ASPECTS OF THE RADIOACTIVE CONTAMINATION OF FOOD AND HUMANS IN ROMANIA, AFTER THE CHERNOBYL ACCIDENT

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INTRODUCTION

The radioactive contamination of the environmental factors in Romania, was shown four days after the accident, by a massive increase in the radioactivity of the air, deposits, soil, and vegetation. It was found that some areas were more contaminated, due to the currents of air that favoured the movement of the masses of contaminated air, and to the fall-out driving the radionuclides toward the ground. Areas with low levels of contamination were identified in the western part of the country, while the most contaminated areas were the mountain regions and the areas in the north-east of the country.

Twenty-one radionuclides were identified by gamma spectrometry, to which Sr-90 and Sr-89 were added, that were detected by radiochemical analysis.

The contents of Cs-137 in the atmospheric deposits did not exceed 80 kBq/m^2, which places the level of contamination in Romania below the levels reported in Ukraine and Belarus (over 200 kBq/m^2), or in Sweden (over 100 kBq/m^2)[1,2] .

MATERIALS AND METHODS

The samples of drinking water and foodstuffs were collected from the whole area of Romania, once a month during 1986-1987, and once a trimester between 1988 and 1992[3] .

Cs-137 and Sr-90 were chemically separated out of large volumes of water (100-300 l), then measured by spectrometry and beta radiation of the Y-90, respectively [4,5] .

The samples of foodstuffs, after being weighed and calcinated, were measured by gamma spectrometry, to determine their contents of Cs-137 and Cs-134. From the same calcinated samples Sr-90 was separated, then measured by means of its daughter Y-90.

The gamma spectrometric measurements were performed by means of Canberra analysers with 4096 channels, endowed with Ge(Li) detectors. The beta measurements were carried out with anticoincidence facilities, Nuclear Enterprises (U.K.)[4,5] .

The concentration factors (CF) in the trophic link soil-plants were also computed, as the ratio between the activity of a radionuclide in a mass of 1 kg of fresh plant, and the activity in 1 kg of soil.

The human contents of Cs-137 and Sr-90 was measured by antropogammametry. The human contents of Cs-137 and Sr-90 was also estimated by computation, as a function of the contents of the radionuclides in the ingested food [2,4-6] .

RESULTS AND DISCUSSIONS

The values of the contents of Cs-137 and Sr-90 in drinking water increased during May 1986, but did not exceed 1 Bq/l. During the following months, the activity of the two radionuclides decreased continuously, until, in 1990, it reached values of only 2-10 mBq/l that were also found prior to the nuclear accident.

Throughout May-July, the contents of Cs-137 in cultivated vegetation was of the order of hundreds of Bq/l, but decreased quite rapidly during the second half of the year 1986 and during the following years, until, in 1989, it reached values lower than 1 Bq/kg. When comparing the activity of this radionuclide in wheat grains to its activity in corn grains, the contents of Cs-137 in wheat was higher by at least one order of magnitude than that in corn (up to 500 Bq/kg).

In 1986, the contents of Cs-137 in animal products (milk and dairy products, meat and derivatives, etc.) showed high values, hundreds of Bq/kg of fresh mass. During 1987, the values decreased by at least one order of magnitude, and in 1990 they reached less than 1 Bq/kg. Isolated peaks of increased contents of Cs-137 were detected at the beginning of the year 1987, mainly in dairy products, due to the use of contaminated vegetation that was stocked during the summer of 1986.

The values of the contents of Sr-90 in vegetation and foodstuffs of animal origin were much lower (with one to two orders of magnitude) than those found for Cs-137.

The contents of Cs-137 in daily menu in the southern part of Romania was about 100 Bq/day during 1986 and the first half of 1987, reached values below 10 Bq/day during the second half of 1987 (the highest intake was due to the wheat flour ground from the crop of the previous year), was only 1 Bq/day since 1988, and decreased even further after 1990. The contents of Sr-90 was lower than 10 Bq/day during 1986, and decreased to about 1 Bq/day in 1988. The two radionuclides detected in the menu during 1987 were mainly due to the flour ground from the crop of the previous year. When it was replaced by the flour from the crop of the year 1987, the contents of Cs-137 in the menu decreased to about 2 Bq/day.

The concentration factors of these two radionuclides in plants, computed for the interval 1987-1992, showed values below one (between 0.01 and 0.11), which explains the rapid decrease of the contents of the radionuclides in plants, then in animals and products of animal origin.

The contents of Cs-137 in human body was maximum during the years 1986 and 1987, approximately 10,000 Bq, and continuously decreased since 1988 due to the low intake from food, reaching, in 1991, values below 100 Bq. Sr-90, computationally estimated as a function of the degree of contamination of the ingested food, was below 100 Bq even in 1986, but decreased much slower than Cs-137.

The relatively rapid metabolic process of Cs-137, and the low intake of this radionuclide from food even since the end of the year 1987, resulted in a quite rapid decrease of its contents in human body, to values below 100 Bq in 1991. As for Sr-90, the intake from food was also low starting with 1987, but the much slower metabolic process of this radionuclide resulted in a much smaller decrease of its radioactive contents, as compared to Cs-137.

In Romania, the level of human and food contamination with Cs-137 and Sr-90 was close to the levels reported in other European countries (Hungary, Poland, etc.), and much lower than those found in Ukraine and Belarus [1].

CONCLUSIONS

1. The radioactive contamination of food reached high values for Cs-137 (hundreds of Bq/l or kg), and lower values for Sr-90 (10 to 100 times lower than Cs-137), during the months May-July 1986.

2. The values of the contents of the radionuclides Cs-137 and Sr-90 in water and food decreased rapidly, even during the second half of 1986, and in 1991-1992 they reached the levels recorded for the periods prior to the accident.

3. The concentration factors for Cs-137 and Sr-90 in plants had low values, usually below one, even since 1986, which explains the rapid decrease of food contamination.

4. The evaluation of the human contamination indicated maximum values by the end of 1986, about 10,000 Bq Cs-137, and less than 100 Bq Sr-90.

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