

RADIOCESIUM ACTIVITY IN THE MUSCLES OF GAME ANIMALS OBTAINED IN THE AREA OF THE OPOLE ANOMALY COMPARED TO POLAND AND EUROPE

SUMMARY

The Chernobyl nuclear power plant accident in 1986 was the greatest nuclear disaster in human history. In consequence of this event, many European regions have been contaminated with various, unstable isotopes, of which the cesium ^{137}Cs is one of most important. Due to its persistence in the environment and ease with which it migrates into trophic chains, this radioisotope pose an environmental threat to both: man and biota. The region of Poland that has been particularly contaminated with ^{137}Cs is called the Anomaly of Opole. So far, the research focused on determining the activity of ^{137}Cs in various elements of the environment within the Opole Anomaly did not include game animals. Taking into account the role of game in the diet of families with hunting or forestry traditions, game may constitute an equally important path of migration of ^{137}Cs from the environment to man as edible mushrooms.

The aim of the study was to determine the ^{137}Cs activity in the muscle tissues of three game species living in the Opole Anomaly: European roe deer (*Capreolus capreolus*), Red deer (*Cervus elaphus*) and Eurasian wild boar (*Sus scrofa*). An attempt was made to determine the effective dose of γ radiation among game consumers and also to determine the ^{137}Cs soil-to-game transfer factors. In addition, in order to determine the long-term trends in ^{137}Cs activity, values of the effective and environmental half-life were calculated ($T_{1/2\text{eff}}$ and $T_{1/2\text{env}}$ respectively) for the studied species from the Opole Anomaly area and from other regions of Poland. The current state of knowledge in the field of calculating the aforementioned half-lives was revised, which was a necessary stage due to the methodological discrepancies in the available literature on this subject. Due to the limitations of the single-phase model (SFO), an attempt was also made to describe the kinetics of ^{137}Cs activity changes using programs that take into account the bi-phasic kinetics in the concentration changes of anthropogenic substances in the environment.

Data describing the specific ^{137}Cs activity in the muscle tissues of game was obtained through self-sampling from the environment, cooperation with the Kup Forest Inspectorate

and courtesy of Voivodship Veterinary Inspectorates from most voivodships of the country. The specific and surface ^{137}Cs activity in soil within the Opole Anomaly was determined independently on the basis of hunting districts constituting a rational unit of the area from the perspective of the existence and acquisition of game. The effective dose of γ radiation was calculated in accordance with the legal guidelines in force in Poland, assuming four possible scenarios for the consumption of game from the forests of the Opole Anomaly. The calculations of $T_{1/2\text{eff}}$ and $T_{1/2\text{env}}$ were made in accordance with the SFO model, assuming that on the basis of empirically determined ^{137}Cs activities it is possible to calculate $T_{1/2\text{eff}}$, and then to extrapolate the $T_{1/2\text{env}}$ value. The following programs, which take into account bi-phasic models, were used to determine the kinetics of ^{137}Cs activity changes in the tissues of game: Excel, PestDF, CAKE and the DEGKIN spreadsheet.

^{137}Cs activity in the muscle tissues of studied game animals in the area of Opole Anomaly should be considered within the legal norms. There were no intra- and inter-species differences in the ^{137}Cs activity among the studied game species within the Opole Anomaly. The annual effective dose for game consumers, according to the most pessimistic scenario, was $134 \mu\text{Sv} \cdot \text{year}^{-1}$. This dose should be considered low and safe for health. Based on $T_{1/2\text{eff}}$ and $T_{1/2\text{env}}$ values, the accumulation of ^{137}Cs was demonstrated in many populations living outside North-Eastern Poland. In the area of the Opole Anomaly, no decrease in the activity of ^{137}Cs was demonstrated in all analyzed game species over the last dozen or so years. Based on the analysis of literature sources, the presence of two concepts for calculating $T_{1/2\text{eff}}$, $T_{1/2\text{env}}$ and $T_{1/2\text{biol}}$ was determined, which may give divergent results without meeting certain methodological conditions that were specified in this study. The strengths and weaknesses of this two, different concepts for calculating $T_{1/2\text{eff}}$, $T_{1/2\text{env}}$ and $T_{1/2\text{biol}}$ were identified through the prism of ease of use and susceptibility to methodological bias. The computer programs used for the calculations of $T_{1/2\text{eff}}$ and $T_{1/2\text{env}}$ showed a bi-phasic kinetics of ^{137}Cs activity changes for several regional populations of studied game species. The strengths and weaknesses of the SFO and bi-phasic kinetic models were identified.