Comments

The use of ethyl alcohol as an internal standard makes it possible to greatly simplify the procedure the quantitative determination of volatile compounds and methanol in alcoholic products. Before implementing a new method in a research laboratory, the method must be validated. Validation of the new method may be done based on experimental data obtained in the laboratory during testing of alcoholic products.

The use of the proposed method ensures high reliability of the data obtained, significantly reduces time, labor, material and financial costs. Analysis of volatile compounds in spirit drinks has never been so easy.

Here you can read modified text of official method, which allows to carry out analysis of alcoholic beverages usinf the developed method.

The places in the text document to be deleted are highlighted in yellow. Embedded parts of the test are highlighted in green. Highlighted in blue are data that will be established based on the results of the performed interlaboratory study.

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National standard of People's Republic of China

GB/T 15038-2006

Substitute for GB/T 15038-1994

Analytical methods of wine and fruit wine

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Contents

Preface

This standard is a revision of GB/T 15038-1994 Analytical Methods of Wine and Fruit Wine.

This standard replaces GB/T 15038-1994.

This standard contains the following major changes compared to GB/T 15038-1994:

- Density bottle method used in alcohol degree analysis is changed to method 1; gas chromatography method is changed to method 2; alcohol meter method is still method 3;
- Add analyzing method for citric acid and methanol;
- Add analyzing method for preservatives;
- Remove the liquid chromatography method in determination of total sugar;
- Change the end point in potentiometric titration method in determination of total acid from PH=9.0 to PH=8.2;
- Make appropriate changes to revised method in determination of volatile acid;
- Include Determination of Sugar Content and Organic Acid in Wine (HPLC method) in Appendix D as an informative appendix;
- Include Determination of Resveratrol in Wine in Appendix E as an informative appendix;
- Include Requirements for Sensory Evaluation of Wine and Wild Grape Wine in Appendix E as an informative appendix.

Appendix A, B and C are normative appendices, while appendix D, E and F are informative appendices.

This standard was proposed by China Light Industry Association.

This standard is under the management of Wine-brewing Sub-technical Committee of National Food Industry Standardization Technical Committee.

Units drafting this standard: China National Research Institute of Food and Fermentation Industry; Yantai Changyu Pioneer Wine Company Limited; Sino-French Joint Venture Dynasty Winery Company Ltd.; China Great Wall Wine Company Limited; National Center of Wine Quality Supervision and Inspection; Suntime International Wine Company Limited.

Major Drafter for this standard: Xinguang Guo, Peixuan Ma, Xiaohong Wang, Chunya Zhang, Yiping Ren, Huanxiang Wang, Baifen Huang.

Previous version replaced by this standard is:

——GB/T 15038-1994.

Analytical Methods of Wine and Fruit Wine

1. Scope

This standard specifies analytical methods of wine and fruit wine products.

This standard applies to wine and fruit wine products.

2. Cited normative documents

The articles in the following documents are cited in this standard and thus become the articles of this standard. For those cited documents marked with date, all the subsequent revisions (excluding corrected contents) or revised versions are not applicable to this standard. However, all the parties reaching an agreement on the basis of this standard are encouraged to discuss whether the latest version of the documents could be adopted. For those cited documents not marked with date,the latest versions are applicable to this standard.

GB/T 601	Chemical Reagents	Preparation of Standard Titration Solution
GB/T 602	Chemical Reagents	Preparation of Standard Solution for impurity determination
GB/T 603	Chemical Reagents	Preparation of formulations and products used in testing methods
GB/T 6682-1992	Specifications of water used in analytical lab and testing methods (neq ISO 3696;1987)	

3. Sensory analysis

3.1 Rationale

Sensory analysis means that evaluators inspect the sensory features of product through sensory organs including mouth, eyes, nose, i.e. inspect and analyze & evaluate the sensory features of wine and fruit wine, such as color, aroma, taste and typicality.

3.2 Tasting wine

3.2.1 Tasting glass

The tasting cup is shown in figure 1.

Unit: mm

a) A tasting glass for wine and fruit wine (full volume is 215ml)

b) A tasting glass for sparkling wine (full volume is 150ml)

Figure 1. Tasting glass

3.2.2 Adjusting temperature

Adjust the temperature of wine until:

The temperature of sparkling wine reaches 9℃-10℃; the temperature of white wine reaches 10℃-15℃; the temperature of rose wine reaches 12℃-14℃; the temperature of red wine or fruit wine reaches 16℃-18℃; the temperature of sweet red wine or sweet fruit wine reaches 18℃-20℃.

For special wine, appropriate temperature range may be chosen based on the above conditions or specified in the product standard.

3.2.3 Order and number

When tasting several types of sample wine, the tasting order is: white first and red later; sugar-free first and sweet later; light first and heavy later; new first and old later; low-grade first and high-grade later. Number the samples according to the tasting order and mark the assigned number on the bottom of the glass.

3.2.4 Pouring wine

Rub to clean the exterior of the wine bottle after adjusting the temperature of the wine. Then carefully open the bottle stopper. Take care not to let any foreign object fall in the bottle. Pour the wine into a clean and dry tasting glass. The height of wine in the glass is usually one fourth to one third of the total height of the glass. The height of sparkling or carbonated wine is one half of the total height.

3.3 Sensory inspection and evaluation

3.3.1 Appearance

Hold the bottom or the pillar of the glass, lift the glass to the eyebrow level and observe under appropriate light (indirent sunlight) the color, transparancy and cleaness of the wine in the glass; if there is any precipitation or suspension in the wine; for sparkling or carbonated wine, observe the sparkling profile. Record detailed observation.

3.3.2 Aroma

At first, smell the aroma with nose under still conditions; then hold the glass with palms to slightly heat the wine and shake the glass to distribute the wine on the wall of the glass. Move the glass slowly under the nose to smell the volatile aroma of wine, distinguish between fruit aroma, wine aroma and other foreign aroma. Write down the evaluation.

3.3.3 Taste

Drink a small amount of sample wine in the mouth. Let the wine distribute over the taste area as evenly as possible. Taste carefully and swallow the wine after establishing a definite impression. Then experience the after-taste. Record the features of taste.

3.3.4 Typicality

Perform a comprehensive analysis based on the features of apperance, aroma and taste. Evaluate the type, style and intensity of typicality. Write down the conclusion (or score).

4 Chemical and Physical Analysis

The water used in this method should meet the requirements for water of grade 3 or above in GB/T 6682-1992 unless otherwise specified. Reagents used in this method are analytical pure (AR) unless otherwise specified. Solutions prepared are aqueous solutions unless otherwise specified.

If there are two or more analytical methods for one test item, the lab may choose one method according to its own conditions. However, method 1 should be the arbitrary method.

4.1 Alcohol Degree

4.1.1 Density Bottle Method

4.1.1.1 Rationale

Remove the non-volatile substances in the sample by distillation. Determinate the density of distilled liquid (aqueous solution of alcohol) by density bottle method. According to the density of distilled liquid, check in appendix A. Obtain the volume fraction (i.e. alcohol degree) at 20℃ and express in % (volume fraction).

4.1.1.2 Instrument

4.1.1.2.1 Analytical balance: accuracy is 0.0001g.

4.1.1.2.2 Glass distiller:500ml.

4.1.1.2.3 Thermostat water bath: precision ±0.1℃.

4.1.1.2.4 Density bottle attached with a thermometer: 25ml or 50ml.

4.1.1.3 Preparation of test sample

Accurately transfer 100ml sample with an 100ml volumetric flask which is clean and dry to a 500ml distilling flask. Use 50ml water to flush the volumetric flask for 3 times. Each time transfer the flushed liquid to the distilling flask. Then add several glass beads to the distilling flask and connect to the condenser. Use the original volumetric flask transfering sample as a receiver (in ice bath). Turn on the cooling water. Heat slowly to distill. Collect the distilled liquid until close to volume. Take away the volumetric flask and put in a stopper. Maintain the temperature of the flask in water bath at 20.0℃±0.1℃ for 30 minutes. Add water to volume. Mix well and store for future use.

4.1.1.4 Analytical procedures

4.1.1.4.1 Mass detemination of distilled water

a) Wash the density botlle and dry it. Weigh the bottle with thermometer and lateral hood. Repeat drying and weighing until the weight is constant(m).

b) Take away the thermometer. Add distilled water which had been boiled and cooled to approximately 15℃ to the density bottle of constant weight until full. Place the thermometer in the bottle. No bubble is allowed in the bottle. Soak the density bottle into the thermostat water bath at 20.0℃±0.1℃. After the temperature of contents in the bottle reaches 20℃ and is maintained for 10 minutes, absorb the overfilled liquid from the lateral tube with filter paper. The liquid level in the lateral tube should be the same as the opening of tube. Immediately put on the lateral hood. Take away the density bottle. Absorb the water on the wall of the bottle, then immediately weigh the bottle(m1).

4.1.1.4.2 Mass determination of the test sample

Pour out the water in the density bottle. Flush the bottle with the test sample (4.1.1.3) for 3 to 5 times. Then fill the bottle with the test sample. Repeat the procedure as described in 4.1.1.4.1 b). Weigh the bottle(m_2).

4.1.1.5 Calculation of results

Calculate the density of sample at 20℃ as formula 1; calculate the corrected value of air buoyancy as formula 2.

$$\rho_{20}^{20} = \frac{m_2 - m + A}{m_1 - m + A} \times \rho_0 \cdots\cdots (1)$$

$$A = \rho_u \times \frac{m_1 - m}{997.0} \cdots\cdots (2)$$

Wherein,

ρ_{20}^{20}—is the density of sample at 20℃, expressed as g/L;

m—is the mass of density bottle, expressed as g;

m_1—is the mass of density bottle and water at 20℃, expressed as g; m_2—

is the mass of density bottle and test sample at 20℃, expressed as g; ρ_0—

is the density of distilled water at 20℃ (998.20g/L);

A—is corrected value of air buoyance;

ρ_u—is the density value of dry air at 20℃ and 1.013.25h Pa (≈1.2g/L);

997.0—is the difference between the density of distilled water and dry air at 20℃, expressed as g/L.

Based on the density of test sample, i.e.ρ20 , check in appendix A and obtain the value of alcohol degree.

The result is presented to one decimal place.

4.1.1.6 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 1% of the arithmetic average.

4.1.2 Gas chromatography

4.1.2.1 Rationale

After the test sample is gasified, it enters the chromatographic column with carrier gas. Since components to be determined have different distribution coefficient in gas and liquid phase, the transport rate of different components in the column differs from each other, thus the components can be separated. The separated components flow out of the column sequentially and then enter the hydrogen flame ionization detector. Determine the nature by comparing the retention time of the peak of the components on chromatogram with that of standard sample; determine the quantity based on peak area (or peak height) by internal standard method.

4.1.2.2 Reagents and Solutions

4.1.2.2.1 Ethanol: chromatographic pure, serving as standard sample.

4.1.2.2.2 4-methyl-2-pentanol: chromatographic pure, serving as internal standard.

4.1.2.2.3 Ethanol standard solution (A): take 5 volumetric flasks of 100ml, transfer 2.00ml, 3.00ml, 3.50ml, 4.00ml and 4.50ml ethanol (4.1.2.2.1) to the flasks, respectively. Then add water to volume, respectively.

4.1.2.2.4 Ethanol standard solution (B): take 5 volumetric flasks of 10ml. Accurately transfer 10.00ml ethanol standard solution (A) of different concentrations; add 0.20ml 4-methyl-2-pentanol(4.1.2.2.2) to the 5 flasks, respectively. Mix well. This solution is used to plot standard curve.

4.1.2.3 Instrument and equipment

4.1.2.3.1 Gas chromatography instrument: equipped with hydrogen flame ionization detector (FID).

4.1.2.3.2 Chromatography column(stainless steel or glass):2mm×2mm or 3mm×3mm；stationary phase: Chromasorb 103, 60 to 80 meshes. Or use other columns with equivalent analytical effects.

4.1.2.3.3 Micro-injector:1μ L.

4.1.2.4 Preparation of test sample

The same as 4.1.1.3.

Accurately dilute the above prepared test sample with a dilution factor of 4 (or dilute appropriately according to alcohol degree), then transfer 10ml to the 10ml volumetric flask, accurately add 0.20ml 4-methyl-2-pentanol(4.1.2.2.2). Mix well.

4.1.2.5 Analytical procedures

4.1.2.5.1 Chromatography conditions

Temperature of column: 200℃

Temperature of gasifying room and detector:240℃.

Flow rate of carrier gas (nitrogen gas):40ml/min;

Flow rate of hydrogen gas: 40ml/min;

Flow rate of air: 500ml/min.

These chromatography conditions, such as flow rate of carrier gas, hydrogen gas and air, differ by Instrument. Determine optimal operation conditions by performing experiments. The criteria is that internal standard peak is completely separated from the peaks of other components in wine sample and ethanol flows out approximately 1 minute later.

4.1.2.5.2 Plotting standard curve: pipette 0.3 μL ethanol standard solution (B) of different concentrations, inject into the chromatography system quickly through the injection inlet. Use the ratio between peak area of standard sample and peak area of internal standard as a function of alcohol concentration, plot standard curve (or establish corresponding regression equation).

4.1.2.5.3 Determination of test sample: pipette 0.3μ L test sample (4.1.2.4) , then perform the procedures as described in 4.1.2.5.2.

4.1.2.6 Calculation of results

Use the ratio between alcohol peak area in test sample and peak area of internal standard to check against the standard curve, then obtain a value (or obtain a value by calculating with regression equation). Multiply the value by dilution factor, then obtain the value of alcohol content in wine sample, expressed as %.

The result should be presented to one decimal place.

4.1.2.7 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 1% of the arithmetic average.

4.1.3 Alcohol meter method

4.1.3.1 Rationale

Remove the non-volatile substances in the sample by distillation. Determinate the volume fraction of alcohol by alcohol meter method. Adjust for temperature according to appendix B, obtain the volume fraction (i.e. alcohol degree) at 20℃.

4.1.3.2 Instrument

4.1.3.2.1 Alcohol meter: value of scale is 0.1°.

4.1.3.2.2 Glass distiller:1000ml.

4.1.3.2.3 Preparation of test sample

Accurately transfer 500ml(increase or reduce the volume according to the requirements of alcohol meter) sample (the temperature of liquid is 20℃) with a 500ml volumetric flask which is clean and dry to an 1000ml distilling flask. The subsequent operations are the same as 4.1.1.3.

4.1.3.4 Analytical procedures

Pour the test sample (4.1.3.3) into a 500ml graduated flask which is clean and dry. Keep still for several minutes. After all the bubbles in the sample disappear, place a clean and dry alcohol meter in the sample and gently press it for once to prevent it from touching the wall of the flask. Meanwhile, place a thermometer in the sample and balance for 5 minutes. Then read the indicated value at the lowest point of meniscus and record the temperature. According to the indicated value on alcohol meter and the temperature, check in appendix B and converse into alcohol degree at 20℃.

The result is presented to one decimal place.

4.1.3.5 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 1% of the arithmetic average.

4.2 Total sugar and reduced sugar

4.2.1 Direct titration method

4.2.1.1 Rationale

When Fehling's solution is boiled together with reduced sugar, cuprous oxide precipitation will be produced. Use methylene blue as indicator solution. Titrate boiled Fehling's solution with sample of hydrolyzed sample. When the end point is reached, a slightly excessive reduced sugar reduces methylene blue to colorless, indicating the end point. According to the consumption of sample, calculate the content of total sugar or reduced sugar.

4.2.1.2 Reagents and materials

4.2.1.2.1 Hydrochloric acid solution (1+1).

4.2.1.2.2 NaOH solution (200g/L).

4.2.1.2.3 Glucose standard solution (2.5g/L): weigh 2.5g (0.0001g accuracy) anhydrous glucose which has been dried for 3 hours in a heating oven at 105℃-110℃ and cooled in a dryer. Dissolve in water and dilute with water to 1000ml.

4.2.1.2.4 Metyelene blue indicator solution(10g/L): weigh 1.0g methylene blue, dissolve in water and dilute to 100ml.

4.2.1.2.5 Fehling's solution (I, II)

a) Preparation

As described in GB/T 603.

b) Standardization

Pre-test: Pipette 5.00ml of Fehling's solution I and II, respectively. Transfer to a 250ml conical flask, add 50ml water, mix well. Then heat on an elecctric oven to boil. Titrate with glucose standard solution (4.2.1.2.3) in boiling status. When the blue color of solution almost disappears and becomes red, add 2 drops of methylene blue indicator solution, continue titration until the blue color completely disappears. Record the volume of consumed glucose standard solution.

Formal test: Pipette 5.00ml of Fehling's solution I and II, respectively. Transfer to a 250ml conical flask, add 50ml water and glucose standard solution (4.2.1.2.3) which is 1 ml less than the consumed volume in pre-test. Heat to boil and maintain boiling status for 2 minutes. Add 2 drops of methylene blue indicator solution, titrate with glucose standard solution to the end point in 1 minute under the boiling condition. Record the total volume(V) of consumed glucose standard solution.

c) Calculation

Calculate as formula (3) the mass of glucose (g) which is equivalent to 5ml of Fehling's solution I and II .

$$F = \frac{m}{1000} \times V \cdots\cdots (3)$$

Wherein,

F—is the mass of glucose which is equivalent to 5ml of Fehling’s solution I and II , expressed as g;

m—is the mass of weighed anhydrous glucose, expressed as g;

V—is the total volume of consumed glucose standard solution, expressed as mL.

4.2.1.3 Preparation of test sample

4.2.1.3.1 Test sample for determing total sugar: Accurately pipette a certain amount of sample (V1)[the temperature of liquid is 20℃], transfer to an 100mL volumetric flask, to make the content of total sugar reach 0.2g to 0.4g. Add 5ml HCl solution (4.2.1.2.1). Add water to 20mL. Mix well. Place in water bath at 68±1℃ to hydrolyze for 15 minutes. Then take out and cool down. Neutralize with NaOH solution (4.2.1.2.2) to become neutral. Adjust the temperature to 20℃. Dilute with water to volume (V2). Store for future use.

4.2.1.3.2 Test sample for determing reduced sugar:Accurately pipette a certain amount of sample (V1)[the temperature of liquid is 20℃], transfer to an 100mL volumetric flask, to make the content of reduced sugar reach 0.2g to 0.4g. Dilute with water to volume . Store for future use.

4.2.1.4 Analytical procedures

Replace the glucose standard solution with the test sample (4.2.1.3). Operate as described in 4.2.1.2.5 b). Record the consumed volume (V3) of the test sample. Calculate the results as formula (4).

To determine dry wine or semi-dry wine with lower content of sugar, pipette a certain amount of sample (V3)[the temperature of liquid is 20℃], transfer to a 250mL conical flask prefilled with 5.0ml of Fehling’s solution I and II. Then use glucose standard solution to operate as described in 4.2.1.2.5 b). Record the consumed volume (V) of glucose standard solution. Calculate the results as formula (5).

4.2.1.5 Calculation of results

The content of total sugar or reduced sugar in dry or semi-dry wine is calculated as formula (4). For the other types of wine, calculate as formula (5).

$$X_1 = \frac{F - c \times V}{(V_1/V_2) \times V_3} \times 1000 \cdots\cdots (4)$$

$$X_2 = \frac{F}{(V_1/V_2) \times V_3} \times 1000 \cdots\cdots (5)$$

Wherein,

X_1—is the content of total sugar or reduced sugar in dry or semi-dry wine, expressed as g/L;

F—is the mass of glucose which is equivalent to 5ml of Fehling's solution I and II , expressed as g;

c—is the concentration of glucose standard solution, expressed as g/mL; V—

is the volume of consumed glucose standard solution, expressed as mL;

V_1—is the volume of pipetted sample, expressed as mL;

V_2—is the volume of diluted or hydrolyzed and diluted sample, expressed as mL;

V_3—is the volume of consumed test sample, expressed as mL;

X_2—is the content of total sugar or reduced sugar in other types of wine, expressed as g/L.

The result is presentedto one decimal place.

4.2.1.6 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 2% of the arithmetic average.

4.3 Sugar-free extract

4.3.1 Rationale

Use the density bottle method to determine the density of the sample or sample from which alcohol has been distilled. Then check in appendix C according to the density value, obtain the content of total extract. Subtract the content of total sugar, then give the content of sugar-free extract.

4.3.2 Instrument

4.3.2.1 Porcelain evaporating dish: 200ml.

4.3.2.2 Thermostat water bath: accuracy±0.1℃.

4.3.2.3 Density bottle attached with thermometer: 25mL or 50mL.

4.3.3 Preparation of test sample

Accurately transfer 100ml sample(the temperature of liquid is 20℃) with an 100ml volumetric flask to a 200ml porcelain evaporating dish. Evaporate in water bath to about one third of the original volume. Then take out the dish and cool. Transfer the remaining liquid carefully to the original volumetric flask. Wash the evaporating dish with water for several times and pour the washing liquid into the volumetric flask. Dilute with water to volume at 20℃.

An alternative method is to use the remaining liquid after alcohol is distilled in 4.1.1.3 and dilute with water to 100mL at 20℃.

4.3.4 Analytical procedures

Method 1: Pipette test sample (4.3.3), operate as described in 4.1.1.4 and calculate the dentisy of sample from which alcohol has been removed($\rho1$) as described in 4.1.1.5. According to the value of $\rho1 \times 1.008\ 80$， check in appendix C and obtain the value of content of total extract (g/L).

Method 2 : Directly pipette untreated sample, operate as described in 4.1.1.4 and calculate the density of sample at 20℃ (ρ_B). Calculate the dentisy of sample at 20℃ from which alcohol has been removed($\rho2$) as formula (6). According to the value of $\rho2$， check in appendix C and obtain the value of content of total extract (g/L).

$$\rho_2=1.001\ 80(\rho_B-\rho)+1000 \quad\cdots\cdots(6)$$

Wherein,

ρ_2—is the dentisy of sample at 20℃ from which alcohol has been removed, expressed as g/L;

ρ_B—is the dentisy of sample at 20℃ containing alcoho, expressed as g/L;

ρ—is the density of alcohol aqueous solution with the same alcohol degree as the sample containg alcohol (this value may use the alcohol density determined in 4.1.1 or the density obtained by checking in appendix A repeatedly according to the alcohol content determined in 4.1.2 or 4.1.3), expressed as g/L;

1.001 80 —is the correction coefficient of the volume of density bottle at 20℃.

The result is presentedto one decimal place.

4.3.5 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 2% of the arithmetic average.

4.4 Total acid

4.4.1 Potentiometric titration

4.4.1.1 Rationale

According to the neutralization of an acid and a base, use NaOH standard titration solution to directly titrate the organic acids in the sample. Specify pH=8.2 to be the end point. Calculate the content of total acid in the test sample based on the volume of consumed NaOH titration solution.

4.4.1.2 Reagents and materials

4.4.1.2.1 NaOH standard titration solution [c(NaOH)=0.05mol/L]; prepare and standardize as according to GB/T 601, dilute accurately.

4.4.1.2.2 Phenolphthalein indicator solution (10g/L); prepare according to GB/T 603.

4.4.1.3 Instrument

4.4.1.3.1 Automatic potentiometric titrator (or pH meter): precision is 0.01pH, attached with an electro-magnetic stirrer.

4.4.1.3.2 Thermostat water bath: precision is ±0.1℃, attached with a shaking device.

4.4.1.4 Preparation of test sample

Pipette about 60mL of sample and transfer to an 100mL beaker. Place the beaker in a 40℃±0.1℃ shaking water bath to stay for 30 minutes. Then take out and cool to room temperature.

Note: Preparation of test sample is only for sparkling wine and carbonated wine, in order to remove carbon dioxide.

4.4.1.5 Analytical Procedures

4.4.1.5.1 Calibrate instrument as specified in the user's instruction.

4.4.1.5.2 Determination

Pipette 10.00 mL of sample (the temperature is 20℃) and transfer to an 100mL beaker, add 50mL water, place an electrode in the beaker and put in a rotor. The place the beaker on the electro-magnetic stirrer and start stirring. Titrate with NaOH titration solution. At the beginning, titrate at a higher speed; when pH of the sample liquid reaches 8.0, slow down the titration, i.e. add a half drop of solution each time until the end point, PH=8.2. Record the volume of consumed NaOH titration solution. Meanwhile, perform a blank test.

4.4.1.6 Calculation of results

Calculate the content of total acid in the sample as formula (7).

$$X = \frac{c \times (V_1 - V_0) \times 75}{V_2} \quad \cdots\cdots\cdots\cdots\cdots\cdots \quad (7)$$

Wherein,

X —is the content of total acid in the sample (counted as tartaric acid), expressed as g/L;

c —is the concentration of NaOH titration solution, expressed as mol/L;

V_0—is the volume of consumed NaOH titration solution in the blank test, expressed as mL;

V_1—is the volume of consumed NaOH titration solution in the titration of sample, expressed as mL;

V_2—is the volume of pipetted sample, expressed as mL;

75—is the value of molar mass of tartaric acid, expressed as g/mol.

The result is presentedto one decimal place.

4.4.1.7 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 3% of the arithmetic average.

4.4.2 Indicator method

4.4.2.1 Rationale

According to the rationale of acid-base titration, use phenolphthalein as the indicator solution and titrate with base standard solution. Calculate the content of total acid according to the consumption of base.

4.4.2.2 Reagents and materials

The same as 4.4.1.2.

4.4.2.3 Analytical procedures

Pipette 2ml~5ml of sample [the temperature is 20℃; the volume of sample may be increased or reduced depending on the shade of color], transfer to a 250ml conical flask, add 50ml water and 2 drops of phenolphthlein indicator solution. Mix well and immediately titrate with NaOH titration solution to the end point and the color does not change within 30 seconds. Record the volume of consumed NaOH titration solution (V1). Meanwhile, perform a blank test.

4.4.2.4 Calculation of results

The same as 4.4.1.6.

4.4.2.5 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 5% of the arithmetic average.

4.5 Volatile acids

4.5.1 Synopsis of the method

Distill the acids with low boiling point in the sample, i.e. volatile acids. Titrate with base standard titration solution. Then determine the content of free sulfur dioxide and binded sulfur dioxide. After calculation and correction, obtain the value of content of volatile acids in the sample.

4.5.2 Reagents and solutions

4.5.2.1 NaOH standard titration solution[c (NaOH) =0.05mol/L]: prepare and standardize according to GB/T 601, dilute accurately.

4.5.2.2 Phenolphthalein indicator solution (10g/L): prepare according to GB/T 603.

4.5.2.3 HCl solution: dilute concentrated HCl with water. The dilution factor is 4.

4.5.2.4 Iodine standard titration solution[c(1/2 I_2)=0.05 mol/L] :prepare and standardize according to GB/T 601, dilute accurately.

4.5.2.5 Potassium iodide

4.5.2.6 Starch indicator solution (5g/L): weigh 5g starch, dissolve in 500ml water. Heat it to boil and continuously stir for 10 minutes. Add 200g sodium chloride. Cool the solution. Dilute with water to 1000ml.

4.5.2.7 Sodium borate saturated solution: weigh 5 g sodium borate ($Na_2B_4O_7.10H_2O$), heat to boil. Cool and store for future use.

4.5.3 Analytical procedures

4.5.3.1 Determined volatile acids: Install distillation device. Pipette 10ml sample(V)[the temperature is 20℃] and distill in the device. Collect 100ml distilled liquid. Heat the distilled liquid to boil, add 2 drops of phenolphthalein indicator solution. Titrate with NaOH titration solution (4.5.2.1) until the solution turns pink and does not change within 30 seconds, i.e. the end point. Record the volume of consumed NaOH titration solution (V1).

4.5.3.2 Determination of free sulfur dioxide: add 1 drop of HCl solution to the above-mentioned solution to acidify the solution, add 2ml starch indicator solution and several particles of potassium iodide. Mix well. Titrate with iodine standard titration solution (4.5.2.4). Record the volume of consumed iodine standard titration solution(V2).

4.5.3.3 Determination of binded sulfur dioxide: add sodium borate saturated solution(4.5.2.7) to the above-mentioned solution until the solution turns pink. Continue to titrate with iodine standard titration solution (4.5.2.4) until the solution turns blue. Record the volume of consumed iodine standard titration solution (V3).

4.5.4 Calculation of results

The content of determined volatile acids in the sample is calculated as formula (8).

$$X_1 = \frac{c \times V_1 \times 60.0}{V} \quad \cdots\cdots \quad (8)$$

Wherein,

X_1—is the content of determined volatile acids in the sample (counted as acetic acid), expressed as g/L;

c—is the concentration of NaOH standard titration solution, expressed as mol/L;

V_1—is the volume of consumed NaOH standard titration solution, expressed as ml;

60.0—is the value of molar mass of acetic acid, expressed as g/mol;

V—is the volume of pipetted sample, expressed as ml.

If the content of volatile acids is close to or exceed the chemical& physical specification, it is necessary to correct. Converse as formula (9) when correcting:

$$X = X_1 - \frac{c_2 \times V_2 \times 32 \times 1.875}{V} - \frac{c_2 \times V_3 \times 32 \times 0.9375}{V} \cdots\cdots (9)$$

Wherein,

X— is the content of actual volatile acids in the sample (counted as acetic acid), expressed as g/L;

X_1—is the content of determined volatile acids in the sample ;

c_2—is the concentration of iodine standard titration solution, expressed as mol/L;

V—is the volume of pipetted sample, expressed as ml;

V_2—is the volume of consumed iodine standard titration solution when titrating free sulfur dioxide, expressed as ml;

V_3—is the volume of consumed iodine standard titration solution when titrating binded sulfur dioxide, expressed as ml;

32—is the value of molar mass of sulfur dioxide, expressed as g/mol;

1.875—is the mass of acetic acid which is equivalent to 1g free sulfur dioxide, expressed as g;

0.9375—is the mass of acetic acid which is equivalent to 1g binded sulfur dioxide, expressed as g.

The result is presentedto one decimal place.

4.5.5 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 5% of the arithmetic average.

4.6 Citric acid

4.6.1 Rationale

For those components entering the column at the same time, they undergo different procedures including dissolution, adsorption, permeation or ion exchange between mobile phase and stationary phase. Together with the mobile phase, these components are distributed between the two phases in the column repeatedly. Since the transport rate of different components in the column is different, the components are separated from each other after passing through a cirtain length of column, flow out of the column in a certain order and enter the signal detector. Then the parameters of the peak of components are displayed on the recorder or data processing device. Determine the quantity by normalization method or external standard method according to the retention time.

4.6.2 Reagents and materials

4.6.2.1 Phosphoric acid

4.6.2.2 NaOH solution[c(NaOH)=0.01mol/L]: prepare according to GB/T 601 and dilute accurately.

4.6.2.3 KH_2PO_4 aqueous solution (0.02mol/L): weigh 2.72g KH_2PO_4, dissolve in water and dilute to 1000mL. Adjust pH with phosphoric acid (4.6.2.1) to pH=2.9. Filter through 0.45μm micro filter membrane.

4.6.2.4 Anhydrous citric acid

4.6.2.5 Citric acid stock solution: weigh 0.05g anhydrous citric acid (accuracy is 0.0001g), dissolve in NaOH solution(4.6.2.2) and dilute to 50mL. This solution contains 1g/L citric acid.

4.6.2.6 A series of citric acid standard solution: dilute the citric acid stock solution with NaOH solution (4.6.2.2) to produce a series of citric acid standard solution of which concentration is 0.05g/L, 0.10g/L, 0.20g/L, 0.40g/L and 0.80g/L, respectively.

4.6.3 Instrument

4.6.3.1 HPCL system: equipped with an ultraviolet detector and column thermostat.

4.6.3.2 Chromatography column: Hypersil ODS2, size of the column: 5.0mm×200mm，particle size of filling material: 5μm. Or use other columns with equivalent analytical effect.

4.6.3.3 Micro-injector:10μL.

4.6.3.4 Vacuum filtering device for mobile phase and micro filter membrane of 0.2μm or 0.45μm.

4.6.3.5 Analytical balance: the accuracy is 0.0001g.

4.6.4 Analytical procedures

4.6.4.1 Preparation of test sample

Pipette 10.00ml sample (the temperature is 20℃) and transfer to an 100ml volumetric flask. Filter through 0.45μm micro filter membrane and store for future use.

4.6.4.2 Determination

4.6.4.2.1 Chromatography conditions

Temperature of the column： room temperature.

Mobile phase: 0.02mol/L, KH2PO4, pH 2.9 (4.6.2.3)

Flow rate :1.0ml/min.

Detector wavelength: 214nm.

Sample size: 10μ L.

4.6.4.2.2 Standard curve

Inject a series of citric acid standard solution (4.6.2.6), respectively. Plot a standard curve of concentration of standard sample vs. peak area. Linear correlation coefficient should be above 0.9990.

4.6.4.2.3 Inject the test sample (4.6.4.1). Determine the nature of chromatography peak of citric acid in the sample according to the retention time of standard sample. Based on the peak area of the sample, check the standard curve and obtain the content of citric acid.

4.6.5 Calculation of results

Calculate the content of citric acid in the sample as formula (10).

$$X = c \times F \quad \cdots\cdots(10)$$

Wherein,

X—is the content of citric acid in the sample , expressed as g/L;

c—is the content of citric acid in determined solution obtained by checking the standard curve, expressed as g/L;

F—is the dilution factor of the sample.

The result is presentedto one decimal place.

4.6.6 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 5% of the arithmetic average.

4.7 Carbon dioxide

4.7.1 Instrument

The instrument for determining the pressure of sparkling wine and carbonated wine is shown in figure 2.

A——Three-jaw;

B——Screw; C——

Gas trap hood;

D——Straight shank fluted twist drill

Figure 2 Instrument for determining the pressure of sparkling wine and carbonated wine

4.7.2 Analytical procedures

4.7.2.1 Adjusting temperature: keep the sample to be determined in 20℃ water bath(or thermostat) for 2 hours to preserve heat.

4.7.2.2 Determination: set the three-jaw(A) to the neck of wine bottle, adjust the screw(B) so as to make gas trap hood (C) fit the bottle lid. Insert the straight shank fluted twist drill (D) and seal. Hold the handle of drill and rotate downward until the lid (cork) is penetrated. Shake the wine bottle. Record the pressure when the pointer of pressure meter stay stable.

The result is presented to two decimal places.

4.7.2.3 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 10% of the arithmetic average.

4.8 Sulfur dioxide

4.8.1 Free sulfur dioxide

4.8.1.1 Oxidation method

4.8.1.1.1 Rationale

Under low temperature, free sulfur dioxide in the sample reacts excessively with peroxide to produce sulfur acid. Then titrate the sulfur acid with base standard solution. In this way the content of free sulfur dioxide in the sample can be determined.

4.8.1.1.2 Reagents and materials

a) Peroxide solution (0.3%): pipette 1ml of 30% peroxide solution (store in a refrigerator after being opened). Dilute with water to 100ml. Prepare the solution on the day it is to be used.

b) Phosphoric acid solution (25%): take 295ml of 85% phosphoric acid and dilute with water to 1000ml.

c) NaOH standard titration solution [c(NaOH)=0.01mol/L]: pipette accurately 100ml NaOH standard titration solution(4.4.1.2.1) and dilute with water without carbon dioxide to 500ml. Store in a bottle sealed by rubber stopper with a soda lime tube inside. Re-prepare the solution every week.

d) Methyl red- methylene blue mixed indicator solution: prepare according to GB/T 603.

4.8.1.1.3 Instrument

a) The instrument determing sulfur dioxide is shown in figure 3.

A—Short-neck flask;

B—Three-way connecting pipe;

C—Ventilation pipe; D—

Straight condensing tube; E—

Bend tube;

F—Vacuum distilling receiver;

G—Pear-shape bottle;

H—Gas scrubber;

I—Right-angel bend tube (connecting with vacuum pump or suction tube)

Figure 3 Instrument for determing sulfur dioxide

b) Vacuum pump or suction tube (glass ejector pump).

4.8.1.1.4 Analytical procedures

a) As shown in figure 3, install the instrument for determing sulfur dioxide. Tube I is connected with vacuum pump (or suction tube). Introduce cooled water into tube D. Take off pear-shaped flask (G) and gas scrubber (H). Add 20ml peroxide solution to flask G, add 5ml peroxide solution to H. Add 3 drops of mixed indicator solution to G and H, respectively, the solution immediately turns purple.

Drip in NaOH standard solution until the solution just turns olive green. Then re-install the instrument. Soak flask A in ice bath.

b) Pipette 20.00ml of sample (the temperature is 20℃). Add the sample to flask A through the upper opening of tube C. Then pipette 10ml phosphoric acid solution(4.8.1.1.2b), also add to flask A through the upper opening of tube C.

c) Turn on the vacuum pump (or suction tube) to suck in air with a flow rate of 1000ml/min to 1500ml/min for 10 minutes. Take off flask G, titrate with NaOH standard titration solution (4.8.1.1.2c) until olive green reappears, i.e. the end point.Record the volume of consumed NaOH standard titration solution. Replace the sample with water and perform a blank test. Analytical procedures in the blank test are the same as above. In general, the solution in tube H should not change color. If the solution turns purple, it is also necessary to titrate with NaOH standard titration solution until olive green appears. Add the volume of consumed NaOH titration solution and that in flask H.

4.8.1.1.5 Calculation of results

The content of free sulfur dioxide in the sample is calculated as formula 11.

$$X = \frac{c \times (V - V_0) \times 32}{20} \times 1000 \quad \cdots\cdots \quad (11)$$

Wherein,

X—is the content of free sulfur dioxide in the sample, expressed as mg/L;

c—is the concentration of NaOH standard titration solution, expressed as mol/L;

V—is the volume of consumed NaOH standard titration solution in determing the sample, expressed in ml;

V_0—is the volume of consumed NaOH standard titration solution in the blank test, expressed in ml;

32—is the value of molar mass of sulfur dioxide, expressed as g/mol;

20—is the volume of pipetted sample, expressed as ml.

The result is presentedas round number.

4.8.1.1.6 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 10% of the arithmetic average.

4.8.1.2 Direct iodine method

4.8.1.2.1 Rationale

According to the oxidation-reduction reaction between iodine and sulfur dioxide, determine the content of sulfur dioxide in the sample.

4.8.1.2.2 Reagents and materials

a) Sulfur acid solution(1+3):take 1 volume of concentrated sulfur acid solution and add slowly to 3 volumes of water.

b) Iodine standard titration solution[c(1/2 I_2)=0.02mol/L] : prepare and standardize according to GB/T 601. Dilute accurately as a dilution factor of 5.

c) Starch indicator solution(10g/L): prepare according to GB/T 603, then add 40g sodium chloride to the solution.

4.8.1.2.3 Analytical procedures

Pipette 50.00ml of sample (the temperature is 20℃), transfer to a 250 iodine flask. Add a small amount of ice fragments, then add 1ml starch indicator solution[4.8.1.2.2c] and 10ml sulfur acid solution[4.8.1.2.2a], immediately titrate with iodine standard titration solution[4.8.1.2.2b] until the color of light blue appears and does not change within 30 seconds, i.e. the end point. Record the volume of consumed iodine standard titration solution (V).

Use water instead of sample to do the blank test with the same operation as the above.

4.8.1.2.4 Calculation of results

The content of free sulfur dioxide in the sample is calculated as formula 12.

$$X = \frac{c \times (V - V_0) \times 32}{50} \times 1000 \quad \cdots\cdots (12)$$

Wherein,

X—is the content of free sulfur dioxide in the sample, expressed as mg/L;

c—is the concentration of iodine standard titration solution, expressed as mol/L;

V—is the volume of consumed iodine standard titration solution in determing the sample, expressed in ml;

V_0—is the volume of consumed iodine standard titration solution in the blank test, expressed in ml;

32—is the value of molar mass of sulfur dioxide, expressed as g/mol;

50—is the volume of pipetted sample, expressed as ml.

The result is presentedas round number.

4.8.1.2.5 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 10% of the arithmetic average.

4.8.2 Total sulfur dioxide

4.8.2.1 Oxidation method

4.8.2.1.1 Rationale

When being heated, the binded sulfur dioxide in the sample will be released and an oxidation-reduction reaction between sulfur dioxide and peroxide will occur. Titrate sulfur acid produced in the reaction with NaOH standard titration solution to determine the content of binded sulfur dioxide in the sample. Adding the value of binded sulfur dioxide and the value of free sulfur dioxide gives the content of total sulfur dioxide in the sample.

4.8.2.1.2 Reagents and materials

The same as 4.8.1.1.2.

4.8.2.1.3 Instrument

The same as 4.8.1.1.3.

4.8.2.1.4 Analytical procedures

Following determination of free sulfur dioxide in 4.8.1.1.4, reconnect flask G in which the solution has been titrated to olive green to tube F. Take off the ice bath under flask A. Carefully heat flask A with soft fire to keep the solution inside slightly boiling. Turn on the vacuum pump. The subsequent procedures are the same as 4.8.1.1.4c).

4.8.2.1.5 Calculation of results

The same as 4.8.1.1.5.

The value obtained is the content of binded sulfur dioxide. Adding the value of binded sulfur dioxide and the value of free sulfur dioxide gives the content of total sulfur dioxide in the sample.

4.8.1.2.6 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 10% of the arithmetic average.

4.8.2.2 Direct iodine method

4.8.2.2.1 Rationale

In alkaline condition, the binded sulfur dioxide is released. Then titrate with iodine standard titration solution to determine the content of binded sulfur dioxide in the sample.

4.8.2.2.2 Reagents and materials

a) NaOH solution (100g/L);

b) The other reagents and solutions are the same as 4.8.1.2.2.

4.8.2.2.3 Analytical procedures

Pipette 25.00 ml of NaOH solution, transfer to a 250ml iodine flask. Then accurately pipette 25.00ml of sample (20℃), soak the tip of pipette into NaOH solution to add the sample. Mix well. Put in the stopper. Stay still for 15 minutes. Then add a small amount of ice fragments,1ml starch indicator solution and 10ml sulfur acid solution, mix well. Immediately titrate with iodine standard titration solution until the color of light blue appears and does not change within 30 seconds, i.e. the end point. Record the volume of consumed iodine standard titration solution (V).

Replace the sample with water and perform a blank test. Analytical procedures in the blank test are the same as above.

4.8.2.2.4 Calculation of results

The content of total sulfur dioxide in the sample is calculated as formula 13.

$$X = \frac{c \times (V - V_0) \times 32}{25} \times 1000 \cdots\cdots (13)$$

Wherein,

X—is the content of total sulfur dioxide in the sample, expressed as mg/L;

c—is the concentration of iodine standard titration solution, expressed as mol/L;

V—is the volume of consumed iodine standard titration solution in determing the sample, expressed in ml;

V_0—is the volume of consumed iodine standard titration solution in the blank test, expressed in ml;

32—is the value of molar mass of sulfur dioxide, expressed as g/mol;

25—is the volume of pipetted sample, expressed as ml.

The result is presentedas round number.

4.8.2.2.5 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 10% of the arithmetic average.

4.9 Iron

4.9.1 Atomic absorption spectrophotometry

4.9.1.1 Rationale

Introduce the treated test sample into the atomic absorption spectrophotometer. Iron in the sample is atomized in the ethyne-air flame. Ground-state iron atom absorbs the light with a characteristic wavelength of 248.3nm. The amount of absorption is proportional to the concentration of iron atoms in the test sample. Determine the absorption and get the content of iron.

4.9.1.2 Reagents and materials

The water used in this method should meet the requirements for water of grade 2 in GB/T 6682-1992. The reagents used in this method are guaranteed reagents (GR).

4.9.1.2.1 Nitric acid solution (0.5%): take 8ml nitric acid and dilute to 1000 ml.

4.9.1.2.2 Iron standard stock solution (1ml solution contains 0.1mg iron): prepare according to GB/T 602.

4.9.1.2.3 Iron standard solution (1ml solution contains 10μg iron): transfer 10.00ml iron standard stock solution to an 100ml volumetric flask. Dilute with nitric acid solution (4.9.1.2.1) to volume. This solution contains 10μg iron per mL.

4.9.1.2.4 Iron standard series: pipette 0.00ml, 1.00ml, 2.00ml, 4.00ml and 5.00ml of iron standard solution(containing 0.0μg,10.0 μg, 20.0μg, 40.0μg and 50.0μg, respectively) respectively. Transfer respectively to 5 volumetric flasks of 100ml. Dilute with nitric acid solution (4.9.1.2.1) to volume, mix well. This series is used for plotting standard working curve.

4.9.1.3 Instrument

Atomic absorption spectrophotometer: equipped with iron hollow cathode lamp.

4.9.1.4 Preparation of test sample

Dilute the sample with nitric acid solution (4.9.1.2.1). Dilution factor is 5 to 10. Mix well and store for future use.

4.9.1.5 Analytical procedures

4.9.1.5.1 Plotting standard working curve: set the instrument to be in optimal condition. Adjust the wavelength to 248.3nm. Introduce the series of standard solution. Use zero adjusting tube to set zero. Determine absorption of each solution. Plot a standard working curve of iron content vs. absorption (or establish regression equation).

4.9.1.5.2 Determination of the test sample: introduce the test sample into the instrument. Determine the absorption. According to the value of absorption, check the standard curve and get the iron content (or use the regression equation to calculate).

4.9.1.6 Calculation of results

The iron content in the sample is calculated as formula 14.

$$X=A\times F \quad \cdots\cdots (14)$$

Wherein,

X—is the iron content in the sample, expressed as mg/L;

A—is the iron content in the test sample, expressed as mg/L;

F—is the dilution factor of the sample.

The result is presented to one decimal place.

4.9.1.7 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 10% of the arithmetic average.

4.9.2 1,10-phenanthroline colorimetry

4.9.2.1 Rationale

After the sample is treated, Fe 3+ in the test sample will be reduced by hydroxylamine HCl to Fe2+ in acidic condition. Fe 2+ will react with 1,10-phenanthroline to produce red chelate. The color shade of the chelate is proportional to iron content. Determine iron content by spectrophotometry.

4.9.2.2 Reagents and materials

4.9.2.2.1 Concentrated sulfur acid

4.9.2.2.2 Peroxide solution(30%)

4.9.2.2.3 Ammonia hydroxide (25%~28%)

4.9.2.2.4 Hydroxylamine HCl solution (100g/L): weigh 100g hydroxylamine HCl, dissolve in water and dilute to 1000ml. Store in a brown bottle at low temperature.

4.9.2.2.5 HCl solution(1+1)

4.9.2.2.6 Acetic acid- sodium acetate solution (pH=4.8): weigh 272g sodium acetate ($CH_3COONa.3H_2O$), dissolve in 500ml water, add 200ml glacial acetic acid. Dilute with water to 1000ml.

4.9.2.2.7 1,10-phenanthroline solution(2g/L): prepare according to GB/T 603.

4.9.2.2.8 Iron standard stock solution (1ml solution contains 0.1mg iron): the same as 4.9.1.2.2.

4.9.2.2.9 Iron standard solution (1ml solution contains 10μg iron): the same as 4.9.1.2.3.

4.9.2.2.10 Iron standard series: pipette 0.00ml, 0.20ml, 0.40ml, 0.80ml , 1.00ml and 1.40ml of iron standard solution(containing 0.0μg, 2.0 μg, 4.0μg, 8.0μg , 10.0μg and 14.0μg, respectively) respectively. Transfer respectively to 6 colorimetric tubes of 25ml. Add water to 10ml. Then add 5ml acetic acid-sodium acetate solution (adjust pH to 3~5), 1ml hydroxylamine HCl solution, mix well. Stay still for 5 minutes. Then add 1ml 1,10-phenanthroline solution. Add water to volume, mix well. Stay still for 30 minutes and store for future use. This series is used for plotting standard working curve.

4.9.2.3 Instrument

4.9.2.3.1 Spectrophotometer

4.9.2.3.2 Hihg-temperature electric oven : 550℃±25℃.

4.9.2.3.3 Porcelain evaporating dish : 100ml.

4.9.2.4 Preparation of test sample

4.9.2.4.1 Dry digestion method: pipette accurately 25.00ml sample (V), transfer to the evaporating dish. Evaporate to dry in water bath. Carefully charring on the electric oven. Then transfer to the 550℃±25℃ high-temperature electric oven to burn until incinerated to white residue. Take out the residue and add 10ml HCl solution to dissolve it. Evaporate in water bath to about 2ml. Add 5ml water. Heat to boil, then transfer to a 50ml volumetric flask. Wash the evaporating dish with water. Pour the washing liquid into the volumetric flask. Dilute with water to volume (V1). Mix well. Meanwhile, perform a blank test.

4.9.2.4.2 Wet digestion method: pipette accurately 1.00ml sample (V) (may increase or reduce the volume, depending on iron content). Transfer to a 10ml Kjeldahl flask. Evaporate on the electric oven until it is close to dry. Take off the flask to cool for a while. Then add 1ml concentrated HCl (may inrease or reduce the volume, depending on sugar content) and 1ml peroxide. Place in a ventilating cabinet to heat for digesting. If the digested liquid appears to be a darker color, continue to add peroxide solution until the liquid turns colorless and transparent. Cool it slightly, add 10ml water,heat with soft fire to boil and keep it boiling for 3 to 5 minutes. Take off and cool. Meanwhile, perform a blank test.

Note: labs may choose either dry or wet method to digest sample according to specific conditions.

4.9.2.5 Analytical procedures

4.9.2.5.1 Plotting standard working curve:

Determine absorption of each solution in the standard series(4.9.2.2.10) under the wavelength of 480nm. Plot a standard working curve of I absorption vs. corresponding iron concentration (or establish regression equation).

4.9.2.5.2 Determination of test sample

Pipette accurately 5ml~10ml (V1) of test sample (4.9.2.4.1) and blank digested liquid and transfer to a 25ml colorimetric tube, respectively. Add water to 10ml. Then operate as described in plotting standard working curve. Determine absorption of each solution and check the standard working curve to get the value of iron content (or calculate using regression equation).

Or, wash the test sample (4.9.2.4.2) and blank digested liquid to a 25ml colorimetric tube, respectively. Add a small piece of Congo red test paper to each tube. Neutralize with ammonia hydroxide until the test paper turns purple blue. Then add 5ml acetic acid-sodium acetate solution to each tube (adjust pH to 3~5). The subsequent procedures are the same as plotting standard working curve.According to the determined absorption, check the standard working curve to get the value of iron content (or calculate using regression equation).

4.9.2.6 Calculation of results

4.9.2.6.1 Calculation for dry method

The iron content in the sample is calculated as formula 15.

$$X = \frac{(c_1 - c_0) \times 1000}{V \times V_2 / V_1 \times 1000} = \frac{(c_1 - c_0) \times V_1}{V \times V_2} \cdots\cdots\cdots\cdots (15)$$

Wherein,

X—is the iron content in the sample, expressed as mg/L;

c_1—is the iron content in the sample for determination, expressed as μg;

c_0—is the iron content in blank liquid, expressed as μg;

V—is the volume of pipetted sample, expressed as ml;

V_1—is total volume of digested liquid of sample, expressed as ml;

V_2—is the volume of test sample for determination, expressed as ml.

4.9.2.6.1 Calculation for wet method

The iron content in the sample is calculated as formula 16.

$$X = \frac{A - A_0}{V} \cdots\cdots\cdots\cdots (16)$$

Wherein,

X—is the iron content in the sample, expressed as mg/L;

A—is the iron content in the sample for determination, expressed as μg;

A_0—is the iron content in blank liquid, expressed as μg;

V—is the volume of pipetted sample, expressed as ml.

The result is presented to one decimal place.

4.9.2.6.3 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 10% of the arithmetic average.

4.9.3 Sulfosalicylic acid colorimetry

4.9.3.1 Rationale

After the sample is treated, Fe 3+ in the sample will react with sulfosalicylic acid in alkaline ammonia solution (pH=8~10.5) to produce yellow complex. Perform colorimetry according to the shade of color.

4.9.3.2 Reagents and materials

4.9.3.2.1 Sulfosalicylic acid solution (100g/L).

4.9.3.2.2 Ammonia hydroxide (1+1.5).

4.9.3.2.3 Iron standard stock solution (1ml solution contains 0.1mg iron): the same as 4.9.2.2.8.

4.9.3.2.4 Iron standard solution (1ml solution contains 10μg iron): the same as 4.9.2.2.9.

4.9.3.2.5 Iron standard series: pipette 0.00ml, 0.50ml, 1.00ml, 1.50ml , 2.00ml and 2.50ml of iron standard solution(containing 0.0μg,5.0 μg, 10.0μg, 15.0μg, 20.0μg and 25.0μg, respectively) respectively. Transfer respectively to 6 colorimetric tubes of 25ml. Add 5ml sulfosalicylic solution to each tube. Neutralize with ammonia hydroxide until the solution turns yellow, then add 0.5ml of the solution. Dilute with water to volume. Mix well.

4.9.3.3 Instrument

The same as 4.9.2.3.

4.9.3.4 Preparation of test sample

The same as 4.9.2.4.

Note: sample size is 5ml for wet digestion method.

4.9.3.5 Analytical procedures

Pipette 5.00ml of test sample treated by dry method (may increase or reduce the volume, depending on the iron content) and the same volume of blank digested liquid, transfer to a 25ml colorimetric tube, respectively. Or wash the test sample treated by wet method and blank digested liquid to a 25ml colorimetric tube, respectively. The subsequent procedures are the same as described in 4.9.3.2.5 . Compare the color with that of standard series. Record the iron content in the standard tube of which the color shade is the same as sample solution.

4.9.3.6 Calculation of results

The same as 4.9.2.6.

The result is presented as round number.

4.9.3.7 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 10% of the arithmetic average.

4.10 Copper

4.10.1 Atomic absorption spectrophotometry

4.10.1.1 Rationale

Introduce the treated test sample into the atomic absorption spectrophotometer. Copper in the sample is atomized in the ethyne-air flame. Ground-state iron atom absorbs the light with a characteristic wavelength of 324.7 nm. The amount of absorption is proportional to copper content in the test sample. Determine the absorption and get the copper content.

4.10.1.2 Reagents and materials

4.10.1.2.1 Nitric acid solution (0.5%).

4.10.1.2.2 Copper standard stock solution (1ml solution contains 0.1mg copper): prepare according to GB/T 602.

4.10.1.2.3 Copper standard solution (1ml solution contains 10μg copper): transfer 10.00ml copper standard stock solution to an 100ml volumetric flask. Dilute with nitric acid solution to volume. This solution contains 10μg copper per mL.

4.10.1.2.4 Copper standard series: pipette 0.00ml, 0.50ml, 1.00ml, 2.00ml, 4.00ml and 6.00ml of copper standard solution(containing 0.0μg,5.0μg, 10.0 μg, 20.0μg, 40.0μg and 60.0μg, respectively) respectively. Transfer respectively to 6 volumetric flasks of 50ml. Dilute with nitric acid solution to volume, mix well. This series is used for plotting standard working curve.

4.10.1.3 Instrument

Atomic absorption spectrophotometer: equipped with copper hollow cathode lamp.

4.10.1.4 Preparation of test sample

Dilute the sample with nitric acid solution accurately. Dilution factor is 5 to 10. Mix well and store for future use.

4.10.1.5 Analytical procedures

4.10.1.5.1 Plotting standard working curve: set the instrument to be in optimal condition. Adjust the wavelength to 324.7nm. Introduce the series of standard solution. Use zero adjusting tube to set zero. Determine absorption of each solution. Plot a standard working curve of copper content vs. absorption (or establish regression equation).

4.10.1.5.2 Determination of the test sample: introduce the test sample (4.10.1.4) into the instrument. Determine the absorption. According to the value of absorption, check the standard curve and get the copper content (or use the regression equation to calculate).

4.10.1.6 Calculation of results

The copper content in the sample is calculated as formula 17.

$$X=A\times F \quad \cdots\cdots (17)$$

Wherein,

X—is the copper content in the sample, expressed as mg/L;

A—is the copper content in the test sample, expressed as mg/L;

F—is the dilution factor of the sample.

The result is presented to one decimal place.

4.10.1.7 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 10% of the arithmetic average.

4.10.2 Sodium diethyldithiocarbamate colorimetry

4.10.2.1 Rationale

Cu2+ reacts with sodium diethyldithiocarbamate (DDTC) in alkaline solution and produces brownish complex. Perform colorimetry after extracting with tetrachloride.

4.10.2.2 Reagents and materials

4.10.2.2.1 Tetrachloride

4.10.2.2.2 Sulfur acid solution[c(1/2 H_2SO_4)=2mol/L]: take 60ml concentrated sulfur acid and slowly add to 1000ml water. Cool the solution and mix well.

4.10.2.2.3 Sodium EDTA ammonium citrate solution: weigh 5 g sodium EDTA and 20g ammonium citrate. Dissolve in water and dilute to 100ml.

4.10.2.2.4 Ammonium hydroxide (1+1).

4.10.2.2.5 NaOH solution (0.05mol/L): prepare according to GB/T 601 and dilute accurately.

4.10.2.2.6 Sodium diethyldithiocarbamate (copper reagent) solution (1g/L): prepare according to GB/T 603 and store in a refrigerator.

4.10.2.2.7 Nitric acid solution (0.5%).

4.10.2.2.8 Copper standard stock solution (1ml solution contains 0.1mg copper): the same as 4.10.1.2.2.

4.10.2.2.9 Copper standard solution (1ml solution contains 10μg copper): the same as 4.10.1.2.3.

4.10.2.2.10 Copper standard series: pipette 0.00ml, 0.50ml, 1.00ml, 1.50 ml, 2.00ml and 2.50ml of copper standard solution(containing 0.0μg,5.0μg, 10.0 μg, 15.0μg, 20.0μg and 25.0μg, respectively) respectively. Transfer respectively to 6 separatory funnels of 125ml. Add sulfur acid solution (4.10.2.3.2) to each solution to 20ml. Then add 10ml sodium EDTA ammonium citrate solution and 3 drops of thymol blue indicator solution. Mix well. Adjust pH with ammonium hydroxide (the color of solution changes from yellow to light blue). Add water to 40ml. Then add 2ml of sodium diethyldithiocarbamate solution (copper reagent) and 10.00ml tetrachloride to each solution. Violently shake to extract for 2 minutes. Stay still to stratify. Then filter the layer of tetrachloride through anhydrous sodium sulfate or absorbent cotton to a 2cm colorimetric cup.

4.10.2.2.11 Thymol blue indicator solution (1g/L): weigh 0.1g thymol blue, dissolve in 4.3ml NaOH solution. Dilute with water to 100ml.

4.10.2.3 Instrument

4.10.2.3.1 Spectrophotometer

4.10.2.3.2 Separatory funnel: 125ml.

4.10.2.4 Preparation of test sample

The same as 4.9.2.4.

Note: sample size is 5ml for wet digestion method.

4.10.2.5 Analytical procedures

4.10.2.5.1 Plotting standard working curve: set the instrument to be in optimal condition. Adjust the wavelength to 440nm. Introduce the series of standard solution. Determine absorption of each solution. Plot a standard working curve of copper concentration vs. absorption (or establish regression equation).

4.10.2.5.2 Determination of the test sample: Pipette 10.00ml of test sample treated by dry method and the same volume of blank digested liquid, transfer to a 125ml separatory funnel, respectively. Or wash all the test sample treated by wet method and blank digested liquid to 125ml separatory funnel, respectively. The subsequent procedures are the same as described in 4.10.2.2.10 and 4.10.2.5.1(for the test sample treated by wet method, sulfur acid solution in step 4.10.2.2.10 is replaced by water, then add water to 20ml, the following procedures are the same). Determine the absorption of each solution. According to the value of absorption, check the standard curve and get the copper content (or use the regression equation to calculate).

4.10.2.6 Calculation of results

4.10.2.6.1 Calculation for dry method

The copper content in the sample is calculated as formula 18.

$$X = \frac{(c_1 - c_0) \times 1000}{V \times V_2 / V_1 \times 1000} = \frac{(c_1 - c_0) \times V_1}{V \times V_2} \quad \cdots\cdots(18)$$

Wherein,

X—is the copper content in the sample, expressed as mg/L;

c_1—is the copper content in the digested liquid of test sample for determination, expressed as µg;

c_0—is the copper content in blank liquid, expressed as µg; V is the volume of pipetted sample, expressed as ml;

V_1—is total volume of digested liquid of sample, expressed as ml;

V_2—is the volume of digested liquid of test sample for determination, expressed as ml.

4.10.2.6.2 Calculation for wet method

The copper content in the sample is calculated as formula 19.

$$X = \frac{A - A_0}{V} \quad \cdots\cdots (19)$$

Wherein,

X—is the copper content in the sample, expressed as mg/L;

A—is the copper content in the test sample for determination, expressed as µg;

A_0—is the copper content in the blank test, expressed as µg;

V—is the volume of pipetted sample, expressed as ml.

The result is presented to one decimal place.

4.10.2.7 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 10% of the arithmetic average.

4.11 Methanol

4.11.1 Gas chromatography

4.11.1.1 Rationale

After the test sample is gasified, it enters the chromatographic column with carrier gas. Since components to be determined have different distribution coefficient in gas and liquid phase, the transport rate of different components in the column differs from each other, thus the components can be separated. The separated components flow out of the column sequentially and then enter the hydrogen flame ionization detector. Determine the nature by comparing the retention time of the peak of the components on chromatogram with that of standard sample; determine the quantity based on peak area (or peak height) by internal standard method (ethanol is internal standard).

4.11.1.2 Reagents and materials

4.11.1.2.1 Ethanol[10%(volume fraction)]: chromatographic pure.

4.11.1.2.2 Methanol solution[2%(volume fraction)]: chromatographic pure, serving as a standard sample. Prepare with ethanol solution(4.11.1.2.1).

4.11.1.2.3 4-methyl-2-pentanol[2%(volume fraction)]: chromatographic pure, serving as a standard sample. Prepare with ethanol solution(4.11.1.2.1).

4.11.1.3 Instrument and equipment

4.11.1.3.1 Gas chromatography instrument: equipped with hydrogen flame ionization detector (FID).

4.11.1.3.2 Capillary column: PEG 20M capillary column(length is 35m~50m, inner diameter is 0.25mm, thickness of coating is 0.2μm). Or use other columns with equivalent analytical effects.

4.11.1.3.3 Micro-injector:1μL.

4.11.1.3.4 Glass distiller:500ml.

4.11.1.4 Analytical procedures

4.11.1.4.1 Chromatography conditions
Carrier gas(high-purity nitrogen): flow rate is 0.5ml/min~1.0ml/min, split ratio is about 50:1, flow rate of makeup gas is about 20ml/min~30ml/min;

Hygrogen gas : flow rate is 40ml/min;

Air : flow rate is 400ml/min;

Temperature of detector(T_D):220℃.

Temperature of injector (T_J):220℃.

Temperature of columnT_C): initial temperature is 40℃.Keep constant temperature for 4 minutes. Increase the temperature at the rate of 3.5℃/min to 200℃, continue to keep constant temperature for 10 minutes.

These chromatography conditions, such as flow rate of carrier gas, hydrogen gas and air, differ by Instrument. Determine optimal operation conditions by performing experiments. The criteria is that internal standard peak is completely separated from the peaks of other components in wine sample .

4.11.1.4.2 Determination of correction factor (f value)

Pipette 1.00ml methanol solution (4.11.1.2.2) and transfer to an 100ml volumetric flask. Add 1.00ml 4-methyl-2-pentanol solution (4.11.1.2.3). Dilute with ethanol solution (4.11.1.2.2) to volume. The concentrations of methanol and internal standard in the above solution are both

0.02%(volume fraction). After the baseline on the chromatography instrument stablizes, inject sample with micro-injector. The sample size is determined by the sensitivity of the instrument. Record the retention time and peak area (or peak height) of methanol and internal standard (ethanol), then calculate the ratio. According to the ratio, calculate the relative correction factor of methanol.

4.11.1.4.3 Preparation of test sample

Accurately transfer 100ml sample(20℃) with an 100ml volumetric flask which is clean and dry to a 500ml distilling flask. Use 50ml water to flush the volumetric flask for 3 times. Each time transfer the flushed liquid to the distilling flask. Then add several glass beads to the distilling flask and connect to the condenser. Use the original volumetric flask transfering sample as a receiver (in ice bath). Turn on the cooling water. Heat slowly to distill. Collect the distilled liquid until close to volume. Take away the volumetric flask and put in a stopper. Maintain the temperature of the flask in water bath at 20.0℃ for 30 minutes. Add water to volume. Mix well and store for future use.

4.11.1.4.4 Analytical procedures

Pipette 10.0ml of test sample (4.11.1.4.3) in a 10ml volumetric flask, add 0.1ml of 4-methyl-2-pentanol solution (4.11.1.2.3) to the flask. Mix well. Inject the sample in the same condition as in determing f value. Confirm the position of methanol peak according to the retention time and determine the peak area of methanol and internal standard (or peak height). Calculate the ratio between the peak areas (or peak heights). Then calculate the methnol content in the wine sample according to the ratio.

4.11.1.5 Calculation of results

The relative correction factor The relative response factor of methanol is calculated as formula 20. Methanol content in the sample is calculated as formula 21.

$$f = \frac{A_1}{A_2} \times \frac{d_2}{d_1} \quad \cdots\cdots (20)$$

$$X_1 = f \times \frac{A_3}{A_4} \times I \quad \cdots\cdots (21)$$

Wherein,

X_1—is methanol content in the sample, expressed as mg/l of 100 % ethanol;
f—is relative correction factor relative response factor of methanol;
A_1—is the peak area (or peak height) of internal standard (ethanol) when determining f value of standard sample;

A_2—is the peak area (or peak height) of methanol when determining f value of standard sample;

A_3—is peak area (or peak height) of methanol in test sample;
A_4—is peak area (or peak height) of internal standard added to (ethanol) in test sample;

d_2—is relative density of methanol; is methanol content in the standard sample, expressed as mg/l of 100 % ethanol;

d_1—is relative density of internal standard; is ethanol content in the standard sample, expressed as mg/l, d_1 = 789270 mg/L;

I—is content of internal standard (ethanol) (added to wine sample), expressed as mg/L, I = 789270 mg/L.

The result is presented as round number.

4.11.1.6 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 10% of the arithmetic average.

4.11.2 Colorimetry

4.11.2.1 Rationale

Methanol is oxidized to formaldehyde, then reacts with fuchsin-sulfurous acid to produce purple blue compound. Compare with the standard series to determine the quantity.

4.11.2.2 Reagents and materials

4.11.2.2.1 Potassium permanganate-phosphoric acid solution: weigh 3 g potassium permanganate, add to the solution mixed by 15ml phosphoric acid (85%) and 70ml water. After potassium permanganate is dissolved, add water to 100ml. Store in a brown bottle to prevent oxidation capacity from lowering. The storage period should not be too long.

4.11.2.2.2 Oxalic acid-sulfur acid solution: weigh 5g anhydrous oxalic acid (H_2C_2O4) or 7g oxalic acid containing 2 molecules of crystal water ($H_2C_2O4.2H_2O$). Dissolve in sulfur acid(1+1) and dilute to 100ml.

4.11.2.2.3 Fuchsin-sulfurous acid solution: weigh 0.1g alkaline fuchsin and grind to fine particles, then add 80℃ water to fushsin (add for several times, total volume of water is 60ml), grind while adding water to dissolve fuchsin. Pipette the solution of upper layer and filter to an 100ml volumetric flask. Cool the solution, then add 10ml sodium sulphite solution (100g/L) and 1ml HCl. Dilute with water to volume. Mix well. Store overnight. If the solution shows color, add a small amount of activated carbon and stir, then filter the solution. Store in a brown bottle and avoid light. If the solution turns red, discard it and re-prepare.

4.11.2.2.4 Methanol standard solution: weigh 1.000g methanol, transfer to an 100ml volumetric flask. Dilute with water to volume. This solution contains 10mg methanol per mL. Store at low temperature.

4.11.2.2.5 Methanol standard application solution: pipette 10.0ml methanol standard solution, transfer to an 100ml volumetric flask. Dilute with water to volume. Pipette another 10.0ml diluted solution, transfer to a 50ml volumetric flask, dilute with water to volume. This solution contains 0.50mg methanol per mL. Store at low temperature.

4.11.2.2.6 Ethanol solution without methanol: pipette 0.3ml solution, examine according instructions. The solution should have no color. If it has color, it needs to be treated. Take 300ml ethanol(95%), add a small amount of potassium permanganate to ethanol. Distill and collect distilled liquid. Add silver nitrate solution (take 1 g silver nitrate and dissolve in a small volume of water) and NaOH solution (take 1.5g NaOH and dissolve in a small volume of water) to distilled liquid. Mix well. Take supernatant to distill. Discard the first 50ml distilled liquid and collect about 200ml distilled liquid of mid-term. Determine the concentration of the distilled liquid by alcohol density meter. Then add water to the liquid to produce ethanol solution without methanol (60%).

4.11.2.2.7 Sodium sulphite solution (100g/L)

4.11.2.3 Instrument

Spectrophotometer

4.11.2.4 Preparation of test sample

Accurately transfer 100ml sample(20℃) with an 100ml volumetric flask which is clean and dry to a 500ml distilling flask. Use 50ml water to flush the volumetric flask for 3 times. Each time transfer the flushed liquid to the distilling flask. Then add several glass beads to the distilling flask and connect to the condenser. Use the original volumetric flask transfering sample as a receiver (in ice bath). Turn on the cooling water. Heat slowly to distill. Collect the distilled liquid until close to volume. Take away the volumetric flask and put in a stopper. Maintain the temperature of the flask in water bath at 20.0℃ for 30 minutes. Add water to volume. Mix well and store for future use.

4.11.2.5 Analytical procedures

Pipette an appropriate volume of test sample(4.11.2.4) according to ethanol concentraton in the sample[if the concentration is 10%, pipette 1.4ml; if the concentration is 20%, pipette 1.2ml].Transfer to a 25ml colorimetric tube with a stopper.

Pipette 0ml, 0.10ml, 0.20ml, 0.40ml, 0.60ml, 0.80ml and 1.00ml methanol standard application solution (equivalent to 0mg, 0.05mg, 0.10mg, 0.20mg, 0.30mg, 0.40mg and 0.50mg, respectively). Transfer to a 25ml colorimetric tube with a stopper, respectively. Dilute with ethanol solution not contaning methanol to 1.0ml.

Add 5ml water to sample tube and standard tube, respectively. Then add 2ml potassium permanganate-phosphoric acid solution to each tube. Mix well. Stay still for 10 minutes. Add 2ml oxalic acid-sulfur acid solution to each tube. Mix well to let the color fade away. Then add 5ml fuchsin-sulfurous acid solution to each tube. Mix well. Stay still for 0.5 hour at the temperature above 20℃. Use a 2cm colorimetric cup. Use zero adjusting tube to set zero. Determine absorption at the wavelength of 590nm. Compare with standard curve or standard color series.

4.11.2.6 Calculation of results

Methanol content in the sample is calculated as formula 22.

$$X = \frac{m_1}{V_1} \times 1000 \quad \cdots\cdots (22)$$

Wherein,

X—is methanol content in the sample, expressed as mg/L;

m_1—is mass of methanol in the sample, expressed as mg;

V_1—is the volume of pipetted sample, expressed as ml.

The result is presented as round number.

4.11.2.7 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 10% of the arithmetic average.

4.12 Ascorbic acid (Vitamin C)

4.12.1 Rationale

Reduced ascorbic acid can reduce 2,6-dichloroindophenol dye. The dye is red in acidic solution and the color of red disapperas when it is reduced. Reduced ascorbic acid is oxidized to dehydroascorbic acid after reducing the dye. If there is no interference of impurity, the amount of standard dye being reduced by a given volume of sample solution is proportional to the content of ascorbic acid in the sample.

4.12.2 Reagents and materials

4.12.2.1 Oxalic acid solution (10g/L): weigh 20g crystal oxalic acid and dissolve in 700ml water, then dilute with water to 1000ml. Take 500ml of this solution, dilute with water to 1000ml.

4.12.2.2 Potassium iodate standard solution (0.1mol/L): prepare and standardize according to GB/T 601.

4.12.2.3 Potassium iodate standard titration solution(0.001mol/L): pipette 1ml potassium iodate standard solution (4.12.2.2). dilute with water to 100ml. This solution contains 0.088μg ascorbic acid per mL.

4.12.2.4 Potassium iodide solution (60g/L).

4.12.2.5 Peroxide solution (3%): pipette 5ml of 30% peroxide solution, dilute with water to 50ml (prepare when needed).

4.12.2.6 Ascorbic acid standard stock solution (2g/L): weigh accurately 0.2g (the accuracy is 0.0001g) ascorbic acid which has been dried for 5 hours in a phosphorus pentoxide dryer, dissolve in oxalic acid solution and dilute to 100ml (store in a refrigerator).

4.12.2.7 Ascorbic acid standard application solution (0.020g/L): pipette 10ml ascorbic acid standard stock solution, dilute with oxalic acid solution (4.12.2.1) to 100ml.

Standardization: pipette 5ml ascorbic acid standard application solution, transfer to a conical flask. Add 0.5ml potassium iodide solution (4.12.2.4) and 3 drops of starch indicator solution. Titrate with potassium iodate standard titration solution until the solution turns light blue and does not change color within 30 seconds, i.e. the end point.

Concentration of ascorbic acid standard application solution is calculated as formula 23.

$$c_1 = \frac{V_1 \times 0.088}{V_2} \quad \cdots\cdots \quad (23)$$

Wherein,

c_1—is the concentration of ascorbic acid standard application solution, expressed as g/L;

V_1—is the volume of potassium iodate standard titration solution consumed in titration, expressed as ml;

V_2—is the volume of pipetted ascorbic acid standard application solution, expressed as ml;

0.088—is the amount of ascorbic acid equivalent to 1ml potassium iodate, expressed as g/L.

4.12.2.8 2,6-dichloroindophenol standard titration solution: weigh 52mg sodium bicarbonate, dissolve in 200ml hot distilled water. Then weigh 50mg 2,6-dichloroindophenol, dissolve in the above-mentioned sodium bicarbonate solution. Cool and dilute to 250ml, filter to a brown bottle, store in a refrigerator. This solution should be stored in a brown bottle and in a refrigerator. At least standardize once a week.

Standardization: pipette 5ml ascorbic acid standard application solution. add 10ml oxalic acid solution (4.12.2.1), shake to mix well. Titrate with 2,6-dichloroindophenol standard titration solution until the solution turns pink and does not change color within 30 seconds, i.e. the end point.

The number of mg of ascorbic acid in per mL of 2,6-dichloroindophenol standard titration solution is calculated as formula 24.

$$c_2 = \frac{c_1 \times V_1}{V_2} \quad \cdots\cdots \quad (24)$$

Wherein,

c_2—is the number of mg of ascorbic acid in per mL of 2,6-dichloroindophenol standard titration solution (titration degree), expressed as g/L;

c_1—is the concentration of ascorbic acid standard application solution, expressed as g/L;

V_1—is the volume of ascorbic acid standard application solution used in titration, expressed as ml;

V_2—is the volume of ascorbic acid standard application solution used in standardization, expressed as ml.

4.12.2.9 Starch indicator solution (10g/L): prepare according to GB/T 603.

4.12.3 Analytical procedures

Pipette accurately 5.00ml sample (20℃), transfer to an 100ml conical flask. Add 15ml oxalic acid solution (4.12.2.1) and 3 drops of peroxide solution (4.12.2.5), shake to mix well. Immediately titrate with 2,6-dichloroindophenol standard titration solution until the solution just turns pink and the color does not fade within 30 seconds, i.e. the end point.

Note: if the color of sample is too dark to observe the end point, discolor with white pottery clay before titration.

4.12.4 Calculation of results

Content of ascorbic acid in the sample is calculated as formula 25.

$$X = \frac{V \times c_2}{V_1} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (25)$$

Wherein,

X—is the content of ascorbic acid in the sample, expressed as g/L;

c_2—is the number of mg of ascorbic acid in per mL of 2,6-dichloroindophenol standard titration solution (titration degree), expressed as g/L;

V—is the volume of 2,6-dichloroindophenol standard titration solution consumed in titration, expressed as ml;

V_1—is the volume of pipetted sample, expressed as ml.

The result is presented as round number.

4.12.5 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 10% of the arithmetic average.

4.13 Sugar content and organic acids

Refer to appendix D for determination methods.

4.14 Resveratrol

Refer to appendix E for determination methods.

4.15 Sensory evaluation

Refer to appendix F for evaluation of wine and wild grape wine.

Appendix A

(Normative appendix)

Reference table for density of aqueous solution of alcohol vs. alcohol degree (alcohol content) (20)

Table A.1 Reference table for density of aqueous solution of alcohol vs. alcohol degree (alcohol content) (20℃)

Density (g/L)	Alcohol Degree (%vol)	Density (g/L)	Alcohol Degree (%vol)	Density (g/L)	Alcohol Degree (%vol)
998.20	0.00	997.43	0.51	996.68	1.01
998.18	0.01	997.42	0.52	996.66	1.02
998.16	0.03	997.40	0.53	996.64	1.04
998.14	0.04	997.38	0.54	996.62	1.05
998.12	0.05	997.36	0.56	996.61	1.06
998.10	0.06	997.34	0.57	996.59	1.07
998.08	0.08	997.32	0.58	996.57	1.09
998.07	0.09	997.30	0.59	996.55	1.10
998.05	0.10	997.28	0.61	996.53	1.11
998.03	0.11	997.26	0.62	996.51	1.12
998.01	0.13	997.24	0.63	996.49	1.14
997.99	0.14	997.23	0.64	996.48	1.15
997.97	0.15	997.21	0.66	996.46	1.16
997.95	0.16	997.19	0.67	996.44	1.17
997.93	0.18	997.17	0.68	996.42	1.19
997.91	0.19	997.15	0.69	996.40	1.20
997.89	0.20	997.13	0.71	996.38	1.21
997.87	0.21	997.11	0.72	996.36	1.22
997.85	0.23	997.09	0.73	996.34	1.24
997.83	0.24	997.07	0.75	996.33	1.25
997.82	0.25	997.06	0.76	996.31	1.26
997.80	0.27	997.04	0.77	996.29	1.27
997.78	0.28	997.02	0.78	996.27	1.29
997.76	0.29	997.00	0.80	996.25	1.30
997.74	0.30	996.98	0.81	996.23	1.31
997.72	0.32	996.96	0.82	996.21	1.33
997.70	0.33	996.94	0.83	996.20	1.34
997.68	0.34	996.92	0.85	996.18	1.35
997.66	0.35	996.91	0.86	996.16	1.36
997.64	0.37	996.89	0.87	996.14	1.38
997.62	0.38	996.87	0.88	996.12	1.39
997.61	0.39	99.85	0.90	996.10	1.40
997.59	0.40	996.83	0.91	996.09	1.41
997.57	0.42	996.81	0.92	996.07	1.43
997.55	0.43	996.79	0.93	996.05	1.44
997.53	0.44	996.77	0.95	996.03	1.45
997.51	0.46	996.76	0.96	996.01	1.46
997.49	0.47	996.74	0.97	995.99	1.48
997.47	0.48	996.72	0.99	995.97	1.49
997.45	0.49	996.70	1.00	995.96	1.50

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
995.94	1.51	995.10	2.09	994.27	2.67
995.92	1.53	995.08	2.11	994.25	2.68
995.90	1.54	995.06	2.12	994.23	2.70
995.88	1.55	995.04	2.13	994.22	2.71
995.86	1.56	995.02	2.14	994.20	2.72
995.85	1.58	995.01	2.16	994.18	2.73
995.83	1.59	994.99	2.17	994.16	2.75
995.81	1.60	994.97	2.18	994.15	2.76
995.79	1.62	994.95	2.19	994.13	2.77
995.77	1.63	994.93	2.21	994.11	2.78
995.75	1.64	994.92	2.22	994.09	2.81
995.74	1.65	994.90	2.23	994.07	2.81
995.72	1.67	994.88	2.24	994.06	2.82
995.70	1.68	994.86	2.26	994.04	2.83
995.68	1.69	994.84	2.27	994.02	2.85
995.66	1.70	994.83	2.28	994.00	2.86
995.64	1.72	994.81	2.29	993.99	2.87
995.63	1.73	994.79	2.31	993.97	2.88
995.61	1.74	994.77	2.32	993.95	2.90
995.59	1.75	994.75	2.33	993.93	2.91
995.57	1.77	994.74	2.34	993.91	2.92
995.55	1.78	994.72	2.36	993.90	2.93
995.53	1.79	994.70	2.37	993.88	2.95
995.52	1.80	994.68	2.38	993.86	2.96
995.50	1.82	994.66	2.39	993.84	2.97
995.48	1.83	994.65	2.41	993.83	2.98
995.46	1.84	994.63	2.42	993.81	3.00
995.44	1.85	994.61	2.43	993.79	3.01
995.42	1.87	994.59	2.44	993.77	3.02
995.41	1.88	994.57	2.46	993.76	3.03
995.39	1.89	994.56	2.47	993.74	3.05
995.37	1.90	994.54	2.48	993.72	3.06
995.35	1.92	994.52	2.50	993.70	3.07
995.33	1.93	994.50	2.51	993.69	3.08
995.32	1.94	994.48	2.52	993.67	3.10
995.30	1.95	994.47	2.53	993.65	3.11
995.28	1.97	994.45	2.55	993.63	3.12
995.26	1.98	994.43	2.56	993.61	3.13
995.24	1.99	994.41	2.57	993.60	3.15
995.22	2.01	994.40	2.58	993.58	3.16
995.21	2.02	994.38	2.60	993.56	3.17
995.19	2.03	994.36	2.61	993.54	3.18
995.17	2.04	994.34	2.62	993.53	3.20
995.15	2.06	994.32	2.63	993.51	3.21
995.13	2.07	994.31	2.65	993.49	3.22
995.12	2.08	994.29	2.66	993.47	3.24

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
993.46	3.25	992.66	3.82	991.87	4.40
993.44	3.26	992.64	3.84	991.85	4.41
993.42	3.27	992.62	3.85	991.83	4.42
993.40	3.29	992.60	3.86	991.82	4.44
993.39	3.30	992.59	3.87	991.80	4.45
993.37	3.31	992.57	3.89	991.78	4.46
993.35	3.32	992.55	3.90	991.77	4.47
993.33	3.34	992.54	3.91	991.75	4.49
993.32	3.35	992.52	3.92	991.73	4.50
993.30	3.36	992.50	3.94	991.71	4.51
993.28	3.37	992.48	3.95	991.70	4.52
993.26	3.39	992.47	3.96	991.68	4.54
993.25	3.40	992.45	3.97	991.66	4.55
993.23	3.41	992.43	3.99	991.65	4.56
993.21	3.42	992.41	4.00	991.63	4.57
993.19	3.44	992.40	4.01	991.61	4.59
993.18	3.45	992.38	4.02	991.60	4.60
993.16	3.46	992.36	4.04	991.58	4.61
993.14	3.47	992.35	4.05	991.56	4.62
993.12	3.49	992.33	4.06	991.54	4.64
993.11	3.50	992.31	4.07	991.53	4.65
993.09	3.51	992.29	4.09	991.51	4.66
993.07	3.52	992.28	4.10	991.49	4.67
993.05	3.54	992.26	4.11	991.48	4.69
993.04	3.55	992.24	4.12	991.46	4.70
993.02	3.56	992.23	4.14	991.44	4.71
993.00	3.57	992.21	4.15	991.43	4.72
992.99	3.59	992.19	4.16	991.41	4.74
992.97	3.60	992.17	4.17	991.39	4.75
992.95	3.61	992.16	4.19	991.38	4.76
992.93	3.62	992.14	4.20	991.36	4.77
992.92	3.64	992.12	4.21	991.34	4.79
992.90	3.65	992.11	4.22	991.33	4.80
992.88	3.66	992.09	4.24	991.31	4.81
992.86	3.67	992.07	4.25	991.29	4.82
992.85	3.69	992.05	4.26	991.28	4.84
992.83	3.70	992.04	4.27	991.26	4.85
992.81	3.71	992.02	4.29	991.24	4.86
992.79	3.72	992.00	4.30	991.22	4.87
992.78	3.74	991.99	4.31	991.21	4.89
992.76	3.75	991.97	4.32	991.19	4.90
992.74	3.76	991.95	4.34	991.17	4.91
992.72	3.77	991.94	4.35	991.16	4.92
992.71	3.79	991.92	4.36	991.14	4.94
992.69	3.80	991.90	4.37	991.12	4.95
992.67	3.81	991.88	4.39	991.11	4.96

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
991.09	4.97	990.33	5.55	989.57	6.12
991.07	4.99	990.31	5.56	989.56	6.13
991.06	5.00	990.29	5.57	989.54	6.14
991.04	5.01	990.28	5.58	989.52	6.16
991.02	5.02	990.26	5.60	989.51	6.17
991.01	5.04	990.24	5.61	989.49	6.18
990.99	5.05	990.23	5.62	989.47	6.19
990.97	5.06	990.21	5.63	989.46	6.21
990.96	5.07	990.19	5.65	989.44	6.22
990.94	5.09	990.18	5.66	989.43	6.23
990.92	5.10	990.16	5.67	989.41	6.24
990.91	5.11	990.14	5.68	989.39	6.26
990.89	5.12	990.13	5.70	989.38	6.27
990.87	5.13	990.11	5.71	989.36	6.28
990.86	5.15	990.09	5.72	989.34	6.29
990.84	5.16	990.08	5.73	989.33	6.31
990.82	5.17	990.06	5.75	989.31	6.32
990.81	5.18	990.05	5.76	989.30	6.33
990.79	5.20	990.03	5.77	989.28	6.34
990.77	5.21	990.01	5.78	989.26	6.36
990.76	5.22	990.00	5.80	989.25	6.37
990.74	5.23	989.98	5.81	989.23	6.38
990.72	5.25	989.96	5.82	989.21	6.39
990.71	5.26	989.95	5.83	989.20	6.40
990.69	5.27	989.93	5.85	989.18	6.42
990.67	5.28	989.91	5.86	989.17	6.43
990.66	5.30	989.90	5.87	989.15	6.44
990.64	5.31	989.88	5.88	989.13	6.45
990.62	5.32	989.87	5.89	989.12	6.47
990.61	5.33	989.85	5.91	989.10	6.48
990.59	5.35	989.83	5.92	989.09	6.49
990.57	5.36	989.82	5.93	989.07	6.50
990.56	5.37	989.80	5.94	989.05	6.52
990.54	5.38	989.78	5.96	989.04	6.53
990.52	5.40	989.77	5.97	989.02	6.54
990.51	5.41	989.75	5.98	989.01	6.55
990.49	5.42	989.73	5.99	988.99	6.57
990.47	5.43	989.72	6.01	988.97	6.58
990.46	5.45	989.70	6.02	988.96	6.59
990.44	5.46	989.69	6.03	988.94	6.60
990.42	5.47	989.67	6.04	988.92	6.62
990.41	5.48	989.65	6.06	988.91	6.63
990.39	5.50	989.64	6.07	988.89	6.64
990.37	5.51	989.62	6.08	988.88	6.65
990.36	5.52	689.60	6.09	988.86	6.67
990.34	5.53	989.59	6.11	988.84	6.68

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
988.83	6.69	988.11	7.25	987.39	7.82
988.81	6.70	988.10	7.26	987.37	7.83
988.80	6.72	988.08	7.27	987.36	7.84
988.78	6.73	988.06	7.29	987.34	7.86
988.76	6.74	988.05	7.30	987.33	7.87
988.75	6.75	988.03	7.31	987.31	7.88
988.73	6.77	988.02	7.32	987.30	7.89
988.72	6.78	988.00	7.34	987.28	7.91
988.70	6.79	987.99	7.35	987.27	7.92
988.68	6.80	987.97	7.36	987.25	7.93
988.67	6.81	987.95	7.37	987.23	7.94
988.65	6.83	987.94	7.39	987.22	7.96
988.64	6.84	987.92	7.40	987.20	7.97
988.62	6.85	987.91	7.41	987.19	7.98
988.60	6.86	987.89	7.42	987.17	7.99
988.59	6.88	987.88	7.44	987.16	8.01
988.57	6.89	987.86	7.45	987.14	8.02
988.56	6.90	987.84	7.46	987.13	8.03
988.54	6.91	987.83	7.47	987.11	8.04
988.52	6.93	987.81	7.48	987.09	8.05
988.51	6.94	987.80	7.50	987.08	8.07
988.49	6.95	987.78	7.51	987.06	8.08
988.48	6.96	987.77	7.52	987.05	8.09
988.46	6.98	987.75	7.53	987.03	8.10
988.45	6.99	987.73	7.55	987.02	8.12
988.43	7.00	987.72	7.56	987.00	8.13
988.41	7.01	987.70	7.57	986.99	8.14
988.40	7.03	987.69	7.58	986.97	8.15
988.38	7.04	987.67	7.60	986.96	8.17
988.37	7.05	987.66	7.61	986.94	8.18
988.35	7.06	987.64	7.62	986.92	8.19
988.33	7.08	987.62	7.63	986.91	8.20
988.32	7.09	987.61	7.65	986.89	8.22
988.30	7.10	987.59	7.66	986.88	8.23
988.29	7.11	987.58	7.67	986.86	8.24
988.27	7.12	987.56	7.68	986.85	8.25
988.25	7.14	987.55	7.70	986.83	8.26
988.24	7.15	987.53	7.71	986.82	8.28
988.22	7.16	987.51	7.72	986.80	8.29
988.21	7.17	987.50	7.73	986.79	8.30
988.19	7.19	987.48	7.74	986.77	8.31
988.18	7.20	987.47	7.76	986.75	8.33
988.16	7.21	987.45	7.77	986.74	8.34
988.14	7.22	987.44	7.78	986.72	8.35
988.13	7.24	987.42	7.79	986.71	8.36
		987.41	7.81	986.69	8.38

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
986.68	8.39	985.98	8.96	985.28	9.53
986.66	8.40	985.96	8.97	985.27	9.54
986.65	8.41	985.94	8.98	985.25	9.55
986.63	8.43	985.93	8.99	985.24	9.56
986.62	8.44	985.91	9.01	985.22	9.57
986.60	8.45	985.90	9.02	985.21	9.59
986.59	8.46	985.88	9.03	985.19	9.60
986.57	8.48	985.87	9.04	985.18	9.61
986.55	8.49	985.85	9.06	985.16	9.62
986.54	8.50	985.84	9.07	985.15	9.64
986.52	8.51	985.82	9.08	985.13	9.65
986.51	8.52	985.81	9.09	985.12	9.66
986.49	8.54	985.79	9.11	985.10	9.67
986.48	8.55	985.78	9.12	985.09	9.69
986.46	8.56	985.76	9.13	985.07	9.70
986.45	8.57	985.75	9.14	985.06	9.71
986.43	8.59	985.73	9.16	985.04	9.72
986.42	8.60	985.72	9.17	985.03	9.74
986.40	8.61	985.70	9.18	985.01	9.75
986.39	8.62	985.69	9.19	985.00	9.76
986.37	8.64	985.67	9.20	984.98	9.77
986.36	8.65	985.66	9.22	984.97	9.78
986.34	8.66	985.64	9.23	984.95	9.80
986.33	8.67	985.63	9.24	984.94	9.81
986.31	8.69	985.61	9.25	984.92	9.82
986.29	8.70	985.60	9.27	984.91	9.83
986.28	8.71	985.58	9.28	984.89	9.85
986.26	8.72	985.57	9.29	984.88	9.86
986.25	8.73	985.55	9.30	984.86	9.87
986.23	8.75	985.54	9.32	984.85	9.88
986.22	8.76	985.52	9.33	984.84	9.90
986.20	8.77	985.51	9.34	984.82	9.91
986.19	8.78	985.49	9.35	984.81	9.92
986.17	8.80	985.48	9.36	984.79	9.93
986.16	8.81	985.46	9.38	984.78	9.94
986.14	8.82	985.45	9.39	984.76	9.96
986.13	8.83	985.43	9.40	984.75	9.97
986.11	8.85	985.42	9.41	984.73	9.98
986.10	8.86	985.40	9.43	984.72	9.99
986.08	8.87	985.39	9.44	984.70	10.01
986.07	8.88	985.37	9.45	984.69	10.02
986.05	8.90	982.36	9.46	984.67	10.03
986.04	8.91	985.34	9.48	984.66	10.04
986.02	8.92	985.33	9.49	984.64	10.06
986.01	8.93	985.31	9.50	984.63	10.07
985.99	8.95	985.30	9.51	984.61	10.08

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
984.60	10.09	983.92	10.66	983.26	11.23
984.58	10.10	983.91	10.67	983.24	11.24
984.57	10.12	983.89	10.68	983.23	11.25
984.55	10.13	983.88	10.70	983.21	11.26
984.54	10.14	983.86	10.71	983.20	11.27
984.52	10.15	983.85	10.72	983.18	11.29
984.51	10.17	983.84	10.73	983.17	11.30
984.49	10.18	983.82	10.75	983.15	11.31
984.48	10.19	983.81	10.76	983.14	11.32
984.47	10.20	983.79	10.77	983.13	11.34
984.45	10.22	983.78	10.78	983.11	11.35
984.44	10.23	983.76	10.79	983.10	11.36
984.42	10.24	983.75	10.81	983.08	11.37
984.41	10.25	983.73	10.82	983.07	11.38
984.39	10.27	983.72	10.83	983.05	11.40
984.38	10.28	983.70	10.84	983.04	11.41
984.36	10.29	983.69	10.86	983.03	11.42
984.35	10.30	983.68	10.87	983.01	11.43
984.33	10.31	983.66	10.88	983.00	11.45
984.32	10.33	983.65	10.89	982.98	11.46
984.30	10.34	983.63	10.91	982.97	11.47
984.29	10.35	983.62	10.92	982.95	11.48
984.27	10.36	983.60	10.93	982.94	11.50
984.26	10.38	983.59	10.94	982.93	11.51
984.24	10.39	983.57	10.95	982.91	11.52
984.23	10.40	983.56	10.97	982.90	11.53
984.22	10.41	983.54	10.98	982.88	11.54
984.20	10.43	983.53	10.99	982.87	11.56
984.19	10.44	983.52	11.00	982.85	11.57
984.17	10.45	983.50	11.02	982.84	11.58
984.16	10.46	983.49	11.03	982.82	11.59
984.14	10.47	983.47	11.04	982.81	11.61
984.13	10.49	983.46	11.05	982.80	11.62
984.11	10.50	983.44	11.07	982.78	11.63
984.10	10.51	983.43	11.08	982.77	11.64
984.08	10.52	983.41	11.09	982.75	11.66
984.07	10.54	983.40	11.10	982.74	11.67
984.05	10.55	983.39	11.11	982.72	11.68
984.04	10.56	983.37	11.13	982.71	11.69
984.03	10.57	983.36	11.14	982.70	11.70
984.01	10.59	983.34	11.15	982.68	11.72
984.00	10.60	983.33	11.16	982.67	11.73
983.98	10.61	983.31	11.18	982.65	11.74
983.97	10.62	983.30	11.19	982.64	11.75
983.95	10.63	983.28	11.20	982.63	11.77
983.94	10.65	983.27	11.21	982.61	11.78

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
982.60	11.79	981.94	12.35	981.30	12.92
982.58	11.80	981.93	12.37	981.29	12.93
982.57	11.81	981.92	12.38	981.27	12.94
982.55	11.83	981.90	12.39	981.26	12.96
982.54	11.84	981.89	12.40	981.24	12.97
982.53	11.85	981.87	12.42	981.23	12.98
982.51	11.86	981.86	12.43	981.22	12.99
982.50	11.88	981.85	12.44	981.20	13.00
982.48	11.89	981.83	12.45	981.19	13.02
982.47	11.90	981.82	12.47	981.18	13.03
982.45	11.91	981.80	12.48	981.16	13.04
982.44	11.93	981.79	12.49	981.15	13.05
982.43	11.94	981.78	12.50	981.13	13.07
982.41	11.95	981.76	12.51	981.12	13.08
982.40	11.96	981.75	12.53	981.11	13.09
982.38	11.97	981.73	12.54	981.09	13.10
982.37	11.99	981.73	12.55	981.08	13.11
982.35	12.00	981.71	12.56	981.06	13.12
982.34	12.01	981.69	12.58	981.05	13.14
982.33	12.02	981.69	12.59	981.04	13.15
982.31	12.04	981.66	12.60	981.02	13.16
982.30	12.05	981.65	12.61	981.01	13.18
982.28	12.06	981.64	12.62	980.99	13.19
982.27	12.07	981.62	12.64	980.98	13.20
982.26	12.08	981.61	12.65	980.97	13.21
982.24	12.10	981.59	12.66	980.95	13.22
982.23	12.11	981.58	12.67	980.94	13.24
982.21	12.12	981.57	12.69	980.93	13.25
982.20	12.13	981.55	12.70	980.91	13.26
982.18	12.15	981.54	12.71	980.90	13.27
982.17	12.16	981.52	12.72	980.88	13.29
982.16	12.17	981.51	12.73	980.87	13.30
982.14	12.18	981.50	12.75	980.86	13.31
982.13	12.20	981.48	12.76	980.84	13.32
982.11	12.21	981.47	12.77	980.83	13.33
982.10	12.22	981.45	12.78	980.81	13.35
982.09	12.23	981.44	12.80	980.80	13.36
982.07	12.24	981.43	12.81	980.79	13.37
982.06	12.26	981.41	12.82	980.77	13.38
982.04	12.27	981.40	12.83	980.76	13.40
982.03	12.28	981.38	12.85	980.75	13.41
982.02	12.29	981.37	12.86	980.73	13.42
982.00	12.31	981.36	12.87	980.72	13.43
981.99	12.32	981.34	12.88	980.70	13.45
981.97	12.33	981.33	12.89	980.69	13.46
981.96	12.34	981.31	12.91	980.68	13.47

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
980.66	13.48	980.03	14.04	979.41	14.61
980.65	13.49	980.02	14.06	979.39	14.62
980.64	13.51	980.00	14.07	979.38	14.63
980.62	13.52	979.99	14.08	979.36	14.64
980.61	13.53	979.98	14.09	979.35	14.65
980.59	13.54	979.96	14.11	979.34	14.67
980.58	13.56	979.95	14.12	979.32	14.68
980.57	13.57	979.94	14.13	979.31	14.69
980.55	13.58	979.92	14.14	979.30	14.70
980.54	13.59	979.91	14.15	979.28	14.72
980.52	13.60	979.89	14.17	979.27	14.73
980.51	13.62	979.88	14.18	979.26	14.74
980.50	13.63	979.87	14.19	979.24	14.75
980.48	13.64	979.85	14.20	979.23	14.76
980.47	13.65	979.84	14.22	979.22	14.78
980.46	13.67	979.83	14.23	979.20	14.79
980.44	13.68	979.81	14.24	979.19	14.80
980.43	13.69	979.80	14.25	979.18	14.81
980.41	13.70	979.79	14.26	979.16	14.83
980.40	13.71	979.77	14.28	979.15	14.84
980.39	13.73	979.76	14.29	979.13	14.85
980.37	13.74	979.74	14.30	979.12	14.86
980.36	13.75	979.73	14.31	979.11	14.87
980.35	13.76	979.72	14.33	979.09	14.89
980.33	13.78	979.70	14.34	979.08	14.90
980.32	13.79	979.69	14.35	979.07	14.91
980.31	13.80	979.68	14.36	979.05	14.92
980.29	13.81	979.66	14.37	979.04	14.94
980.28	13.82	979.65	14.39	979.03	14.95
980.26	13.84	979.64	14.40	979.01	14.96
980.25	13.85	979.62	14.41	979.00	14.97
980.24	13.86	979.61	14.42	978.99	14.98
980.22	13.87	979.60	14.44	978.97	15.00
980.21	13.89	979.58	14.45	978.96	15.01
980.20	13.90	979.57	14.46	978.95	15.02
980.18	13.91	979.55	14.47	978.93	15.03
980.17	13.92	979.54	14.48	978.92	15.05
980.15	13.93	979.53	14.50	978.91	15.06
980.14	13.95	979.51	14.51	978.89	15.07
980.13	13.96	979.50	14.52	978.88	15.08
980.11	13.97	979.49	14.53	978.87	15.09
980.10	13.98	979.47	14.55	978.85	15.11
980.09	14.00	979.46	14.56	978.84	15.12
980.07	14.01	979.45	14.57	978.83	15.13
980.06	14.02	979.43	14.58	978.81	15.14
980.04	14.03	979.42	14.59	978.80	15.16

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
978.78	15.17	978.17	15.73	977.56	16.29
978.77	15.18	978.16	15.74	977.54	16.30
978.76	15.19	978.14	15.75	977.53	16.31
978.74	15.20	978.13	15.76	977.52	16.32
978.73	15.22	978.12	15.78	977.50	16.34
978.72	15.23	978.10	15.79	977.49	16.35
978.70	15.24	978.09	15.80	977.48	16.36
978.69	15.25	978.08	15.81	977.46	16.37
978.68	15.26	978.06	15.83	977.45	16.39
978.66	15.28	978.05	15.84	977.44	16.40
978.65	15.29	978.04	15.85	977.43	16.41
978.64	15.30	978.02	15.86	977.41	16.42
978.62	15.31	978.01	15.87	977.40	16.43
978.61	15.33	978.00	15.89	977.39	16.45
978.60	15.34	977.98	15.90	977.37	16.46
978.58	15.35	977.97	15.91	977..36	16.47
978.57	15.36	977.96	15.92	977.35	16.48
978.56	15.37	977.94	15.93	977.33	16.49
978.54	15.39	977.93	15.95	977.32	16.51
978.53	15.40	977.92	15.96	977.31	16.52
978.52	15.41	977.90	15.97	977.29	16.53
978.50	15.42	977.89	15.98	977.28	16.54
978.49	15.44	977.88	16.00	977.27	16.56
978.49	15.45	977.86	16.01	977.25	16.57
978.46	15.46	977.85	16.02	977.24	16.58
978.45	15.47	977.84	16.03	977.23	16.59
978.44	15.48	977.82	16.04	977.21	16.60
978.42	15.50	977.81	16.06	977.20	16.62
978.41	15.51	977.80	16.07	977.19	16.63
978.40	15.52	977.78	16.08	977.17	16.64
978.38	15.53	977.77	16.09	977.16	16.65
978.37	15.55	977.76	16.11	977.15	16.66
978.36	15.56	977.74	16.12	977.13	16.68
978.34	15.57	977.73	16.13	977.12	16.69
978.33	15.58	977.72	16.14	977.11	16.70
978.32	15.59	97.70	16.15	977.09	16.71
978.30	15.61	977.69	16.17	977.08	16.73
978.29	15.62	977.68	16.18	977.07	16.74
978.28	15.63	977.66	16.19	977.06	16.7
978.26	15.64	977.65	16.20	977.04	16.76
978.25	15.65	977.64	16.21	977.03	16.77
978.24	15.67	977.62	16.23	977.02	16.79
978.22	15.68	977.61	16.24	977.00	6.80
978.21	15.69	977.60	16.25	976.99	16.81
978.20	15.70	977.58	16.26	976.98	16.82
978.18	15.72	977.57	16.28	976.96	16.84

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
976.95	16.85	976.35	17.41	975.74	17.96
976.94	16.86	976.33	17.42	975.73	17.98
976.92	16.87	976.32	17.43	975.72	17.99
976.91	16.88	976.31	17.44	975.70	18.00
976.90	16.90	976.29	17.45	975.69	18.01
976.88	16.91	976.28	17.47	975.68	18.02
976.87	16.92	976.27	14.48	975.67	18.04
976.86	16.93	976.25	17.49	975.65	18.05
976.84	16.94	976.24	17.50	975.64	18.06
976.83	16.96	976.23	17.52	975.63	18.07
976.82	16.97	976.21	17.53	975.61	18.08
976.81	16.98	976.20	17.54	975.60	18.10
976.79	16.99	976.19	17.55	975.59	18.10
976.78	17.01	976.18	17.56	975.57	18.12
976.77	17.02	976.16	17.58	975.56	18.13
976.75	17.03	976.15	17.59	975.55	18.15
976.74	17.04	976.14	17.60	975.53	18.16
976.73	17.05	976.12	17.61	975.52	18.17
976.71	17.07	976.11	17.62	975.51	18.18
976.70	17.08	976.10	17.64	975.50	18.19
976.69	17.09	976.08	17.65	975.48	18.21
976.67	17.10	976.07	17.66	975.47	18.22
976.66	17.11	976.06	17.67	975.46	18.23
976.65	17.13	976.04	17.68	975.44	18.24
976.63	17.14	976.03	17.70	975.43	18.25
976.62	17.15	976.02	17.71	975.42	18.27
976.61	17.16	976.00	17.72	975.40	18.28
976.59	17.18	975.99	17.73	975.39	18.29
976.58	17.19	975.98	17.75	975.38	18.30
976.57	17.20	975.97	17.76	975.37	18.32
976.56	17.21	975.95	17.77	975.35	18.33
976.54	17.22	975.94	17.78	975.34	18.34
976.53	17.24	975.93	17.79	975.33	18.35
976.52	17.25	975.91	17.81	975.31	18.36
976.50	17.26	975.90	17.82	975.30	18.38
976.49	17.27	975.89	17.83	975.29	18.39
976.48	17.28	975.87	17.84	975.27	18.40
976.46	17.30	975.86	17.85	975.26	18.41
976.45	17.31	975.85	17.87	975.25	18.42
976.44	17.32	975.84	17.88	975.24	18.44
976.42	17.33	975.82	17.89	975.22	18.45
976.41	17.35	975.81	17.90	975.21	18.46
976.40	17.36	975.80	17.92	975.20	18.47
976.38	17.37	975.78	17.93	975.18	18.48
976.37	17.38	975.77	17.94	975.17	18.50
976.36	17.39	975.76	17.95	975.16	18.51

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
975.14	18.52	974.55	19.08	973.95	19.63
975.13	18.53	974.53	19.09	973.94	19.65
975.12	18.55	974.52	19.10	973.92	19.66
975.11	18.56	974.51	19.11	973.91	19.67
975.09	18.57	974.49	19.13	973.90	19.68
975.08	18.58	974.48	19.14	973.88	19.69
975.07	18.59	974.47	19.15	973.87	19.71
975.05	18.61	974.46	19.16	973.86	19.72
975.04	18.62	974.44	19.17	973.85	19.73
975.03	18.63	974.43	19.19	973.83	19.74
975.01	18.64	974.42	19.20	973.82	19.75
975.00	18.65	974.40	19.21	973.81	19.77
974.99	18.67	974.39	19.22	973.79	19.78
974.97	18.68	974.38	19.23	973.78	19.79
974.96	18.69	974.36	19.25	973.77	19.80
974.95	18.70	974.35	19.26	973.75	19.81
974.94	18.71	974.34	19.27	973.74	19.83
974.92	18.73	974.33	19.28	973.73	19.84
974.91	18.74	974.31	19.30	973.72	19.85
974.90	18.75	974.30	19.31	973.70	19.86
974.88	18.76	974.29	19.32	973.69	19.88
974.87	18.78	974.27	19.33	973.68	19.89
974.86	18.79	974.26	19.34	973.66	19.90
974.84	18.80	974.25	19.36	973.65	19.91
974.83	18.81	974.23	19.37	973.64	19.92
974.82	18.82	974.22	19.38	973.62	19.94
974.81	18.84	974.21	19.39	973.61	19.95
974.79	18.85	974.20	19.40	973.60	19.96
974.78	18.86	974.18	19.42	973.59	19.97
974.77	18.87	974.17	19.43	973.57	19.98
974.75	18.88	974.16	19.44	973.56	20.00
974.74	18.90	974.14	19.45	973.55	20.01
974.73	18.91	974.13	19.46	973.53	20.02
974.71	18.92	974.12	19.48	973.52	20.03
974.70	18.93	974.10	19.49	973.51	20.04
974.69	18.94	974.09	19.50	973.50	20.06
974.68	18.96	974.08	19.51	973.48	20.07
974.66	18.97	974.07	19.53	973.47	20.08
974.65	18.98	974.05	19.54	973.46	20.09
974.64	18.99	974.04	19.55	973.44	20.10
974.62	19.01	974.03	19.56	973.43	20.12
974.61	19.02	974.01	19.57	973.42	20.13
974.60	19.03	974.00	19.59	973.40	20.14
974.59	19.04	973.99	19.60	973.39	20.15
974.57	19.05	973.98	19.61	973.38	20.16
974.56	19.07	973.96	19.62	973.37	20.18

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
973.35	20.19	972.76	20.74	972.16	21.30
973.34	20.20	972.74	20.76	972.15	21.31
973.33	20.21	972.73	20.77	972.13	21.32
973.31	20.23	972.72	20.78	972.12	21.33
973.30	20.24	972.70	20.79	972.11	21.35
973.29	20.25	972.69	20.80	972.09	21.36
973.28	20.26	972.68	20.82	972.08	21.37
973.26	20.27	972.67	20.83	972.07	21.38
973.25	20.29	972.65	20.84	972.05	21.39
973.24	20.30	972.64	20.85	972.04	21.41
973.22	20.31	972.63	20.86	972.03	21.42
973.21	20.32	972.61	20.88	972.02	21.43
973.20	20.33	972.60	20.89	972.00	21.44
973.18	20.35	972.59	20.90	971.99	21.45
973.17	20.36	972.57	20.91	971.98	211.47
973.16	20.37	972.56	20.92	971.96	21.48
973.15	20.38	972.55	20.94	971.95	21.49
973.13	20.69	972.54	20.95	971.94	21.50
973.12	20.41	972.52	20.96	971.93	21.51
973.11	20.42	972.51	20.97	971.91	21.53
973.09	20.43	972.50	20.98	971.90	21.54
973.08	20.44	972.48	21.00	971.89	21.55
973.07	20.45	972.47	21.01	971.87	21.56
973.05	20.47	972.46	21.02	971.86	21.57
973.04	20.48	972.45	21.03	971.85	21.59
973.0	20.49	972.43	21.04	971.83	21.60
973.02	20.50	972.42	21.06	971.82	21.61
973.00	20.51	972.41	21.07	971.81	21.62
972.99	20.53	972.39	21.08	971.80	21.63
972.98	20.54	972.38	21.09	971.78	21.65
972.96	20.55	972.37	21.10	971.77	21.66
972.95	20.56	972.35	21.12	971.76	21.67
972.94	20.57	972.34	21.13	971.74	21.68
972.92	20.59	972.33	21.14	971.73	21.69
972.91	20.60	972.32	21.15	971.72	21.71
972.90	20.61	972.30	21.17	971.70	21.72
972.89	20.62	972.29	21.18	971.69	21.73
972.87	20.64	972.28	21.19	971.68	21.74
972.86	20.65	972.26	21.20	971.67	21.75
972.85	20.66	972.25	21.21	971.65	21.77
972.83	20.67	972.24	21.23	971.64	21.78
972.82	20.68	972.22	21.24	971.63	21.79
972.81	20.70	972.21	21.25	971.61	21.80
972.80	20.71	972.20	21.26	971.60	21.81
972.78	20.72	972.19	21.27	971.59	21.83
972.77	20.73	972.17	21.29	971.57	21.84

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
971.56	21.85	970.96	22.40	970.36	22.95
971.55	21.86	970.95	22.42	970.35	22.97
971.54	21.87	970.94	22.43	970.33	22.98
971.52	21.89	970.92	22.44	970.32	22.99
971.51	21.90	970.91	22.45	970.31	23.00
971.50	21.91	970.90	22.46	970.29	23.01
971.48	21.92	970.88	22.48	970.28	23.03
971.47	21.93	970.87	22.49	970.27	23.04
971.46	21.95	970.86	22.50	970.26	23.05
971.44	21.96	970.84	22.51	970.24	23.06
971.43	21.97	970.83	22.52	970.23	23.07
971.42	21.98	970.82	22.54	970.22	23.09
971.41	21.99	970.81	22.55	970.20	23.10
971.39	22.01	970.79	22.56	970.19	23.11
971.38	22.02	970.78	22.57	970.18	23.12
971.37	22.03	970.77	22.58	970.16	23.13
971.35	22.04	970.75	22.60	970.15	23.15
971.34	22.05	970.74	22.61	970.14	23.16
971.33	22.07	970.73	22.62	970.12	23.17
971.31	22.08	970.71	22.63	970.11	23.18
971.30	22.09	970.70	22.64	970.10	23.19
971.29	22.10	970.69	22.66	970.09	23.21
971.28	22.11	970.67	22.67	970.07	23.22
971.26	22.13	970.66	22.68	970.06	23.23
971.25	22.14	970.65	22.69	970.05	23.24
971.24	22.15	970.64	22.70	970.03	23.25
971.22	22.16	970.65	22.72	970.02	23.27
971.21	22.18	970.61	22.73	970.01	23.28
971.20	22.19	970.60	22.74	969.99	23.29
971.18	22.20	970.58	22.75	969.98	23.30
971.17	22.21	970.57	22.76	969.97	23.31
971.16	22.22	970.56	22.78	969.95	23.33
971.14	22.24	970.54	22.79	969.94	23.34
971.13	22.25	970.53	22.80	969.93	23.35
971.12	22.26	970.52	22.81	969.91	23.36
971.11	22.27	970.50	22.82	969.90	23.37
971.09	22.28	970.49	22.83	969.89	23.39
971.08	22.30	970.48	22.85	969.87	23.40
971.07	22.31	970.47	22.86	969.86	23.41
971.05	22.32	970.45	22.87	969.85	23.42
971.04	22.33	970.44	22.88	969.84	23.43
971.03	22.34	970.43	22.89	969.82	23.45
971.01	22.36	970.41	22.91	969.81	23.46
971.00	22.37	970.40	22.92	969.80	23.47
970.99	22.38	970.39	22.93	969.78	23.48
970.98	22.39	970.37	22.94	969.77	23.49

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
969.76	23.51	969.15	24.06	968.54	24.61
969.74	23.52	969.14	24.07	968.53	24.62
969.73	23.53	969.12	24.08	968.51	24.63
969.72	23.54	969.11	24.09	968.50	24.64
969.70	23.55	969.10	24.10	968.49	24.65
969.69	23.57	969.08	24.12	968.47	24.66
969.68	23.58	969.07	24.13	968.46	24.68
969.66	23.59	969.06	24.14	968.45	24.69
969.65	23.60	969.04	24.15	968.43	24.70
969.64	23.61	969.03	24.16	968.42	24.71
969.62	23.63	969.02	24.18	968.41	24.72
969.61	23.64	969.00	24.19	968.39	24.74
969.60	23.65	968.99	24.20	968.38	24.75
969.59	23.66	968.98	24.21	968.37	24.76
969.57	23.67	968.96	24.22	968.35	24.77
969.56	23.69	968.95	24.24	968.34	24.78
969.55	23.70	968.94	24.25	968.32	24.80
969.53	23.71	968.92	24.26	968.31	24.81
969.52	23.72	968.91	24.27	968.30	24.82
969.51	23.73	968.90	24.28	968.28	24.83
969.49	23.75	968.88	24.29	968.27	24.84
969.48	23.76	968.87	24.31	968.26	24.86
969.47	23.77	968.86	24.32	968.24	24.87
969.45	23.78	968.84	24.33	968.23	24.88
969.44	23.79	968.83	24.34	968.22	24.89
969.43	23.80	968.82	24.35	968.20	24.90
969.41	23.82	968.80	24.37	968.19	24.92
969.40	23.83	968.79	24.38	968.18	24.93
969.39	23.84	968.78	24.39	968.16	24.94
969.37	23.85	968.76	24.40	968.15	24.95
969.36	23.86	968.75	24.41	968.14	24.96
969.35	23.88	968.74	24.42	968.12	24.97
969.33	23.89	968.72	24.44	968.11	24.99
969.32	23.90	968.71	24.45	968.10	25.00
969.31	23.91	968.70	24.46	968.08	25.01
969.29	23.92	968.68	24.47	968.07	25.02
969.28	23.94	968.66	24.49	968.06	25.03
969.27	23.95	968.64	24.50	968.04	25.05
969.25	23.96	968.63	24.51	968.03	25.06
969.24	23.97	968.62	24.52	968.02	25.07
969.23	23.98	968.60	24.53	968.00	25.08
969.22	24.00	968.59	24.55	967.99	25.09
969.20	24.01	968.58	24.56	967.98	25.11
969.19	24.02	968.56	24.57	967.96	25.12
969.18	24.03	938.56	24.58	967.95	25.13
969.16	24.04	968.55	24.59	967.94	25.14

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
967.92	25.15	967.30	25.70	966.68	26.25
967.91	25.17	967.29	25.71	966.67	26.26
967.90	25.18	967.28	25.73	966.65	26.27
967.88	25.19	967.26	25.74	966.64	26.28
967.87	25.20	967.25	25.75	966.63	26.30
967.86	25.21	967.24	25.76	966.61	26.31
967.84	25.23	967.22	25.77	966.60	26.32
967.83	25.24	967.21	25.78	966.59	26.33
967.82	25.25	967.20	25.80	966.57	26.34
967.80	25.26	967.18	25.81	966.56	26.36
967.79	25.27	967.17	25.82	966.54	26.37
967.78	25.28	967.16	25.83	966.53	26.38
967.76	25.30	967.14	25.84	966.52	26.39
967.75	25.31	967.13	25.86	966.50	26.40
967.74	25.32	967.12	25.87	966.49	26.41
967.72	25.33	967.10	25.88	966.48	26.43
967.71	25.34	967.09	25.89	966.46	26.44
967.70	25.36	967.07	25.90	966.45	26.45
967.68	25.37	967.06	25.92	966.43	26.46
967.67	25.38	967.05	25.93	966.42	26.47
967.65	25.39	967.03	25.94	966.41	26.48
967.64	25.40	967.02	25.95	966.39	26.50
967.63	25.42	967.01	25.96	966.38	26.51
967.61	25.43	966.99	25.98	966.37	26.52
967.60	25.44	966.98	25.99	966.35	26.53
967.59	25.45	966.97	26.00	966.34	26.55
967.57	25.46	966.95	26.01	966.33	26.56
967.56	25.48	966.94	26.02	966.31	26.57
967.55	25.49	966.93	26.03	966.30	26.58
967.53	25.50	966.91	26.05	966.28	26.59
967.52	25.51	966.90	26.06	966.27	26.60
967.51	25.52	966.88	26.07	966.26	26.62
967.49	25.53	966.87	26.08	966.24	26.63
967.48	25.55	966.86	26.09	966.23	26.64
967.47	25.56	966.84	26.11	966.22	26.65
967.45	25.57	966.83	26.12	966.20	26.66
967.44	25.58	966.82	26.13	966.19	26.68
967.43	25.59	966.80	26.14	966.17	26.69
967.41	25.61	966.79	26.15	966.16	26.70
967.40	25.62	966.78	26.17	966.15	26.71
967.39	25.63	966.76	26.18	966.13	26.72
967.37	25.64	966.75	26.19	966.12	26.73
967.36	25.65	966.73	26.20	966.11	26.75
967.34	25.67	966.72	26.21	966.09	26.76
967.33	25.68	966.71	26.22	966.08	26.77
967.32	25.69	966.69	26.24	966.06	26.78

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
966.05	26.79	965.42	27.34	964.78	27.88
966.04	26.81	965.40	27.35	964.76	27.90
966.02	26.82	965.39	27.36	964.75	27.91
966.01	26.83	965.37	27.37	964.73	27.92
966.00	26.84	965.36	27.39	964.72	27.93
965.98	26.85	965.35	27.40	964.71	27.94
965.97	26.87	965.33	27.41	964.69	27.95
965.95	26.88	965.32	27.42	964.68	27.97
965.94	26.89	965.31	27.43	964.66	27.98
965.93	26.90	965.29	27.45	964.65	27.99
965.91	26.91	965.28	27.46	964.64	28.00
965.90	26.92	965.26	27.47	964.62	28.01
965.89	26.94	965.25	27.48	964.61	28.03
965.87	26.95	965.24	27.49	964.59	28.04
965.86	26.96	965.22	27.51	964.58	28.05
965.84	26.97	965.21	27.52	964.57	28.06
965.83	26.98	965.19	27.53	964.55	28.07
965.82	27.00	965.18	27.54	964.54	28.08
965.80	27.01	965.17	27.55	964.52	28.10
965.79	27.02	965.15	27.56	964.51	28.11
965.78	27.03	965.14	27.58	964.49	28.13
965.76	27.04	965.12	27.59	964.48	28.13
965.75	27.06	965.11	27.60	964.47	28.14
965.73	27.07	965.10	27.61	964.45	28.16
965.72	27.08	965.08	27.62	964.44	28.17
965.71	27.09	965.07	27.64	964.42	28.18
965.69	27.10	965.05	27.65	964.41	28.19
965.68	27.11	965.04	27.66	964.40	28.20
965.67	27.13	965.03	27.67	964.38	28.21
965.65	27.14	965.01	27.68	964.37	28.23
965.64	27.15	965.00	27.69	964.35	28.24
965.62	27.16	964.99	27.71	964.34	28.25
965.61	27.17	964.97	27.72	964.33	28.26
965.60	27.19	964.96	27.73	964.31	28.27
965.58	27.20	964.94	27.74	964.30	28.29
965.57	27.21	964.93	27.75	964.28	28.30
965.55	27.22	964.92	27.77	964.27	28.31
965.54	27.23	964.90	27.78	964.26	28.32
965.53	27.24	964.89	27.79	964.24	28.33
965.51	27.26	964.87	27.80	964.23	28.34
965.50	27.27	964.86	27.81	964.21	28.36
965.49	27.28	964.85	27.82	964.20	28.37
965.47	27.29	964.83	27.84	964.18	28.38
965.46	27.30	964.82	27.85	964.17	28.39
965.44	27.32	964.80	27.86	964.16	28.40
965.43	27.33	964.79	27.87	964.14	28.41

Table A.1 (continued)

Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)	Density(g/L)	Alcohol Degree(%vol)
964.13	28.43	963.47	28.97	962.81	29.51
964.11	28.44	963.46	28.98	962.80	29.52
964.10	28.45	963.45	28.99	962.78	29.53
964.09	28.46	963.43	29.00	962.77	29.55
964.17	28.47	963.42	29.02	962.76	29.56
964.16	28.49	963.40	29.03	962.74	29.57
964.14	28.50	963.39	29.04	962.73	29.58
964.03	28.51	963.37	29.05	962.71	29.59
964.01	28.52	963.36	29.06	962.70	29.60
964.00	28.53	963.35	09.08	962.68	29.62
963.99	28.54	963.33	29.09	962.67	29.63
963.97	28.56	963.32	29.10	962.65	29.64
963.96	28.57	963.30	29.11	962.64	29.65
963.94	28.58	963.29	29.12	962.63	29.66
963.93	28.59	963.27	29.13	962.61	29.67
963.92	28.60	963.26	29.15	962.60	29.69
963.90	28.62	963.25	29.16	962.58	29.70
963.89	28.63	963.23	29.17	962.57	29.71
963.87	28.64	963.22	29.18	962.55	29.72
963.86	28.65	963.20	29.19	962.54	29.73
963.84	28.66	963.19	29.20	962.52	29.75
963.83	28.67	963.17	29.22	962.51	29.76
963.82	28.69	963.16	29.23	962.49	29.77
963.80	28.70	963.14	29.24	962.48	29.78
963.79	28.71	963.13	29.25	962.47	29.79
963.77	28.72	963.12	29.26	962.45	29.80
963.76	28.73	963.10	29.28	962.44	29.82
963.75	28.75	963.09	29.29	962.42	29.83
963.73	28.76	963.07	29.30	962.40	29.84
963.72	28.77	963.06	29.31	962.39	29.85
963.70	28.78	963.04	29.32	962.38	29.86
963.69	28.79	963.03	29.33	962.36	29.87
963.67	28.80	963.02	29.35	962.35	29.89
963.66	28.82	963.00	29.36	962.34	29.90
963.65	28.83	962.99	29.37	962.32	29.91
963.63	28.84	962.97	29.38	962.31	29.92
963.62	28.85	962.96	29.39	962.29	29.93
963.60	28.86	962.94	29.40	962.28	29.95
963.59	28.87	962.93	29.42	962.26	29.96
963.57	28.89	962.91	29.43	962.25	29.97
963.56	28.90	962.90	29.44	962.23	29.98
963.55	28.91	962.89	29.45	962.22	29.99
963.53	28.92	962.87	29.46	962.20	30.00
963.52	28.93	962.86	29.48	962.19	30.02
963.50	28.95	962.84	29.49	962.17	30.03
963.49	28.96	962.83	29.50	962.16	30.04

Appendix B

(Normative appendix)

Conversion table for alcohol meter temperature vs. alcohol degree (alcohol content)

Table B.1 Conversion table for alcohol meter temperature vs. alcohol degree (alcohol content)

Temperature of solution /°C	Indicatory value on alcohol meter									
	35	34.5	34	33.5	33	32.5	32	31.5	31	30.5
	Alcohol content when the temperature of alcohol meter is 20°C(%vol)									
35	28.8	28.2	27.8	27.3	26.8	26.4	26.0	25.5	25.0	24.6
34	29.3	28.8	28.3	27.8	27.3	26.8	26.4	25.9	25.4	25.0
33	29.7	29.2	28.7	28.2	27.7	27.2	26.8	26.3	25.8	25.4
32	30.1	29.6	29.1	28.6	28.1	27.6	27.2	26.7	26.2	25.8
31	30.5	30.0	29.5	29.0	28.5	28.0	27.6	27.1	26.6	26.2
30	30.9	30.4	29.9	29.4	28.9	28.4	28.0	27.5	27.0	26.5
29	31.3	30.8	30.3	29.8	29.4	28.8	28.4	27.9	27.4	26.9
28	31.7	31.2	30.7	30.2	29.8	29.2	28.8	28.3	27.8	27.3
27	32.2	31.6	31.2	30.6	30.2	29.6	29.2	28.7	28.2	27.7
26	32.6	32.0	31.6	31.0	30.6	30.0	29.6	29.1	28.6	28.1
25	33.0	32.5	32.0	31.5	31.0	30.5	30.0	29.5	29.0	28.5
24	33.4	32.9	32.4	31.9	31.4	30.9	30.4	29.9	29.4	28.9
23	33.8	33.3	32.8	32.3	31.8	31.3	30.8	30.3	29.8	29.3
22	34.2	33.7	33.2	32.7	32.2	31.7	31.2	30.7	30.2	29.7
21	34.6	34.1	33.6	33.1	32.6	32.0	31.6	31.1	30.6	30.1
20	35.0	34.5	34.0	33.5	33.0	32.5	32.0	31.5	31.0	30.5
19	35.4	34.9	34.4	33.9	33.4	32.9	32.4	31.9	31.4	30.9
18	35.8	35.3	34.8	34.3	33.8	33.2	32.8	32.3	31.8	31.3
17	36.2	35.7	35.2	34.7	34.2	33.7	33.2	32.7	32.2	31.7
16	36.6	36.1	35.6	35.1	34.6	34.1	33.6	33.1	32.6	32.1
15	37.0	36.5	36.0	35.5	35.0	34.5	34.0	33.5	33.0	32.5
14	37.4	36.9	36.4	35.9	35.4	35.0	34.4	34.0	33.5	32.0
13	37.8	37.3	36.8	36.4	35.9	35.4	34.9	34.4	33.9	32.4
12	38.2	37.8	37.3	36.8	36.3	35.8	35.3	34.8	34.3	33.8
11	38.7	38.2	37.7	37.2	36.7	36.2	35.7	35.2	34.7	34.2
10	39.1	38.6	38.1	37.6	37.1	36.6	36.1	35.6	35.1	34.6

Table B.1 (continued)

Temperature of solution /℃	Indicatory value on alcohol meter									
	30	29.5	29	28.5	28	27.5	27	26.5	26	25.5
	Alcohol content when the temperature of alcohol meter is 20℃(%vol)									
35	24.2	23.7	23.2	22.8	22.3	21.8	21.3	20.8	20.4	20.0
34	24.5	24.0	23.5	23.1	22.7	22.2	21.7	21.2	20.8	20.4
33	24.9	24.4	23.9	23.5	23.1	22.6	22.0	21.6	21.2	20.8
32	25.3	24.8	24.2	23.8	23.4	22.9	22.4	22.0	21.6	21.2
31	25.7	25.2	24.7	24.2	23.8	23.3	22.8	22.4	21.9	21.4
30	26.1	25.6	25.1	24.6	24.2	23.7	23.2	22.8	22.3	21.9
29	26.4	26.0	25.5	25.0	24.6	24.1	23.6	23.2	22.7	22.2
28	26.8	26.4	25.9	25.4	24.9	24.4	24.0	23.5	23.0	22.6
27	27.2	26.7	26.3	25.8	25.3	24.8	24.4	23.9	23.4	22.9
26	27.6	27.1	26.6	26.2	25.7	25.2	24.7	24.2	23.8	23.3
25	28.0	27.5	27.0	26.6	26.1	25.6	25.1	24.6	24.1	23.7
24	28.4	27.9	27.4	26.9	26.4	26.0	25.5	25.0	24.5	24.0
23	28.8	28.3	27.8	27.2	26.8	26.3	25.8	25.4	24.9	24.4
22	29.2	28.7	28.2	27.7	27.2	26.7	26.2	25.8	25.3	24.8
21	29.6	29.1	28.6	28.1	27.6	27.1	26.6	26.1	25.6	25.1
20	30.0	29.5	29.0	28.5	28.0	27.5	27.0	26.5	26.0	25.5
19	30.4	29.9	29.4	28.9	28.4	27.9	27.4	26.9	26.4	25.9
18	30.8	30.3	29.8	29.3	28.8	28.3	27.8	27.2	26.7	26.2
17	31.2	30.7	30.2	29.7	29.2	28.6	28.1	27.6	27.1	26.6
16	31.6	31.1	30.6	30.1	29.5	29.0	28.5	28.0	27.5	27.0
15	32.0	31.5	31.0	30.5	29.9	29.5	28.9	28.4	27.9	27.4
14	32.4	31.9	31.4	30.9	30.4	29.9	29.3	28.8	28.3	27.8
13	32.8	32.3	31.8	31.2	30.8	30.3	29.7	29.2	28.7	28.2
12	33.3	32.8	32.1	31.6	31.2	30.7	30.2	29.6	29.1	28.5
11	33.7	33.2	32.7	32.0	31.6	31.1	30.6	30.0	29.5	28.9
10	30.1	33.6	33.1	32.5	32.0	31.5	31.0	30.4	29.9	29.3

Table B.1 (continued)

Temperature of solution /℃	Indicatory value on alcohol meter									
	25	24.5	24	23.5	23	22.5	22	21.5	21	20.5
	Alcohol content when the temperature of alcohol meter is 20℃(%vol)									
35	19.6	19.2	18.8	18.4	17.9	17.4	16.9	16.4	16.0	15.6
34	20.0	19.6	19.1	18.6	18.2	17.7	17.2	16.8	16.4	16.0
33	20.3	19.8	19.4	19.0	18.6	18.1	17.6	17.2	16.7	16.2
32	20.7	20.2	19.8	19.4	18.9	18.4	17.9	17.4	17.0	16.6
31	21.0	20.6	20.2	19.8	19.3	18.8	18.3	17.8	17.4	17.0
30	21.4	20.9	20.5	20.0	19.6	19.1	18.6	18.2	17.7	17.3
29	21.8	21.3	20.8	20.4	19.9	19.4	19.0	18.5	18.0	17.6
28	22.1	21.6	21.2	20.7	20.2	19.8	19.3	18.8	18.4	17.9
27	22.5	22.0	21.5	21.0	20.6	20.1	19.6	19.2	18.7	18.2
26	22.8	22.4	21.9	21.4	20.9	20.5	20.0	19.5	19.0	18.6
25	23.2	22.7	22.2	21.8	21.2	20.8	20.3	19.8	19.4	18.9
24	23.5	23.1	22.6	22.1	21.6	21.1	20.7	20.2	19.4	19.2
23	23.9	23.4	22.9	22.4	22.0	21.5	21.0	20.5	20.0	19.5
22	24.3	23.8	23.3	22.8	22.3	21.8	21.3	20.8	20.4	19.9
21	24.6	24.1	23.6	23.1	22.6	22.2	21.7	21.2	20.7	20.2
20	25.0	24.5	24.0	23.5	23.0	22.5	22.0	21.5	21.0	20.5
19	25.4	24.8	24.4	23.8	23.3	22.8	22.3	21.8	21.3	20.8
18	25.7	25.2	24.7	24.2	23.7	23.2	22.6	22.1	21.6	21.1
17	26.1	25.6	25.1	24.5	24.0	23.5	23.0	22.5	22.0	21.4
16	26.5	25.9	25.4	24.9	24.0	23.8	23.3	22.8	22.3	21.8
15	26.8	26.3	25.8	25.3	24.7	24.2	23.7	23.1	22.6	22.1
14	27.2	26.7	26.2	25.6	25.1	24.6	24.0	23.5	23.0	22.4
13	27.6	27.1	26.5	26.0	25.4	24.9	24.4	23.8	23.3	22.7
12	28.0	27.4	26.9	26.4	25.8	25.3	24.7	24.2	23.6	23.0
11	28.4	27.8	27.3	26.7	26.2	25.6	25.0	24.5	23.9	23.4
10	28.8	28.2	27.7	27.1	26.6	26.0	25.4	24.8	24.3	23.7

Table B.1 (continued)

Temperature of solution /℃	Indicatory value on alcohol meter									
	20	19.5	19.	18.5	18	17.5	17	16.5	16	15.5
	Alcohol content when the temperature of alcohol meter is 20℃(%vol)									
35	15.2	14.8	14.5	14.0	13.6	13.2	12.8	12.4	12.1	11.6
34	15.5	14.2	14.8	14.4	13.9	13.5	13.1	12.8	12.4	12.0
33	15.8	15.4	15.1	14.6	14.2	13.8	13.4	13.0	12.6	12.2
32	16.2	15.8	15.4	15.0	14.5	14.0	13.6	13.2	12.9	12.4
31	16.5	16.1	15.7	15.2	14.8	14.4	13.9	13.5	13.1	12.6
30	16.8	16.4	16.0	15.5	15.1	14.7	14.2	13.8	13.4	12.9
29	17.2	16.7	16.3	15.8	15.4	15.0	14.5	14.1	13.6	13.2
28	17.5	17.0	16.6	16.1	15.7	15.2	14.8	14.4	13.9	13.4
27	17.8	17.3	16.7	16.4	16.0	15.5	15.1	14.6	14.2	13.7
26	18.1	17.6	17.2	16.7	16.3	15.8	15.4	14.9	14.4	14.0
25	18.4	18.0	17.5	17.0	16.6	16.1	15.4	15.2	14.7	14.2
24	18.7	18.3	17.8	17.3	16.9	16.4	15.9	15.4	15.0	14.5
23	19.0	18.6	18.1	17.6	17.1	16.6	16.2	15.7	15.2	14.7
22	19.4	18.7	18.4	17.9	17.4	17.0	16.5	16.0	15.5	15.0
21	19.7	19.2	18.7	18.2	17.7	17.2	16.7	16.2	15.7	15.2
20	20.0	19.5	19.0	18.5	18.0	17.5	17.0	16.5	16.0	15.5
19	20.3	19.8	19.3	18.8	18.3	17.8	17.3	16.8	16.3	15.8
18	20.6	20.1	19.6	19.1	18.6	18.1	17.6	17.0	16.5	16.0
17	20.9	20.4	19.9	19.4	18.9	18.3	17.9	17.3	16.8	16.2
16	21.2	20.7	20.2	19.7	19.2	18.6	18.1	17.5	17.0	16.5
15	21.6	21.0	20.5	20.0	19.4	18.9	18.3	17.8	17.2	16.7
14	21.9	21.3	20.8	20.2	19.7	19.1	18.6	18.0	17.5	16.9
13	22.2	21.6	21.1	20.5	20.0	19.4	18.8	18.3	17.7	17.2
12	22.5	21.9	21.4	20.8	20.2	19.7	19.1	18.5	18.0	17.4
11	22.8	22.2	21.7	21.1	20.5	20.0	19.4	18.8	18.2	17.6
10	23.1	22.5	22.0	21.4	20.8	20.2	19.6	19.0	18.4	17.8

Table B.1 (continued)

Temperature of solution /℃	Indicatory value on alcohol meter									
	15	14.5	14	13.5	13	12.5	12	11.5	11	10.5
	Alcohol content when the temperature of alcohol meter is 20℃(%vol)									
35	11.2	10.8	10.4	10.0	9.6	9.2	8.7	8.3	7.9	7.4
34	11.5	11.0	10.6	10.2	9.8	9.4	8.9	8.5	8.1	7.6
33	11.8	11.4	10.9	10.4	10.0	9.6	9.1	8.7	8.3	7.8
32	12.0	11.6	11.0	10.6	10.2	9.8	9.4	9.0	8.5	8.0
31	12.2	11.8	11.4	11.0	10.5	10.0	9.6	9.2	8.7	8.2
30	12.5	12.0	11.6	11.1	10.7	10.2	9.8	9.3	8.9	8.4
29	12.7	12.3	11.8	11.4	10.9	10.5	10.0	9.5	9.1	8.6
28	13.0	12.6	12.1	11.6	11.2	10.7	10.3	9.8	9.2	8.9
27	13.2	12.8	12.3	11.9	11.4	10.9	10.5	10.0	9.5	9.1
26	13.5	13.0	12.6	12.1	11.7	11.2	10.7	10.2	9.8	9.3
25	13.8	13.3	12.8	12.4	11.9	11.4	10.9	10.4	10.0	9.5
24	14.0	13.5	13.1	12.6	12.1	11.6	11.2	10.7	10.2	9.7
23	14.3	13.8	13.3	12.8	12.3	11.8	11.4	10.9	10.4	9.9
22	14.5	14.0	13.6	13.1	12.6	12.1	11.6	11.1	10.6	10.1
21	14.8	14.3	13.8	13.3	12.8	12.3	11.8	11.3	10.8	10.3
20	15.0	14.5	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5
19	15.2	14.7	14.2	12.7	13.2	12.7	12.2	11.7	11.2	10.7
18	15.5	15.0	14.4	13.9	13.4	12.9	12.4	11.9	11.4	10.9
17	15.7	15.2	14.7	14.1	13.6	13.1	12.6	12.1	11.5	11.0
16	15.9	15.4	14.9	14.3	13.8	13.3	12.8	12.2	11.7	11.2
15	16.2	15.6	15.1	14.5	14.0	13.5	12.9	12.4	11.9	11.3
14	16.4	15.8	15.2	15.7	14.2	13.6	13.1	12.5	2.0	11.5
13	16.6	16.0	15.5	14.9	14.4	13.8	13.2	12.7	12.2	11.6
12	16.8	16.2	15.7	15.1	14.5	14.0	13.4	12.8	12.3	11.8
11	17.0	16.4	15.8	15.3	14.7	14.1	13.6	13.0	12.4	11.9
10	17.2	16.6	16.0	15.4	14.9	14.3	13.7	13.1	12.6	12.0

Table B.1 (continued)

Temperature of solution /℃	Indicatory value on alcohol meter									
	10	9.5	9	8.5	8	7.5	7	6.5	6	5.5
	Alcohol content when the temperature of alcohol meter is 20℃(%vol)									
35	6.8	6.4	6.0	5.6	5.2	4.8	4.3	3.8	3.3	2.8
34	7.1	6.6	6.2	5.8	5.3	4.9	4.5	4.0	3.5	3.0
33	7.3	6.8	6.4	6.0	5.5	5.1	4.7	4.2	3.7	3.2
32	7.5	7.0	6.6	6.2	5.7	5.2	4.8	4.3	3.8	3.4
31	7.7	7.2	6.8	6.4	5.9	5.4	5.0	4.5	4.0	3.6
30	7.9	7.5	7.0	6.6	6.1	5.6	5.2	4.7	4.2	3.8
29	8.2	7.7	7.2	6.8	6.3	5.8	5.4	4.9	4.4	4.0
28	8.4	7.9	7.5	7.0	6.5	6.1	5.6	5.1	4.6	4.2
27	8.6	8.1	7.7	7.2	6.7	6.3	5.8	5.3	4.8	4.3
26	8.8	8.2	7.9	7.4	6.9	6.4	6.0	5.5	5.0	4.5
25	9.0	8.6	8.1	7.6	7.1	6.6	6.2	5.7	5.2	4.7
24	9.2	8.8	8.3	7.8	7.3	6.8	6.3	5.8	5.4	4.9
23	9.4	8.9	8.4	8.0	7.5	7.0	6.5	6.0	5.5	5.0
22	9.6	9.1	8.6	8.2	7.7	7.2	6.7	6.2	5.7	5.2
21	9.8	9.3	8.8	8.3	7.8	7.3	6.8	6.3	5.8	5.4
20	10.0	9.5	9.0	8.5	8.0	7.5	7.0	6.5	6.0	5.5
19	10.2	9.7	9.2	8.7	8.2	7.6	7.2	6.6	6.1	5.6
18	10.4	9.8	9.3	8.8	8.3	7.8	7.3	6.8	6.3	5.8
17	10.5	10.0	9.5	9.0	8.5	8.0	7.4	6.9	6.4	5.9
16	10.7	10.2	9.7	9.1	8.6	8.1	7.6	7.0	6.5	6.0
15	10.8	10.3	9.8	9.3	8.8	8.2	7.7	7.1	6.6	6.1
14	11.0	10.4	9.9	9.4	8.9	8.3	7.8	7.2	6.7	6.2
13	11.1	10.6	10.0	9.5	9.0	8.4	7.9	7.4	6.8	6.3
12	11.2	10.7	10.1	9.6	9.1	8.5	8.0	7.4	6.9	6.4
11	11.3	10.8	10.2	9.7	9.2	8.6	8.1	7.6	7.0	6.5
10	11.4	10.9	10.3	9.8	9.3	8.7	8.2	7.6	7.1	6.5

Table B.1 (continued)

Temperature of solution /℃	Indicatory value on alcohol meter									
	5	4.5	4	3.5	3	2.5	2	1.5	1	0.5
	Alcohol content when the temperature of alcohol meter is 20℃(%vol)									
35	2.4	2.0	1.6	1.1	0.6	—	—	—	—	—
34	2.6	2.2	1.8	1.3	0.8	—	—	—	—	—
33	2.8	2.4	1.9	1.4	0.9	—	—	—	—	—
32	3.0	2.6	2.1	1.6	1.1	0.6	0.1	—	—	—
31	3.1	2.6	2.2	1.7	1.2	0.7	0.2	—	—	—
30	3.3	2.8	2.4	1.9	1.4	0.9	0.4	0.1	—	—
29	3.5	3.0	2.5	2.1	1.6	1.1	0.6	0.2	—	—
28	3.7	3.2	2.7	2.2	1.8	1.3	0.8	0.3	—	—
27	3.9	3.4	2.9	2.4	1.9	1.4	1.0	0.4	—	—
26	4.0	3.6	3.1	2.6	2.1	1.6	1.1	0.6	0.1	—
25	4.2	3.7	3.2	2.8	2.3	1.8	1.3	0.8	0.3	—
24	4.4	3.9	3.4	2.9	2.4	1.9	1.4	0.9	0.4	—
23	4.6	4.1	3.6	3.1	2.6	2.1	1.6	1.1	0.6	0.1
22	4.7	4.2	3.7	3.2	2.7	2.2	1.7	1.2	0.7	0.2
21	4.8	4.4	3.9	3.4	2.9	2.4	1.9	1.4	0.9	0.4
20	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0	0.5
19	5.1	4.6	4.1	3.6	3.1	2.6	2.1	1.6	1.1	0.6
18	5.3	4.8	4.2	3.7	3.2	2.7	2.2	1.7	1.2	0.7
17	5.4	4.9	4.4	3.9	3.4	2.8	2.3	1.8	1.3	0.8
16	5.5	5.0	4.5	4.0	3.4	2.9	2.4	1.9	1.4	0.9
15	5.6	5.1	4.6	4.1	3.6	3.0	2.5	2.0	1.5	1.0
14	5.7	5.2	4.7	4.2	3.9	3.1	2.6	2.1	1.6	1.1
13	5.8	5.3	4.8	4.2	3.7	3.2	2.7	2.2	1.7	1.2
12	5.9	5.4	4.8	4.3	3.8	3.3	2.8	2.2	1.8	1.2
11	6.0	5.4	4.9	4.4	3.9	3.3	2.8	2.3	1.8	1.3
10	6.0	5.5	5.0	4.4	3.9	3.4	2.9	2.4	1.8	1.3

Appendix C

(Normative appendix)

Reference table for density vs. total extract content (round number)

Table C.1 Reference table for density vs. total extract content (as round number) g/L

Density (20℃)	The fourth round number of density									
	0	1	2	3	4	5	6	7	8	9
100	0	2.6	5.1	7.7	10.3	12.9	15.4	18.0	20.6	23.2
101	25.8	28.4	31.0	33.6	36.2	38.8	41.3	43.9	46.5	49.1
102	51.7	54.3	56.9	59.5	62.1	64.7	67.3	69.9	72.5	75.1
103	77.7	80.3	82.9	85.5	88.1	90.7	93.3	95.9	98.5	101.1
104	103.7	106.3	109.0	111.6	114.2	116.8	119.4	122.0	124.6	127.2
105	129.8	132.4	135.0	137.6	140.3	142.9	145.5	148.1	150.7	153.3
106	155.9	158.6	161.2	163.8	166.4	169.0	171.6	174.3	176.9	179.5
107	182.1	184.8	187.4	190.0	192.6	195.2	197.8	200.5	203.1	205.8
108	208.4	211.0	213.6	216.2	218.9	221.5	224.1	226.8	229.4	232.0
109	234.7	237.3	239.9	242.5	245.2	274.8	250.4	253.1	255.7	258.4
110	261.0	263.6	266.3	268.9	271.5	274.2	276.8	279.5	282.1	284.8
111	287.4	290.0	292.7	295.3	298.0	300.6	303.3	305.9	308.6	311.2
112	313.9	316.5	319.2	321.8	324.5	327.1	329.8	332.4	335.1	337.8
113	340.4	343.0	345.7	348.3	351.0	353.7	356.3	359.0	361.6	364.3
114	366.9	369.6	372.3	375.0	377.6	380.3	382.9	385.6	388.3	390.9
115	393.6	396.2	398.9	401.6	404.3	406.9	409.6	412.3	415.0	417.6
116	420.3	423.0	425.7	428.3	431.0	433.7	436.4	439.0	441.7	444.4
117	447.1	449.8	452.4	455.2	457.8	460.5	463.2	465.9	468.6	471.3
118	473.9	476.6	479.3	482.0	484.7	487.4	490.1	492.8	495.5	498.2
119	500.9	503.5	506.2	508.9	511.6	514.3	517.0	519.7	522.4	525.1
120	527.8	—	—	—	—	—	—	—	—	—

Table C.2 Reference table for density vs. total extract content (decimal place)

The 1st place Decimal fraction Of density	Total extract Content/g/L	The 1st place Decimal fraction Of density	Total extract Content/g/L	The 1st place Decimal fraction Of density	Total extract Content/g/L
1	0.3	4	1.0	7	1.8
2	0.5	5	1.3	8	2.1
3	0.8	6	1.6	9	2.3

Appendix D

(Informative appendix)

Determination of sugar content and organic acids in wine (HPLC method)

D.1 Rationale

After being separated and purified through anion solid-phase extraction column, sugar, alcohols and organic acids are separated. To determine each of the following components In chromatographic column, use diluted sulfur acid solution as mobile phase and detect by differential refraction detector and ultraviolet detector to determine the quantity of each of the following components: sugar-alcohols including sucrose, glucose, fructose, glycerol and organic acids including citric acid, malic acid, succinic acid, lactic acid and acetic acid.

D.2 Reagents and materials

D.2.1 Methanol (chromatographic pure)

D.2.2 Standard substances: citric acid, tartaric acid, D-malic acid, succinic acid, lactic acid, acetic acid, sucrose, glucose, D-fructose and glycerol.

D.2.3 Super-pure water: prepared by the lab.

D.2.4 Standard stock solution of sugar and alcohols: weigh 0.05g of sucrose, glucose and fructose, respectively (accuracy is 0.0001g). Dissolve with super-pure water and dilute to 50ml. This solution contains 1g/L of sucrose, glucose and fructose; weigh 0.20g glycerol standard substance (the accuracy is 0.0001g), dissolve with super-pure water and dilute to 50ml. This solution contains 4g/L of glycerol.

D.2.5 Standard series solution of sugar and alcohols: dilute the standard stock solution of sugar and alcohols with super-pure water to mixed standard series solution containing 0.05g/L, 0.10g/L, 0.20g/L, 0.40g/L and 0.80g/L of sugar and 0.20g/L, 0.40g/L ,0.80g/L,1.60g/L and 3.20g/L of glycerol.

D.2.6 Standard stock solution of organic acids: weigh 0.05g of citric acid, tartaric acid, malic acid, succinic acid, lactic acid and acetic acid, respectively (the accuracy is 0.0001g). Dissolve with super-pure water and dilute to 50ml. This solution contains 1g/L of citric acid, tartaric acid, malic acid, succinic acid, lactic acid and acetic acid, respectively.

D.2.7 Standard series solution of organic acids: dilute the standard stock solution of organic acids with super-pure water to mixed standard series solution containing 0.05g/L, 0.10g/L, 0.20g/L, 0.40g/L and 0.80g/Lof organic acids.

D.2.8 Sulfur acid solution (1%): add 198ml re-distilled water to 2ml concentrated sulfur water.

D.2.9 Ammonium hydroxide solution (1%)

D.2.10 Sulfur acid solution (1.5mol/L): pipette 4.5ml concentrated sulfur acid and dilute with re-distilled water to 100ml.

D.2.11Sulfur acid solution (0.0015mol/L): pipette accurately 1ml sulfur acid solution (D.2.10) and dilute with re-distilled water to 1000ml.

D.2.12 Sulfur acid solution (0.0075mol/L): pipette 5ml sulfur acid solution (D.2.10) and dilute with re-distilled water to 1000ml.

D.2.13 NaOH solution (8%): weigh 4g NaOH and dissolve in 50ml water.

D.3 Instrument

D.3.1 HPLC instrument: equipped with ultraviolet detector or diode array detector and hemostat.

D.3.2 Chromatography column: Fetigsaule RT300-7.8 or other solid-phase extraction columns with equivalent analytical effect.

D.3.3 Strong-anion exchange solid-phase extraction column: LC-SAX SPE (3ml) or other solid-phase extraction columns with equivalent analytical effect.

D.3.4 Solid-phase extraction device: ALLTECH or other devices with equivalent analytical effect.

D.3.5 Micro-injector: 50μL or100μL.

D.3.6 Vacuum filtering device for mobile phase and micro filter membrane of 0.2μm or 0.45μm.

D.4 Analytical procedures

D.4.1 Activation of solid-phase extraction column

Set the solid-phase extraction column in the solid-phase extraction device, add 2ml～3ml of methanol by slowing dripping (about 4 to 6 drops/min). When close to the end , add 2 to 3ml of super-pure water also by slowing dripping; when close to the end, add 2 to 3ml of 1% ammonium hydroxide by dripping. When the height of liquid is approximately 1mm, turn off the control valve. Do not drip to dry.

D.4.2 Preparation of sample solution

Place a 10ml empty volumetric flask for receiving sugar and alcohols at the receiving position. Pipette accurately 2ml of wine sample with micro-pipette, transfer to the solid-phase extraction column.

D.4.2.1 1st step dilution: dilution of sugar-alcohol

Slowly drip to pass through the column. When the height of liquid is about 1mm, add 4ml super-pure water. Slowly drip for two times to dilute. Collect all the diluted liquid in a 10ml volumetric flask. Take out the flask, adjust pH with NaOH solution (D.2.13) to 6. Then dilute with super-pure water to 10ml. The diluted liquid serves as separated sample liquid for sugar and alcohols.

D.4.2.2 2nd step dilution: dilution of organic acids

Place a 10ml empty volumetric flask for receiving organic acids at the receiving position. Add 4ml sulfur acid solution (D.2.8) by slowly dripping for 2 times to dilute. Finally extract all the diluted solution from the column. Take out the flask, adjust pH with NaOH solution (D.2.13) to 6. Then dilute with super-pure water to 10ml. The diluted liquid serves as separated sample liquid for organic acids.

D.4.2.3 Determination of sample

D.4.2.3.1 Determination of sugar and alcohols

D.4.2.3.1.1Chromatography conditions

Chromatography column: Fetigsaule RT 300-7.8. Or other columns with equivalent analytical effect.

Temperature of column: 30℃.

Mobile phase: sulfur acid solution (0.0015mol/L).

Flow rate : 0.3ml/min.

Sample size: 20µL.

Install the column before determination. Adjust the temperature of column to 30℃. Add mobile phase at a flow rate of 0.3ml/min to balance.

D.4.2.3.1.2Determination

When the system becomes stable, inject samples in order under the above-mentioned chromatography conditions.

Inject the sample of mixed standard series solution of sugar and alcohols, respectively. Plot a standard curve of concentraion of standard sample vs. peak area. Linear correlation coefficient should be above 0.9990.

Inject the sample solution (D.4.2)(sugar content and alcohol content in the sample should be in the range of standard series). Determine the nature according to retention time, determine the quantity according to peak area by external standard method.

D.4.2.3.2 Determination of organic acids

D.4.2.3.2.1Chromatography conditions

Chromatography column: Fetigsaule RT 300-7.8. Or other columns with equivalent analytical effect.

Temperature of column: 55℃.

Mobile phase: sulfur acid solution (0.0075mol/L).

Flow rate : 0.3ml/min.

Detector wavelength:210nm.

Sample size: 20µL.

Install the column before determination. Adjust the temperature of column to 55℃. Add mobile phase at a flow rate of 0.3ml/min to balance.

D.4.2.3.2.2Determination

When the system becomes stable, inject samples in order under the above-mentioned chromatography conditions.

Inject the sample of standard series solution of organic acids. Plot a standard curve of concentraion of standard sample vs. peak area. Linear correlation coefficient should be above 0.9990.

Inject the sample solution (D.4.2)(content of organic acids in the sample should be in the range of standard series). Determine the nature according to retention time, check the standard curve to obtain the value of quantity according to peak area.

D.5 Calculation of results

The content of each component in the sample is calculated as formula D.1.

$$X_i = c_i \times F \cdots\cdots \quad \text{(D.1)}$$

Wherein,

X_i—is the content of each component in the sample, expressed as g/L;

c_i—is the content of each component in the sample by checking the standard curve, expressed as g/L;

F—is the dilution factor.

The results are presented to one decimal place.

D.6 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 10% of the arithmetic average.

Appendix E

(Informative appendix)

Determination of resveratrol in wine

E.1 High performance liquid chromatography (HPLC)

E.1.1 Rationale

After extracting by acetic ester and clean-up in Cle-4 column, determine resveratrol in wine by HPLC.

E.1.2 Reagents and materials

E.1.2.1 Anhydrous alcohol, 95% alcohol, acetic ester, toluene, sodium chloride

E.1.2.2 Acetonitrile: chromatographic pure.

E.1.2.3 Trans-resveratrol

E.1.2.4 Standard stock solution of trans-resveratrol (1.0mg/ml): weigh 10.0mg trans-resveratrol, transfer to a 10ml brown volumetric flask. Dissolve with methanol and dilute to volume. Store it in a refrigerator for future use.

E.1.2.5 Standard series solution of trans-resveratrol: dilute standard stock solution of trans-resveratrol with methanol to standard series solution with concentration of 1.0μg/ml, 2.0μg/ml,5.0μg/ml and 10.0μg/ml, respectively.

E.1.2.6 Cis-resveratrol: irradiate standard stock solution of trans-resveratrol under the light with a wavelength of 254nm. Then determine the content of trans-resveratrol by this method. Calculate the conversion rate and obtain the value of cis-resveratrol content. Prepare standard series solution of cis-resverotrol by the method for trans-resveratrol.

E.1.3 Instrument

E.1.3.1 HPLC instrument: equipped with ultraviolet detector.

E.1.3.2 Rotating evaporator;

E.1.3.3 Chromatographic column ODS-C18, or other columns with equivalent analytical effect

E.1.3.4 Cle-4 clean-up column (1.0g/5mL), or other columns with equivalent clean-up effect.

E.1.4 Preparation of test sample

E.1.4.1 Extraction of resveratrol in wine: take 20.0ml wine; add 2.0g sodium chloride to wine. After sodium chloride is dissolved, add 20.0 ml acetic ester. Shake and extract, separate organic phase, pass through anhydrous sodium sulfate. Repeat the previous procedures. Then vacuum evaporate in a 50℃ water bath. Evaporate to dry with nitrogen gas. Add 2.0ml anhydrous alcohol to dissolve the remainder, and then transfer to a tube.

E.1.4.2 Shower the Cle-4 clean-up column with 5ml acetic ester first. Then add 2ml sample (E.1.4.1), add 5ml acetic ester to shower away the impurity. Dilute with 10ml of 95% alcohol and collect diluted liquid, evaporate to dry with nitrogen gas. Add 5ml mobile phase to dissolve.

E.1.5 Analytical procedures

E.1.5.1 Chromatography conditions

Chromatography column: ODS-C 18 column, 4.6mm×250mm, 5µm.Or other columns with equivalent analytical effect.

Mobile phase: acetonitrile+ re-distilled water =30+70.

Temperature of column: room temperature.

Flow rate :1.0ml/min.

Detector wavelength:306nm.

Sample size: 20µL.

Install the column before determination.Add mobile phase at a flow rate of 1.0ml/min to balance.

E.1.5.2 Determination

When the system becomes stable, inject samples in order under the above-mentioned chromatography conditions.

Inject the sample of standard series solution of cis- and trans-resveratrol, respectively. Plot a standard curve of concentraion of standard sample vs. peak area. Linear correlation coefficient should be above 0.9990.

Inject the sample solution (E.1.4.2)(content of resveratrol in the sample should be in the range of standard series). Determine the nature of resveratrol peak of the sample according to the retention time of standard substance, determine the content of resveratrol according to peak area of sample by external standard method.

E.1.6 Calculation of results

The content of resveratrol in the sample is calculated as formula E.1.

$$X_i = c_i \times F \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad \text{(D.1)}$$

Wherein,

X_i—is the content of resveratrol in the sample, expressed as g/L;

c_i—is the content of resveratrol in the sample by checking the standard curve, expressed as g/L;

F—is the dilution factor.

The results are presented to one decimal place.

Note: the total content of resveratrol is the summation of cis- and trans-resveratrol.

E.1.7 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 10% of the arithmetic average.

E.2 Gas chromatography/Mass spectrometry (GS/MS)

E.2.1 Rationale

After extracting by acetic ester and clean-up in Cle-4 column, derive with BSTFA+1% (Φ)TMCS, then determine the nature and content of resveratrol in wine by GC/MS. Quantitative ion is 444.

E.2.2 Reagents and materials

E.2.2.1 BSTFA [N,O-Bis (trimethylsilyl) trifluoro acetamide]+1%(Φ)TMCS (trimethylchlorosilane)

The others are the same as E.1.2.

E.2.3 Instrument

E.2.3.1 GC/MS instrument

E.2.3.2 Rotating evaporator

E.2.3.3 Chormatographic column: HP-5 MS5% phenyl methyl polysiloxane flexible quartz capillary column (30m×0.25mm×0.25μm) or other columns with equivalent analytical effect.

E.2.3.4 Cle-4 clean-up column (1.0g/5ml) or other clean-up columns with equivalent analytical effect.

E.2.4 Preparation of test sample

E.2.4.1 Extraction of resveratrol in wine: take 20.0ml wine; add 2.0g sodium chloride to wine. After sodium chloride is dissolved, add 20.0 ml acetic ester. Shake and extract, separate organic phase, pass through anhydrous sodium sulfate. Repeat the previous procedures. Then vacuum evaporate in a 50℃ water bath. Evaporate to dry with nitrogen gas.

E.2.4.2 Derivation: add 0.1ml BSTFA+1%TMCS to the sample treated in step E.2.4.1. Put in a stopper and shake in a vortex mixer. Heat it for 0.5 hour at 80℃. Then evaporate to dry with nitrogen gas. Add 0.1ml toluene to dissolve the sample.

E.2.4.3 Take appropriate volume of reservatrol standard solution. Evaporate it to dry with nitrogen gas. Derive as described in E.2.4.2.

E.2.5 Analytical procedures

E.2.5.1 Mass spectrometry conditions:

Column temperature procedure: initial temperature is150℃.Keep constant temperature for 3 minutes. Then increase the temperature at the rate of 10℃/min to 280℃, and keep constant temperature for 10 minutes;

Temperature of injector :300℃;

Carrier gas(high-purity nitrogen: 99.999%): flow rate is 0.9ml/min;

split ratio is 20:1;

temperature of EI source: 230℃;

electric energy: 70 eV;

temperature of interface: 280℃;

voltage of electric multiplier : 1,765V;

scan mode m/z: 35 amu~450 amu;

quantative ion: 444;

solvent delay: 5 minutes;

sample size: 1.0μL.

E.2.5.2 Determination

The same as E.1.5.2.

E.2.6 Calculation of results

The same as E.1.6.

E.2.7 Precision

Absolute difference between two independent determination results obtained under reproductive conditions should not exceed 10% of the arithmetic average.

Appendix F

(Informative appendix)

Requirements for sensory evaluation of wine and wild grape wine

F.1 Basic requirements

F.1.1 Requirements for environment

F.1.1.1 Requirements for tasting room

a) Have suitable and comfortable light condition;

b) Easy to clean, far away from noise; sound insulation is preferred;

c) No any odor, easy to ventilate and exhaust.

F.1.1.2 Light source

Light source for tasting room may use natural sunlight or fluorescent lamp; light should be uniform scattering light.

F.1.1.3 Temperature and humidity

The temperature and humidity should be constant in tasting room and create a comfortable environment. The suitable range for temperature and humidity is 20℃~22℃ and 60%~70%, respectively.

F.1.1.4 Tasting compartment

The tasting compartments should be separated from each other. Infrastructure inside the compartment should be easy to clean and suitable to compare the color of wine; the compartment should provide drinkable tap water. A foot-controlled tap is preferred, so that tasters can free their hands to work.

F.1.2 Requirements for tasting cup

A standard cup for tasting wine is required. Such a cup is made from colorless and transparent crystal glass containing about 9% lead; no any mark or bubble is allowed; the cup rabbet should be smooth, uniform and round; the cup should be able to stand a temperature range of 0℃~100℃; the volume is 210ml to 225ml.

F.1.3 Requirements for personnel

People to taste wine should be those who have obtained appropriate qualification (state-level wine taster); in general, a singular number of tasters is required; as many as possible; no less than 7.

F.1.4 Treatment of sample

Place the sample at 20±2℃ for 24 hours to reach a balanced state [or in a 20±2℃ water bath to keep warm for 1 hour]. Then mark with ciphers and perform sensory evaluation.

Note: information about samples to be evaluated should be strictly confidential to wine tasters.

F.1.5 Scoring method

Every taster gives a score for each item according to the requirements specified in detained rules. Total the scores. Then total the total score given by all the tasters and average it. The average is the sensory score of the wine.

F.2 Standard phrases for scoring

Refer to table F.1.

F.3 Detailed rules for scoring wine

Refer to table F.2.

F.4 Detailed rules for scoring wild grape wine

Refer to table F.3.

Table F.1 Standard phrases for scoring

Score range		Features
wine	Wild grape wine	
> 90	> 85	Have correct color, nice-looking, harmonic, transparent, Have luster; dense fragrance, elegant aroma of fruit and wine; Full-bodied, fresh, tasty and refreshing, long-lasting after-Taste; unique style, elegant and perfect.
89~80	84~75	Have correct color, transparent and clear, no obvious Suspensions; satisfactory aroma of fruit and wine; not very Rich , soft and refreshing, pleasing sweetness; definite type, good style
79~70	74~65	Color is slightly changed; transparent, no impurity; less Aroma of fruit and wine, no foreign aroma; harmonic-bodied , pure; have typicality, no enough elegance.
69~65	64~60	Obviously different from the correct color; slightly turbid, Have no luster or artificially colored; no enough aroma of Fruit, not pleasing, or have foreign aroma; light-bodied, Inharmonic, or have other obvious defects (any one of the Above criteria except color is met, the wine is evaluated to Be unqualified)

Table F.2 Detailed rules for scoring wine

Item			Requirements	
Appear-ance Score10	Color Score 5		White wine	Close to colorless, light yellow, Straw yellow, green-straw yellow, golden yellow
			Red wine	Red purple, dark red, ruby, Tile red, brick red, yellow-red, Brown-red, black- red
			Rose wine	Yellow-rose red, orange-rose red, Rose red, orange red, light red, Purple-rose red
	Score 5	Extent of Transpa-Rancy	Transparent and clear, have luster, no obvious Suspensions(for wine sealed by cork, presence of 3 wooden bits no larger than 1mm is allowed)	
		Extent of sparkling	When sparkling wine is poured into a cup, there should Be fine beady bubbles rising which continue for a while, The foams should be fine and white	
Aroma Score 30	Non-flavored wine		Pure, elegant, pleasing and harmonic aroma Of fruit and wine	
	Flavored wine		Pure and elegant aroma of wine, harmonic Aroma of fragrant plants	
Taste Score 40	Dry wine, semi-dry wine (Including flavored wine)		Full-bodied, harmonic, pleasing, tasty and refreshing	
	Sweet wine, semi-sweet wine (including flavored wine)		Full-bodied, pleasing sweetness, soft and fine taste	
	Sparkling wine		Elegant taste, pure, harmonic, pleasing, have A stimulating flavor	
	Carbonated wine		Refreshing , pleasing and pure taste, have a Stimulation flavor	
Typicality score 20			Perfect type, distinctive style, elegant	

Table F.3 Detailed rules for scoring wild grape wine

Item			Requirements	
Appear-ance Score10	Color Score 5		Rose wine (including flavored Wine)	Yellow-rose red, orange-rose red, Rose red, orange red, light red, Purple-rose red
			Red wine (including flavored Wine)	Red purple, dark red, ruby, Cardinal red, tile red, brick red, yellow-red, Brown-red, black- red
	Score 5	Extent of Transparancy	Transparent and clear, have luster, no obvious Suspensions(for wine sealed by cork, presence of 3 wooden bits no larger than 1mm is allowed)	
		Extent of sparkling	When wild grape wine is poured into a cup, there Should be white or slightly red bubbles rising.	
Aroma Score 30	Wild grape wine			Pure, elegant, pleasing and harmonic aroma Of fruit and wine
	Flavored wild grape wine			Pure and elegant aroma of wild grape wine, Harmonic aroma of fragrant plants
Taste Score 40	Dry wild grape wine, semi-dry wild grape wine (Including flavored wine)			Full-bodied, harmonic, pleasing, tasty and refreshing
	Sweet wild grape wine, semi-sweet wild grape wine (including flavored wine)			Full-bodied, pleasing sweetness, soft and fine taste
	Carbonated wild grape wine			Elegant taste, pure, harmonic, pleasing, have A stimulating flavor
Typicality score 20				Perfect type, distinctive style, elegant