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On the environmental trail of food pathogens

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Tracking one of the deadliest food contamination organisms through produce farms and natural environments alike, Cornell microbiologists are showing how to use big datasets to predict where the next outbreak could start.

Specifically, the lethal listeria bacterium, Listeria monocytogenes, might be lurking in moist soil, close to open water and near livestock pastures, according to a *Journal of Food Protection* article, "Geographical and Meteorological Factors Associated with Isolation of Listeria Species in New York State Produce Production and Natural Environments."

"Due to the complexity of landscapes, it's basically impossible to know which environments favor the presence of listeria species or other disease-causing bacteria that may contaminate foods," said Martin Wiedmann, professor of food science and one of five researchers behind the article in the *Journal of Food Protection*. "We thus took a 'big data' approach that combined data from hundreds of bacterial samples from farms and forests across upstate New York with mapping data to identify locations that may favor the presence of specific bacteria."

The researchers were not surprised to find L. monocytogenes – the deadliest of some 15 listeria species and the cause of listeriosis, which sickened 147 people (and killed 33) with contaminated cantaloupes in 2011 – in farm fields and forests near pastures. Thriving in fecal matter and soil, the rod-shaped bacterium can travel through surface water and other mechanisms to places where human and animal food is grown.

The point of their research was to prove that so-called index organisms (such as other species of listeria collected in samples) can stand in for one bad actor (such as L. monocytogenes) and facilitate detection of microbes of interest. They investigated this by testing whether the same spatial factors that predict the presence of the index organisms also predict the presence of the bad actor.

About 33 percent of samples from New York's natural environments had some kind of listeria (not necessarily L. monocytogenes), as did 34 percent of samples from produce farms. Samples were taken by scooping sub-surface soil, dragging sterile swabs across land surfaces, and collecting feces and jars of water. Only three of 14 possible geographical factors – soil moisture, proximity to pastures and proximity to water – were highly associated with the isolation of pathogenic (L. monocytogenes) and nonpathogenic (L. innocua, L. seeligeri and L. welshimeri) listeria in produce production environments, Wiedmann and his colleagues reported.

Importantly this study, along with other recent work by this group, provides a blueprint that enables scientists to combine large public datasets that are freely available (like digitized maps and weather data) with lab and testing data to improve food safety and quality.

Be careful where you drink

One of the natural-environment sites for the listeria survey was Connecticut Hill Wildlife Management area, the 11,645-acre, mostly evergreen forest that is many Ithacans' favorite place for hiking, bird watching, skiing, horseback riding, primitive camping, fishing and other nonmotorized activities.

There and at other natural sites around the state, listeria was more likely to be found in soil samples rather than in surface water (ponds, creeks,

ditches), which is where farm-related listeria was most prevalent.

That doesn't mean the sparkling clear water at Connecticut Hill is safe to drink. Water in any place frequented by humans and other animals can bear pathogens like giardia, the protozoan parasite or salmonella bacteria.

Water bottles filled from the tap could be the best alternative to sipping surface water; the index-organism study found zero listeria in municipal and well water samples.

More information: "Geographical and meteorological factors associated with isolation of listeria species in new york state produce production and natural environments." *J Food Prot*. 2014 Nov;77(11):1919-28. DOI: 10.4315/0362-028X.JFP-14-132.

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