

MEAT RESEARCH NEWS LETTER

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A REFRACTOMETRIC METHOD FOR THE ESTIMATION OF FAT IN MEAT

The accuracy of any method of fat estimation depends on:

- (a) obtaining representative samples for analysis
- (b) precision of method for determining fat contents of sample.

The importance of controlling fat contents within narrow limits is well known. Too high a fat content may lead to claims and too low a fat content may mean that the processor is not getting the best monetary return possible.

The purpose of this News Letter is to set out information on a new method of fat analysis so that Management can compare it with their own technique and make their own decision concerning its use. Alternative methods are available and can be obtained from the Meat Research Laboratory on request.

Refractometric methods for the estimation of fat are based on observations of the refractive index (R.I.) of solvents containing fat. The R.I. is related to the quantity of fat extracted from the meat sample by the solvent employed.

The procedure involves placing the meat sample and solvent in a blender. Maceration results in very rapid transfer of the fat into the solvent. The concentration in the solvent is then determined immediately by taking some of the solution, placing on the prism of a refractometer, reading the R.I. and determining fat percentage from a chart. One analyst can analyse six samples per hour.

Advantages of the Method:

- (1) The method is fast: It takes about 10 minutes from commencement of the preparation of macerated sample to reading of fat percentage. Multiple samples can be prepared and held at 40°C before measurement of the refractive index.
- (2) The method is easy to use and involves little skill and training.
- (3) A larger sample is used for extraction of fat than in some currently used methods. The relatively large sample of 50 gm or more reduces the sampling error compared to samples of around 10 gm.
- (4) The method is adequately accurate. For fat contents under 20%, the results on 50 gm samples are within 1% of the value obtained by the AOAC ether solvent extraction method. For fat contents over 20%, the error may be up to 2%.
- (5) The extracting materials are relatively cheap. Ortho-dichlorobenzene, which can be obtained from chemical supply houses, costs approximately \$12.00 per gallon. When not recovering the ortho-dichlorobenzene, the solvent cost per 50 gm meat sample test is 26.5¢. When recovering the ortho-dichlorobenzene, the solvent cost per test is approximately 2.5¢.

Disadvantages of the Method:

- (1) The refractometer and associated equipment are relatively expensive. The Meat Research Laboratory uses an Abbè refractometer made by Fuji Optical Works, Japan, and this sells for about \$350 in Australia. The constant temperature water supply used is a Haake Ultra-thermostat and costs about \$400. However, any constant temperature water supply which is at 40°C ± 0.5°C can be used to maintain the temperature in the refractometer and suitable equipment can be obtained for about \$100. A suitable blender costs \$100.
- (2) Ortho-dichlorobenzene is moderately toxic and has a penetrating odour which induces sneezing in some people. Also, it could taint meat. It is necessary to provide a fume cupboard or exhaust fan over the area used for fat estimation and also for recovery of the solvent.
- (3) Ortho-dichlorobenzene is inflammable and has a flash point of 79°C (174°F).
- (4) Because of the above disadvantages, the method should only be used in a well ventilated laboratory under the supervision of a chemist or quality control officer.

Method: See attached sheets

THE REFRACTOMETRIC METHOD FOR THE
ESTIMATION OF FAT IN MEAT

Equipment:

Balance - good physical balance with accuracy of 0.1g.
Refractometer, Constant temperature circulating water bath.
Steam distillation apparatus (for recovery of ortho-dichlorobenzene).
Beakers, funnels, flasks, filter papers (Whatman No. 4),
Kleenex tissues, thermometer, hot plate.
Blender (Waring or M.S.E. Atomix).

Materials:

Ortho-dichlorobenzene
Diethyl ether (for cleaning refractometer prism)

Procedure:

- (1) The meat is sampled by the core technique. To attain accuracy, at least 50 gm should be used for each test.
- (2) The core samples are cut into smaller sections and the weighed meat sample is placed in a high speed blender. A quantity of ortho-dichlorobenzene is added to the meat and the mixture macerated for 3-4 minutes. The number of mls. of ortho-dichlorobenzene to be added is equal to twice the number of grams in the meat sample, e.g. 60 gms. meat to 120 mls. ortho-dichlorobenzene. The mixture is decanted from the blender bowl and filtered through a Whatman No.4 filter paper (any method which thoroughly separates the fat containing solvent would be suitable).

It is desirable to hold the filtered solution in a water bath at 40°C until the R.I. is measured.

- (3) The refractometer prism is cleaned with a tissue soaked in ether and wiped dry with a clean tissue paper. The filtered solution is applied to the refractometer prism and wiped off. A further addition of several drops of the solution is applied to the prism, and the R.I. of the mixture read according to the instructions with the instrument. It is essential to operate the instrument at 40°C \pm 0.5°C (e.g. by circulation of temperature controlled water) and to maintain the solution to be measured at the same temperature. For a 1°C change in temperature, there will be an approximate change of 0.0004 in R.I. If the solution is not 40°C when put on the prism, it will quickly equilibrate to that temperature (an indication of this is the changing R.I. reading until the temperature becomes constant).

To obtain satisfactory fat estimations, it is essential that the R.I. be accurate to 0.0002. To ensure this, 2-3 readings are taken on the sample (or until consecutively identical readings are obtained). The prism is wiped clean with a tissue, and a further application of the same filtered solution placed on the prism and read in the same manner. If the readings of the two samples are not within 0.0002, then the prism is wiped clean and another sample of the same solution read. The readings of the 2-3 samples are averaged.

- (4) The fat content corresponding to the R.I. is read from a calibration chart relating R.I. to percentage fat content. A copy of the calibration chart used at the Meat Research Laboratory is attached, but it is recommended that where works quality control laboratories have the facilities, they should prepare their own calibration chart.

The chart shown is based on 50 grams of meat and 100 ml solvent at 40°C and is applicable for fat contents up to 40%. For higher fat contents, half the quantity of meat, or double the volume of solvent should be used (and the percentage fat reading doubled).

Alternative Procedures:

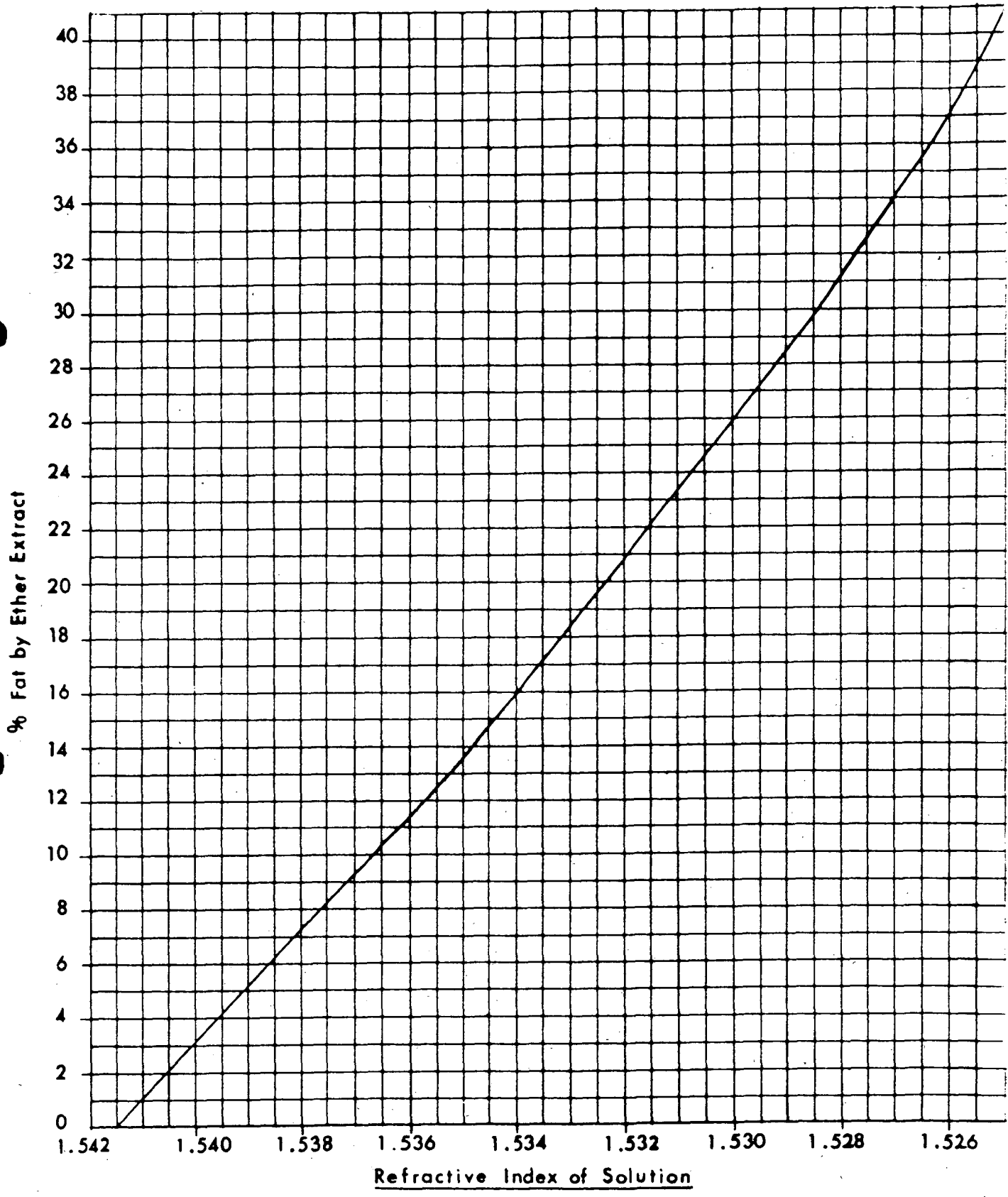
- (a) A mixture of ortho-dichlorobenzene and di-iso octyl phthalate can be used. The mixed solvent has less odour than the single solvent but is not as sensitive. When not recovering the ortho-dichlorobenzene, the solvent cost per 50 gm meat sample test is 16.5¢. When recovering the ortho-dichlorobenzene, the solvent cost per test is approximately 4.5¢.
- (b) If a blender is not available, the meat sample can be comminuted by mincing. The analytical procedure is slightly different from that described since heating is required to extract the fat. The time per test will consequently be longer and greater care is needed to ensure adequate extraction of fat.

Mincing has the disadvantage that fat tends to be left behind in the barrel of the mincer.

GENERAL

If any Works is interested in using the Refractometer technique, they are invited to contact the Meat Research Laboratory to arrange a demonstration or to have any queries answered.

Graph relating refractive index of ortho dichlorobenzene solution at 40°C to % fat in beef samples. (Works should carry out their own calibrations)



NEWS JOTTINGS:

Next issue will be Tenderising of Meat by Ageing.

The Meat Research Laboratory now has a staff of 64 including 25 graduates.

It is pleasing to note that the Laboratories are attracting many visitors. During February we had visits from the Hon. Malcolm Fraser, Minister for Education and Science, and from Lord Trenchard, Chairman of Walls Meat Group Ltd.