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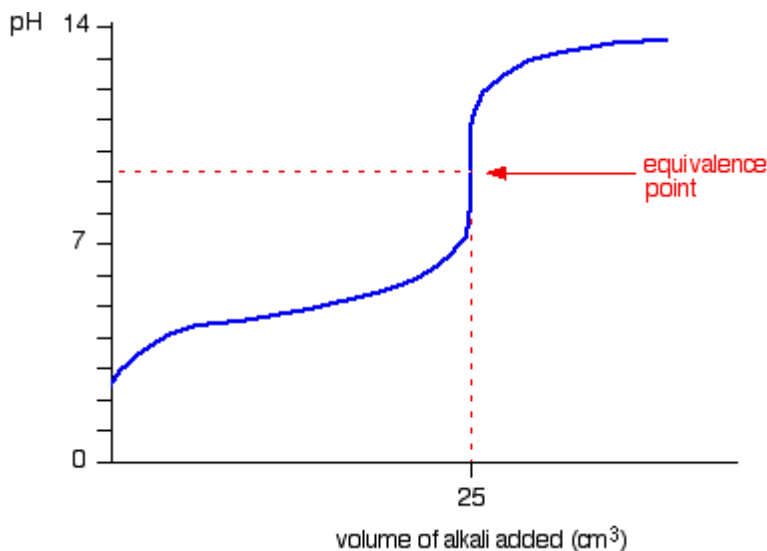
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## Determination of Titratable Acidity in Wine or Juice

### **Chemical Concepts and Techniques:**

Titrate acidity is a measure of all the available hydrogen ions present in the sample. Because the weak acids are present in solution as several different chemical species in chemical equilibrium, the titration process can be time-consuming due to necessary shifts in the equilibrium as free  $H^+$  ions are consumed.

Titrate acidity in grape juice or wine is by convention expressed as g/L tartaric acid, although of course the actual acidity is a mixture of acids, predominately tartaric and malic, but also citric, succinic and trace amounts of other weak and strong acids. However, only one inflection point is seen in the titration curve despite the mixture of acids. This is due to the fact that the  $pK_a$  values of the acids are not sufficiently different for separate inflection points to be distinguished.



Titrate acidity is measured by titrating a sample of wine or juice against a strong base, 0.1M sodium hydroxide. As the acids in wine/juice are predominately weak acids, the equivalence point occurs at a pH greater than 7.0 (7.4-8.4 typical range). As the acid profile of a given wine or juice is unique to that sample, the true equivalence point will vary with each individual wine. Accepted convention is to use a standardised endpoint of pH 8.2, to allow comparison of wines. Note that use of phenolphthalein indicator will detect an endpoint between pH 8.0-10.0, depending on the intensity of the pink colour obtained. The endpoint should be determined as the first **persistent (>15 seconds) pale pink** if phenolphthalein is used.

## Equipment Required:

25mL or 50mL burette  
10mL volumetric pipette  
Electronic pH meter (or use indicator as below)  
hot plate  
boiling granules  
100mL beakers

## Reagent Preparation:

**0.1M sodium hydroxide (standardised):** Dilute a standardised 1.0 M NaOH solution by a factor of 10. Standardise before use against potassium hydrogen phthalate or commercial standardised 0.1M HCl solution.

**Phenolphthalein indicator (1% ethanolic):** Weigh out 0.5 g of phenolphthalein. Prepare a 50% ethanol (ethyl alcohol) solution consisting of 50ml ethanol and 50 ml water. Dissolve the phenolphthalein thoroughly in the 50% ethanol solution. Use from a bottle fitted with an eye dropper. Store the rest in a stoppered bottle.

**CO<sub>2</sub>-free distilled/deionised water:** freshly boiled, cooled and stored in closed container

**pH buffers (if using pH meter):** Use commercially prepared pH 4 and pH 7 buffers

**Deactivated carbon:** (if required to decolourise red wines) Commercial grade.

## Method:

### *To degas wine sample:*

1. Preheat a hot plate to the highest setting.
2. Pipette 10.0mL of wine into a 100mL glass beaker. Add a few boiling granules.
3. Place on hot plate. Allow to heat until boiling and remove promptly. Do not allow sample to boil more than a few seconds.
4. Cool sample before titrating

### *To titrate sample:*

1. Add a portion of freshly boiled, cooled distilled or deionised water to wine sample, so that total volume is sufficient to cover pH probe (not necessary if using an indicator)
2. Titrate with 0.1M NaOH to either a pH of 8.2, or the first persistent pale pink colour if using phenolphthalein indicator.
3. Determine the Titratable acidity using the following formula:

$$\text{Titrateable acidity (g/L tartaric acid)} = 75 \times \text{molarity(NaOH)} \times \frac{\text{titre(mL)}}{\text{Volume of sample(mL)}}$$

### Points to Consider:

- Carbon dioxide and sulphur dioxide cause a positive interference due to the presence of carbonic and sulphurous acid respectively. In practice it is acceptable to ignore the very small contribution of SO<sub>2</sub>, however carbon dioxide can cause errors of over 1g/L, so **degassing of the sample is essential** for accurate results.
- The best way to degas a wine is to subject it to a strong vacuum. However, in order to assess whether a particular vacuum pump or apparatus is sufficiently effective in removing dissolved carbon dioxide, extensive testing or validation of the system would need to be performed. Heating the sample rapidly to boiling is an acceptable alternative. Do not allow the sample to continue boiling as this can cause the loss of volatile acids, or may cause soluble organic acids to degrade.
- Titration of weak acid species causes equilibrium shifts as the free H<sup>+</sup> ions are consumed by NaOH, then regenerated from undissociated acid species. For accurate results it is important to allow sufficient time for mixing and reaction after each addition of NaOH. If using an indicator, it is important to recognise that an indicator colour change that **does not persist, but fades**, is caused by further production of H<sup>+</sup> ions due to equilibrium shift, and should not be taken as the endpoint.
- 0.1M sodium hydroxide is relatively unstable with respect to concentration and should be standardised weekly against potassium hydrogen phthalate or standard volumetric acid solution. Store with a CO<sub>2</sub> soda lime trap attached.
- Use of phenolphthalein indicator works well with white or pale coloured wines. However it is difficult to see the endpoint with pink or red wines. Pink or red wines need to be decolourised with activated carbon and filtered before testing. Alternately, a pH meter can be used to determine the endpoint of pH 8.2.
- If using a pH meter it is important that the **dilution water be free of carbon dioxide** to avoid errors. Use freshly boiled cooled distilled or deionised water. Alternatively, carefully adjust the pH of distilled or deionised water to pH 8.2 before using as dilution water.
- Titratable acidity is not the same as total acidity, as some weak acid species may be permanently bound as potassium salts. Therefore titratable acidity values for a given wine will vary with the potassium ion concentration.

### References:

Zoecklein, Fugelsang, Gump & Nury, *Production Wine Analysis*, Van Nostrand Reinhold, 1990

Iland, Ewart, Sitters, Markides & Bruer, *Techniques for chemical analysis and quality monitoring during winemaking*, Patrick Iland Wine Promotions, 2000