Radionuclide Identification of Environmental Objects and Food in some Districts of Ratkha-Lechkhumi Region, Determination and Hygienic Assessment of Irradiation Doses of Population

Klara Gelashvili, Nino Vepkhvadze, Nino Kiladze

Department of Public Health, Tbilisi State Medical University, Georgia

ABSTRACT

Radionuclide content in the environmental objects (water, soil) and food has been studied in Ambrolauri, Oni and Lentekhi districts of Ratkha-Lechkhumi region, Georgia. Defined internal and total irradiation doses for the population and proposed preventive measures for its reduction were detected. Internal irradiation dose for the population due to K-40 was identified as 2,72 mSv/y, total irradiation dose – 3,87 mSv/y. To reduce the total irradiation dose of a population it is necessary to prohibit the use of high activity water for drinking; provision of the population with new sources of low activity water; minimize and control of irradiation doses from artificial sources including means of regulation of medical radiological procedures and rational use of fertilizers with K-40 content.

KEYWORDS: *radionuclide identification, irradiation doses, preventive measures*

Influence of ionizing radiation (IR) can cause threats to human health [1,5]. So, protection of population's rights is necessary, which includes minimization of harmful effects caused by irradiation and protection of future generation's health [4].

Internal irradiation of a population constitutes 2/3 of total irradiation dose. Therefore, determination and hygienic assessment of these doses is very important in terms of influence on health status.

The aim of the research was radionuclide identification of the environmental objects (water, soil) and food in Ambrolauri, Oni and Lentekhi districts of Ratkha-Lechkhumi region, Georgia. Determination of internal and total irradiation doses for the population, their hygienic assessment and preventive measures for its reduction were studied. This study was conducted by the state program "Radiation". The qualitative and quantitative radionuclide identification of the samples from studied objects was conducted in the Laboratory of Radiology of Radioecology and Ecology Institute of Georgian Agricultural Scientific Academy by means of alfa-, gamma- spectrometric analyzer (Canbera company).

RESULTS AND CONCLUSIONS

1. The content of radionuclides in the environmental objects and food products of local production

The radioactivity of waters in studied territory of Ratkha-Lechkhumi region mainly is caused by the existence of radionuclides of natural origin, especially K-40 (60-282 Bq/l), which is 3-13 times more than the norms of radiation safety [2]. The comparatively high amount of K-40 was detected in mineral waters – 145-369 Bq/l.

In the drinking waters the presence of Pb-212 and Pb-214 and small amounts of Sr-85 was detected. The amount of other natural radionuclides was found to be normal.

Significantly was increased the amount of Ra-224 (9-36 times) Ra-226 (294 times), Th-234 (3-10 times) in drinking water. The amount of U-235 was much less increased (2 times).

Thus, the fraction of total mass activity of the natural radionuclides in waters of the studied territory of Ratkha-Lechkhumi region is more than acceptable, which is the result of high content of radionuclides in the environmental objects of study. This proves proof of our previous studies results that the investigated regions also belong to the number of comparatively high radiation background.

The natural radioactivity of soils in Ratkha-Lechkhumi region is mainly caused by K-40 (842-2460 Bq/l) and Pb-212 (57-162 Bq/l). Other natural radionuclides are comparatively rare. In almost every soil study radionuclides of artificial origin – Cs-137 (38-165 Bq/l) have been detected, which is the indicator of artificial radionuclide pollution.

The quantitative and qualitative radionuclide identification in the studied region was conducted in the local food products: milk, corn, potato, bean, cabbage, apple and tomato. The amount of K-40 in all these products was 131-7753 Bq/kg. The largest amount was found in corn, potato, cabbage, which are products widely used by the population.

The reason for the high amount of K-40 in food products is from its presence in the water and soil, which may be caused not only by natural, but also by technological reasons, particularly from the result of the fertilizers with high content of potassium, which than enters in to the products.

In some samples the presence of Cs-137 (80-253 Bq/kg) was found. The concentration of Cs-137 didn't exceed the recommended norms, except for corn from Ambrolauri district. The radioactivity of corn was 3,2 times more than recommended. This corn should be excluded from use.

The artificial pollution of the environment especially waters and soil and food products with Sr-85 and Cs-137 has been linked with Chernobyl Disaster, although residues of global environmental pollution could be a factor as well.

2. The calculation of the irradiation doses of a population

The investigations showed that the radioactivity of drinking water is mainly caused by K-40. Taking into consideration that physiological norm of water consumption for adult person is 1,5 liter a day, the internal irradiation dose of population due to K-40 content in water was calculated. This dose for the population of Ratkha-Lechkhumi region is 0,5 mSv/y,

which is much more than acceptable limits according to recommended by NRS-2000 – 0,1 mSv/y (p.8.3.6). It should be noted, that the given dose is maximum, as it doesn't consider the process of metabolism. But considering that measurements potentially were taken from irradiation produced only by K-40 and not by all other natural and artificial radionuclides, the dose could be very high. The conclusion is that it is necessary to limit the usage of some highly active waters for drinking purposes and to search for less radioactive sources of water. Moreover the above-mentioned waters contained increased amounts of Ra-224, Ra-226 and U-235 (α-radiation).

The radioactivity of the food cultivated in the investigated areas is mainly caused by K-40. Thus, during the measuring of internal irradiation dose of the population by studying the nutritional status of population much attention was paid to the K-40 levels.

The internal irradiation dose of the population in Ratkha-Lechkhumi region received from food products was 2.22 mSv/y. If we add to this amount the irradiation dose from water, the internal irradiation dose of population will be – 2.72 mSv/y. Calculation do not take into account the process of metabolism in the body. Thus, the calculated doses are a bit higher that the actual doses. It should also be considered that only the local food products were studied, population use also imported products as well, which also contain a certain amount of radionuclides. The other radionuclides were not considered, so the internal irradiation dose from food products could potentially be higher. According to the literature the internal irradiation dose due to the radionuclides of soil origin is 1,325 mSv/l.

In previous years we studied radioecological situation of Ratkha-Lechkhumi (radiation background of open areas and building) and with these components the external irradiation dose (1,15 mSv/y) of population [6,7] was calculated and the internal irradiation was found to be twice as much.

Total irradiation dose for the population of Ratkha-Lechkhumi region is 3,87 mSv/y (according to the reference data allowed dose is approximately 2 mSv/y [3].

To reduce the total irradiation dose of population it is necessary to prohibit the use of high activity water for drinking; provision of the population with new sources of low activity water; in Ambrolauri district excluded the use of corn grown across the river Rioni.

It is necessary to control and minimize irradiation doses from artificial sources including means of regulation of medical radiological procedures and rational use of fertilizers with K-40 content. It is necessary undertake the chemical analysis of waters, where detected content of Pb-212 and Pb-214; wide scale epidemiological study of populations health status; and ideally to conduct geological studies to reveal anomalous areas.

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Радионуклидная идентификация объектов окружающей среды и пищевых продуктов некоторых районов Рача-Лечхумского региона, определение доз облучения населения и их гигиеническая оценка

Клара Гелашвили, Нино Вепхвадзе, Нино Киладзе

Кафедра общественного здравоохранения Тбилисского государственного медицинского университета, Грузия

Р Е З Ю М Е

Изучен радионуклидный состав объектов окружающей среды (вода, почва) и пищевых продуктов Амболаурского, Онского и Лентехского районов Рача-Лечхумского региона Грузии, определены внутренние и суммарные дозы облучения населения и, с целью их уменьшения, намечены превентивные мероприятия. Внутренняя доза облучения населения за счет К-40 составляет 2,72 м3в/г, суммарная доза равняется 3,87 м3в/г. С целью уменьшения суммарной дозы облучения населения необходимо запрещение использования высокоактивных питьевых вод и обеспечение населения новыми, менее активными питьевыми источниками, контроль и минимизация доз облучения, обусловленных искусственными и техногенными источниками, что, в первую очередь, должно производиться за счет урегулирования медицинских лучевых процедур и рационального использования удобрений, содержащих К-40.

Ключевые слова: *радионуклидная идентификация, дозы облучения, превентивные мероприятия*