2.5 The water content of fatty products

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interTESS (Version 13.12 B214, Export 2000)

Task

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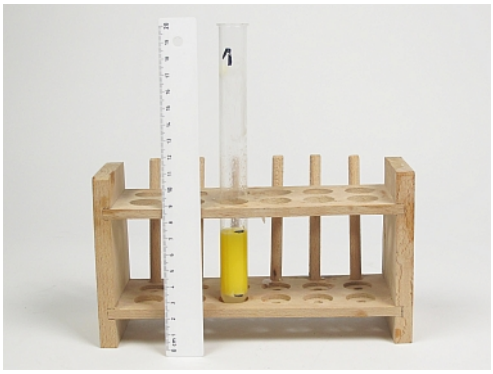
How much water is there in butter?

Determine the water content of various fatty products.



Use the space below for your own notes.

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Additional Information

When butter is heated, it changes colour several times. A milky white melt is first formed. After cooling, a solid yellow layer and a whitish, turbid liquid are formed.

Notes on content and learning objectives

- Butter and margarine are water-in-fat emulsions, which contain about 18 % water.
- Medium-fat products, such as medium-fat milk, contain more than 50 % water and are therefore not suitable for frying, cooking or baking.

Notes on the method

With the help of this experiment, the dependence of the suitability for storage on the water content of a food can be worked out, whereby the possibility of conserving foods by removing water can be referred to in particular. The topic overweight and fatty products can be addressed.

Fundamentals and remarks

Butter is won from milk or cream. A differentation is made between sweet cream butter and sour cream butter. To produce sour cream butter, bacteria cultures are added to the cream. Butter contains 81–85 % milk fat, 14–18 % water and 0.5–2.0 % non-fat dry mass.

Margarine contains approx. 80 % vegetable fat, 18 % water and approx. 0.5 % emulsifiers such as lecithin, mono- and diacetyl-triglycerides.

Medium-fat products, such as medium-fat milk and margarine, contain approx. 40 % fat, more than 50 % water, 3–6 % milk proteins and emulsifiers. Their packaging must be labelled with the inscription "not suitable for baking or frying".

Clarified butter is pure butter-fat which has been separated from water and protein. It is obtained by melting butter, and must contain a maximum of 0.03 % water. It can therefore be stored for up to 4 years at 0–5 °C.

Hints on going deeper

- Legal requirements on labelling foods.
- The storage capability of products containing fat.
- The conservation of foods by removing water.

Notes on the set-up and procedure

Preparation

The foods should be as cold as possible, as inserting them in the test tubes is then easier.

Medium-fat margarine can be used instead of medium-fat milk.

Notes on the students experiments

Indicator paper for water can be used to prove that the lower phase is water.

The water contents determined in this experiment are primarily for orientation purposes. To determine the water content exactly, the food must be weighed in a heat-dried metal dish, carefully melted, the water evaporated off and the cooled dish re-weighed.

Waste disposal

The lower, aqueous solutions can be poured to drain. The upper fat phases can be put in the normal waste container.

Material

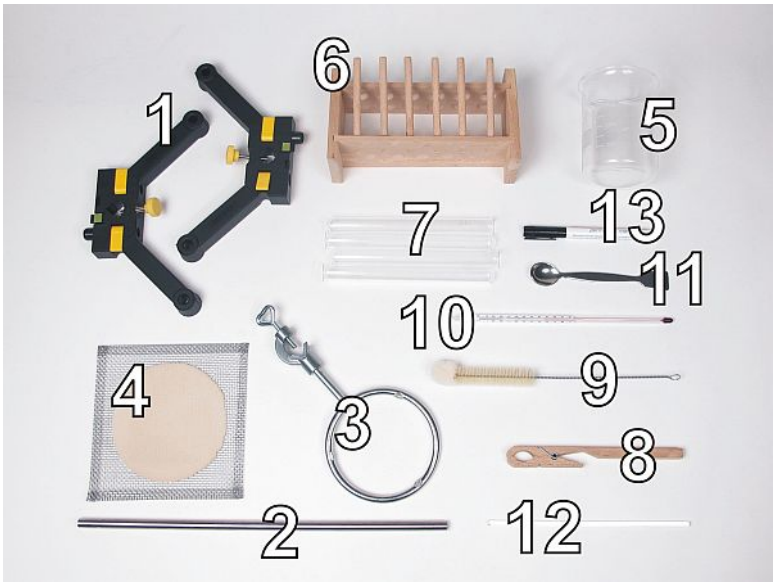
Material from "TESS advanced Chemistry Set Food Chemistry, FCH" (Order No. 15306-88)

Position No.	Material	Order No.	Quantity
1	Support base variable	02001-00	1
2	Support rod, *l* = 370 mm, *d* = 10 mm	02059-00	1
3	Ring with boss head, i. d. = 10 cm	37701-01	1
4	Wire gauze 160 mm x 160 mm, ceramic cen.	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	Students thermometer,-10...+110°C, l = 180 mm	38005-02	1
11	Spoon, special steel	33398-00	1
12	Glass rod, boro 3.3, l=200mm, d=6mm	40485-04	1
13	Lab. pencil, waterproof	38711-00	1

Chemicals, Additional Material

Position No.	Material	Order No.	Quantity
	Bunsen burner /DIN/,nat.g.,w.cock	32168-05	1
	Safety gas tubing, DVGW, sold by metre	39281-10	1
	Boiling beads, 200 g	36937-20	
	Ruler		
	Butter		
	Clarified butter		
	Margarine		
	Milk, medium fat		

Material required for the experiment



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.

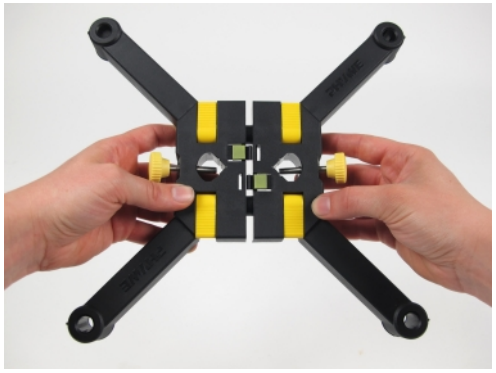


Fig. 2

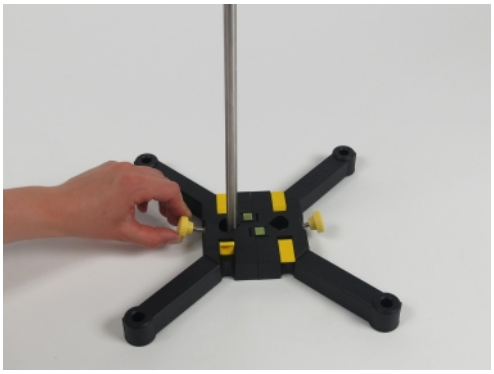


Fig. 3

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!

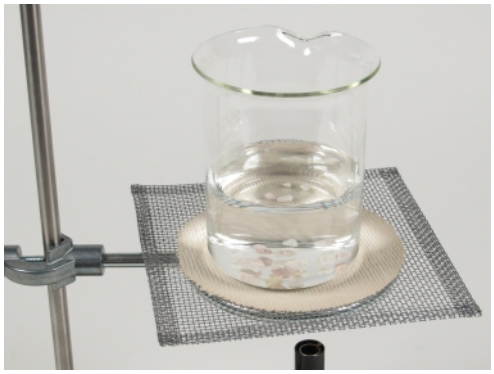


Fig. 7

Action

Procedure

Put the following substances in the appropriate test tubes, each until it is one third full.

Test tube	Food
1	Butter
2	Margarine
3	Milk, medium fat
4	Clarified butter

Fig. 8

Place test tube 1 in the hot water bath just prepared (Fig. 9). When the butter has completely melted, stand the test tube in the test tube rack to cool. Should different phases have separated in the test tube, mark the height of the phase boundary and the total height of the butter with a lab pencil (Fig. 10).

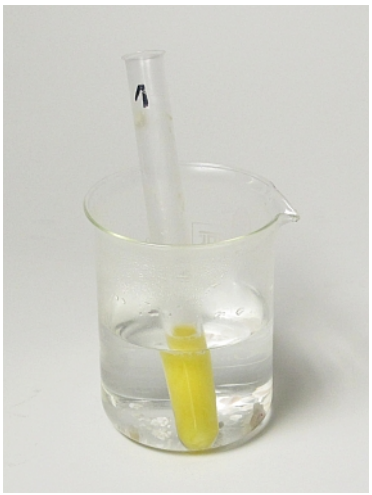


Fig. 9

Fig. 10

Melt the other foods similarly. Check the temperature of the water bath with a thermometer, it should not go below 80 °C. Should different phases have separatedd in the test tubes, mark the heigt of the phase boundary on the test tube with a lab pencil.

Measure the height of the lower phase and the total height of the food with a ruler.

Waste disposal

The lower, aqueous solutions can be poured to drain. The upper fat phases can be put in the normal waste container.

Results

Note your observations in the following table.

Table 1

Test tube	Food	Number of phases	Height of the food in cm	Height of the lower phase in cm
1	Butter			
2	Margarine			
3	Milk, medium fat			
4	Clarified butter			

See Table.

Test tube	Food	Number of phases	Height of the food in cm	Height of the lower phase in cm
1	Butter	2	5.0	0.9
2	Margarine	2	5.0	0.9
3	Milk, medium fat	2	4.9	2.6
4	Clarified butter	1	4.9	-

The high-fat foods melt in hot water. After a short time, two phases separate in test tubes 1 to 3. On cooling, a solid upper phase and a liquid lower phase are formed. The lower phase in the test tubes 1 and 2 is whitish and turbid, in test tube 3 it is relatively clear. In test tube 4 only a single uniform phase is formed, and this solidifies again on cooling.

Evaluation

Question 1

Calculate the water contents of each individual food from the ratio of the heigt of the lower phase to the total height of the food.

Table 2

Food	Ratio of the height of the lower phase to that of the food	% water
Butter		
Margarine		
Milk, medium fat		
Clarified butter		

See table.

Food	Ratio of the height of the lower phase to that of the food	% water
Butter	0,9 / 5,0	18
Margarine	0,9 / 5,0	18
Milk, medium fat	2,6 / 4,9	53
Clarified butter	-	-

Question 2

Draw conclusions from your observations.

Butter and margarine contain approximately the same amount of water, about 18 %. They are water-in-fat emulsions. On heating the high-fat foods, they are separated into a lighter fat phase and a heavier aqueous phase containing proteins.

Medium-fat milk contains more than 50 % water, whereas in clarified butter hardly any water is detectable.

Question 3

For which purpose are the four high-fat foods used?

Butteer and margarine are predominately used as spreads, for baking, cooking and frying. Clarified butter preferably for frying and cooking.

Question 4

Complete the following statements.

1. Butter and margarine contain roughly [ ] % water.
2. They are [ ]-emulsions.
3. On heating, high-fat products separate into a lighter [ ] and a heavier, [ ] layer containing proteins.
4. Medium-fat margarine contains [ ] % water, it is not suitable for [ ] and [ ].

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1. Butter and margarine contain roughly *18 %* water.
2. They are *water-in-fat* emulsions.
3. On heating, high-fat products separate into a lighter *fat* phase and a heavier, *aqueous* layer containing proteins.
4. Medium-fat margarine contains *50 %* water, it is not suitable for *baking* and *frying*. 1. Butter und Margarine enthalten ungefähr 18 % Wasser.

Question 5

Explain the inscription "not suitable for baking or frying" on a beaker containing spread.

Medium-fat margarine is used almost exclusively as a spread for a calorie-conscious diet. Because of the high water content, it is not suitable for baking or frying (danger of spurting).

Question 6

Butter and margarine must be stored cool, why?

Butter and half-fat margarine must be stored coolotherwise they melt in parts or completely and depart in a aqueous, protein containing phase and a fat phase.