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Original Paper

Effect of Yuanbao Maple Tea Powder with High Chlorogenic Acid Content on Bread Quality

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Abstract

Using Yuanbao maple leaves as raw materials, the extraction process of chlorogenic acid in leaves was optimized, and single-factor and orthogonal experiments were carried out on ultrasonic temperature, time, and solid-liquid ratio through ultrasonic extraction. The results showed that the optimal level of the experiment was when the ratio of solid to liquid was 16:1, the concentration of ethanol was 60%, and the ultrasonic time was 15 min, and the extraction amount was 6.86% (mass fraction). Under the optimal extraction process conditions, the dynamic content of chlorogenic acid in the growth cycle of Yuanbaofeng in 2020 was analyzed. The results showed that the content of chlorogenic acid in the leaves of Yuanbaofeng in June was the highest, and the content in September was the least. In order to further explore the effect of Yuanbao maple tea powder on bread quality, different proportions of Yuanbao maple tea powder were added to bread to study its sensory effects on bread. The effects of scores, moisture content, texture, polyphenol content, antioxidant activity and other qualities. The results show that the water holding capacity, elasticity and anti-oxidation of bread are the best when the addition amount of GTB is 0.5%. Less elastic, more difficult to chew, and gradually unstable antioxidant properties.

Keywords

Yuanbao maple leaf, chlorogenic acid, dynamic change, quality, antioxidant activity

1. Introduction

Acer truncatum Bunge (*Acer truncatum Bunge*), a deciduous tree belonging to the sapindales, Aceraceae, Acer genus, alias flat base maple, color number, maple and ingot tree, etc., its leaves after drying cool like the ancient "gold ingot" name (Ma, Li, Li, et al., 2021). As a unique tree species in China, Acer Truncatum Bunge is an important plant resource integrating edible, medicinal, ornamental and economic values. Maple Leaf is the raw material of China's precious tea, Maple Dew tea. In modern times, it has been processed and developed into a variety of instant tea and health tea. Studies have found that there are a variety of bioactive ingredients in the maple leaf of ingot. Chlorogenic acid is an important secondary metabolite in the maple leaf of Ingot. It has become one of the hot spots in the study of bioactive substances because of its biological activities such as antibacterial, anti-inflammatory, antiviral, antioxidant, hypoglycemic and lipids lowering, and immune regulation (Yan, Yao, & Wei, 2021), and is known as "plant gold". In addition, chlorogenic acid is also widely used in food, medical treatment, health care, cosmetics and other industries as a new natural preservative and fresh-keeping agent (Yan, Yao, & Wei, 2021).

Ingot maple leaf is a raw material with high chlorogenic acid content, which is as high as 4.83% (Wang, Zhang, & Liu, 2008). The domestic research on chlorogenic acid started late, because of its poor stability, low solubility, poor absorption and other characteristics, which also makes chlorogenic acid in food application is very limited. Studies have shown that chlorogenic acid can be used as an antioxidant and antibacterial agent in meat and aquatic products to extend the shelf life of meat; In fruits and vegetables, it can prevent fruit rot. However, chlorogenic acid is less commonly used in other types of food, and there has been little research on its application to bread. In addition, the Ingot maple leaf can replace the expensive honeysuckle for the extraction of chlorogenic acid, with the advantages of high yield, low cost and easy promotion, and the market development potential is very great. Therefore, the use of Ingot maple leaf as the source of chlorogenic acid added in food has a very considerable application prospect.

In this study, the ultrasonic extraction method of Ingot maple leaf was used as raw material, and the ultrasonic temperature, time, solid -liquid ratio of single factor and orthogonal experiments were carried out to explore the best extraction process of chlorogenic acid, and the seasonal change of chlorogenic acid content in Ingot maple leaf was analyzed. The tea powder of Ingot maple leaf was added into bread products after superfine grinding, and the effects of Ingot maple leaf tea powder on the sensory, texture and antioxidant properties of bread were determined. This study can provide reference for the extraction and application of chlorogenic acid in the leaves of Maple Ingot, and provide scientific support for the development and utilization of chlorogenic acid in more food fields.

2. Materials and Methods

2.1 Materials and Reagents

Ingot Maple Leaf: Shandong Dadai Group; Ethanol, methanol, anhydrous sodium carbonate: Tianjin Kemiou Chemical Reagent Co., LTD.; Chlorogenic acid standard: Shanghai McLean Biochemical Technology Co., LTD.; 1 mol/L folinol: Tianjin Jizhong Technology Co., LTD.; Gallic acid: Nanjing Chemical Reagent Co., LTD.

2.2 Instruments and Equipment

Multifunctional grinder (2500C) : Yongkang Hongsun Electromechanical Co., LTD.; Visible

Spectrophotometer (F755b) : Shanghai Precision Scientific Instrument Co., LTD.; Electric blast drying box (DHG-9240) : Shanghai Yiheng Scientific Instrument Co., LTD.; Box-type resistance Furnace (1Y24-12-10) : Shanghai Longyue Instrument Equipment Co., LTD.; Centrifuge (TDZ4- WS) : Changsha Xiangyi Centrifuge Instrument Co., LTD.; Ultrasonic cleaner (SB -25-12DTD) : Xinzhi Technology Co., LTD.; Texture instrument (TA.XTPLUS) : Shanghai Luxiangyi Centrifuge Instrument Co., LTD.; Freeze-dryer (SCIENTZ-10N) : Ningbo Xinzhi Biotechnology Co., LTD.

3. Method

3.1 Making Yuanbao Maple Tea Powder

The Ingot maple leaves used in the experiment were collected from the Ingot Maple planting base of Shandong Dada Group. During its growth cycle, fresh Ingot maple leaves of different months were collected, and the surface dust was wiped off and put into a constant temperature drying oven at 70℃ for 2.5~3.5 hours until the leaves were dried to constant weight. The fine powder was obtained after the 80-mesh screen was crushed with a high-power grinder. Then the fine powder was processed into 200 μm of fine powder by ultra-fine grinding equipment, and *Acer truncatum Bunge* powder (ATB) was obtained.

3.2 Preparation of Chlorogenic Acid Standard Solution and Drawing of Standard Working Curve

Weigh accurately 0.02 g of chlorogenic acid standard, dissolve it in 60% ethanol and quantify it to a 100.00 mL volumetric flask, i.e., obtain a standard solution of 0.200 mg/mL. Accurately transfer 0.00 mL, 0.20 mL, 0.40 mL, 0.60 mL, 0.80 mL, 1.00 mL, 1.20 mL, and 1.40 mL of standard solution into a 10.00 mL colorimetric tube, quantify it to the scale with 60% ethanol, and obtain a series of standard solutions with concentrations of 0, 40.0, 80.0, 120.0, 160.0, 200.0, and 280.0 μg/mL. Shake well and measure the absorbance at 330 nm in an UV-Vis spectrophotometer.

3.3 Single Factor Experiment for Extraction of Chlorogenic Acid

The extraction steps of chlorogenic acid content in Yuanbao Maple tea powder are as follows: Accurately weigh 1.000 g of Yuanbaomaple tea powder, add different volumes and concentrations of ethanol solution, set different ultrasonic extraction time, after 0.45μm microporous filter membrane filtration, use UV-visible spectrophotometer to determine the light absorption value at 330 nm wavelength, through the calculation of the content of chlorogenic acid in Yuanbaomaple tea powder.

Solid-liquid ratio single factor experiment: The solid-liquid ratio of 70% ethanol and maple leaf tea powder was set as 10:1, 12:1, 14:1, 16:1, 18:1, 20:1 (the solid -liquid ratio of 1:10 means that 10 ml of 70% ethanol solution with pH7.0 is used, and 1.000 g of maple leaf tea powder is used), extracted by ultrasonic wave for 20 min (Su, Luo, & Deng, 2004), and then measured the absorption value after filtration. The effect of solid-liquid ratio on the extraction rate of chlorogenic acid was studied.

Ethanol concentration single factor experiment: Add 10 ml ethanol solution with the concentration of 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, ultrasonic extraction for 20 min (Su, Luo, & Deng, 2004), filter and determine the absorption value, and study the influence of ethanol concentration on the extraction rate of chlorogenic acid.

Extraction time single factor experiment: 10 ml of 70% ethanol solution was added, and the ultrasonic extraction time was 5 min, 10 min, 15 min, 20 min and 25 min respectively (Luo, Su, & Yang, 2007). The absorption value was determined after filtration, and the influence of extraction time on the extraction rate of chlorogenic acid was studied.

3.4 Chlorogenic Acid Content Calculation Formula

$Y = c \times V \times 10 \times 1000 / m$

Y -- extraction rate of chlorogenic acid, %; C -- determination of the concentration of chlorogenic acid in the liquid, mg/mL; V -- volume of chlorogenic acid extract, mL; m -- raw material in ingot maple leaf, g.

3.5 Orthogonal Experimental Design for Extraction of Chlorogenic Acid from Ingot Maple Leaf

Table 1. Experimental Factors for Extraction of Chlorogenic Acid from Maple Leaf of Ingot

Leve	Factor A	Factor B	Factor C
	Solid-liquid ratio	Ethanol concentration (%)	Ultrasound time (min)
1	7:1	50	13
2	10:1	55	15
3	13:1	60	20
4	16:1	65	25

3.6 Recipe and Process of Bread

Bread preparation formula: 714g of high gluten flour, 178.5g of low gluten flour, 8.9g of yeast, 178.5g of salt, 580g of water and different proportions of Yuan Baomaple tea powder (ATB), that is, ATB weight accounted for 0%, 0.5%, 1%, 1.5%, 2%, 2.5%, 3% of the total weight of flour.

The production process of bread: flour and tea powder mixing → dough molding → relaxation → dough splitting → shaping → plate loading → awakening → baking → finished product.

3.7 Basic Testing Methods of Bread

Determination of bread moisture content: refer to GB 5009.3-2016 "Determination of moisture in Food Safety National Standard" (direct drying method), at the temperature of 101℃ ~105℃ using volatilization method to determine the weight lost in the sample drying, and then calculate the moisture content by weighing before and after drying.

Bread texture: Test parameter setting: using TP/0.5 probe, determination conditions: 5 g force, trigger mode Auto, pre-test rate is 3.0mm /s, test rate is 1.0mm /s, after test rate is 1.0mm /s, compression 50%, interval time is 5 s. Bread hardness, cohesiveness, chewability, resilience and elasticity were determined by the above method of bread texture measurement. The definition of texture parameters is shown in Table 2.

Table 2. Definitions of Texture Parameters

Parameters	Definitions
Hardness /g	The maximum peak value at first compression, where the hardness value of most samples is deformed at its maximum.
Cohesiveness	The relative resistance of the sample to a second compression after the first compression deformation.
Chewability /g	Used only to describe a solid state test sample, numerically expressed as the product of adhesiveness and elasticity. The test sample cannot be both solid and semi-solid, so it is not possible to describe the structural properties of a test sample in terms of both resistance and adhesivity, i.e., stickiness ×elasticity.
Resilience	Represents the ability of the sample to bounce back during the first compression process, and is the ratio of the elastic energy released by the sample returned during the first compression cycle to the energy consumption of the probe during compression.
Elasticity	Expressed as the ratio of the recovered height of the sample detected in the second compression to the amount of deformation in the first compression.

3.8 Sensory Evaluation of Bread

After baking, the bread is left at room temperature to cool and then the sensory quality evaluation is carried out. According to GB/T 20981-2007 bread sensory evaluation method, 7 students rated the form, color, odor, taste and organization of bread.

3.9 Determination of Tea Polyphenol Content and Antioxidant Capacity of Bread

The bread with the crust removed was freeze-dried and ground, sieved to obtain bread flour. 1 g of bread flour and 30 ml of 80% methanol solution were immersed in a water bath at 50 ℃ for 3 h, and the supernatant was obtained by centrifugation, which was the extraction solution, for the determination of polyphenol content and antioxidant capacity of bread tea.

Determination method of tea polyphenols: refer to GB/T 8313-2018 tea polyphenols and catechins content detection method, unit is mg/g.

Determination of antioxidant capacity of bread: The determination of antioxidant capacity of bread was referred to the method in the literature (Pang, Si, & Wang, 2010), and slightly modified. 2 mg DPPH was accurately weighed and dissolved in methanol, and the volume was fixed to 500 mL after dissolution. Add 1 mL sample solution and 3 mL DPPH solution into the test tube successively, mix well, stand in the dark place for 30 min, and then measure the absorption value of the sample at 516 nm by ultraviolet spectrophotometer. The DPPH free radical clearance rate was calculated according to the following formula, and the IC50 value was calculated.

$$DPPH\ (\%) = \frac{A_0\ (A_i + A_j)}{A_0} \times 100\%$$

Where: $A0$ is the absorbance value without adding scavenger; A_i is the absorption value of adding the scavenger; A_j is the absorbance value of the reagent blank.

Data processing and analysis

Microsoft office Excel 2021 and SPSS 22.0 Chinese software were used for data analysis. *T-test* was used for comparison between the two groups of data, and one-way ANOVA was used for comparison between multiple groups of data. $P < 0.05$ was considered statistically significant.

4. Results and Analysis

4.1 Single Factor Extraction Experiment of Chlorogenic Acid Content in Acer Formosa

4.1.1 Influence of Solid-liquid Ratio on Extraction rate

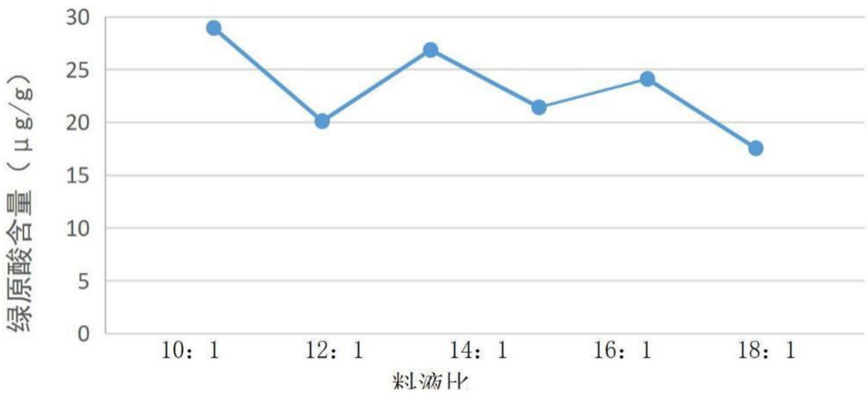

Figure 1. Effects of Solid-liquid Ratio on Extraction Rate

As can be seen from Figure 1, the extraction rate was the highest when the solid -liquid ratio was 1:10 (i.e., 10.0 ml ethanol solution and 1.000 g sample of Acer Forba), and the extraction rate of chlorogenic acid under other solid-liquid ratio conditions was lower than that under 10:1 solid -liquid ratio. Therefore, the optimal solid -liquid ratio should be 10:1 when extracting chlorogenic acid from Acer forba.

4.1.2 Influence of Ethanol Concentration on the Extraction Rate

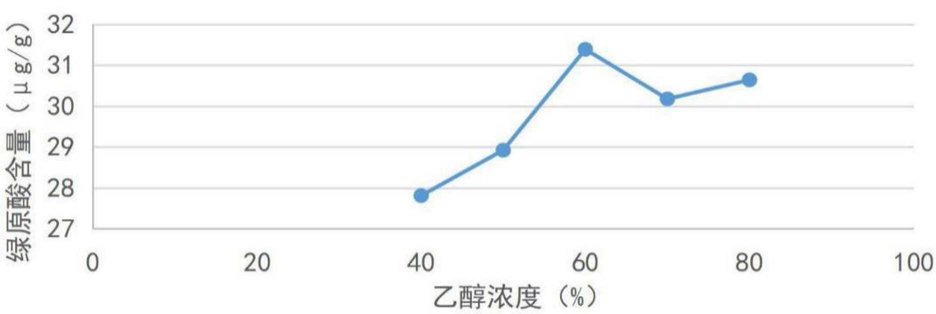

Figure 2. Influence of Ethanol Concentration Used for Extraction on Extraction Rate

As can be seen from Figure 2, the extraction rate of chlorogenic acid in the tea powder increases with the increase of ethanol concentration, reaching the highest point when the ethanol concentration is 60%, and the extraction rate decreases when the ethanol concentration is 70%. Although the extraction rate is higher than that at 70% concentration, it is still lower than that at 60% concentration. Therefore, the optimal ethanol concentration should be 60% when extracting chlorogenic acid from maple leaf of Ingot.

4.1.3 Influence of Ultrasonic Time on Extraction Rate

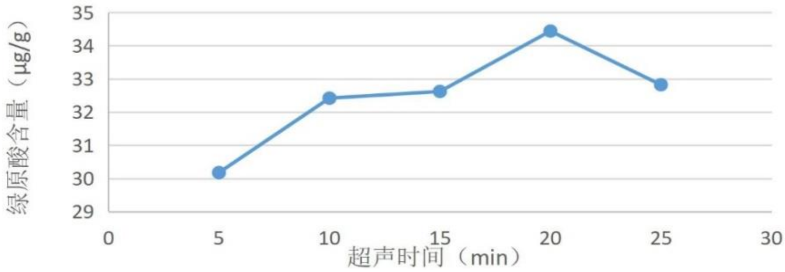

Figure 3. Influence of Ultrasonic Time on Extraction Rate

As can be seen from Figure 3, the extraction rate of chlorogenic acid from Acer nuba is also related to the ultrasonic time, and the extraction rate of chlorogenic acid continues to increase with the extension of ultrasonic time, reaching the highest point when the ultrasonic time is 20 min, while the extraction rate of chlorogenic acid continues to decline with the increase of ultrasonic time. Therefore, the optimal ultrasonic time should be selected as 20 min when extracting chlorogenic acid from Acer Nuba.

According to the above experiments, the optimal single factor level should be selected when extracting the chlorogenic acid content in Acer forba as follows: the ratio of solid to liquid is 1:10, the concentration of ethanol used for extraction is 60%, and the extraction time is 20 min.

4.2 Orthogonal Experiment for Extraction of Chlorogenic Acid

4.2.1 Orthogonal Experiment

Table 3. Orthogonal Experiment Results of Chlorogenic Acid in Ingot Maple Leaf

Treatment No.	A	B	C	D	E	Chlorogenic acid extract
	Solid- liquid ratio	Ethanol concentration	Ultrasoun d time	Empty line	Empty column	Access rate (%)
1	1 (7-1)	1 (50)	1 (13)	1	1	5.43
2	1 (7-1)	2 (55)	2 (15)	2	2	6.31
3	1 (7-1)	3 (60)	3 (20)	3	3	6.58
4	1 (7-1)	4 (65).	4 (25)	4	4	5.87

5	2 (10:1)	1 (50)	2 (15)	3	4	6.53
6	2 (10:1)	2 (55)	1 (13)	4	3	6.92
7	2 (10:1)	3 (60)	4 (25)	1	2	6.84
8	2 (10:1)	4 (65).	3 (20)	2	1	6.45
9	3 (1)	1 (50)	3 (20)	4	2	7.03
10	3 (1)	2 (55)	4 (25)	3	1	6.21
11	3 (1)	3 (60)	1 (13)	2	4	6.58
12	3 (1)	4 (65).	2 (15)	1	3	5.45
13	4 (now)	1 (50)	4 (25)	2	3	6.54
14	4 (now)	2 (55)	3 (20)	1	4	6.86
15	4 (now)	3 (60)	2 (15)	4	1	7.12
16	4 (now)	4 (65).	1 (13)	3	2	6.42
K1j	24.19	25.53	23.35	24.58	25.21	
K2j	26.74	26.3	25.41	25.88	26.6	
K3j	25.27	27.12	26.92	25.74	25.49	
K4j	26.94	24.19	25.46	26.94	25.84	
K1j	6.05	6.38	6.34	6.15	6.3	
K2j	6.69	6.58	6.35	6.47	6.65	
K3j	6.32	6.78	6.73	6.44	6.37	
K4j	6.74	6.05	6.37	6.74	6.46	
Rj	0.69	0.73	0.39	0.59	0.35	

It can be seen from Table 3 that B > A > C can be obtained after range analysis. Therefore, among the single factors for the extraction of chlorogenic acid from Ingot maple leaf, the change of ethanol concentration has the greatest influence on the extraction rate, and the extraction time has the least influence on the extraction rate. According to the orthogonal experiment, it was found that the extraction rate of chlorogenic acid was the highest (7.12%) when the ratio of solid to liquid was 16:1, the concentration of ethanol was 60% and the ultrasonic time was 15 min.

4.3 Change of Chlorogenic Acid Content in Leaf of Ingot in Different Months

Under the optimal extraction conditions of chlorogenic acid, chlorogenic acid was extracted from the maple leaves of Ingot in different months in 2020, and its content was determined. As can be seen from Figure 4, the chlorogenic acid content in leaves is the highest in June, and the least in September, mainly because leaves in June are in the mature stage, the climate is the most suitable, the water content is sufficient, the energy supply is sufficient, and the organic components are accumulated more. In the experiment, it is found that leaves stretch in June, the drying time is stable, and the pulverized samples contain less water and are bright green. It is suitable for storage.

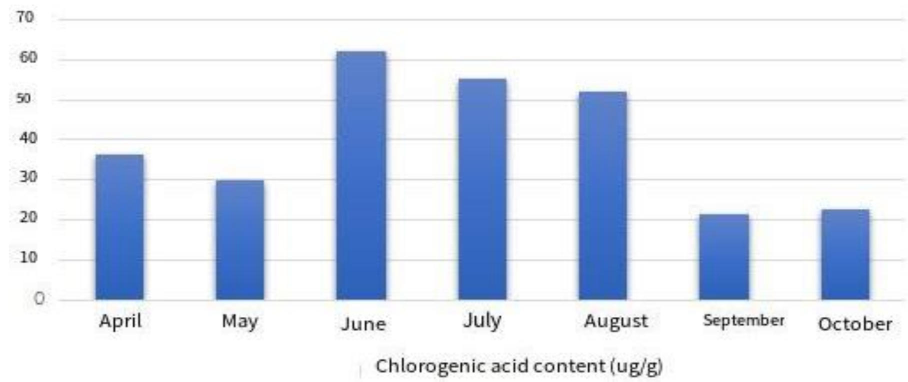

Figure 4. Change of Chlorogenic Acid Content in Different Months

4.4 Effect of Tea Powder on Bread Quality

Except for 2.3, all the other tea powder used in the experiment was processed from leaves in June, and the tea powder used in the subsequent experiment on the influence of bread quality was prepared by ultramicro-grinding of maple leaf.

4.4.1 Influence of Tea Powder on Bread Moisture

As can be seen from Figure 5, the moisture content of bread decreases with the addition of tea powder. The reason may be that tea polyphenols in tea powder dilute the content of gluten protein, thus leading to the decrease of water retention of bread. Secondly, the addition of tea polyphenols will compete with gluten protein to bind water, thus affecting the formation of gluten network structure, which will further reduce the water retention of bread. The water content of 0.5%GTB group was 38.75%, which was the highest in the GTB group. This may be due to the fact that when tea powder was added in a small amount, the gluten membrane was fully formed and expanded during dough fermentation, keeping water in the dough. The moisture content of 2.5%GTB and 3%GTB groups was between 36% and 36.5%, which may be due to the fact that when tea powder was added in large quantities, tea powder would compete with substances such as starch and gluten protein in bread to absorb water, thus inhibiting the extension of gluten, weakening its retention of carbon dioxide and other gases, and speeding up the water loss in bread.

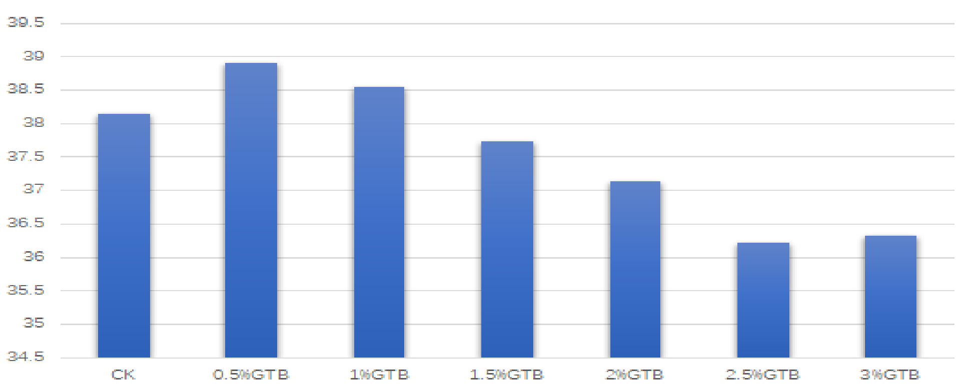

Figure 5. Influence of Ultra-fine Tea on Bread Moisture

4.4.2 Effects of Tea Powder on Sensory Quality of Bread

The cross-section of each group of bread is shown in Figure 6. With the increase of tea powder addition, the color of bread gradually deepens, and the pores first increase and then decrease. The appearance, color, flavor, taste and total score of the ultra-fine green tea bread with different added amounts were scored, and the results were shown in the table.

Figure 6. Cross-sectional Appearance of Ultra-fine Tea Flour Bread

Note. CK: Tea powder is not added; 0.5%, 1%, 1.5%, 2%, 2.5%, 3%, GTB: adding 0.5%, 1%, 1.5%, 2%, 2.5%, 3%, content of superfine tea powder

As can be seen from Table 4, CK bread has complete appearance, good color, golden color, no tea smell, but has obvious bread aroma, and suitable taste without sticking teeth. The score of GTB in form and color was low, indicating that the addition of ultra-fine tea powder may have adverse effects on the form and color of bread. When the amount of added is less than 1.5%, the flavor and color of the bread are decreased, and a small amount of added tea powder will make the bread lose its original color; When the added amount is greater than 1.5%, the taste, smell and color will increase, but when the added amount is more than 2.5%, the bitter taste of tea will decrease in taste, of which 2.5%GTB group scored the highest, the bread has a complete appearance, moderate elasticity, appropriate softness, and more obvious tea aroma. Gu Zongzhu and Zong Zhenshuo et al. found that the optimal addition amount of ultrafine tea powder was 3%, which had the fragrance of tea and the taste was more in line with the taste of most people. However, in this experiment, 2.5% of tea powder was added, with a total score of 92.90 and the highest taste of 18.78; The least liked was the added amount of 0.5%, the total score was only 85.56, its odor score was the lowest except CK, only 14.11, it has a light tea flavor, color score is also the lowest, because the color is not uniform and not beautiful; The reason for the lower score of 3%GTB group was that the taste was a little bitter.

Table 4. Quality Analysis Table of Ultrafine Tea Powder Bread

Samples	Morphology	Luster	Scent	Tissue	Mouthfeel	Total point s
CK	19.44±0.88[a]	19.00±1.41[a]	9.55±0.73[c]	16.55±1.94[a]	18.33±2.5[a]	82.87
0.5%GTB	19.22±0.83[a]	16.89±1.27[a]	14.11±1.9[b]	17.11±1.86[a]	18.56±1.81[a]	85.56
1%GTB	18.33±2.06[a]	17.44±2.30[a]	14.67±3.94[b]	18.44±2.13[a]	18.56±2.24[a]	87.44
1.5%GTB	19.00±1.22[a]	17.56±1.33[a]	17.67±1.80[a]	17.78±1.48[a]	18.33±1.73[a]	90.34
2%GTB	18.78±0.97[a]	18.33±1.00[a]	18.56±1.01[a]	18.33±1.50[a]	18.67±2.12[a]	92.67
2.5%GTB	18.89±1.17[a]	18.78±0.67[a]	18.56±1.59[a]	17.89±1.96[a]	18.78±1.48[a]	92.90
3%GTB	18.44±3.24[a]	18.44±1.88[a]	19.11±1.69[a]	18.11±3.44[a]	15.78±3.77[b]	89.88

4.4.3 Effect of Tea Powder on Texture of Bread

Texture is mainly to determine the physical property parameters of food, including hardness, cohesiveness, chewability, resilience and elasticity. The influence of tea powder on the physical properties of bread can be quantitatively observed. The hardness of bread added with tea powder shows an increasing trend, while the time change is very stable, and the force shows a decreasing trend. Compared with the blank sample, the hardness of the bread with the added maple leaf ingot was significantly different. When the added amount reached 3%, the hardness and chewability were significantly increased, which may be due to the fact that the polyphenols in the maple leaf Ingot destroyed the formation of gluten network structure in the bread. With the increase of the added amount of maple leaf Ingot, the formation of gluten network structure became more difficult. The holding property of gluten decreased and the internal structure became rough, which led to the increase of bread hardness and chewability, and the decrease of elasticity. When the addition of tea powder is below 3%, there is no significant change in the chewability of bread.

Table 5. Effects of Tea Powder on Texture Characteristics of Bread

Samples	Hardness /g	cohesiveness	Time (s)	Force	distance
CK	243±25[a]	0.89±0.01[a]	5.860	10.6122	9.961
0.5%GTB	140±5[d]	0.90±0.01[a]	5.880	9.5612	9.995
1%GTB	186±4[c]	0.85±0.02[b]	5.884	7.7001	10.000
1.5%GTB	135±4[d]	0.85±0.01[b]	5.884	10.0867	10.000
2%GTB	125±8[d]	0.88±0.00[a]	5.884	12.7060	10.000
2.5%GTB	137±4[d]	0.88±0.01[a]	5.886	7.1435	10.000
3%GTB	207±11[b]	0.88±0.00[a]	5.884	8.2590	10.000

4.4.4 Determination of Antioxidant Properties of Bread

Studies have shown that chlorogenic acid is a highly efficient phenolic antioxidant. Due to its existence, it can greatly extend the shelf life of food, so it has strong antioxidant capacity. Antioxidants refer to a class of substances that can remove oxygen free radicals, inhibit or remove to slow down the oxidation reaction, and more (Fan, Yao, & Zhao, 2006) antioxidants are added to food substances.

The detection of the antioxidant capacity of bread is referred to the method of literature (Luo, Su, & Yang, 2007), and slightly modified. 2 mg DPPH was accurately weighed and dissolved in methanol, and the volume was fixed to 500 mL after dissolution. Add 1 mL sample solution and 3 mL DPPH solution into the test tube successively, mix well, stand in the dark place for 30 min, and then measure the absorption value of the sample at 516

nm by ultraviolet spectrophotometer. The DPPH free radical clearance rate was calculated according to the formula, and the IC_{50} value (Fan, Yao, & Zhao, 2006) was calculated.

Table 6. Changes in Antioxidant Activity (%) of Bread During Storage

Sample/d	0	2	4	6	8	10	12	14
CK	28 ± 0.05^{d}	14 ± 0.01^{e}	19 ± 0.01^{e}	19 ± 0.01^{e}	18 ± 0.03^{c}	17 ± 0.00^{g}	15 ± 0.02^{e}	14 ± 0.03^{c}
0.5%GTB	78 ± 0.03^{a}	85 ± 0.02^{a}	87 ± 0.10^{a}	85 ± 0.02^{a}	92 ± 0.02^{a}	86 ± 0.00^{a}	83 ± 0.12^{a}	79 ± 0.05^{a}
1%GTB	76 ± 0.07^{b}	76 ± 0.05^{b}	76 ± 0.01^{b}	76 ± 0.01^{b}	83 ± 0.6^{a}	82 ± 0.10^{b}	80 ± 0.04^{ab}	76 ± 0.04^{a}
1.5%GTB	68 ± 0.04^{cb}	73 ± 0.01^{b}	65 ± 0.04^{dc}	74 ± 0.00^{b}	71 ± 0.03^{b}	76 ± 0.01^{c}	74 ± 0.06^{cd}	81 ± 0.06^{a}
2%GTB	64 ± 0.02^{b}	66 ± 0.03^{c}	64 ± 0.02^{dc}	46 ± 0.06^{d}	65 ± 0.04^{b}	65 ± 0.04^{e}	67 ± 0.02^{cb}	62 ± 0.06^{b}
2.5%GTB	54 ± 0.05^{c}	64 ± 0.06^{c}	70 ± 0.03^{b}	78 ± 0.04^{b}	68 ± 0.05^{b}	73 ± 0.03^{d}	69 ± 0.03^{cb}	70 ± 0.13^{a}
3%GTB	52 ± 0.09^{c}	59 ± 0.10^{b}	54 ± 0.06^{d}	54 ± 0.05^{c}	52 ± 0.04^{b}	64 ± 0.05^{f}	61 ± 0.02^{d}	55 ± 0.10^{b}

It can be seen from Table 6 that CK group has a certain antioxidant capacity, which may be due to the high protein content in flour, which can weaken the recrystallization of starch particles, delay the aging of bread tissue, and have antioxidant properties. It leads to the Maillard reaction in the baking process of bread, and its products have antioxidant ability (Wang, Ma, & Wang, 1997). The antioxidant activity of bread decreases with time; On day 0, the highest antioxidant activity was found in 0.5%GTB group, and there was no significant difference between 0.5%GTB group and 1%GTB group. The antioxidant activity of 0.5%GTB group was still the highest at day 2 to 10, which was significantly different from that of other GTB groups; On day 14, the highest antioxidant activity was found in 1.5%GTB group. With the increase of tea powder, the antioxidant activity of bread showed a decreasing trend. In general, the antioxidant activity was the most stable in 0.5%G TB group, while the antioxidant activity was the best in 1.5%GTB group. This suggested that the amount of bread added was not only affected by the volume of bread and starch recovery, but also related (Wang, Ma, & Wang, 1997) to the addition of tea powder.

5. Conclusion

On the basis of single factor experiment, the optimal extraction conditions of chlorogenic acid were obtained by orthogonal experiment as solid -liquid ratio 1:16, ethanol concentration 60% and ultrasonic time 15 min, and the extraction amount was 7.12%. Under the optimal extraction conditions, the dynamic content of chlorogenic acid in the growth cycle of Maple leaf in 2020 was analyzed. The results showed that the content of chlorogenic acid in leaves of Maple leaf in June was the highest (62.15ug /g), and the content of chlorogenic acid in September was the least (21.35ug/g). The chlorogenic acid extraction process adopted in this study is simple to operate, and the optimal extraction conditions of chlorogenic acid have good repeatability, which can provide reference for the extraction and preparation of chlorogenic acid under laboratory conditions.

In order to further explore the antioxidant effect of chlorogenic acid in food, the effects of different amounts of Yuanbaomaple tea powder on bread quality were studied. The results showed that the addition of Yuanbaomaple tea powder had certain effects on the sensory quality of bread. For most people, the bread made when the content of Yuanbaofeng tea powder is 2.5% is more recognized by everyone, with full shape, uniform color, obvious tea flavor, and the highest total score. When the tea powder added amount is 0.5%, the water content of the bread is the highest, because the tea powder is added in a small amount, and the gluten is fully expanded during the dough fermentation process, thus confining the water in the dough; At the same time, when the added amount of tea powder is 0.5%, the antioxidant capacity is also the most stable. When the added amount reached 3%, the hardness and chewability increased significantly. The reason may be that with the increase of the added amount of tea powder, it is not conducive to the formation of gluten network structure, resulting in the decrease of gluten's gas retention, the internal structure becomes rough, the hardness and chewability increase, and the elasticity decrease. To sum up, 2.5%GTB bread is the best in taste; The 0.5%GTB bread is the best in terms of nutritional value. The results of this study provide theoretical basis for the development of the unique flavor of Yuanbao maple tea combined with bread, and broaden the reuse of forestry resources.

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