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# Electronic Nose Smells the Danger in Tainted Foods

*(Reprinted from the CANR Communications by Dick Lehnert)*

Just as DNA fingerprinting can put criminals in jail, an "electronic nose" can detect the presence of dangerous bacteria infecting animals or riding on fresh fruits and vegetables. It identifies them from their "bad breath."

"We can detect E. coli 0157:H7 from its gas signature," says Evangelyn Alocilja, a professor in the Department of Agricultural Engineering at Michigan State University. She points at four wavy lines on her computer screen: E. coli 0157:H7 puts a distinctive second bump on the line, and the other E. coli strains she has tested do not.

E. coli is commonly found in the environment and in the human intestine, and it is usually no threat to health. But one strain, 0157:H7, has made headlines. It can kill children and elderly people who ingest as few as five colony-forming units. With most disease-causing organisms, it takes millions – not five – to make a person sick.

*Dr. Evangelyn C. Alocilja*

Alocilja built the detecting device from seven gas sensors that look like little microphones. Each detects a type of gas – alcohol, animes and carbon dioxide, for example – emitted during bacterial metabolism. Various combinations of these create distinctive odors.

Data from the sensors is assembled into a series of wavy lines on a computer screen. The peaks and valleys are like the wavy lines of fingerprints, distinctive in this case to specific strains of bacteria. The computer can look for patterns among large sets of data.

Alocilja still has a lot of work ahead of her. A Lansing-based biotechnology company, Neogen, is providing her its inventory of 25,000 strains of E. coli. She will use them to confirm and refine her research, making sure no other strains produce the same signature as 0157:H7.

Then she will move out of the laboratory and into the real world. "We want to test it on farms sometime soon," she said. Cattle are a reservoir of 0157:H7. It is an acid-loving strain that grows best when something happens to alter stomach conditions in cattle. Then it flourishes and is shed in the manure. Alocilja wants to detect it there, at the farm, before animals come to slaughter plants.

"Instead of putting more pressure on beef packers to find and eliminate contamination, it would be more cost-effective to prevent it," she said.

She envisions a future where cattle feeders monitor their farms so they know if 0157:H7 is being shed. A change in management, such as reducing the amount of grain in the diet, might eliminate the shedding. High-grain diets can create the acidic stomach conditions in which this bacterial strain thrives.

"We can minimize the potential hazard to consumers by detecting it where it can be corrected, at the farm level," she said.

Alocilja's work is supported by funding from the Revitalization of Michigan Animal Agriculture Initiative and from Project GREEEN, the plant initiatives at MSU.

The plant side of this story is that E. coli can contaminate fruits and vegetables. It moves into the environment from animal and human wastes, which are applied to land both for disposal and for recovery of plant nutrients. From the soil, bacteria move onto fruits such as tomatoes, strawberries and dropped apples by rain spattering or direct soil contact.

"We are looking for a method that can quickly detect the presence of dangerous organisms," she said.

Used at a border crossing, for example, the nose could scan loads of strawberries or tomatoes. Current methods of testing take too long. Samples can be taken from incoming loads, but the trucks are not typically held. The fruit would perish in the time it takes to collect and analyze a sample from a laboratory culture.

E. coli is not the only target in Alocilja's sights. She wants to work next with Salmonella and Listeria, using her electronic nose to sniff their gases and letting her computer draw graphs of their distinctive odors. These organisms, too, cause food poisoning and are in soil and water in the environment.

The technology Alocilja uses has many favorable aspects. The sensor could be configured various ways – one way to scan a load of strawberries, another as a rectal probe for cattle.

"It is very inexpensive," she said. "The sensors are available off the shelf."

The detector doesn't come into contact with what it samples, so there is nothing to become contaminated or that needs special disposal reserved for biohazards. It does not require the expertise that chemical analysis does.

Where did she get the idea for this sniffer?

"I was reading the story of Bambi to my six-year-old son," she said. "As hunters came closer to Bambi, she was able to smell the danger. ‘Smell the danger', I thought. That's a good idea.