Sampling shiitake-inoculated logs for stable cesium concentration

Martin O’Brien
Graduate School of Agricultural and Life Sciences, The University of Tokyo
Project Associate Professor

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.