

Cesium-134 in Human Autopsy Tissue*

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SINCE 1959, the Los Alamos Scientific Laboratory Industrial Hygiene Group has been engaged in a program of examining human autopsy tissue for the presence of plutonium and correlating any such activity with body burdens or fractions thereof as established by urine assay. This study (CAMPBELL *et al.*, 1973), has produced information on the deposition of plutonium in man due to fall-out in the global environment and in those people engaged in plutonium fabrication, research, or development activities. In 1972, the Division of Biomedical and Environmental Research became interested and provided additional funds to expand the program. At this time, autopsy tissues are being obtained from six geographic locations in the U.S.

Since 1959, 859 sets of tissues have been examined. In 1971, a program was established to gamma scan all of the larger tissues as received at the laboratory, followed by a quantitative gamma count for radioactivity in the ashed samples. Routine gamma counting was done on a 4 x 4 in. NaI detector. The wet tissue was first scanned for a qualitative determination of the presence of any gamma emitting isotopes. Those tissues in which positive results are observed, were recounted following their reduction to a mineral ash by muffling. The reduced mass and volume improved the geometry factors and provided a quantitative measurement. Since 1971, ^{134}Cs has been identified in 42 of 621 tissue sets examined. Confirmatory identification of the ^{134}Cs was made in a few cases using a Ge(Li) detector. Figure 1 shows a typical NaI gamma count of one tissue. Prominent in the spectrum are the two photopeaks of ^{134}Cs at 0.605 and 0.796 MeV, and the ^{40}K photopeak at 1.460 MeV.

The range of activity found was 0.07-0.81 pCi/g of liver tissue and 0.07-0.31 pCi/g of lung tissue, as shown in Table 1. In some of the cases, ^{134}Cs has been identified in the wet tissue but the ashed samples are not yet available for quantitative analysis. In order to establish a minimum detection limit for the ^{134}Cs , an accounting of the contribution of the ^{40}K continuum in that area had to be made. The background in the ^{134}Cs channels was observed to be correlated to the amount of ^{40}K present in the tissue and

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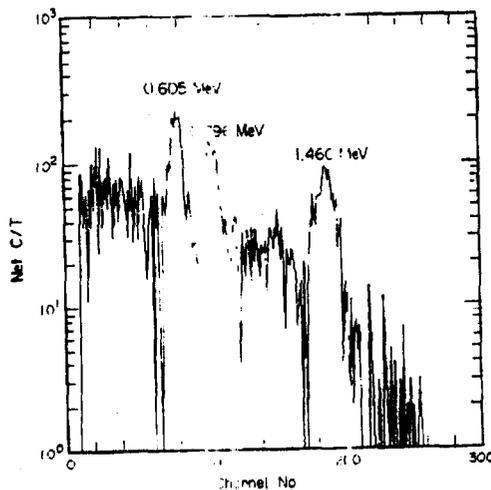


FIG. 1. Typical gamma count of an ashed tissue containing ^{134}Cs and ^{40}K .

varied from sample to sample. A straight line relationship was used to predict the amount of background in the ^{134}Cs channels given the count in the ^{40}K channels. This background was then used as the parameter (mean) of a Poisson distribution. The percentile of the given Poisson distribution was then taken as the minimum detection limit (TÆTJEN, 1975).

At the present time, plans are underway to obtain complete medical, occupation and residence histories on each of these cases to identify the source of this activity. Of particular interest is the information needed to determine if all of these cases had received injections of a radioisotope for medical scanning techniques. It has been shown (BATTIST *et al.*, 1970; ARONSON, 1971; WOOD and BOWEN, 1971; BARRALL, 1972; PODOLAK, 1972) that ^{134}Cs is a contaminant on the columns and in the eluates of some commercial $^{99\text{m}}\text{Tc}$ generators. Fourteen of 16 cases whose medical histories are known, from three of the locations sending autopsy tissue, have been identified as having received $^{99\text{m}}\text{Tc}$ for scanning purposes. We are awaiting the results of further inquiries of this nature.

There are numerous references in the literature to ^{134}Cs being found in lake waters (FOLSON *et al.*, 1972; NELSON *et al.*, 1971) rain (CIGNA, 1971), water effluents from nuclear processing plants (MARTIN, 1973; PEN-THREATH *et al.*, 1971), and nuclear power plants (NELSON *et al.*, 1971; KRIEGER and FISHKORN, 1973).

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Table 1. Cesium-134 in ashed human autopsy tissue (quantitative measurements with NaI detector)

Case No.	Liver pCi/gr am	LUNG pCi/gr am
6-66	0.09	<MDA*
8-18	0.07	NQD**
8-110	0.11	0.07
8-124	<MDA	<MDA
8-140	0.27	0.24
9-40	0.14	0.07
9-56	<MDA	<MDA
9-58	NQD	0.07
9-60	0.09	<MDA
9-74	NQD	0.07
9-84	<MDA	0.19
9-86	NQD	0.08
9-88	0.26	NQD
9-90	<MDA	0.07
9-102	<MDA	<MDA
9-112	0.38	<MDA
10-6	NQD	<MDA
11-10	<MDA	<MDA
11-36	<MDA	<MDA
11-42	0.11	<MDA
11-54	0.15	0.07
11-104	NQD	<MDA
12-6	0.12	0.13
12-12	<MDA	<MDA
12-44	<MDA	<MDA
12-68	0.21	0.15
12-74	0.16	0.07
12-84	0.47	NQD
12-118	<MDA	<MDA
12-132	NQD	<MDA
12-134	0.20	0.07
14-26	0.32	NQD
14-104	NQD	<MDA
14-120	NQD	<MDA
14-132	0.21	0.07
14-136	0.08	0.31
14-140	0.11	NQD
15-6	0.43	0.19
15-40	0.81	0.09
15-64	<MDA	NQD
16-14	0.11	0.10
16-36	NQD	NQD

*Minimum detectable amount
**No quantitative data yet

¹³⁴Cs has also been found in the human population of Scandinavia (LIDÉN and ANDERSON, 1972). The activity of ¹³⁴Cs found in the Alaskan Eskimos (HANSON *et al.*, 1966), is thought to be due to fall-out from early Russian weapons tests where stable cesium was used as a tracer and the ¹³⁴Cs was produced by the low yield (n, γ) reaction. These tests occurred during the early 1960s and are not suspected as the primary source of activity in the cases presented here since the half-life of ¹³⁴Cs is 2.05 yr.

The widespread use of ^{99m}Tc in medical scanning procedures indicates that the appearance of ¹³⁴Cs in

human tissue due to the contamination of the generators should be of interest to those radiologists making dose calculations.

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