

Relationship of fungal spore-organic tracer and ^{137}Cs in ambient aerosols from Fukushima: Nighttime emission of radioactive Cs by fungi

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A severe nuclear accident occurred in March 2011 at the Fukushima Dai-ichi nuclear power plant (FDNPP) operated by the Tokyo Electric Power Company (TEPCO), causing serious environmental contamination of radionuclides over wide areas covering eastern Japan and the western North Pacific. Igarashi et al. (2015) reported the impacts from the FDNPP accident over 3 years in Tsukuba, Ibaraki (ca. 170 km southwest from the FDNPP). The monthly atmospheric ^{90}Sr and ^{137}Cs deposition fluxes in March 2011 reached approximately 5 Bq/m²/month and 23 kBq/m²/month, respectively, which are 3–4 and 6–7 orders of magnitude higher, respectively, than those before the accident. Even after 7 years of the accident, high levels of ^{137}Cs are found in ambient aerosols from some areas of Fukushima especially during rain event. We presume that biological processes such as fungal activity emit radionuclides deposited over soil to the atmosphere. Fungi can uptake various metal ions including potassium and ^{137}Cs from soil using the soil network system.

To prove the hypothesis, we collected ambient aerosols (day and night, n=40) from Namie-cho in Fukushima, Japan in August to October 2017 using quartz fiber filters and high volume air sampler. The aerosols samples were analyzed for ^{137}Cs using a Ge-semiconductor detector. An aliquot of filter samples were extracted with dichloromethane/methanol (2:1) mixture. The extracts were concentrated using a rotary evaporator under vacuum and then reacted with BSTFA reagent to derive TMS derivatives of sugar compounds. The derivatives including fungal organic tracers were measured using a gas chromatography/mass spectrometer. We detected high levels of fungal tracers such as arabitol, mannitol and trehalose in the aerosol samples. Interestingly, nighttime samples showed a positive correlation between trehalose and ^{137}Cs , although there is no correlation in daytime aerosols. Similar correlations were not observed for another fungal spore tracers such as arabitol and mannitol. The results will be discussed from the viewpoint of soil-to-air re-suspension of ^{137}Cs via biological and meteorological soil/air interaction.