The radioactivity monitoring of wild boars in the South Bohemian Region

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Abstract

The Regional Veterinary Administration of South Bohemian Region, the State Veterinary Administration, performed a monitoring procedure within the framework of an emergency inspection in December 2012 focusing on the presence of radionuclides in wild boar meat. Samples of game were collected in all districts of the South Bohemian Region. This special inspection resulted in confirmation of above-limit values for the sum total of Cs^{137} and Cs^{134} radionuclides present in samples from two locations: Šumava National Park (Nová Pec area) and Novohradské Mountains (Kraví Hora and Jelení Hřbet hunting areas). Additional samples from the above-mentioned and adjacent hunting areas were collected at the beginning of 2013 focusing on more accurate geographical definition of the area in which increased values of radionuclides in wild boar meat are found. Emergency veterinary measures were issued to the users of hunting areas in which above-limit values of radionuclides Cs^{137} and Cs^{134} were repeatedly found.

Meat, monitoring, radionuclide caesium Cs^{137}, wild boars

Introduction

At the end of the year 2012, the State Veterinary Administration conducted an extraordinary inspection targeted at the detection of radionuclides, specifically the sum total values of caesium Cs^{137} and Cs^{134}, in the meat of bagged wild boars. The inspection was conducted in Karlovy Vary, Plzeň and South Bohemian Regions. Its objective was to verify levels of radionuclide contamination in the meat of wild boars bagged in the regions in view of increased incidence of above-threshold sum-total values of caesium (Cs^{134} and Cs^{137}) of from Šumava National Park in Plzeň Region in 2011 and 2012. The decision was also prompted by reports from Bavaria of increased radionuclide contamination of the meat of wild boars bagged in areas adjacent to the Bavarian Forest, where Cs^{137} values often exceeded a mass activity of 600 $Bq \cdot kg^{-1}$. In contrast, the situational overviews of the State Veterinary Administration from the last five years relating to food chain contamination with exogenous substances did not generally contain any values in excess of the safe limit for the presence of radionuclides in foodstuffs, including game. The situation was the same in the South Bohemian Region. Targeted monitoring exclusively assaying radionuclides is intended to map the real situation in the region under investigation.

Radioactivity is generally defined as a phenomenon in which the nuclei of atoms of one element spontaneously convert to nuclei of another element to the accompaniment of emission of high-energy radiation. Nuclei exhibiting this property are called radionuclides. The unit of radioactive source activity is the Becquerel (Bq), which represents the average rate of disintegration of one atom per second (mean disintegrations per unit time). Due to continuing irradiation following the Chernobyl accident, the maximum permitted level of radioactive contamination of foodstuffs according to Radiation Protection Decree no 307/2002 expressed as the total sum of the mass activities of Cs^{134} and Cs^{137} (or the total sum of Cs), is 600 $Bq \cdot kg^{-1}$. Section 103 of Decree no 307/2002 specifically states: for

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radioactive contamination of foodstuffs by continuing irradiation following the Chernobyl nuclear power plant accident, the maximum permitted levels of radioactive contamination of foodstuffs shall apply until the entry into force of the Treaty of Accession of the Czech Republic to the European Union. Since the Treaty of Accession of the CR to the European Union (EU) came into force, the maximum permitted levels of radioactive contamination of foodstuffs in the case of a radiological emergency have been governed by European Council Regulation (Euratom) no 3954/87.

However, for the application of food law in the area of radioactive contamination of foodstuffs, EU Member States generally use European Council Regulation (EC) no 733/2008 on the conditions governing imports of agricultural products originating in third countries following the accident at the Chernobyl nuclear power plant. Article no 2, Paragraph 2 (b) of that Regulation lays down the maximum cumulative activity of Cs^{134} and Cs^{137} (sum total of Cs) at 600 $Bq \cdot kg^{-1}$ for all products other than milk and milk products listed in Annex II and foodstuffs intended for the special feeding of infants during the first four to six months of life. In connection with the above regulations, the Czech State Office for Nuclear Safety issued an opinion stating that it considered it reasonable to apply the maximum permitted mass activity level of $Cs^{137} \cdot kg^{-1}$ of 600 Bq stipulated in Council Regulation (EC) no 733/2008 to regulate the placing of the meat of wild boars (game) on the domestic market. The opinion of the Office for Nuclear Safety was upheld by the Ministry of Agriculture, which laid down the mass activity of the total sum of Cs of 600 $Bq \cdot kg^{-1}$ as a mandatory criterion for assessing foodstuffs as safe pursuant to Article 14 of the European Parliament and Council Regulation (EC) no 178/2002.

Materials and Methods

Samples of the meat of bagged boars for special monitoring purposes were collected in the South Bohemian Region from 1st to 19th December 2012. One sample of frozen meat from the environs of the city of Písek was from a boar killed on 28th August 2012, the other boars were hunted in December 2012. The number of samples to be collected in individual districts was stipulated in advance. A total of 32 samples were collected. A larger numbers of samples collected in the Prachatice, Český Krumlov and České Budějovice districts were justified by a higher probability of the detection of elevated radionuclide levels in game, and also because they were locations at a higher elevations adjacent to the Šumava massif – the protected landscape area of Šumava National Park and the southernmost separate territory within Šumava, Novohradské Mountains. The inspectors from the Regional Veterinary Administration wrote a report on inspection findings for each sample including certain background information such as the hunting area, the hunting area's registration number and operator, cadastral area number, animal, category (piglet, yearling, sow and boar), seal number, date of hunting, and location details – approximate GPS coordinates. The weight of each sample was 500 g of pure muscle tissue. Samples were examined by gamma ray spectral analysis at the laboratory of the State Veterinary Institute in Prague accredited by the Czech Institute for Accreditation.

Results

The threshold value (mass activity) of the total sum of caesium, i.e. 600 $Bq \cdot kg^{-1}$ of pure muscle tissue, was not exceeded in 29 of the total of 32 samples collected. The mean value was 92.78 $Bq \cdot kg^{-1}$, ranging from 1.43 $Bq \cdot kg^{-1}$ to 518.54 $Bq \cdot kg^{-1}$ (Table 1).

Three samples exceeded the threshold level (mass activity) of 600 Bq/kg for the total sum of caesium. Those were neighbouring hunting areas in Novohradské Mountains (České Budějovice district), i.e. the hunting areas Kraví Hora (total sum of caesium 2 776.23 $Bq \cdot kg^{-1}$) and Jelení Hřbet (sum total of caesium 6 998.15 $Bq \cdot kg^{-1}$). The third hunting area in the Prachatice district of Šumava National Park was Nová Pec hunting area of the National Park Administration (sum total of caesium 745.79 $Bq \cdot kg^{-1}$). Precautionary measures were imposed by the Regional Veterinary Administration and the operators of all three hunting areas were ordered to collect samples from subsequently bagged wild boars. In all three hunting areas, the threshold value for the total sum of caesium of 600 $Bq \cdot kg^{-1}$

Table 1. Overview of below-threshold mass activity values for the total sum of caesium in samples of game from individual Southern Bohemian districts

District	No of samples	Mean activity (Bq·kg^{-1})	Activity range (Bq·kg^{-1})
České Budějovice	5	61.48	9.53 – 144.61
Český Krumlov	5	84.67	4.03 – 459.95
Jindřichův Hradec	3	34.7	1.43 – 74.26
Písek	3	20.0	13.65 – 40.81
Prachatice	10	145.07	4.49 – 518.54
Strakonice	3	253.51	2.37 – 504.66
Tábor	3	7.12	1.4 – 13.22

Table 2. Summary of above-threshold mass activities for the total sum of caesium in samples of game collected in hunting areas during repeated sampling

District	Hunting area	No of samples	Mean activity (Bq·kg^{-1})	Activity range (Bq·kg^{-1})
České Budějovice	Kraví Hora	3	5 132.87	20.06 – 8 044.47
České Budějovice	Jelení Hřbet	2	5 104.00	3 209.87 – 6 998.15
Prachatice	Nová Pec (Šumava National Park Administration)	4	1 076.25	888.56 – 1 317.62

was exceeded in all subsequently collected samples with the exception of a sample from one piglet (20.06 Bq·kg^{-1}) from Kraví Hora hunting area. In Kraví Hora hunting area, the values were exceeded more than tenfold (Table 2). The emergency veterinary measures were then put in place in all three hunting areas.

The next step taken by the Regional Veterinary Administration was to define the size of the area in which tests for above-threshold values of radionuclides in boar meat samples need to be conducted. Operators of all the hunting areas adjacent to the above hunting areas, i.e. 10 hunting areas in Novohradské Mountains and 7 hunting areas in Šumava National Park, were contacted. Because above-threshold values were detected in some other samples of boar meat, emergency veterinary measures were put in place in three other hunting areas in Novohradské Mountains, i.e. Vysoká, Rychnov u Nových Hradů and Žofín hunting areas (Table 3). In the other 14 hunting areas, above-threshold values were detected only sporadically.

Table 3. Adjacent hunting areas in which emergency veterinary measures were put in place following the detection of above-threshold mass activity for the total sum of caesium in samples of game

District	Hunting area	No of samples	Mean activity (Bq·kg^{-1})	Activity range (Bq·kg^{-1})
České Budějovice	Vysoká	3	2 947.20	1 587.61 – 4 987.64
České Budějovice	Rychnov u Nových Hradů	5	6 935.06	809.25 – 14 252.14
Český Krumlov	Žofín	4	3 568.68	173.53 – 12 099.98

Discussion

Elevated levels of radioactive caesium activity are generally attributed to the extent to which soil is contaminated by the Chernobyl fallout. The consequences of nuclear accidents can have a prolonged character in some biocenoses due to the ability of some radionuclides

to move from the abiotic component of the environment to the biotic component and then to accumulate in it. This is also the case for the radionuclide Cs^{137}, also accompanied for a short time by Cs^{134} (Dvořák et al. 2010). Cs^{137} is currently considered the most important man-made source of gamma radiation in the environment. It has a half-life of about 30 years and is the cause of long-term exposure through the food chain and external exposure due to its accumulation in the soil (Rachubik 2008). As far as forest ecosystems are concerned, the percentage of radionuclide occurrence is clearly largest in the soil. Forest soil is different from agriculturally exploited soil. Soils in temperate forests are made up of several layers: the forest floor, the semi-organic layer and the mineral layer (Kalač 2012). The highest incidence of Cs^{137} is found on the boundary between the humus layer and the mineral soil (measured in south-eastern Bavaria) and its percentage in the soil decreases with increasing depth. It is assumed that the movement of radioactive caesium from soil to plants and fungi and to animals is much higher in forest ecosystems than in the agricultural environment. Animals that get their feed in forests absorb radioactive caesium in higher quantities in comparison with animals reared for food production and fed harvested forage (Rachubik 2008).

Conclusions

Two locations where above-threshold total sum amounts of caesium (Cs^{134} and Cs^{137}) which were repeatedly demonstrated in the meat of bagged boars identified during the inspection by the State Veterinary Administration in the South Bohemian Region. These locations are ecosystems with a predominance of forests at higher elevations of the Novohradské Mountains (Vysoká and Kraví Hora) and a continuous forest zone in the Šumava National Park and the Šumava Protected Landscape Area in Nová Pec and Stožec cadastral areas. In the adjacent areas at lower altitudes and with a smaller proportion of forests and a higher proportion of agricultural land, findings of above-threshold values of total sum of caesium (Cs^{137} and Cs^{134}) are rare.

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The Decree no 307/2002 The State Office for Nuclear Safety on Radiation Protection

The Proposal for a Council Regulation (Euroatom) (EC) no 3954/ 87 laying down maximum permitted levels of radioactive contamination of food and feed following a nuclear accident or any other case of radiological emergency