Measuring the amount of vitamin C in fruit drinks

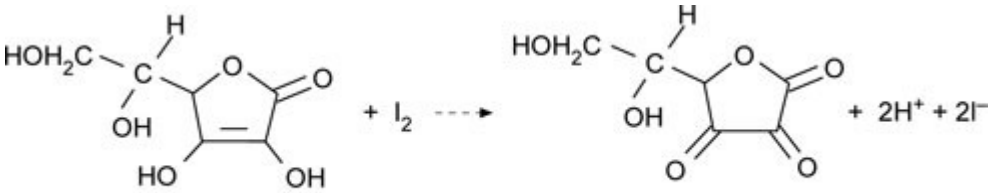
In this experiment you will be finding out how much vitamin C there is in a fruit drink. The chemical name for vitamin C is ascorbic acid.

The basis of the experiment is as follows.

A known amount of iodine is generated by the reaction between iodate, iodide and sulphuric acid:

$IO_3^-(aq) + 5I^-(aq) + 6H^+(aq) \rightarrow 3I_2(s) + 3H_2O(l)$

A measured amount of fruit drink is added. The ascorbic acid in the drink reacts quantitatively with some of the iodine as the iodine is in excess:



Ascorbic acid Dehydroascorbic acid

The excess iodine is then titrated against standard sodium thiosulphate solution:

$I_2(aq) + 2S_2O_3^{2-}(aq) \rightarrow S_4O_6^{2-}(aq) + 2I^-(aq)$

From the titration results the amount of iodine that reacts with the sodium thiosulphate solution can be found. Since the total amount of iodine originally formed is known the amount that reacts with the ascorbic acid is found by difference. Therefore the amount of ascorbic acid that reacts with this amount of iodine can be found.

Instructions

1. Set up the microscale titration apparatus (see p. 8).
2. Fill the apparatus with sodium thiosulphate solution (see p. 9).
3. Using the glass pipette add 2 cm^3 of potassium iodate solution to the beaker.
4. Measure, using the measuring cylinder, 3 cm^3 of potassium iodide solution, then add this to the beaker. (Note: the potassium iodide solution is added in slight excess.)
5. Add three drops of sulphuric acid. A yellow-brown colour appears due to iodine.
6. Add a few drops of starch solution. A deep blue-black colour forms.
7. Using the glass pipette add 1 cm^3 of the fruit drink to the beaker and swirl gently.
8. Titrate the remaining iodine in the beaker against the sodium thiosulphate solution. (The beaker can be swirled very gently to mix the chemicals. Alternatively, the tip of a plastic pipette can be used as a mini stirring rod.) The disappearance of the deep blue-black colour marks the end-point.
9. Do a duplicate titration and check the agreement between the two titres. If it is acceptable take the mean value of the two titres and use it for your calculations.

Calculations

A specimen result and calculation is given below. Study this carefully and use it as a guide for working out the vitamin C content of your fruit drink.

The volume of thiosulphate delivered during the titration = 0.74 cm^3.

The concentration of thiosulphate = 0.010 mol dm^{-3}.

Therefore the number of moles of thiosulphate =

$$\frac{0.74 \times 0.010}{1000} = 7.4 \times 10^{-6}$$

Therefore the number of moles of iodine that this reacts with during the titration is 3.7 x 10^{-6}

The total number of moles of iodine produced in the reaction between iodate, iodide and sulphuric acid based on using 2 cm^3 of iodate with a concentration of 0.0012 mol dm^{-3} =

$$\frac{3 \times 2 \times 0.0012}{1000} = 7.2 \times 10^{-6}$$

Therefore the number of moles of iodine that reacts with the ascorbic acid is 7.2 × 10^{-6} - 3.7 × 10^{-6} = 3.5 × 10^{-6}.

Since 1 mole of iodine reacts with 1 mole of ascorbic acid then the number of moles of ascorbic acid is also 3.5 × 10^{-6}.

The volume of the fruit juice used is 1 cm^3. Therefore the number of moles of ascorbic acid in 1000 cm^3 = 3.5 × 10^{-3}.

The relative molar mass of ascorbic acid = 174.12 g. Therefore the mass of ascorbic acid (in 1000 cm^3) = 174.12 × 3.5 × 10^{-3} = 0.609 g.

Therefore the vitamin C content of the fruit drink = 61mg per 100 cm^3.

Health & Safety

Students must wear eye protection.

Sulfuric acid, 1 mol dm^{-3} $H_2SO_4(aq)$, is an IRRITANT.

Credits

Health & safety checked May 2018

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