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Short Communication

Chinese Rice Wine is Aged at A Certain Temperature with Steamed Whole-Grain Glutinous Rice Before Being Concentrated

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Abstract

The production of high-quality Chinese rice wine is largely dependent on the fermentation temperature. However, there are no reports on the kinetics of ethanol, sugar and acid in the Chinese rice wine fermentation mixture treated at different temperatures. The effect of fermentation temperature on the quality of Chinese rice wine has been studied. The composition and concentration of ethanol, sugar, glycerol and organic acids in the mixture of Chinese rice wine samples were determined by HPLC method. Both the highest ethanol concentration and the highest glycerol concentration were obtained in the fermentation medium treated at 23°C. The highest maltose peak (90 g/L) was obtained at 18°C. Both lactic acid and acetic acid peak at 33°C. Experimental outcomes show that temperature contributes significantly to ethanol production, sour flavor content and sugar content in fermentation liquid of Chinese Rice Water.

Keywords: Fermentation; Rice; Temperature

Introduction

Chinese rice wine, a natural and undistilled alcohol, is very popular in China and its market is booming. Annual consumption is about 1.4 million tons. Until now, China's rice winemaking process has been mainly controlled by an experienced technician rather than scientific instruments. This method of technical control outcomes in a different flavor of each batch of Chinese rice wine [1]. Currently, how to prepare all batches of Chinese rice wine with the same taste is still an unsolved problem. Delicious taste becomes more important than ever for Chinese rice wine. Younger drinkers have more options for drinks. Therefore, the wine must be tasty and stable to attract more customers. Therefore, it is very important to study the effect of temperature on the aging process of Chinese rice wine. Similar to sake and other rice wines, Chinese rice wine fermentation can be divided into two stages: The main stage is called primary fermentation and the second stage is called post-fermentation. In the main stage, rice before steaming, yeast Saccharomyces cerevisiae and wheat are mixed together and fermented for 96 hours. In the whole process of making Chinese rice wine, the main stage is the heart of the Chinese rice wine making process and determines the quality of Chinese rice wine [2-4]. The main step of fermentation is typical saccharification and simultaneous fermentation as well as semi-solid and semi-liquid fermentation. Since the concentrations of pre-steamed rice and wheat in the mash are very high, the SSF and SSSLF procedures can reduce the growth inhibition of yeast cells with high sugar concentrations and facilitate beneficial for ethanol production during Chinese rice winemaking. Therefore, the ethanol concentration can be high and even greater than 20% in the final stage of the main fermentation step. The effect of temperature on alcoholic fermentation has been studied extensively in beer, wine and other ethanol fermentations. Research outcomes show that temperature can affect the production of glycerol and ethanol. The effects of temperature, pH and sugar concentration on the growth rate and cell biomass of wine yeasts were studied in grape juice wines. Fermentation temperature can affect microbial populations during grape fermentation and subsequently affect wine ethanol production. Yeast strain and temperature can affect the rate of fermentation of the grapes and the quality of the wine. Temperature can affect the membrane lipid composition of the yeast Saccharomyces cerevisiae and subsequently the ethanol production. Furthermore, an appropriate pH value is also required for yeast growth and ethanol production. Due to the increasingly recognized importance of sugars and acids and their relationship to alcohol quality, it is important to study the effects of fermentation temperature, organic acids and glycerol compounds in Chinese rice wine brewing process [5]. Experiments simulating Chinese rice wine fermentation were carried out at different temperatures with gradually decreasing degrees. Based on previous research, 33°C is the highest designed temperature in plant fermentation, 28°C is the desired temperature for the growth of this yeast cell, and 25°C to 28 °C is the desired temperature to start fermentation, as 5°C is a temperature gradient and 23°C and 18°C were chosen for comparison. Accordingly, these four temperatures were selected. Natural fermentation at room temperature of 16°C and labeled as RT was added as a control. The outcomes of the study have contributed significantly to the understanding of the role of temperature in the kinetics of ethanol, organic acids, glycerol and sugars in Chinese rice wine aging and also provide useful insights. to improve the quality of Chinese rice wine [6,7].

Analysis

The concentrations of sugar, glycerol, ethanol and organic acids were determined by HPLC. At the predetermined time, 1 mL of the alcohol sample was taken for analysis. Durapore membrane filters are used to filter wine samples. The Aminex HPX-87H column is used to determine the concentration of sugar, glycerol, ethanol and organic acids. The Bio-Rad HPLC column heater was used to maintain the column temperature at 55°C. The Bio-Rad 125-0131 Protector Box is used to protect the column. Eluted compounds were detected simultaneously using an Agilent 1200 Series VWD G1314B detector, Santa Clara, CA, USA and a RID detector G1362A. The solvent delivery

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system was operated by an Agilent 1200 Series G1311A Quaternary Pump, Santa Clara, CA, USA. Each 1000 mL mobile phase consists of 1270 μL sulfuric acid and 60 mL acetonitrile [8-10]. Samples were eluted with the mobile phase at a flow rate of 0.5 mL/min. The injection volume for each sample was 20 μL per fixed loop with a run time of 30 min. HPLC system was used. Separate calibration standard curves have been constructed.

Discussion

The concentration of maltotriose at different temperatures is different from that of glycerol and fructose. The maximum concentrations of maltotriose at different temperatures in descending order were 33°C, 18°C, 28°C, TA and 23°C. It is clear that all fructose concentrations at different temperatures have the same form. Fructose concentrations began to accumulate and peaked after 40 h, after which all fructose concentrations at different temperatures showed slight variation. Since saccharification ends after 40 hours, fructose cannot be used by Saccharomyces cerevisiae Su-25 and other microbial cells. Similar profiles for maltose concentration and maltotriose concentration were observed under all tested temperature conditions. The maximum maltose concentration of 54.5 g/L during the final fermentation should be achieved at 33°C at 140 h and 12.4 g/L at 18°C. For other conditions, maltose concentrations were low. The highest total sugar concentration was below 105 g/L at all temperatures during the process. Concentrations below this may inhibit yeast cell growth and fermentation. This experimental outcome is consistent with previous research. The glucose concentration at different temperatures was low and below 4 g/L during fermentation. The outcomes suggest that glucose should not be the main sugar used by Saccharomyces cerevisiae Su-25 and other microbial cells for ethanol and acid production during Chinese rice wine fermentation. The fermentation kinetics of maltotriose and maltose are quite similar. This phenomenon can be explained below. At low and high temperatures, the fermentation rate is low. Since maltose and maltotriose are slowly utilized by microbial cells, higher residual maltose and maltotriose amounts are observed. However, high and low fermentation rates differ between low and high temperatures. The metabolic activity of cells at low temperatures is often low, which can cause a delay in ethanol biosynthesis. In contrast, at higher temperatures, cell senescence was faster, reducing ethanol formation in most fermentation. In addition, in theory, Saccharomyces cerevisiae Su-25 uses maltose rather than glucose to produce ethanol and stimulants. This is different than previously reported in the literature.

Conclusion

Higher temperatures can enhance organic acid production by stimulating the growth of Lactobacillus. The concentrations of acetic acid, tartaric acid and lactic acid at 33°C were statistically significantly higher than at other temperatures. Tukey's test was used to analyze variance to find significant differences between the different treatments at levels. Lactic acid is produced mainly by Lactobacillus. High temperatures can accelerate the growth of Lactobacillus as well as the production and accumulation of lactic acid. Although there is evidence that temperature can affect the production of ethanol, glycerol and organic acids, their optimal levels in Chinese rice wine fermentation and how to precisely control the ratio of them by temperature control remains unclear. Therefore, the development of a kinetic model to describe the effect of temperature on the production of ethanol, glycerol and organic acids during Chinese rice wine fermentation is necessary and is currently underway.

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