Study on Ultramicro Powder Fruit Wine of Pitaya Fruit and Carrot

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Abstract: The ultrafine powder was obtained by ultrafine pulverization of pitpitas fruit and carrot, and the effects of fermentation temperature, raw material ratio and pulverized particle size on the brewing process of pitpitas fruit and carrot ultrafine powder were investigated by single factor experiment, and then the fermentation process was optimized by response surface analysis. The optimum fermentation process was determined as fermentation temperature 26 ℃, raw material ratio was 3:5, and grinding particle size was 170 mesh. Under these conditions, the sensory score of ultrafine powder of dragon fruit and carrot was 88 points, and the alcohol content was 12.4% vol.

1. Introduction

Pitaya fruit, also known as red dragon fruit, green dragon fruit, fruit of high nutritional value, not only contains a variety of amino acids needed by the human body and rich trace elements, in medicine, it has the effect of detoxification, eye, blood sugar, blood fat, blood pressure and so on have a certain effect.[1]Carrot is A kind of vegetable commonly eaten by people. In China, it is called "tuginseng", which is rich in sugar, protein, vitamin A, carotene and polyphenols. It has anti-cancer, anti-hypertension, anti-oxidation and anti-aging effects.[2]

In this study, the ultrafine powder of pitayana fruit and carrot was used as raw material to design the brewing technology of fruity wine with strong aroma and provide reference for the future development of compound fruity wine with ultrafine powder as raw material.

2. The Materials and Methods

2.1 The Materials and Reagents

Fresh red pitaya, carrot, sugar; Saccharomyces cerevisiae SC203; Angel yeast active dry yeast; Flynn's reagent, etc.

2.2 The Instruments and Equipment

Yqs-400 supersonic airflow mill; FAI1204B electronic balance; Yx-18hm autoclave; Sw-cj-1bu super clean table; Ghp-9050 constant temperature incubator; Slicing machine; PHB - 3 cp H meter; 0-40 alcohol meter; ATC hand sugar meter; Model 721 spectrophotometer, etc.

2.3 The Process Flow and Operation Points:

Pitaya, carrot pretreatment → Slice →Freeze-dried → Supersonic airflow pulverization →Deploy mixed → Vaccination(yeast activation) clarify → Aging →Fermentation, filtration → Hot and cold processing →Bottling

Operation points:

(1)Raw material treatment: dragon fruit and carrot with moderate maturity were selected and sliced with a slicer. The slice thickness was 0.2-0.4cm. The thin sheet was dried at low temperature and the moisture content was controlled at 3 % ~ 9 %. The high speed crusher was used to crush the raw material for 35 s, and then the low temperature ultrafine crusher was used to crush the raw material to the target size. [3]

(2) Pre-fermentation: the processed dragon fruit and carrot superfine powder were put into the fermentation tank in a certain proportion, and the activated saccharomyces cerviae SC203 was added

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in a certain proportion. Meanwhile, the yeast nutrient powder was added in a ratio of 0.4% ~ 0.5%.[4]Within 8 ~ 12 h after inoculation, the yeast was thoroughly stirred to evenly distribute in the raw material. After inoculation with yeast, the temperature rose to 23 ℃, 27 ℃ and 30 ℃.The fermentation sugar degree was controlled to 22 degrees by adding granulated sugar. The H value of solution was adjusted to 3.5. Ferment for 7 to 10 days. [5]

(3) Post-fermentation: after the end of the pre-fermentation, simple filtration was conducted to enter the post-fermentation stage. The fermentation temperature was controlled at 27 ℃ for 10-12 days.

(4) Aging and clarification: aging of liquor for 3 to 6 months.And the method of glue clarification was used to clarify the liquor.

2.4 Single Factor Test

The main factors affecting the production of ultrafine powder wine of pitaya fruit and carrot are: fermentation temperature, raw material ratio and crushing particle size.Design A fermentation temperature of 23 ℃, 25 ℃, 27 ℃, 29 ℃; The ratio of raw materials (pita fruit: carrot) was 1:5, 2:5, 3:5, 4:5, 1:1 (g:g). C, the particle size was 80 mesh, 110 mesh, 140 mesh, 170 mesh and 200 mesh. The single-factor control variable method was used to complete the three single-factor tests. The alcohol content in each test group was determined and the sensory evaluation of fruit wine was conducted. Each test group was determined three times and the average value was taken.[6]

2.5 Main Fermentation Conditions Were Optimized by Response Surface Method

It is uncertain whether the above three single factors have a cross influence. Box-behnken regression test design was adopted, and the sensory score (Y) was used as the response value to determine the optimal fermentation process conditions of dragon fruit carrot ultra-fine powder fruit wine through the response surface. The design factors and levels of the test are shown in table 1.[7]

Table 1 Factors and Levels of Box-Behnken Experimental Design

factors	- 1	0	1
A: fermentation temperature (℃)	25	27	29
B: raw material ratio (g: g)	C (2, 5)	D (3, 5)	E (4, 5)
C: crushing size (mesh)	140	170	200

Determination method

Alcohol content: determination by densitometer method;[8]

Sensory evaluation: 12 oenophiles were selected to score according to the criteria set in table 2 based on 4 indicators: color, aroma, taste and body. The full score was 100, and the average value was used as the comprehensive sensory evaluation.

Table 2 Evaluation Criteria Of Dragon Fruit and Carrot Superfine Powder Fruit Wine

project	describe	score
appearance	The liquor is clear and transparent, light yellow, without suspended substance	16-20
	The liquor is clear and transparent, with good luster and no obvious suspended substance	11-15
	The liquor is turbid and has obvious suspended substance	≤10
Colour and lustre	Purplish red, uniform texture, clear and transparent	17-20
	Reddish brown, the ground is basically uniform, poor luster	14-16
	Light red, texture is not uniform, poor luster	≤13
The aroma	It has obvious bouquet of wine, malt and harmonious bouquet	17-20
	Hop aroma is not obvious, malt aroma is weak	13-16
	The yeast flavor is obvious and the wine is not harmonious	≤12
On the palate	The taste is pure, the wine body is refreshing, the coordination, does not have the miscellaneous taste	35-40
	The wine is harmonious and refreshing	28-34
	Smelly and discordant	≤27

3. Results and Analysis

3.1 Influence of Fermentation Temperature

The fermentation temperature will directly affect the growth of saccharomyces cerevisiae in super fine powder fruit wine of dragon fruit and carrot. The results of different fermentation temperatures are shown in table 3.

Table 3 Effect of Fermentation Temperature on Ultrafine Powder of Pitaya Fruit and Carrot Fruit Wine

Fermentation temperature (℃)	23	25	27	29
Alcohol content(%Vol)	7.9	9.8	12.6	10.3
The sensory score	75	79	82	78

As can be seen from table 3, both the alcohol content and sensory score of dragon fruit carrot superfine powder wine show a trend of increasing first and then decreasing with the rise of fermentation temperature. When the fermentation temperature is lower than 27 ℃, the alcohol content increases with the rise of temperature.When the temperature is higher than 27 ℃, the alcohol content decreases with the increase of temperature. The reason is that the activity of saccharomyces cerevisiae is optimal at 27 ℃. When the fermentation temperature was 27 ℃, the sensory score was 85 points, reaching the maximum. Therefore, three temperatures were selected, 25 ℃, 27 ℃ and 29 ℃, respectively, for subsequent experiments.

3.2 Influence of the Ratio of Raw Materials on Ultrafine Powder of Pitaya Fruit and Carrot Fruit Wine

The difference in the ratio of raw material quality (pitdragon fruit: carrot =g:g) will affect the taste and alcohol content of the fruit wine. The influence of different raw material ratio is shown in table 4

Table 4 Effects of the Ratio of Raw Materials on Ultrafine Powder of Pitaya Fruit and Carrot Fruit Wine

Ratio of raw materials	a.	b	c	d	e
Alcohol content (%Vol)	8.1	9.9	12.8	11.1	10.5
The sensory score	75	77	84	78	75

According to table 4, the ratio of two raw materials (dragon fruit: carrot =g:g) was a (1:5), b (2:5), c (3:5), d (4:5) and e (1:1).Due to the difference in reducing sugar content and wine yield between different raw materials, the higher the proportion of pitdragon fruit, the higher the alcohol content. When the ratio of c (3:5) was adopted, the alcohol content was 13% vol and the sensory score was 81. Therefore, three proportion methods, c, d and e, were selected for subsequent experiments.

3.3 Impact of Crushing Particle Size

The impact of crushing size is shown in table 5.

Table 5 Effect of Crushing Particle Size on Ultrafine Powder of Pitaya Fruit and Carrot Fruit Wine

Crushing size (mesh)	80	110	140	170	200
Alcoholcontent (%Vol)	7.8	9.9	12.3	13.2	13.4
The sensory score	70	81	82	85	84

As can be seen from table 5, with the increase of crushing particle size, the sensory score of dragon fruit carrot ultrafine powder fruit wine showed a trend of rising first and then falling, while the alcohol content showed an upward trend all the time.The size of crushing particle will affect the flavor and color of fruit wine. If the ultrafine powder particles are too large, the leaching of nutrients in the raw materials will be affected and the taste of the wine will be reduced. If crushed too fine, will cause the body is too spicy, wine weakened. When the pulverization size was 170 mesh, the alcohol content and sensory score reached the highest, 13 %vol and 86 points, respectively. Therefore, three conditions of grinding particle size of 140 mesh, 170 mesh and 200 mesh were selected for subsequent tests.

3.4 Response Surface Optimization Analysis

The results of response surface variance analysis are shown in table 6.

According to the results of variance analysis and regression equation, P=0.003 < 0.01 of the model (highly significant), and P=0.7880 > of the missing item test (insignificant), indicating that the test method is feasible. The determination coefficient of the model R=0.9639, and the adjusted determination coefficient RAdj=0.9176, indicating that the fitting degree of the regression equation is good.[22] As can be seen from table 3, the influences of factors A, AB, AC, BC, B and C are significant or extremely significant, while the influences of factors B, C and A are not. [222]

Table 6 Response Surface Variance Analysis Results

source	Sum of squares	Degrees of freedom	Themean square	The F value	P values	significant
Theregression model	94.92	9	10.55	20.80	0.0003	* *
A	3.12	1	3.12	6.17	0.0431	*
B	0.13	1	0.13	0.25	0.6345	
C	0.50	1	0.50	0.98	0.3537	
AB	6.25	1	6.25	12.32	0.0098	* *
AC	4.00	1	4.00	7.89	0.0261	*
BC	4.00	1	4.00	7.89	0.0261	*
$a.^2$	2.21	1	2.21	4.36	0.0791	
B^2	31.27	1	31.27	61.65	0.0001	* *
C^2	37.27	1	37.27	73.48	< 0.0001	* *
residual	3.55	7	0.51			
Loss of quasi item	0.75	3	0.25	0.36	0.7880	
Pure error	2.80	4	0.70			
A combined	98.47	16				

Note: “*” means significant influence on the results (0.01 < P < 0.05), and “**” means extremely significant influence on the results (P < 0.01).

3.5 Response Surface Analysis and Optimization of Fermentation Process Conditions

In order to further study the interaction between relevant factors, the response surface analysis of the regression model was carried out using design-expert software, and the corresponding response surface and contour diagram were obtained. The regression simulation equation of sensory score (Y) response surface was obtained by analyzing the data: Y = 87.20-0.63 A + 0.12 c-1.25 AB +1.00 ac-1.00 bc-0.72 a-2.72 b-2.89 C. ^{2}The optimal results were obtained through the equation, and the fermentation temperature was 25.66 ℃, the raw material ratio was 0.64 (g:g), and the grinding size was 166.90 mesh. To facilitate the experiment, the fermentation temperature was modified to 26 ℃, the raw material ratio was 0.6 (3:5) (g:g), and the grinding particle size was 170 mesh. The sensory score of fruit wine was 88 points on average when the experiment was repeated for 3 times.

4. Conclusion

Through single factor test and response surface design and analysis, the optimal brewing process of ultrafine powder fruit wine of dragon fruit and carrot was determined as follows: the fermentation temperature was 26 ℃, the raw material ratio was 3:5, and the crushing particle size was 170 mesh. Under these conditions, the sensory score of dragon fruit and carrot superfine powder wine was 88 points, and the alcohol content was 12.4% vol. The wine was clear and transparent, with strong bouquet and aroma, which could meet the needs of most people.

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