

Alkenes: double bonds and addition reactions

Chemistry grades 11-12 (A Level · IB · Class 11-12) · Lab

Name: _____ Date: _____ Class: _____

Which edible oil contains the most carbon-carbon double bonds? In this lab you use dilute bromine water, the classic alkene test, as a measuring tool. You will titrate five oils, subtract a blank and convert the data into moles of Br₂ per 100 g, a value linked to the iodine value used in food analysis.

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Aim

To compare how much C=C unsaturation five edible oils contain by titrating each with dilute bromine water, and to convert the titres into moles of Br₂ per 100 g of oil.

Equipment

- bromine water, 0.020 mol/dm³, in a burette
- five vegetable oils: sunflower, rapeseed, olive, palm, coconut
- propanone (10 cm³ for each titration)
- top-pan balance (0.01 g), 100 cm³ conical flasks, white tile, 10 cm³ measuring cylinder
- stopwatch, gloves, goggles

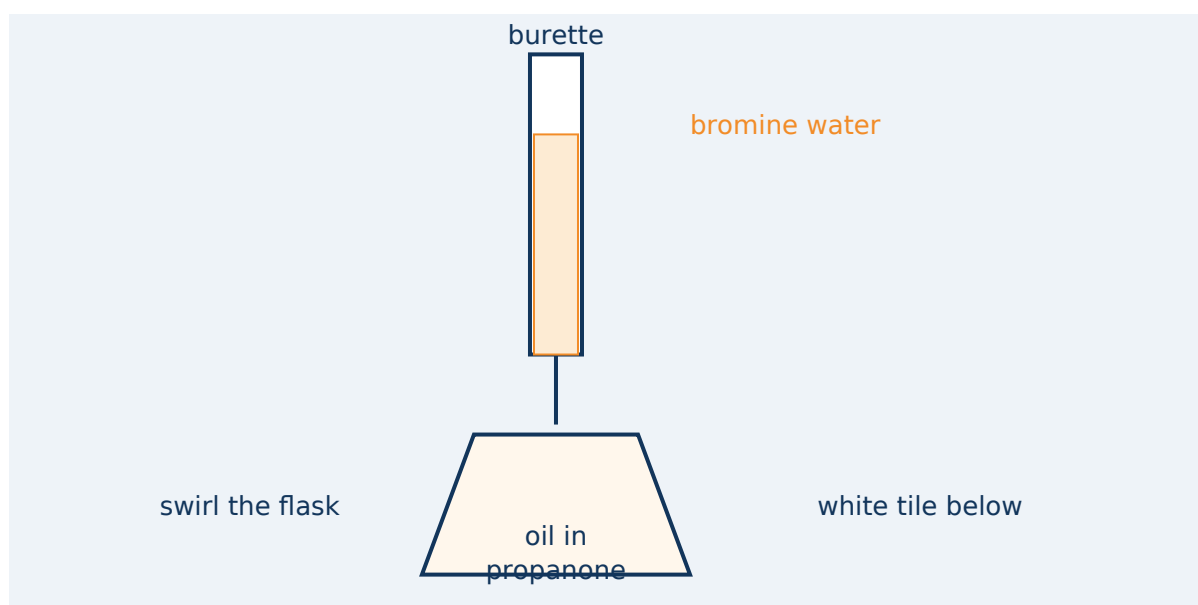
Safety

Safety

Bromine water is toxic and corrosive: wear goggles and gloves, work in a fume cupboard and keep a thiosulfate solution ready for spills. Propanone is highly flammable, so no naked flames. Dispose of waste in the labelled halogen bottle.

Method

1. Weigh 0.100 g of oil into a conical flask and add 10 cm³ of propanone; swirl until dissolved.
2. Fill the burette with bromine water and note the reading.
3. Add bromine water in 1 cm³ portions with swirling, then dropwise near the end point.
4. Stop when the orange colour lasts for 30 seconds.
5. Record the titre. Repeat for a second trial, then for each oil.
6. Do a blank titration with 10 cm³ of propanone only.



Titrating oil in propanone with dilute bromine water: the end point is the first orange colour that lasts 30 seconds.

Results

Sample measurements (blank titre = 0.3 cm³):

Oil	Titre 1 / cm ³	Titre 2 / cm ³	Mean / cm ³
Sunflower	24.0	24.2	24.1
Rapeseed	21.1	20.9	21.0
Olive	15.3	15.1	15.2
Palm	9.5	9.7	9.6
Coconut	1.8	2.0	1.9

Analysis questions

Question 1 Corrected titres

Subtract the blank titre from each mean and give the corrected titres for palm and coconut oil.

Question 2 Moles of bromine

Calculate the amount of Br₂ that reacted with 0.100 g of sunflower oil.

Question 3 Per 100 g of oil

Convert the result for sunflower oil to moles and to mass of Br₂ per 100 g of oil ($M(\text{Br}_2) = 159.8 \text{ g/mol}$).

Question 4 Coconut oil value

Repeat the calculation for coconut oil (mol Br₂ per 100 g).

Question 5 Ranking and meaning

Rank the oils from most to least unsaturated and relate the result to their use in cooking.

Question 6 Number of C=C per molecule

Olive oil gives 0.298 mol Br₂ per 100 g. The mean triglyceride has M = 880 g/mol. Calculate the average number of C=C per molecule.

Question 7 Errors and improvements

Give two sources of error and one improvement.