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## ACTIVITY LEVELS OF CS-137 AND K-40 IN THE GASTRO-INTESTINAL TRACT OF A COW

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### INTRODUCTION

In comparison to single intakes it is of particular interest to study the distribution of radionuclides in the body of domestic animals after continuous ingestion of radionuclides. We performed a study to determine the activity concentrations of Cs-137 and of the naturally occurring K-40 throughout the whole gastro-intestinal tract of a cow.

The cow was born one year after the fallout following the Chernobyl accident. Therefore the activity level in the cow resulted from the activity originating from the mother-cow and the activity due to chronically ingestion of highly contaminated forage during four years. The cow was slaughtered in November 1992 and dissected in anatomical parts /1, 2/. Samples of the whole digestive apparatus were taken to determine the activities.

Further analysis of measured data will be used to develop and to describe models for continuous ingestion.

### EXPERIMENTAL PROCEDURES

All samples were taken during or immediately after the slaughtering of the cow. Activities of Cs-137 and K-40 in the samples were determined simultaneously by gamma counting with the help of semiconductor-detectors and the usual software. As containers for the samples we used Marinelli-beakers or small cylindrical containers consisting of perspex.

The activities of the contents from the forestomachs, abomasum and the guts were determined immediately after sampling. Other samples of tissues or organs had to be deep-frozen and were thawed before measuring. We performed mechanical procedures to separate the samples from complex structures in correspondence to their anatomical sites and their physiological function.

Some samples containing fat and vascular systems were molten to obtain the activities of pure fat.

### EXPERIMENTAL RESULTS

All activities are related to November 14, 1992, the day of slaughtering. Values in the Tables are presented with a confidence level of  $2\sigma$ .

Rank of tissues and organs with high specific activities ( $> 200$  Bq/kg) of Cs-137:

Glandula parotis  $>$  Lymph nodes (head)  $>$  Tongue (upper part)  $>$  Pancreas  $>$  Musculus mylohyoideus  
 $>$  Glandula mandibularis  $>$  Pillars (rumen).

Samples of tissues with low specific activities ( $< 40$  Bq/kg) of Cs-137:

Pure fat  $<$  Omentum majus  $<$  Omentum minus  $<$  Gall bladder (wall)  $<$  Mesenterium commune  $<$  Small intestine (wall)  $<$  Colon (wall).

High specific activities ( $> 90$  Bq/kg) of K-40 were found in:

Pancreas  $>$  Tongue (upper part)  $>$  Lymph nodes (head).

Samples with low specific activities ( $< 12$  Bq/kg) of K-40:

Pure fat  $<$  Omentum minus  $<$  Omentum majus.

Among the samples of the gastro-intestinal tract the highest values for the ratio of the activity

concentrations of Cs-137 and K-40 were found for the glandula parotis ( $R = 4.88 \pm 0.81$ ) and the mucosa of the reticulum ( $R = 3.65 \pm 0.70$ ). The lowest values for the ratio R are valid for the contents in rumen + reticulum ( $R = 1.17 \pm 0.15$ ) and for the liquid in the rumen ( $R = 1.21 \pm 0.15$ ).

#### Glands:

	Activ.conc. Cs-137 (Bq/kg)	Activ.conc. K-40 (Bq/kg)
Glandula parotis	351.6 ± 33.0	72.1 ± 9.3
Glandula mandibularis	254.5 ± 22.8	76.4 ± 10.8
Liver	194.1 ± 5.4	102.9 ± 4.2
Gall bladder	43.8 ± 2.2	25.3 ± 2.0
Pancreas	274.6 ± 24.6	106.3 ± 13.0

**Table 1:** Activity concentrations of glands.

Table 1 shows a summary of activity concentrations in the glands of the digestive tract. As mentioned above, we observed the highest activity concentration of Cs-137 for the glandula parotis. The liver as the greatest gland had a moderate activity concentration. Considering the amount of single samples to the total activities results in the fact, that the liver (mass: 5.67 kg) makes 18.8 % of the total activity of Cs-137 (5 867 Bq) in the GI-tract.

#### Muscle tissues:

	Activ.conc. Cs-137 (Bq/kg)	Activ.conc. K-40 (Bq/kg)
Buccae	216.5 ± 19.4	62.8 ± 7.9
Tongue	319.9 ± 14.2	131.1 ± 14.2
Musc. mylohyoideus	271.1 ± 32.8	71.2 ± 15.9
Pharynx	214.9 ± 26.0	67.2 ± 16.0
Musc. oesophagus	220.2 ± 19.8	76.8 ± 11.1
Pillars (rumen)	235.7 ± 9.0	78.0 ± 5.0

**Table 2:** Activity concentrations of muscle tissues.

In tissues similar to muscle tissues (Table 2) the highest concentration of Cs-137 was found for the tongue. The pillars of the rumen showed also considerable concentrations of Cs-137.

#### Fatty tissues and lymph nodes:

	Activ.conc. Cs-137 (Bq/kg)	Activ.conc. K-40 (Bq/kg)
Rumen:		
Fat+vascular system	101.7 ± 3.4	31.5 ± 1.8
Lymph nodes	160.3 ± 14.2	77.7 ± 8.4
Omentum majus:		
Fat+vascular system	22.1 ± 1.2	11.9 ± 1.4
Omentum minus:		
Fat+vascular system	25.9 ± 3.4	11.0 ± 3.0
Lymph nodes (mixed)	142.8 ± 17.0	85.9 ± 13.8
Mesenterium commune:		
Fat+vascular system	33.4 ± 1.9	19.1 ± 1.8
Lymph nodes	89.9 ± 7.6	64.3 ± 7.3

**Table 3:** Activity concentrations of fatty tissues and lymph nodes.

The activity concentrations of Cs-137 and K-40 in both omenta were very low (Table 3). The lymph nodes embedded in the structures showed high activity concentrations. Samples of the omenta and mesenterium were also molten and then the activities of the pure fat were measured. Activity levels of Cs-137 and K-40 for the pure fat were found to be at the detection limits of the spectrometers (0.5 Bq - 1.0 Bq).

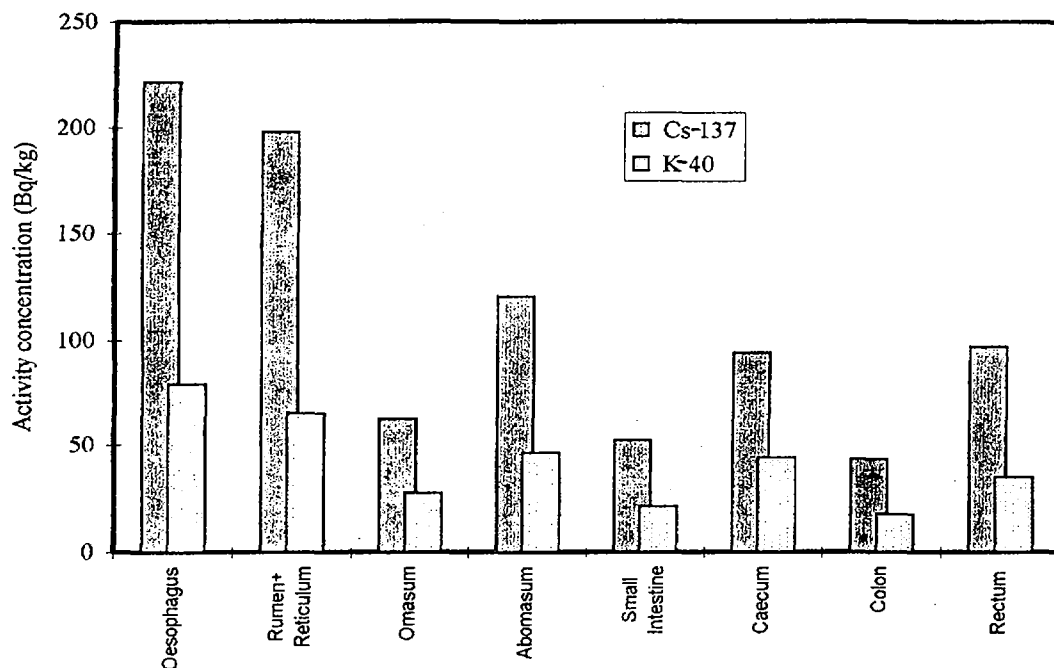
#### Other samples:

	Activ.conc. Cs-137 (Bq/kg)	Activ.conc. K-40 (Bq/kg)
Blood	16.2 ± 1.0	22.1 ± 2.2
Milk	116.0 ± 7.0	50.2 ± 5.0
Urine	195.4 ± 11.5	497.9 ± 49.8
Faeces	347.1 ± 20.8	77.3 ± 7.7

**Table 4:** Activity concentrations of other interesting samples.

In Table 4 values for the activity concentrations of some other interesting samples are given. The values for the activity concentrations of blood and urine lead to Ratios  $R < 1$  (blood:  $R = 0.73 \pm 0.08$ ; urine:  $R = 0.39 \pm 0.05$ ). In comparison to these values the ratios for milk and faeces are  $R = 2.31 \pm 0.27$  and  $R = 4.49 \pm 0.52$ , respectively.

Fig. 1 illustrates the activity concentration of Cs-137 and K-40 in the walls surrounding the compartments of the GI-tract. Concerning the activity concentration of Cs-137 we can observe a decreasing tendency throughout the tract, whereas the activity concentration of K-40 shows moderate variations. The ratio  $R$  remains to a high degree constant throughout the tract.



**Fig. 1:** Activity concentrations of Cs-137 and K-40 in the walls of the GI-tract.

In Fig. 2 the activity concentrations of Cs-137 in the contents, mucosae and the muscle walls of the tract are compared. It can be seen that the activity concentrations of Cs-137 in the contents of the compartments increase throughout the tract. All activity concentrations are related to wet weight. Great variations of the activity concentration occur in the mucosae and the muscle walls. A remarkable tendency of the activity concentrations can be observed for the structures of the both compartments rumen+reticulum and abomasum.

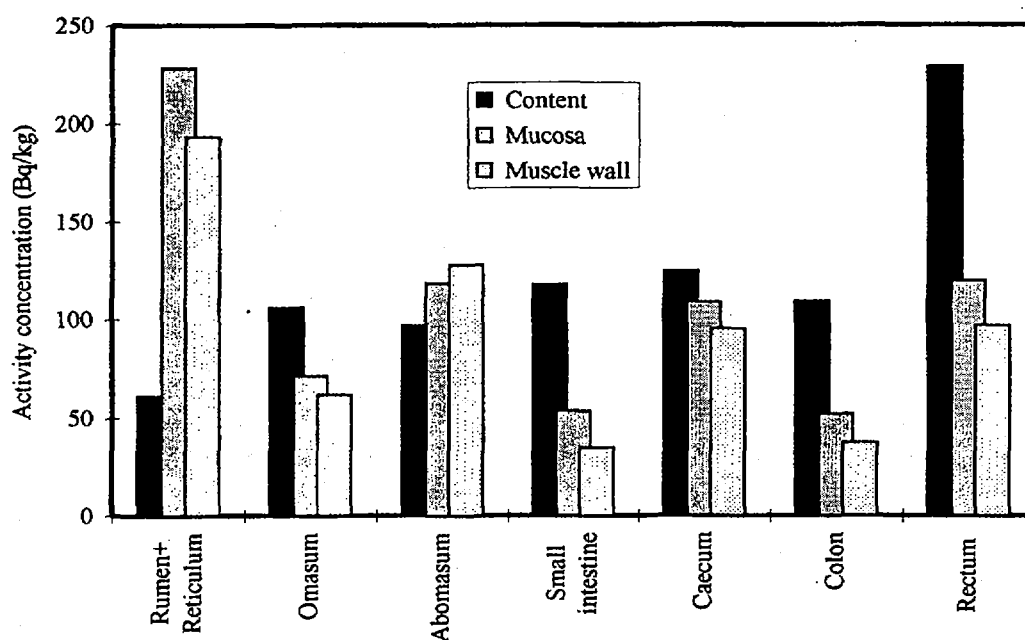


Fig. 2: Activity concentrations of Cs-137 in the contents, mucosae and muscle walls of the GI-tract.

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