

Meat technology – information sheet

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Crude Fat Determination - Soxhlet Method

Fat is important to all aspects of meat production and processing. Fresh and frozen meat prepared for manufacturing purposes is specified in terms of fat content (expressed as chemical lean). This is an important specification of commercial trading as well as being an important technical specification for product end-use. Manufacturing meat that is traded as a commodity on the international market is specified in terms of its fat content (expressed as chemical lean) and this is one of the primary product testing criteria for product imported by our overseas customers.

Apart from the commercial importance of the fat content of unprocessed meat, especially manufacturing meat, fat content is an important technical and regulatory specification for almost all processed meat products.

There are several rapid methods for determining the fat content of meat and meat products and these methods mostly produce results that are sufficiently accurate and reliable for routine product testing purposes. Given the importance of fat content however as a commercial and

regulatory specification, it is necessary to have a method that is recognised as a standard and which can be referred to as a means of validating rapid methods and in dispute resolution processes.

The “Soxhlet” method described here is recognised by the Association of Official Analytical Chemists (AOAC) as the standard method for crude fat analysis. In addition, some rapid instrumental methods are also approved by the AOAC.

Application

The Soxhlet method for determining crude fat content is a lengthy process requiring up to a day for a single analysis. The solvent extraction step alone takes six hours. The method is therefore not favoured for routine testing purposes in the meat industry, rather it is used as a standard reference method.

As well as being used to determine the fat content of meat and meat products, the Soxhlet method can be used to determine the fat content of meat meal. In the case of meat meal, the Soxhlet method is often the method of choice as a routine test.

Outline of Method

Crude fat content is determined by extracting the fat from the sample using a solvent, then determining the weight of the fat recovered. The sample is contained in a porous thimble that allows the solvent to

completely cover the sample. The thimble is contained in an extraction apparatus that enables the solvent to be recycled over and over again. This extends the contact time between the solvent and the sample and allows it time to dissolve all of the fat contained in the sample. In order for the solvent to thoroughly penetrate the sample it is necessary for the sample to be as finely comminuted as possible.

Before the solvent extraction step can begin the sample must be dried. Often a moisture analysis is required as well as a fat analysis and this can be achieved by accurately weighting the sample after drying and before extraction, as well as before drying. If a moisture analysis is not required the sample need only be weighed before drying and again after solvent extraction. In either case the sample must be weighed accurately on an analytical balance at each stage of the analysis.

When the sample is being weighed it is important not lose any part of it including any moisture that may weep from the sample during weighting. Loss of this moisture can be avoided by weighing the sample directly into a pre-dried extraction thimble or alternatively on to a pre-dried filter paper. If a moisture analysis is required, the dried extraction thimble or filter paper also has to be pre-weighed. After weighing, the sample (in the thimble or filter paper) can be placed in the oven for drying. After drying, the sample can be placed directly into the distillation apparatus for extraction. A diagram of the extraction apparatus is shown in Figure 1.

Method

Equipment

- Analytical balance (at least 1 mg sensitivity).
- Electrical drying oven to be operated at $102^{\circ}\text{C} \pm 1^{\circ}\text{C}$.
- Soxhlet extraction unit comprising:
 - Round bottom flask, 150 mL

- Soxhlet extractor with 60 mL siphoning capacity and condenser.
- Cellulose extraction thimbles (28 x 80 mm)
- Fume cupboard
- Heat source, either electric heating mantle, or steam bath 100 mL beaker
- Desiccator with silica gel desiccant
- Glass rod

Reagents

- Petroleum spirit boiling point $60\text{-}80^{\circ}\text{C}$
- Cotton wool free of fat
- Acid washed sand

Procedure

Note: Steps 8 – 12 are performed in a fume cupboard.

1. Rinse all glassware with petroleum spirit, drain, dry in an oven at 102°C for 30 min. and cool in a desiccator.
2. Place a piece of cotton wool in the bottom of a 100 mL beaker. Put a plug of cotton wool in the bottom of an extraction thimble and stand the thimble in the beaker.
3. Accurately weigh 5 g of sample into the thimble. Add 1 - 1.5 g of sand and mix the sand and sample with a glass rod. Wipe the glass rod with a piece of cotton wool and place cotton wool in the top of the thimble. (Addition of sand is not required for analysis of meat meal). Dry the sample in an oven at 102°C for 5 hours. The drying step may be omitted in the analysis of meat meal.
4. Allow the sample to cool in a desiccator.
5. Take the piece of cotton wool from the bottom of the beaker and place it in the

top of the thimble.

6. Insert the thimble in a Soxhlet liquid/solid extractor (Figure 1).
7. Accurately weigh a clean, dry 150 mL round bottom flask and put about 90 mL of petroleum spirit into the flask.
8. Assemble the extraction unit over either an electric heating mantle or a water bath.
9. Heat the solvent in the flask until it boils. Adjust the heat source so that solvent drips from the condenser into the sample chamber at the rate of about 6 drops per second.
10. Continue the extraction for 6 hours.

For sausage meat and other emulsified products, the extraction should be performed in stages: Extract for about 4 hours, then remove the heat source and drain the solvent from the extractor in the flask. Remove the thimble from the extractor and transfer the sample to a 100 mL beaker. Break up the sample with a glass rod. Return the sample to the thimble and replace the thimble in the extractor. Rinse the beaker with petroleum spirit and pour rinsings into the extract. Continue extraction for a further two hours.

11. Remove the extraction unit from the heat source and detach the extractor and condenser. Replace the flask on the heat source and evaporate off the solvent. (The solvent may be distilled and recovered).
12. Place the flask in an oven at 102°C and dry the contents until a constant weight is reached (1-2 hours).
13. Cool the flask in a desiccator and weigh the flask and contents.

Weight of empty flask (g) = W_1

Weight of flask and extracted fat (g) = W_2

Weight of sample = S

$$\% \text{ Crude fat} = \frac{(W_2 - W_1) \times 100}{S}$$

Figure 1 Soxhlet Extraction Apparatus

