

8:10 Meat Analysis by Infra-red Transmission

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Introduction

It is clear that there is a need for rapid analysis of meat and meat products. Components of interest include some or all of fat, protein, carbohydrate and moisture. This paper shows how infra-red transmission (IRT) may be used in the meat industry.

The Superscan instrument (Foss Electric) applies the IRT principle to the analysis of meat and meat products. Following dispersion of the sample in an appropriate solution, fat may be measured at $5.7\mu\text{m}$, protein at $6.5\mu\text{m}$ and carbohydrate at $9.5\mu\text{m}$. Water may also be measured spectroscopically but is normally obtained more accurately from a calibration based on the other measurements.

Instrument

The equipment consists of a reactor, a pump, a measuring unit and a printer or microcomputer.

The reactor disperses the sample in the alkaline dispersing solution. The sample and solution are contained in a metal beaker with a closely fitting lid and the dispersion is carried out by a cylindrical weight on a central spindle, which is activated by the rapid vibration promoted by the reactor.

The pump and measuring unit have been developed from the well-established Milkoscan range used in the dairy industry for analysing milk and milk products. At the heart of the measuring unit is a sealed optics box containing the source, detector, measuring cuvette and optical filter wheel.

Procedure

As in all meat analysis, accurate and representative sampling is essential. An 11g sample is mixed with 100ml dispersing reagent in the metal container. The container is placed in the reactor and the dispersion takes place (normally for 4 minutes). Foam is dispersed using anti-foaming agent.

If necessary the temperature of the mixture is adjusted to about 50°C . The solution is then taken up by the instrument and results are obtained after 1 minute. The instrument then goes into its automatic cleaning cycle.

An analysis, from sample weighing to the end of the cleaning, takes about 10 minutes. When a series of samples is analysed, results may be obtained at 4 minute intervals.

Ancillary equipment

In order to obtain a well-mixed sample of meat, the Mühle Boy grinder is usually employed. This has a dual cutting edge which is very effective in breaking down large particles and eliminating long fibres.

A Hewlett Packard HP85 microcomputer is normally interfaced with the instrument. This enables a new calibration to be applied to the instrument at the touch of a key. Also the sample and diluent may be weighed fairly roughly, with the computer applying the dilution ratio to the results as produced. The results may be stored and processed. For UK users the computer may also calculate meat content from the results, based upon the traditional Stubbs-More formula.

Applications

The Superscan has been successfully applied to the analysis of a wide range of meat products and also to some other foods. In meat processing, the Superscan may be used for the analysis of raw materials, intermediates and/or finished products as required.

(a) Raw Meats

Beef, pork, lamb, chicken, turkey etc., may all be analysed. As with all meat analysis, accuracy is heavily dependent upon the quality of sampling. With good sampling, accuracy is excellent. At a UK research institute, 24 samples of turkey meat gave standard deviations of accuracy against reference methods of 0.33% for fat (correlation coefficient 0.98), 0.30% for protein (0.97) and 0.42% for moisture (0.86).

(b) Bacon and Cooked Ham

As with raw meat, the Superscan has been successfully applied to the analysis of bacon and cooked ham. In the case of moisture measurements on bacon, accuracy is improved by including a salt (or ash) measurement in the calibration. On 17 samples analysed at a large supermarket group laboratory, standard deviations of accuracy obtained were 0.30% for fat (correlation coefficient 1.00), 0.32% for protein (1.00) and 0.37% for moisture (1.00).

(c) Offals and pet food

The wide variety of raw materials and finished products in the meat-based pet food industry can be analysed by Superscan. Some products may be difficult to sample, particularly those containing rinds. Products containing crushed bone may require the Superscan to be cleaned with 2% acetic acid following the analysis in order to remove phosphate from the cuvette.

(d) Burners and Sausages

The Superscan has been successfully applied to the analysis of meat and finished products in beefburger and sausage standardisation. In the case of sausages, it has been found that several groups of sausage may be collected together within a single calibration (e.g. pork, beef and "pork and beef"). On a series of 40 sausages of different types, standard deviations of accuracy were 1.42% for fat (correlation coefficient 0.99), 0.45% for protein (0.94), 0.50% for carbohydrate (0.99) and 0.67% for moisture (0.99). In this case, carbohydrate reference results were obtained by difference, ie (100-F-P-A-ash).

(e) Pie fillings and pastry

A wide variety of pie fillings has been analysed by Superscan. Most were very successful but Cornish Pasties gave poorer accuracy, possibly due to the sampling difficulties. Results for pie fillings were much the same as for sausages.

With pastry, only half the normal sample weight was taken to reduce the viscosity of the final mixture. In the UK, the components of greatest interest are fat and carbohydrate.

(f) Spreads, pastes and pates

The Superscan has also been applied to the analysis of spreads and related products. In general it was found that separate calibrations needed to be set up for meat, and fish-based products. Some unusual types, such as crab-based products, might also need separate calibrations. Because of the homogeneous nature of the product, excellent accuracy may be obtained. Results for salmon pate from a major manufacturer were typical. Standard deviations of accuracy on 60 samples were 0.23% for fat (correlation coefficient 0.94), 0.35% for protein (0.97) and 0.45% for moisture (0.84).

(g) Fish, fish products and other foods

Fish and processed fish products may be analysed by Superscan in much the same way as for meat and meat products. Products such as fish fingers and sardines are typical.

The Superscan has also been applied to the analysis of non-meat products such as cheese, egg and bread. A wide range of applications is envisaged.

General

Calibrations for the Superscan use only a single component measurement plus a constant for fat, protein and carbohydrate and a three-component measurement plus a constant for moisture. The small number of measurements involved ensures that the Superscan is easy to calibrate and ensures that the calibrations are robust.

Compared with reference methods, the Superscan is usually much more rapid and as seen above it is very accurate. Since carbohydrate is usually obtained by difference using reference methods, which are liable to inaccuracy, it is probably true to say that IRT is the best method available for the determination of carbohydrate in meat products.

Compared with near infra-red reflectance, the Superscan requires more sample treatment but is more reliable owing to the larger sample taken and simplicity of the calibrations.