### Animal Manure Composting Safety Considerations

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### Manure Composting

Composting provides a way to process manure in a way that reduces volume, creates a stable organic fertilizer, and potentially destroys pathogens and weed seeds in manure. Livestock and poultry manure composts are an excellent source of slow-release plant nutrients. They also provide organic matter that improves soil properties by supplying "food" for soil organisms that slowly convert organic nutrients into plant-available forms and improve soil properties that improve water infiltration, water holding capacity, and aggregate stability. Although compost can contribute to overall plant and soil health, some caution is warranted when applying compost to soils, particularly when used on growing crops.

#### Pathogen Exposure Risks: Ingestion and Inhalation

Animal manure contains bacteria such as *Escherichia coli* (*E.coli*), *Listeria*, and *Salmonella*. While every warmblooded animal (including people) houses billions of bacteria in their digestive tract, some bacteria can cause disease in humans and other animals. These are called "pathogens." People can be exposed to pathogens from animal manure through direct contact with raw produce fertilized with improperly composted manure or through contact with water contaminated with pathogens through runoff. There is also an exposure risk from inhalation of airborne contaminants when managing immature compost.

When turning or spreading compost material, fine solid particles and liquid droplets can become airborne. Bacteria and fungi can attach to and travel with those particles. In addition to pathogenic bacteria, another concern is antibiotic-resistance genes and bacteria in untreated animal manure. For instance, antibiotic-resistant *E.coli* can transfer antibiotic resistance genes to the human gut



**Fig. 1.** Antibiotic-resistant bacteria ingested by people may transfer antibiotic resistance genes to the gut microbiota. Though such a transfer is harmless in general, gut microbiota can pass the antibiotic resistance gene to a pathogen if people are infected. In this case, the pathogen would become antibiotic-resistant.

microbial community. Such a transfer is harmless when the person is healthy. However, during an infection, there will be an increased risk that infection-causing bacteria to become antibioticresistant. In our studies, we measured the presence of multiple antibiotic-resistant genes and two bacteria, E. coli and Salmonella, in mature and immature compost samples. Many types of E.coli exist that are nonpathogenic, but Salmonella is a well-known foodborne pathogen. In recent studies, Salmonella was not detected in the samples from composted manure. However, E.coli and co-existing antibiotic-resistant genes were detected in samples of immature compost. Such a co-existence suggests that E.coli is most likely to contain some of those antibioticresistant genes.

# Minimizing Pathogen Exposure by Ingestion

Considering the possibility that ingesting *E. coli* may introduce antibiotic resistance genes to the human gut bacterial community, good hygiene practices should always be used when handling compost. Good hygiene practices often include:

- Wearing gloves when handling raw manure or immature compost and discarding gloves properly after use;
- Washing hands with soap for at least 20 seconds after handling raw manure or immature compost, and using an alcohol-based hand sanitizer, if available.

In general, applying compost to growing crops should be done to reduce the risk of contaminating the plant with bacteria. It is recommended to:

- Avoid applying raw manure or immature compost to growing crops intended for human consumption (National Organic Program regulations require waiting at least 120 days before harvesting if raw manure is applied to a crop consumed without cooking;
- Thoroughly wash vegetables and fruits that are consumed raw without peeling as they present the greatest risk of ingesting harmful bacteria;
- Establish an initial carbon-to-nitrogen (C:N) ratio of between 25:1 and 40:1 in compost piles to optimize conditions for microbial activity that drives the composting process;
- Monitor internal pile temperature regularly; maintaining a temperature between 131°F and 170°F for three days is recommended if using an invessel or static aerated pile system; a temperature of between 131°F and 170°F for 15 days is recommended if using a windrow composting system;
- Turn compost material a minimum of five times during this period to ensure uniform heating;
- Protect finished compost from contamination sources such as runoff from an unfinished compost pile;
- Keep equipment used to work with raw manure separate from equipment used with composted



**Fig. 2.** Both pathogenic and non-pathogenic bacteria can attach to compost-originated particulate matters. People can inhale these particulate matters when they are handling the compost material.

# Minimizing Pathogen Exposure by Inhalation

When handling immature compost, caution should be observed to reduce the risk of inhaling airborne particles. A bacteria of increasing concern is *Legionella pneumophila*, which causes legionellosis. The symptoms of legionellosis include:

- Coughing
- Muscle acheHeadache
- Fever, chills
- Shortness of breath

If not treated, the disease can progress and require hospital treatment. In severe cases, people can die from legionellosis.

People who develop legionellosis symptoms within 2-10 days after handling compost should see a doctor without delay.

In our studies, besides *Legionella pneumophila*, we also detected *Pseudomonas aeruginosa* and *Mycobacterium spp.*, which are opportunistic pathogens. These bacteria take advantage of an individual's weakened immune system to create an infection of the respiratory system, urinary tract, or soft tissue.

Both *Legionella pneumophila* and *Pseudomonas aeruginosa* are resistant to high temperatures. Studies show that they can survive at temperatures higher than 131°F. Therefore, they can still be found in compost samples heated during the process. Measures need to be taken to avoid inhaling airborne pathogens when working with both immature and mature composts. Airborne pathogens especially affect older people, former or current smokers, people with underlying lung disease, and other long-term health conditions such as diabetes. The measures that should be taken when handling compost include:

- Avoid working in unventilated places such as closed sheds or greenhouses;
- When turning compost, wear an N95 mask or a respirator with particulate filters (if qualified) to avoid inhaling particles and make sure the mask or respirator fits properly (test before using);
- In case an N95 mask is not available, a 600 TPI cotton mask will help to reduce inhaling particles;
- Avoid turning compost on windy days;
- When needed, gently wet compost to reduce aerosolization of dust particles;
- When mixing, consider using a front-end loader with a sealed cab and filters fitted to the air intakes;
- Always involve your workers when you are addressing health risks; and
- Seek medical attention immediately if you develop a severe cough or other symptoms of respiratory infection.

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#### References

- <u>Cornell Waste Management Institute</u>
- Enhancing safety of locally grown produce
- Legionnaires' disease and legionellosis
- <u>USDA National Organic Program (NOP)</u>

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