Comparison of Total Flavonoids Content in Different Bamboo Shoots and Different Parts

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Abstract: The paper determined the content of total flavonoids in different types and parts of rhizome shoot and winter bamboo shoots by UV spectrophotometry for comparison. The results showed that the bamboo shoot sheath had a higher level of total flavonoids than in the bamboo shoots, and the rhizome shoot had a higher level of total flavonoids than the winter bamboo shoots in different parts.

1 Introduction

Bamboo shoot is the new bud of Poaceae and Bambusoideae [1]. There are more than 500 types of bamboo shoots in China, most of which are edible [2]. The mild flavor, tender-crisp texture and rich nutrition of bamboo shoots have earned it the reputation of "the king of vegetable" [3]. Bamboo shoots are rich in dietary fiber, flavonoids, active polysaccharides, and boasts a variety of amino acids and other components. Flavonoids have multiple functions, such as scavenging free radicals, anti-aging, anti-bacteria, anti-virus, improving immunity, which are often used in medicine, food and cosmetics [4-6]. This paper takes the percentage of total flavonoids extracted from bamboo shoots as an indicator to extract the total flavonoids, and compared the content of total flavonoids in different types and parts of bamboo shoots, which provided theoretical basis for further developing bamboo shoots that are edible and of medical value.

2 Instrument and Reagent

Reagent: Rutin standard: Shanghai Yuanye Biotechnology Co., Ltd. The anhydrous ethanol, aluminum nitrate, sodium hydroxide and sodium nitrite are all analytically pure. The rhizome shoots and winter bamboo shoots were purchased from Huzhou, Zhejiang.

Instrument: Electric blast drying oven (DHG-9053A): Shanghai Shanzhi Instrument Equipment Co., Ltd.; ultraviolet visible spectrophotometer (UV-1780): Shimadzu, Japan; electronic balance (FA604): Shanghai Hengping.

3 Preparation of solution

3.1 Preparation of raw materials

After the two kinds of bamboo shoots were cleaned, the shoot and sheath were separated and dried at 60°C in the electric blast drying oven according to the experimental requirements. Then, they were crushed to obtain bamboo shoot samples, which were placed in wide-mouth bottles for later use. Among them, (1) was the sheath of winter bamboo shoot, (2) was the sheath of the rhizome shoot, (3) was the winter bamboo shoot, and (4) was the rhizome shoot. The results of the following experiments were marked using the numbers above.

3.2 Preparation of reference solution

10 mg of rutin reference substance were taken and weighed before being placed in a 50 mL volumetric flask, where it was dissolved with 60% ethanol, diluted it to scale, sealed and shaken to get reference solution for later use.

3.3 Preparation of test solution

3g of different parts of both types of bamboo shoots were taken and weighed before being placed in a 250mL round-bottom flask. 60% ethanol were added for reflux extraction for 2 times, 30min each time. Then, they were taken out, cooled, shaken evenly and filtered. The filtrates were combined and evaporated, and treated with 60% ethanol at constant volume in the 10mL volumetric flask as the test solution for later use.

4 Making standard curve

We accurately measured 1mL, 2ml, 3ml, 4ml, 5ml and

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6ml of reference solutions, put them into the 25 mL volumetric flasks and added 1 mL of 5% sodium nitrite solution before shaking the solution and leaving it there for 6 min. Then, we added 1ml of 10% aluminum nitrate solution before shaking the solution and leaving it there for 6 min. After that, we added 10 mL of sodium hydroxide test solution, followed by the addition of 60% ethanol to constant volume. Then, it was sealed and shaken, and placed there for 15 min. We took the corresponding reagent as the control, measured the absorbance at 510nm, drew the standard curve with the concentration(C) as the abscissa and the absorbance(a) as the ordinate, where the regression equation: Y=0.48875X-0.02096, R2=0.99338 was obtained, indicating that the rutin had a good linear relationship with absorbance in the concentration range of 0.008-0.048 mg/ml.

5 Method

5.1 Precision test

We accurately measured 3mL of reference solution and put it in a 25 mL volumetric flask. Based on the method specified by the standard curve preparation, we measured the absorbance after “adding 1mL of 5% sodium nitrite solution” consecutively 6 times and calculated the RSD value, which was determined at 0.34%, as shown in Table 1, indicating good precision.

Table 1 Precision Test

	1	2	3	4	5	6	Average	RSD（%）
Absorbance	0.265	0.266	0.265	0.264	0.266	0.264	0.265	0.34

5.2 Stability test

We accurately measured 1mL of the test solution, and placed it in the 25 mL volumetric flask. Based on the method specified by the standard curve preparation, we added the corresponding reagents after “adding 1mL of 5% sodium nitrite solution”. When the reaction of the color system was over, we recorded the absorbance value every 15 min for 90 min continuously, and calculated the RSD value to investigate its stability [10]. The RSD was calculated to be 0.84%, as shown in Table 2, indicating that the test solution had good stability within 90 min after color reaction.

Table 2 Stability Test

	1	2	3	4	5	6	Average	RSD（%）
Absorbance	0.189	0.190	0.187	0.185	0.184	0.186	0.187	0.84

5.3 Repeatability test

We accurately measured 1mL, 2mL and 3mL of different test solutions, and placed them in 25 mL volumetric flasks respectively. Based on the method specified by the standard curve preparation, we measured the absorbance after “adding 1mL of 5% sodium nitrite solution”. The RSD were calculated to be 0.84%, 0.51% and 0.28% respectively, as shown in Table 3, indicating high repeatability.

Table 3 Repeatability Test

	1	2	3	4	5	6	Average	RSD（%）
Absorbance	0.189	0.190	0.187	0.185	0.184	0.186	0.187	0.84
	0.553	0.550	0.554	0.553	0.547	0.548	0.551	0.51
	1.070	1.069	1.068	1.066	1.073	1.074	1.070	0.28

5.4 Recovery rate test

We added a certain amount of rutin reference substance into the test solution with certain content of total flavonoids, and prepared a new test solution based on the method of test preparation. We accurately measured 1 mL of the test solution, and place it in 25 mL volumetric flasks. According to the method specified by the standard curve preparation, we measured the absorbance after “adding 1mL of 5% sodium nitrite solution” [11-12]. Results: The recovery rate of six samples ranged from 97.15% to 105.29%, with an average recovery rate of 100.10%. The results are shown in Table 4, indicating high accuracy and reliability.

Table 4 Sample Recovery Rate

No.	Weighing Sample（g）	Addition（g）	Actual Value（g）	Recovery Rate（%）	Average Recovery Rate（%）
1	0.0047	0.0015	0.0046	100.75	100.10
2	0.0023	0.0008	0.0023	98.58	
3	0.0014	0.0007	0.0016	97.15	
4	0.0038	0.0012	0.0037	100.25	
5	0.0037	0.0013	0.0038	105.29	
6	0.0020	0.0010	0.0023	98.58	

6 Results

6.1 Calculation of total flavonoids content in bamboo shoots

Based on data below and the regression equation of the rutin standard curve: Y=0.48875X-0.02096, R2=0.99338, we obtained the percentage content of total flavonoids, as shown in Table 5.

Table 5 Content of Total Flavonoids

No.	Absorbance	Sample (g)	Total Flavonoids Content (mg/g)	Percentage Content(%)
①Sheath of Winter Bamboo Shoot	0.534	3.0023	283.867	9.46
②Sheath of Rhizome Shoot	0.613	3.0174	324.276	10.75
③Winter Bamboo Shoot	0.151	3.0333	87.959	2.90
④Rhizome Shoot	0.170	3.0394	97.678	3.21

6.2 Comparison of total flavonoids content in bamboo shoots

6.2.1 Comparison of total flavonoids content in different parts of the bamboo shoots

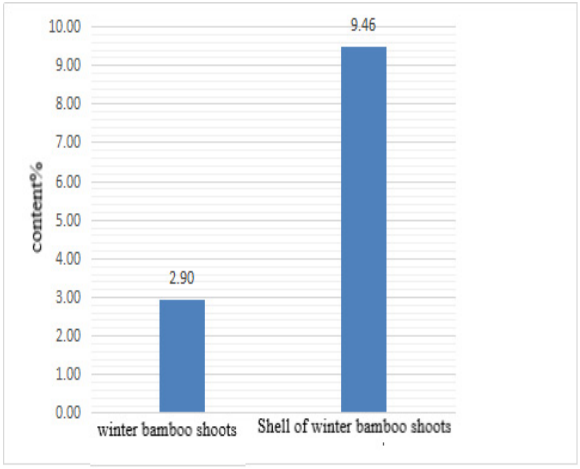

Figure 1 Comparison of total flavonoids content in different parts of inter bamboo shoots

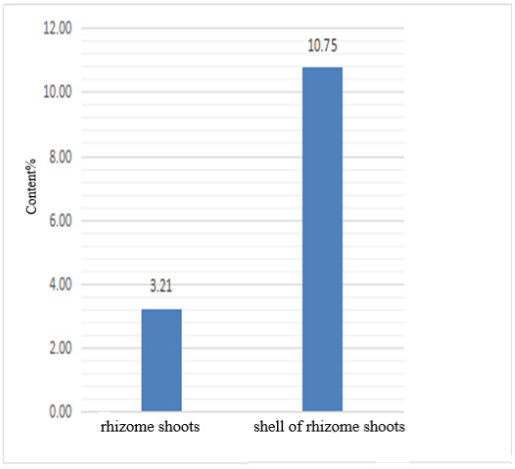

Figure 2 Comparison of total flavonoids content in different parts of Rhizome Shoots

It can be seen from Figure 1 and Figure 2 that the sheath has a higher content of total flavonoids than the shoot itself. The content of total flavonoids in the sheath of winter bamboo shoot was up to 9.46%, while the shoot itself had a percentage content of 2.90%. For the rhizome shoots, the content of total flavonoids in the sheath was as high as 10.75%, while the shoot itself had a percentage content of mere 3.21%. The content of total flavonoids in the sheath of winter bamboo shoots and rhizome shoots was more than 3 times that of the shoots.

In general, the content of total flavonoids in the sheath is higher than that in the shoots. Meanwhile, the total flavonoids content of rhizome shoots was higher than that of the winter bamboo shoots.

6.2.2 Comparison of total flavonoids content in the same part of different bamboo shoots

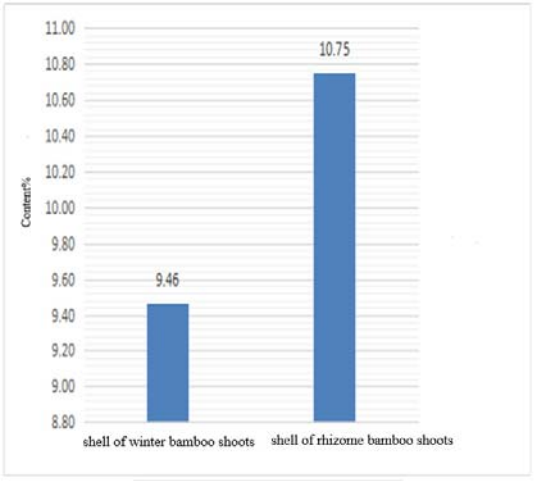

Figure 3 Comparison of Total Flavonoids Content in the Sheath of Different Bamboo Shoots

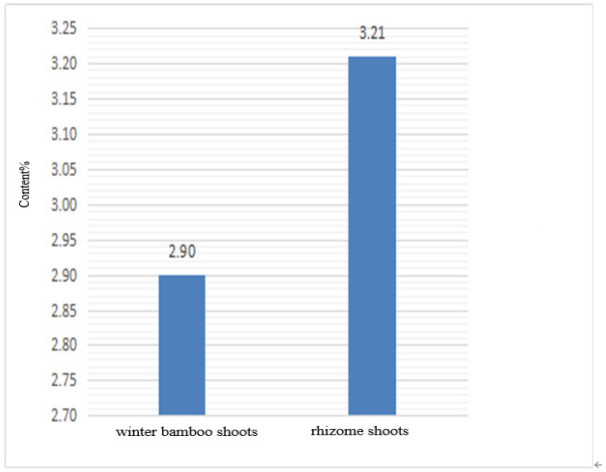

Figure 4 Comparison of Total Flavonoids Content in the Shoot of Different Bamboo Shoots

From Figure 3 and Figure 4, it is known that the content of total flavonoids in the same part of rhizome shoots is higher than the winter bamboo shoots produced in the same area. The content of total flavonoids in the sheath of winter bamboo shoots was up to 9.46%, while the number was as high as 10.75% for the rhizome shoots. The content of total flavonoids in the shoot of winter bamboo shoots could reach 2.90%, and that in the rhizome shoots can reach 3.21%. The content of total flavonoids in the sheath and shoot of rhizome shoots is more than twice that of the winter bamboo shoots. Generally, the rhizome shoots have a higher content of total flavonoids than the winter bamboo shoots in both the sheath and the shoot.

6.2.3 Comparison of total flavonoids content in different parts and different types of bamboo shoots

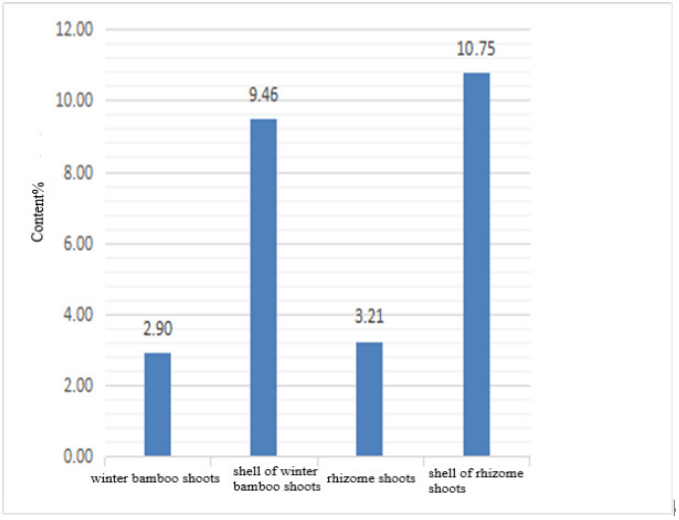

Figure 5 Comparison of Total Flavonoids Content in Different Parts and Different Types of Bamboo Shoots

From Figure 5, it is known that the total flavonoids content in the sheath of different types and different parts of bamboo shoots from the same area is higher than that in the shoot. The total flavonoids content in the sheath and shoot of winter bamboo shoots can reach 9.46% and 2.90%, respectively. However, the total flavonoids content in the sheath and shoot of rhizome shoots gets as high as 10.75% and 3.21% respectively. The content of total flavonoids in the sheath of winter bamboo shoots and rhizome shoots is more than 3 times that of the shoot.

7 Conclusion

The paper measured the total flavonoids content in bamboo shoots by UV spectrophotometry. By comparing the contents of total flavonoids in different parts of rhizome shoots and winter bamboo shoots, we found that the sheath had a higher level of total flavonoids than in the shoot, and the rhizome shoots had a higher content of total flavonoids than winter bamboo shoots. The results could provide references for the selection of bamboo shoots.

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