

Quantitative determination of fat / Soxhlet extraction



The students learn the quantitative determination of fat by using the Soxhlet extraction.

Chemistry

Organic chemistry

Distillation & Purification



Difficulty level

medium



Group size

2



Preparation time

10 minutes



Execution time

10 minutes

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General information

Application



Experimental setup

The discussion of healthy nutrition focuses on the fat content of foodstuffs. For this reason, it is important to know the exact fat content of individual foodstuffs. The experiment shown here presents a method for the quantitative determination of the fat content of foodstuffs by extraction using a Soxhlet apparatus.

This small size of this Soxhlet extractor makes it possible to extract small quantities using extremely small amounts of solvent.

Other information (1/2)

Prior knowledge



The experiment "Solubility of fats" should be carried out prior to this experiment if possible. The process "Distillation" should be also be previously explained, or a distillation should have been previously carried out. Dividing the experiment over two single lessons is recommended. If the fat content of different types of sausages (or food) is measured, the results can be entered in a table and can be compared with another.

Scientific principle



This small size of this Soxhlet extractor makes it possible to extract small quantities using extremely small amounts of solvent.

Other information (2/2)

Learning objective



The students learn the quantitative determination of fat by using the Soxhlet extraction.

Tasks



The students are to calculate the fat content of a sausage by using Soxhlet extraction.

Other information (2/2)

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Learning objective



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Tasks



The students are to calculate the fat content of a sausage by using Soxhlet extraction.

Safety instructions

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- Petroleum ether is highly flammable. Extinguish all open flames before handling it!
- Wear protective glasses!
- For the H- and P-phrases please refer to the corresponding safety data sheets.
- The general instructions for safe experimentation in science education apply to this experiment.

Equipment

Position	Material	Item No.	Quantity
1	Extraction tube,type Soxhlet, GL 25/12	MAU-27226000	1
2	Dimroth-Condensor, GL 25/12	MAU-27223500	1
3	Extraction sleeves 10x110mm,pkg 5	32995-02	1
4	Boiling beads, 200 g	36937-20	1
5	Heating mantle f. roundbottom flask, 100 ml	49541-93	1
6	Clamp for heating mantle	49557-01	1
7	Power regulator	32288-93	1
8	Short distillation head, GL 18/8	MAU-27224500	1
9	Lab thermometer,-10..+110 °C	38056-00	1
10	Round bottom flask, 100ml, GL 25/12	35841-15	1
11	Support base, variable	02001-00	1
12	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	1
13	Boss head	02043-00	2
14	Universal clamp	37715-01	2
15	Mortar with pestle, 150 ml, porcelain	32604-00	1
16	Beaker, Borosilicate, low-form, 400 ml	46055-00	1
17	Laboratory pen, waterproof, black	38711-00	1
18	Rubber tubing, i.d. 6 mm	39282-00	1
19	Hose clip, diam. 8-16 mm, 1 pc.	40996-02	1
20	Spoon, special steel	33398-00	1
21	Crucible tongs, 200 mm, stainless steel	33600-00	1
22	Protecting glasses, clear glass	39316-00	1
23	Rubber gloves, size M (8), one pair	39323-00	1
24	Universal oven, 32 liters, 230 V	49559-93	1
25	Petroleum ether, 40-60 C 250 ml	30184-25	1
26	Sodium sulphate dried 250 g	48344-25	1

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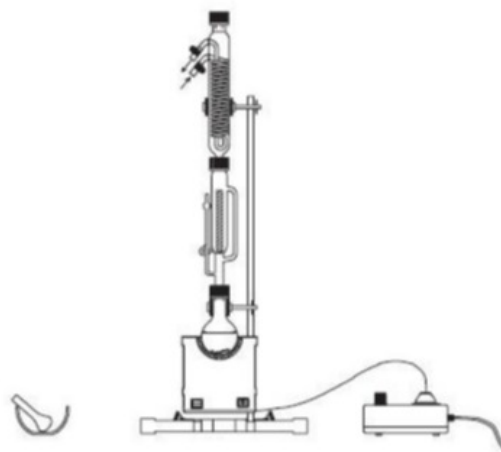


Setup and procedure

Setup

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- Label a round bottom flask and put three boiling stones into it.
- Place the flask in a drying oven at 105 °C for 30 minutes.
- After the flask has cooled, in a desiccator whenever possible, determine the exact mass of the flask.
- Set up a Soxhlet extraction apparatus as shown in Fig. right. To obtain the exact fat content, the flask must be dried to constant weight and be allowed to cool in a desiccator. To remove the solvent a distillation apparatus is used.



Experimental setup

Procedure (1/3)

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- Chop up a piece of sausage with a household foodprocessor. Weigh 10 g of the chopped sausage into a mortar and add twice the amount of sodium sulphate (anhydrous). Carefully grind the substances with the pestle.
- **Note:** Homogenous sausages such as fine liver sausage or meat-spreads need not be homogenized with the foodprocessor. If anhydrous sodium sulphate is not available, the sausage must be dried for several hours prior to the extraction.
- Quantitatively transfer the mixture from the mortar to an extraction thimble, e.g. using a spatula. Wipe the mortar, pestle and spatula successively with three walnut sized pieces of cotton wool. Put these pieces of cotton wool also in the thimble.
- Position the extraction thimble in the Soxhlet attachment. Fill the labelled round bottom flask containing the boiling stones two thirds full with petroleum ether. Fit the flask under the Soxhlet attachment. Check the cold water circulation and switch on the heating mantle.

Procedure (2/3)

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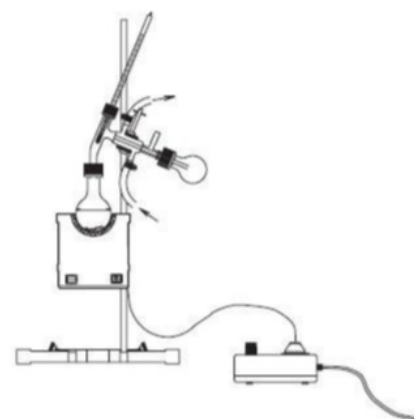
- Select the heating step on the heating mantle or on the power supply at which the solvent boils in a controlled way. Extract the sausage for at least 3 hours.
- When the solvent in the Soxhlet attachment is not colourless after the time given, then the extraction time must be appropriately lengthened.
- Remove the Soxhlet attachment and the condenser from the apparatus when the solvent in the Soxhlet attachment has just siphoned out.
- Lower the heating mantle about 5 cm. Use crucible tongs to carefully take the extraction thimble out of the Soxhlet attachment.



Procedure (3/3)

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- Subsequently set the apparatus up for distillation, as shown in Fig. right. Lift the heating mantle up under the round bottom flask and distil the whole of the petroleum ether over into the second flask. Switch off the heating mantle and remove it immediately the boiling temperature on the thermometer drops below 50 °C. The residue must not be overheated. Put the flask in a fume cupboard so that any remaining petroleum ether can evaporate off.
- When the residue in the flask no longer smells of solvent, place the flask in a drying oven at 105 °C for 30 minutes. After the flask has cooled, in a dessicator whenever possible, determine the exact mass of the flask plus the residue.



Subsequently set the apparatus up for distillation

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Evaluation

Evaluation (1/5)

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The fat content in foods is at the centre of attention in the discussion on a healthy diet. There is an indirect connection between overweight and fat. The use of fat in the production of foods is strictly controlled.

- The fat content in foods can be quantitatively determined by extraction, using a Soxhlet apparatus.
- Foods contain different amounts of fat, the fat content in sausages ranges roughly from 10% to 65%.
- Certain fats are essential, and must be taken in with food.

Evaluation (2/5)

The quantitative determination of fat with a Soxhlet apparatus is a standard method in food analysis. Water must be removed from the food prior to extraction, by grinding it with anhydrous sodium sulphate or by heating it in a drying oven at 105 °C. The dried food can then be extracted. The fat content of cheese, nuts or fish, for example, can be determined in the way described. Fat in bread, cakes and pastries are frequently present in a bound form. They must frequently be decomposed, e.g. with hydrochloric acid (acc. to Weibull/Stoll) prior to the quantitative fat determination.

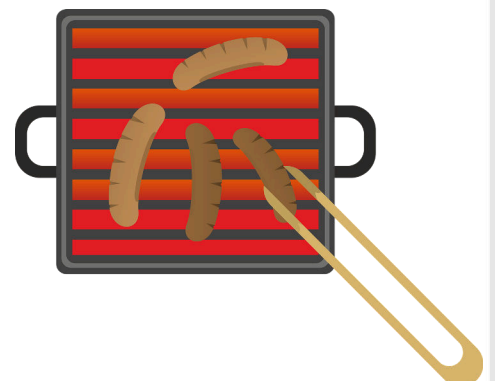
Hints on going deeper

This topic offers the possibility of an inter-disciplinary discussion on the aspects of nutrition. Knowledge of food chemistry can be applied in biology lessons, e.g. the problem of the essential fatty acids, unsaturated and saturated fatty acids, or overweight.

Evaluation (3/5)

What is the approximate fat content in sausages?

- the fat content in sausages ranges roughly from 65% to 100%.
- None of the answers is correct.
- The fat content in sausages ranges roughly from 10% to 65%.
- The fat content in sausages ranges roughly from 2% to 10%.



✓ Überprüfen

Evaluation (4/5)

Mark the correct statements.

- The use of fat in the production of foods is strictly controlled.
- The fat content in foods is at the centre of attention in the discussion on a healthy diet.
- None of the statements is correct.
- Certain fats are essential, and must be taken in with food.
- The fat content in foods can be quantitatively determined by extraction, using a Soxhlet apparatus.

✓ Überprüfen

Evaluation (5/5)

Summary of the experiment!

The quantitative determination of fat with a [] is a standard method in food analysis. Water must be [] from the food prior to extraction, by grinding it with anhydrous sodium sulphate or by heating it in a drying oven at []. The dried food can then be [].

The fat content of cheese, nuts or fish, for example, can be determined in the way described.

Soxhlet apparatus

105°C

removed

extracted

✓ Überprüfen