Farm-to-food study aims to understand the effect of manure management practices on antibiotic resistance and residues

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Pilot-scale anaerobic digestion reactors at the USDA Beltsville Agricultural Research Center. The replicate digesters, designed by University of Maryland researcher Stephanie Lansing, will be used in the new study. Credit: Edwin Remsberg/University of Maryland

Researchers from four U.S. universities are teaming up with dairy farms across the Northeast and Mid-Atlantic to study the effect of three different manure management techniques on preventing the occurrence and spread of antimicrobial-resistant bacteria, genes tied to resistance,

and antibiotic residues—traces of antibiotics and the compounds they break down into.

Investigations on the occurrence and spread of antibiotic resistance have been mostly conducted in the clinical settings. However, there are concerns that discharges from municipal wastewater and agricultural wastes may also contribute to the occurrence and spread of antibiotic resistance in the environment. Therefore, it is important to study how manure management practices and manure treatment systems can reduce the risk of antibiotic residues entering local waterways.

Although there has not been direct evidence of resistance spreading as the result of antimicrobial and antibiotic use on dairy farms, given the potential risk, a team of scientists—led by the University at Buffalo, in partnership with Cornell University, the University of Maryland and the University of Michigan—will investigate the fate of therapeutic antimicrobials used in dairy herds by examining if and how various methods to treat manure affect the viability of residuals monitored, and the potential movement of any residuals from farms to the environment.

"Our findings could have important implications for human health and food safety," said lead researcher Diana Aga, Henry M. Woodburn Professor of Chemistry in the UB College of Arts and Sciences. "Animal manure is recycled to a farm's land base for use as organic fertilizer for growing crops to feed cows. This means that there is the potential for antibiotics and antibiotic-resistant bacteria to escape from the manure into the environment, potentially entering waterways or being taken up by plant material used as cow feed."

The $1 million project, funded by the USDA's National Institute of Food and Agriculture, will evaluate how well three different waste-processing techniques—anaerobic digestion, composting, and long-term storage—remove drugs and germs in excrement. To evaluate the

techniques, the scientists will collect manure samples from six dairy farms in New York State, three in Maryland and two in Pennsylvania. Samples will be gathered before and after treatment, and tested for levels of antibiotics, antibiotic-resistant bacteria and resistance genes.

Additional techniques will be used to explore anaerobic digestion, an advanced treatment method that employs microorganisms to break down and convert biodegradable matter into products that include biogas, liquid fertilizer and solid matter that is sometimes repurposed as bedding for animals.

Besides examining manure that has undergone this process on farms, the team will spike manure with antibiotics and resistance genes in controlled experiments that use anaerobic bioreactors in the lab at the University of Michigan, as well as larger scale anaerobic digestion reactors designed and built by Stephanie Lansing, a scientist on the project and an associate professor of environmental science and technology at the University of Maryland.

And while dairy farm manure is only rarely used to fertilize crops for human consumption, the team will also grow three food crops to see whether the plants take up antibiotics and resistance genes from treated and untreated manure—potatoes (grown below ground), lettuce (grown above ground and eaten fresh), and corn (grown above ground and eaten cooked).

"Dairy farming is the highest valued agricultural business in New York State," said research team member Curt Gooch, a Senior Extension Associate in Cornell University's College of Agriculture and Life Sciences. "Dairy farmers have used cow manure to organically fertilize feed crops since cows have been housed in barns. Looking specifically at the effect of manure handling systems on manure residuals provide the industry an opportunity to better understand current manure handling

practices and their effect on certain constituents not studied much before."

Additionally, the team includes extension/outreach specialists at Cornell and the University of Maryland who will monitor antibiotic use at participating farms, understand the farms' waste-processing methods, and raise awareness of advanced manure management technologies.

Provided by University at Buffalo