

# Study on Clarification Effect and Stability of Fragrans Mead by Clarification Process

Qing Xia<sup>1,a</sup>, Cheng Chao<sup>1,b</sup>, Jing Chen<sup>1,c</sup>, Xiaying Zhang<sup>1,d</sup>, Kaibo Lv<sup>\*1,e</sup>

<sup>1</sup>School of Environmental and Biological Engineering Wuhan Technology and Business University, Wuhan 430065, China

<sup>a</sup>251706352@qq.com, <sup>b</sup>2434150803@qq.com, <sup>c</sup>1973066317@qq.com, <sup>d</sup>1950033606@qq.com, <sup>e</sup>32969265@qq.com

**Abstract.** In order to study the best clarification conditions of osmanthus honey wine, single factor experiment and orthogonal experiment were used. The experimental results show that: When the type of clarifying agent was chitosan, the concentration of clarifying agent was 0.25%, and the clarifying time was 14 h, the maximum light transmittivity was  $80.8 \pm 0.10\%$ . After cold and hot treatment, standing at room temperature and oxidation stability test results showed that the stability of osmanthus honey wine with chitosan and potassium pyrosulfite was the best, and the wine body could not only maintain the flavor of the original wine, but also maintain the flavor of the original wine. The storage time is longer. After clarification, the sensory evaluation of the product was  $86.9 \pm 0.69$  points, the light transmittance was  $80.8 \pm 0.10\%$ , and the alcohol content was  $6.4 \pm 0.05$  %Vol.

**Key words:** mead; fragrans; orthogonal test; clarification; stability

Fragrans, a kind of plant referring to oleaceae, belongs to evergreen trees and shrubs. The production of fragrans in Xianning ranks first among the five major fragrans producing areas in China[1]. Fragrans flower is abundant in polyphenols[2], flavonoids[3] and other bioactive ingredients[4-5]. Honey is rich in nutrients and bioactive ingredients, with antioxidant, antibacterial, anti-inflammatory and other effects[6]. Mead has a long brewing history, which not only retains the nutrients of natural honey[7], but also can effectively increase amino acids[8], minerals[9-10] and other important active substances after fermentation[11]. However, when active protein and polyphenols are mixed, complex polyphenols are responsible for most of the turbidity in the wine[7]. Therefore, although fragrans mead has important economic and medicinal value, it contains a large amount of protein, ester[12] and other macromolecular substances after fermentation, which will cause the mead to be cloudy, and it is easy to be oxidized during storage, resulting in reduced sensory evaluation and deterioration of nutrients. At present, there are many studies on the brewing process of fragrans wine[13], but few reports on its clarification technology and stability. At present, the main means of clarification are adding clarificant and mechanical filtration. This experiment mainly solves its clarification problem by adding clarificant and conducts stability test. In order to solve the problem of clarification and stability of fragrans mead, the effects of different clarifying agent dosage and clarifying time on the light transmittance of fragrans mead were investigated, and stability tests were conducted to find the best clarifying agent and clarifying treatment method, which provided technical support for the clarification and preservation of fragrans mead.

## 1. Materials and Methods

### 1.1 Materials and Instruments

Locust flower honey from Dalian Sangdi Bee Co., LTD.; Fragrans from Xianning August Flower Food Co., LTD.; Pure drinking water from Jin Mai Lang Co., LTD.; White sugar from Taikoo Sugar Co., LTD.; Angel wine and fruit wine specialized yeast RW from Angel Yeast Co., LTD.; Bentonite, gelatin, chitosan, diatomite, egg white powder and potassium metabisulfite were brought from Fukang Biological Co., LTD., all of which are standard products; Aluminum nitrate, glucose China Pharmaceutical Group Co., LTD., are standard products; Sodium nitrite, aluminum nitrate, sodium hydroxide, ethanol, sulfuric acid, phenol, disodium hydrogen phosphate, sodium

dihydrogen phosphate were brought from China Pharmaceutical Group Co., LTD., all of which are analytically pure.

Constant temperature water bath HH-S2 from Changzhou Jintan Dadi Automatic Instrument Factory; Thermostatic incubator SPX-100B-D type from Shanghai Boxun Industrial Co., Ltd. Medical Equipment Factory; Clean bench SW-CJ-2D type from Suzhou Purification Equipment Co., Ltd; Portable turbidimeter WZB-175 type from Shanghai Yidian Scientific Instrument Co., Ltd; Handheld Sugarimeter T-32ATC type from Chizhou Jiuhua Optical Instrument Co., Ltd; Visible spectrophotometer 722E type from Shanghai Spectrometer Co., Ltd.

## 1.2 Test Method and Procedures

### 1.2.1 The effect of clarificant and its dosage on transmittance

Gelatin concentration: Add gelatin and clarify for 12 hours. Observe the transmittance of the wine at gelatin concentrations of 0.05%, 0.15%, 0.25%, 0.35%, 0.45%, and 0.55%.

Egg white powder concentration: Add egg white powder and clarify for 12 hours. Observe the transmittance of the wine at egg white powder concentrations of 0.05%, 0.15%, 0.25%, 0.35%, 0.45%, and 0.55%.

Chitosan concentration: Chitosan was added and clarified for 12 hours. The transmittance of the wine was investigated at chitosan concentrations of 0.05%, 0.15%, 0.25%, 0.35%, 0.45%, and 0.55%.

Diatomite concentration: Add diatomaceous earth and clarify for 12 hours. Observe the transmittance of the wine at diatomaceous earth concentrations of 0.05%, 0.15%, 0.25%, 0.35%, 0.45%, and 0.55%.

Bentonite concentration: Add soap soil and clarify for 12 hours. Observe the transmittance of the wine at soap soil concentrations of 0.05%, 0.15%, 0.25%, 0.35%, 0.45%, and 0.55%.

### 1.2.2 Clarification single factor experiment

Clarification time: 0.25% gelatin, egg white powder, chitosan, diatomite, and bentonite were added separately, and the transparency of the wine was investigated at clarification times of 3, 6, 9, 11, 12, 14, 16, 17, and 18 hours.

### 1.2.3 Clarification orthogonal experiments

Conduct clarification orthogonal experiments according to Table 1.

Table 1 Clarify the orthogonal test table

Level	Element		
	A Clarificant type	B Clarificant concentration (%)	C Clarificant time (h)
1	chitosan	0.15	12
2	diatomite	0.25	13
3	bentonite	0.35	14

### 1.2.4 Determination of light transmittance

Add an appropriate amount of clarificant to the original wine and let it stand for an appropriate time. Determine the transmittance T [13] using a 1cm colorimetric dish at 610 nm

### 1.2.5 Sensory evaluation

Each time, there are 10 evaluators, half male and half female, who refer to reference[14] and make slight modifications to formulate the scoring standard Table 2. The evaluation results are calculated by using a percentage system.

Table 2 Sensory score criteria

Project	Standard	Sensory score(points)
Color	Clear and transparent, without any pigmentation	20~25

(25points)	Moderate clarity and transparency, with a sense of pigmentation	10~20
	Poor clarity and heavy pigmentation	0~10
Smell (15 points)	Rich and mellow aroma, with a strong floral aroma	10~15
	The aroma and mellow aroma are not heavy, but there is a slight odor	5~10
	No fragrance, with irritating odor	0~5
Taste (40points)	Full of alcohol flavor, with a sweet aroma of honey and fragrans	25~40
	The taste of the wine is slightly light and accompanied by a sour taste	10~25
	Bitter on the palate with a strong sour taste	0~10
	Good transparency and uniform wine quality	15~20
Stability (20points)	The wine is turbid and lacks transparency	10~15
	The wine has flocculent sediment and high turbidity	0~10

---

### 1.2.6 Product stability experiment

Heat treatment experiment: Place the fragrans mead in an 80 °C water bath for 20 minutes, then cool it down and measure its turbidity value[14];

Room temperature storage experiment: Put the fragrans mead in a room temperature environment for 7 days and measure its turbidity value[14];

Cold treatment experiment: Place the fragrans mead at 4 °C for 7 days and measure its turbidity value[14];

Oxidation stability experiment: Open the lid of fragrans mead and expose it to air. After 3 days, measure its turbidity value[14].

### 1.2.7 Product quality analysis indicators

Determination of flavone content: This experiment is conducted in accordance with GB/T 12143-2008 General Analysis Methods for Beverages[15].

Determination of soluble solid content: This experiment is conducted in accordance with GB/T 12143-2008 General Analysis Methods for Beverages[15].

Determination of total acid content: This experiment is conducted in accordance with the GB 12456-2021 National Food Safety Standard for the Determination of Total Acid in Food[16].

Determination of polyphenol content: This experiment is conducted in accordance with GB/T 31740.2-2015 Tea Products Part 2: Tea Polyphenols[17].

Determination of alcohol content: This experiment is conducted in accordance with GB 5009.225-2016 National Food Safety Standard for the Determination of Ethanol Concentration in Liquor[18].

## 1.3 Data Processing

The experimental results are repeated three times and the average and standard deviation are taken. SPSS 27 is used for statistical analysis of the data, and Origin 2022 is used for plotting.

## 2. Result and Analysis

### 2.1 The effect of clarificant and its dosage on transmittance

#### 2.1.1 The effect of gelatin concentration on the transmittance of liquor

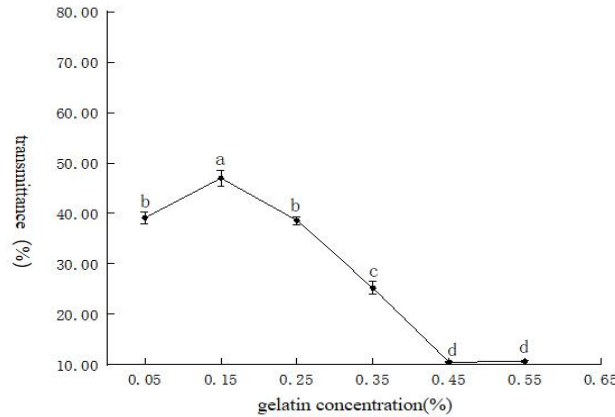


Figure 2 The effect of gelatin concentration on the transmittance of liquor

As can be seen from Figure 2, when the gelatin concentration is 0.15%, the light transmittance reaches the highest level of 47.00%, and then decreases rapidly. With positive charge, gelatin can electrically neutralize and coagulate with negatively charged substances such as tannin pentosan in fragrans mead, thus clarifying the wine[19] and increasing the light transmittance. However, when the concentration is too high, there is the problem of excessive gelatin, and the stability of the wine becomes poor, resulting in the decrease of transmittance.

#### 2.1.2 The effect of egg white powder concentration on the transmittance of liquor

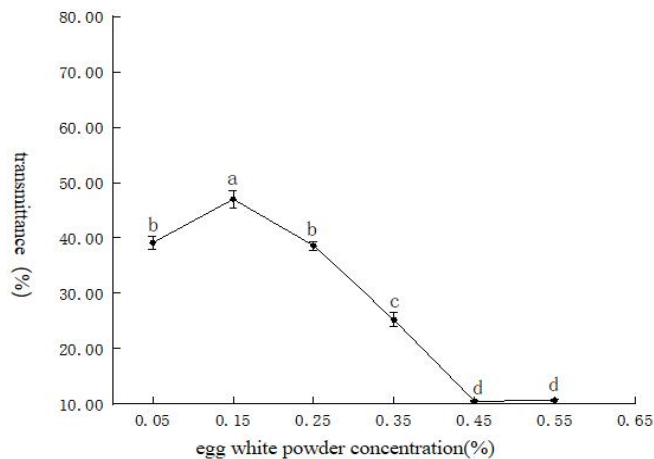


Figure. 3 The effect of egg white powder concentration on the transmittance of liquor

According to Figure 3, as the concentration of egg white powder increases, the transmittance first increases and then decreases. When the concentration of egg white powder is 0.15%, the highest transmittance is 50.26%. The combination of egg white powder and tannins in fragrans mead forms a colloid, which can adsorb suspended solids and precipitate[20], resulting in an increase in transmittance; But as the concentration of egg white powder increases, the surface hydrophobicity and particle turbidity of egg white protein will gradually increase[21], resulting in a decrease in the transmittance of the wine body.

### 2.1.3 The effect of chitosan concentration on the transmittance of liquor

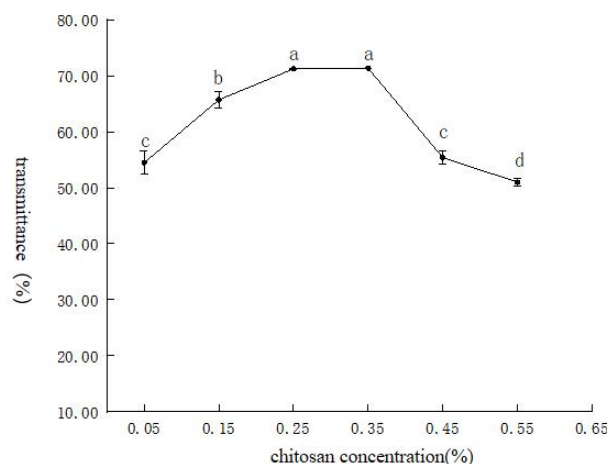


Figure 4 The effect of chitosan concentration on the transmittance of liquor

As shown in Figure 4, with the increase of chitosan concentration, the transmittance first increases and then decreases. When the chitosan concentration is 0.35%, the highest transmittance is 77.33%. According to reference[22], chitosan has a significant clarifying effect on fruit wine and is a cationic flocculant with strong adsorption, resulting in a higher transparency of the wine body; But as the addition amount continues to increase, excessive chitosan will wrap around the particles and affect the bridging effect[23], leading to a decrease in transmittance.

### 2.1.4 The effect of diatomite concentration on the transmittance of liquor

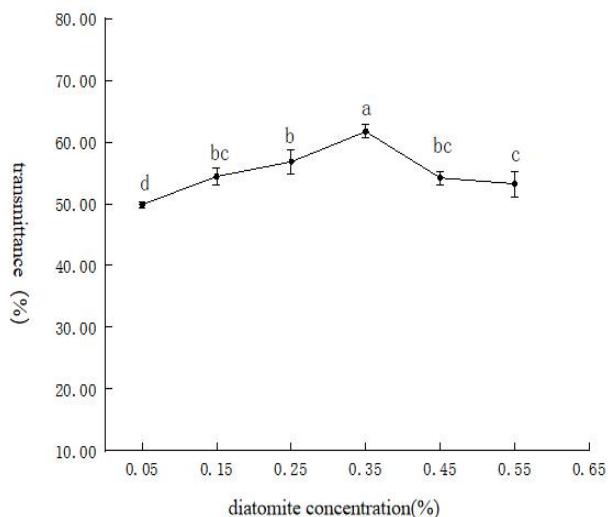


Figure 5 The effect of diatomite concentration on the transmittance of liquor

According to Figure 5, as the concentration of diatomite increases, the transmittance first increases and then decreases. When the concentration of diatomite is 0.35%, the highest transmittance is 61.70%. Diatomite is an amorphous silica material formed from the remains of diatoms[24], which can adsorb proteins and yeast cells to clarify wine and increase transmittance; However, when the dosage of diatomite is 0.35%, it has already achieved the sedimentation effect on the majority of suspended solids in the wine body. When the dosage is further increased, it actually increases the total amount of suspended solids in the fruit wine system[25], leading to a decrease in transmittance.

### 2.1.5 The effect of bentonite concentration on the transmittance of liquor

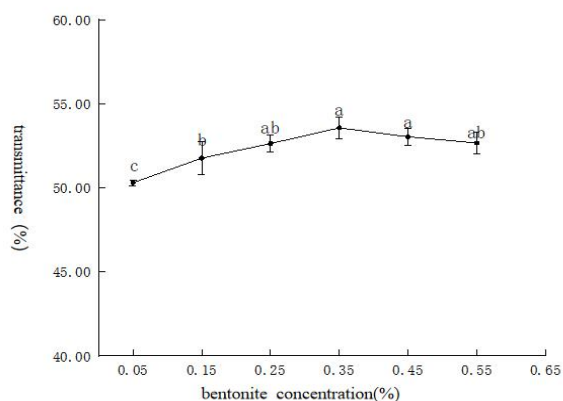


Figure 6 The effect of bentonite concentration on the transmittance of liquor

According to Figure 6, as the concentration of bentonite increases, the transmittance gradually increases. When the concentration of bentonite is 0.35%, the highest transmittance is 53.56%. When the concentration of bentonite is greater than 0.35%, the transmittance slightly decreases. After absorbing water and expanding, bentonite forms a suspension of negatively charged colloidal particles, which can form flocculent precipitates with positively charged proteins and other turbid substances[26], reducing the turbidity of the wine and increasing the transparency of the wine; As the concentration of bentonite increases, the flocculation effect of bentonite on liquor has reached its maximum, and it has little effect on the change of liquor transmittance.

### 2.2 The effect of clarification time on the transmittance of liquor

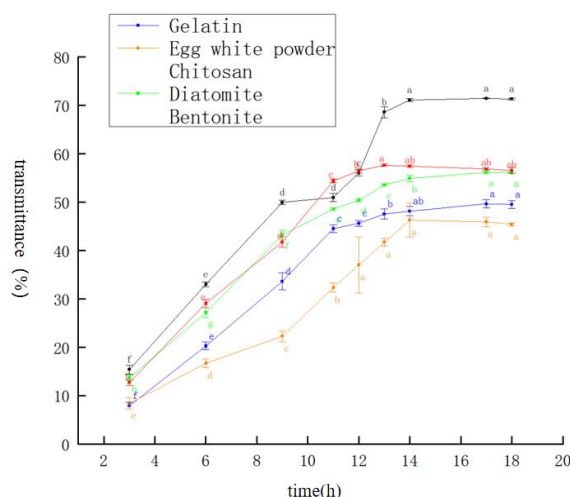


Figure 7 The effect of clarification time on the transmittance of liquor

As shown in Figure 7, the transmittance rapidly increases with time and then slows down. The highest clarification rate of chitosan is 71.4% at 17 hours. Compared with the other groups, the addition of 0.45% chitosan resulted in an overall higher transmittance, which had a significant impact on the transmittance of the liquor ( $p < 0.05$ ). To save time, a clarification time of 12-14 hours is selected for orthogonal experiments.

### 2.3 Clarification orthogonal experiment

Considering the clarification ability of different clarifying agents on fragrans mead, chitosan, diatomite, and bentonite have better effects than gelatin and egg white powder. The optimal

concentration of these three clarificants can be optimized between 0.15% and 0.35%. Therefore, three factors, namely the type of clarificants, the concentration of clarificants, and the clarification time, are selected for orthogonal experiments. The results are shown in Tables 3 and 4.

Table 3 Clarification orthogonal experiment

Number	A Clarificant type	B Clarificant concentration(%)	C Clarification time(h)	transmittance(%)
1	1	3	3	75.50
2	3	2	1	59.70
3	3	1	3	60.30
4	2	3	1	57.80
5	3	3	2	60.40
6	2	2	3	65.70
7	1	2	2	73.40
8	2	1	2	53.10
9	1	1	1	63.10
k1	70.67	58.83	60.20	
k2	58.87	66.27	62.30	
k3	60.13	64.57	67.17	
R	11.80	7.44	6.97	

Table 4 Orthogonal Variance Analysis

Element	III Class sum of squares	Free degree	Mean square	F	P	Significance
A Clarificant type	251.796	2	125.898	138.688	0.007	**
B Clarificant concentration	91.016	2	45.508	50.131	0.020	*
C Clarification time	76.629	2	38.314	42.207	0.023	*
Error	1.816	2	0.908			

Note: - indicates not significant, \* indicates significant, \* \* indicates extremely significant (P>0.05 indicates not significant, P<0.05 indicates significant, P<0.01 indicates extremely significant)

According to Tables 3 and 4, the type of clarificants has the greatest impact on sensory evaluation; The primary and secondary influencing factors are A>B>C, that is, the order of factors is clarificants type>clarificants concentration>clarification time. The type of clarificants has a significant impact, while clarificants concentration and clarification time have a significant impact. The optimal fermentation combination is A1B2C3, with chitosan as the clarificants, a clarificants concentration of 0.25%, and a clarification time of 14 hours. Under this clarification condition, the clarified fragrans mead has a transparent color and consistent sensory evaluation with before clarification. According to the results of the orthogonal experiment, the validation experiment is repeated three times under the optimal condition of K value, and the transmittance is obtained to be  $80.80 \pm 0.10\%$ , which is consistent with the results of the orthogonal experiment.

## 2.4 Product Stability Experiment

Table 5 Product stability experiment results

Experiment No.	Original wine	Chitosan+ Potassium metabisulfite	Bentonite+ Potassium metabisulfite	Diatomite+ Potassium metabisulfite
Heat treatment/FTU	$121.30 \pm 0.10$	$7.33 \pm 0.05$	$108.66 \pm 0.15$	$106.26 \pm 0.15$
Room	$124.20 \pm 0.10$	$8.50 \pm 0.10$	$10.03 \pm 0.21$	$10.30 \pm 0.10$

temperature/FTU				
Cold treatment/FTU	11.96±0.11	7.66±0.15	9.73±0.05	9.50±0.10
Oxidative stability/FTU	122.56±0.15	7.20±0.1	10.60±0.10	10.00±0.17

Note: The experimental results are obtained through three parallel groups

From Table 5, it can be seen that among the finished wine samples after heat treatment, the wine with chitosan and potassium metabisulfite is the most stable, with a turbidity of 7.3 FTU and almost no precipitation, while others will produce precipitation; Heating treatment can accelerate the movement and performance changes of various macromolecules in wine, thereby forming larger aggregates and settling down more quickly. Chitosan has greater adsorption capacity for macromolecules in wine and stronger stability. In the finished wine sample placed at room temperature, the wine body with the addition of clarificants and potassium metabisulfite is basically stable, and its turbidity is less than 20 FTU, with almost no precipitation. The turbidity of the wine without potassium metabisulfite is 124.3 FTU, causing precipitation, but the impact on the quality of the wine body is relatively small; Potassium metabisulfite has a bactericidal effect on the liquor, leaving its senses unchanged. The finished wine sample after cold treatment has good stability, with a turbidity of 12.1 FTU and no crystal precipitation; The low-temperature environment makes the wine relatively stable and effectively inhibits bacterial growth, keeping the wine in a stable state. The oxidation stability of three kinds of wine samples added with clarificant and potassium pyrosulfite is good, and their turbidity is less than 20 FTU. The stability of blank wine samples is poor, and their turbidity is 122.6 FTU. The addition of clarificants has color protection and flocculation effects on the liquor, so the stability of the three types of liquor samples with the addition of clarificants and potassium metabisulfite is better than that without clarificants. Among them, the fragrans mead with chitosan and potassium metabisulfite added has the best stability.

## 2.5 Product Quality Analysis

Table 6 Product Quality Analysis

Analysis indicators	Product samples				Average value±SD
	Original wine	1	2	3	
Sensory evaluation (score)	84.73±0.32	86.50	87.70	86.50	86.90±0.69
Transmittance(%)	19.70±0.10	80.80	80.70	80.90	80.80±0.10
Flavone content(mg/mL)	1.61±0.02	1.47	1.49	1.46	1.47±0.02
Soluble solid content(°Bx)	10.26±0.11	10.20	10.20	10.30	10.23±0.05
Total acid content(%)	1.20±0.10	0.91	1.00	1.11	1.00±0.10
Polyphenol content(mg/mL)	0.04±0.00	0.03	0.03	0.04	0.03±0.00
Alcohol content(%Vol.)	5.36±0.05	5.20	5.20	5.40	5.27±0.12

According to Table 6, the sensory evaluation of the product after clarification and addition of preservatives is 86.90 ± 0.69 points, with a transmittance of 80.80 ± 0.10%, a flavone content of 1.47 ± 0.02 mg/mL, a soluble solid content of 10.23 ± 0.05 ° Bx, a total acid content of 1.00 ± 0.10%, a polyphenol content of 0.03 ± 0.00 mg/mL, and an alcohol content of 5.27 ± 0.12% vol. At this time, the wine is clear and transparent, with a golden color and a fusion of fragrans, honey, and wine aromas. The wine has a uniform quality and can be stored for a long time.



### 3. Conclusion

This paper uses single factor experiments and orthogonal experiments to study the optimal clarification conditions of fragrans mead. The results show that the type of clarificant is chitosan, the concentration of clarificant is 0.25%, and the maximum transmittance obtained at a clarification time of 14 hours is  $80.8 \pm 0.10\%$ . The type of clarificant has the greatest impact on sensory evaluation, and the type of clarificant has a significant impact. The concentration and clarification time of clarificant had a significant impact. Under this clarification condition, the clarified fragrans mead has a transparent color and consistent sensory evaluation with clarification before. The experimental results of cold and hot treatment, room temperature standing, and oxidation stability show that the fragrans mead made of chitosan and potassium metabisulfite has the best stability. The wine not only retains the flavor of the original liquor, but also has a longer storage time. After clarification, the sensory evaluation of the product is  $86.9 \pm 0.69$  points, with a transmittance of  $80.8 \pm 0.10\%$  and an alcohol content of  $5.27 \pm 0.12\%$  vol. The wine is clear and transparent, with a golden color and a fusion of fragrans, honey, and wine aromas. The wine has a uniform quality and can be stored for a long time.

### Fund Project:

Scientific Research Project of Wuhan Technology and Business University(A2021005); National Innovation and Entrepreneurship Training Program for college students (202213242009).

### References

- [1] Shu Taokui, Wu Yong. Investigation and Analysis of Diseases and Pests of fragrans in Xianning and Comprehensive Control [J]. Modern Horticulture, 2022, 45 (17): 87-88. DOI: 10.14051/j.cnki.xddy.2022.17.060
- [2] Wang Baojun,Luan Fei,Bao Yiwen, et al. Traditional uses, phytochemical constituents and pharmacological properties of Osmanthus fragrans: A review[J]. Journal of Ethnopharmacology,2022,293.
- [3] Wu Lipeng,Liu Junyi,Huang Weisu,et al . Exploration of fragrans fragrans Lour.'s composition, nutraceutical functions and applications[J]. Food Chemistry,2022,377.
- [4] Liu Yan,Huang Weisu,Zhu Yuhang,et al. Acteoside, the Main Bioactive Compound in fragrans fragrans Flowers, Palliates Experimental Colitis in Mice by Regulating the Gut Microbiota.[J]. Journal of agricultural and food chemistry,2022.
- [5] Le Duc Dat, Lee Ye Eun, Lee Mina. Triterpenoids from the leaves of fragrans fragrans var. aurantiacus with their anti-melanogenesis and anti-tyrosinase activities.[J]. Natural product research,2022,36(24).
- [6] CIANCIOSI D, FORBES-HERNANDEZ T Y, AFRIN S, et al. Phenolic compounds in honey and their associated health benefits: A review[J]. Molecules, 2018, 23(9): 2322.
- [7] Dong Caiwen, Wang Minglei, Bai Shaoyi, et al. Optimization of fermentation process conditions for honey wine [J]. Grain, Oil and Food Science and Technology, 2021, 29 (05): 191-196. DOI: 10.16210/j.cnki-1007-7561.2021, 05.026
- [8] Vojtěch Kružík. Characteristic parameters of honey wines and dessert meads[J]. Czech Journal of Food Sciences,2022,40(1).42-50.
- [9] Fentie Eskindir Getachew,Jeong Minsoo,Emire Shimelis Admassu,et al. Fermentation dynamics of spontaneously fermented Ethiopian honey wine, Tej[J]. LWT,2022,155.
- [10] Fentie Eskindir Getachew,Jeong Minsoo,Emire Shimelis Admassu,et al. Development of mixed starter culture for the fermentation of Ethiopian honey wine, Tej[J]. Scientific Reports,2022,12(1), 13431 .
- [11] Fu Guocheng. Research on Turbidity Components and Clarification Techniques in Honey Wine [J]. Brewing, 2013,40 (04): 8-11

- [12] Chen Tao, Li Jiayou, Lu Zhufeng, et al. Study on the Influence of Fragrans on the Brewing Process and Aroma Components of Rapeseed Nectar Wine [J]. *Brewing Technology*, 2020 (07): 22-26. DOI: 10.13746/j.njkj.2020094
- [13] Liao Yunli, Xia Jinmei, Liu Rongli, et al. Rapid Pretreatment Process for Marine Bacterial Fermentation Broth [J]. *Food and Fermentation Industry*, 2014,40 (07): 56-61. DOI: 10.13995/j.cnki.11-1802/ts.2014.07.014
- [14] Huang Xiaolan, He Xufeng, Zhou Xiangde, et al. The Effect of Clarification Process on the Clarification Effect and Quality of Fermented Ginseng Wine [J]. *Food and Machinery*, 2022, 38 (09): 191-197. DOI: 10.13652/j.spjx.1003.5788.2022.90184
- [15] GB/T 12143-2008, General Analytical Methods for Beverages [S]
- [16] GB 12456-2021, National Food Safety Standard for the Determination of Total Acid in Food [S]
- [17] GB/T 31740.2-2015, Tea Products Part 2: Tea Polyphenols [S]
- [18] GB 5009.225-2016, National Food Safety Standard for the Determination of Ethanol Concentration in Liquor [S]
- [19] Luo Anwei, Liu Xinghua, Shi Hui, et al. Research on Clarification Technology of Navel Orange Dry Wine [J]. *Journal of Northwest A&F University (Natural Science Edition)*, 2007 (10): 178-182. DOI: 10.13207/j.cnki.jnwafu.2007.10.037
- [20] Qu Qinbing, Wang Jialin A Study on the Clarification process of Apple Cider [J]. *Brewing*, 2011, 38 (01): 75-77.
- [21] Zhang Mengqi Study on the Interaction Between Egg Protein and Soy Protein Isolate and its Gel Properties [D]. Jiangnan University, 2021. DOI: 10.27169/d.cnki.gwqgu.2021.000056
- [22] Yujia Diao,Xueqing Yu,Chaohong Zhang,Yingjun Jing. Optimisation of the clarification of kiwifruit juice with tannic acid-modified chitosan[J]. *Czech Journal of Food Sciences*,2021,39(3).
- [23] Huang Xiaotian, Bart, Wei Piwei, et al. Clarification Effects of Different Clarificants on Hovenia duleis Thunb Fruit Wine [J]. *Food Industry*, 2021, 42 (12): 280-286
- [24] Fathy Nady A.,Mousa Sahar M.,Aboelenin Reham M.,Sherief Marwa A.,Abdelmoaty Alaa S.. Strengthening the surface and adsorption properties of diatomite for removal of Cr(VI) and methylene blue dye[J]. *Arabian Journal of Geosciences*,2022,15(22).
- [25] Ding Yanpeng Research on the Processing Technology and Bitter Taste of Red Jujube Wine [D]. Central South University of Forestry and Technology, 2012
- [26] Li Na, Ren Jie, Wang Liwei, et al. Identification and Stability Improvement of Precipitates from Fermented Wolfberry Wine [J/OL]. *Food Industry Technology*: 1-19 [2023-01-07] DOI: 10.13386/j.issn1002-0306.20220200