1. Principle

The predried sample is extracted with petroleum ether. After extraction, the solvent is distilled and the residue is dried and weighed.
The fat content is calculated as the difference between the weight at the start and the end of the analysis.

2. Methods and Sources

2.1. Method

Arbeitsgemeinschaft Getreideforschung e, V., Detmold; Standard-Methoden für Getreide, Mehl und Brot, Fettbestimmung in Getreide und Müllereiprodukten.

2.2. Product table - Point 7

Food Composition and Nutrition Tables; S. W. Souci, W. Fachmann, H. Kraut; 5th revised and completed edition, medpharm Scientific Publishers, Stuttgart 1994, CRC PRESS, Tokyo

3. Chemicals

Quality: p.a.

3.1. Petroleum ether, boiling range 40 to 60 °C

4. Instruments

4.1. Rotary crusher or beater mill or star-mixer
4.2. Analytical balance, precision of 0.1 mg
4.3. Desiccator, with a drying agent, e.g. Blaugel
4.4. SOXTHERM extraction unit micro or macro with MULTISTAT, cat. no. 13-0011, or SOXTHERM Manager, cat. no. 13-0012
4.5. Drying oven, heated electrically, with natural aeration and automatic temperature control with ± 2 °C precision
4.6. Cotton wool, chemically clean and fat-free

5. Analysis

5.1. Preparation of the Extraction Beakers

3 - 5 boiling stones are put into each extraction beaker. The beakers are dried in a drying oven for about one hour at 103 °C ± 2 °C. After cooling down to room temperature in the desiccator, the beakers are weighed with a precision of 0.1 mg.

5.2. Sample Preparation

A representative average sample has to be used. The sample is ground so that at least 90 % of the sample will pass a sieve of 0.300 mm mesh size. When working with Vulgare wheat 90 % under 1 mm is sufficient.

5.3. Drying Process

5 - 10 g sample are weighed into a beaker (precision 0.1 mg) and dried at 98 °C for 1 - 2 hours.

5.5. Extraction

The predried sample is covered with cotton wool (4.6.).
After adding 150 ml (SOXTHERM macro) or 100 ml (SOXTHERM micro) Petroleum ether (3.1.), the sample is extracted using the following program:

Parameters for the Instruments and Connections:

Size of the extraction beakers:	micro, cat. no. 13-0051
	macro, cat. no. 13-0050
Type of seal:	Viton, cat. no. 1000578
Extraction thimbles:	Type SE33A, 33 x 80 mm, cat. no. 13-0054
	Type SE33B, 33 x 94 mm, cat. no. 13-0057
Holder for thimbles:	SHK2, cat. no. 13-0062
Boiling stones:	cat. no. 1000774

Connection for compressed air
or compressor: 4.5 bar minimum or cat. no. 13-0010
Water connection
or recirculating condenser: 0.5 bar minimum

Parameters for the Program:

Program Step	Parameter	Comment
T-Classification	200 °C	
Extraction Temperature	150 °C	
Reduction Interval	4 min	
Reduction Pulse	2 s	
Hot Extraction	30 min	Sample must be immersed completely
Evaporation A:	5 intervals	After A the level of the solvent should be at least 10 mm below the thimble.
Rinsing Time	60 min	
Evaporation B:	3 - 4 intervals	After B the extraction beaker should be more or less free of extraction agent.
Evaporation C:	0 min	

After the program is run, the extraction beakers are dried in the drying chamber for 60 minutes at 103 °C ± 2 °C. Then, they are put into a desiccator, left to cool down to room temperature and weighed with a precision of 0.1 mg. In order to check the weight consistency, the samples are dried for another 15 minutes and weighed again after cooling down. This procedure is repeated as long until successive weights show no more difference than 0.1 % of the initial sample weight. Should the weight increase, then the previous lower value should be taken. Extraction, drying and weighing have to be done immediately after each other.

6. Results

6.1. Calculation

The content of free fat (w) in g/100 g (or %) of the sample is calculated using the following formula:

$$w = \frac{(m_2 - m_1) * 100}{m_0}$$

m_1: Mass of the empty extraction beaker with boiling stones [g]
m_2: Mass of the extraction beaker with fat after drying [g]
m_0: Sample weight at the start of the analysis [g]

The result is expressed to one decimal place.

6.2. Reliability of the Method

The deviation between double determinations must not exceed 0.1 %.

7. Product table

Sample Type	Initial Sample Weight [g] +/- 10 %	Theoretical Total Fat Content [%]
Amaranth, Seed	5.000	6.56 – 10.25
Buckwheat, shucked corn	10.000	1.40 – 2.00
Buckwheat groats	10.000	0.50 – 2.30
Buckwheat flour, whole meal	10.000	2.40 – 2.80
Barley, without husk, whole grain	10.000	1.80 – 2.25
Pearl barley	10.000	1.00 – 2.70
Barley groats	10.000	1.00 – 2.00
Flour of spelt grain, whole meal	10.000	2.55
Unripe spelt grain	10.000	2.70
Flour of unripe spelt grain	10.000	1.80 – 2.20
Oats, without husk, whole grain	5.000	6.81 – 7.47
Rolled oats	5.000	6.30 – 8.50
Groats	5.000	4.80 – 6.48
Oat meal	5.000	6.70 – 7.50
Millet, shucked corn	10.000	2.00 – 5.00
Maize, whole grain	5.000	3.20 – 4.30
Corn flakes	10.000	0.40 – 0.80
Corn flour	10.000	1,56 – 3,90
Quinoa (Pigweed)	5.000	5.01 – 5.94
Rice, unpolished	10.000	1.70 – 2.90
Rice, polished	10.000	0.50 – 1.00
Rice, polished, cooked, drained	10.000	0.16
Rice flour	10.000	0.50 – 1.00
Rye, whole grain	10.000	1.60 – 2.60
Rye flour, Type 815	10.000	0.91 – 1.25
Rye flour, Type 997	10.000	0.90 – 1.41
Rye flour, Type 1150	10.000	1.30
Rye flour, Type 1370	10.000	1.26 – 1.50
Rye flour, Type 1800	10.000	1.40 – 1.60
Rye germ	5.000	10.50 – 12.00
Sorghum	10.000	0.10 – 5.80
Triticale	10.000	2.08 – 2.65
Wheat, whole grain	10.000	1.90 – 2.10
Wheat grits	10.000	0.63 – 1.00
Wheat flour, Type 405	10.000	0.90 – 1.03
Wheat flour, Type 550	10.000	1.00 – 1.40
Wheat flour, Type 630	10.000	1.50 – 1.56
Wheat flour, Type 812	10.000	1.30
Wheat flour, Type 1050	10.000	1.60 – 1.90
Wheat flour, Type 1700	10.000	2.00 – 2.30