Comparing the pathogen numbers in backyard and commercial composts

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From left to right: Neslihan Akdeniz, Helen Nguyen, and Yuqing Mao investigated different compost samples to compare the number of pathogens and antibiotic resistance genes. Credit: Jillian Nickel

Compost—organic material that is added to soil to help plants grow—is

widely used by gardeners because it improves soil health and reduces the amount of organic waste in landfills. Although several studies have looked at commercial composts, very few have investigated backyard compost samples. In a new study, researchers have measured the number of pathogens in both types of compost.

"The main difference between backyard and commercial compost is the composition. Backyard compost is made from plant-based materials like vegetable scraps and coffee grounds because online tutorials recommend them. Additionally, animal-source materials are harder to compost. On the other hand, many of the commercial composts are made from farm manure," said Yuqing Mao, a graduate student in the Nguyen lab.

Regardless of the source, the process of composting usually, but not always, gets rid of pathogens because it involves multiple stages of high heat. "There may be some pathogens that survive, either because they are heat resistant or they get introduced at a later stage," Mao said.

The researchers collected samples of backyard compost from two gardeners at Urbana-Champaign and used six types of commercial compost, which were bought from the supermarket. They also used two control samples: soil that has never been treated with compost and immature compost, which has not been put through the high-temperature treatment. They extracted DNA samples and used qPCR to identify and measure the abundance of specific genes.

"We looked at airborne and foodborne pathogens. People are usually more concerned with the latter because they use the compost to grow vegetables," Mao said. The researchers looked at the foodborne pathogens *Escherichia coli* and *Salmonella enterica* and the airborne pathogens *Mycobacterium* spp., *Legionella pneumophila*, and *Pseudomonas aeruginosa*. Since bacteria have very long DNA sequences, the study focused on genetic markers—genes that are unique

to each organism.

"We did not find any *Salmonella* in our samples and *E. coli* was only present in the immature compost sample, meaning that if the compost is made properly, it is unlikely that they will get contaminated by foodborne pathogens," Mao said. "On the other hand, we found that *L. pneumophilia* was present in four of the commercial samples but not in the other samples. The other two airborne pathogens were found in both backyard and commercial compost samples."

Unfortunately, the qPCR method cannot distinguish between live and dead pathogens. The researchers hope that they can improve the method to detect only the viable cells so that they can better assess the threat to humans. Additionally, they would like to study more samples to validate their conclusions.

The group also looked at the number of antibiotic resistance genes across the samples. Bacterial communities that have higher frequencies of these genes are more likely to spread them, resulting in a dangerous problem. "Overall, the immature compost samples have the highest abundance of antibiotic resistance genes, indicating that the high heat during composting may degrade some of these genes," Mao said.

It is unclear how the airborne pathogens are finding their way into the compost samples. The researchers are now trying to understand the source of contamination better so that they can help protect gardeners. "We also want to look at what composting conditions work best to remove these pathogens and the antibiotic resistance genes," said Helen Nguyen (IGOH), Ivan Racheff Professor in Civil and Environmental Engineering.

Mao has prepared a set of guidelines for gardeners who are interested in using animal manure composting, which can be found here.

The paper "Quantification of pathogens and antibiotic resistance genes in backyard and commercial composts" was published in Science of The Total Environment and can be found at doi.org/10.1016/j.scitotenv.2021.149197. Neslihan Akdeniz, a clinical assistant professor in agricultural and biological engineering, is a co-author on the paper and lent her expertise in composting with livestock manure.

More information: Yuqing Mao et al, Quantification of pathogens and antibiotic resistance genes in backyard and commercial composts, *Science of The Total Environment* (2021). DOI: 10.1016/j.scitotenv.2021.149197

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