

# EFFECTIVE DOSE EQUIVALENT TO BREAST FED INFANTS DUE TO ARTIFICIAL AND NATURAL RADIOACTIVITY

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## 1. Introduction

Since many years health organisations have paid attention to the contamination of human milk caused by the exposure of pregnant women to toxic substances. In particular, several chemical pollutants, which undergo very slow metabolism processes in the human body, can be accumulated in wet tissues and released to the milk. It has been observed (1) that in the case of some chemical substances (like DDT or PCB) the levels in human milk are higher than those in cow's milk. It is now well known that human milk is a biological gauge of environmental pollution. However, in the case of radioactive contaminations more experimental work and theoretical interpretation of data are yet needed. Generally speaking, available information seems to indicate that relative levels of some radionuclides in human milk may be different from those present in the maternal diet.

After the Chernobyl accident, the Italian National Institute of Health (ISS), with the collaboration of the Epidemiological Unit of Latium District, started a research devoted to the study of the radioactive contamination of human milk in Latium. The motivation is three-fold, namely: i) to measure the contamination of a food product utilised for infants in order to assess the corresponding dose to breast-fed infants; ii) to clarify any possible correlations between radioactive levels in human milk and those in the total body; iii) to correlate the levels in human milk with those in the maternal diet.

## 2. Main features of the collected samples

Samples of human milk have been collected from one Milk Bank (which gathers milk from more than ten clinics and hospitals in Rome) and from the two greatest University Polyclinics in Rome. It should be pointed out that such health units receive patients from the whole Latium District. Each sample is a mixing of milk from 5-10 women, collected within the first week after the child birth.

In order to check if the collected samples are representative of the situation in the District, a comparison among the distributions of some parameters relative to milk donors and to the whole class of pregnant women in Latium has been carried out. Indeed several factors (like the age of the mother, the weight of the child, the parity, the job of the mother and her food habits) may affect the representativeness of the samples. Such a comparison (see ref. 2) has clearly shown that the samples are really representative of the present situation in the Latium District.

### 3. Radioactivity in human milk samples

Gamma activities of human milk samples of about 450 ml have been measured with two coaxial intrinsic HpGe detectors (efficiency 38.2% and 26.6%, resolution 1.95 keV and 1.73 keV, respectively). The values of I-131, Cs-134 and Cs-137 concentrations have been published in refs. 2 and 3. The I-131 concentration has never exceeded 4 Bq/l and the Cs-134 + Cs-137 concentration has always been lower than 9 Bq/l. The corresponding effective dose equivalents have been evaluated for breast-fed infants born in three different periods (namely, at the end of April '86, October '86 and March '87), assuming the NRPB (4) conversion factors and the conservative hypotheses of 0.9 l/d milk ingestion and of a six-month breast feeding period. The calculated doses turned out to be lower than 15  $\mu$ Sv (3). It must be stressed that the highest doses were received in the first period due to the I-131 contribution, even if the ban of consumption of leafy vegetables for the whole population and that of cow's milk for pregnant women and children under ten lowered the intake of I-131 during May '86.

In this paper attention is paid mainly to natural radioactivity and to a comparison between cesium and potassium concentrations in human milk. In Fig. 1 the monthly averages of K-40 concentration found in the samples are shown and compared with the corresponding Cs-137 mean concentrations. The uncertainties, represented by one standard deviation in Fig. 1, depend on the number of samples measured each month and are higher for potassium concentration due to background subtraction. The mean value of K-40 concentration in the period May '86 - November '87 was  $(19.9 \pm 2.6)$  Bq/l, whereas the corresponding value observed (6) in cow's milk from the Central Dairy of Rome was  $(57 \pm 10)$  Bq/l.

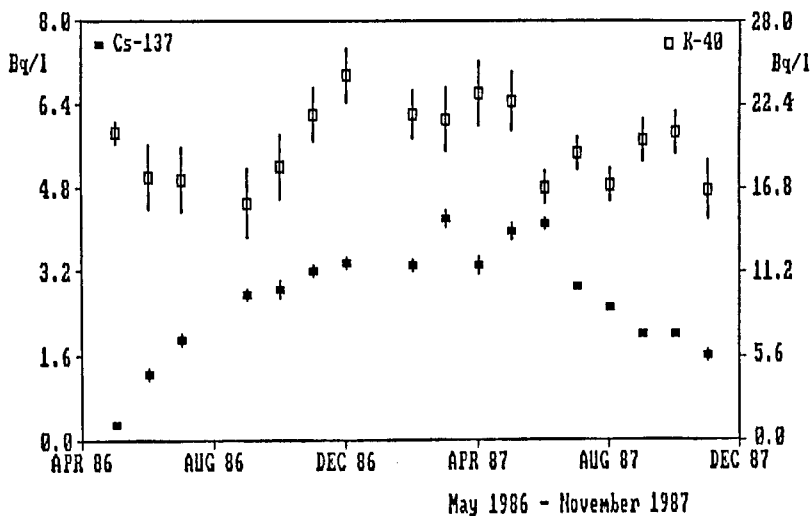


Fig. 1. Monthly averages of Cs-137 and K-40 concentration measured in human milk samples.

In Fig. 2 the monthly averages of Cs-137 concentration in human milk and cow's milk (from the Central Dairy of Rome) are

compared. It can be seen that the Cs-137 level was much higher in cow's milk than in human milk during the whole '86 and the first half of '87.

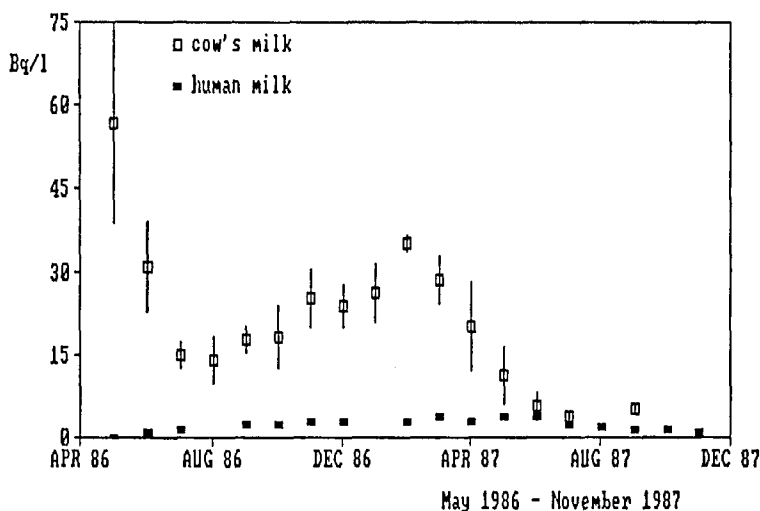


Fig. 2. Monthly averages of Cs-137 concentration in human milk and in cow's milk (6) from the Central Diary of Rome (errors are one standard deviation and represent the spread of the data within each month).

Total potassium concentration has been measured in some human milk samples and - for comparison - in some cow's and sheep's milk ones (see ref. 5 for the radioactivity measurements). The potassium mean content was found to be 0.75 g/l, 1.47 g/l and 1.20 g/l for human, cow's and sheep's milk respectively. The value for human milk is higher than some values found in literature (see ref. 7), but it is well known that it is highly dependent on mother's diet and other factors. The ratio between the K-40 and total K concentrations turns out to be in the range (28 - 36)  $\text{Bq}\cdot\text{l}^{-1}/\text{g}\cdot\text{l}^{-1}$ , in good agreement with the isotopic ratio of natural potassium (0.0118 %). This fact makes it possible to use directly the K-40 concentration measured in the samples instead of the total potassium concentration in evaluating the Cs-137 to potassium ratio. In Fig. 3 the monthly averages of the Cs-137/K-40 ratio observed in human milk samples are shown. It can be seen that the ratio is always lower than 25%, whereas the corresponding ratio in cow's milk (6) is higher than 30% up to May '87.

Unfortunately, up to now available experimental data cannot allow any meaningful assessment of the Cs-137/K-40 ratio in the total diet of pregnant women in Latium. However it is interesting to note that the Cs-137/K-40 ratio measured (5) in wheat samples from Latium was found to be higher than 30%.

The results presented clearly shows that the Cs-137 contamination in human milk has been very low both in an absolute sense and in comparison with cow's milk. Furthermore, the Cs-137/K-40 ratio has been lower than the corresponding ratio in cow's milk

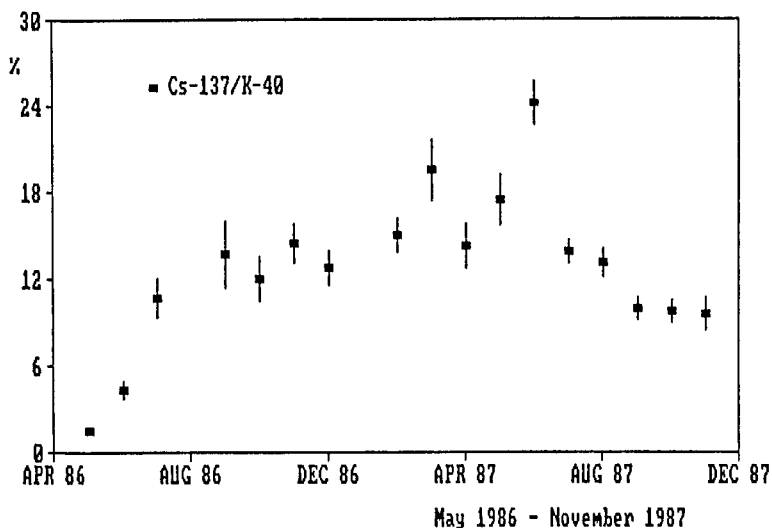


Fig. 3. Values of the Cs-137/K-40 ratio found in human milk.

and, probably, in mother's diet, unlike the case found by other authors in the past (8).

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