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Institute of Radiation Physics, Finland Institute of Technology, Helsinki, and Biochemical Institute, Helsinki

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Caesium 137 in Finnish Grass and Cow's Milk

In the previous issue of these Annales (1) an investigation on contamination of Finnish grass and cow's milk by radionuclides is described. Collection of representative grass and milk samples from 9 experimental farms between latitudes 60°—69°N and longitudes 23°—27°E and the results of ^{90}Sr determinations made from them are described in the above-mentioned publication.

We have determined the ^{137}Cs contents of the same samples by γ-spectrometry. Determinations were made from milk and grass ash prepared below 450°C as described by Paakkola *et al.* (1), the spectrometric method being similar to procedures described in several earlier papers, *e.g.* by Löw and Edvarson[2]) and by Lillegraven[3]).

The detector used in this work was a sodium iodide (thallium activated) crystal 1½ in diam. × 1 in. with a phototube 6292, manufactured by Du Mont. Ash samples were placed in an aluminium container (wall thickness 1.0 mm) round the crystal to make the geometric efficiency as high as possible. The volume of the container used was about 100 cm^3 and the weight of the ash samples varied between 7 and 15 g. The shielding system, made from the barrel of an old canon, has been described by A. Vuorinen[3]. Background was checked occasionally during the measuring period and in the energy range 50 keV—1.8 MeV it was about 45 cpm. Pulse amplitude spectra were analysed with a Hutchinson-Scarrot type 70—100 channel pulse height analyser manufactured by Sunvic Control in Britain.

Before and after every count of a sample the energy calibration was made with a $^{137}Cs + {}^{60}Co$ preparation. After a counting time of 5—6 hours the drift of photopeaks of Cs and Co was not more than $\pm$ 1 channel.

Activity calculation of the milk samples was done in the usual way. After background subtraction a correction was made for the potassium in the sample. Calibration was done with a standard sample of ^{137}Cs and with KCl. The results are given in Table 1. The accuracy is estimated to be better than $\pm$ 20%.

The calculation of the ^{137}Cs activity of the grass samples is less easy than in the case of the milk samples. Figure 1 illustrates a differential pulse

Table 1

^{137}Cs in Finnish Milk in 1959

Sample No.	Farm	Latitude	Date (1959)	Milk ash g	^{137}Cs $\mu\mu c$	$\mu\mu c$ ^{137}Cs/ gK	$\mu\mu c$ ^{137}Cs/ 1 milk
1.	Apukka	66°N	Aug. 29	8.83	82	60	48
2.	Viik	60°N	—»—	13.3	122	43	23
3.	Malminkartano	60°N	Aug. 31	14.5	94	37	18
4.	Halola	63°N	Sept. 1	12.7	59	21	12
5.	Jokioinen	61°N	Aug. 30	14.0	63	21	11
6.	Anttila	60°N	Aug. 31	13.7	64	25	13
7.	Kreuksela	65°N	Sept. 2	13.0	140	51	28
8.	Myttäälä	61°N	Aug. 29	13.2	48	19	10
9.	Toivonniemi	69°N	Sept. 6	12.0	500	220	260

height spectrum taken from grass sample number 9. The determination of ^{137}Cs is complicated by the relatively high amount of radioactive zirkonium + niobium in the sample. Because the ^{137}Cs and ^{95}Zr + ^{95}Nb peaks are fairly well separated, it is possible to estimate the relative amount of ^{95}Zr + ^{95}Nb in the spectrum.

This is done by taking only that part from the photopeak which is far enough from the photopeak of ^{137}Cs. After an estimation of the relative amount of ^{95}Zr + ^{95}Nb in the spectrum, a correction for pulses due to them in the ^{137}Cs-channels in addition to the background- and ^{40}K-pulses, becomes possible. A more reliable but also more tedious way to distinguish the two peaks from each other would be the »try and correct» method.

The results are given in Table 2. Our results show that contamination by ^{137}Cs of milk produced in South Finland is of the same order as that of milk of other countries with similar climatic conditions (2,5—8). Samples from North Finland (nos. 7, 1, 9, lats. 65°—69°N) show higher contamination, comparable, for instance, with the values from Wales (9). The cause of this is not known, but it is not due to higher rainfall (see ref. 1) as in the case of Wales. A more detailed study of the conditions in Lapland will be needed.

The ratio ^{137}Cs/^{90}Sr (Table 2) has been calculated on the basis of the present results and those of Paakkola *et al.* (1). Similarly, for the 2 nothernmost samples (1 and 9) this ratio is about 3 times as high as the average of the other samples. No correlation is visible between the values of this ratio in grass and in milk. The discrimination factor grass-milk to ^{137}Cs is also presented in Table 2. The mean for it is 0.28.

Table 2

^{137}Cs in Grass Samples Corresponding to the Milk Samples of Table 1.

Sample No	Farm	Grass ash g	^{137}Cs μμc	μμc ^{137}Cs/ gK	μμc ^{137}Cs/ g dry grass	DF*)	Ratio Cs/Sr**) in grass	in milk	μμc ^{137}Cs/ l milk
1.	Apukka	10.6	300	87	2.5	0.69	0.91	16.2	48
2.	Viik	8.6	940	220	11	0.20	2.48	6.4	23
3.	Malminkartano	9.1	250	98	2.6	0.37	0.78	8.2	18
5.	Jokioinen	11.4	330	86	2.3	0.25	1.05	5.8	12
6.	Anttila	8.3	790	290	12	0.086	3.77	5.1	11
7.	Kreuksela I	12.0	690	210	7.0	0.26	1.52	7.7	13
7b.	Kreuksela II	13.3	780	190	6.6	0.26	1.54	3.2	28
8.	Myttäälä	11.7	310	100	2.3	0.19	0.57	3.2	10
9.	Toivonniemi	12.0	3500	1100	30	0.21	4.90	19.0	260

*) $DF = \frac{\mu\mu c\ ^{137}Cs/gK \text{ in milk}}{\mu\mu c\ ^{137}Cs/gK \text{ in grass}}$

**) $\frac{\mu\mu c\ ^{137}Cs/gK}{\mu\mu c\ ^{90}Sr/g\ Ca}$

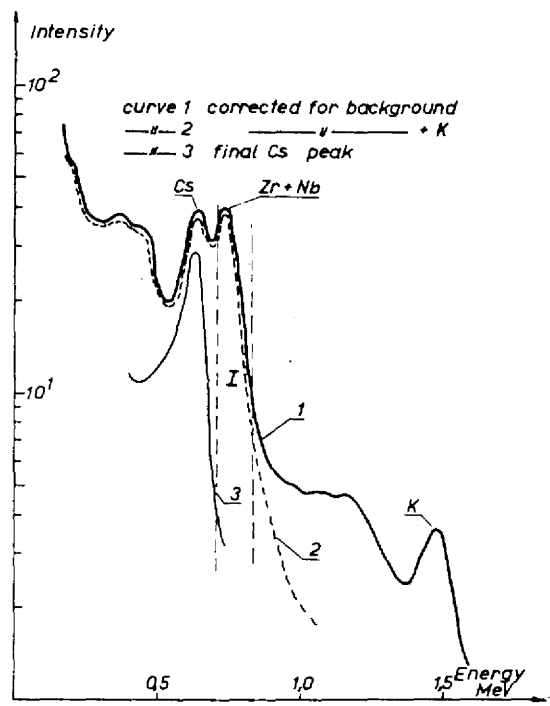

Fig. 1. Differential pulse height spectrum of grass sample No 9.

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