A Study on the Characteristic Aroma of the 'Gongniang No. 1' Brandy

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Abstract: The aroma components of brandy were analyzed by gas chromatography-mass spectrometry (GC-MS). In the three years, 8 alcohols were found in common among aroma components. The relative contents of iso-amyl alcohol, lauryl alcohol and nerve-blossom tertiary alcohol were relatively high, giving brandy rose and violet flower fragrance. There are 4 kinds of aldehydes in common. Furfural and benzaldehyde give brandy almond fragrance. Luben-violone and ter-damarienone were detected in all three vintages of brandy, giving it a floral and fruitlike flavor. There are two acids in common. There are 28 esters in common, giving brandy its rich aroma of fruit and wine.

1. Introduction

Aroma composition is the main factor that constitutes the quality of brandy and determines the flavor and typicality of brandy. Brandy aroma complex components, which come from three aspects: first, from the grape itself. With the processing of grape wine and the distillation of original brandy, the aroma components of grape varieties play an important and even decisive role in brandy. Second, from the fermentation process and distillation process. Various esters, alcohols, aldehydes, and organic acids produced by the activity and chemistry of yeast and other microorganisms. Thirdly, the brandy is aged in oak barrels, and the aromatic substances are soaked in oak barrels [1-4]. As a result, brandy has both elegant and delicate aromas of grape fruit and strong aromas of oak, along with alcohols and esters developed during distillation and storage. To analyze the chemical composition of its aroma and study its aroma characteristics, so as to provide scientific basis for research on key technologies of brandy brewing, optimization of production technology, improvement of production management, construction of characteristic aroma group model, sensory evaluation of products, publicity and expression, etc. It is an important content and main purpose of brandy scientific research.

The grape variety'gongniang no.1' bred independently in China, is a hybrid of rose grape and mountain grape. At present, it is cultivated on a large scale in northeast China, Inner Mongolia and shandong. The red wine produced by this grape variety is ruby red, clear and transparent, with a long aftertaste and excellent quality. It has the characteristics of mountain wine and is well received at home and abroad.At the same time, 'gongniang no.1' grape has good agricultural biological characteristics, with strong plant growth potential, high germination rate of eyes and strong knot strength. Its per mu yield can reach 3000kg, and it is extremely cold tolerant, drought tolerant, wet-resistant, resistant to black pox, anthrax, white rot, and salt and alkali resistant [5].However, one of the outstanding problems in the current single-variety dry red wine made with 'gongniang no.1' grape is that the acidity is too high, which affects the taste of the wine. Therefore, it is now mostly used to make rose wine and ice wine.

This study tested the aroma components of brandy produced from the grape of 'gongniang no.1', analyzed the composition of aroma components, and gave the composition of characteristic aroma compounds, in order to provide the basis for the directional winemaking of 'gongniang no.1' grape and provide scientific research and technical support for the development of grape industry.

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2. Materials and methods

2.1 Materials and Reagents

'gongniang no.1' brandy sample: shandong rizhao sun city winery;2-octanol (purity 99.99%) : Sigma inc.

2.2 Instruments and Equipment

GC-2010 / QP 2010 Plus gas chromatography-mass spectrometer: Shimadzu, Japan;Stabilwax - DA capillary column (30 m × 0.32 mm × 0.25 sustaining m) chromatogram: Restek, USA;50/30 livm DVB/CAR/PDMS: Supelco, USA;Hh-s4 digital constant temperature water bath: jiangsu jinyi instrument technology co., LTD.ML204 electronic balance: mettler Toledo instrument (Shanghai) co., LTD.2.2 test methods

2.3 Method

2.3.1 Preparation of 'Gongniang No.1' Brandy

Grape raw materials for the 2015, 2016, 2017 'gongniang no.1' maturity good grapes, grape juice after optimizing commercial yeast fermentation adopt sharan DE pot type distillation distillation process, break off both ends, intercepting bodied wine degrees is about 55-58% vol, in moderate toasty oak barrel storage after 6 months after adjust wine degree about 42% vol continue to store after aging for 3 years.

2.3.2 Determination of Aroma Components

Dilute the brandy to about 10%vol, take 8 mL of the sample and put it into a 15mL sample extraction bottle. Add 2-octanol (internal standard) with 5 livl concentration of 1g/L and magnetic rotor on the solid phase microextraction table for 45 ℃ constant temperature extraction for 45min.The adsorbed and balanced extraction head was inserted into the gas chromatographic injector and analyzed for 30min. At the same time, the instrument was started to collect data.

The heating procedure was as follows: the temperature was kept at 40℃ for 1min, then increased to 120℃ at 8 ℃/min for 3min, then increased to 210 ℃ at 15℃/min for 10 min. The injector temperature is 250 ℃, the interface temperature is 250 ℃, carrier gas (He), no shunt injection. Mass spectrometry conditions: electron bombardment (EI) ion source; Electron energy 70EV; Ion source temperature: 200℃;Full scan mode, quality scan range of 30~500u.

2.4 Data Analysis

Qualitative analysis: the volatile components were identified by computer comparison with standard mass spectrograms provided by NIST08 and WILEY7 mass spectrograms, and the qualitative analysis was carried out in combination with relevant literature reports.

Quantitative analysis: quantitative analysis of each component by semi-quantitative method. The calculation formula is as follows:

$$Xi = (Ai/As) \times Cs$$

Where, Xi is the content of the object to be measured, Cs is the concentration of the internal standard (2-octanol), Ai is the peak area of the object to be measured, and As is the peak area of the internal standard.

3. Results and analysis

Qualitative and quantitative analysis of aroma substances in 'gongniang no.1' brandy.

Table 1 Shows the Results of the Test of 'Gongniang No.1' Brandy.

Table 1 Test Results Of Aroma Components of ‘Gongniang No 1’ Brandy

Aroma components	Relative amount mg/l		
	2015	2016	2017
propyl alcohol	-	1.8344±0.0954	-
isobutanol	0.7351±0.0407	0.8072±0.0959	0.6923±0.0289
butanol	0.1528±0.0057	0.1929±0.0397	-
isoamyl alcohol	3.5954±0.0254	7.3960± 0.4727	3.7488±0.1882
hexyl alcohol	0.1918±0.0092	0.3527±0.1385	0.1477±0.0036
terpineol	-	0.0594±0.0054	-
decanol	0.0971±0.0036	0.1243±0.0152	0.1002±0.0110
linalool	0.0280±0.0044	-	-
phenethyl alcohol	0.3344±0.0498	0.5160±0.1020	0.4860±0.0342
laurinol	0.1522±0.0306	0.2234±0.0209	0.1625±0.0098
nerolidol	0.1008±0.0195	0.1512±0.0365	0.1093±0.0031
cedrol	-	0.1163±0.0103	0.0974±0.0060
tetradecanol	0.4478±0.0976	0.8808±0.0919	0.4785±0.0201
farnesol	0.1700±0.0395	-	0.2055±0.0154
octadecanol	-	0.0731±0.0118	-
hexanal	0.1967±0.0434	0.4083±0.0381	0.2332±0.0163
furfural	1.8213±0.3175	3.6278±0.6650	1.8724±0.1117
5-methylfurfural	0.2766±0.0496	0.5631±0.0411	0.2422±0.0215
decanal	0.0393±0.0048	0.0765±0.0230	-
benzaldehyde	0.0673±0.0319	0.0715±0.0182	0.0598±0.0026
cinnamyl aldehyde	-	0.0053±0.0012	-
phenylacetaldehyde	-	-	0.0804±0.0121
stearaldehyde	-	-	0.1566±0.0972
2,3-pentanedione	0.1575±0.0135	-	-
2-Octanone	0.0081±0.0013	-	-
α-ionone	4.7123±0.2133	5.7694±1.0861	4.8435±0.1340
β-Damascenone	0.2226±0.0278	0.2388±0.0330	0.2202±0.0084
nonadecanone	0.1053±0.0092	-	-
hexanoic acid	0.0182±0.0020	0.0692±0.0506	0.0584±0.0273
decanoic acid	1.8727±0.2602	2.4881±0.2414	2.0046±0.0914
myristic acid	0.0772±0.0262	-	0.0682±0.0036
palmitic acid	0.0608±0.0058	-	-
lauric acid	1.0258±0.0701	1.3960±0.1436	-
ethyl formate	-	0.6865±0.0120	-
ethyl acetate	4.2728±0.1616	5.0478±0.0110	4.6054±0.0223
ethyl 2-methylbutyrate	0.4148±0.0443	0.6003±0.1816	0.3914±0.0490
ethyl isovalerate	0.5120±0.0544	0.8696±0.0427	0.5850±0.0115
iso-amyl acetate	0.9151±0.1188	0.8161±0.2408	0.7330±0.4452
ethyl valerate	-	0.8113±0.0180	0.8718±0.0211
Isoamyl butyrate	0.0027±0.0014	-	-
ethyl caproate	9.0230±0.4492	10.2858±2.0296	10.2526±0.2787
isoamyl caproate	-	-	0.9089±0.0247
isobutyl caproate	0.0084±0.0015	-	0.0674±0.0173
propyl hexanoate	0.0101±0.0012	0.0302±0.0080	-
hexyl acetate	0.1061±0.0062	0.0735±0.0194	0.0886±0.0033
ethyl heptanoate	0.0529±0.0061	0.0635±0.0120	0.0911±0.0065
ethyl lactate	0.0263±0.0037	0.0538±0.0078	0.0321±0.0048
methyl octanoate	0.2086±0.0294	0.2705±0.0620	0.2132±0.0093
ethyl caprylate	87.3411±7.2243	89.5225±0.9570	92.4511±1.9700
3-ethyl nonenenate	0.3008±0.0644	-	0.3095±0.0664
ethyl nonanoate	0.2674±0.0297	0.3416±0.0860	0.3322±0.0315
Isobutyl n-Octanoate	0.1080±0.0261	0.2081±0.0363	0.1171±0.0251
isoamyl caprylate	0.5472±0.0363	0.5315±0.0542	0.4913±0.0083
methyl caprate	0.3431±0.0177	0.4617±0.0994	0.3620±0.0218
ethyl caprate	90.0501±0.3381	89.6156±1.6005	98.7531±2.7137
isoamyl caprate	1.1810±0.0397	1.7824±0.2431	1.1539±0.0835
butyl caprate	0.1230±0.0095	0.1215±0.0081	-

decanoic acid ester	0.0471±0.0027	0.0598±0.0064	-
isobutyl decanoate	0.1090±0.0039	0.1353±0.0118	0.1132±0.0074
diethyl succinate	0.1879±0.0161	0.4377±0.2007	0.4219±0.0400
ethyl myristate	3.6684±0.4720	7.3198±0.3590	3.5812±0.2658
ethyl undecanoate	0.0489±0.0017	0.0671±0.0063	0.0519±0.0121
phenethyl acetate	0.1939±0.0335	0.2666±0.0684	0.2337±0.0280
ethyl laurate	31.0436±1.5563	50.8888±1.9299	33.9755±0.9539
ethyl 2-furoate	0.0825±0.0283	0.1248±0.0182	0.0702±0.0043
linoleic acid ethyl ester	0.1248±0.0535	0.1102±0.0355	0.1313±0.0048
ethyl-9-decenoate	0.0563±0.0027	-	0.0437±0.0078
isoamyl laurate	0.0951±0.0322	0.1604±0.0618	0.1329±0.0418
hexyl dodecanoate	0.0832±0.0158	0.1276±0.0647	-
lauryl acetate	0.0276±0.0053	-	-
methyl palmitate	-	-	0.2760±0.0049
ethyl palmitate	0.5948±0.1206	1.0895±0.0267	0.6208±0.0593
isopropyl palmitate	0.0519±0.0041	0.0798±0.0160	0.1554±0.0179
ethyl 9-hexadecenoate	0.4230±0.0747	0.6688±0.0130	0.4231±0.0695
9-ethyl pentaenoate	0.0593±0.0115	0.0776±0.0054	-
butyl laurate	0.0655±0.0084	-	-
whiskey lactone	0.1381±0.0082	0.1629±0.0050	0.3456±0.1090
guaiacol	-	-	0.0708±0.0019
citronellyl acetate	0.0588±0.0079	-	-
linalyl isovalerate	0.2013±0.0104	-	-

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4. Discussion and conclusion

High alcohols in brandy are derived from the fermentation of raw wine, which plays an important role in the formation of typical brandy flavor. LEE J W et al. [8] showed that isobutanol has the aroma of fusel oil, while isoamyl alcohol has the aroma of cocoa and almond. Esters are formed by esterification of alcohols during fermentation, distillation and aging. Studies by DIEGUEZ S C, BENKWITZ F et al. [9-10] showed that ethyl acetate, ethyl caproate and ethyl decanoate are the backbone aroma of esters and have a fruity flavor. Terpenes and C13 isoprene play a major role in the aromatic properties of brandy. Studies by VARARU F et al. [11] have shown that aldehydes mainly include benzaldehyde and furfural. Benzaldehyde has an almond flavor, which is especially important for the quality of brandy, and furfural has a smell of caramel, wood and toast. Tany-damazenone has a sweet fruity odor and a low threshold. In this study, aroma components of brandy made from different years of 'gongniang no.1' grapes were analyzed. Alcohols, C13 isoprene and esters accounted for an important proportion in aroma components, which was consistent with most research results.

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