# Development and Processing of *Millettia speciosa* Instant Tea

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**Abstract** This paper analyzed the effect of raw material crushing fineness, cooking time, ethanol content during ethanol precipitation and other factors on the preparation of raw material extract from *Millettia speciosa* Champ. instant tea. The raw materials of *Millettia speciosa* Champ., Philippine flemingia root and radix fici simplicissimae were crushed into 10 mesh or finer powder, and cooked for 60 min. During ethanol precipitation, the ethanol content was about 50% to 70%, standing 12 h. The ophiopogon root was cooked in 1∶15 boiling water for 45 min, and chrysanthemum was leached for 45 min with 1∶20 demineralized water at 80 ℃. After concentration, preparation and spray drying, the finished *Millettia speciosa* Champ. instant tea was created. The detection of each product index indicated that *Millettia speciosa* Champ. instant tea had good taste and flavor, and there were no heavy metals, harmful substances and excessive microbes, thereby showing that the raw material of *Millettia speciosa* Champ. instant tea was selected reasonably, the mixture ratio was rational, and the processing technology was of some security, stability and maturity, which provided a theoretical basis for its development and application.

**Key words** *Millettia speciosa* Champ., Instant tea, Processing technology, Index detection

## 1 Introduction

*Millettia speciosa* Champ. is a plant in the Leguminosae family, known as Niudaliteng, Daliniu, Shanlianou, Polianou, Diou, Xueteng *etc.* [1], growing in thickets, woodland and wilderness. It is produced in Guangdong, Guangxi, Hainan and other places. It was initially recorded in *Essentials of Herbal Properties*[2], known as Daliniu, and also frequently recorded in the modern herbal medicine books. Its root can be used as medicine to moisten the lung and relieve the cough, treat strain of lumbar muscles, kidney deficiency, rheumatism and paralysis[3]. It is the medicinal and edible plant widely used in southern China. The roots and leaves of *Millettia speciosa* Champ. contain triterpenoid saponins, isoflavones, chalcones, polysaccharides, coumarin, alkaloids[4-7] and other components, with obvious anti-inflammatory, immunomodulatory effect as well as antioxidant and free radical-scavenging effect[7-10]. Our research group previously isolated and identified isoflavones, chalcones and steroids from the stem of *Millettia speciosa* Champ., and analyzed the fat-soluble components in the leaves of *Millettia speciosa* Champ.[11]. By the study on processing methods, raw material extract acquisition and preparation and finished product index testing, we explored the processing technology and product quality standards of *Millettia speciosa* Champ. instant tea, in order to provide a theoretical basis for its development and application.

## 2 Materials and methods

**2.1 Materials** The root collected from Fanjia Forest Reserve in Danzhou City in September 2015, was identified by researcher Wang Zhunian from Tropical Crops Genetic Resources Institute of Chinese Academy of Tropical Agricultural Sciences as *Millettia speciosa* Champ., with the specimen number of As20150912. It was stored in Tropical Crops Genetic Resources Institute of Chinese Academy of Tropical Agricultural Sciences. Ophiopogon root and chrysanthemum were purchased from Guang'antang Drugstore; sugar and maltodextrin were purchased from Baijiahui Supermarket, as commercially available food. Instruments: electronic scale, spray dryer, rotary evaporator, cooling water circulation device, water purification machine, pulverizer, packaging machine, sealing machine.

**2.2 Methods**

**2.2.1** Formulation. The formulation of *Millettia speciosa* Champ. instant tea was shown in Table 1.

**2.2.2** Preparation of raw material extract. (i) Preparation of *Millettia speciosa* Champ., Philippine flemingia root, and radix fici simplicissimae extract. After selecting dry *Millettia speciosa* Champ., Philippine flemingia root and radix fici simplicissimae without mildew, the impurities were removed and they were washed with water to eliminate the adhering soil and worm eggs. Then the grinder was used to grind them into fine powder, respectively, the dry powder was cooked in 1∶3 boiling water for 60, 120, 180 min, respectively, and extract I was obtained after cooling and filtering. The filter residue was cooked in 1∶2 boiling water for 60 min, and extract II was obtained after cooling; extract I and extract II were combined to get *Millettia speciosa* Champ., Philippine flemingia root and radix fici simplicissimae extract. After being concentrated to thick paste, 30% - 50%, 50% - 70%, 70% - 90% ethanol was added, respectively. After sufficient stirring, it was allowed to stand for sedimentation, and sedimentation time was 10, 12, 14 h, respectively. The sediments were washed with ethanol, and wash solution was combined with filtrate for vac-

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uum recovery of ethanol to get the *Millettia speciosa* Champ., Philippine flemingia root and radix fici simplicissimae extract. (ii) Preparation of ophiopogon root extract. After removing impurities, the ophiopogon root was cooked in 1∶10, 1∶15, 1∶30 boiling water, respectively, and it was filtered using nylon cloth with more than 160 meshes to get the ophiopogon root extract. Extraction time was 5, 45, 60 min, respectively. (iii) Preparation of chrysanthemum extract. High quality chrysanthemum was selected, and chrysanthemum and demineralized water (1∶10, 1∶20, 1∶30) were leached in the leaching tank at a certain temperature (60, 80, 100℃). It was filtered using the nylon cloth with more than 160 meshes to get ophiopogon root extract. The extraction time was 25, 45, 65 min, respectively. (iv) Concentration. The previously obtained extract was mixed and concentrated under reduced pressure to solid with content of 20% – 25%, to get leaching concentrate.

**Table 1 Formulation of *Millettia speciosa* Champ. instant tea**

| Medicinal name | Weight//g | Accessory name | Weight//g |
|---|---|---|---|
| *Millettia speciosa* Champ. | 500 | Sugar powder | 1000 |
| Philippine flemingia root | 225 | Maltodextrin | 800 |
| Radix fici simplicissimae | 125 | Cyclodextrin | 200 |
| Ophiopogon root | 100 | Citric acid | 3.5 |
| Chrysanthemum | 50 | | |

**2.2.3** Preparation. Sugar was weighed according to the proportion, crushed and sifted through 80-mesh sieve to get sugar powder. According to the formulation in Table 1, sugar powder, maltodextrin, cyclodextrin and citric acid were weighed and added to leaching concentrate. After being heated to 65℃, the blender was started to sufficiently stir to fully dissolve the accessories in leaching concentrate.

**2.2.4** Spray drying. The filtered mixture was pumped into spray-drying tower with high pressure pump, and the pressure atomizer was used to disperse concentrate into tiny uniform droplets and inject them into the high-temperature hot air. They were instantly evaporated into small solid particles of tea powder, and then immediately discharged from the drying tower. After cooling and powder sifting, the finished product of *Millettia speciosa* Champ. instant tea was packaged.

**2.2.5** Test. Some items (appearance, packaging, net content, sensory index, physical and chemical index, microbial index, moisture and ash content) concerning the products were tested, and it was finished after passing the inspection and entering warehouse.

## 3 Results and analysis

**3.1 Processing flow chart** Under the experimental conditions, the water extraction and ethanol precipitation technology was used to develop and process *Millettia speciosa* Champ. instant tea. The processing flow chart was shown in Fig. 1.

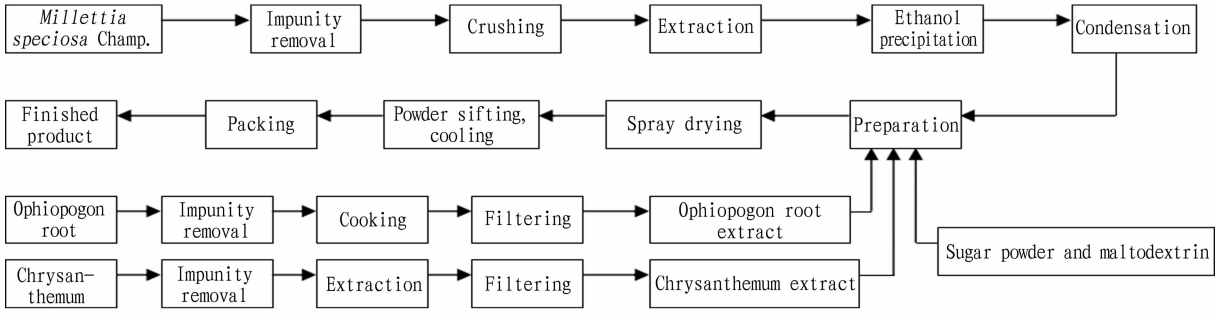


**Fig. 1 Processing flow chart of *Millettia speciosa* Champ. instant tea**

**3.2 Effect of crushing fineness and cooking time on extract preparation** From Table 2, it was found that raw material was pulverized to 10-mesh fine powder, and cooked for 60 min. The extraction rate was high, and extract had good solubility and the solution was clear. The cooking time was elongated, but 40-mesh and 80-mesh raw material was too subtle and easy to precipitate in bottom of the pot, so there was a need for constant stirring, which consumed a lot of time. The filtering was insufficient after cooking, and the filtrate was suspended, with poor quality.

**Table 2 Effect of crushing mesh of *Millettia speciosa* Champ., Philippine flemingia root and radix fici simplicissimae raw material on extract preparation**

| Raw material fineness//mesh | Cooking time //min | Extract yield//% | Sensory evaluation |
|---|---|---|---|
| 10 | 60 | 32 | Good solubility, clear solution, good quality |
| 40 | 120 | 24 | Poor solubility, little precipitation in solution, poor quality |
| 80 | 180 | 20 | Poor solubility, suspended solution, very poor quality |

**3.3 Effect of ethanol content during ethanol precipitation on extract preparation** From Table 3, it was found that when the ethanol content was 50% to 70% and the ethanol precipitation was full after standing 12 h, the extract had good solubility and good quality. The quality under the ethanol content of 70% – 90% was basically the same as that under the ethanol content of 50% – 70%, but a large amount of ethanol was used in the actual production and the cost was relatively high.

**Table 3 Effect of ethanol content during ethanol precipitation on *Millettia speciosa* Champ., Philippine flemingia root, radix fici simplicissimae extract preparation**

| Ethanol content//% | Precipitation time//h | Extract yield//% | Sensory evaluation |
|---|---|---|---|
| 30-50 | 14 | 14 | Insufficient ethanol precipitation, a lot of precipitation after extract water dissolution, poor solubility, poor quality |
| 50-70 | 12 | 22 | Sufficient ethanol precipitation, good extract water solubility, clear solution, good quality |
| 70-90 | 10 | 20 | Sufficient ethanol precipitation, good extract water solubility, clear solution, good quality |

**3.4 Effect of amount of water and cooking time on ophiopogon root extract preparation** From Table 4, it was found that after being cooked for 45 min in 1∶15 boiling water, the ophiopogon root extract yield was high; after being cooked for 25 min in 1∶10 boiling water, the ophiopogon root extraction was insufficient, there was saturation, and the irrational water using amount led to low extract yield; after being cooked for 65 min in 1∶30 boiling water, the ophiopogon root extract yield was equivalent to that under 1∶15 boiling water, but the amount of water was large, the cooking time was long, and the product cost was increased in the actual production and processing.

**Table 4 Effect of amount of water and cooking time on ophiopogon root extract preparation**

| Amount of water | Cooking time//min | Extract yield//% |
|---|---|---|
| 1∶10 | 25 | 43 |
| 1∶15 | 45 | 52 |
| 1∶30 | 65 | 50 |

**3.5 Effect of amount of water, temperature and extraction time on chrysanthemum extract preparation** From Table 5, it was found that using 1∶20 demineralized water for extraction for 45 min at 80℃, the chrysanthemum extract yield was high, and there was pleasant aroma. Using 1∶10 demineralized water for extraction for 25 min at 60℃, the chrysanthemum extraction was not sufficient, and due to small amount of water and low temperature, the extract yield was not high and there was poor aroma. Using 1∶30 demineralized water for extraction for 65 min at 100℃, the ophiopogon root extract yield was equivalent to that under 1∶20 demineralized water conditions, but the water consumption was high, cooking time was long, and the product cost increased in the actual production and processing. In addition, due to high extraction temperature and long extraction time, it led to volatilization of inherent chrysanthemum aroma, as well as poor aroma of chrysanthemum.

**3.6 Index detection**

**3.6.1** Sensory index. From Table 6, it was found that color, aroma, taste and appearance were perfectly combined in *Millettia speciosa* Champ. instant tea, which further verified the importance of ethanol precipitation technology in the preparation of *Millettia speciosa* Champ., Philippine flemingia root, radix fici simplicissimae extract.

**Table 5 Effect of amount of water and cooking time on chrysanthemum extract preparation**

| Amount of water | Temperature//℃ | Extraction time //min | Extract yield//% | Sensory evaluation |
|---|---|---|---|---|
| 1∶10 | 60 | 25 | 11 | Poor aroma |
| 1∶20 | 80 | 45 | 16 | Pleasant aroma |
| 1∶30 | 100 | 65 | 18 | Poor aroma |

**Table 6 Sensory index**

| Items | Index | Item | Index |
|---|---|---|---|
| Color | Yellowish-brown | Trait | Solid powder |
| Taste, smell | Moderately sweet and sour, fragrant and refreshing, natural aroma of *Millettia speciosa* Champ., radix fici simplicissimae and chrysanthemum, no peculiar smell | Impurities | Clear, no precipitation, no impurities |

**3.6.2** Physical and chemical index. From Table 7, it was found that there were no excessive heavy metals and harmful substances in *Millettia speciosa* Champ. instant tea, which further illustrated the reasonable selection of raw materials for *Millettia speciosa* Champ. instant tea.

**Table 7 Physical and chemical index**

| Items | Index | Measured index | Detection method basis |
|---|---|---|---|
| Water content//% | ≤6 | 3.20 | GB 5009.3-2010 |
| Carbohydrate content//% | ≥80 | 92.45 | Chinese Food Composition Table |
| Lead (Pb) content//mg/kg | ≤1.0 | Not detected | GB 5009.12-2010 |
| Arsenic (As) content//mg/kg | ≤0.5 | 0.03 | GB/T 5009.11-2003 |
| Copper (Cu) content//mg/kg | ≤5.0 | 1.3 | GB/T 5009.13-2003 |

**3.6.3** Microbiological index. As shown in Table 8, there were no excessive microbes in *Millettia speciosa* Champ. instant tea, demonstrating that the processing technology had a certain degree of security, stability and maturity.

**Table 8 Microbial index**

| Items | Index | Measured index | Detection method basis |
|---|---|---|---|
| Total number of colony//CFU/g | ≤1000 | 15 | GB 4789.2 -2010 |
| Coliform group count// MPN/g | ≥0.4 | <0.3 | GB 4789.3 -2010 |
| Mold count//CFU/g | ≤25 | <1×10 | GB 4789.15 -2010 |
| Yeast count//CFU/g | ≤25 | <1×10 | GB 4789.15 -2010 |
| Salmonella | Negative | Not detected | GB 4789.4 -2010 |
| Shigella | Negative | Not detected | GB 4789.5 -2012 |
| Staphylococcus aureus | Negative | Not detected | GB 4789.10 -2010 |
| Hemolytic streptococcus | Negative | Not detected | GB/T GB 4789.11 -2003 |

## 4 Conclusions and discussions

Through the study on processing methods, raw material extract preparation and product index detection, the processing technology and product quality standards of *Millettia speciosa* Champ. instant tea were explored in order to provide a theoretical basis for its development and application. Through the detection of sensory index, physical and chemical index and microbiological index, they were all within the normal range, and did not exceed the standard, indicating that the processing technology had a certain degree of stability and maturity, and could provide scientific basis for industrializing organisms. The existing instant tea seldom takes the herbal extract as the main component, and due to taste and solubility problems, the herbal ingredients will lead to poor taste, color and solubility. This study developed a kind of instant tea with *Millettia speciosa* Champ. extract as the main component, and designed technical scheme for the production of *Millettia speciosa* Champ. instant tea. The water decoction for raw material extraction, combined with concentration and dry production process, caused the effective components of product to have high purity, good taste, good solubility, and good health care effect. *Millettia speciosa* Champ. instant tea had low production costs and simple process, and there was perfect combination of color, aroma, taste and appearance in instant tea. Long-term drinking would produce good health effects, such as fatigue resistance, endurance and immunity enhancement and blood lipid reduction. The technical method could help to achieve industrial production and increase the added value and resource utilization rate of *Millettia speciosa* Champ. Therefore, the development of *Millettia speciosa* Champ. instant tea expanded the market for *Millettia speciosa* Champ. raw material, and filled the market gap of *Millettia speciosa* Champ. instant tea.

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