CONSIDERATION OF DOSE TO A PERSON EATING GAME AND MUSHROOMS IN UKRAINE

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October 23, 2000

INTRODUCTION

The original question was whether it would be possible to estimate the potential range of concentration of ^{137}Cs in meat and vegetables from the Chernobyl region of Ukraine. The reason for the question was that a person from Michigan was recently hunting near Kyiv/Chernobyl and ingested contaminated meat and mushrooms. Later, additional important information was received that the person camped southeast of the Chernobyl site near a reservoir. Also, he had been whole body counted and found to have a whole body content of 11 nCi. Additional information would also be helpful—How long was he in the region? Exactly where was the hunting camp? And so forth. However, more than enough information is available to calculate the dose and risk received by the person.

ESTIMATE OF ^{137}Cs CONTENT IN MEAT AND MUSHROOMS

By happenstance a major paper on internal dose was published in the October issue of *Health Physics* (Likhtarev et al. 2000). Also, the new report of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR 2000) was just distributed in October. Both of these documents contain relevant new information.

In order to estimate concentrations of ^{137}Cs in meat and vegetation it is important to know the deposition of ^{137}Cs per unit area and the characteristics of the soil. The latter is important as it has been found that the uptake from soil to milk (via vegetation) varies enormously with the type of soil (Likhtarev et al. 2000). From the descriptive material available it seems reasonable to assume that the person of interest was in the region of the large Kyiv Reservoir; this reservoir is also the source of much of the drinking water for Kyiv. Based upon information in Likhtarev et al. (2000) and UNSCEAR (2000), the deposition of ^{137}Cs per unit area in this region was 40 to 185 kBq m^{-2}. Further, from Likhtarev et al. (2000) the uptake factor from soil-to-milk is 0.1 to 0.5 Bq L^{-1} per kBq m^{-2}; this value is the needed data on soil "characteristics." Thus, we can estimate that the range of concentration, c_m, of ^{137}Cs in milk in this region would vary from 4 to 90 Bq L^{-1} *in 1987*. Such a concentration would decrease with time according to Likhtarev et al. (2000) by the following:

$$c_m(t) = c_m(0) \cdot \left[0.9 \cdot e^{-0.236t} + 0.1 \cdot e^{-0.046t}\right],$$

where t is time in years. With t equal to 13 y the calculated values in 2000 are 0.4 to 9 Bq L^{-1}.

From Likhtarev et al. (2000) it can be expected that the comparable concentrations in *wild game* would be 9 times higher and in *mushrooms* 10 times higher.

ESTIMATE OF INTERNAL DOSE

If the amounts of wild game and mushrooms can be estimated by the person of interest, it is easy to calculate dose, D_g, as

$$D_g = \left(c_{wg} \cdot i_{wg} + c_{mush} \cdot i_{mush}\right) \cdot DC_g \ ,$$

where i is the amount of wild game or mushrooms ingested and DC_g is the dose coefficient for ingested ^{137}Cs. The value of DC_g for effective dose for an adult is 1.3×10^{-8} Sv Bq^{-1} (ICRP 1998).

A much more realistic and useful approach is to calculate the dose on the basis of the measured body burden. This was given as 11 nCi (410 Bq). One important piece of information is missing—How long after the intake was the body burden measured? ICRP (1993) gives the elimination rate of ^{137}Cs from the body as

$$A(t) = A(0)\left[0.10\mathrm{e}^{-0.693t/2} + 0.90\mathrm{e}^{-0.693t/110}\right]$$

where in this case t is time in days.

As an example calculation, we can assume that t is equal to 30 days. Then $A(0)$ would have been 550 Bq, which is generally consistent with the estimated concentrations in wild game and mushrooms calculated above. This estimated original body burden would result in an effective committed dose of 7 μSv.

This very small dose can be compared to the average dose from natural background of 2400 μSv *per year*.

ESTIMATE OF EXTERNAL DOSE

It is well to keep in mind that external dose would also result from the ^{137}Cs activity in the soil. Based on another Likhtarev et al. paper that has been submitted to *Health Physics,* it can be estimated that the external effective dose in the area of this contamination would be approximately 1 μSv day^{-1}.

RISK MANAGEMENT

A few years ago I read in a Kyiv newspaper that 772 persons had died in 1997 from eating poison mushrooms. I can't vouch for the absolute validity of the number, but my Ukrainian family members tell me that they believe this number can be correct. If so, the risk of dying of mushroom poisoning in Ukraine is about 2×10^{-5} *per year*. In contrast we can use the ICRP (1991) estimate of lifetime risk from a dose of 10 μSv and calculate a risk of 5×10^{-7}. Neither risk is very large, but the risk from eating mushrooms picked in the wild would seem to be far higher than the risk from ingested ^{137}Cs in the area. In addition, the risk from poison mushrooms is very real, while many would argue that the risk from such a small amount of radiation is purely theoretical.

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