Radiocaesium in *Cortinarius* spp. mushrooms in the regions of the Reggio Emilia in Italy and Pomerania in Poland

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**Abstract** Activity concentrations of $^{134}$Cs and $^{137}$Cs have been determined in 23 species of mushrooms of the genus *Cortinarius* (59 individual samples) collected from the Reggio Emilia in Italy 1992–1999 and in 4 species (16 composite samples and 413 individuals) from the Pomerania region in Poland from 1996 to 2015. Across all the *Cortinarius* species from the Reggio Emilia, the activity concentrations were relatively high in *Cortinarius alboviolaceus*, *Cortinarius duracinus*, *Cortinarius orellanus*, *Cortinarius rapaceus*, and *Cortinarius subannulatus*, in which $^{137}$Cs was at 10,000 ~ 100,000 Bq kg$^{-1}$ dry biomass (db) in 1994. Smaller activity concentrations were found in *Cortinarius bivelus*, *Cortinarius bulliardii*, *Cortinarius cotoneus*, *Cortinarius largus*, *Cortinarius lividoviolaceus*, *Cortinarius purpureus*, *Cortinarius rufo-olivaceus*, *Cortinarius torvus*, and *Cortinarius venetus* with levels at 1000 ~ 6000 Bq kg$^{-1}$ db from 1992 to 1994, and further in *Cortinarius anserinus*, *Cortinarius auroroturbinate*, *C. largus*, *Cortinarius praestans*, *Cortinarius purpurascens*, *Cortinarius scarus*, *Cortinarius sebaceous*, *Cortinarius talus*, and *Cortinarius variecolor* with activity concentrations at 100 ~ 600 Bq kg$^{-1}$ db in 1994. All the data were calculated for dehydrated fungal material corrected back to the exact date samples of collection. The greatest activity concentrations of $^{137}$Cs both in Italy (1992–1999) and Poland (1996–2010) were found in the popular *Cortinarius caperatus*, confirming its very high capacity of radiocaesium accumulation. Besides $^{137}$Cs, the isotope $^{134}$Cs was detected in some species from the Reggio Emilia. An average calculated ratio of activities of $^{134}$Cs to $^{137}$Cs referenced to 1986 was equal to 0.38 in mushrooms from the Reggio Emilia, and this value slightly differ from that specific for Chernobyl fallout, which was 0.54. It was calculated that $^{137}$Cs originating from Chernobyl accident constituted about 68 % of the total activity concentration of the isotope in Reggio Emilia in 1986, while as much as 32 % of $^{137}$Cs in mushrooms were from the global fallout from nuclear bomb testing.

**Keywords** Europe · Edible fungi · Macromycetes · Radioactivity · Radiocaesium

**Introduction**

The fallout from the atmospheric nuclear explosions of the twentieth century caused a global scale pollution with partly long-lived radionuclides (Bem et al. 1990; Grueter 1964; Saniewski et al. 2016). Further, two major scale nuclear power plant (NPP) accidents in Chernobyl (Ukraine, 1986) and Fukushima Daiichi (Japan, 2011) released radionuclides of various half-lives (Steinhauser 2014). The releases from the Chernobyl NPP exceeded the releases from Fukushima by one order of magnitude and caused more severe radiation related health effects (Steinhauser et al. 2014). The Chernobyl accident caused severe pollution of soils with caesium radioisotopes $^{134}$Cs and $^{137}$Cs in the vicinity of the nuclear facility and...
more or less in the neighboring regions in Europe (De Cort et al. 1998). The influence of the Fukushima accident on radioactivity levels in Europe was regarded as negligible (Steinhauser et al. 2013).

Mushrooms growing in the wild are specifically prone to contamination with several metallic elements (Falandysz and Borovička 2013). The nuclear weapon tests and Chernobyl accident caused a long-lasting accumulation of the radionuclides with long half-lives in soils and mushrooms. An especially high accumulation was observed for $^{137}\text{Cs}$ (Bakken and Olsen 1990; Baldini and Nyatemu 1990; Bulko et al. 2014; Falandysz et al. 2015a; García et al. 2015; Grodzinskaya et al. 2003, 2013; Mietelski et al. 2010). Mushrooms absorb both natural and artificial radionuclides originating from fallout and from soil substrata, and $^{137}\text{Cs}$ is often a major contaminant but because of species-specific accumulation some other radionuclides can also highly matter for some mushrooms and regions (Steinhauser et al. 2014; Kirchner et al. 1998).

Radiocaesium isotopes ($^{134}\text{Cs}$ and $^{137}\text{Cs}$) are rapidly accumulated by mushrooms from the soil contaminated with deposited fallout. This is because of a high similarity of $^{134}\text{Cs}$ and $^{137}\text{Cs}$ to stable Cs ($^{133}\text{Cs}$)—a natural metallic trace element in mushrooms on one side and because of the very efficient mycelial network on the other side. There is also some chemical and physical analogy between the isotopes of Cs and the isotopes of potassium (K) which is the most abundant metallic macro element present in mushrooms. Potassium concentration was found to be in the range from 34,000 to 52,000 mg kg$^{-1}$ dry biomass (db; median values) in caps of edible Brown Birch Scaber Stalk Leccinum scabrum (Falandysz et al. 2007a).

The rate or efficiency of $^{134}\text{Cs}$ and $^{137}\text{Cs}$ accumulation by mushrooms can be related to status of the stable Cs in their flesh, which seems to be species specific. For example, Macrolepiota procera (Scop.) Singer is poor in total Cs with a range in caps from 0.015 to 0.043 mg kg$^{-1}$ db; Amanita muscaria (L.) Lam., from 0.063 to 0.83 mg kg$^{-1}$ db; L. scabrum with from 2.7 to 7.2 mg kg$^{-1}$ db and Sorcodon imbricatus (L.) P. Karst., with 28 ± 9 mg kg$^{-1}$ db (Kotlew et al. 2015; Falandysz et al. 2007a, b, 2008). This implies that differences in the efficiency of absorption of $^{137}\text{Cs}$ by fungi and accumulation in fruiting bodies follow their stable Cs status, while surplus of “easily” available $^{137}\text{Cs}$ in soil solution can also matter for high accumulation. In 2000, the authors Yoshida et al. reported on a good correlation between $^{137}\text{Cs}$ and stable $^{133}\text{Cs}$ contained in several species of mushrooms from Finland, Germany, and Japan (Yoshida et al. 2000).

Gypsy Cortinarius caperatus (Pers.) Fr (earlier called Rozites caperatus (Pers.) P. Karst.,) is one of many species of the genus Cortinarius (Index Fungorum 2015). This edible and tasty mushroom is popular in many regions of Europe (Falandysz 2014). Shortly after the collapse of the Chernobyl nuclear power plant, C. caperatus collected in Europe showed high levels of radioactivity because of accumulated radiocesium (Byrne 1998; Eckl et al. 1985; Haselwandter et al. 1988; Strandberg 1994, 2004).

Both, Italy and Poland were affected by radionuclides released from the Chernobyl accident but there is a variation of the amount of deposition of radiocesium over Europe (De Cort et al. 1998). This study aimed to update and document information on radioactivity from radiocesium accumulated in mushrooms of some Cortinarius species and especially in C. caperatus collected in the Reggio Emilia in Italy and Pomerania in Poland. Italy and Poland are among the European countries where foraging of mushrooms is a traditional activity.

Materials and methods

The fruitbodies of the genus Cortinarius such as Cortinarius alboviolaceus (Pers.) Fr; Cortinarius anserinus (Velen.) Rob. Henry; Cortinarius auroturbinitus (Seer.) J.F. Lange; Cortinarius bivelus (Fr.) Fr.; Cortinarius bulliardii (Pers.) Fr; Cortinarius cotoneus Fr.; Cortinarius duracinus Fr., current name Cortinarius rigens (Pers.) Fr.; Cortinarius herpeticus for which current name is Cortinarius scaurus (Fr.) Fr.; Cortinarius largus Fr.; Cortinarius lividoviolaceus (Rob. Henry ex M.M. Moser) M.M. Moser; Cortinarius melliolens Jul. Schäff., with current name Cortinarius talus Fr.; Cortinarius orellanus Fr., Cortinarius phoeniceus with current name Cortinarius purpureus (Bull.) Bidaud, Moënne-Locc., & Reumaux; Cortinarius praestans (Cordier) Gillet; Cortinarius purpurascens Fr.; Cortinarius rapaceus Fr.; Cortinarius rufo-olivaceus (Pers.) Fr.; Cortinarius sebaceus Fr.; Cortinarius submelliolens Jul. Schäff. & M.M. Moser; Cortinarius torvus (Fr.) Fr.; Cortinarius variecolor (Pers.) Fr., and Cortinarius venetus (Fr.) Fr. were collected from the Reggio Emilia in Italy in 1992–1994, and Cortinarius caperatus (Pers.) Fr (earlier called R. caperatus (Pers.) P. Karst) in 1992–1995 and 1999 (coordinates: 44°42’ N 10°38’ E) (Table 1). The fruitbodies of C. caperatus were also collected from Pomerania in Poland in 1996–2010 (coordinates: 54° 29’ N 18°15’ E). Additional samples of Cortinarius species such as Cortinarius agathosmus Brandrud, H. Lindstr. & Melot, Cortinarius olivaceofuscus Kühner, Cortinarius trivialis J.E. Lange, and Cortinarius violaceus (L.) Gray were gathered in 2013 and in 2015 in region of the village of Pomlewo (Pomerania; coordinates: 54° 13’07” N 18°21’28” E) (Table 1).

The individual cap, stipe, or a whole fruiting bodies samples were cleaned from plant and soil debris using a soft brush and a disposable plastic knife, dried, and ground (Cocchi et al. 2006; Falandysz 2014). In the case of 23 species of mushrooms from the Reggio Emilia in Italy, a single whole fruiting body was examined for each species (in total 59 individual
Table 1  Activity concentration of $^{137}$Cs in *Cortinarius* spp. from the Reggio Emilia in Italy and the region of the Pomerania land in Poland (Bq kg$^{-1}$ dry biomass)

| Localization, species, date or year and sample size (n = number of fruiting bodies) | Whole fruiting bodies |
|---|---|
| | Caps | Stipes |
| Italy; *C. alboviolaceus*, 1994–09-04/10–04 n = 2$^a$ | 12,000 ± 60 (12,000–12,000) | |
| Italy; *C. anserinus*, 1994–09-19 n = 1$^a$ | 120 ± 10 | |
| Italy; *C. auroturbinitus*, 1994–11-25 n = 1$^a$ | 570 ± 20 | |
| Italy; *C. bivelus*, 1994–09-19 n = 1$^a$ | 3200 ± 28 | |
| Italy; *C. bulliardii*, 1993–11-08 n = 1$^a$ | 2600 ± 30 | |
| Italy; *C. caperatus*, 1992–10-01/12/02/12 n = 6$^a$ | 33,000 ± 35,000 (6300–100,000) 21,000$^*$ | |
| Italy; *C. caperatus*, 1993–08-15/10–02/15 n = 3$^a$ | 15,000 ± 8000 (5800–21,000) 18,000 | |
| Italy; *C. caperatus*, 1994–08-10/07/28/09–26/10–01/02 n = 6$^a$ | 9900 ± 5360 (3300–18,800) 9900 | |
| Italy; *C. caperatus*, 1995–09-02/09/17 n = 16$^a$ | 13,000 ± 3900 (5800–16,000) 14,000 | |
| Italy; *C. caperatus*, 1999–07-29/10–24 n = 2$^a$ | 17,000 (15,000–19,000) | |
| Italy; *C. cotoneus*, 1994–09-19/10–12 n = 3$^a$ | 3100 ± 2700 (340–5800) 3200 | |
| Italy; *C. duracinus*, 1994–11-25 n = 1$^a$ | 12,000 ± 100 | |
| Italy; *C. herpeticus* (*C. scaurus*), 1994–09-19 n = 1$^a$ | 290 ± 20 | |
| Italy; *C. largus*, 1992–10-25 n = 1$^a$ | 220 ± 13 | |
| Italy; *C. largus*, 1994–10-16 n = 1$^a$ | 1100 ± 20 | |
| Italy; *C. lividoviolaceus*, 1994–09-19 n = 1$^a$ | 1700 ± 25 | |
| Italy; *C. melliolens* (*C. talus*), 1994–10-14 n = 1$^a$ | 180 ± 10 | |
| Italy; *C. orellanus*, 1994–10-25 n = 1$^a$ | 26,000 ± 180 | |
| Italy; *C. phoeniceus* (*C. purpuratus*), 1994–09-19 n = 1$^a$ | 2700 ± 28 | |
| Italy; *C. praestans*, 1993–09-24 n = 1$^a$ | 130 ± 9 | |
| Italy; *C. purpurascens*, 1994–09-19 n = 1$^a$ | 220 ± 12 | |
| Italy; *C. rapaceus*, 1994–10-15 n = 1$^a$ | 31,000 ± 200 | |
| Italy; *C. rufo-olivaceus*, 1994–09-19 n = 1$^a$ | 2400 ± 23 | |
| Italy; *C. sebaceus*, 1994–09-19 n = 1$^a$ | 380 ± 19 | |
| Italy; *C. subannulatus*, 1994–10-01 n = 1$^a$ | 18,000 ± 130 | |
| Italy; *C. torvus*, 1994–10-08 n = 1$^a$ | 5600 ± 50 | |
| Italy; *C. variecolor*, 1994–09-19 n = 1$^a$ | 320 ± 17 | |
| Italy; *C. venetus*, 1994–10-14 n = 1$^a$ | 5600 ± 44 | |
| Poland; *C. caerulescens*, Pomlewo, 2013 n = 3$^w$ | 18 ± 4$^w$ | |
| Poland; *C. caerulescens*, Pomlewo, 2015 n = 25$^{aw}$ | 5.8 ± 1.0 | 5.1 ± 1.0 |
| Poland; *C. caerulescens*, Pomlewo, 1996 n = 20$^{aw}$ | 13,000 ± 110 | 4200 ± 45 |
| Poland; *C. caperatus*, WLP, 1998 n = 15$^{aw}$ | 16,000 ± 180 | 5300 ± 65 |
| Poland; *C. caperatus*, Darłubska Wilderness, 2001 n = 15$^{aw}$ | 6300 ± 60 | 2000 ± 19 |
| Poland; *C. caperatus*, Przymuszewo, 2002 n = 16$^{aw}$ | 12,000 ± 94 | 5400 ± 43 |
| Poland; *C. caperatus*, Darłubska Wilderness, 2003 n = 15$^{aw}$ | 5100 ± 43 | 2100 ± 19 |
| Poland; *C. caperatus*, Słupska county, Kępić, 2003 n = 31$^{aw}$ | 5200 ± 49 | 2000 ± 19 |
| Poland; *C. caperatus*, Sułęczyno, 2006 n = 70$^{aw}$ | 5200 ± 50 | 3500 ± 25 |
| Poland; *C. caperatus*, Strzebielino, 2006 n = 16$^{aw}$ | 4600 ± 42 | 1800 ± 23 |
| Poland; *C. caperatus*, Tuchola Pinewoods, Lubichowo, 2007 n = 53$^{aw}$ | 7300 ± 58 | 2900 ± 24 |
| Poland; *C. caperatus*, Gotubie, 2008 n = 15$^{aw}$ | 6500 ± 47 | 3000 ± 22 |
| Poland; *C. caperatus*, Tuchola Pinewoods, Lubichowo, 2010 n = 16$^{aw}$ | 5600 ± 58 | 1900 ± 24 |
| Poland; *C. olivaceofuscus* Pomlewo, 2013 n = 14$^{aw}$ | 10 ± 2 | |
| Poland; *C. olivaceofuscus* Pomlewo, 2015 n = 35$^{aw}$ | 9.2 ± 2.0 | 6.9 ± 1.6 |

Notes: $^a$ Number of individual samples; $^{aw}$ Number of individuals in a pool; TLP (Trójmiejski Landscape Park); WLP (Wdzydze Landscape Park); “ Mean ± S.D. (range) and median value; ” Measurement uncertainty
samples), and from the Pomerania region, 16 composite samples were examined, which were prepared using from 3 to 70 individuals per location (Table 1). The activity concentrations of $^{134}$Cs and $^{137}$Cs in samples collected in Italy and Poland were determined using a validated method of gamma spectrometry with coaxial high purity germanium (HPGe) detectors.

Details on the gamma spectrometer calibration, detector parameters, and quality assurance of the measurements and instrument used in Italy [HPGe high purity detectors (P-type HPGe and HPGe-N-EG G ORTEC), relative efficiencies between 25 and 80 % and resolution of approximately 2.0 keV (FWHM) at 1.33 MeV energy), shielded by lead walls (thickness about 10 cm), calibrated with multirange source QCY 48 (energy range between 59 keV and 1.836 MeV) and equipped with spectra processing program (GammaVision 7:02-ORTEC)] were provided in a paper by Consiglio et al. (1990). For instrument used in Poland, the germanium detector relative efficiency was 18 % and a resolution of 1.9 keV at 1.332 MeV (with associated electronics). The equipment was calibrated using a multi-isotope standard and the method was fully validated. The reference solution, “Standard solution of gamma emitting isotopes, code BW/Z-62/27/07” produced at the IBJ-Swierk near/Otwock in Poland, was used for preparing reference samples for equipment calibration. The same geometry of cylindrical dishes with 40 mm diameter (as applied for environmental samples) was used for reference samples during equipment calibration. The laboratory involved was subject to routine checks to ensure high standards of analytical quality and analytical control and participated successfully in the inter-comparison exercises organized by IAEA-MEL Monaco (IAEA-414, Irish and North Sea Fish) to confirm the reliability and accuracy of the method (Falandysz et al. 2015a, b; Wang et al. 2015; Zalewska and Saniewski 2011). Repeated analysis gave values of $^{137}$Cs—5.06 ± 0.64 Bq kg$^{-1}$ db, $^{40}$K—474.5 ± 19.3 Bq kg$^{-1}$ db, while the estimated target value was equal to 5.18 ± 0.10 Bq kg$^{-1}$ db for $^{137}$Cs and 481 ± 16 Bq kg$^{-1}$ db for $^{40}$K. In the gamma spectrometry measurements, the limit of quantification was calculated using GENIE 2000 as a Minimum Detectable Activity (MDA) defined by Curie (1968). Data were calculated for dehydrated fungal material (at 105 °C) and corrected back to the exact date of sample collection.

Results and discussion

Table 1 presents all the mushroom names, site locality, year of collection, number of fruitbodies, and measurement data. The fruitbodies collected in the Reggio Emilia in the period from 1992 to 1994 showed relatively high activity concentrations of $^{137}$Cs (half-life $T_{1/2}$ 30.05 years) at a range from 120 Bq kg$^{-1}$ db in $C. anserinus$ to 31,000 Bq kg$^{-1}$ db in $C. rapaceus$, with both collected in 1994 (Table 1). If recalculated to fresh weight (assuming a moisture content of fruiting bodies at 90 %), the values would be 12 Bq kg$^{-1}$ for $C. anserinus$ and 3100 Bq kg$^{-1}$ for $C. rapaceus$.

In some Cortinarius species, in Reggio Emilia, $^{134}$Cs (half-life $T_{1/2}$ 2.06 years) was detected, but activity concentrations were visibly lower. They ranged from 8 Bq kg$^{-1}$ db in $C. cotoneus$ to 987 Bq kg$^{-1}$ db in $C. rapaceus$, and the latter showed also the greatest $^{137}$Cs activity concentration. It has been shown that there is a relationship between the activity concentration of both isotopes in mushrooms (fruiting bodies). The ratio of activity concentrations of $^{134}$Cs to concentrations of $^{137}$Cs referenced to 1986 varied within a narrow range from 0.29 to 0.46. The averaged value was 0.38. It should be noted that this value only slightly differs from that specific for the Chernobyl fallout, which was 0.54 (Aarkrog et al. 1988; Strandberg 2004). Taking into account the value specific for the Chernobyl fallout and activity concentrations of $^{134}$Cs referenced to 1986, it is possible to calculate activity concentrations of $^{137}$Cs originating from the Chernobyl accident. It was calculated that this $^{137}$Cs constituted about 63 % of the total activity concentration of the isotope present in 1986 in fruiting bodies of examined mushrooms (the range is from 53 to 85 %). This means that as much as 32 % of $^{137}$Cs in mushrooms were from the global fallout from nuclear bomb testing.

The species $C. anserinus$, $C. auroturbinitus$, $C. scaurus$ (herpeticus), $C. largus$ (one sample), $C. (talus) melliolens$, $C. praestans$, $C. purpurascens$, $C. sebaceus$, and $C. variecolor$ did not show $^{134}$Cs at a level > 0.1 Bq kg$^{-1}$ db, while activity levels of $^{137}$Cs were <300 Bq kg$^{-1}$ db (Table 1). $C. caperatus$ collected in Poland did not show activity concentrations from $^{134}$Cs at the time of analysis (spring 2012).

Across all the Cortinarius sporocarps examined from Reggio Emilia, the activity concentrations were relatively high in $C. alboviolaceus$, $C. caperatus$, $C. duracinus$, $C. rapaceus$, and $C. subannulatus$ in which $^{137}$Cs was at 10,000 ~ 100,000 Bq kg$^{-1}$ db. Smaller activity concentrations were found in $C. bivelus$, $C. bulliardii$, $C. cotoneus$, $C. largus$, $C. lividoviolaceus$, $C. phoenicus$ ($C. purpurescens$), $C. rufolivaceus$, $C. torvus$, and $C. venetus$ with levels at 100 ~ 6000 Bq kg$^{-1}$ db, and further in $C. anserinus$, $C. auroturbinitus$, $C. herpeticus$ ($C. scaurus$), $C. herpeticus$ ($C. scaurus$), $C. largus$, $C. melliolens$ ($C. talus$), $C. praestans$, $C. purpurascens$, $C. sebaceus$, and $C. variecolor$ with activity concentrations at 100 ~ 600 Bq kg$^{-1}$ db (Table 1).

Cortinarius caperatus and also Cortinarius armillatus (Fr.) Fr., highly accumulated pre- and post-Chernobyl $^{137}$Cs. [$^{25-26}$] Cortinarius fruitbodies of $C. caperatus$, $C. armillatus$, and Cortinarius traganus (Fr.) Fr., were very efficient accumulators of $^{134}$/$^{137}$Cs (median value of $^{137}$Cs in individuals from Slovenia was respectively at 22,000, 44,000, and 12,000 Bq kg$^{-1}$ db), while $C. praestans$ was a weak
accumulator, as indicated by our results and a study by Byrne (1998). Our results for C. caperatus as efficient accumulators of 137Cs agreed with data by Strandberg (1994 and 2004), while that for C. armillatus this is new record. The largest amount of data on 137Cs in this study concerns C. caperatus, both from the Reggio Emilia in Italy and Pomerania in Poland (Table 1). This species accumulates 137Cs much more efficiently in caps than in stipes and the range of the values of 137Cs cap to stipe activity concentration quotient (QC/S) for the fruitbodies collected in Pomerania was from 1.4 to 3.1.

The highest activity concentration of 137Cs (16,000 Bq kg⁻¹ db) in caps of C. caperatus from northern Poland was identified in a sample gathered in 1998. High activity concentrations were also found in individuals collected in 1996 (13,000 Bq kg⁻¹ db) and in 2002 (12,000 Bq kg⁻¹ db). The activity concentrations of 137Cs in most samples collected in the period from 2001 until 2010 remained in the range from 3800 to 9000 Bq kg⁻¹ db. Regarding the northern Polish region, the lowest 137Cs activity concentrations were determined for other species of the genus Cortinarius that were collected in 2013 and 2015. In 2013, 137Cs in fruiting bodies of C. olivaceofuscus was at 11 Bq kg⁻¹ db and in C. caerulescens at 18 Bq kg⁻¹ db. In 2015, the activity concentration in C. trivialis was at 93 Bq kg⁻¹ db, while the caps and stipes of C. caerulescens and C. trivialis were at a level of a few Bq kg⁻¹ db (Table 1).

There were some similarities in the 137Cs activity concentrations in C. caperatus collected in the Reggio Emilia in 1995 and 1999 (at 14,000 and 17,000 Bq kg⁻¹ db or 1400 and 1700 Bq kg⁻¹ fresh weight base, respectively) and fruitbodies collected in 1996–1998 in Pomerania (in caps at 13,000–16,000 Bq kg⁻¹ db or 1300–1600 Bq kg⁻¹ fresh weight base) (Table 1). The fruitbodies of C. caperatus sampled in Denmark in 1994 contained 137Cs at 13,000 Bq kg⁻¹ db, while individuals from a montane region of Norway sampled in 1994 contained 137Cs at 7700 Bq kg⁻¹ db (median value) (Strandberg 1994 and 2004).

Recently, coral fungi of the genus Clavaria were reported as efficient accumulators of radiocaesium and samples collected in Japan after the Fukushima nuclear accident showed radiocaesium at 28,000 Bq kg⁻¹ fresh weight base (Merz et al. 2015).

Conclusion

The greatest activity concentrations of 137Cs in mushrooms of the genus Cortinarius collected both in the Reggio Emilia in Italy and in the region of northern Poland were found in C. caperatus, which is one of the most popular species from this genus, and it’s very high capacity for radiocaesium accumulation was confirmed. Besides 137Cs, the isotope 134Cs was detected in some species from Italy. An average calculated ratio of activities of 134Cs to 137Cs referenced to 1986 was equal to 0.38 in mushrooms from the Reggio Emilia, and this value slightly differs from that specific for the Chernobyl fallout, which was 0.54. It was calculated that 137Cs originating from the Chernobyl accident constituted about 68 % of the total activity concentration of the isotope in Reggio Emilia in 1986, while as much as 32 % of 137Cs in mushrooms resulted from the global fallout from nuclear bomb testing.

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