
Alcoholic Strength in Wine

Reference: **OIV Method - MA - AS312 - 01A** - Alcoholic strength by volume

Tested with **VELP Scientifica UDK 149 Automatic Kjeldahl Distillation Unit** (Code F30200140)



Introduction

Wine is one of the most ancient alcoholic beverage: its consumption is widespread around the world and it is a part of customs and tradition of many people. It is produced solely by fermentation (total or partial) of the fruit of the vine, grapes (either pressed or not), or must, and it is dependent on the complex biochemical transformations caused by microorganisms (e.g. *Saccharomyces cerevisiae*) and influenced by technical and environmental factors.

The ethylic alcohol, produced during the fermentation, determines the alcoholic strength and it can be measured by volume as “the number of liters of ethanol contained in 100 liters of wine, both volumes being measured at temperature of 20°C. It is expressed by the symbol %vol”.

Alcoholic Determination in Wine

Steam distillation is a method to determine the alcoholic strength in wine, made previously alkaline by a suspension of calcium hydroxide: the distillate obtained is an ethanol – water mixture and, using a measurement of density by a pycnometer and expressing the results through the official tables, the alcoholic strength can be calculated.

Sample

Italian Red Wine Alcoholic strength by volume (labeled value): 11.5 % vol

Sample Preparation

To remove the carbon dioxide, stir gently the sample (1000 ml in a 2000 ml flask) with a VELP magnetic stirrer.

Chemicals and Equipment

- Suspension of calcium hydroxide 2 M: 120 grams of CaO in 1 liter of water at 60-70 °C
- Alcoholic strength kit (code A00000285) composed by:
 - Tweezer for closing the NaOH tube
 - Kjeldahl balloon 500 ml for the distillation of sample (Code A00000082)
- Pycnometer (volume 100 ml or 50 ml)
- 200 ml volumetric flasks with stopper
- Analytical balance
- Cooled Incubator (VELP Scientifica FOC Series i.e. code F10400320)

Procedure

Measure out 200 ml of the wine using a graduated flask and thermostat it at 20 °C. Let the sample adjust to temperature, this will take about 15 minutes. Bring down the volume of the sample exactly 200 ml by taking away excess sample by a small pipette. Transfer the wine to the 500 ml test tube. In order to collect all the mixture residues, rinse the volumetric flask four times with successive 5 ml washings of water and add 10 ml of distilled water as receiving solution in the same volumetric flask. Then, pour 10 ml of the suspension of calcium hydroxide to the test tube. The colour of the wine must change from red to deep grey. For very acid wines, it's suggested to add some drops of phenolphthalein in the test tube, until the color of the indicator changes. Place the volumetric flask in a beaker filled with cold water and ice, next to the UDK149. Insert the distillate outlet tube (it must be put in contact with the receiving solution) and fix it well using parafilm.

Distillation

Condition the UDK 149 unit by performing a Wash down and distill the samples setting the method below:

- H₂O (dilution water): 0 ml
- NaOH (32%): 0 ml
- H₃BO₃ (4% with indicators): 0 ml
- Steam Power: 80%
- Distillation Time: 6.30 minutes *

* In UDK 149 settings, set a distillation time to obtain a maximum of 200 ml of distillate. After the distillation, position the receiving flask in the thermostat for about 15 min. and finally bring up to volume (200 ml) using distilled water at 20 °C.

Density of the Distillate

Measure the density of the distillate through a pycnometer:

1. Weigh the empty pycnometer, clean and dry, with all parts in place (M_{pyc} in g)
2. Weigh the pycnometer filled with the distillate at 20 °C (M_{dist} in g)
3. Calculate the density of the distillate at 20 °C ($D_{dist, 20°C}$) following the formula:

$$D_{dist, 20°C} = (M_{dist} - M_{pyc}) / (V_{pyc} \times 1000)$$

V_{pyc} (m^3) is the volume of the empty pycnometer and is calculated as follows:

$$V_{pyc} = (M_{pyc, H_2O} - M_{pyc}) / (\rho_{H_2O, 20°C} \times 1000)$$

Where:

M_{pyc, H_2O} = pycnometer weight filled with water at 20 °C (g) $\rho_{H_2O, 20°C}$ = density of the water at 20 °C (0.99823 g/ml)

4. Use the density table to express the results (OIV method - MA - AS312 - 01A)
5. Among measurements rinse the pycnometer with the next alcoholic solution.
6. During the entire procedure take care to avoid fat from fingertips, temperature changes when holding the pycnometer and air bubbles in it.

Typical Results on Red Wine

Sample quantity (ml)	Alcohol strength (% vol) **
200	11.48
200	11.65
200	11.49
200	11.48
200	11.58
Average ± SD%	11.54 ± 0.08
RSD% *	0.7

* RSD% = (Standard Deviation x 100) / Average

** For results conversion, official standard tables (OIV method - MA - AS312 - 01A) have been used.

For the verification of the distillation apparatus, the OIV Method - MA - AS312 - 01A specifies that, distilling an ethanol water mixture with an alcoholic strength of 10% vol. five times in succession, the loss of alcohol must be smaller than 0,02% vol. during each distillation.

The UDK 149 satisfies completely the OIV Method - MA - AS312 - 01A.

Conclusion

The obtained results are reliable and reproducible in accordance with the expected values, with a low relative standard deviation (RSD < 1%), that means high repeatability of the results.

Benefits of UDK 149 are:

- High level of precision and reproducibility
- High productivity
- Worldwide official method
- Reliable and easy method
- Time saving
- Affordable equipment cost
- Moderate running costs