

Flavor And Stability Improvement Of Purple Sweet Potato - Peanut Compound Beverage

Jiang guangyang¹, Zeng xuedan¹, Wang zhangying², Chen anjun¹, Li shanshan¹,
Liu xingyan, Li meiliang¹, Shen guanghui¹, Wu hejun¹, Zhang zhiqing^{1,*}

¹College of Food Science, Sichuan Agricultural University, Ya'an 625014, China;

²Crops research institute Guangdong academy of agricultural sciences, Guangzhou, 510000, China

Abstract. In order to improve the flavor and stability of purple sweet potato and peanut compound beverage, the orthogonal experiment was used to determine the optimum process of enzymatic hydrolysis and composite stabilizer. The results showed that the ratio of purple sweet potato to peanut was 8: 1 (w / w), and raw to liquid ratio was 1: 8 (w / w). In addition, 0.3% glucoamylase was added to the mixture and incubated at 65°C for 1.5 h. Carrageenan, xanthan gum, sodium alginate and CMC-Na were compound stabilizer at the best concentration of 0.06%, 0.2%, 0.1%, 0.04%.

1. Introduction

Purple sweet potato is rich in anthocyanins and phenols, and has strong antihypertensive effects, anti-oxidation and can alleviate liver injury (Kano M et al., 2005). Peanut kernel has high nutritive value, which is rich in unsaturated acid, protein and 8 kinds of essential amino acids (Ramachandran S et al., 2007). Peanut protein drinks are widely praised by consumers in the market. The processing of food-grade beverages, starch easily settles and causes beverage delamination, which affects the sensory quality of beverages, and peanut protein is also unstable and easily precipitates. There is a synergistic effect between the stabilizers, and the stability of the mixture is higher than that of any one of the systems. The use of a composite stabilizer can provide better stabilization effects (Shen J R et al. 2017).

Purple sweet potato peanut drink can fully utilize the unique color and rich physiological functions of purple sweet potato, and can also combine the rich texture of peanut protein. A compound beverage was prepared from purple sweet potato and peanut, combined with enzymatic hydrolysis and compound stabilizer to improve its flavor and stability, so as to prepare the purple sweet potato compound beverage with good stability and good taste, and provide a reference for the research of food and peanut protein drinks.

2. Materials and Methods

2.1. Raw materials and instruments

Guang Zi No. 1, (provided by Crops of Guangdong Academy of Agricultural Sciences). α -amylase $\geq$ (10000 U/g), glucoamylase $\geq$ (10000 U/g); Carrageenan, Huangyuan Glue, sodium alginate and sodium carboxymethyl cellulose (CMC) are all food grades. A115036 handheld Abbe refractometer



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(Shanghai Bangxi Instrument Technology); FJ-200-SH digital high-speed dispersion homogenizer (Shanghai Standard Model Factory).

2.2. Single factor experiment

The quality ratio of purple sweet potato and peanut were 1:1, 2:1, 4:1, 6:1, 8:1 and 10:1 (w:w) as comparative tests, adding 6 times water to mix. After confirming the mass ratio, the ratio of liquid to liquid was chosen as 1:2, 1:4, 1:6, 1:8, 1:10, 1:12, respectively, and the sensory score was used as the reference standard of the above factors. Then select the amount of glucoamylase. 200 mL of purple sweet potato and peanut juice were added, and 0.05%, 0.1%, 0.15%, 0.2%, 0.25%, and 0.3% of glucoamylase was added, and digested at 60°C for 60 min to measure the growth rate of soluble solids. Next select the temperature of the enzymolysis. Taking 200 mL purple sweet potato peanut juice, and add 0.2% glucoamylase enzyme at 45, 55, 60, 65, 70, and 75 °C for 60 min to determine the growth rate of soluble solids (%). Last select the time of enzymolysis. 200 mL of purple sweet potato and peanut juice, and 0.2% glucoamylase were added to determine the soluble solid growth at 60 °C for 0.5 h, 1 h, 1.5 h, 2 h, 2.5 h, and 3 h. rate(%).

2.3. Optimization of the best enzymatic process

Based on the above single factor test results, the L9(3³) orthogonal test was used to determine the optimal conditions for enzymatic hydrolysis, The enzymolysis temperatures were 55, 60, and 65°C, and the enzymolysis times were 1.5, 2, and 2.5 h. The enzyme usage was 0.2, 0.25, and 0.3%.

2.4. Optimization of the optimum compound stabilizer ratio

According to the results of the previous experiment, L9(4³) orthogonal test was used to determine the optimum amount of the composite stabilizer. The amount of carrageenan used was 0.04, 0.06, 0.08%, xanthan gum 0.1, 0.15, 0.2%, sodium alginate 0.05, 0.1, 0.15%, CMC 0.04, 0.08, 0.12%.

2.5. Index determination

Soluble solids growth rate/% = $(A_2 - A_1) / A_1 \times 100$ (1)

A1: the soluble solids content of the juice after beating; A2: the soluble solid content of the beverage after the digestion.

The static stratification rate (Fan Z J et al., 2014) : Sterilize at 80 °C for 30 min, and then leave to stand at room temperature for 2 days. Then measure the height and total height of the water layer of the beverage and calculate the delamination rate according to the formula:

$$\text{Static stratification rate}/\% = L_w / L_s \times 100\% \quad (2)$$

L_w: height of water layer; L_s: total height of beverage.

2.6. Sensory evaluation

Select 10 food professionals with sensory evaluation experience to evaluate the sensory evaluation of purple potato peanut compound beverage, and refer to the standard design of Huang Jian Rong et al (Huang J R et al. 2012).

2.7. Statistical analysis of data

All tests were repeated 3 times and the results were expressed as mean ± standard deviation and plotted with Origin 9.0.

3. Results and analysis

3.1. Effect of raw material ratio on flavor

According to Fig. 1a, with the increase of the proportion of purple potatoes, the sensory scores showed a trend of rising first and then decreasing. When the quality ratio of purple sweet potato and peanuts was 8:1, the flavor was the best, which was accepted by most of the tasters. After determining the

mass ratio of purple sweet potato and peanut, the ratio of solid to liquid was tested. The results are shown in Fig. 1b. With the decrease of the liquid-to-liquid ratio, the sensory score increased first and then decreased. When the ratio of material to liquid was 1:8, the sensory score was highest. Huang Jianrong et al used the preparation of a compound beverage with a malt-fragrance and rich purple sweet potato flavor to determine the highest sensory score when the ratio of purple sweet potato and malt was 5:7. Different raw material ratios can highlight the different flavor characteristics and styles of the products.

This study focused on the characteristics of a rich purple potato flavor in compound beverages, a bright purple color, and peanut flavor. However, resulting in precipitation of the product after it was placed for a period of time, which affected its sensory and product quality. Comprehensive research on predecessors, further enzymatic hydrolysis of starch (Lv M X et al., 2017), simultaneous conversion of insoluble starch and other substances into soluble solids reduces the risk of precipitation, and more soluble solids can also improve product flavor.

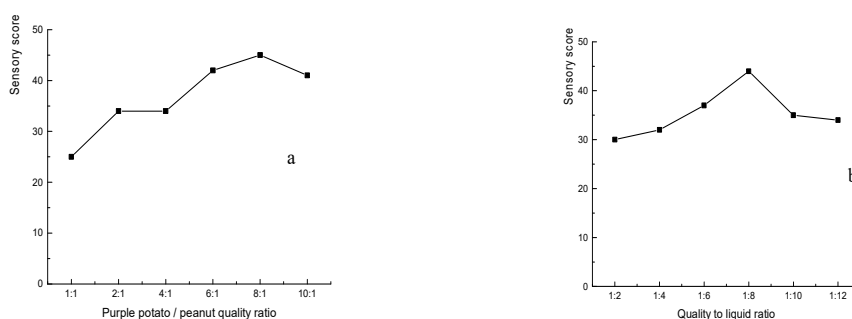


Fig. 1. Effect of mass ratio of purple sweet potato and peanut on sensory evaluation; a purple sweet potato/ peanut mass ratio; b Quality and liquid ratio

3.2. Optimization of enzymatic hydrolysis of purple sweet potato and peanut beverage

3.2.1. Choice of optimal glucoamylase dosage

The result is shown in Fig. 2a. The addition rate of glucoamylase was 0.05%-0.3%. The growth rate of soluble solids in purple sweet potato peanut juice increased with the increase of enzyme amount. When the enzyme amount exceeded 0.25%, the growth rate of soluble solid content had no obvious changes. At this point, the growth rate of soluble solids reached a maximum of 53%. When the amount of saccharifying enzyme has reached saturation, the beverage substrate has been substantially enzymatically (Han Y J, 2003). Considering the enzymatic hydrolysis effect and economic efficiency, the optimal glucoamylase addition amount was 0.25%.

3.2.2. Optimum temperature for enzyme digestion

The result is shown in Fig. 2b, with the increase of temperature, the effect of enzymatic hydrolysis was getting better and better. When the temperature reached 65, the enzyme activity had basically stopped, but the solubility of soluble solids increased greatly, so the growth rate of soluble solids of purple sweet potato juice reached a maximum of 51%. With increasing temperature, the growth rate of soluble solids decreased, and the high temperature of enzymatic hydrolysis destroyed the structure of the enzyme, protein denaturation, and the other part of the sugar was decomposed (Li H I et al., 2010). The optimum enzymatic hydrolysis temperature was 65.

3.2.3. Optimum selection of enzymolysis time

The result is shown in Fig. 2c, when the enzymatic hydrolysis time is 0.5-2 h, the growth rate of soluble solids increases with time. When the time of enzymatic hydrolysis exceeds 2 h, the growth rate of soluble solids tends to be stable, and the substrate of purple sweet potato juice has been completely enzymolysis (Xiang, Y et al., 2017).

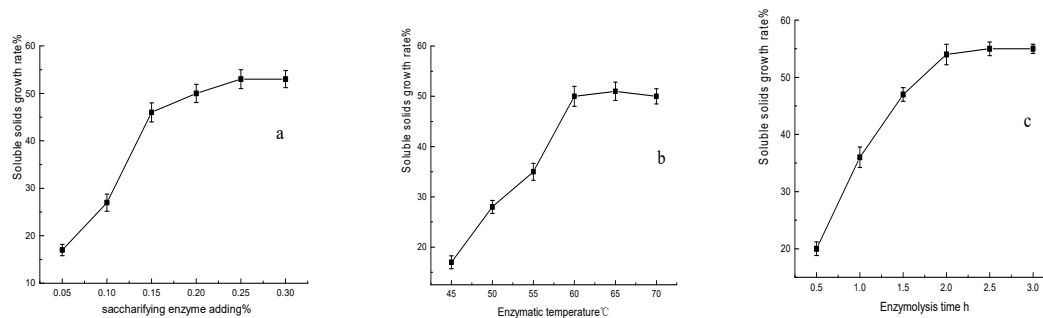


Fig. 2. Optimization of purple sweet potato and peanut beverage hydrolysis technology
 a. Effect of saccharifying enzyme adding dosage on soluble solids in purple sweet potato peanut slurry
 b. Effect of enzymatic temperature on soluble solids in purple sweet potato peanut slurry
 c. Effect of enzymatic time on soluble solids in purple sweet potato peanut slurry

3.2.4. Orthogonal test and results

According to the above single factor experiment results, the $L_9(4^3)$ orthogonal test design table is selected. The effects of glucoamylase dosage, enzymolysis time, and enzymolysis temperature on the growth rate of soluble solids in purple potato and peanut composite beverage were investigated. The factor level is shown in Table 1, and the orthogonal results are shown in Table 1.

Table 1. Results of orthogonal test

number	A	B	C	Sg /%
1	1	1	1	33.3
2	1	2	2	24.0
3	1	3	3	43.0
4	2	1	2	30.0
5	2	2	3	52.0
6	2	3	1	43.3
7	3	1	3	64.5
8	3	2	1	36.7
9	3	3	2	40.0
K_1	100.3	127.8	113.3	
K_2	125.3	112.7	94	
K_3	141.2	126.3	159.5	
k_1	33.4	42.6	37.8	
k_2	41.7	37.6	31	
k_3	47.0	42.1	53.2	
R	13.6	5.0	22.2	

According to Table 2, the best combination is $A_3B_1C_3$, the optimum enzymolysis temperature is 65°C, the best time is 1.5 h and the optimum enzyme dosage is 0.3%. The orthogonal experiment design seventh groups are combined $A_3B_1C_3$, and the growth rate of soluble solids is 64.5%, which is the optimal result. The above studies have shown that the difference in the results of glucoamylase digestion may be related to the size of the product substrate, enzyme species, and enzyme activity. The glucoamylase treatment can saccharify the macromolecules digested by α -amylase into small molecules (glucose) (Zhou X R et al, 2017).

In summary, the prepared purple sweet potato peanut compound beverage has been improved in flavor and stability, and can be accepted by most sensory evaluation personnel. After a week of high temperature sterilization, there will still be a stratification in the product. The analysis may be due to differences in the lipids, proteins and other substances in the aqueous solution due to the difference in

hydrophilicity c , and the destruction of lipid-proteins after high-temperature sterilization. The delamination caused by the encapsulation properties of sugar is a common problem in many protein milk drinks. Therefore, on the basis of the existing research, this study further added compound stabilizers to alleviate the stratification of purple sweet potato peanut beverages and improve product stability.

3.3. Orthogonal test and results of composite stabilizer

After selecting the optimum addition amount of the four stabilizers by single factor, orthogonal optimization was performed. The results are shown in Table 2.

Table 2. Compound Stabilizer Orthogonal Results

number	A	B	C	D	sr/%
1	1	1	1	1	14.7
2	1	2	2	2	12.3
3	1	3	3	3	8.0
4	2	1	2	3	24.3
5	2	2	3	1	23.6
6	2	3	1	2	21.2
7	3	1	3	2	11.6
8	3	2	1	3	6.3
9	3	3	2	1	21.7
K1	35	50.6	42.2	60	
K2	69.1	42.2	58.3	45.6	
K3	39.6	50.9	43.2	38.6	
k1	11.7	16.9	14.01	20	
k2	23.0	14.0	19.43	15.2	
k3	13.2	16.97	14.4	12.87	
R	11.3	2.97	5.42	7.13	

According to Table 2, the factors affecting the stratification rate of the stabilizers are: carrageenan > CMC > sodium alginate > xanthan gum. The best combination of tests was $A_2B_3C_2D_1$, namely, the amount of carrageenan was 0.06%, xanthan gum was 0.2%, sodium alginate was 0.1%, and CMC was 0.04%. After three times of verification test of the purple sweet potato peanut juice after the optimal enzymatic hydrolysis, 0.06% carrageenan, 0.2% xanthan gum, 0.1% sodium alginate, and 0.04% CMC were allowed to stand for 2 days at room temperature. The static delamination rate was measured. And the result is 5.4%.

The results are obviously better than the orthogonal test group, indicating that the optimized conditions for this test are reliable and can be used as the best combination of compound stabilizers. Gao Lei et al (Gao L and Li H Y, 2017) in the study of walnut purple sweet potato composite health drink development showed that adding 0.1% CMC-Na, carrageenan 0.10%, 0.11% monoglyceride, sucrose ester 0.10%, the product body without uniform precipitation. The use of composite stabilizers in food and peanut protein beverages is quite different. It may be due to the large differences in the use of composite raw materials, the inconsistent proportion of raw materials, and the inconsistent pH of beverages.

The results showed that the optimum amount of compound stabilizer was 0.06% carrageenan, 0.2% xanthan gum, 0.1% sodium alginate, and 0.04% CMC-Na.

4. Conclusions

This study started from the basic formulation of the product and gradually solved the problem of taste. Single factor experiments combined with sensory evaluation results showed that the optimum ratios of raw materials were: purple sweet potato: peanut 8:1 (w/w), and the ratio of material to liquid was 1:8 (w/w). Orthogonal results showed that when the amount of glucoamylase was 0.3%, the enzymolysis

temperature was 65 °C, and the enzymolysis time was 1.5 h, the growth rate of soluble solids reached a maximum of 64.5%; when the additive amount of saccharification enzyme was 0.06% of carrageenan, xanthan gum 0.2%, sodium alginate 0.1%, CMC-Na 0.04%, composite beverage standing delamination rate was 5.4%. In this study, purple sweet potato and peanut were mixed to prepare a composite beverage. The method has simple operation, good reproducibility and high degree of industrialization, and can provide experimental basis for the development of purple sweet potato peanut beverage.

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