The solubility of fats (Item No.: P7185300)

Curricular Relevance

Area of Expertise: Chemie
Education Level: Klasse 10-13
Topic: Organische Chemie
Subtopic: Lebensmittelchemie: Fette, Kohlenhydrate, Aminosäuren/Proteine, Vitamine, Gewürze
Experiment: Löslichkeit von Fetten

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	20 Minutes	2 Students

Additional Requirements:

Experiment Variations:

Keywords:

food chemistry, fats, solubility

Task and equipment

Information for teachers

Additional Information

"Grease marks" is a common term for fat or oil stains on paper or clothing. How can grease stains be cleaned off?

Notes on content and learning objectives

- Fats and oils are insoluble in water, and very sparingly soluble in cold alcohol.
- Fats are highly soluble in organic solvents such as benzine, ether, aromatic hydrocarbons and halogenated hydrocarbons.
- The solubility of fats is associated to their chemical structure. They consistsof long, unpolar hydrocarbon chains.
- Fats are therefore highly soluble in unpolar solvents. Like dissolves like.

Notes on the method

This experiment is particularly suitable as an introduction to the themes "extracting fat" and "removing grease stains".

Fundamentals and remarks

Fats and oils are insoluble, or only sparingly soluble, in polar solvents such as water and alcohol. They are highly soluble in organic solvents such as petroleum ether and acetone.
The solubility of fats is influenced by their unpolar molecular structure, particularly by the hydrocarbon chains. For this reason, fats dissolve perferably in unpolar liquids.
To illustrate the molecular structure of fats, the students can use a molecular model kit to build a fat molecule. The solubility of fats in the named solvents can then be illustrated.

Hints on going deeper

- The difference between an emulsion and a solution can be worked out.
- Knowledge on the digestion of fats can be utilized.

Notes on set-up and procedure

Preparation:
Pentane or other alkanes can be used instead of petroleum ether. Halogenated or aromatic hydrocarbons should definitely not be used as solvents, because they are potential health hazards.

Notes on the students experiment:
Be certain to ensure that the bunsen burner flame is extinguished when the water has been heated.

Hazard and Precautionary statements

Acetone

H225:	Highly flammable liquid and vapour.
H319:	Causes serious eye irritation.
H336:	May cause drowsiness or dizziness.
P210:	Keep away from heat/sparks/open flames/hot surfaces – No smoking.
P233:	Keep container tightly closed.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing.

Ethanol:

H225:	Highly flammable liquid and vapour.
P210:	Keep away from heat/sparks/open flames/hot surfaces – No smoking.

Petroleum ether:

H225:	Highly flammable liquid and vapour.
H304:	May be fatal if swallowed and enters airways.
H315:	Causes skin irritation.
H361f:	Suspected of damaging fertility or the unborn child.
H336:	May cause drowsiness or dizziness.
H373:	May cause damage to organs through prolonged or repeated exposure.
H411:	Toxic to aquatic life with long lasting effects.
P210:	Keep away from heat/sparks/open flames/hot surfaces – No smoking.
P233:	Keep container tightly closed.
P240:	Ground/bond container and receiving equipment.
P273:	Avoid release to the environment.
P281:	Use personal protective equipment as required.
P301 + P310:	IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.
P302 + P352:	IF ON SKIN: Wash with soap and water.
P304 + P340:	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P308 + P313:	IF exposed or concerned: Get medical advice/attention.
P331:	Do NOT induce vomiting.
P403 + P235:	Store in a well ventilated place. Keep cool.

Hazards

- Acetone, ethanol and petroleum ether are highly inflammable. Extinguish all open flames before handling them!
- Wear protective glasses!
- Carry out the experiment in a fume cupboard, whenever possible!

Waste disposal

Pour the solution in test tube 1 to drain.
Pour the solutions in test tubes 2, 3 and 4 into the container for combustible organic solvents.

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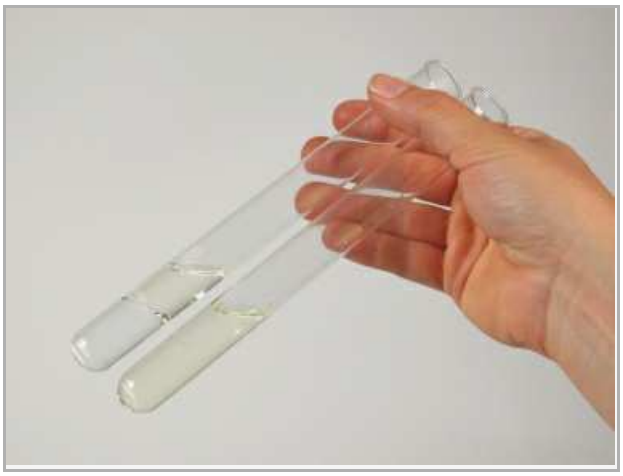
Task and equipment

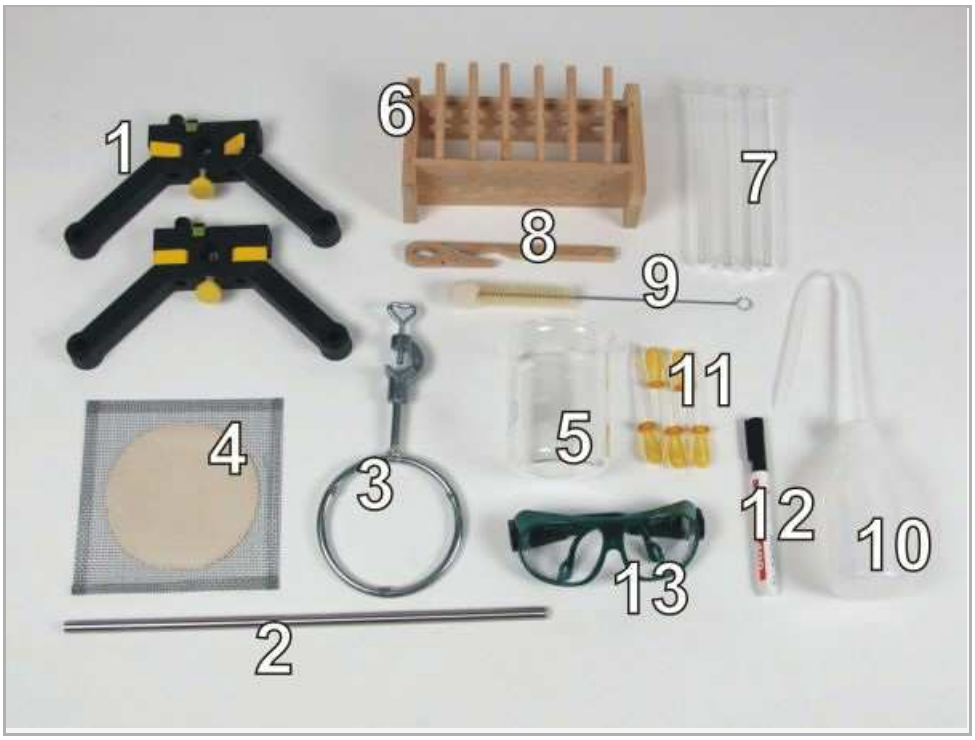
Task

Fats and oils are insoluble in water and form specks of fat. In which liquids are fats soluble?

Test the solubility of edible oils.



Equipment



Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
3	Ring with boss head, i. d. = 10 cm	37701-01	1
4	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
5	Glass beaker DURAN®, short, 400 ml	36014-00	1
6	Test tube rack for 12 tubes, holes d= 22 mm, wood	37686-10	1
7	Test tube, 180x18 mm,100pcs	37658-10	(4)
8	Test tube holder, up to d 22mm	38823-00	1
9	Test tube brush w. wool tip,d25mm	38762-00	1
10	Wash bottle, 250 ml, plastic	33930-00	1
11	Pipette with rubber bulb	64701-00	5
12	Labor pencil, waterproof	38711-00	1
13	Protecting glasses, clear glass	39316-00	1
	Butane burner f.cartridge 270+470	47536-00	1
	Butane catridge CV 300 Plus, 240 g	47538-01	1
	Acetone, gr 1 l	30004-70	1
	Petroleum ether, 40-60 gr 1000 ml	30184-70	1
	Denaturated alcohol (spirit for burning), 1000 ml	31150-70	1
	Water, distilled 5 l	31246-81	1
	Boiling beads, 200 g	36937-20	1
Additional material			
	Vegetable oil (sunflower oil, olive oil,...)		

Set-up and procedure

Set-up

Hazards

- Acetone, ethanol and petroleum ehter are highly inflammable. Extinguish all open flames before handling them!
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Setup

Number four test tubes from 1 to 4 and stand them next to each other in the test tube rack (Fig. 1).

Fig. 1

Assemble the stand as shown in figures 2 to 6. Fasten the support ring to the support rod and place the wire gauze on it. Adjust the height of the support ring so that the flame of the burner just reaches the wire gauze.

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Half-fill the beaker with water and add a few boiling stones. Heat it to boiling, then put it aside. Extinguish the bunsen burner flame!

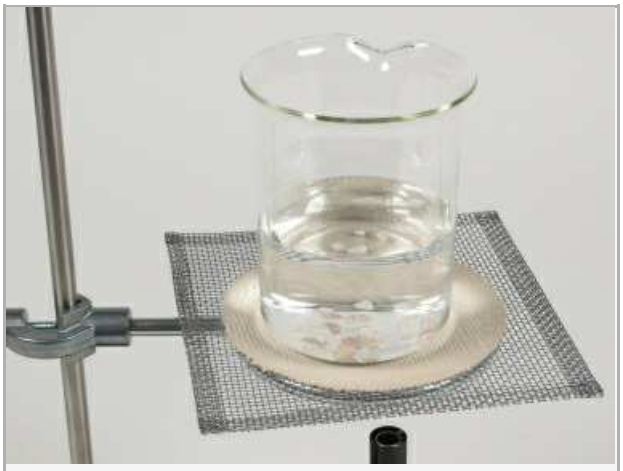

Fig. 7

Procedure

Half-fill the beaker with water and add a few boiling stones. Heat it to boiling, then put it aside. Extinguish the bunsen burner flame!

Test tube	Liquid
1	distilled water
2	Ethanol
3	Petroleum ether
4	Acetone

Add five drops of edible oil to each test tube. Try to dissolve the oil in the various liquids by shaking the test tubes.

Fig. 8

Place test tube 2 in the beaker of hot water and leave it there for about 5 minutes. Take it out of the water bath and carefully shake the mixture.

Waste disposal

Pour the solution in test tube 1 to drain.
Pour the solutions in test tubes 2, 3 and 4 into the container for combustible organic solvents.

Report: The solubility of fats

Result - Table 1

Note your observations in the following table.

Test tube	Liquid	Solubility
1	Distilled water	1
2a	Ethanol (cold)	1
2b	Ethanol (hot)	1
3	Petroleum ether	1
4	Acetone	1

Evaluation - Question 1

Draw conclusions from your observations.

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Evaluation - Question 2

Try to find other solvents in which edible oil is highly soluble.

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Evaluation - Question 3

Complete the following statements:

1. Fats and oils are only sparingly soluble in _____, they are highly soluble in _____ and _____.
2. Fats are insoluable in _____. Their _____ is below 1 g / cm^3, so that they swim on the surface of _____.
3. Because of their long _____, fats have an unpolar character. They therefore dissolve well in _____ solvents.