Sampling shiitake-inoculated logs for stable cesium concentration

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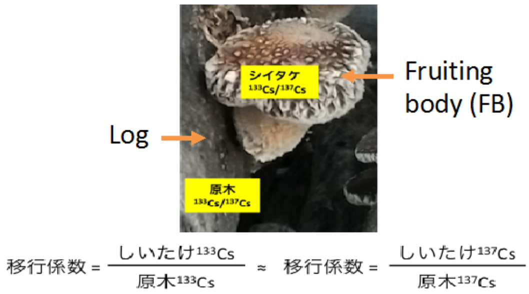

Shiitake is a wood-decaying fungus that can obtain its nutrients directly from dead trees. This fungus uses an extensive `root` system, known as mycelium, to penetrate the wood and transfer nutrients to its fruiting body (= edible mushroom part). Shiitake can simultaneously take up harmful radionuclides (e.g., ^{137}Cs), if present in the wood, and accumulate them in their fruiting bodies. Therefore, there is a real risk of shiitake mushrooms containing ^{137}Cs if grown on ^{137}Cs-contaminated logs. The ratio of ^{137}Cs in a fruiting body to its concentration in wood, known as the transfer factor (TF), is a measure of the ability of shiitake to accumulate ^{137}Cs. A higher TF between shiitake and logs increases the probability that radiocesium concentration in shiitake will exceed the maximum tolerable level of radioactivity in food (i.e., 100 Bq/kg) set by the Japanese government. Because the provisional limit of radiocesium allowed in logs for mushroom cultivation is < 50 Bq/kg, a TF of greater than 2 would result in ^{137}Cs concentration in fruiting bodies to exceed 100 Bq/kg. There are two main obstacles to accurately determine the log-to-shiitake TF of ^{137}Cs: Firstly, ^{137}Cs is currently not evenly distributed within logs. The solution here is to determine the log-to-shiitake TF of stable cesium (^{133}Cs) instead of ^{137}Cs because these elements are chemically similar and ^{133}Cs is naturally distributed within logs. Secondly, the current in-house method to collect a representative wood sample for ^{133}Cs analysis takes ~ 2.5 hours per log because it involves mechanically breaking and milling the entire log. In the current study, we investigated if sawdust obtained from cutting a log along its length was as robust but a faster alternative to providing a representative wood sample to determine the TF of ^{133}Cs between logs and shiitake.

Oak logs with ready-to-harvest shiitake fruiting bodies were cut into nine 10-cm discs and each disc was separated into bark, sapwood and heartwood and the concentration of ^{133}Cs was measured in sapwood, heartwood, sawdust (generated from cutting each disc) and fruiting bodies (collected separately from each disc), and the wood-to-shiitake transfer factor (TF) was calculated. We found the TF of ^{133}Cs based on heartwood (TF = 29), sapwood (TF = 27) and sawdust (TF = 24) to be approximately similar and therefore sawdust samples can be used to represent the log; it was also found to be a faster method (~ 10 minutes per log) to collect samples. This new method will greatly reduce both the time and labor for sample collection and preparation and allow ^{133}Cs to be used as a proxy element to determine the log-to-shiitake TF of ^{137}Cs.