Radiocesium in mycorrhizal macro fungi in Finnish Lapland during 1981-2011

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Introduction

STUK- Radiation and Nuclear Safety Authority has monitored radioactivity concentrations in mycorrhizal macro fungi in the Kivalo research area 70 km southeast of Rovaniemi since early 1980s. In this study statistical values of radiocesium concentrations were calculated and ecological half-lives in fungal species estimated. The aim of this study was to explore changes in $^{137}$Cs concentrations with time in various mushrooms in different habitats.

Materials and Methods

Samples of Suillus variegatus, Lactarius rufus, Lactarius Vietus, Russula decolorans, Russula paludosa, Russula xerampelina, Russula vinosa, Cortinarius armillatus and Rozites caperatus (Fig. 1) were collected in four forest stands (Fig. 2). In laboratory the mushrooms were cleaned, sliced, dried at 105°C and homogenized before gammaspectrometric measurement. The small samples collected in Kivalo in 1981 - 1985 were obtained from archives of the Finnish Forest Research Institute in Rovaniemi and represent pre-Chernobyl accident levels.

Results and Discussion

$^{137}$Cs concentrations varied in 1981 – 1985 from 280 to 6500 and in 1989 – 2011 from 120 to 9030 Bq/kg d.w. The statistical values of fungi are presented in Table 1 (number of samples, min, max, mean $^{137}$Cs Bq/kg d.w.) The mean concentrations are presented in Fig. 3 with dots and bars which indicate the minimum and maximum values of the sampling year. The lowest values were measured in Russula and the highest in Cortinarius armillatus (non-edible) and Rozites caperatus. The ecological half-lives, $T_{1/2}$, for the concentration decrease were estimated using loglinear regression analysis. After sampling period 1989 – 2000 the $T_{1/2}$ values were estimated to vary from 8 to 18 years, except for Cortinarius 30 years. After a longer sampling period 1989 – 2011 the estimated $T_{1/2}$ of all mushrooms varied 10 – 17 years. The longest half-lives were measured in fungi from fresh heaths.

Conclusions

After the Chernobyl accident in 1986 the $^{137}$Cs concentrations in environment consisted of both the global and Chernobyl fallout. For the present the mushroom $^{137}$Cs levels in Northern Finland are not higher than before the accident and in all edible mushroom species they remain below the EU recommendation (600 Bq/kg f.w.). According to this study, the most sensitive fungus is Cortinarius armillatus, which grows mainly in fresh heaths. $^{137}$Cs concentrations in Cortinarius still increased 5 – 6 years after the Chernobyl accident whereas the concentrations of other species decreased. Cortinarius is not edible, but it is an excellent indicator for Cs in a late phase of fallout situation. A small amount of Fukushima derived $^{134}$Cs (1.2 Bq/kg d.w.) was observed in Cortinarius in mixed stands of the Kivalo research area in 2011.