Changes of aroma components of pineapple wine during fermentation with ADT strain

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Abstract. In order to analyze the changes of volatile organic compounds produced by pineapple juice under the action of ADT yeast, the fermented wine was analyzed by headspace solid-phase microextraction gas chromatography-mass spectrometry. The results showed that a total of 37 volatile compounds were detected by GC-MS in the wine fermented, including 24 kinds of esters, 8 kinds of alcohols and 5 kinds of acids, among which decanoic acid, ethyl ester, hexadecanoic acid, ethyl ester, acetic acid, 2-phenylethyl ester, 3-methylbutyl ester, phenylethyl alcohol and octanoic acid, which are the main flavors of pineapple wine, are always present. Octanoic acid, ethyl ester, 1-Butanol, acetic acid, 2-phenylethyl ester, hexanoic acid, ethyl ester, acetic acid, 2-methylpropyl ester and decanoic acid and ethyl ester have a significant increase in the fermentation process. Among them, 1-Butanol, 3-(Methylthio) propyl acetate has a pleasant banana odor, 8 kinds of alcohols were detected, and phenylethyl alcohol was the main alcohol in the fermentation process, has a pleasant jasmine and rose aroma. A total of six acids were detected, octanoic acid and hexanoic acid content are higher in the fermentation.

1. Introduction  
Pineapple (Ananas comosus [L.]), a famous tropical fruit, is rich in sugar, protein, and vitamins. The pineapple also has the medicinal value of relieving heat and improve dyspepsia and urine unfavorablenes[1]. China's pineapple cultivation and production are mainly concentrated in Guangdong, Taiwan, Hainan, Guangxi, Fujian, Yunnan and other regions, of which Taiwan, among them, Guangdong and Hainan are the largest bases for pineapple cultivation, processing and exporting in China[2,3]. Pineapple has moderate sugar and acidity, rich aroma, high nutritional value, contains a variety of organic acids, amino acids, vitamins and other nutrients, including VC content up to 42 mg/100 g[4].

In the wine brewing, the quality of pineapple wine, alcohol, aroma and fermentation speed were directly affected by the strains[5]. Fruit wine has a unique flavor and contains high levels of nutrients, which do not only make full use of fruit resources but also promote economic benefits and occupy a larger market[6]. The species of strain have an important influence on the flavor and quality of the wine and play an important role in the formation of beneficial substances in wine[7].

2. materials and methods Section

2.1 Sample Pre-treatment
Caffeine Pineapple: purchased from Wal-Mart in Zhanjiang City, Guangdong Province; ADT active brewed dry yeast: purchased from Shanghai Dingtang International Trade Company; mass spectrometry combined analyzer: Shimadzu Corporation; PAL System triple injector: Switzerland (50/30 μm, DVB/CAR/PDMS): Supelco USA; Capillary vf-Wax (30 μm × 0.25 μm, 0.25 μm).

2.2 Sample preparation method
After the main fermentation, take 0.5 mL wine sample, add 15 mL headspace bottle, seal with lid.

2.3 Qualitative and semi-quantitative analysis
Qualitative Analysis: Mass spectral results were searched by the Wiley.lib database and the 14.lib library of the National Institute of Standards and Technology (NIST), with similarity index (SI)> 90 (maximum match value 100) of the identification results to be reported.
Semi-quantitative analysis: the peak area normalization method to calculate the relative content of volatile components in pineapple win.

3. results and analysis
After a database search and comparison, the aroma changes of the main volatile components and some volatile components in the pineapple wine were identified as follows: Table 1 shows that in the pineapple wine brewing process, a total of 37 kinds of aroma components, of which 24 kinds of esters, 8 kinds of alcohols, 5 kinds of acids. A total of 21 kinds of aroma substances were identified in the fruit juices. The main components of the aroma were ethyl 3- (methylsulfanyl) propanoate, propanoic acid, 3- (methylthio) -, methyl ester, hexanoic acid, -ethyl-, cis-5,8,11,14,17-Eicosapentaenoic acid. The proportion of various volatile components in fruit juice during the fermentation process varied greatly. Among them, decanoic acid, ethyl ester, hexadecanoic acid, ethyl ester, acetic acid, 2-phenylethyl estate, 3-methylbutyl ester, phenylethyl alcohol, octanoic acid are the main flavors of pineapple wine during the fermentation.

Among esters, octanoic acid, ethyl ester, 1-Butanol, 3-methyl-, acetate, acetic acid, 2-phenylethyl ester, hexanoic acid, -methylpropyl ester, decanoic acid, ethyl ester in the fermentation process increased significantly, forming the characteristic aroma of pineapple wine. Alcohol species in the fermentation process both the type and content have increased, phenylethyl alcohol content in the fermentation is always higher, up to 30.77%. Octanoic acid content is relatively high throughout the fermentation process.

Table 1 Changes in volatile components and relative content of yeast ADT fermented liquor

| Serial number | Compound name                                      | Relative content (%) | fruit juice | 1 | 2 | 3 | 4 | 5 | 6 |
|---------------|---------------------------------------------------|----------------------|------------|---|---|---|---|---|---|
|               |                                                   |                      |            |   |   |   |   |   |   |
| 1             | Ethyl 3-(methylsulfanyl)propanoate                | 6.68                 | 2.57       | 0.39 | 0.44 | 0.2 | 0.55 | 0.45 |
| 2             | Propanoic acid, 3-(methylthio)-, methyl ester     | 3.3                  | 0.19       | 0.37 | 0.5  | 0.15 | 0.24 |
| 3             | Tetradecanoic acid, ethyl ester                  | 1.33                 |            | 0.02 |
| 4             | Butanoic acid, 2-methyl-, ethyl ester             | 1.28                 |            |     |
| 5             | Hexanoic acid, 5-(acetyloxy)-, methyl ester       | 1.19                 |            |     |
| 6             | Butanoic acid, 2-methyl-3-oxo-, methyl ester      | 1.12                 | 0.09       |     | 0.05 | 0.05 |
| 7             | Octanoic acid, ethyl ester                       | 0.93                 | 7.17       | 1.85 | 2.49 | 3.97 | 3.38 | 4.62 |
| 8             | Butanoic acid, 2-methyl-, methyl ester            | 0.88                 |            |     |
| 9             | 2(3H)-Furanone, 5-butyldihydro-                  | 0.81                 |            |     |
| 10            | Methyl decanoate                                  | 0.69                 |            |     |
| 11            | Hexanoic acid, methyl ester                      | 0.6                  |            |     |
| 12 | Hexadecanoic acid, ethyl ester | 0.38 | 2.82 | 2.46 | 0.79 | 2.7 | 0.08 | 0.99 |
| 13 | Decanoic acid, methyl ester | 0.32 |
| 14 | Ethyl 3-acetoxyhexanoate | 0.28 | 0.08 |
| 15 | Butanoic acid, ethyl ester | 0.21 | 0.28 | 0.11 | 0.64 | 0.33 | 0.41 | 0.3 |
| 16 | Nonanoic acid, methyl ester | 0.21 |
| 17 | 1-Butanol, 3-methyl-, acetate | 0.12 | 5.95 | 0.44 | 17.78 | 10.14 | 15.64 | 16.74 |
| 18 | Decanoic acid, ethyl ester | 10.87 | 4.33 | 1.49 | 9.48 | 1.39 | 1.08 |
| 19 | Dodecanoic acid, ethyl ester | 10.34 | 37.2 | 0.38 |
| 20 | Acetic acid, 2-phenylethyl ester | 7.1 | 8.23 | 13.53 | 5.35 | 10.33 | 7.13 |
| 21 | Hexanoic acid, ethyl ester | 2.82 | 0.88 | 0.76 | 0.86 | 0.86 | 1.08 |
| 22 | 3-methylbutyl decanoate | 0.52 |
| 23 | Acetic acid, 2-methylpropyl ester | 0.36 | 0.41 | 1.46 | 0.44 | 1.21 | 0.91 |
| 24 | 3-(Methylthio)propyl acetate | 0.33 | 0.55 | 0.56 | 0.2 | 0.17 | 0.14 |
| 25 | Nonanoic acid, ethyl ester | 0.03 | 0.24 | 0.07 | 0.12 | 0.17 | 0.14 |
| 26 | Ethyl 9-hexadecenoate | 7.1 | 1.76 | 0.21 |
| 27 | Ethyl 9-decenoate | 1.57 | 0.15 |
| 28 | Octanoic acid, 3-methylbutyl ester | 0.91 | 0.44 | 0.23 | 0.18 | 0.16 | 0.15 |
| 29 | 1-Butanol, 2-methyl-, acetate | 0.44 | 2.55 | 1.17 | 1.85 | 2.07 |
| 30 | 1-Propanol, 3-(methylthio)- | 0.54 | 0.77 | 0.51 | 0.22 | 0.51 | 0.33 |
| 31 | 6-Heptanoic acid, ethyl ester | 0.29 |
| 32 | Neopentyl 2-oxobutanoate | 0.05 | 0.1 | 0.07 |

**Alcohols**

| 1 | 1-Hexanol, 2-ethyl- | 8.88 |
| 2 | 1-Octadecanol | 0.24 |
| 3 | 1-Heptanol | 0.06 | 0.13 | 0.07 |
| 4 | 1-Propanol, 3-(methylthio)- | 0.54 | 0.77 | 0.51 | 0.22 | 0.51 | 0.33 |
| 5 | Phenylethyl Alcohol | 9.03 | 30.77 | 26.19 | 10.96 | 23.89 | 16.91 |
| 6 | 1,3-Butanediol | 2.47 |
| 7 | 3-Pentanol, 3-methyl- | 0.09 | 0.04 |
| 8 | 2,3-Butanediol | 1.62 | 2.07 | 0.3 |
| 9 | 2-Heptanol | 3.15 | 3.4 |
| 10 | Cyclobutanemethanol | 0.94 |

**Acids**

| 1 | Dodecanoic Acid | 1.03 | 0.4 |
| 2 | cis-5,8,11,14,17-Eicosapentaenoic acid | 1.88 |
| 3 | Octanoic acid | 4.07 | 0.78 | 3.86 | 0.83 | 2.43 | 3.63 |
| 4 | Decanoic acid | 1.22 |
| 5 | Butanoic acid | 0.1 | 0.14 | 0.07 | 0.01 |
| 6 | Hexanoic acid | 1.32 | 1.69 | 0.45 | 1.84 | 1.05 |

4. conclusion

HS-SPME combined with GC-MS was used to analyze the changes of aroma compositions of pineapple wine fermented by yeast ADT, which is a quick and easy method. This paper mainly analyzes the changes of the three volatile components in the fermentation process of esters, alcohols and acids, indicating that the types and contents of the aroma components in the fermentation process
of the juice are constantly changing. The results showed that 24 kinds of esters were detected. Octanoic acid, ethyl ester, acetic acid, 2-phenylethyl ester, 1-Butanol have a pleasant banana smell. Alcohol substances were detected in 8 kinds and phenylethyl alcohol is the main alcohol in the fermentation process, which has a pleasant jasmine and rose incense[8]. A total of six acids were detected, octanoic acid and hexanoic acid content are higher in the fermentation.

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