

Colorimetric analysis of 2-hydroxybenzoic acid

Student worksheet

Health and safety note

Wear eye protection

Principle

2-hydroxybenzoic acid contains a phenol group. It produces a violet-blue complex when it reacts with iron(III) ions in weakly acidic solution. The intensity of the colour can be used to determine the concentration of 2-hydroxybenzoic acid in solution.

This reaction can be used for the quantitative analysis of low concentrations of 2-hydroxybenzoic acid in solution. You can find the concentration of the solution of 2-hydroxybenzoic acid using a colorimeter. You can also use simple colour matching although the results will be less precise.

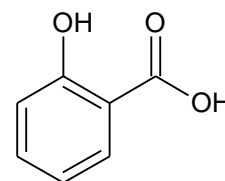


Figure A molecule of 2-hydroxybenzoic acid (also called salicylic acid).

Equipment and materials

- Colorimeter and suitable filter (green/yellow). A solution of the complex displays maximum absorption at 530 nm
- Cuvette
- 100 cm³ volumetric flask (x 4 or reuse same flask washing thoroughly between solution preparations)
- 10 cm³ graduated pipette and pipette filler
- 2-hydroxybenzoic acid stock solution
- 0.025 mol dm⁻³ iron(III) nitrate solution
- Deionised/distilled water

Method

1. Pipette 10 cm³ of 2-hydroxybenzoic acid stock solution into a 100 cm³ volumetric flask. Make it up to volume with 0.025 mol dm⁻³ iron(III) nitrate solution. This is standard solution 1.
2. In a similar way make up standard solutions 2 to 5 using 8 cm³, 6 cm³, 4 cm³ and 2 cm³ of 2-hydroxybenzoic acid stock solution.

Standard solution	Volume of stock solution /cm ³	Concentration of 2-hydroxybenzoic acid /g dm ⁻³
1	10	0.080
2	8	0.064
3	6	0.048
4	4	0.032
5	2	0.016

Note: These are based on a stock solution that is 0.8 g dm⁻³ 2-hydroxybenzoic acid.

3. Measure the absorbance of each standard solution using the colorimeter, fitted with a suitable filter.
4. Plot a graph of absorbance against concentration of 2-hydroxybenzoic acid. This is the calibration graph.
5. Pipette 10 cm^3 of solution of unknown 2-hydroxybenzoic acid concentration into a 100 cm^3 volumetric flask. Make it up to volume with 0.025 mol dm^{-3} iron(III) nitrate solution. Measure its absorbance and calculate the concentration of 2-hydroxybenzoic acid.