Shining a Light on Food Poisoning

As the Department of Food Science and Agricultural Chemistry celebrates 25 years of studying the good and the bad in food, one of its hallmark innovations — a specialized infrared technology that identifies food-borne pathogens — is getting ready to leave the nest.

By Philip Trum

Food-borne illnesses affect more than 12 million Canadians each year. Always unpleasant, sometimes fatal, bad food takes a huge toll: By some estimates, salmonella, E. coli and other bacteria are responsible for $1.3 billion annually in lost productivity and medical bills. And that's just in Canada.

For the past 25 years, researchers in the Department of Food Science and Agricultural Chemistry have been exploring the molecular underpinnings of what we eat. Some of their projects look at how we can prevent unwelcome microbial reactions from ever starting. One of the department's marquee projects, however, takes a different approach to the problem: Identify spoiled food as fast as possible so nobody eats it.

"Every organism has an infrared signature that is as unique as a human fingerprint," explains Ashraf Ismail, associate professor in the department. A technology called Fourier transform infrared (FTIR) spectroscopy is the metaphorical magnifying glass for detecting this fingerprint — and an efficient way to identify food-borne pathogens in a fraction of the traditional time.

When the McGill Infrared (IR) Group started its research with FTIR spectroscopy, the technology's food application was limited to analyzing the nutritional composition of milk. But Ismail and professor Frederick R. van de Voort thought FTIR technology had potential for even broader applications in food science and food analysis. Today, the McGill IR Group has one of the world's best-equipped research facilities for FTIR spectroscopy.

The process starts by growing a bacterial culture from the food in question (Health Canada regulations for bacteria analysis require a lab culture), which takes eight to 48 hours. After smearing a tiny amount of the culture on an infrared-transparent slide, an analyst then uses an FTIR spectrometer to measure the absorption of infrared light by the bacteria. The resulting spectrum is matched to a database of spectra from hundreds of bacteria. Identifying the mystery bacteria takes less than two minutes. Traditional lab analysis, which is done using a variety of biochemical tests, takes 24 hours — or more — on top of the culturing time.

"Smear a sample on a slide, shine infrared light on it, and you're done," says Ismail. "It doesn't get much easier to use — and there's basically zero overhead."

In August, the McGill IR Group finished a series of Health Canada challenge studies. They began by placing known bacteria into five different types of foods. They

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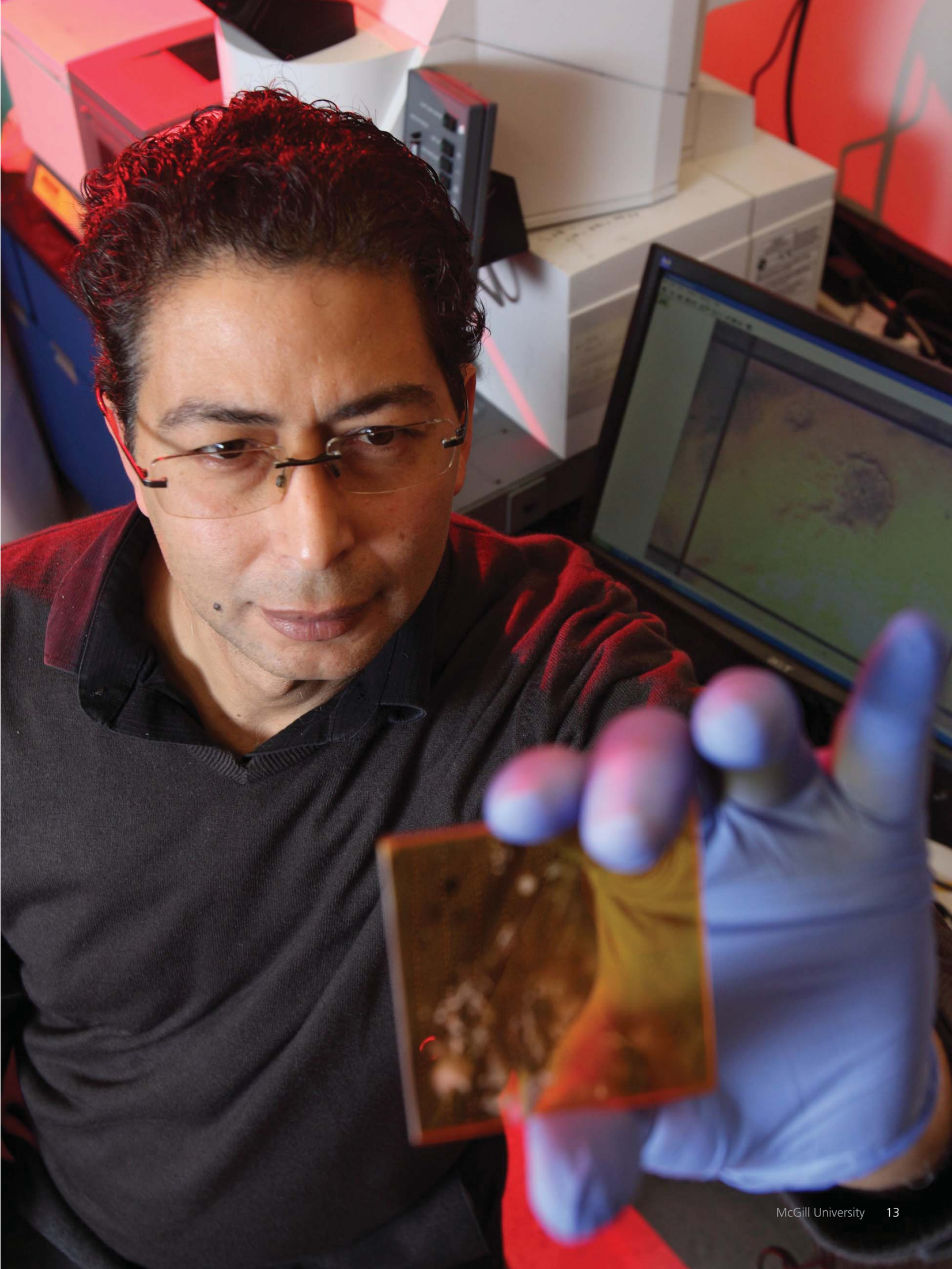
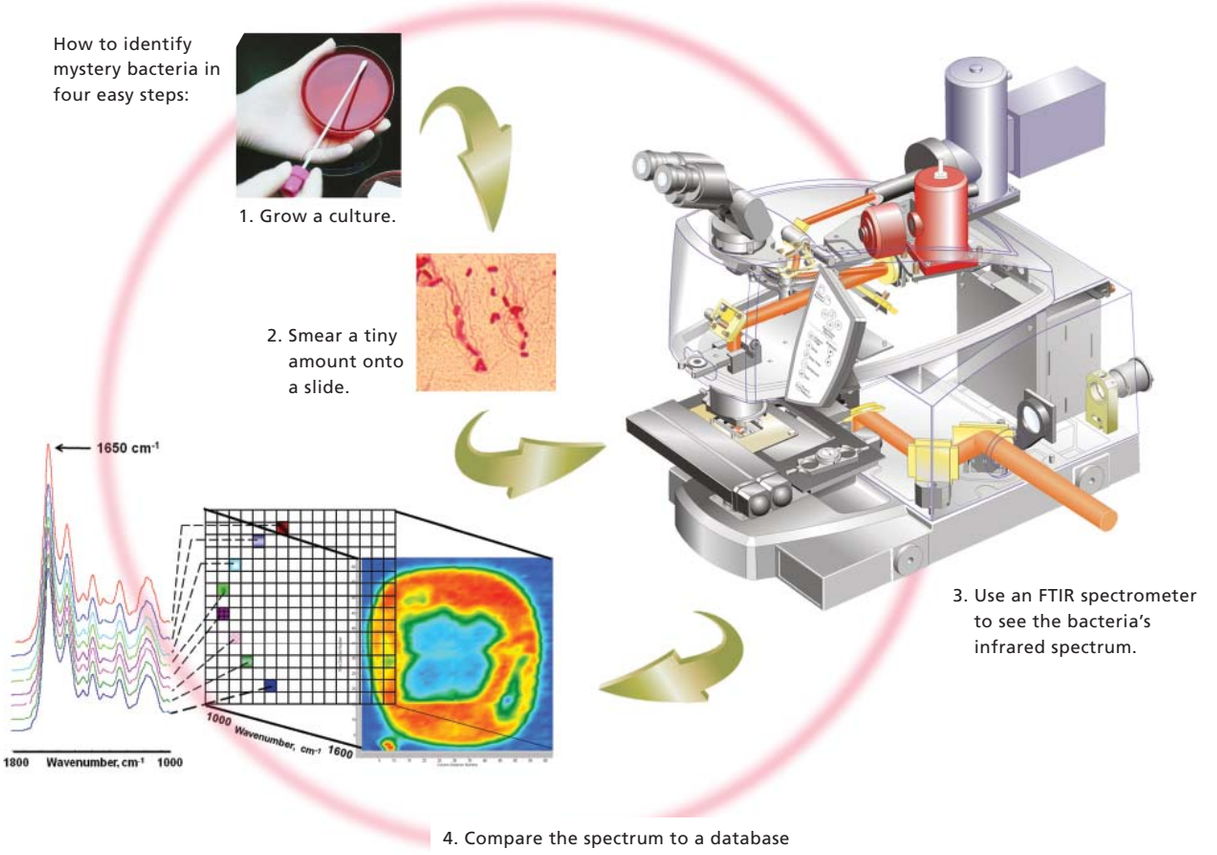
Professor Ashraf Ismail prepares a slide of unknown bacterial culture. He'll identify the sample by comparing its infrared spectrum to a database of spectra from hundreds of bacteria.





then extracted the organism, cultured it, and identified it using both the two-minute FTIR analysis and the standard 24-hour method. The FTIR identification hit the mark 100 per cent of the time.

"We're at the level where the confidence one can have in the results of the technique is comparable to that for the other techniques," says an obviously proud Ismail. "The next step will be to repeat those tests using unknown pathogens."

The time advantage provided by the FTIR technology has major implications. There's a great advantage to knowing as early as possible which bacteria has compromised the food supply. A full, speedy recall of contaminated products mitigates the potential adverse health effects of food-borne pathogens — the proverbial ounce of prevention.

Ismail and his department have a long history of industry collaborations. Some of these are research collaborations, such as when van de Voort and Ismail helped Frito-Lay determine "best before" dates for their potato chips based on the specific oil oxidation profile for each batch of frying oil. (There isn't a one-size-fits-all expiry date; the profile dictates how long each batch will retain its fresh taste after leaving the factory). Now, with FTIR bacteria identification technology having proved itself to Health Canada, Ismail says it's time for the private sector to pick up the ball and run with it. The McGill IR Group has been working with McGill's Office of Sponsored Research to get this technology out of the lab and into the world. The ultimate extension would be scaling down the FTIR technology into a hand-held device that could be used by regulatory agencies doing supermarket spot checks, or safety managers inspecting their production lines. Ismail would love to see it. But he's not the man to do it.

"I'm a biochemistry researcher," he says. "The systems I love studying happen to be proteins, micro-organisms and food products, but we're a research laboratory — not a product development centre. We've shown feasibility. We developed the software and the system for analysis. We trained the students who know how to use this technology— students who, in many cases, helped create the technology in the first place. Now it's time for industry to translate all this into a product for whatever market segments. I've been working on this for 20 years. Maybe it's time for a change."

He breaks into a little grin. "But it's so fun I almost can't believe I get paid to do it."

■ *The McGill IR Group is funded through a Natural Sciences and Engineering Research Council Collaborative Research and Development grant, which sees the federal government match industry funding two-to-one. The project's industry partner is Agilent Technologies (Canada) Inc. The McGill IR Group has also collaborated with Health Canada and the U.S. Food and Drug Administration on the development of the FTIR bacteria identification technology.*