Radioactive Contamination of Ukrainian Mushrooms

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Even 18 years after the Chernobyl catastrophe, radioactive contamination of wild growing mushrooms, in some cases reaching very high levels, created human health problems resulting from their nutritional and medicinal use. According to radioecological evaluations, the internal dose of irradiation in this case may reach 40–60%. A combination of macro- and micromycetes mycelial biomass and its capacity to uptake and retain radionuclides play very important roles in their migration and distribution. Actually, knowledge about the mechanisms involved in the accumulation and retention is incomplete. There is a positive correlation among the levels of soil contamination, degree of humidity, pH, rainfall, and radionuclide accumulation in mushrooms, although the species and ecological specificities of uptake are also observed. To measure species specificity of uptake, species-hyperaccumulators—for instance, radiocaesium—were used as bioindicators of contaminated soils. Among them, the widely spread and common species, *Lactarius rufus* (Scop.:Fr.) Fr. and *Paxillus involutus* (Batsch:Fr.) Fr., not consumed by the population because of their inedibility and toxicity, are now the most convenient test objects for long-term monitoring.

During the last few years in about 80% of mushroom samples traditionally included in the Ukrainian diet—species of Boletaceae (*Xerocomus* spp., *Suillus* spp., *Leccinum scabrum* (Bull.:Fr.)

S.F.Gray, *Boletus edulis* Bull.:Fr.) and *Cantharellus cibarius* (Fr.:Fr.) Fr. taken from areas with an average soil contamination of 0.1–5 Ci/km^2 (presently, the collecting and consuming of wild growing mushrooms are practically not controlled)—the ^{137}Cs levels exceeded permissible limits adopted in the Ukraine (2500 Bq/kg d.w.). Mushrooms growing in the Exclusion Zone, in the vicinity of the Chernobyl Power Plant (with ^{137}Cs contamination density of 837 Ci/km^2) accumulated up to millions of Bq/kg d.w. In 2004 ^{137}Cs activity in samples from the location of Novo-Shepelychi was within (in Bk/kg d.w.) 340,000 (*Armillariella mellea* (Vahl.:Fr.) P.Kumm.) to 20,000,000 (*Xerocomus subtomentosus* (L.:Fr.) Quél.), and ^{90}Sr within 2000 (*X. subtomentosus*) to 13,000 (*Stropharia aeruginosa* (W.Curt.:Fr.) Quèl.). Transfer factors for ^{137}Cs were in *X. subtomentosus* 645, *P. involutus* 548, *Lactarius turpis* (Weinm.)Fr. 280, *L. deliciosus* (L.:Fr.) S.F.Gray 222; for ^{90}Sr Tf were in *S. aeruginosa* 6.0, *L. turpis* 5.1, *A. mellea* 3.1. The ratio of ^{137}Cs/^{90}Sr was within the range of 7.5–10,000.

Mushrooms growing on the highly contaminated territories are permanently subjected to chronic irradiation. Taking into account polymorphism peculiar to mushrooms, the direct finding of morphose for them is difficult. Microstructural morphology of three bioindicative species using light and electron scanning microscopy was studied. It was statistically established that the spore length in *Xerocomus badius*(Fr.:Fr.) Kühn. ex Gilb., *Paxillus involutus,* and *Lactarius turpis* samples collected in the Exclusion Zone was bigger than in the controls. In some cases, in the hymenophore of studied samples, parts with abnormally large as well as with very small spores were found. The observed variability indicated that high dosages resulting from radionuclides incorporated by mycelium and fruiting bodies from contaminated soils affect the hereditary structures of mushrooms.

In nature mushrooms accumulate less ^{90}Sr than ^{137}Cs. In cultivation conditions, increasing levels of radiostrontium accumulation for *Lentinus edodes* (Berk.) Singer and *Pleurotus ostreatus* (Jacq.:Fr.)P. Kumm. (Grodzinskaya and Kuchma, 2004) were observed. This phenomenon can be connected to the higher biological availability of ^{90}Sr from mixed and watered substrates. An increase of ^{90}Sr activity in wood (observed in the last few years in contaminated territories) inevitably will cause an increase in its content in lignotroph species. Therefore, the selective control of ^{90}Sr accumulation in cultivated lignotrophs, even in territories with low surface soil contamination, is strongly recommended.

REFERENCE

Grodzinskaya A. A., Berreck M., Haselwandter K., and Wasser S. P. 2003. Radiocesium contamination of wild-growing medicinal mushrooms in Ukraine. *Int J Med Mushr*, **5**, 61–86.