

**Procedure for determining radionuclides  
in samples of cheese (imports)  
by gamma spectrometry**

F- $\gamma$ -SPEKT-MIPRO-01

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# Procedure for determining radionuclides in samples of cheese (imports) by gamma spectrometry

## 1 Scope

The procedures described in the following are used for analysing samples of (imported) cheese that are to be routinely monitored according to the Precautionary Radiation Protection Act.

## 2 Sampling

With cheese products differing to an extraordinary extent as to texture, shape, size and wrapping, taking representative samples is a challenge.

For the purpose of monitoring radioactivity, the sample size needs to be sufficient to fill a 1-l-measuring vessel. It therefore has to amount to at least 1,5 kg, because losses cannot be avoided during the preparation of samples. The sample has to be representative of an imported batch. This means that an adequately large number of random samples have to be collected in the case of smaller units. In the case of larger cheese units, e.g. wheels of cheese, a sufficiently large number of partial subsamples have to be collected. The techniques of collecting these subsamples by means of a core drill and the tools to be used are described in DIN standard 10 327 «Milch and Milchprodukte; Probenentnahmetechnik» (1). All samples of cheese are to be packed to prevent loss of water during transport. Adequate cooling may be required for storing samples.

## 3 Analysis

### 3.1 Principle of the procedure

The sample material is fragmented, homogenised, immediately transferred to a suitable, watertight measuring vessel and measured with a Ge-gamma spectrometer.

### 3.2 Sample preparation

The aim of preparing the samples is to obtain a homogeneous mass of cheese that will be sufficiently large to fill as homogeneously as possible a 1 l-Marinelli beaker or similar vessel. Filling ring dishes with a highly viscous mass may prove difficult so that these instances may require the use of cylindrical screw-capped vessels into which the mass of cheese can be forced with greater homogeneity.

Samples are prepared by removing wrappings and cutting off rinds. Brine or oil may have to be drained from delicatessen cheeses with the aid of a coarse sieve and residues of these liquids wiped off with absorbent paper.

Different methods may have to be used to disintegrate and homogenize the samples depending on the texture of the product. Most easily processed are hard cheeses that can be grated or simply mashed with adequate kitchen tools for homogenisation. Cheeses that are not too viscous can usually be homogenised by hand or with kneading machines. Sample preparation is time consuming. Highly viscous and sticky types of cheese must be homogenized with the aid of an extruder (min-

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cer). In this case, the total sample has to be passed through the machine repeatedly to mix it thoroughly.

The samples prepared thus are then pressed homogeneously into the measuring vessels. The measuring vessels need to be closed to prevent the loss of water during the measuring process.

### **3.3 Radiochemical separation**

No radiochemical separation is required.

## **4 Measuring the activity**

Basic information on, and aids for, gamma-spectrometry are contained in chapters IV.1.1 through IV.1.3 of this procedures manual.

The gamma spectra are measured with a Ge-spectrometer ( $> 15\%$  efficiency relative to a 3" x 3" NaI(Tl)-detector for the 1,33 MeV-line of Co-60) in 1 l-Marinelli beaker or screw-capped cylindrical vessels with a corresponding capacity.

Detailed information is provided in section 4 of procedure F- $\gamma$ -SPEKT-MILCH-01 on matters such as calibrating the gamma-spectrometer, the problem of summation losses, which may assume significant values in particular when large-volume detectors are employed, as well as self-absorption issues in samples. Self-absorption losses can usually be neglected in the case of measuring samples of cheese, as the mass of cheese that can be forced into measuring vessels has a density near  $1 \text{ g/cm}^3$ .

## **5 Calculation of the results**

High-performance software for analysing gamma spectra and calculating the activity concentration of radionuclides is available from a number of software suppliers. Preference should be given to software that makes provision for calculating decision thresholds and detection limits of all major radionuclides according to chapter IV.5 of this procedures manual (see also section 6) and employs the decision threshold as a criterion in the search algorithms to decide whether or not a line is distinct from the background.

Specific activities of nuclides or their detection limits are always to be reported in  $\text{Bq}\cdot\text{kg}^{-1}$  WM (wet mass).

## **6 Characteristic limits of the procedure**

The gamma spectrometric detection limits for nuclides in cheese are lower than in other biological materials, because cheese usually has a relatively low K-40 content of  $10 \text{ Bq}\cdot\text{kg}^{-1}$  to  $60 \text{ Bq}\cdot\text{kg}^{-1}$  owing to the manufacturing process. Increased potassium contents will be encountered in those types of cheese that have been fortified with potassium salts (potassium nitrate or potassium-containing emulsifying salts). The detection limits depend on the efficiency of the detector used, the nuclear-physical data of the radionuclides to be measured and on the background spectrum of the measuring configuration in the case of potassium-deficient cheeses. If the potassium content is elevated, the background spectrum of the measuring configuration is less important.

Characteristic limits are calculated according to equation (4.32a) of chapter IV.5, section 4.5 of this procedures manual. If the algorithms for calculating the detection limits of the software employed do not correspond to the equation in chapter IV.5, corrections may have to be applied subsequently. Examples of characteristic limit calculations in gamma spectrometry are also provided in chapter IV.5, sections 6.4 and 6.5. These examples may be applied to the present case analogously.

Attainable detection limits are 1,2 Bq·kg<sup>-1</sup> WM (shielding with ordinary lead modules) and 0,13 Bq·kg<sup>-1</sup> WM (low-level measuring configuration) for the reference nuclide Co-60, and 0,8 Bq·kg<sup>-1</sup> WM (shielding with ordinary lead modules) and 0,09 Bq·kg<sup>-1</sup> WM (low-level measuring configuration) for Cs-137. These values were obtained from a sample of Tilsit cheese that was fragmented and homogenised with a kitchen processor (1007 g of cheese each in a 1 l-Marinelli beaker, detector: 25 % relative efficiency, measuring period: 12 hours). The specific activity of K-40 in this cheese was 18,5 Bq·kg<sup>-1</sup>.

## **7 Catalogue of chemicals and equipment**

### **7.1 Chemicals**

No chemicals are required.

### **7.2 Equipment**

In addition to the measurement, equipment listed in procedure F- $\gamma$ -SPEKT-MILCH-01, a kitchen processor with attachments for grating, shredding, kneading and extruding is required for preparing the samples.

### **References**

- (1) DIN 10327:1973-08: „Milch und Milchprodukte; Probenahmetechnik“ („Milk and milk products; sampling technique“); German Institute for Standardisation, Beuth Verlag GmbH, Berlin