Analysis of Aromatic Compositions of Pineapple Wines Fermented with Different Yeasts

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Abstract: The pineapple peel slag as raw material with 4 strains of wine-brewing yeast: CY3079, DV10, K1 and QA23, aroma components of pineapple wine with different yeast strains after primary fermentation were analyzed and compared by using solid phase microextraction and gas chromatography-mass spectrum. The results showed that the pineapple wine contained 38, 32, 27, and 27 kinds of aroma components, pineapple wine of QA23 yeast fermentation aroma had more aroma components, the main aroma components of pineapple wine were esters and alcohols, esters content of pineapple wine with QA23, K1, DV10 and CY3079 fermented were 51.71%, 45.01%, 30.27% and 19.86% respectively. The main esters composition included isoamyl acetate, ethyl caproate, octylic acid ethyl ester, ethyl decanoic acid and lauric acid ethyl ester, in addition to the ethanol in wine, 2, 3-butanediol, (2R, 3R)-(-)-2, 3-butyleneglycol phenyl ethanol content is higher, the highest content of benzene ethanol, 11.74%, 11.74%, 12.15% and 11.74% respectively.

Keywords: pineapple peel; fermentation; wine; aroma compounds.

1. Introduction

Pineapple (Ananas comosus (L.) Merril.) known as bromel, is a bromeliaceae and ananas (Ananas Merr.) Perennial herb, is China's tropical, subtropical regions one of the four major fruits. In China mainly distributed in Guangdong, Hainan, Yunnan and other places. According to the National Bureau of Statistics data show that China's total production of pineapple production in 2014 is about 143.27 million t, Its output after Thailand, the Philippines, of which the output of Guangdong Province reached 91.76 million t, accounting for more than 90% of the national pineapple production. At present, China has become one of the world's largest manufacturers of pineapple, a large number of pineapples for fresh, processed into canned, fruit juice, jam, etc, resulting in a large number of pineapple skin and other by-products. Pineapple skin residue rich in nutrients, rich in sugar, protein, vitamins and microbial production for the breeding of nutrients, is a good raw material for wine, which can greatly improve the added value of pineapple skin residue, both to promote the development of pineapple industry, but also reduce the waste of resources to protect the environment[1-6].

The main product of pineapple by-product processing for a long time is feed, but the feed brought low economic value, thus restricting the development of pineapple by-products processing and utilization. With the development of pineapple industry, pineapple by-product processing methods are gradually diversified, such as pineapple peel vinegar 3, pineapple skin residue brandy 4, pineapple skin fermentation lactic acid drinks5. Alcohol consumption in recent years to promote low-alcohol instead of a high degree of wine, fruit wine to replace the food wine, so the development of pineapple dumplings wine conform to the situation.

But the current level of pineapple processing is not high, how to make the pineapple color flavor retained in the wine, so that wine has a special aroma and attractive color has become a key issue. Aroma is an important part of the sensory quality of fruit and wine, and also determines the flavor and typicality of the wine. Yeast species has an important effect on the flavor and quality of the fruit wine, which plays an important role in the formation of fragrant substances in fruit wine [6]. Li et al explored three strains of Saccharomyces cerevisiae for aroma composition relative content of dry red wine, there is a significant difference[7]. Sun et al found wine aroma components no difference, but Species and content of the difference is large, Sun et al adopted six strains...
of yeast fermentation mulberry wine, the results show that the aroma components of wine no difference, but the difference between species and content leading to wine sensory evaluation there are differences [8]. At present, there are many studies on the aroma components of pineapple, but only a few reports on the aroma components of pineapple wine [9-12]. In this experiment, four kinds of Saccharomyces cerevisiae were incubated with CY3079, DV10, K1 and QA23. The headspace-solid phase microextraction (HS-SPME) and gas chromatography-mass spectrometry spectrometry (GC-MS) to analyze the volatile components of pineapple skin residue fermented wine in order to provide scientific basis for the production of pineapple wine.

2. Materials and Methods

2.1. Materials, reagents and instruments

Caine Pineapple: purchased in Guangdong Province Zhanjiang City Wal-Mart supermarket; Brewery active dry yeast: CY3079 (C), DV10 (D), K1 (K), QA23 (Q), purchased in Shanghai Jietu Industry and Trade corporation. GCMS, QP2010 Plus Gas chromatography. Mass Spectrometer Analysis Analyzer: Shimadzu Corporation; PAL System Triple in the injector: Swiss CTC company; Extraction head (50/30 µm . DVB/CAR/PDMS): American Supelco; Capillary column vf-Wax (30 µm×0.25 µm, 0.25 µm) American Varian corporation.

2.2. Method

2.2.1 The process of fermented wine

Pineapple cleaning, boiled (15 min)→Peeled→cut→Sugar and sugar deployment→ Sterilization (boiled)→ Refrigeration → Inoculation and fermentation → Primary fermentation(28 °C) → Filtration → After fermentation(20 °C)→Filtration→Clarify→Canned→Finished product

2.2.2 Sample pretreatment method

After the end of the main fermentation, 0.5 mL of wine was add into 15 mL bottle and sealed.

2.2.3 Gas chromatographic conditions

Gas chromatographic (GC) conditions: Capillary column; program temperature: the initial temperature of 45 °C, keep 2 min. At a rate of 5 °C/min to 180 °C and then at a rate of 20 °C/min to 240 °C for 2 min; Inlet temperature 250 °C; carrier gas high purity helium (He), flow rate 1 mL/min; splitless injection. Mass spectrometry (MS) conditions: Electron ionization (EI) source, electron power 70eV. Ion source temperature 230 °C, four pole temperature 250 °C, full scan mode, scanning range 35~500 m/z, solvent delay 3.5 min.

2.2.4 Qualitative and semi-quantitative analysis

Qualitative analysis: The results of the mass spectrometry were analyzed by the Wiley.lib database and national institute of standards and technology NIST14. Library search, Only match values (similarity index, SI) >90 (The maximum match value is 100) identification results to be reported. Semi-quantitative analysis: The relative content of volatile components in the fruit of the dragon fruit was calculated by the peak area normalization method.

3. Results and discussion

3.1. Analysis of Aroma Components by GC-MS

Figure 1 is Q, K, C, D strains brewed pineapple wine aroma components GC-MS total ion chromatogram, search by comparison, identify the major volatile components and some of the volatile components of the aroma described in Table 1.
As can be seen from Table 1, four kinds of yeast brewed pineapple wine, identified a total of 44 kinds of aroma ingredients, of which 10 kinds of alcohols, 23 kinds of esters, 10 kinds of acids. Among them, 38, 32, 27 and 27 were detected in Q, K, C and D. The four kinds of pineapple wine have the same aroma composition, but the content is different, so that the four kinds of wine have different aroma components, constitute the similarity and typicality of pineapple wine.

Fig. 2 Alcohols, esters and acids in aroma components in pineapple wine.
The fruit of the wine has a pleasant aroma [13]. Four kinds of pineapple wine were detected in 23 kinds of esters, produced by yeast and bacterial activity. They can also be produced by etherification. The vast majority of esters are of the neutral esters (ethyl acetate, ethyl lactate, etc.) is an important aroma in wine [11,12].

<table>
<thead>
<tr>
<th>No.</th>
<th>Compound Name</th>
<th>Formula</th>
<th>Molecular Mass</th>
<th>Relative Abundances/%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alcohols</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1-Butanol, 3-methyl</td>
<td>C₈H₁₆O</td>
<td>122.16</td>
<td>Q: 10.83, K: 7.45, C: 10.37, D: /</td>
</tr>
<tr>
<td>4</td>
<td>1-Butanol, 3-methyl</td>
<td>C₈H₁₆O</td>
<td>116.16</td>
<td>Q: 6.08, K: 0.09, C: 0.08, D: 0.09</td>
</tr>
<tr>
<td>6</td>
<td>Butanoic acid, 2-methyl-1,3-oxy, methyl ester</td>
<td>C₈H₁₆O₂</td>
<td>116.16</td>
<td>Q: 0.04, K: 0.07, C: 0.14, D: /</td>
</tr>
<tr>
<td>11</td>
<td>Butanoic acid, 2-methyl-1,3-oxy, methyl ester</td>
<td>C₈H₁₆O₂</td>
<td>116.16</td>
<td>Q: 0.04, K: 0.07, C: 0.14, D: /</td>
</tr>
<tr>
<td>16</td>
<td>Nonanoic acid, ethyl ester</td>
<td>C₈H₁₆O₂</td>
<td>116.16</td>
<td>Q: 0.04, K: 0.07, C: 0.14, D: /</td>
</tr>
<tr>
<td>17</td>
<td>Decanoic acid, ethyl ester</td>
<td>C₈H₁₆O₂</td>
<td>116.16</td>
<td>Q: 0.04, K: 0.07, C: 0.14, D: /</td>
</tr>
<tr>
<td>18</td>
<td>Dimethyl anthranilate</td>
<td>C₈H₁₆O₂</td>
<td>116.16</td>
<td>Q: 0.04, K: 0.07, C: 0.14, D: /</td>
</tr>
<tr>
<td>20</td>
<td>Octanoic acid, 3-methylbutyly ester</td>
<td>C₈H₁₆O₂</td>
<td>116.16</td>
<td>Q: 0.04, K: 0.07, C: 0.14, D: /</td>
</tr>
<tr>
<td>21</td>
<td>ISOBYTYL CAPRATES</td>
<td>C₈H₁₆O₂</td>
<td>116.16</td>
<td>Q: 0.04, K: 0.07, C: 0.14, D: /</td>
</tr>
<tr>
<td>22</td>
<td>ISO AMYL DECANOATES</td>
<td>C₈H₁₆O₂</td>
<td>116.16</td>
<td>Q: 0.04, K: 0.07, C: 0.14, D: /</td>
</tr>
<tr>
<td>32</td>
<td>Comparison of ester composition</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
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3.2. Comparison of ester composition

Ester is a kind of important aroma in wine. Most of the neutral esters (ethyl acetate, ethyl lactate, etc.) are produced by yeast and bacterial activity. They can also be produced by etherification. The vast majority of esters are of the neutral esters (ethyl acetate, ethyl lactate, etc.) is an important aroma in wine [13]. Four kinds of pineapple wine were detected in 23 kinds of esters,

Table 1. The relative content of aroma volatile compounds in pineapple wine

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a total of seven kinds of ingredients. According to the study shows that pineapple aroma ingredients are the most esters, especially ethyl acetate, methyl acetate and methyl 3-methylthiopropionate, the formation of the characteristics of pineapple aroma [14-15]. The yeast content of yeast was the highest, followed by K and D yeast, and the content of C yeast was the lowest, accounting for 51.71%, 45.01%, 30.27% and 19.86%. The contents of isoamyl acetate, ethyl n-hexanoate, ethyl octanoate, ethyl decanoate and ethyl laurate were higher in different brewed yeast extracts. Decanoic acid ethyl ester has a sweet fruit aroma, octanoate with floral, fruity and brandy scent [16].

3.3. Comparison of alcohol composition
Alcohol is the main aroma of wine, mainly through the metabolism of glucose metabolism and amino acid metabolism [17]. Alcohols in the number of carbon atoms greater than 2 aliphatic alcohols for the higher alcohols, at low concentrations of rose fragrance, is a class of important flavor substances [18]. The contents of Q, K, C and D were 14.8%, 34.11%, 48.54% and 36% respectively, and the contents of C were the highest in alcohol and the wine flavor was prominent. (2R, 3R)-(−)-2,3-butanediol and phenylethanol were higher, and the content of phenylethanol was the highest (11.74%, 12.15%, 14.98% And 18.27%. Phenylethyl alcohol is a yeast that produces erythritol through the phosphoric acid-pentose pathway under aerobic conditions and is further converted to a sweet flower [19].

3.4. Comparison of acid composition
The alcoholic acid substances are mainly derived from raw materials and fermentation processes that produce yeast and lactic acid bacteria. A total often acids were detected in four wine, four of which were common to four kinds of wines. Four yeast fermented wine in the acid content of the acid is relatively bitter, the content was 6.05%, 6.01%, 4.34% and 7.14%, which is higher with the content of ethyl octane would like to ask very high. The content of ethyl-(Z)-4-decanic acid in yeast fermented wine was significantly higher than that of the other three yeast fermented wines. Acid substances have an important contribution to the sensory quality of wine, and when the content is below the threshold, the aroma is balanced, balanced, and above the threshold will have a negative effect on the aroma[20].

4. Conclusion
The aroma components of four kinds of Saccharomyces cerevisiae wine were detected by HS-SPME-GC-MS. There were 44 aroma components of aroma constituents, including 10 kinds of alcohols, 23 kinds of esters, 10 kinds of acids, 1 kind of trepans. Among them, 38, 32, 27 and 27 were detected in Q, K, C and D yeast. Four kinds of pineapple wine in addition to the common alcohol contains alcohol, esters and acids, but also contains a large number of pineapple main aroma components, such as ethyl acetate, methyl acetate and methyl 3-methylthiopropionate. So that the typical nature of pineapple wine; Four kinds of wine aroma components of different content, so that four kinds of wine with different aroma ingredients, constitute the similarity of pineapple wine. The yeast content of yeast was the highest, followed by K and D yeast, and the content of C yeast was the lowest, accounting for 51.71%, 45.01%, 30.27% and 19.86%, of which isoamyl acetate, ethyl hexanoate , Ethyl octanoate, ethyl caprate and ethyl laurate, and the yeast is suitable for the fermentation of pineapple wine.

5. Acknowledgement
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6. References