

Vintage titrations: tannin in wine

Time

2 h.

Curriculum links

Redox titrations using potassium manganate(VII).

Group size

2.

Materials and equipment

Materials per group

- 50 cm³ samples of red wine (for white wine see below)
- 50 cm³ of 0.004 mol dm⁻³ potassium manganate(VII)
- 1 g activated charcoal
- deionised water
- 10 cm³ of 0.5% indigo carmine indicator solution. (The indigo carmine indicator is made up by dissolving 0.5 g of the dyestuff in 60 cm³ warm deionised water. The solution is cooled, 4 cm³ of conc H₂SO₄ is added, and the volume made up to 100 cm³ with deionised water. The solution is filtered through a No. 42 Whatman paper).

Equipment per group

- 50 cm³ burette
- 5 cm³ and 2 cm³ pipettes
- funnel
- filter paper
- 10 cm³, 25 cm³ and 250 cm³ measuring cylinders
- 250 cm³ conical flasks
- 50 cm³ beaker
- white tile
- safety glasses.

Safety

Eye protection must be worn for preparing solutions.

Solutions themselves are of low hazard but eye protection is advisable when heating any liquid.

Risk assessment

It is the responsibility of the teacher to carry out a suitable risk assessment.

This is an open-ended problem solving activity, so the guidance given here is necessarily incomplete. Teachers need to be particularly vigilant, and a higher degree of supervision is needed than in activities which have more closed outcomes. Students must be encouraged to take a responsible attitude towards safety, both their own and that of others. In planning an activity students should always include safety as a factor to be considered. Plans should be checked by the teacher before implementing them.

You must always comply with your employer's procedures and in some cases may decide that a particular activity is inappropriate in your situation. Further information on Health and Safety should be

obtained from reputable sources such as CLEAPSS [<http://science.cleapss.org.uk/>] in England, Wales and Northern Ireland and, in Scotland, SSERC [<https://www.sserc.org.uk/>].

Commentary

The colour of red wine is due to the presence of anthocyanidins, a class of flavonoids.¹ Tannin is a collective name for other largely colourless but bitter flavonoids which are also present in the wine. In making red wine the crushed grapes are put into vats. Some of the stems, the skins, and the pulp remain with the juice forming a residue which is known as the must. The alcohol in the fermenting juice extracts colour from the skins and the longer the juice is in contact with the must the darker the wine. In the process tannin is also extracted into the wine.

White wine, which should not pick up any colour from the grape skins, is made by pressing the grapes as quickly as possible and the juice alone is then set to ferment. The level of tannin in white wines is only about one-tenth of that found in red wine.

The procedure described below is based on that described by Professor G.W.A. Fowles of University of Reading.² During trialling most students needed a lot of guidance to work through this procedure.

Procedure

Actual titration

A funnel is placed in the neck of a 250 cm³ conical flask. 5 cm³ of wine is pipetted and 10 cm³ of deionised water is added. The flask is heated gently until the volume of the wine and water is reduced to 5–7 cm³. The alcohol will now have boiled off. 25 cm³ of cold deionised water is now added and 2 cm³ of indigo carmine indicator is added by using a pipette. (As the indicator uses up some potassium manganate(VII) it is important to measure it out carefully so that it can be allowed for in the 'blank'.)

0.004 mol dm⁻³ KMnO₄ is placed in the burette and the mixture is titrated. A golden yellow colour appears at the end point. Let this titre be A cm³.

Blank titration

20–25 cm³ of the wine is placed in a beaker with 1 g of activated charcoal and the mixture is stirred thoroughly. The mixture is then filtered and 5 cm³ of the decolorised wine is transferred to a 250 cm³ conical flask using a pipette.

The procedure described in 'Actual titration' is repeated. This blank titration will allow for the indicator and for any oxidisable substances in the wine apart from the anthocyanidins and the tannins.

Let the volume of the blank titre be B cm³.

Calculation

The amount of potassium manganate(VII) used in oxidising the tannins (and anthocyanidins) is A – B = C cm³.

Tannins are of variable composition. The titration is referred to a standard tannin solution for which 1 cm³ of 0.004 mol dm⁻³ KMnO₄ = 0.0832 mg tannin.

Therefore % tannin in wine = 0.01664 C

The level of tannin for burgundies and clarets will be in the range 0.15 – 0.4%.

Extension

In his book *Chemistry in the Marketplace* Ben Selinger describes a series of experiments on wine analysis³ with Australian wines which are designed for first year undergraduates.

References

1. P. W. Atkins, *Molecules*. New York: Scientific American Library Series, 1987.

2. G. F. W. Fowles, *Educ. Chem.*, 1978, **15**, 89.

3. B. Selinger, *Chemistry in the marketplace*, 4th edn. London: Harcourt Brace Jovanovich, 1989.

Credits

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