ingredient Yunnan coffea arabica pericarp, mannitol, dextrin, auxiliary components lactose, microcrystalline cellulose, magnesium stearate, etc. unchanged, set the optimal flavor modifier type addition gradient of 0.13%, 0.26%, 0.39%, 0.52%, 0.65% to carry out the single factor experiment, Three parallel experiments were carried out in each group to explore the effect of the amount of flavor modifier added on Yunnan Coffea arabica peel buccal tablets by referring to the sensory evaluation scores.

3.2.2. One-way experiment for screening of fillers, the

Starch, lactose, calcium sulfate, etc. are selected as the filler auxiliary materials, and the 76.6g Yunnan Coffea arabica pericarp buccal tablet content is taken as the standard condition. Under the condition that the main ingredient, Yunnan Coffea arabica pericarp, mannitol, dextrin, and the auxiliary ingredients, saccharin sodium, microcrystalline cellulose, and magnesium stearate, are kept constant, the flavor modifier type addition experiment is set as starch, lactose Single factor experiment of three groups of filler types with calcium sulfate content of 0.39%, three parallel experiments were conducted in each group, and the effect of filler types on Yunnan coffea arabica pericarp lozenges was explored by referring to sensory evaluation scores.

After obtaining the best filler, take the 76.6g Yunnan Coffea arabica pericarp buccal tablet content as the standard condition, and under the condition of keeping the addition amount of the main ingredient Yunnan Coffea arabica pericarp, mannitol, dextrin, auxiliary ingredients saccharin sodium, microcrystalline cellulose, magnesium stearate, etc. unchanged, set the optimal filler type addition gradient of 0.13%, 0.26%, 0.39%, 0.52%, 0.65% to carry out the single factor experiment, Three parallel experiments were carried out in each group to explore the effect of filler addition on Yunnan Coffea arabica pericarp buccal tablets by referring to sensory evaluation scores.

3.2.3. One-way experiment for screening of adhesives, the

The adhesive uses sodium carboxymethyl cellulose, methyl cellulose, microcrystalline cellulose, etc. as the auxiliary materials of the adhesive, and the 76.6g Yunnan Coffea arabica pericarp buccal tablet content is taken as the standard condition. Under the condition of keeping the addition amount of the main ingredient Yunnan Coffea arabica pericarp, mannitol, dextrin, auxiliary ingredients saccharin sodium, calcium sulfate, magnesium stearate, etc. unchanged, Set up three groups of single factor experiments of adhesive type addition, including sodium carboxymethyl cellulose, methyl cellulose and microcrystalline cellulose, with the addition amount of 13.05%. Three parallel experiments were conducted for each group of experiments to explore the impact of adhesive type addition on Yunnan coffea arabica pericarp buccal tablets by referring to sensory evaluation scores.

After obtaining the best adhesive, take the 76.6g Yunnan Coffea arabica pericarp buccal tablet content as the standard condition, and under the condition of keeping the addition amount of the main

ingredient Yunnan Coffea arabica pericarp, mannitol, dextrin, auxiliary ingredients saccharin sodium, calcium sulfate and magnesium stearate unchanged, set the optimal adhesive type addition gradient to 7.83%, 10.44%, 13.05%, 15.66% and 18.27% for single factor experiments, Three parallel experiments were carried out in each group to explore the effect of adhesive addition on Yunnan Coffea arabica pericarp buccal tablets by referring to sensory evaluation scores.

3.3. Orthogonal Experimental Setup of Yunnan Small-Grain Coffee Pericarp Containing Tablets, the

The orthogonal experimental setup of Yunnan small-grain coffee pericarp containing tablets is shown in Table 3.

Table 3. Orthogonal experiment level settings

Level	Coffee pericarp addition amount (A)/%	Mannitol addition (B)/%	Adding amount of saccharin sodium (C)/%	Calcium sulfate addition (D)/%
1	32.63	13.05	0.26	0.26
2	39.16	15.66	0.39	0.39
3	45.69	18.27	0.52	0.52

4. SENSORY SCORING INDICATORS

The sensory scoring indexes of Yunnan small-grain coffee pericarp containing tablets are shown in Table 4.

Table 4. Sensory scoring indexes of Yunnan small-grain coffee pericarp

Project	scoring criteria	Score
Color (30 points)	The tablets show a uniform brown color The tablets show a more uniform yellowish whitish color Tablets whitish, uneven color	25-30 20-25 <20
Fragrance (25 points)	It has a distinctive coffee peel flavor and no off-flavors Distinctive coffee-peel flavor, some off-flavors No coffee-peel flavor, noticeable off-flavor	20-25 15-20 <15
Flavor (20 points)	With the characteristic aroma of coffee rind, harmonized flavor Coffee rind aroma is light and harmonized Coffee pericarp with low aroma and no characteristic flavor	15-20 10-15 <10
Organizational status (15 points)	Containing tablets with uniform mixing inside and outside Uneven mixing of inside and outside of tablets	10-15 <10
Hardness (10 points)	The hardness of the tablets is moderate, not easy to fall apart Containers are very hard or soft	5-10 <5

Note:Sensory ratings were evaluated by food-related majors (ten students).

5. DETERMINATION OF PRODUCT INDICATORS

5.1. Measurement of Physical and Chemical Indicators

The settings for the determination of physicochemical indexes of Yunnan small-grain coffee pericarp tablets are shown in Table 5.

Table 5. Determination of physical and chemical indicators

testing program	Detection methods	testing standards
Moisture	Direct drying method	GB 5009.3-2016 Determination of moisture in food [20]
Ash	direct ashing method	GB 5009.4-2016 Determination of Ash in Food [21]
Chlorine dioxide	UV spectrophotometry	GB 5009.244-2016 Determination of Chlorine Dioxide in Food [22]
reducing sugar	Direct titration	GB 5009.7-2016 Determination of reducing sugar in foods [23]
Caffeine	UV spectrophotometry	GB 14758-2010 Food additive Caffeine [24]

5.2. Determination of Microbiological Indicators

The settings for the determination of physicochemical indexes of Yunnan small-grain coffee pericarp tablets are shown in Table 6.

Table 6. Measurement of microbial indicators

testing program	Detection methods	testing standards
total number of colonies	Plate counting	GB 4789.2-2022 Determination of total bacterial count [25]
Coliforms	Plate counting	GB 4789.3-2016 Coliform count [26]
Pathogenic bacteria	Plate counting	GB 4789.4-2016 Detection of Salmonella [27] GB 4789.5-2012 Inspection of Shigella [28] GB 4789.10-2016 Staphylococcus aureus [29]

6. RESULTS AND ANALYSIS

6.1. Determination of the Optimal Process for Small-Grain Coffee Pericarp Tablets From Yunnan, the

6.1.1. Results of the one-way experiment on the addition of coffee pericarp powder, the

Coffee pericarp accounts for about 45% of the fresh coffee fruit [30]. The pericarp is rich in nutrients and antioxidant ingredients, accounting for a large proportion in fresh coffee fruits. In the primary processing and production of coffee, dry processing is adopted, and 0.12~0.18 t coffee pericarp will be obtained for each ton of coffee beans, while the output of coffee pericarp will reach 0.5 t by wet processing [31].

After the drying and grinding process, the powdered small-grain coffee pericarp from Yunnan becomes pure and free of impurities, giving off a strong and authentic coffee pericarp flavor. However, its bitter taste may not be very popular among consumers, so it is necessary to improve the flavor with other auxiliary ingredients to enhance its popularity and taste. As shown in Figure 2, the sensory evaluation of Yunnan small-grain coffee pericarp powder improved gradually with the increase of the added amount of other ingredients. When the added amount reached 39.16%, the sensory evaluation reached the highest point. However, due to the prominent bitter and astringent flavor of Yunnan small-grain coffee pericarp powder, the sensory evaluation was lowered by the excessive addition of the coffee pericarp powder. When the addition of 39.16% of Yunnan small-grain coffee powder was optimal, the sweetness of the tablets was moderate, the color was uniform, and the smell of coffee pericarp was strong.

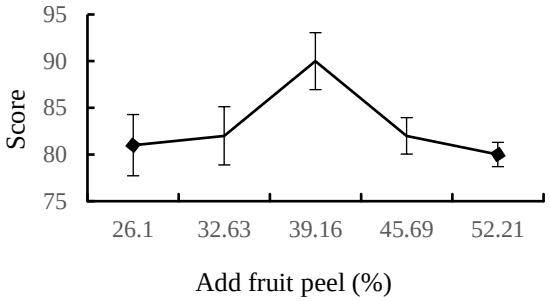

Figure 2. Effect of the addition of Yunnan small-grain coffee pericarp powder on sensory scores

6.1.2. Results of the one-way experiment on mannitol addition, the

Mannitol [32] The chemical formula is CHO, which is a sugar alcohol and an isomer of sorbitol. Easily soluble in water, it is a white crystalline powder with a sweet taste similar to sucrose. It is the main source of sweet taste of lozenges, can increase the storage life of lozenges, improve the taste of lozenges, and has a significant impact on the taste and taste of lozenges [33].

According to the data in Figure 3, the sensory scores increased as the mannitol content increased. The sensory evaluation peaked at 15.66% of mannitol, when the sweetness was just right and the tablets made from Yunnan small-grain coffee hulls gave off a strong aroma and a pleasant aftertaste. However, if the amount of mannitol added exceeds this percentage, the tablets may lose flavor, become unsmooth, and mask the original aroma of the coffee pericarp.

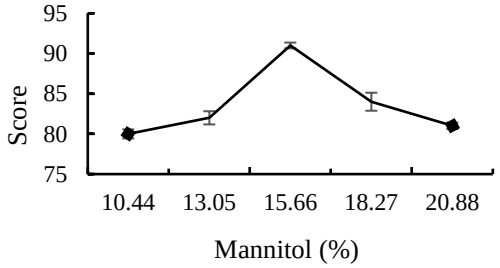

Figure 3. Effect of mannitol addition on sensory scores

6.1.3. One-way experiment on dextrin addition

Maltodextrin is a mixture obtained by the partial hydrolysis of starch, which appears in the form of a white to light yellow powder, does not contain any obvious foreign impurities, has a peculiar odor, and has a low sweetness. It has the characteristics of not sweet or slightly sweet, as well as good digestibility, low calorie, solubility, and small fermentability. Maltodextrin has excellent solubility, low energy properties, mild fermentation properties, excellent filling effect, anti-hygroscopicity, excellent thickening properties and stability. It contains not only various sugar polymers, but also healthful trace elements such as calcium and iron, as well as minerals required by the human body. These ingredients are essential for maintaining the body's metabolic functions.

As shown in Fig. 4, the sensory evaluation increased with the increase of dextrin addition ratio, and the sensory score reached the maximum when the dextrin content reached 19.58%; moreover, the higher the dextrin content, the higher the hardness of the product, which would affect the structural properties of the tablets.

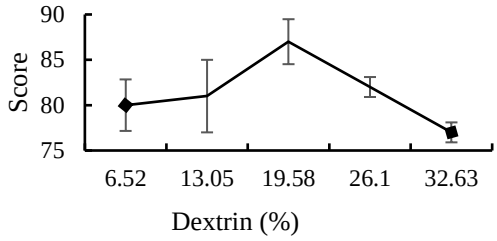

Figure 4. Effect of dextrin addition on sensory scores

6.2. One-way Experiment on the Excipients of Yunnan Small-Grain Coffee Pericarp Containing Tablets Dextrin

In order to improve the taste and texture of Yunnan Coffea arabica pericarp buccal tablets, the types and amounts of flavoring agents, fillers and adhesives were screened, and the best proportion of ingredients was determined. Under the condition of keeping the main raw materials of Yunnan Coffea arabica peel powder, mannitol, dextrin and magnesium stearate unchanged, the effect of different concentrations of flavoring agent (0.13% to 0.65%), filler (0.13% to 0.65%) and adhesive (7.83% to 18.27% g) on the sensory quality of the lozenges was evaluated through sensory scores.

6.2.1. One-way experiment for the screening of flavoring agents, the

A flavoring agent is an excipient used in pharmacy to mask or ameliorate the bitter or other unpleasant taste of a drug, such as pungent and irritating flavors. The purpose of adding a flavoring agent is to improve the acceptability and compliance of the medication by allowing the patient to receive the treatment without feeling uncomfortable because of the bitter taste of the medication. Flavor enhancers can improve the sensory evaluation, taste and consumer acceptability of tablets [34] The screening of flavoring agents was carried out by using the sensory scores of powdered sugar, sorbitol, sodium saccharin and menthol as the excipients, and the highest sensory score was obtained when sodium saccharin was used as the excipient, which was the most suitable flavoring agent for Yunnan small-grain coffee pericarp tablets, and sodium saccharin was able to mask part of the bitterness of the coffee pericarp powder, so as to make the tablets have a better flavor. When powdered sugar was used, the flavor of Yunnan small-grain coffee pericarp tablets was not coordinated; when sorbitol was used, the flavor of Yunnan small-grain coffee pericarp tablets was thin, with no sweetness and prominent bitterness; and when menthol was used, the flavor of menthol was too heavy, which masked the original flavor of the coffee pericarp powder and made the tablets with a low tablet formation rate.

Figure 5. Results of flavoring agent screening

According to the data in Figure 6, the sensory evaluation increased with the increase in the proportion of sodium saccharin. When the content of sodium saccharin reaches 0.39%, the sensory evaluation is the highest, and then the sweetness is moderate, the Yunnan small-grain coffee rind tablets have a strong odor and sweetness, while the addition of too much sodium saccharin will make the tablets

taste worse, the sweet and sour are not coordinated, and the flavor of the coffee rind will be covered up. The flavor of the coffee bark is not harmonized with the sweetness and sourness of the coffee

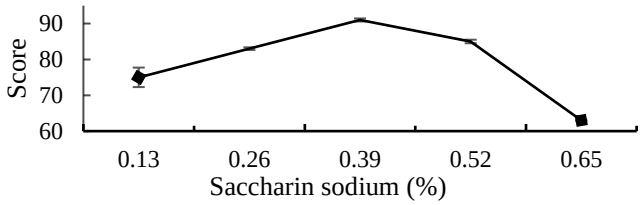

Figure 6. Effect of saccharin sodium addition on sensory scores

6.2.2. One-way experiment for screening of fillers, the

A filler (also known as filler, filler, filler) is a solid substance that, when added to other materials, enhances or alters the properties of those materials. It can not only improve the performance of the material, but also increase its capacity and weight, while reducing costs. Filler can improve the performance of Yunnan small grain coffee peel powder, adding filler not only to ensure a certain volume size, but also can reduce the dose deviation of the efficacy of tablets, improve the compression molding of the material, etc., to facilitate the molding of tablets [35] The fillers were selected as starch, lactose, calcium sulfate and other fillers. Starch, lactose, calcium sulfate and other fillers were selected as excipients, and the screening of fillers was carried out by sensory scoring criteria, and Figure 7 shows that calcium sulfate has the highest sensory scoring and is the most suitable filler for Yunnan small-grain coffee pericarp tablets, and calcium sulfate can coordinate the coffee pericarp tablets so that the flavor is better and the structure is stable. When lactose was used, Yunnan small grain coffee pericarp tablets were more stable; when starch was used, Yunnan small grain coffee pericarp tablets were fragile.

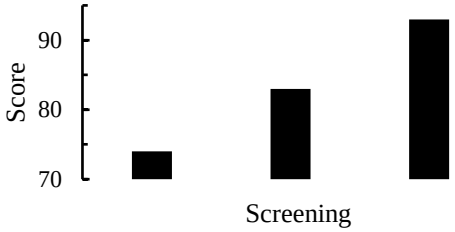

Figure 7. Filler screening results

According to the data in Fig. 8, the sensory evaluation scores increased with the increase of the addition proportion of calcium sulfate. The sensory score reached the highest point when the percentage of calcium sulfate added reached 0.39%. At that time, the structure of the tablets was stable and the tablet formation rate was high, but the addition of too much calcium sulfate would cause the tablets to have a poor texture and be too hard.

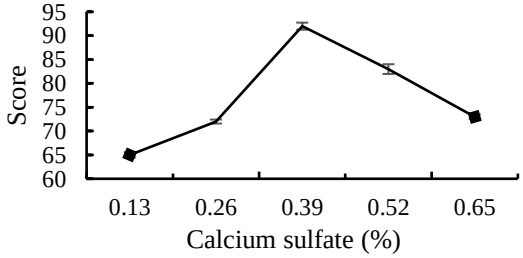

Figure 8. Effect of calcium sulfate addition on sensory scores

6.2.3. One-way experiments for the screening of adhesives, the

Adhesive (also known as adhesive, commonly known as "glue") is a kind of material that can use its interface adhesion ability and internal cohesion to firmly combine two materials. Its role is to establish a connection without causing other changes. It will not cause significant changes in the structure of the bonded material, and can provide sufficient strength for the bonding. Adhesives such as sodium carboxymethyl cellulose, methyl cellulose and microcrystalline cellulose are selected, and the selection of adhesives is carried out according to the sensory scoring standard. However, since the addition amount of sodium carboxymethyl cellulose and methyl cellulose to form lozenges is greater than the maximum daily intake of human body, microcrystalline cellulose can only be selected.

It can be observed from Fig. 9 that the sensory evaluation scores increased with the increase of the addition proportion of microcrystalline cellulose. When the proportion of microcrystalline cellulose reached 13.05%, the sensory score reached the peak, which means that at this proportion, the structure of the tablets was the most stable, and the yield was high and the hardness was moderate during the production process. However, if the addition of microcrystalline cellulose exceeds this percentage, the overall quality of the product may be affected, such as the taste of the tablets deteriorates and the tablets are too hard.

When Yunnan small grain coffee pericarp powder add 39.16%, mannitol add 15.66%, dextrin add 19.58%, 13.05% microcrystalline cellulose add 13.05%, 2.61% magnesium stearate add 0.39% calcium sulfate add 0.39% sodium saccharin add 0.39% when the finished product of Yunnan small grain coffee pericarp tablets for brown round flaky solid, with Yunnan small grain coffee pericarp Unique odor, uniform color, aroma and coordination, uniform mixing, no gravel feeling, acceptable, consistent size, no missing edge, no cracking, no obvious spots.

6.3. Results and Analysis of Orthogonal Experiments of Yunnan Small-Grain Coffee Pericarp Containing Tablets, the

The results of orthogonal experiments of Yunnan small-grain coffee pericarp containing tablets are shown in Table 7.

Table 7. Results of orthogonal experiments

experimental factors	A	B	C	D	Results
1	1	1	1	1	88.3
2	1	2	2	2	84.4
3	1	3	3	3	89.6
4	2	1	2	3	78.2
5	2	2	3	1	89.0
6	2	3	1	2	87.4
7	3	1	3	2	90.4
8	3	2	1	3	95.2
9	3	3	2	1	80.0
K_1	87.33	85.33	90	85.67	
K_2	84.67	89.33	80.67	87	
K_3	88.33	85.67	89.67	87.67	
R	3.66	4	9.33	2	
The optimal combination	$A_3B_2C_1D_3$				
Impact size	C>B>A>D				

According to the analysis in Table 7, in the eighth experiment, the content of saccharin sodium is the highest among all experimental groups, and the comprehensive score of this group is also the highest.

In order to better understand the specific impact of various factors on the peel preparation process of Yunnan Coffea arabica, the importance of different factors can be judged by observing the R value in Table 5. According to these data, it can be concluded that among the factors affecting the test results, the addition of saccharin sodium is the most important, followed by the addition of mannitol, followed by the addition of Yunnan Coffea arabica pericarp, and finally the addition of calcium sulfate. Specifically, the order of influence degree is saccharin sodium addition, mannitol addition, Yunnan coffea arabica pericarp addition and calcium sulfate addition. The order of influence of each factor on the test results is C>B>A>D. It can be seen from the analysis that the addition of saccharin sodium has a significant impact on the process of Yunnan Coffea arabica pericarp buccal tablets. The addition of mannitol, coffee pericarp and calcium sulfate had no significant effect on the process of Nanxiaoli coffee pericarp buccal tablet. According to the comprehensive scoring results in Table 7, combined with the analysis, the optimal conditions are: $A_3B_2C_1D_3$: 45.69% of Yunnan Coffea arabica pericarp, 15.66% of mannitol, 0.26% of saccharin sodium and 0.52% of calcium sulfate.

6.4. Results and Analysis of Physicochemical Indexes of Yunnan Small-Grain Coffee Pericarp Containing Tablets

The physicochemical index settings and results of Yunnan small-grain coffee pericarp tablets according to the conclusions obtained from the experiments are shown in Table 8.

Table 8. Physical and chemical indicator settings and results

Testing program	Detection indicators	Test results
Moisture/%	≤5.0	≤0.09
Ash/%	≤8.0	≤2.05
Chlorine dioxide	GB 5009.244-2016	Not detected
reducing sugar	GB 5009.7-2016	12 (g/100g)
Caffeine	GB 14758-2010	21.19 (mg/g)

6.5. Results and Analysis of Microbiological Indicators of Small-Grain Coffee Pericarp Tablets from Yunnan, China

The microbiological index settings and results of Yunnan small-grain coffee pericarp tablets according to the conclusions obtained from the experiment are shown in Table 9.

Table 9. Microbial indicator settings and results

testing program	Detection indicators	test results
Total number of colonies/	≤750	Not detected
Coliforms/	≤30	Not detected
Pathogenic bacteria (Salmonella, Shigella, Staphylococcus aureus)	Not detectable	Not detected

7. DISCUSSION AND PERSPECTIVES

In the coffee making process, coffee rinds are generally discarded as waste, which not only causes waste of resources, but also pollutes the environment [30] Nowadays, the growth rate of coffee consumption in China is growing rapidly at 20%~30% per year, higher than 2%~5% in the world. Nowadays, the growth rate of coffee consumption in our country is 20%~30% per year, which is higher than the world's 2%~5%, thus causing a large amount of coffee peel to be discarded. At present, there are not many reports on coffee pericarp, so it is necessary to study the extraction process of coffee pericarp [4] The problems in the production process of Yunnan small grain coffee pericarp tablets are mainly in the two aspects of instrumentation and raw materials. The quality of raw

materials, purity, storage conditions and other factors will also have an impact on the Yunnan small-grain coffee pericarp tablets, such as water content and impurity content of raw materials and other differences will lead to differences in the experimental results. Therefore, we should strictly check the status of the instruments and equipment, select high-quality raw materials and pay attention to the storage conditions to ensure the accuracy and reliability of the experimental results before conducting the experiments. At the same time, possible problems should be recorded in time during the experimental process, and corresponding measures should be taken to solve them, so as to improve the success rate and reproducibility of the experiments.

Coffee rind is mostly used for industrial feed, composting, etc. In recent years, it is also used for food consumption, but most of it is still used for brewing and coffee rind tea, and in the future, it will be used in a large number of edible food. Therefore, Yunnan small coffee rind tablets as a green and nutritious and efficient food, the development of the development is imperative, is the historical trend of development, should be vigorously developed and developed to reduce the waste of resources and pollution of the environment.

8. CONCLUSION

The process of making small-grain coffee pericarp from Yunnan into tablets was optimized by one-way and orthogonal experiments, and the best formulation included: 45.69% of Yunnan small-grain coffee pericarp powder, 19.58% of dextrin, 15.66% of mannitol, 15.66% of microcrystalline cellulose, 2.61% of magnesium stearate, and 0.52% of calcium sulfate, Sodium saccharin 0.26%. The taste of Yunnan small-grain coffee pericarp tablets produced by this process is unique, with consistent color, smooth surface, delicate taste, and sensory evaluation can reach 95 points. Its physical and chemical indexes and microbiological indexes are also in line with the corresponding standards, which is an innovative product and helps to promote the food development of Yunnan small-grain coffee pericarp resources.

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