

**INSIDE: GUELPH FOOD INVENTORY 2000**

# Research

UNIVERSITY  
of GUELPH

Volume XV Number 1 Spring 2000

**Farmers' markets:  
Giving the economy  
a \$1.5-billion boost.  
See page 22.**

Students  
Mike West and  
Crystal Norris

**BUILDING THE FOUNDATION FOR  
GOOD FOOD**

# Research

Volume XV, Number 1  
*Research*, University of Guelph, Spring 2000

A publication to promote dialogue, understanding and communication about research accomplishments and activity at the University of Guelph.

## FOCUS: THE FOUNDATION OF GOOD FOOD

SPECIAL SECTION:  
 Guelph Food Inventory 2000

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## Guelph's Green Revolution is a green evolution



Editors are great at making bigger-than-life pronouncements to support their editorial positions. For example, as we were putting the finishing touches on this, our Good Food issue, I was all set to write about Guelph's "Green Revolution." Canadians are developing an eye-opening passion for the food they eat, the way farmers grow it and the research that goes into it. There's no question we're entering a new era for food; that's why we chose it as this issue's theme.

But when, I wondered, did this revolution actually *begin*? We know the broader Green Revolution — the one that fostered massive technological changes in developing countries' agriculture — is now some 40 years old. So what's the chronology of Guelph's Green Revolution?

A quick check of the Guelph Food Inventory, which you'll find in the latter part of this issue, cleared up that question — *Guelph's Green Revolution actually started 126 years ago*, following the opening of Ontario School of Agriculture and Experimental Farm on May 1, 1874, through to the establishment of the Macdonald Institute in 1903 and the Ontario Veterinary College here in 1922.

Food research spanned many disciplines even back then and continues to do so. Researchers across campus embrace consumer needs and provide a strong infrastructure for understanding societal interests in food. Still others develop and nurture the basic science that leads to applied research. Government and industry partners contribute financially to fund research activity.

It's an all-encompassing approach, one that's worked for decades and led to a collaborative, community-like research environment at Guelph. In March, University of Guelph president Mordechai Rozanski summed it up as he accepted a \$12.5-million cheque for research infrastructure from the Ontario Innovation Trust (see story on page 4): "Our success reflects a strategic approach to multidisciplinary collaboration among the colleges that focuses on areas where we know we can be distinctive and successful."

The global Green Revolution sparked technological advances and expanded food supply and self-sufficiency to an extent, but it also created some environmental and social problems. Guelph researchers are learning from those lessons and being mindful of the risk associated with research and development, too. The story of their own Green Revolution — their green *evolution* — follows.

Owen Roberts  
 Editor

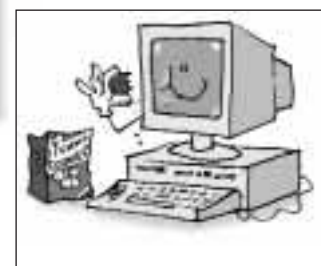
## Quality advances through technology ... 6

New analytical techniques are enhancing food quality. Guelph's strengths cover everything from "fuzzy" mathematical techniques for achieving cookie perfection, to developing new processing methods using mustard, to mimicking mother's milk in infant formula.



## Consumer issues and concerns ... 16

Ultimately, it's consumers who determine what foods are destined for the marketplace. Researchers are investigating consumers' acceptance of and opinions about food biotechnology, farmers' markets, convenience foods, "green" products and even milk ads.



## Improving health and nutrition ... 24

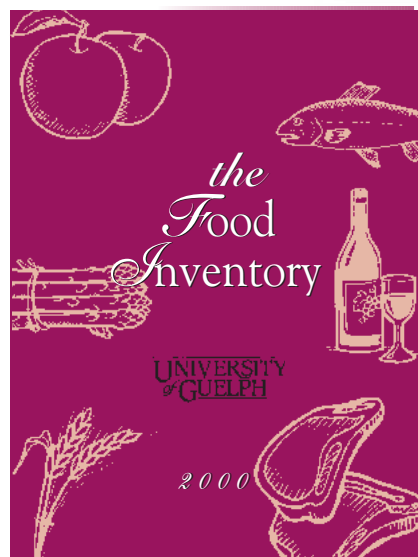
Food is about maintaining and improving health. Guelph researchers are looking at ways food makes life better, by lowering blood cholesterol levels, boosting the immune system or delivering oral vaccines. Food is also being improved to have a longer shelf life.

## Safe food: The modern mantra ... 40

Everyone in the food production and processing chain is consumed with safe food. Researchers are helping achieve higher standards of safety by developing new monitoring tests and safety programs, and by studying the risks of new technology.

## The Guelph Food Inventory 2000 ... 53

For the past century, Guelph researchers have been quietly developing and enhancing a unique record of foods. Some of their achievements are documented in this food inventory, a tribute to those who have dedicated their lives to Canadian food.



### FRESH FOOD, FRIENDLY FACES...

The bustling Guelph Farmers' Market was a fitting venue for our cover photo, based on Ontarians' attraction to farmers' markets, which pump an estimated \$1.5 billion into the province's economy. Besides visiting the Guelph market, agricultural communication students Mike West and Crystal Norris contributed a story (about flax and immunity) to this edition of *Research*, on page 50.

Cover photo by Martin Schwalbe, with assistance from Adventure Foods (Simcoe) and Larry Lorimer.



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MARTIN SCHWALBE

**David Bogart** (left), executive director of the Ontario Innovation Trust, joins Guelph-Wellington MPP **Brenda Elliott** in delivering a \$12.5-million cheque to University of Guelph president **Mordechai Rozanski** and vice-president (research) **Larry Milligan**.

# The foundation of good food

*Partnerships bring together unparalleled resources and expertise*

BY CHRISTINA CLARK AND CORIE LOK

**F**ive years ago, when food scientist Prof. Rickey Yada considered collaborators for his research in structural proteins, he immediately thought of other food scientists, until he met physicist Prof. John Dutcher.

Dutcher, then a new faculty member, had done appreciable research in the kind of plastic films often used in food packaging; Yada recognized that food scientists could better understand how to improve packaging with more fundamental knowledge about the physics of plastics. The duo teamed up, and ultimately their collaboration led to the new \$2.1-million Centre for Food and Soft Materials Science, led by Dutcher. It's a formalized collaboration of 26 researchers in six U of G departments including Chemistry and Biochemistry, Microbiology, and Molecular Biology and Genetics.

"To make major advancements in any given field, it's necessary to go outside the traditional modes of thinking," says Dutcher. "When using new techniques to solve old problems, you're poised to accomplish something new and innovative."

The centre is one of nine new major research projects on campus, covering a variety of research areas and involving more than 200 researchers. The total estimated value of the projects is \$60 million, including support from the Canada Foundation for Innovation (CFI), the

**The research community helps ensure consumers' needs are met.**

Ontario Innovation Trust (OIT) and the Ontario Research and Development Challenge Fund, other sources of federal and provincial funding and industry partners.

"Our success reflects a strategic approach involving multidisciplinary collaboration among the colleges," says University of Guelph president Mordechai Rozanski.

The University of Guelph's commitment to the agri-food industry, combined with society's increasing interest in the sector, has been a crucial factor driving the new research infrastructure. The Department of Food Science and the newly renovated Food Science building, a \$15-million partnership among the University, government and industry, anchors the ever-expanding one-stop food research concept that's evolved.

Yada says Guelph's strengths are drawn together by its partnerships, offering resources and expertise in areas such as food safety, processing, chemistry, packaging and engineering. He says researchers and other experts in these areas are helping ensure that consumers' and the food industry's changing needs and demands can be met by the ever-expanding food industry.

"In my conversations both within the food industry and with other food science departments across Canada, people are starting to identify Guelph as *the* centre for food," says Yada. "They see all the activity going on here, and in that light, we've come up with this idea of Guelph being a one-stop shop."

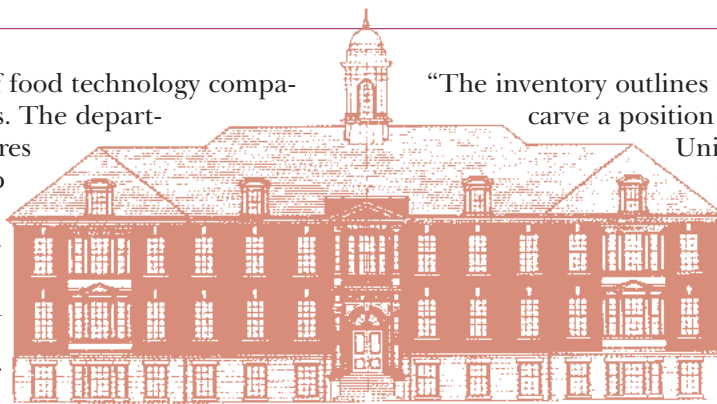
Guelph's Food Science Department is the academic

centre of a booming cluster of food technology companies and government agencies. The department is the engine that prepares quality students for leadership roles in the agri-food industry. Graduates enter the workforce with a broad scope, thanks to their exposure to an increasing number of leading players in the agri-food sector on or near campus.

Yada says graduates' academic experiences are enhanced by Guelph's diversity. Those who look to the University and its food research partners for expertise have access to a wide range of basic and applied science.

For example, some of the department's areas of strength and expertise include soft materials, food safety, packaging and advanced processing technologies. Researchers work together to add value to food products through the development of new technologies and improvements on existing processes. Collaborations with other colleges and faculties at the University result in studies in nutritional science, engineering, applied human nutrition, plant agriculture, family and consumer studies and veterinary science contributing to the overall offering of food research expertise.

Yada says it's this interconnectedness and co-operation in food research that makes Guelph such a hot-spot for quality food research. Part of that reputation stems from Guelph's long history in agri-food research and development. A brief history of Guelph's contribution to food research over the last century is the focus of the Food Inventory, the special section in this issue of *Research*.



"The inventory outlines the strengths that have helped carve a position of excellence for the University of Guelph in agri-food research," he says, "and will surely be followed by even more exciting food research in this new century."

Indeed, the new century is off to a good start at Guelph. In March, University of Guelph officials welcomed OIT executive director David Bogart and Guelph - Wellington MPP Brenda Elliott, who brought with them OIT's \$12.5-million commitment to Guelph's new research initiatives, including several in food research. This support — which matches earlier funding from the CFI, as well as industry partnerships and in-kind support from the University — marks a new era in research infrastructure support at Guelph.

"The level of federal and provincial funding collectively represents an unprecedented scale of investment in research infrastructure at Canadian universities," says plant agriculture Prof. Mike Dixon. In conjunction with the European Space Agency and the U.S. National Aeronautics and Space Administration, Dixon and his research team received \$3.15 million through OIT and CFI to develop terrestrial space application for plants...including learning how to grow food in outer space. 🍎



**For over a century, food has been an integral part of the University of Guelph's teaching and research. Since 1891, the Dairy Short Course has been teaching students (the 1959 class is pictured here) to make cheese. Now known as Cheesemaking Technology, the course is still taught annually in the Department of Food Science.**

## Combining heritage and high-tech

BY MARGARET BOYD

The Sept. 17, 1999, grand reopening of the Food Science building, following an award-winning multi-million-dollar renovation, symbolized a coming together of Guelph's heritage and the new era of food research it's entering.

The Department of Food Science was founded in 1888 as the Department of Dairying, and the building's inscription retains its dairy heritage. It was especially fitting that the building reopened in 1999, the 125th anniversary of the Ontario Agricultural College (OAC).

"Throughout our history, our successes have come as the result of collaboration among researchers, sharing their scientific data to build better food products for consumers," says OAC dean Rob McLaughlin.

Renovations to the building, originally constructed in 1922, were made possible by support from the provincial

and federal governments, the food industry, University of Guelph alumni and friends of the department. A large portion of the final phase of the renovation was funded through the federal and provincial government's Canada/Ontario Infrastructure Works program.

The renovations took eight years to complete and outfitted the building with state-of-the-art laboratories and classroom space. During this period, faculty, staff and students were located in at least five different locations on campus. And to everyone's credit, the department maintained its reputation for high-quality teaching and research.

# Spoilage takes a 'nose' dive

*The fragrance industry's electronic nose finds a food freshness application*

BY CAROL PILLEY

Perfume manufacturers and food processors may have a common ally in their quest for quality — the FOX3000 Electronic Nose.

The device mimics the human nose by detecting and identifying odour patterns. It's been used for the past five years by the fragrance industry to verify uniformity in batches of perfume. Now it's being tested for its ability to rapidly detect micro-organisms that cause premature spoilage in vegetables.

Its target is volatile compounds — compounds that are readily given off as gas or vapour, which most people have experienced when food products spoil in the refrigerator. As vegetables age, they give off volatile compounds at trace levels, which can be used to measure spoilage. The spoilage process can quickly cause problems in both appearance and quality.

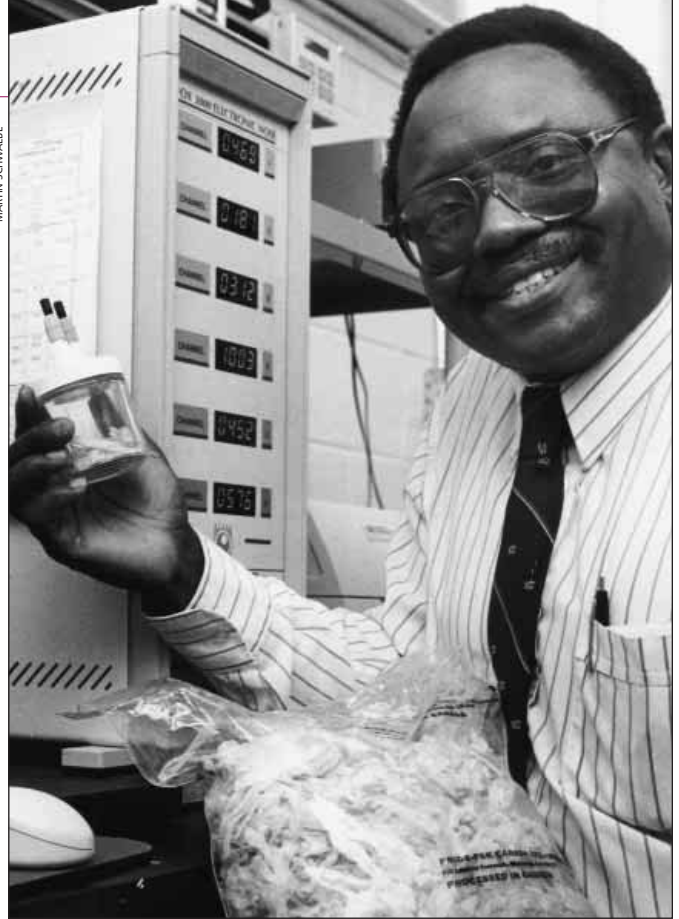
Joseph Odumeru of the University of Guelph's Laboratory Services and Robin McKellar of Agriculture and Agri-Food Canada (AAFC) are trying the electronic nose on lettuce, the biggest-selling pre-packaged vegetable.

"The potential of the electronic nose to detect early signs of spoilage means processors can select good-quality raw products," says Odumeru. "This, in turn, could mean a longer shelf life for the final product."

Ready-to-use vegetables such as carrots and broccoli — freshly cut and pre-packaged vegetables to be eaten with little or no preparation — are growing in popularity with convenience-conscious consumers and institutions such as hospitals and prisons. Sales in Canada are increasing, says Odumeru, and extending the shelf life of these vegetables could help boost sales even more.

But the freshness window is small. The current shelf

***"The potential of the electronic nose to detect early signs of spoilage means processors can select good-quality raw products."***



Joseph Odumeru uses the FOX3000 Electronic Nose to detect spoilage in vegetables.

life of most ready-to-use vegetables, including lettuce, is 10 days. It's shorter for some — sliced green peppers can spoil in six days, and celery may not last much longer than nine. And although vegetable spoilage is both inevitable and natural, it can be hastened by processing techniques such as cutting.

This releases a vegetable's nutrients, which then become available to bacteria, increasing the chance of microbial growth. Physiological changes that occur during raw vegetable processing can also lead to spoilage. For example, oxidation causes the browning often seen in fresh-cut vegetables.

"If the product has a shelf life of only a few days, rapid assessment of both the raw and processed products is very important," says Odumeru. "If the raw product is spoiled or is beginning to spoil, the processed vegetable will not last long on the shelves."

The electronic nose has already been used successfully in AAFC laboratories in Guelph to differentiate agri-food products such as juice and wine varieties. Odumeru and McKellar expect results on lettuce by the end of this year.

This research is sponsored by AAFC and the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Special Research Fund.



# Cookie quality control

*Computer program selects the best flour for first-rate biscuits*

BY ARIANA MURATA

When consumers bite into a store-bought cookie, they expect the sweet taste of familiarity and consistent quality.

That's why a specialized computer software program based on "fuzzy" mathematical techniques — statistical tools that allow for shades of grey, rather than all-or-none variables — is being designed to help biscuit makers bake batch after batch of uniform high-standard cookies.

U of G engineering professors Valerie Davidson, Ralph Brown and Otman Basir, along with research engineer Karen Conrad, are using computer software to analyse the quality of biscuit-making flour. The program considers properties such as protein, ash and moisture content and water-absorption ability.

## FUZZY MATH FOR CONSISTENCY

Using "fuzzy" mathematical techniques as well as statistical analysis, the researchers are comparing these properties with previously gathered data. Fuzzy techniques allow the program user to input linguistic (verbal) information, including personal observations about the flour.

"The software will help bakery personnel identify 'unusual' characteristics before the flour is used and, if possible, recommend changes in the manufacturing process to compensate," says Davidson. "This will improve efficiency in the bakery."

The research is being conducted in collaboration with Nabisco Ltd.-Peak Freans Bakery in East York, Ont. Focusing on wire-cut biscuits such as oatmeal cookies, the team gathered data from the bakery's flour mills and assessed comments from professional bakers about the texture and "feel" of a good-quality

dough.

Because there are so many variables involved in flour production, the computer program also incorporates multi-dimensions. For example, wheat growth is influenced by both climate and location, so no two wheat crops are ever the same. The Guelph program translates these multi-variables into multi-dimensions, allowing for graphical analysis.

The researchers then determine which factors are the most important in influencing consistent flour quality.

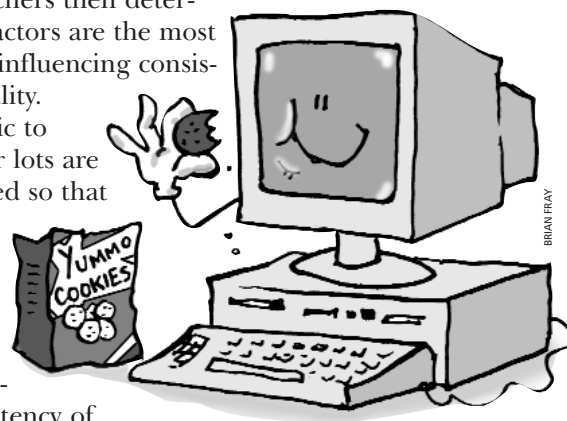
Factors specific to different flour lots are also considered so that more general information — such as seasonal variations — is used in assessing the consistency of flour quality.

## MANY POSSIBLE USES

Davidson says the computer program has significant cross-disciplinary potential. It could be extended to other bakery products, food-manufacturing processes such as flour milling and coffee roasting, and even to the agricultural sector for uses such as decision-support for spatially variable pesticide application.

"Although some components are specific to biscuit baking, the methods are general and could be used in many applications," she says.

Engineering undergraduates James Tung and Julie O'Mahony also contributed to this project, which was sponsored by Materials and Manufacturing Ontario and received in-kind contributions from Nabisco Ltd.-Peak Freans Bakery.



# The protein machine

Can cheese-making enzymes enhance other areas of food processing?

BY JUHIE BHATIA

Enzymes traditionally used for manufacturing cheese are being targeted at a University of Guelph research laboratory to see how they can enhance food processing.

MARTIN SCHWALBE



Rickey Yada believes the cog-like structure of food-related proteins could enhance food processing.

Unravelling the relationship between the structure and function of a class of food-related enzymes called aspartic proteinases (proteins that speed up biological reactions) could lead to more efficient aids for a wide range of food processes, says Prof. Rickey Yada, chair of the Department of Food Science.

This group of enzymes, which includes rennin and pepsin, is used in cheese production to initiate milk clotting. Identifying the structural components of these enzymes is the goal of research by Yada, research associate Takuji Tanaka and graduate students Ken Payie, Mark Yoshimasu, Monika Okoniewska and Brian Bryska.

The researchers are using the enzyme pepsin as a model for other enzymes. What they learn about

pepsin may eventually be transferred to other food-industry enzymes used in food processes such as meat tenderization and juice clarification.

“Certain enzymes in the aspartic proteinases have unique functional properties,” says Yada, “and we need to know what underlies this diversity. Once we understand how they work, it’s easier to predict how they will react under certain conditions and redesign them for specific uses through genetic engineering.”

## STRUCTURE AFFECTS FUNCTION

The biological activity of an enzyme depends on its structure. The research team is applying various molecular biology techniques to analyse the components of pepsin. This involves specific changes to different regions of the pepsin molecule. By studying enzymes at a molecular level, researchers can pinpoint specific parts of the pepsin structure that affect its function.

“Proteins are like a machine,” says Yada. “If you alter one cog, you may affect a cog in another part. An understanding of this machine will increase its efficiency and remove much of the guesswork.”

Experiments so far have shown that changing certain parts of the pepsin molecule reduces its ability to function. These changes include altering part of the molecule that stabilizes pepsin and keeps it inactive until it’s ready to become activated, and changing a “lid” that covers the active part of the enzyme.

These findings are leading to insights on a fundamental molecular level, but more research is needed to apply them on a practical level.

The team is also analysing aspartic proteinases from plant sources and comparing them with those from animal sources to see if variation exists between the structure and function of these various enzymes.

This research is sponsored by the Natural Sciences and Engineering Research Council (NSERC) and the Ontario Ministry of Agriculture, Food and Rural Affairs. Undergraduate student Joel Wedge is also contributing to the project through an NSERC undergraduate fellowship.

**“Proteins are like a machine. If you alter one cog, you may affect a cog in another part.”**

# A chick named VIC: bacteria's nemesis

BY MIRJANA VRBASKI

The answer to bacterial growth problems in poultry could rest with a chick named VIC.

VIC is an acronym for Virtual Image Chicken, a model that simulates the colonization properties of salmonella bacteria and their modes of survival. The model is being designed by Agriculture and Agri-Food Canada (AAFC) food scientist Robin McKellar in association with University of Guelph food science graduate student Grant Campbell.

Getting to the bottom of salmonella's colonization and survival properties is vital because it is one of the leading food-borne disease-causing organisms in Canada.

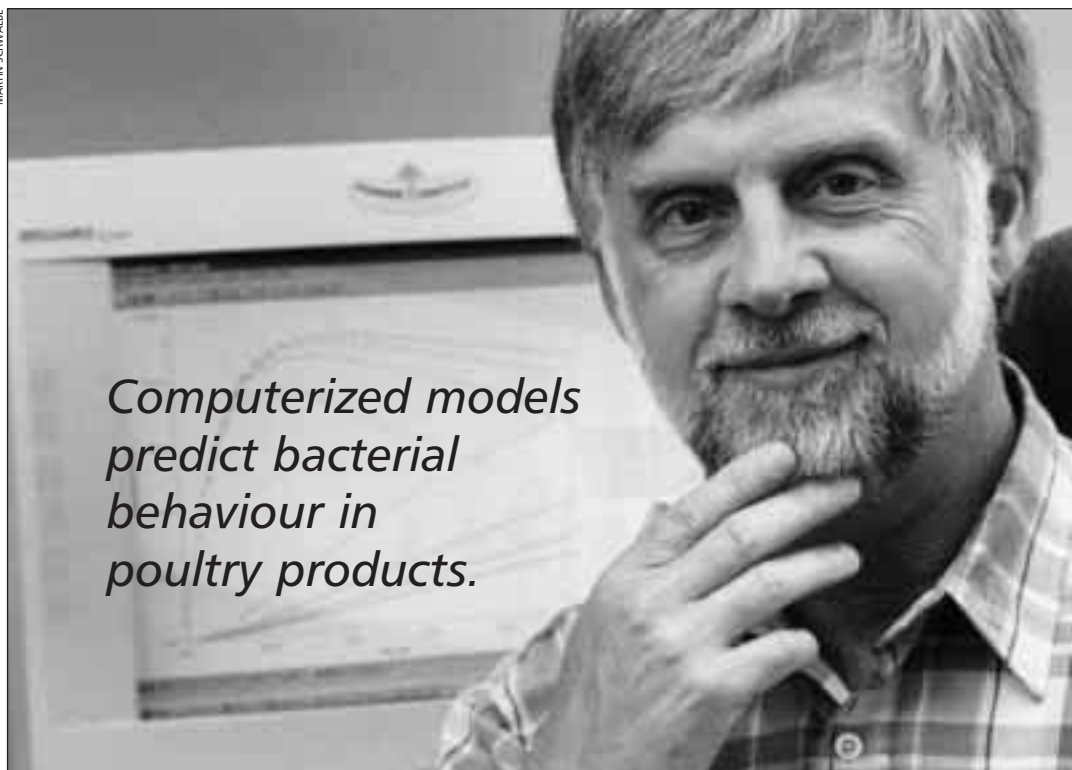
The technology McKellar is using simulates models of bacterial growth to provide a framework for understanding food's "microbial ecology" — the relation and interaction between micro-organisms and their environment. McKellar hopes this will lead to new and improved methods of eliminating bacteria and enhanced food quality and safety.

"Modelling bacterial growth will allow us to predict bacterial behaviour," he says. "This will improve bacterial detection and elimination methods."

Campbell is investigating how bacteria attach to different surfaces such as animal intestinal walls, the reasons for their release from some surfaces, and the ability of bacteria to compete for attachment.

To study the potential of bacteria to eliminate one another by competing for attachment sites, McKellar is designing the specialized VIC. It simulates the reaction of a certain bacterium naturally found in chicken, called "resident bacterium," to a bacterium artificially introduced into chicken, called "invader

MARTIN SCHWABE



*Computerized models predict bacterial behaviour in poultry products.*

Robin McKellar is using the VIC computerized model of bacterial behaviour to put an end to salmonella in poultry.

bacterium." In fact, the VIC model mimics an already existing model designed by U.S. scientists and used to study invader and resident *Escherichia coli* in human intestines.

The original model simulated the ability of resident and invader strains of *E. coli* to out-compete one another. The VIC model will be used to predict whether some bacterial strains can be used as invader bacteria to wipe out salmonella.

To be effective, invaders need to grow, multiply and overtake the resident bacteria. They must be able to attach to a site and colonize the organism. But because the number of sites is limited, resident bacteria have an advantage over

invaders; by colonizing the organism first, they occupy most of the available sites.

Introducing invader bacteria into chicken as a way of eliminating salmonella will work only if the invaders are stronger and able to attach better and faster than the residents, says McKellar.

"Understanding bacterial growth will help us design systems to prevent their growth," he says. "This means better food quality with secured reliability and reputation for the food industry."

This research is funded by AAFC. Also involved in the study are AAFC food scientists Jim Chambers and Roger Wheatcroft, as well as Bill Ross of Health Canada in Ottawa and Jozsef Baranyi of the Food Research Institute in Reading, England. 🍷

***"Modelling bacterial growth will allow us to predict bacterial behaviour."***

# No more hit-and-miss

*Meat probe improves quality assessment even further*

BY MIRJANA VRBASKI

The odds of choosing tasty meats at the grocery store could soon be improved thanks to a connective tissue (CT) probe that will be able to predict meat quality for tenderness and flavour.

Previously, the probe determined only the toughness level of meat by measuring connective tissue content — the protein matrix of meat that gives it structure, holds moisture and influences toughness. But now, it's getting a new use.

“There are many attributes that affect the tenderness of meat, so concentrating on connective tissue isn't enough,” says animal science researcher Bethany Uttaro, who is refining the device with its inventor, Prof. Howard Swatland, Animal and Poultry Science.

“Once the CT probe can determine other meat properties, its role in the meat industry will be crucial,” she says.

A potential use for the CT probe is to relate tenderness, juiciness, flavour and meat colour characteristics. Stress before slaughter causes meat to become light and tough when cooked; exhaustion causes it to be tough and dark. Uttaro's goal is to measure carcass colouring with the probe to estimate meat toughness and flavour. This could also contribute to lessening variation within grading categories.

The probe works by shining a stream of ultraviolet light on a meat sample to make the connective tissue fluoresce. Reading the amount of fluorescence allows researchers to analyse the number and structure of tissues,

and predict its toughness level, grade and market destination.

The problem, however, is that even though this method grades meat into different categories, there's still a

lot of variation within each category. That makes buying beef in a grocery store mostly a hit-and-miss pursuit, where consumers can never be sure of consistently getting the same quality of meat, says Uttaro.

By covering more aspects of meat grading, the CT probe can help solve this problem. For example, the probe is capable of measuring sarcomere (muscle fibre) length in meat. This arrangement of filaments in a carcass also affects meat tenderness — the shorter the filament, the tougher the meat.

Other areas of Uttaro's research include determining which parts of the carcass are best for sampling different aspects of meat grading, and identifying the most effective positioning of the probe for taking measurements.

“Ultimately, we want to expand the uses of the probe to provide a consistency in product quality and maximize the meat industry's success,” says Uttaro. “If we want Canada to compete in the world market, we have to make sure our products are reliable.”

This research is sponsored by the Ontario Cattlemen's Association and Ontario Pork.



Bethany Uttaro uses the CT probe to ensure consistent beef quality.

**“Once the CT probe can determine other meat properties, its role in the meat industry will be crucial.”**

MARTIN SCHWALBE



BY ARIANA MURATA

**Steve Cui** has discovered yellow mustard gum, a new product that could prove useful in the food-processing industry.

**M**ustard's popularity may soon transcend that of the humble hot dog. A recently discovered link between yellow mustard seed mucilage and reduced blood cholesterol and glucose levels has launched a search for new products based on the tangy seed.

One of the most promising uses is yellow mustard gum. Agriculture and Agri-Food Canada (AAFC) research scientist Steve Cui, who works with the food research program in Guelph and is also a special graduate faculty member in the University of Guelph's Department of Food Science, combined yellow mustard mucilage (YMM) — a water-soluble dietary-fibre component that makes up five per cent of yellow mustard seed — with locust bean gum (LBG), a popular stabilizing agent in the food industry.

The result: yellow mustard gum. Cui says it has viscous and gelling properties 20 to 30 times that of the original starting materials. That makes it useful as a stabilizer and texture-improving agent in processed foods.

"This is an exciting discovery," says Cui. "The interaction of yellow mustard mucilage and locust bean gum allows us to produce a product that is both extremely effective and cost-efficient."

#### **ECONOMICAL AND HEALTHY**

His experiments with varying ratios of YMM and LBG in yellow mustard gum found that the optimum product contained nine parts YMM to one part LBG. This is important because LBG is expensive and produced in small quantities. On the flip side, yellow mustard is one of the major condiments produced in Canada, and mustard seed is available at low cost.

Yellow mustard gum can be used as a stabilizer and texture-improving agent in foods containing both oil and

# Magic mustard

*New yellow mustard gum might be processing fix-all*

water, such as salad dressings and mayonnaise. Oil and water differ in density (weight), polarity (charge) and viscosity (rate of flow), making it difficult to combine the two in a food product without separating. Yellow mustard gum greatly increases the overall viscosity of the total oil-water mix,

resulting in a uniform and stable product.

The yellow mustard gum can also be used in processed meats, which tend to "sweat," making them unappealing to consumers. Because the gum has excellent gelling and water-binding qualities, it can absorb excess moisture when added to processed meats.

#### **A WINNING COMBINATION**

LBG is already used widely on its own as a stabilizer in the food industry. For example, it's added to ice cream to prevent the formation of ice crystals. When combined with YMM, however, it's not only more effective and less expensive, but it also gains the added health benefits of the yellow mustard seed.

Cui plans to conduct further experiments with potential applications of yellow mustard gum. Possible uses include skin lotions and cosmetics.

This research was sponsored by the Ontario Research Enhancement Program (OREP), a \$4-million federally funded research initiative administered by the AAFC's research branch with input from the agriculture and agri-food sector, universities and the province. OREP supports 25 research projects in universities and research centres across the province, with the University of Guelph as a major participant. Projects focus on two key areas identified by the agriculture and agri-food community — consumer demand for higher-quality safe products and ensuring that crop-production management systems are environmentally sustainable.



### Food scientists find more effective method of food dehydration

BY LAURA LEVAC AND HENDRIK KAHAR

Improved nutritional quality in dehydrated fruits and vegetables is the goal of a dehydration and preservation technique called superior osmotic treatment. The technique, being developed by University of Guelph food scientists John Shi and Marc Le Maguer, retains nutrition and taste and uses less energy than conventional dehydration methods. They're working to perfect the technology as an alternative to hot-air drying and canning.

The technique's most significant feature is its ability to protect the nutritional content of food, which can be lost through oxidation and degradation that occurs during processing. Although osmotic dehydration isn't new, the Guelph team is the first to apply it to food processing.

"Superior osmotic treatment will bring better-tasting — and more nutritious — dried foods to supermarket shelves," says Shi. "We're

working to ensure maximum nutrition retention for dehydrated foods."

This method of dehydration draws water out of food by osmosis. Because the water comes out of the food at room temperature, superior osmotic treatment doesn't use a lot of energy, as hot-air drying does. It

also extends shelf life without affecting taste, texture and colour, the other drawbacks of hot-air drying. And while water's taken out of foods, valuable nutrients stay in.

"Other drying methods can lead to vitamin and nutrient losses," says Shi. "Because osmotic treatment is operated at room temperature, almost all nutrients, including those



John Shi (left) and Marc Le Maguer serve tomatoes preserved by superior osmotic treatment.

MARTIN SCHWABE

sensitive to heat, are retained, and the concentration of these nutrients is increased."

For example, tomato products dehydrated by osmosis have more than five to eight times the nutrient content of fresh tomatoes. One of these valuable nutrients is lycopene, the pigment responsible for the red colour of ripe tomatoes. Lycopene is an antioxidant thought to neutralize harmful substances that can cause cancer and cardiovascular disease. Osmotic treatment allows for higher lycopene retention in tomatoes than conventional dehydration does.

This technology is now being used in the food industry in Europe, Asia, South America and the United States. In Canada, demand for this new tech-

nology is rising among producers of frozen vegetables.

Shi and Le Maguer have published several research papers and have presented their findings to both the Canadian Institute of Food Science and Technology and the Institute of Food Technology in the United States. They have also been invited to host a number of workshops in Europe and have registered a patent for their technology in Canada.

To promote dialogue and information among other food researchers, Shi has set up a Web page at <http://www.uoguelph.ca/~odmlm>. Each week, researchers from North America, South America and Asia exchange information on this site.

This research is sponsored by the Natural Sciences and Engineering Research Council, the Ontario Ministry of Agriculture, Food and Rural Affairs, and Agriculture and Agri-Food Canada.

## Osmosis — a nutritious alternative

**"Superior osmotic treatment will bring better-tasting — and more nutritious — dried foods to supermarket shelves."**

# Shocking news about juice

*It gets a boost from alternative pasteurization technique*

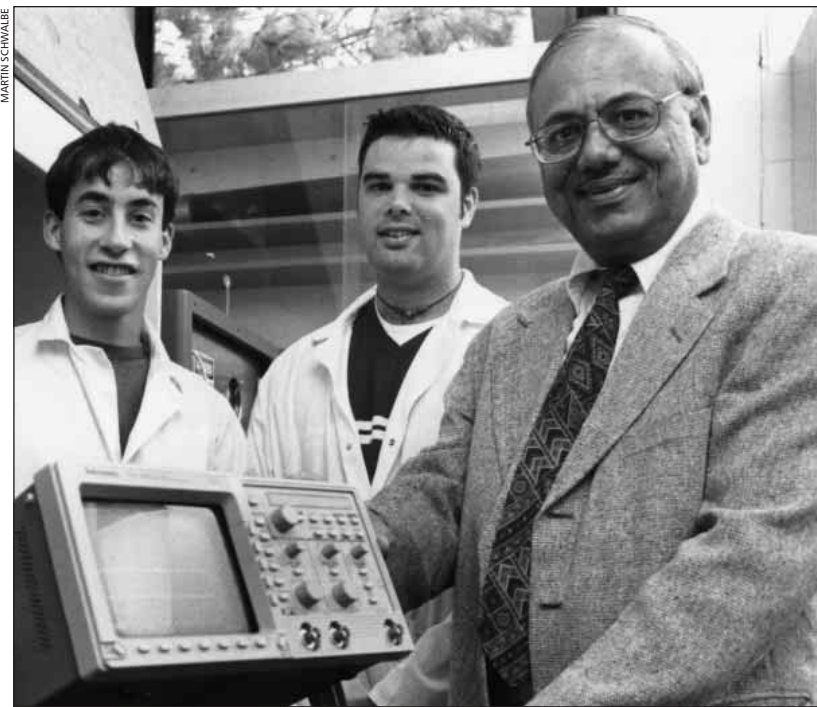
BY MARIANNE CLARK

When it comes to fruit and vegetable juices, heat is out and nutrients are in with a new non-thermal pasteurization technique. University of Guelph engineering professor Gauri Mittal is part of a research team that has discovered and patented a unique way to pasteurize liquids such as juices without heat. The innovative method involves applying uniquely shaped high-voltage electrical pulses — up to 30,000 volts — to foods for just a microsecond. The voltage is high enough to split the cell walls of micro-organisms (such as bacteria) in the fluids so they can't repair themselves and are destroyed.

"This method produces the same results as regular or thermal pasteurization, but goes about it in a completely different way," says Mittal.

This new technique reaps the same benefit as standard pasteurization — eliminating bacteria — and offers some unique advantages over thermal pasteurization. For example, by using high-voltage pulses to kill undesirable micro-organisms without increasing the temperature of the food, the nutrient value remains stable and flavour is maintained. In contrast, heat pasteurization reduces vitamin A content in apple juice and milk and vitamin C content in orange juice. As a result, producers must replace the lost vitamins to meet nutritional standards. What's more, flavour can be adversely affected during the thermal pasteurization process.

***This process eliminates the need to reintroduce lost vitamins.***



Gauri Mittal (right) and graduate students Keith Smith (left) and Matt Hodgins have developed a new pasteurization technique that does not require heat.

"High-voltage pasteurization is energy- and cost-efficient," says Mittal. "It could mean significant cost cutting for producers because they won't have the costly task of adding vitamins lost during thermal pasteurization."

The energy saving to be realized by this procedure is dramatic, he says. One litre of juice requires more than 200,000 joules (or 49,000 calories) to be pasteurized. With the new technique, that number is reduced to about 1,000 joules.

But how effective is the new procedure? Can liquid food be preserved without the use of heat to kill micro-organisms? According to Mittal's study, the answer is yes. Liquid foods that were subjected to the high-voltage technique proved to keep just as well as heat-pasteurized food after four weeks, with no detectable differences. All trials to date

have revealed the voltage-pasteurized food to be tasty and the method to be equally effective as thermal pasteurization.

Mittal is working in collaboration with Guelph food microbiologist Mansel Griffiths, James Cross of the University of Waterloo, former PhD student Shelly Ho and M.Sc. students Keith Smith and Matt Hodgins. The team expects the process will be ready for application in two years.

This research is sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs, and the Electrical Power Research Institute. 🍷

# Mimicking mother's milk

*New technique boosts infant formula with healthy fats*

BY JUHIE BHATIA

**I**nfant formula now has the potential to more closely resemble human milk in its composition and nutritional properties, say University of Guelph researchers.

Food science professors Alejandro Marangoni and Robert Lencki and research associate Wendy Willis worked

for three years to develop a bovine milk-fat fractionation process called Butterfrac. It separates fat into different fractions, yielding specialty fats that can be used in the manufacture of products like infant formula oil. Using bovine milk fat as a base for infant formula oils is more appropriate than using vegetable oils because bovine milk fat more closely resembles human milk fat.

"Human breast milk is the standard by which all infant formulas should be judged," says Marangoni. "Current formulas in North America fall short of this standard because they lack key components required for proper infant growth and development, or their levels are not optimal."

The researchers have formed a spinoff company called Fractec Research and Development, Inc., to promote the use of their fractionation technique. Fractec's infant formula oil contains many key nutritional components, including long-chain saturated fatty acids at position sn-2, which are more efficiently absorbed and used by infants for growth; cholesterol, which is required for nerve formation and is



Robert Lencki (left) and Alejandro Marangoni, shown here with their families, are developing an infant formula with healthier fats.

lacking in most infant formulas; arachidonic acid for proper growth; and docosahexaenoic acid for optimal visual and brain development.

"If women cannot breast-feed or choose not to, they should at least have the

option of an infant formula whose lipid composition mimics or is close to that of human breast milk," says Lencki.

The Butterfrac process used by Fractec is one of only two fat fractionation processes worldwide.

"A Butterfrac fractionation results in low-, medium- and high-melting fractions, each with totally distinct functional properties," says Lencki. "The trick is to find an application for each component and optimize the different products manufactured."

It's the low-melting fraction that is ideal as an infant formula oil, says Marangoni. Fractec is now looking to use the medium- and high-melting fractions as confectionery fats such as chocolate centres. Also under study is a strategy to remove a fraction containing the valuable flavour components prior to fractionation to produce a butter flavour concentrate. This could be used in foods like ice cream and cookies, Lencki says.

This research was originally funded by Fractec R&D and more recently by the Dairy Farmers of Ontario and the National Research Council.

***"Human breast milk is the standard by which all infant formulas should be judged."***

# Food safety is in the numbers

## *Robot counts bacteria to protect consumers*

BY KELLY CROWE

When it comes to food, safety in numbers means making sure the numbers of harmful bacteria are low. Throughout the food industry, it's being increasingly recognized how important it is to count pathogen cells, to pinpoint steps in processes that may be a source of bacterial contamination — and a risk to food safety and quality.

That's part of the rationale of HACCP (Hazard Analysis at Critical Control Points), a program being adopted widely by food producers and processors. To help meet this need, Agriculture and Agri-Food Canada (AAFC) researchers are working on the Mark IV robotic enumerator system. It's designed to detect and count specific bacteria in foods, based on their unique genetic features.

### A HIGHLY SPECIALIZED SYSTEM

"The Mark IV system should be of great use in situations that require rapid enumeration of bacteria," says Greg Poushinsky, director of AAFC's food research program in Guelph.

The Mark IV system is a specialized PCR (polymerase chain reaction) machine that looks somewhat like a multi-disc CD player. Samples take turns being cycled through different temperatures and reaction conditions. The target sequences of DNA (specific to the bacterial type being tested) multiply themselves and, after being stained with special dyes, become detectable to a camera. For example, when a food sample containing bacteria is spread thinly on a solid surface, the Mark IV system will allow the number of cells of specific bacteria such as salmonella in that food to be rapidly estimated.

Researchers hope the robot will routinely give test results within two hours.

### COMMERCIAL POTENTIAL OF MARK IV

As the Mark IV system was being developed, University of Guelph agricultural economics and business professor Francesco Braga and graduate student Vicky Grahovac considered its commercial possibilities.

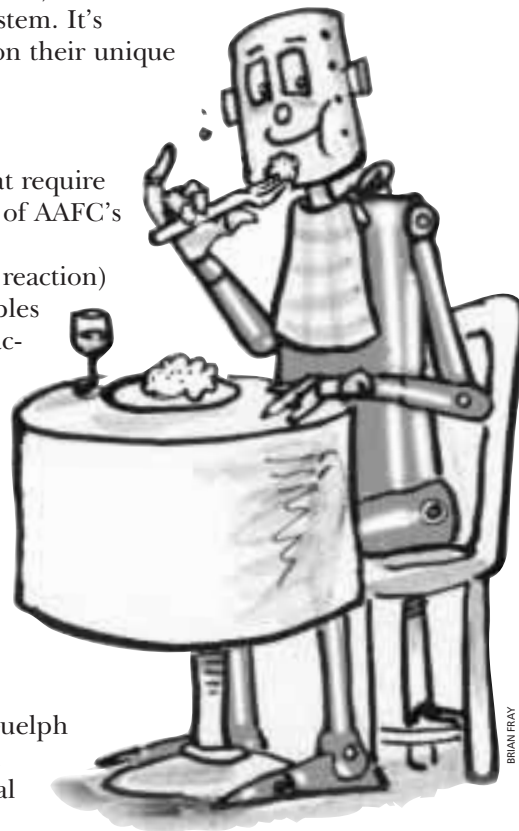
"Traditionally, scientists and business in this area have worked separately," says Braga. "Once a technology was developed by researchers and it was ready for commercialization, professionals would work to find its specific market and applications."

Braga and Grahovac suggest there are clearly different markets for the Mark IV system in the food industry. Some potential users would have the expertise to apply it themselves, with minimal services. Other companies might require and pay for the service to test the safety of their products.

Braga also suggests that the pathogens of specific interest would depend on the type of food. For example, salmonella may be important in the poultry industry, but *Escherichia coli* may be of more immediate concern in beef.

"In this project, we have tried to pave the way for the Mark IV system, so that this Canadian technology may succeed that much sooner in the world's marketplace," says Braga.

This research was sponsored by AAFC. 🍷



# Proceed, cautiously

*Dietitians are guardedly optimistic about the benefits of nutraceuticals*

BY IAN LANG

Consumers are eagerly embracing the arrival of nutraceuticals and functional foods — foods and ingredients with specific stated health benefits — but most dietitians are not.

A survey of 151 dietitians by University of Guelph researchers found the group wary of health claims for nutritionally enhanced products and concerned about legal regulations.

Survey leaders Prof. Judy Sheeshka of the Department of Family Relations and Applied Nutrition and Bonnie Lacroix of Laboratory Services say the attitudes of professional dietitians towards the flood of new nutritional products are clear.

“Dietitians feel that before we all start self-medicating, regulations need to be established and claims for long-term health benefits need to be supported by facts,” says Sheeshka. “But they also feel this is an exciting field of research with tremendous potential.”

Whether it’s “functional foods,” such as genetically altered vegetables that contain high levels of beneficial nutrients, or “nutraceuticals,” such as powders and pills with high concentrations of food-based extracts, consumers are exposed to a barrage of competing health and nutrition messages at every turn, says Sheeshka. Words such as “psyllium,” “allicin” and “lycopene” have made their way from obscure journal references to the tips of consumers’ tongues.

But what exactly are these products? How do they work? Are they safe? And should their manufacturers be regulated in terms of the health claims they can make? According to Sheeshka, these questions are at the heart of some serious concerns for many Canadian dietitians.

***“Regulations need to be established and claims for long-term health benefits must be supported by facts.”***



MARTIN SCHWALBE

Judy Sheeshka is wary of unregulated nutraceuticals and functional foods.

The telephone survey of a random sample of Canadian dietitians asked about the effectiveness of new products, the willingness of experts to recommend them and the perceived trustworthiness of the manufacturers and their supporting research.

Sheeshka says that although most dietitians are interested in the potential health benefits of these products, they’re wary about some of the supporting research. For example, although clinical evidence indicates that compounds in garlic can reduce blood pressure or that tomatoes can decrease the risk of prostate cancer, most dietitians would like to see results from multi-year human research studies before endorsing a particular supplement or genetic enhancement.

Dietitians are also concerned about the regulation of new health products, which Sheeshka describes as “a big grey area.” Nutraceuticals are neither foods nor drugs, so they tend to fall through the regulatory cracks, and the federal government is currently grappling with this issue. Dietitians want to ensure that consumers are not going to be misled by unproven health claims, she says, and they hope strong legislation will be in place soon.

This project was supported by the Canadian Foundation for Dietetic Research.

# Spicing up seniors' lives

*Nutrition education targets a mostly ignored audience*

BY MARIANNE CLARK

A new program designed to boost the nutritional status of senior citizens is spicing up life for residents of a Guelph seniors' centre — and it has implications right across the country.

The Evergreen Action Nutrition Program started last fall at the Evergreen Seniors' Centre, thanks to a collaborative effort led by Prof. Heather Keller of the University of Guelph's Department of Family Relations and Applied Nutrition and the seniors themselves.

"This program is designed to meet the nutritional needs of the elderly," says Keller. "The Evergreen members have let us know what their needs are, and now we're trying to meet them. I hope the Evergreen Action Nutrition Program will serve as a template for other service providers in this field so that seniors' needs don't go unaddressed."

Although the program is being developed at Guelph, Keller says seniors' nutrition problems are common across the country. With this in mind, the program aims to make seniors more aware of the importance of proper nutrition and to encourage them to take their health into their own hands. Resources, workshops and individual counselling are used to relay nutrition and health information to them from expert sources.

## REVEALING PROBLEM AREAS

A recent nutritional survey of Evergreen Seniors' Centre members revealed that more than half of the respondents were at nutritional risk. The questionnaire identified four problem areas:

- low fruit and vegetable consumption;
- cooking difficulties stemming from physical limitations and lack of motivation;
- a lack of awareness of the overall importance of proper nutrition and the consequences of poor nutrition; and
- specific disease conditions that limit food intake and choices.

The survey was conducted by Keller, who worked with the Evergreen seniors over a two-

year period to develop a validated questionnaire called Seniors in the Community: Risk Evaluation for Eating and Nutrition (SCREEN). The SCREEN questionnaire was completed by 247 Evergreen members.

The questionnaire led to collaboration with Guelph professors Joseph Tindale, Joan Norris and Marg Hedley, who, with Keller, designed a one-year pilot participatory nutrition education initiative with support from the Danone Institute. Program developers took a community approach to the project and encouraged seniors to voice their concerns and contribute ideas. Members of the Evergreen Centre were involved in planning groups that identified unmet needs and considered activities that could help meet them.

## MANY SERVICES OFFERED

The program uses a variety of approaches to address nutrition issues. A resource person is on-site 15 hours a week and is available to answer questions and distribute reading materials. Monthly workshops are held to address specific issues that coincide with the needs and interests of the seniors. Individual counselling is available to all members and is especially helpful to those with specific dietary demands due to disease. Finally, cooking demonstrations are offered to encourage members to cook nutritious meals.

"The response has been great," says Keller. "Some of the members already seem happier and more enthusiastic and energetic."

She plans to have the program thoroughly evaluated at the end of this year and hopes to obtain funding to continue the program for a few more years.

This research is supported by the Danone Institute.



Heather Keller is addressing the nutritional needs of seniors in a new pilot study based in Guelph.

DEAN PALMER / THE SCENARIO

# Green is supreme

Survey finds consumers will pay 40 per cent more for environmentally 'green' products

BY MIRJANA VRBASKI

Consumers are willing to pay up to 40 per cent more for environmentally friendly products, according to a University of Guelph consumer acceptance study of "green" products.

Profs. Erna van Duren and Kimberly Rollins of the Department of Agricultural Economics and Business and graduate student Alexandra Beckett wanted to see how far Canadians would go in support of green products, which they defined as goods



Matthew and Emily Schieck are big fans of 'green' products such as apple juice and apples.

that are less detrimental to the environment.

Their survey, conducted at the University's Child-Care and Learning Centre and at Tributaries, a Guelph health food store and café, was based on consumers' reactions to a hypothetical

product — "green" apple juice. It was chosen because apple juice is a grocery staple for consumers who are parents and because it was the centre of a hot debate a decade ago when actress Meryl Streep declared it unsafe.

Van Duren says the study found that consumers are willing to contribute to environmental stewardship by buying green products and that they demonstrate considerable goodwill towards a clean environment.

"Goodwill alone won't solve the environmental problems we're faced with," she says, "but it will raise and direct the general consciousness

towards the environment and its protection, which is a very good starting point."

Now, the researchers want to expand their study by including biotechnology products, to see how much consumers would be willing to pay for products that aren't genetically modified. "It would be interesting to see how this would influence our food industry," says van Duren.

Beckett received an award for best M.Sc. research thesis from the Canadian Agricultural Economics and Farm Management Association for her contributions to the survey, which was sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs.

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*Editor's note: While this research was being conducted, ecological apple juice was launched on the market. Juice producers agreed to pay growers a 10-per cent premium on apples grown in a "green" environment. The product was priced at \$2.79 for a 1.36-litre bottle. And although consumers say they'll pay more for green products, they didn't in this case; after meeting market resistance, the price was reduced to \$1.99.*



**"Goodwill can raise the general consciousness toward the environment and its protection."**

# Both sides, now

*When it comes to biotechnology, the public wants the whole story*

BY MARIANNE CLARK

Consumers are more likely to support genetically modified food products if they're given specific information and know the benefits and risks involved, say University of Guelph researchers.

A survey of university students conducted by Prof. Karen Finlay, Consumer Studies, and graduate student Sue Morris found that consumers want more details about these foods.

"Consumers want to know how biotechnology affects the food on their table before they buy into it," says Finlay. "They want the whole story."

## ACCEPTANCE LEVELS VARY

When Morris began her market research studies with Finlay two years ago, she was interested in public perceptions of biotechnology and why some people are more accepting of buying genetically modified food products than others. She also wanted to know if the type of information the public receives has an impact on their attitudes towards biotechnology or their buying behaviour.

For her study, she used a sample of 111 students from the University of Guelph. She did an initial survey in fall 1997 to measure levels of general scientific knowledge and support of biotechnology. Students then participated in a laboratory study where they were exposed to various types of information pertaining to biotechnology and related products, such as modified tomatoes and various types of fruit.

The subjects were presented with either balanced information, which considered both the risks and benefits of a product, or unbalanced information, which focused only on benefits. After receiving the information, they were surveyed again to see if levels of support had shifted and, if so, what information made a difference.

## DETAILS ARE ESSENTIAL

Results show a moderate to high level of biotechnology support and a moderate level of scientific knowledge. They also reveal that consumers are interested in specific information about biotech products.

"People aren't just interested in hearing that biotechnology has helped develop a whole gamut of products and is environmentally friendly," says Finlay. "They



Karen Finlay (centre) highlights the importance of balanced information to consumers of biotech products.

want details. They want to know, for example, that a particular tomato can ripen naturally, be shipped from South America without damage and be ready on their dinner table that night."

## MORE KNOWLEDGE, MORE SUPPORT

Subjects who received balanced information about specific biotechnology products perceived lower levels of risk associated with these products than did those exposed to unbalanced information. They were also more likely to buy and support the product. Generally, they were more comfortable and trusting of a specific biotech product if they knew both sides of the story.

Results also showed that improving general knowledge about biotechnology did increase acceptance among people who initially had lower levels of overall biotech knowledge.

Finlay supports this straightforward marketing approach and believes manufacturers and marketers can learn from this study.

"Good marketing involves being up front with consumers. If they're going to buy a food product and feed it to their family, they have to trust it. Consumers need to be respected because it's their vote that manufacturers and marketers depend on."

This research is relevant to consumers, producers and marketers alike, says Finlay. With biotechnology becoming more commonplace, further research exploring similar themes is essential, she says.

# Best beef on the block

BY MARK FRAYNE

Computer technology will soon help beef farmers breed animals for the characteristics consumers ask for at supermarkets and restaurants. Prof. Jim Wilton, director of the University of Guelph's Centre for Genetic Improvement of Livestock, is heading a five-year study that's designed to meet everyone's taste for beef. Working with Prof. Steve Miller, he's implementing new computer-based technologies to help producers breed cattle for uniform, nutritious and consumer-desirable beef, while improving cost-effectiveness in production.

Wilton's study will use advanced computer technology, combined with a vast computerized collection of data, to develop computer software that will be used to match animals with their optimal mates.

## BRIDGING THE GAP

This technology will use existing measuring devices such as real-time ultrasound and electronic feed-intake measurements (FIM) to inform producers of the specific traits of their animals. The information generated from the study will help bridge the gap between beef producers and consumers.

"Producers are looking much harder at what they're producing," says Wilton. "Beef producers have become very aware of the need of restaurants and supermarkets to provide beef that consumers demand."

Customized beef products could lead to a more stable and competitive marketplace. At the same time, producers need new technologies to be more efficient in production, he says.

Repeated real-time ultrasound will be used to measure many meat traits in the live animal and to determine specific selection criteria. The technology will be beneficial to producers targeting specific markets, such as restaurants demanding beef with a specified fat content for desired texture and taste.

"In ultrasound, we're looking for still further improvements in equipment, which currently puts limits on what we can do," says Wilton. "The development of better equipment will lead to cost-effectiveness in research."

Electronic FIM allows him to quantify the feeding characteristics of test cattle. Measurements will take place repeatedly throughout the study to identify

MARTIN SCHWALBE



*Consumers and producers win with new electronic technology*

Larry Banks (top left), Jim Wilton (top right) and Steve Miller use computer technology to help farmers breed cattle for characteristics that consumers desire.

growth patterns and will be incorporated into genetic evaluations. These will then be used by artificial intelligence means to optimally select animals for desired characteristics.

## WEB SITE BEING DEVELOPED

Ultimately, a Web site will be developed for beef producers (cow-calf and feedlot), packers and retailers. The Web site will rank the genetic worth of a producer's animals for specific economic situations. It will also have the capacity to help producers make economically sound decisions by matching the genetic characteristics of the animals to the best feeding regimens.

"We have to be aware of what characteristics producers want and provide the tools to accommodate more effective genetic selection," Wilton says.

The data to be generated in this study will be published by Beef Improvement Ontario (BIO). Funding for this project is supplied by BIO and the Natural Sciences and Engineering Research Council.



# Safe!

*Public believes food safety in grocery stores is not a problem*

BY MARIANNE CLARK

*It's Friday night, the work week is over and on your way home you realize you're famished. But you don't feel like cooking and there's nothing in the fridge. Suddenly a neon supermarket sign appears down the road. Perfect — they have a prepared salad counter! And rotisserie chicken. A hearty meal is waiting for you just inside! Ah, convenience. What would we do without it?*

\* \* \*

With convenience foods come a new concern: food safety. In the past, food-safety training for employees has been a stronger tradition in restaurants and institutional food services than in grocery stores.

John Walsh, director of the School of Hotel and Food Administration (Hafa), wondered how the public feels about this. To find out, he conducted a survey on consumer perceptions of supermarket food-safety procedures — and learned that consumers generally believe the convenience foods they buy at the supermarket are safe.

This issue arises from a growing phenomenon called “home meal replacement.” This refers to society's shift from meat-and-potato dinners served at 5:30 p.m. by Mom to the diversity of family structure and food shopping now available. Increasing numbers of families no longer cook meals at home where they eat together, but instead choose semi-prepared or fully prepared foods bought from the grocery store or restaurant.

Twenty years ago, the situation was different, says Walsh, because there were two distinct shopping groups. One included shoppers in food stores shopping for family meals. The other consisted of those who bought and ate meals away from home — everyone from the lone business

MARTIN SCHWABE



**Supermarkets** have gained the confidence of consumers when it comes to food safety and convenient products.

**Home meal replacement has made grocery store food safety an issue.**

traveller to entire families out for dinner. Now, with the introduction of semi- or fully prepared foods, those two groups have blurred. Grocery stores sell foods that are semi-prepared or even ready-to-eat, such as barbecued spareribs, deli-style sandwiches and potato salad.

This is where a potential problem lies. For a long time, strict regulations and standards have applied to restaurants and their employees. Today, many restaurants have mandatory educational training courses based on food safety. But what about retailers now selling prepared food? Anyone can walk into any grocery store and buy assorted salads and hot meats. Are the store employees trained like those in commercial food service? Do the same safety standards apply? Should they? And most importantly, how does the public feel about this?

Walsh set out to answer these questions by conducting a telephone survey involving 100 residents in Guelph and surrounding area. Questions were simple, asking for information such as where people shop, what they buy and which store employees they believe should be wearing gloves.

Preliminary results show the majority of shoppers (approximately 75 per cent) perceive food safety as “satisfactory” at their grocery stores, while around 20 per cent find it “excellent”. The remaining five per cent believe that food safety is “unsatisfactory”.

“People feel comfortable with the level of food safety in grocery stores,” says Walsh. “However, safety procedures and standards are different than those in the food-service industry.”

Further analysis of the results will be carried out later this year. This research is supported in part by the Heart Health Foundation.

# What makes markets special?

BY MIRJANA VRBASKI

Fresh food and a friendly setting are the main attractions of farmers' markets, but they also provide an economic value of \$1.5 billion for the province, a University of Guelph study reveals.

The study, which looked at 19 farmers' markets across Ontario, was conducted by Prof. Harry Cummings, School of Rural Planning and Development, and graduate students Don Murray and Galin Kora. They set out to measure the economic impact of farmers' markets in Ontario, but found their value cannot always be measured in dollars and cents.

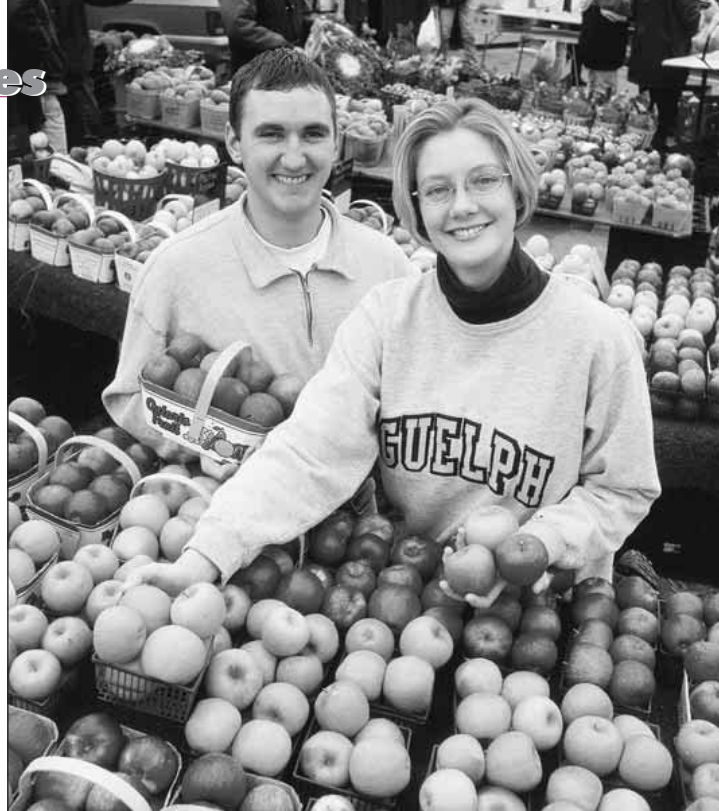
"The market is a place where customers meet their friends and where they have a personalized relationship with vendors," says Cummings. "They cease to be simply buyers and sellers to each other."

## PERSONALIZED SHOPPING

Since 1990, farmers' markets have undergone a rebirth, mostly because of consumer demand for personal shopping experiences. Today, Ontario's 127 farmers' markets draw an estimated 600,000 to 800,000 people each year.

To determine the impact of farmers' markets, the researchers designed surveys for customers, vendors, market managers and area business owners. The researchers conducted more than 4,600 personal interviews with customers to determine their purchasing habits and to pinpoint the markets' challenges and opportunities.

Fresh, high-quality produce is the main feature that attracts customers to a market, the study found. Also highly valued by customers



The market is a place for consumers such as Mike West and Crystal Norris to connect with vendors.

*They're a direct link between producers and consumers*

are product variety and the opportunity to purchase products from local growers and craft vendors. The most popular products are vegetables and fruit, as well as baked goods, honey, syrup, plants, flowers and crafts.

"One of the most important traits of farmers' markets is their direct link between consumers and farmers, removing the middleman," says Cummings. "Not having to pay the middleman allows more product value for the producers and provides consumers with a tie to the local economy. In this way, the local economy is supported through both the retail and producer end."

There's no doubt that markets have come a long way since 1780, when Ontario's first farmers' market was established in Kingston. Now, they're springing up in communities across the province — and growing in size, too, which raises issues such as limited parking and facilities. Cummings says the next challenge for these cornerstones of community unity will be to retain their personal, friendly atmosphere while still being able to please their growing clientele.

This study was sponsored by Farmers' Markets of Ontario and Agriculture and Agri-Food Canada through the CanAdapt program (administered by the Agricultural Adaptation Council).

**Markets provide an economic value of \$1.5 billion to the province.**

# Milking advertising for all it's worth

*Study reveals advertising dollars are well spent*

BY KELLY CROWE

Think you aren't affected by milk ads on TV? According to a University of Guelph researcher, advertising has a huge impact on our shopping habits and is well worth the money for the industry.

In the case of milk ads, dairy producers can almost double the return on money they spend, says Prof. Ellen Goddard, Agricultural Economics and Business. Her studies show that for every dollar the Dairy Farmers of Ontario (DFO) spent on advertising in 1997/98, there was a return of \$1.85.

"Farmers used to think they had an assured market and didn't need to advertise," says Goddard. "Now, because of competition and growing health concerns about fat and nutrition, producers have to work harder to get people to buy their product."

Through the University's Generic Advertising Research Program, she is examining advertising generated by specific industries or groups such as the DFO and the Canadian Egg Marketing Agency to promote their agricultural commodities (versus "brand" advertising, which tends to be more product-specific and competitive).

Goddard's main concern is whether or not it's profitable for producers to spend money on generic advertising. She's looking at two main questions. Do sales increase because of generic advertising? And if they do, is it worth the money or is advertising a bad economic investment?

**For every dollar spent on advertising in 1997/98 by the Dairy Farmers of Ontario, there was a return of \$1.85.**



MARTIN SCHWALBE

Ellen Goddard's studies show there are substantial returns in the dairy industry from advertising dollars.

According to Goddard, these questions are of particular importance to the DFO, by far the biggest spender on advertising. In 1997/1998, dairy farmers spent \$11 million on advertising. That's twice as much as egg producers and significantly more than other marketing boards in the province.

But with each advertising dollar fetching the DFO \$1.85 in return, the payoff is equally high. And Goddard estimates that in the two-year period from 1995 to 1997, generic advertising boosted the DFO's monthly sales 1.3 per cent. That translates into a sales gain of more than a million litres a month, bringing total milk sales up to 83 million litres each month in Ontario.

## ECONOMETRICS PROVIDE THE ANSWER

To arrive at these conclusions, Goddard uses "econometrics," the application of statistics to the analysis of economic data and models. Research on the effectiveness of advertising can range from short- to long-term analysis. Short-term analysis, usually undertaken by market research techniques such as questionnaires, provides a good indication of whether or not consumers like particular ads, associate the ads with the right product and intend to purchase more of the product.

In her long-term analysis, Goddard uses statistics and economic graphs to map out how much money was spent on generic advertising and how much milk the public consumed, over a period of years. From this she is able to determine to what extent consumers respond to generic advertising.

The Generic Advertising Research Program is sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs, the DFO, the Dairy Farmers of Canada, the Canadian Egg Marketing Agency and the Ontario Egg Producers' Marketing Board. 🍓

# Growing strawberries in Ontario's far north



MARGARET BOYD

In New Liskeard, Becky Hughes is evaluating the effect of growth retardants on greenhouse potato plantlets.

BY MARGARET BOYD

Pockets along a 1,500-kilometre stretch of Ontario from New Liskeard as far west as Thunder Bay and the Manitoba border hold surprisingly strong agricultural land. Fertile soil and unique climate make them compatible with a range of cash and forage crops — and for extensive agricultural trials at U of G's New Liskeard, Thunder Bay and Emo research stations and the Verner Test Site.

At the New Liskeard Agricultural Research Station, researchers are evaluating crops such as strawberries, raspberries, tomatoes, pasture legumes and grasses, soybeans, canola and cereal grains bred specifically for northern climates. The station also has a seed potato tissue culture lab that produces seed for all of Ontario in agreement with the Ontario Seed Potato Growers' Association.

Horticultural crops are a major focus of New Liskeard research. Horticultural researcher Becky

Hughes is evaluating winter-hardy strawberries and raspberries and developing disease-free potato mini-tubers in conjunction with U of G's Department of Plant Agriculture.

Hughes's berry research has led to the breeding of a new cold-hardy strawberry selection called 16NL11 that should be available for grower trials in the year 2000. (More than 300 acres are devoted to strawberry production in the north.) In 1994, she began the process by evaluating more than 350 strawberry seedlings from the Horticultural Research Institute of Ontario at Simcoe that survived a northern winter. They were monitored individually, and crosses were evaluated for quality and yield. Based on those experiments, 20 plants were chosen and propagated.

The labour-intensive experiments led to the selection of 16NL11, now being tissue-cultured for virus testing. Once testing is complete, the strawberry will be propagated for growers.

This project is supported by the Ontario Berry Growers Association.

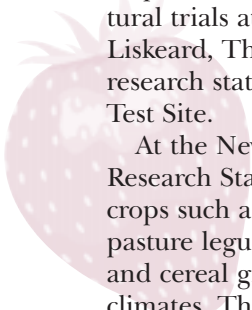
In New Liskeard's seed potato tissue culture lab and greenhouses, 700 kilograms of Nuclear mini-tubers are produced annually for Ontario seed potato growers. The north is ideal for seed potato production because it is free of the green peach aphid, the main vector of potato viruses, says Hughes.

"Money is paid for clean, disease-free seed," she says. "The green peach aphid doesn't usually make it to New Liskeard."

Hughes is working with Prof. Vince Machado, Plant Agriculture, to evaluate the effect of growth retardants on greenhouse potato plantlets. Reduced leafy growth would save valuable space in greenhouses, but researchers want to ensure that yields will not be adversely affected.

Funding for most of the research at the northern stations comes from the University of Guelph/OMAFRA research program under the enhanced partnership. 🍓

**Fertile soil and unique climate make northern agricultural land compatible with a range of cash crops.**



# These tomatoes can chill out

BY CAROL PILLEY

*M*ove over, Flav'r Sav'r tomatoes. Tastier, firmer tomatoes with a longer shelf life are being developed by University of Guelph researchers using genetic engineering techniques.

Food science professor Gopi Paliyath and research associate Kurt Almquist predict that these tomatoes could have double or triple the normal shelf life. Potentially, they could ripen on the vine for a longer period and tolerate refrigeration before processing, without compromising quality and nutritional value.

With Ontario's short growing season for field tomatoes, improving these characteristics is important.

"Our goal is to provide consistent and long-term availability of Ontario-grown field tomatoes for both the fresh market and processing industry," says Paliyath.

## PREVENTING DETERIORATION

Improving the shelf life and quality of tomatoes is based on an understanding of the pathway involved in cell membrane degradation, a key process causing the deterioration of tomatoes and other perishable fruits and vegetables. Tomatoes are highly sensitive to cold temperatures, and exposure to cold stress triggers the activity of phospholipase D, an enzyme that initiates cell membrane breakdown.

Paliyath and Almquist are trying to inhibit the activity of phospholipase D to prevent or slow down the degradation of the cell membrane. The first step in this process is to regulate the enzyme's activity, using molecular biology techniques.

To that end, the gene that codes for phospholipase D is removed, copied and then reinserted into the tomato in reverse, a method known as anti-sense technology. This could turn off the action of phospholipase D and inhibit the degradation of the cell membrane.

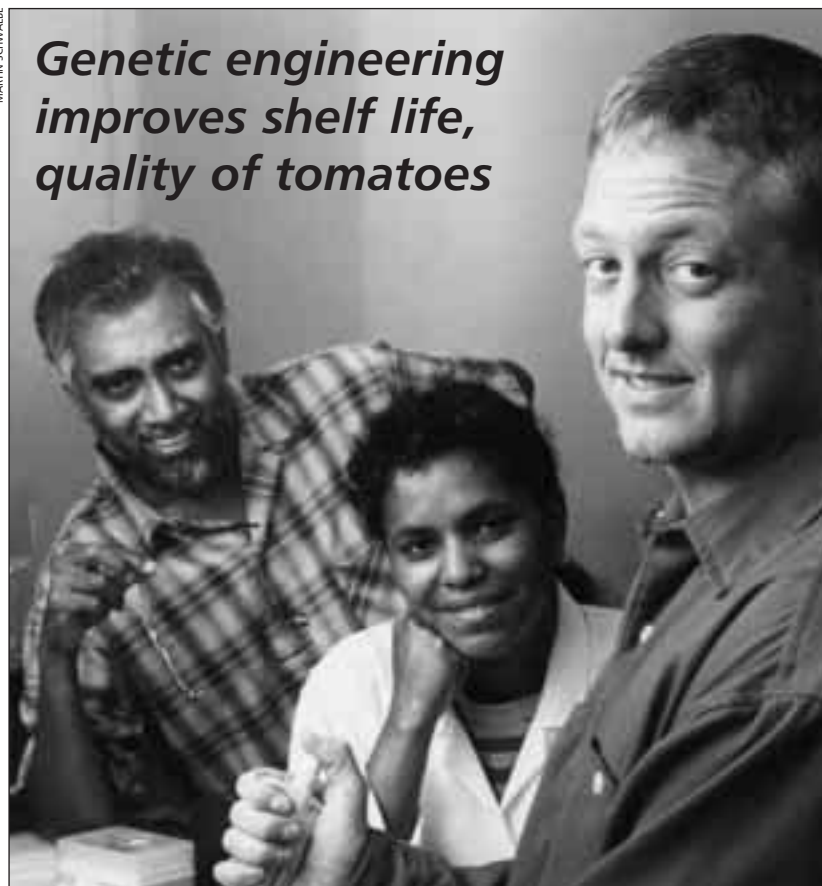
The result will be a genetically altered tomato with increased shelf life, better quality and other potential features such as chilling tolerance, making it suitable for long-term storage.

## A SUPERIOR VARIETY

The Flav'r Sav'r tomato has been genetically altered to slow the softening process by blocking an enzyme that breaks down the cell wall. It results in a tomato that can ripen for a longer period on the vine and still retain firmness during transport. But the inside of the cells would continue to degrade, resulting in a tomato that lacks flavour and eating quality.

MARTIN SCHWALBE

*Genetic engineering improves shelf life, quality of tomatoes*



Gopi Paliyath (left), Reena Pinhero and Kurt Almquist are developing tastier, better-quality tomatoes with improved shelf life and chilling tolerance.

This won't be the case with the new tomato variety, say the researchers. The degradation of the cell membrane is inhibited, so nutrients stay within the cells. In plants, the cell wall provides structural support for the cell, and the cell membrane regulates what moves in and out. Cellular contents such as nutrients are lost if the integrity of the cell wall is preserved but the cell membrane is not.

Paliyath expects these tomatoes will remain firm during transport because enhancing the integrity of the cell membrane will also improve the quality of the cell wall.

In the future, he hopes to use this method to improve shelf life, quality and chilling tolerance in other fruits and vegetables, including peaches, plums, cherries, peppers, potatoes and leafy vegetables. Food science post-doctoral researcher Reena Pinhero and plant agriculture graduate student Vansantha Rupasinge are studying some of these aspects.

This research is sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs. 🍅

# Frozen physics

Here's the science behind ice cream

BY NATASHA MARKO AND KELLY CROWE

Physics is often called on to explain gravity or electromagnetics, but it's mostly forgotten when it comes to ice cream. According to food science professor Doug Goff, however, it's a natural link for a scientist like him who's trying to understand how to make ice cream even better.

Goff is examining the interactions among the various components of ice cream — fat, milk solids, stabilizers and emulsifiers — and the physical changes that occur during processing, storage and consumption of the frozen treat.

He says understanding physics is vital for developing new and improved ice cream products and packaging technologies that will maintain ice cream quality from the time of production to the time it arrives at the supermarket.

"It's difficult to get good, fresh ice cream and maintain its quality all the way to the consumer," says Goff. "And that's what my research focuses on, finding a way to keep quality high as ice cream makes its long trip to the store."

## LEADERS IN ICE CREAM RESEARCH

The University of Guelph has long been recognized by industry as a leader in ice cream research. Since 1914, Guelph's ice cream technology course — an annual one-week intensive training course for personnel from the ice cream manufacturing, supply and retail sectors — has attracted participants from around the world. Goff has taught the course for the past decade.

The four components of ice cream interact to form four phases — ice crystals, air

bubbles, an unfrozen serum phase and fat globules. Fat is particularly important for more than just good taste — in this application, it's a "partial coalescent," meaning it forms globules that add to the three-dimensional structure and texture of ice cream. Fat globules are largely responsible for the mouldable and packaging properties of ice cream. Goff believes fat is a vital and defining component of ice cream and argues that artificial non-fat varieties are not truly ice cream.

## THE REAL THING

History suggests he's right. Since the time of Alexander the Great, people have been searching for the perfect food combination of cool and sweet. Marco Polo brought an early form of sherbet from the Middle East in the 14<sup>th</sup> century; it eventually became ice cream or "cream ice," as it was called when it reached the table of Charles I three centuries later.

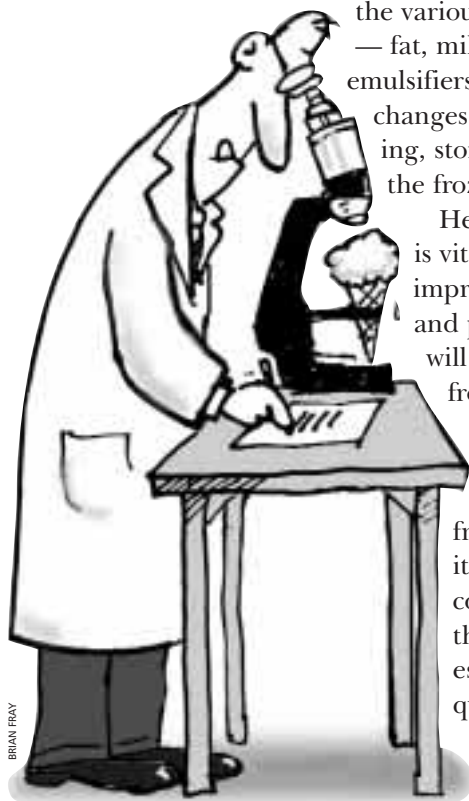
Over time, the ice cream market changed with the development of hand-operated ice cream machines and other inventions that made ice cream more accessible to the public. Today, Canadians devour about 350 million litres of ice cream each year.

## GUILT-FREE DESSERT?

And although calorie counters continue to pursue guilt-free ice cream, Goff says it's a fruitless effort.

"Ice cream is not supposed to be part of a person's everyday diet — it's something to enjoy from time to time. You can't really have ice cream without fat because fat plays a major role in its texture, shape, packaging properties and taste."

This research is supported by the Natural Sciences and Engineering Research Council, the Ontario Ministry of Agriculture, Food and Rural Affairs, the Ontario Dairy Council, Good Humour-Breyers Canada Inc. and Germantown International.



# The fruits of their own labour

*Natural pesticides could keep fruit fresh longer*

BY JUHIE BHATIA

**F**resh fruit may stay fresh longer if a natural pesticide being studied by University of Guelph researchers makes the grade.

The potential of natural fruit “volatiles” to improve the storage qualities of fresh fruit is being examined by Lisa Skog of the Department of Plant Agriculture’s Vineland Research Station; Prof. Dennis Murr, Plant Agriculture; and Brian McGarvey of Agriculture and Agri-Food Canada (AAFC).

Volatiles are natural compounds that contribute to the aroma and flavour of fruit. In high concentrations, however, some are antimicrobial agents that can protect against fungal organisms and damage.

“If natural fruit volatiles prove effective, then growers, distributors and consumers will all benefit,” says Skog. “It could lead to a healthier product, less storage decay, longer shelf life and decreased losses during shipping.”

Fruit boosts its production of certain volatiles in response to injury, microbial attack or environmental stress. Many fruit volatiles — which include aldehydes, ketones and alcohols — are commercially available for flavour additives in some foods, but they don’t all act as antimicrobial agents.

Skog is evaluating the effectiveness of 20 different volatiles in decreasing brown rot and blue mould

microbial diseases in Ontario peaches and pears. A pear processor collaborating on the project estimates that a 75-per-cent decrease in the incidence of blue mould alone could save \$30,000 per year.

Fruit losses from spoilage are partly due to a recent push to use fewer conventional post-harvest pesticides. This has decreased pesticide residues and risks to consumers, says Skog, but it has also increased post-harvest decay during long-distance shipping and storage of fresh fruit. Pesticide reductions allow latent infections — which originate in the field but show no immediate and visible symptoms — to become active. And fruit processors and growers pay the price in product losses and longer

processing times required to remove spoiled fruit.

Skog hopes the low-risk natural volatiles can be an effective substitute for conventional post-harvest pesticides.

“The application of antimicrobial volatiles against post-harvest decay is advantageous because the volatiles quickly dissipate and little residue remains,” she says. “And because the compounds occur naturally in the plant, they may actually enhance flavour.”

Results so far indicate that five of the 20 volatiles under study are effective antimicrobial agents. Laboratory trials have shown they protect fruit against latent infections, spores and active infections. Skog predicts volatiles will be highly effective in preventing latent infections from becoming active because they can penetrate the fruit surface.

This research is sponsored by the Vineland Growers Co-operative, Nabisco Ltd. and AAFC through the Ontario Research Enhancement Program.



Lisa Skog at Vineland Research Station is using natural pesticides to keep fruit fresh longer.

**If natural fruit volatiles prove effective, growers, distributors and consumers will all benefit.**

# Top-grade tomatoes

*Processing-tomato crop yields double in 10 years*

MARGARET BOYD

Steve Loewen evaluates tomato varieties for yield, handling and processing performance.

BY MARGARET BOYD

In the past 10 years, Ontario's tomato industry has chalked up impressive increases, with average yields doubling from 18.1 tons to 37 tons per acre.

This phenomenon can be credited to many factors, including better varieties, added incentives for growers, investment and improved technology, says Steve Loewen, a researcher at the University of Guelph's Ridgetown College. And the success of Ontario's \$59-million processing-tomato industry is making other countries sit up and take notice — the Mediterranean association of tomato-producing countries is studying Ontario's lead.

"Everyone except the rest of Ontario seems to know about it," says Loewen, who's been evaluating new tomato varieties for the past 11 years. "Processing-tomato production in Ontario is a big success story."

The dramatic increases in yield have occurred while acreage devoted to tomato crops and the number of growers have declined. In 1998, processors took in about 560,000 tons of tomatoes grown on 15,060 acres in southwestern Ontario. In 1994, about 539,000 tons were grown on 19,834 acres. The number of growers has declined also — from 533 in 1988 to just under 200 in 1998.

This is evidence that the industry is becoming more focused and better managed, says Loewen, who works with growers and processors to identify, evaluate and recommend new varieties. In the past 10 years, he's evaluated more than 100 different varieties of processing tomatoes in multi-location yield and processing trials.

This year, he evaluated 33 varieties in four locations throughout southwestern Ontario as one component of a

larger research program encompassing about 12 acres of research plots. The varieties are evaluated for yield, handling and processing performance over the range of soil types and microclimates found in the main production areas of Ontario.

Research has had an important impact on yield increase, says Loewen. During the past decade, a group of tomato cultivars became available that had the potential for higher yields and better quality, and these varieties have consistently performed well.

Research-driven changes in farming practices that have influenced yield increases include plant plug technology, which provides transplants that establish quickly and are disease-free, and a move from single- to twin-row planting in the field. Weather-timed disease-forecasting models have also improved quality and reduced costs by reducing the impact of fungal diseases affecting tomatoes.

Processors have also played a role. Many have shifted their focus from whole peeled tomatoes to include sauces and diced, crushed or stewed tomato finished products, which allows for better use of the raw product. Together with the growers, they've developed a productivity incentive that allows processors to purchase tomatoes over contract at a lower price and reduces production costs

for growers as yield per acre increases.

Consumer demand for tomatoes is expected to rise as well. Growing awareness of tomatoes as a rich source of lycopene, a natural food pigment with antioxidant properties, could lead to increases in consumption and to the development of new products.

This research is sponsored by the Ontario Tomato Research Institute, the Mid-America Food Processors Association and the Ontario Ministry of Agriculture, Food and Rural Affairs. 🍅

**Better varieties, added incentives for growers and improved technology have resulted in increased yields in Ontario.**

# Preventive poultry

*Researchers are finding ways to raise chickens with healthier fats*

BY JUHIE BHATIA

Broiler chickens may soon be putting on a little fat — the good kind — through the creation of a niche-market poultry product.

Animal and poultry science professor Steve Leeson is raising broiler chickens with a greater proportion of omega-3 fatty acids in their body fat. Omega-3s are known to have beneficial effects on human health.

Leeson's project involves adding flaxseed to chickens' diet. Flaxseed is a natural feed source high in omega-3s; he successfully integrated it into omega-3-enriched eggs by feeding flaxseed to laying hens. These eggs are now on supermarket shelves and are increasing in popularity with health-conscious consumers.

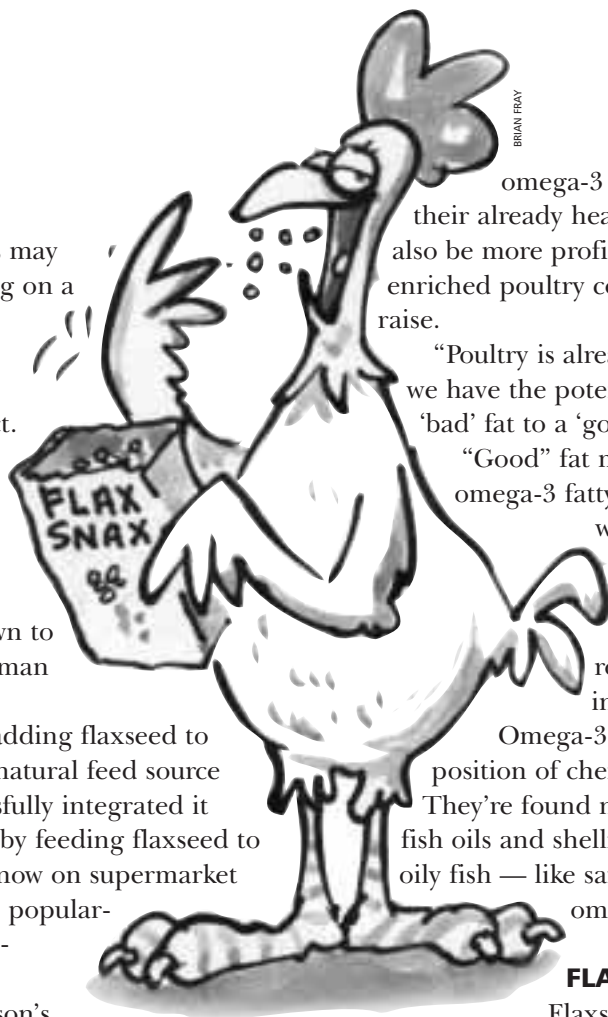
In the past two years, Leeson's work has focused on raising broiler chickens on a diet supplemented with flaxseed. He says the challenge is to find a level of flax that is palatable for chickens and economical for producers and tastes good to consumers.

## FINDING THE BALANCE

"Ideally, we want to get a high level of omega-3 incorporation into the poultry. Finding the balance is tricky because high flaxseed levels often result in a fishy-tasting chicken and could create a very expensive poultry meat."

He predicts that omega-3-enriched poultry will be available on the market by the end of this year.

Enriching poultry products with these beneficial



omega-3 fatty acids can further improve their already healthy image, says Leeson. They will also be more profitable for producers, even though enriched poultry costs 15 to 20 per cent more to raise.

"Poultry is already a lean meat," he says, "but now we have the potential to modify ordinary fat from a 'bad' fat to a 'good' fat."

"Good" fat may be an appropriate term for omega-3 fatty acids because they're associated with decreased incidence of heart disease. They prevent plaque buildup in arteries, warding off heart attacks. They also play a role in the brain development of infants and aid in visual functions.

Omega-3 fatty acids get their name from the position of chemical bonds on fatty acid chains. They're found naturally in high concentrations in fish oils and shellfish. But North Americans eat little oily fish — like sardines — and lack sufficient omega-3s in their diet.

## FLAX FACTS

Flaxseed is a plant source naturally high in omega-3 fatty acids, but is more often used in industrial processes such as paint production than as a feed source. Although some breads now contain flax, its use in foods is still uncommon because a high consumption of flax can lead to adverse health effects such as diarrhea. But this doesn't happen when omega-3s are consumed in animal products.

Leeson's work doesn't stop with eggs and poultry. He's also in the preliminary stages of supplementing the diets of turkey and swine with flaxseed to increase the proportion of omega-3 fatty acids in the total fat content of these meats.

This research is sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs.

# Deliciously safe sausage

*Improved drying techniques target E. coli reduction*

BY ARIANA MURATA

**A** deli can be made famous for its dried salami . . . or for a rare case of *E. coli* food poisoning. But the risk of *E. coli* contamination could be substantially reduced with new analysis methods being developed at the University of Guelph.

Tests to identify and eliminate the bacterial strain *Escherichia coli* O157:H7 (which causes “hamburger disease”) from dry fermented sausage products are being devised by food science professors Shai Barbut and Mansel Griffiths, along with research technician Diane Wood. They’re using bacteria genetically engineered to contain the firefly gene for fluorescence, which allow them to rapidly and accurately measure bacterial counts. It’s part of a novel technique called bioluminescence, in which bacteria generate a blue-green glow, making the counting of bacteria easier and more accurate.

Fermented sausages, such as dried deli salami, constitute less than 15 per cent of all sausages produced (most sausages, such as frankfurters, summer sausage and bologna, are cooked at temperatures high enough to destroy *E. coli*). But the cooking process can alter the distinctive flavour of dry fermented sausages.

The researchers are experimenting with different sausage drying conditions to find the method that will result in the highest bacteria kill rate and keep fermented sausage products safe for consumption.

“*E. coli* O157:H7 can cause fatal food poisoning,” says Barbut. “It’s essential

that we find the optimum way to inactivate it in our food products.”

In validation trials, sausages are inoculated with a high concentration of *E. coli*, then placed in a drying oven under different conditions for four to eight weeks. The goal is to achieve a state known as “99-percent kill” — meaning a 100-fold reduction in bacterial numbers.

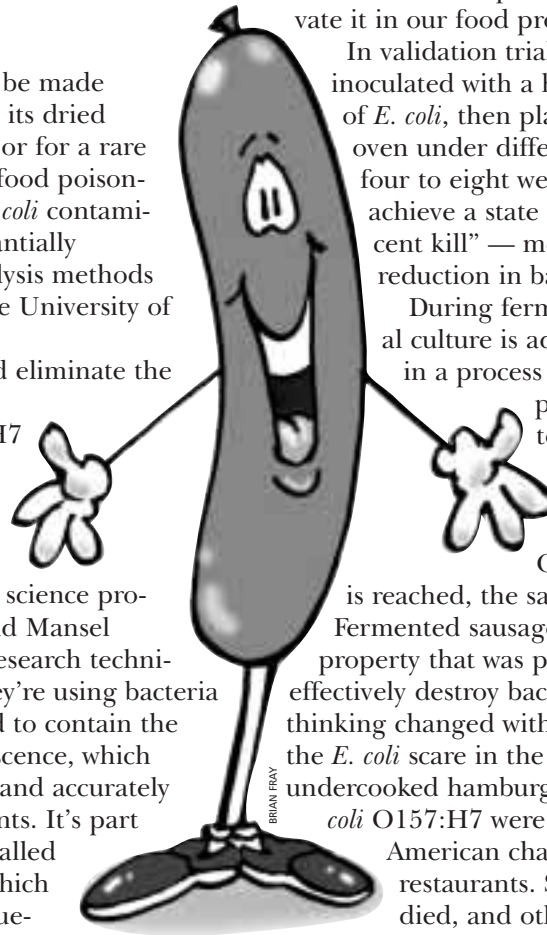
During fermentation, a bacterial culture is added to the sausage in a process similar to yogurt production. The bacteria produce acid, which causes the pH of the sausage to drop quickly.

Once an optimal pH is reached, the sausage is dried.

Fermented sausage is quite acidic, a property that was previously thought to effectively destroy bacteria. But that thinking changed with the beginning of the *E. coli* scare in the early 1990s, when undercooked hamburgers harbouring *E. coli* O157:H7 were served in an American chain of fast-food restaurants. Several children died, and others were left on permanent kidney dialysis. Later, *E. coli* O157:H7 was also found in low-acid foods such as apple cider and in fermented sausage.

Barbut acknowledges the seriousness of O157:H7, but he doesn’t want to blow the danger out of proportion. There’s little reason to be worried about becoming sick from fermented sausage, he says. The presence of microorganisms in food depends on the amount of water in a product that’s available to microbes, and fermented sausage has extremely low water activity. Still, safety is paramount.

This research is sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs and 10 meat-processing companies.



**It’s essential to inactivate *E. coli* O157:H7 in our food products.**

# Cutting cholesterol

*Study shows oat bran ingredient reduces heart disease risk by one-fifth*

BY KELLY CROWE

**T**he key medicinal ingredient in oat bran could reduce the risk of heart attack by 20 per cent, say Guelph researchers.

In a research trial, a concentrate of beta glucan — a fibre that makes up between four and six per cent of the dry oat grain — was able to lower low-density lipoprotein cholesterol (also known as LDL or “bad” cholesterol) by eight to 10 per cent. This equals a one-fifth reduction in the risk of heart disease.

The U.S. Food and Drug Administration says three grams a day of beta glucan is enough to significantly lower elevated cholesterol. It takes just two servings of about 20 grams of high-quality oat bran, the oat product that has the highest levels of beta glucan, to consume three grams of the fibre. Researchers in this project used six grams.

“Back when there was a big hype about oats, North Americans were eating them in foods — such as muffins — that often didn’t have enough beta glucan,” says Peter Wood, an Agriculture and Agri-Food Canada (AAFC) research scientist and adjunct professor in Guelph’s Department of Food Science. “Now that we know exactly what brings about those benefits, we can make sure people eat products that will provide the health benefits.”

## FINDING THE PERFECT FORMULA

Wood and his associates set out to test the effectiveness of beta glucan. The first step was to make a consumable form of the fibre to use in a study. Wood worked with Paul Fedec of the POS (Protein, Oil, Starch) Pilot Plant Corp. in Saskatoon to develop a powder formulation of concentrated beta glucan, consisting of 80-per-cent beta glucan and 20-per-cent other materials such as proteins and starches. The powder was developed to be added to drinks.

The next step was to test the effectiveness of the powder. Working with a group from the Ottawa Civic Hospital — including Dr. Jan Braaten and Fraser Scott of Health Canada, dietitian Patricia Bradley, statistician Mark Wolynetz and nursing co-ordinator Doreen Riedell — Wood set up clinical trials. Subjects consumed about six grams of the beta glucan concentrate daily with their main meals, and their cholesterol levels were monitored weekly. Participants had

elevated cholesterol levels and were aged between 40 and 65. The group had a balance of men and women.

## THE THICKER, THE BETTER

In addition to finding that the beta glucan concentrate lowered LDL cholesterol by eight to 10 per cent, Wood learned there may be a mathematical relationship between the viscosity or thickness of the



Peter Wood is studying the heart-healthy ingredient in oat bran.

drink and the resulting reduction in cholesterol. The thicker the drink, the more cholesterol is reduced.

The problem is that a thick beta glucan drink has the consistency of wallpaper paste, a quality that’s not very palatable, he says. His next step is to establish exactly why this relationship exists and to develop methods that make beta glucan easier to consume. He also wants to determine the exact dosage of beta glucan needed for cholesterol reduction and to discover how, exactly, it works.

“We’ve taken out the active component of oat and have established its physiological effects,” says Wood. “Now, we need to move back to the matter itself and make the components work together.”

This research was sponsored by AAFC, which also co-funded the clinical trials with Quaker Oats.

### Threatened ancient food grain preserved by Guelph researcher

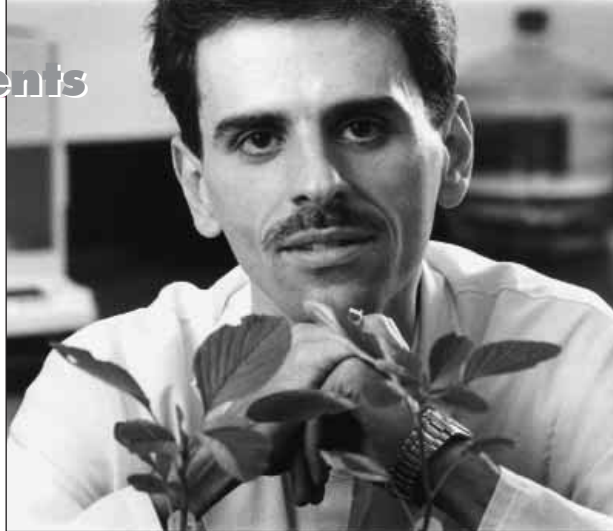
BY JUHIE BHATIA

Despite its name, seabeach amaranth (*Amaranthus pumilus*) hasn't been enjoying much of a leisurely oceanside existence. The little-known domestic food plant species, which some believe may provide valuable health benefits, was listed as a globally threatened plant species in 1993. Its habitat is being destroyed not only by natural disasters such as the recent spate of Atlantic coastal hurricanes, but also by cottage seawalls and beach erosion. Most people consider it a weed.

But amaranth has found a friend in Massimo Marcone, an adjunct professor in the Department of Food Science. He's studying the seed components of the ancient plant, whose closest relative, *Amaranthus hypochondriacus*, has been used lately by health-food advocates who extol its nutritional and functional properties. Marcone is trying to scientifically confirm the functional properties of the plant to maintain stocks of the species, which have dwindled to about 3,000 individual *Amaranthus pumilus* plants left growing in the wild.

"Virtually all known wild plant species have been destroyed by the recent hurricanes," says Marcone. "We don't have to go to Brazilian rainforests to see a decrease in biodiversity — it's happening on our own continent."

Production and consumption of the amaranth grain goes way back. It peaked during the Mayan and Aztec periods in Central America, where it was used as a food crop and ceremonial plant. Its decline began when Spanish conquerors legislated a ban



MARTIN SCHWABE

Massimo Marcone is exploring the threatened amaranth plant for potential health benefits.

# Amaranth finds an ally

**"Virtually all known wild plant species have been destroyed by recent hurricanes."**

controlled. Marcone managed to get a few seeds from the U.S. Department of Agriculture to determine exact levels of their components, such as proteins, fats and carbohydrates. Each of these components has the potential for additional uses, increasing the seeds' value beyond a cereal grain alternative and perhaps making it a functional food.

"We don't know if there's anything else of value in *Amaranthus pumilus* because it's never been explored," he says. "We know it's been used for many years, but we need screening to validate its benefits, and this must be done before it becomes extinct."

Marcone hopes his research will encourage the conservation of seabeach amaranth. He's now growing his own seeds to produce a sustainable population that can then be more extensively studied. If beneficial properties are discovered, a cultivated form will be developed and long-term storage of the seed can be provided. The preliminary data look promising for maintaining stocks of the plant, he says.

A report of Marcone's research on this threatened plant species appeared in the February 2000 issue of the *Journal of Agricultural and Food Chemistry*. It can be found on the Internet at <http://pubs.acs.org/journals/jafcau/index.html>. 🍌

forbidding its production and use — under punishment of death — to destroy the Aztec religion.

Amaranth has regained popularity, primarily in the health-food industry. It contains a large amount of protein, dietary fibre and minerals compared with traditional grains.

The seabeach amaranth Marcone is studying is native to beaches of the Atlantic coast. Its salt tolerance, decreased water requirement and ability to ease soil erosion make it environmentally hardy. In its wild form, seabeach amaranth can also contain high levels of squalene, an oil lubricant used in the pharmaceutical and cosmetic industries. Squalene is currently derived from sharks and whales, but a plant source could decrease this marine dependency.

In the United States, seabeach amaranth is so threatened that the distribution of its seed, even for scientific purposes, is tightly

# One-stop chemistry shop

BY CAROL PILLEY

**A**ntioxidants — compounds that help

prevent cancer and heart disease — are prized by food processors who are sensitive to the desires of health-conscious Canadian consumers. So when a food processor approached the University of Guelph's

Laboratory Services to investigate how processing, packaging and storage

affect vitamin C and beta carotene in ready-to-eat vegetables, chemists at Lab Services were put to work. They recommended the most suitable packaging and processing methods for preserving the quality of the vegetables.

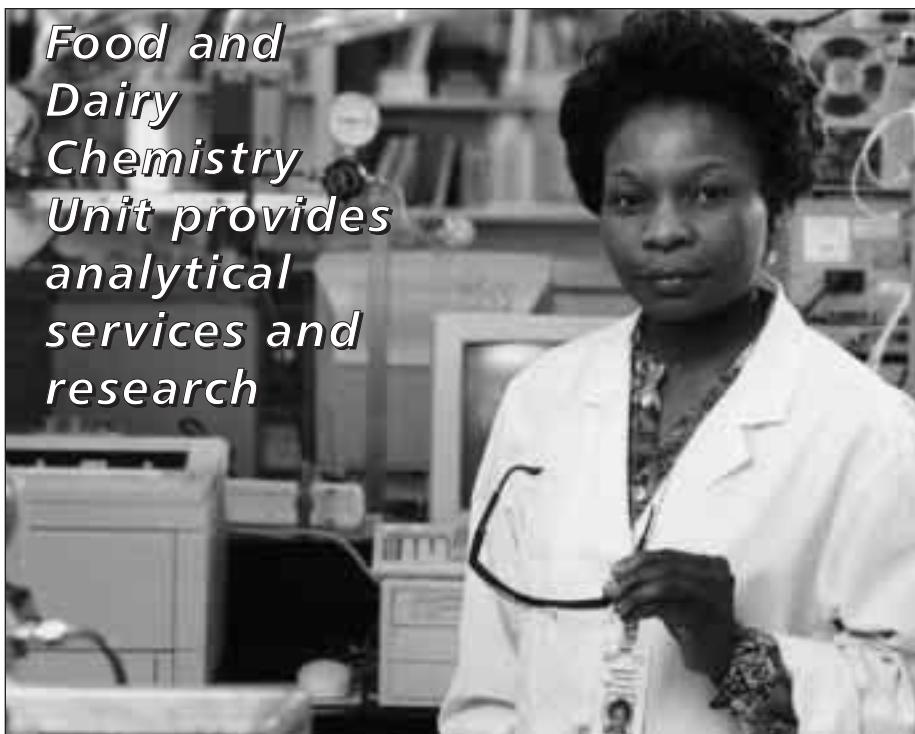
## PROVIDING ANSWERS FOR CONSUMERS

Whether it's vitamins, fats or proteins, consumers want to know what's in the food they eat and that it's the best it can be. The Food and Dairy Chemistry Unit at Laboratory Services is helping to supply answers that respond to public concerns. The unit fields numerous requests from clients who serve the public interest.

A variety of services are available in food analysis and research through the Food and Dairy Chemistry Unit, providing clients with one-stop shopping. A wide range of clients — government agencies, research and development agencies, and private industry such as food processors, labs and individuals — approach the unit for help in addressing specific concerns or curiosities.

"For example, a single milk sample could be tested in our laboratory for fat, protein, lactose, vitamin A and many other components," says research scientist Temitope Ayanbadejo. "This multi-faceted approach to food and dairy analysis is very convenient for our clients."

*Food and Dairy Chemistry Unit provides analytical services and research*



MARTIN SCHWALBE

**Topé Ayanbadejo** helps ensure client needs are met at Guelph's Laboratory Services.

Research and service work on food and dairy components is carried out in four smaller units that provide analytical services within the Food and Dairy Chemistry Unit.

- The Infrared (IR) Unit provides a service for milk composition analysis. IR technology allows for high-speed testing of milk samples — up to 400 samples can be tested in an hour.

- The Protein Unit is involved in testing for compounds such as protein, nitrogen, casein and iodine. Here, scientists can also determine if cow's milk has been contaminated with something else, such as goat's milk.

- The Carbohydrate, Solids and Water Soluble Vitamins Unit provides testing in a variety of foods and dairy products and analyses sugar, fibre and vitamin contents. Food labelling for packaged foods, which may soon be mandatory in Canada, is provided as an optional service.

- The Lipid Analytical Unit provides fat analysis in food and dairy products, fatty acid profiling and fat-soluble vitamin analysis. The Food and Dairy Chemistry Unit is the only lab in Ontario certified by the U.S. Food and Drug Administration to test for fat-soluble vitamins A and D.

In addition to these four units, training in aspects of food analysis and consultative services are also provided by the Food and Dairy Chemistry Unit.

Some of the unit's future projects may include research on vitamin E levels in beef and dairy products and the nutritional and nutraceutical aspects of ginseng — timely subjects for both consumers and producers.

***"The multi-faceted approach to food analysis is very convenient for our clients."***



# Milk for immunity



MARTIN SCHWALBE

Mansel Griffiths works with milk peptides to boost human health.

BY JUHIE BHATIA

With the help of some beneficial bacteria, nature's perfect food — milk — may be able to boast even more health-enhancing compounds.

On their own, most milk proteins don't have any particular immune-enhancing activity. But certain micro-organisms found in dairy products such as yogurt and cheese can break some milk proteins into peptides — the building blocks of protein — that do the body good.

Prof. Mansel Griffiths, Department of Food Science, is working with bacterial species that can break milk proteins into peptides that stimulate immunity.

"I want to use milk micro-organisms to produce substances in food that benefit human health," says Griffiths. "These foods can be used as special dairy products for immuno-compromised people such as the elderly, pregnant women and those undergoing chemotherapy."

Young women and college-age students account for the highest percentage of milk drinkers. But the age distribution of the Canadian population is changing, and the largest sector of milk drinkers will soon be between 60 and 65. To increase milk consumption among the elderly, new ways must be developed to make milk more appealing, says Griffiths. Healthier milk may be the key to opening up this market and to creating new markets for other groups, such as health-conscious consumers.

**Bacteria could help boost nutritious qualities of milk.**

## THE PROPER PEPTIDES

Here's how the milk peptides work. Lactic acid and bifido bacteria are normally added to milk to initiate the production of yogurt and cheese. When these micro-organisms grow and ferment in milk, they break down milk proteins — including whey and casein — into smaller peptides. Some of these peptides stimulate the immune system and others have beneficial cardiovascular effects.

Griffiths' research is a two-step process — identifying and evaluating the peptides. He's currently in the identification phase, which involves fermenting milk with different species of bacteria. The pattern of peptides produced is examined, and samples are placed in culture with immune cells to identify those with the ability to stimulate cytokines, agents involved in the immune response. Griffiths hopes this will lead to the identification of bacterial species that produce active peptides in the largest quantity.

The final challenge will be to deliver these potentially active compounds as efficiently as possible, he says. One delivery option involves micro-organisms that produce active peptides, which can be used in dairy products such as yogurt. Once consumed, the bacteria will break milk proteins into active peptides inside the digestive system. The second option is to manufacture the active peptides and add them to a variety of food products.

"These peptides could be used by the food industry either to produce new foods or to enhance existing ones," Griffiths says.

This research is sponsored by the Dairy Farmers of Ontario. 🍎

MARTIN SCHWABE



Yoshinori Mine uses antibodies derived from egg yolk to prevent rotavirus.

BY LAURA LEVAC

Laying hens hold the potential to produce mass quantities of life-saving antibodies, says a University of Guelph food scientist.

Prof. Yoshinori Mine, who holds the Chair in Egg Material Science, has found that hens can be specifically tailored as a production vehicle for valuable antibodies — proteins that elicit a specific immune response.

Mine says that concentrated antibodies derived from the egg yolk of hens can be administered as an effective vaccine against rotavirus infection. The formulation — already being used in cattle — is now being adapted for rotavirus infection in humans, a potentially deadly disease that currently can't be controlled because there is no effective vaccine against it.

"Human and bovine rotavirus are serious problems in North America and around the world," says Mine. "By collecting antibodies from egg yolk, we can ensure an abundant supply of the antibody and prevent infection from occurring."

Rotavirus is an intestinal infection commonly affecting children under the age of two and is a significant health problem, particularly in developing countries. Children afflicted with the virus experience severe diarrhea, which can lead to dehydration and eventually death. Rotavirus is considered one of the most serious diseases in the world, with up to three million children dying from it each year. Development of an effective vaccine could reduce all diarrheal deaths by 30 per cent and save millions of children's lives, Mine says.

The disease has also caused devastating effects in the North American cattle industry. It's estimated that five per cent of newborn calves die from the intestinal infection before they're a month old, costing the industry up to \$7 billion a year.

# Beating out a deadly virus

But that could soon change. Mine has found that hens fed active rotavirus antibodies obtained from animal sources transport these antibodies through their blood and deposit them into their egg yolk. The antibodies can be mechanically extracted from the yolk and concentrated into a pill that can be administered orally. That's important because an oral vaccine introduces the antibody directly into

the affected area — the gut — where it's needed, says Mine.

Although the antibody can be extracted from human breast milk or animal blood, there are several advantages to using hens' egg yolk, he says. It's easier to collect eggs from hens than blood from animals, and collecting antibody from egg yolk is also considered more hygienic.

In addition, large-scale facilities for feeding hens for egg production are already in place and poised to take on the increased production that would be required to ensure an abundant supply of rotavirus vaccine. This, in turn, would benefit Canadian egg producers.

But the key advantage to using hens as incubators for vaccines is that antibodies are transferred very efficiently to eggs and in high concentrations.

"The amount of antibodies produced in the eggs of one hen is equivalent to that produced from the blood of 40 rabbits," says Mine. "Because rotavirus affects us on such a large scale, it's important to have a cheap and abundant supply of antibodies."

This research is sponsored by the Ontario Egg Producers' Marketing Board, the Ontario Cattlemen's Association and the Ontario Ministry of Agriculture, Food and Rural Affairs.

***"Because rotavirus affects us on such a large scale, it's important to have a cheap, abundant supply of antibodies."***

BY JUHIE BHATIA

New markets for soybeans, Ontario's most lucrative crop, hinge on making them as "thirsty" as possible, say researchers.

Soybean quality—which is based on water absorption as well as yield and disease resistance—is continually being enhanced through research. At the University of Guelph, for example, plant agriculture professor Istvan Rajcan is using genetics as a tool to improve soybeans' resistance to diseases such as white mould. And on the food side of soybean research, John Mullin of the Agriculture and Agri-Food Canada (AAFC) Greenhouse and Processing Crops Research Centre in Harrow, Ont., is targeting the relationship between the carbohydrate composition of foods containing soybeans and their ability to absorb water.

Soy foods include miso, tempeh, tofu and soy milk. To avoid processing problems, it's vital to soak the beans and



# Soybeans,

get them waterlogged quickly and uniformly. Ideally, water absorption will increase the weight of the bean by 2.4 times.

### PECTIN'S POTENTIAL

Mullin is analysing the potential role of pectin in soybean water uptake in hopes of enhancing this critical quality. Pectin is a complex carbohydrate structure often used as a gelling and stabilizing agent in foods. It is valued for its water-holding capacity, particularly in citrus fruits and apples.

"Improving the quality of soy food soybeans could lead to increased Ontario exports," says Mullin. "There's also the possibility of a huge domestic market for soy foods, arising from increasing interest in the health value of soy products and the changing ethnic mix in Canada."

Soybeans chalk up more than \$200 million in exports for farmers annually. But certain aspects of soybean quality still don't measure up to beans abroad. Currently, there's a significant difference in the quantity of water

# Innovate

## Seed with more solutions



# soaking wet

absorbed by various soybean cultivars from Canada and Japan, and certain varieties are renowned over others for superior water absorption. Mullin is comparing the carbohydrate components of these cultivars with “stone seed” — an experimental line that absorbs very little water — to determine if the presence of pectin accounts for the differences in water uptake.

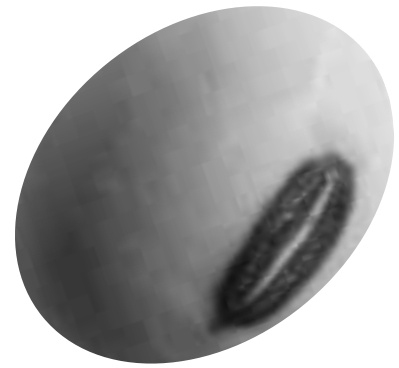
Mullin’s studies involve mechanically detaching the soybean’s seed coat from the main part of the seed. Each part is then fractionated, which separates carbohydrates into various components, including pectin. The pectin portion is then examined for differences in monosaccharide (simple sugars) composition.

## A NEW UNDERSTANDING

“We’re hoping that differences in these monosaccharides will aid in understanding pectin’s role in water absorption,” says Mullin. “This may be the key to greater water absorption and better-quality soy

food soybeans.”

His study is sponsored by the Ontario Research Enhancement Program (OREP), a \$4-million federally funded initiative administered by the research branch of AAFC with input from the agriculture and agri-food sector, universities and the province. OREP supports 25 projects at universities and research centres across the province, with U of G as a major participant. Projects focus on two key areas identified by the agriculture and agri-food community — consumer demand for higher-quality safe products and ensuring that crop production management systems are environmentally sustainable.



# ation

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# A soybean a day

## Looking to soybeans to fight high cholesterol

BY CLAIRE MOXON

**H**igh blood cholesterol levels could be lowered by increasing soybean consumption, say researchers at the University of Guelph and the University of Toronto.

The research is timely. The U.S. Food and Drug Administration (FDA) has now made it official that soy protein can help reduce the risk of heart disease, one of the leading causes of death in North America. On Oct. 26, 1999, the FDA authorized the health claim that “25 grams of soy protein a day, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease.”

A recent three-phase, four-week clinical trial involving U of G’s Laboratory Services and the Department of Nutrition at the University of Toronto is investigating blood cholesterol levels in participants receiving soy-based food products such as soy burgers, puddings, milk and desserts.

“In addition to soy protein, we’re hoping to find that the isoflavones in soybeans have a positive effect on cholesterol levels,” says Chung-Ja Jackson, a researcher at the Guelph Centre for Functional Foods (part of Laboratory Services), who is collaborating with U of T nutrition researcher David Jenkins. “If they do, we may be able to make dietary recommendations for people who are trying to lower their cholesterol levels and improve their quality of life.”

Some of the group’s findings were presented at the Canadian Federation of Biological Societies meeting in Winnipeg in June 1999 and at the Third International Symposium on the Role of Soy in Preventing and Treating Chronic Diseases, held in Washington, D.C., in November.



MARTIN SCHWALBE

Chung-Ja Jackson examines the health benefits of soybeans.

### MANY HEALTH BENEFITS

The potential ability of isoflavones to reduce blood cholesterol is a new addition to the growing list of health benefits provided by this group of compounds. Soy foods have already been shown to help prevent other health problems such as cancer of the colon, breast and prostate, as well as menopausal symptoms and osteoporosis.

Soybeans have been an important part of Asian diets for centuries and are known to help reduce incidence rates of women’s health problems in particular. This is because isoflavones are weak phytoestrogens — compounds that can mimic human estrogen. Although there are other lifestyle factors that play a role in the decreased rates of women’s health problems in

Asia, diets high in soybean products are believed to be a significant factor.

### ISOFLAVONES ARE KEY

Jackson’s role is to measure levels of isoflavones in soy foods consumed by volunteers, as well as levels of isoflavone metabolic break-down products in the participants’ urine. There are 12 different types (isomers) of isoflavones in soybeans and soy food products that she is able to isolate, identify and quantify. Changes in blood cholesterol levels are measured at the University of Toronto.

Jackson’s previous research shows that some soybean varieties have different levels of isoflavones. The location and the year in which the soybeans are grown can also affect isoflavone levels. The research, together with the development of analytical methods for detecting isoflavones in soybeans and soy foods and their metabolites in urine, was funded by the Ontario Soybean Growers’ Marketing Board and the Ontario Ministry of Agriculture, Food and Rural Affairs. The work is being done in collaboration with industrial partners Loblaw’s, Yves Veggie Cuisine, So Good, Soy City Foods and La Soyaine. 🍓

# The DHA designer line

*Dairy products are being enriched with crucial fats*

BY JUHIE BHATIA

A whole line of Guelph-developed dairy products made from milk enriched with docosahexanoic acid (DHA) and designed to increase DHA consumption in the general population is being readied for supermarket shelves.

University of Guelph food scientist Art Hill and master's student Hong Wang are assessing milk enriched with a vital omega-3 fatty acid for cheese and other dairy products. They're evaluating how the physical and chemical qualities of cheese are affected by using milk enriched with DHA.

So far, their studies have shown that these products have excellent flavour and good shelf life.

## A VALUABLE INGREDIENT

DHA is vital for infants, nursing mothers and the aging population because of its role in brain and retinal development and its protective effect against cardiovascular disease. The major dietary sources of DHA are fish and fish oils, and it can also be found in minor amounts in eggs and some meats.

In North America, DHA levels in breast milk are lower than normal due to low dietary consumption of DHA.

"We want to extend the range of products that contain high levels of DHA to incorporate this important fatty acid into the general food supply," says Hill. "Cheese and other dairy products are widely consumed and can act as valuable carriers for DHA."

## COWS AS "BIOREACTORS"

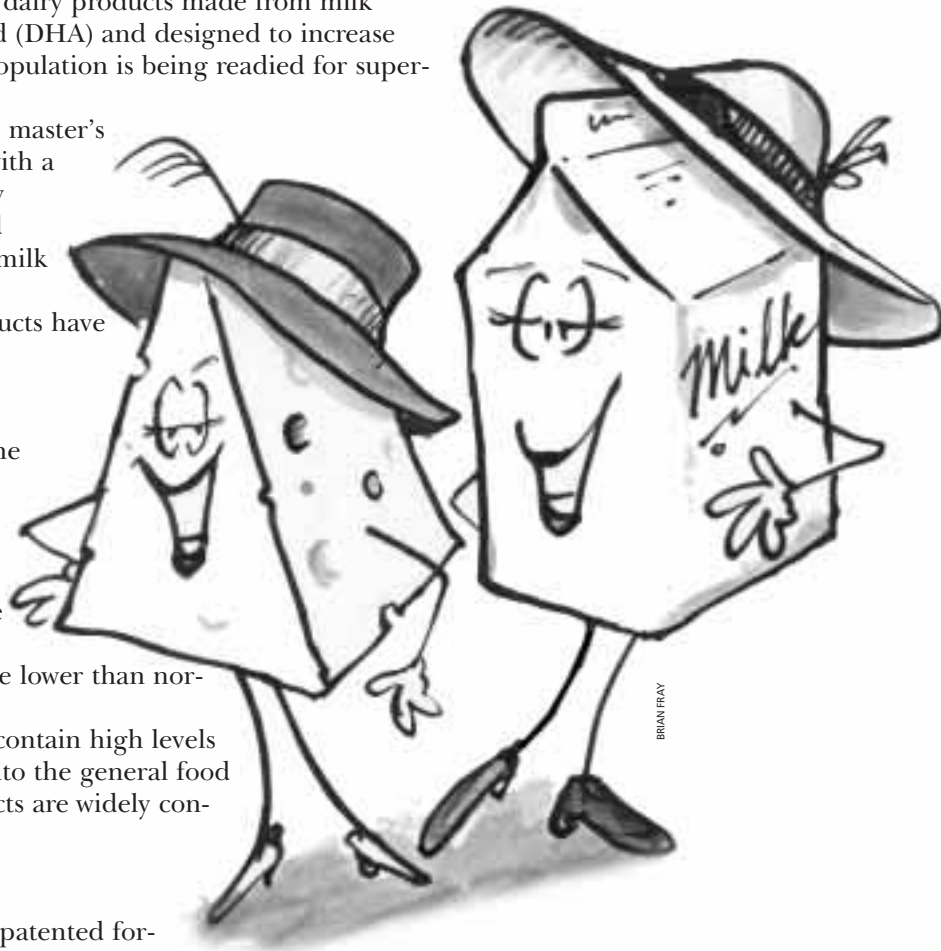
The process begins with DHA-enriched milk, a patented formula developed by University of Guelph animal science researchers Brian McBride and Tom Wright. They add fish meal to dairy cattle feed to boost the animals' consumption of DHA. The cows then act as "bioreactors" and effectively transfer DHA from their diet to their milk.

On its own, DHA is less stable than other fats. That leads to concerns that dairy products made from DHA-enriched milk would spoil more quickly than products made from regular milk. Cheese that's been on the shelf for too long, for example, oxidizes and develops a cardboard flavour. But to Hill's surprise, DHA-enriched cheese didn't oxidize any more quickly than control cheese in laboratory experiments. The reason, he discovered, is that DHA is naturally stabilized when cows incorporate the fatty acid into fat globules in their milk.

## TASTE PREFERENCE NOTED

"Taste panelists actually preferred the flavour and texture of the DHA cheese," he says. "The stronger cheese flavour is one consumers tend to favour."

Hill's research team has also looked at the processing qualities of DHA-enriched milk for the production of butter and possibly ice cream. Steps are being taken to patent the process for making these DHA-enriched dairy products. 🍓



# Healthy animals, safe food

*Animal Health Laboratory helps ensure food safety in Ontario*

BY NATASHA MARKO AND CAROL PILLEY

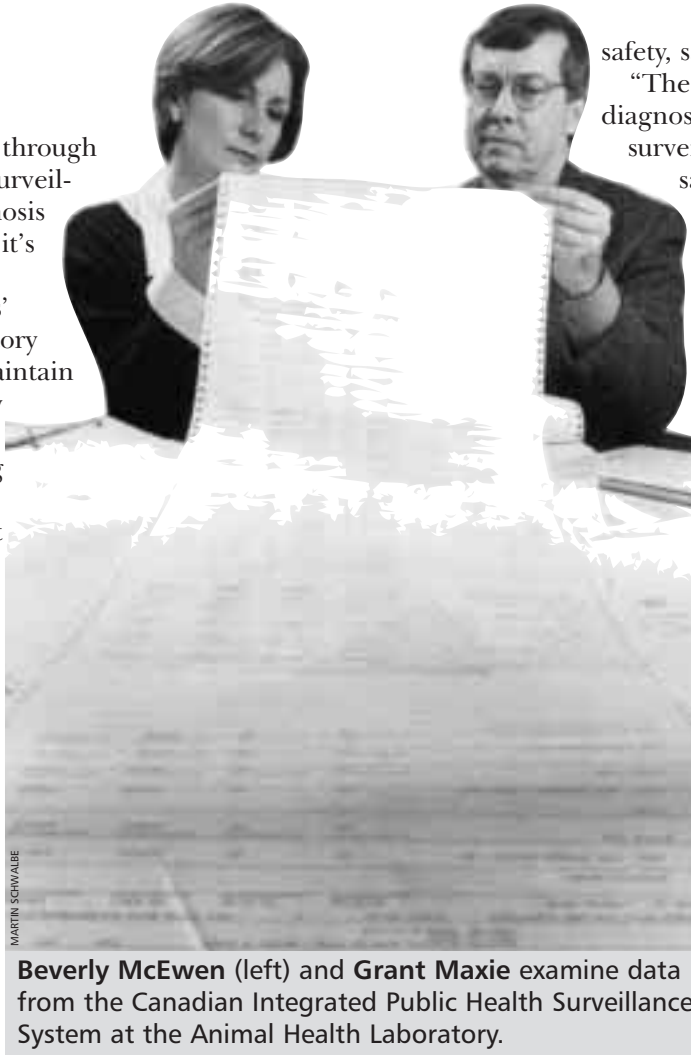
**S**afe food through disease surveillance, diagnosis and research — it's a cornerstone of Laboratory Services'

Animal Health Laboratory (AHL). The lab helps maintain food safety in Ontario by carefully monitoring disease trends and ensuring healthy animals.

The AHL involvement with food-producing (not just companion) animals, as well as its association with highly skilled diagnosticians and university faculty, gives the lab a unique position in animal health. It also makes it a perfect partner for a wide array of interests.

Last spring, for example, the lab and Health Canada embarked on a project to create a new database development project for disease surveillance. Diagnostic data from the AHL, Health Canada and the food microbiology unit of Laboratory Services is being entered into a data-management system through the Canadian Integrated Public Health Surveillance System (CIPHS). If a disease outbreak occurs in a population of food-producing animals or in humans in Canada, the CIPHS can be accessed to trace any common disease links between the two populations.

This kind of program is beneficial in ensuring food



**Beverly McEwen (left) and Grant Maxie examine data from the Canadian Integrated Public Health Surveillance System at the Animal Health Laboratory.**

safety, says AHL manager Grant Maxie. "The AHL plays a critical role in diagnostic services that support disease surveillance, public health and food safety," he says. "This program is just one example of what makes the AHL cutting edge."

Many AHL research initiatives are oriented towards food safety. They include a two-year collaborative project with Health Canada, the Ontario Ministry of Agriculture, Food and Rural Affairs and the University of Guelph's Department of Population Medicine to survey bacterial resistance to microbes in food-producing animals. Researchers hope to gain a better understanding of the emergence and distribution of microbial-resistant bacteria. It's a topic that's driving both human and animal health — microbial overuse has led to the emergence of bacterial strains that are resistant to once-powerful remedies.

"More information on the frequency and distribution of resistant bacteria in Ontario is necessary to prioritize research and regulatory activities in food safety," says Maxie.

Diagnostic testing of animal samples is a core function of the AHL, with bacteriology and toxicology representing only some of the areas in which analytical testing is available. Producers and veterinarians work together with the AHL to prevent and control disease and to promote healthy food-producing animals.

For more information about AHL services and research, visit the Web site [www.uoguelph.ca/labserv](http://www.uoguelph.ca/labserv).

# Is the Monarch out of the woods?

*New research suggests Bt corn will not spell the end of this butterfly*

BY JESSICA WHITMORE

The Monarch butterfly is alive and well, despite exaggerated and misleading reports that biotechnology is threatening it, says a University of Guelph researcher.

Field research conducted by Prof. Mark Sears, chair of the University of Guelph's Department of Environmental Biology and chair of the Canadian Corn Pest Coalition, shows pollen from Bt corn — *Bacillus thuringiensis*, a naturally occurring soil-borne bacterium that selectively targets specific groups of insects — is not found in high enough doses on most milkweed plants (the food plant of the caterpillars) to hurt Monarch butterfly larvae.

Although Bt is harmless to humans and other animals, a U.S. study claimed pollen from BT corn damaged Monarch butterfly larvae. The study sparked a media frenzy and public concern about genetically modified foods.

Sears says the U.S. study didn't demonstrate to what extent its preliminary findings applied to field situations. The study was completed in a lab, and the dosage of pollen used wasn't reported.

"The actual threat to the Monarch butterfly can only be determined by assessing the dosage that affects the larvae and their degree of exposure to BT corn pollen in the field," says Sears.

Sears is leading a two-year project to determine the ecological impacts of BT corn pollen on selected non-target butterfly species, including the Monarch. So far, studies indicate that BT corn is not as big a threat as some environmentalists and the news media had anticipated.

"Outside of cornfields, you probably wouldn't find concentrated dosages of pollen because wind and rain remove it from the surface of the milkweed leaves," says Sears.

His study focused on Bt pollen and how far it travels. He examined milkweed stands in cornfields, at their

**So far, studies indicate that Bt corn pollen is not as big a threat as some had anticipated.**



CANDICE SLACK

Mark Sears is looking at the effect of Bt corn pollen on the Monarch butterfly.

edges, then at distances of five, 10, 25, 50 and 100 metres away. He found that within the fields, approximately 150 pollen grains/cm<sup>2</sup> were found on milkweed leaves. At the field edges, 80 to 100 grains/cm<sup>2</sup> were found, and at five metres, only one grain/cm<sup>2</sup> was found. He then compared these findings with values obtained from a "dose-response assay" — from which data of increasing doses are plotted against increased mortality rates — to determine dosages with negative effects on Monarch butterfly larvae.

Results show that 135 grains/cm<sup>2</sup> — the lowest dosage he has tested on milkweed leaves so far and similar to that found on milkweed leaves in the field — had no greater effect on Monarch larvae than when they were fed non-Bt pollen.

"Our findings are consistent with other studies across North America," says Sears. "BT corn has always shown to be harmless to both humans and animals, and we now know it isn't a major threat to the Monarch butterfly."

Sears is being assisted by research associate Diane Stanley-Horn and research technician Heather Mattila from the University of Guelph, along with seed industry representatives and corn growers. His research is sponsored by the Canadian Food Inspection Agency and Environment Canada.

DAVID ELLIOT



# Exposing bacteria

*Detection methods for bacterial biofilms are further refined*

BY MIRJANA VRBASKI

**D**isease-causing bacteria that form on food-processing equipment and packaging will have less chance of surviving as University of Guelph researchers refine pathogen detection methods.

Heidi Schraft detects bacteria, even if they hide beneath a biofilm.

Food science professor Heidi Schraft and graduate students Nan Tang and Min-Seok Chae are taking aim at something called “bacterial biofilms,” small colonies of bacteria surrounded by plaque-like substances. The coating makes them resistant to environmental stresses — such as sanitizers and heating, which would normally kill them — and to conventional detection techniques.

The researchers have targeted *Campylobacter*, a bacterium frequently found on raw poultry products that can cause food poisoning. This pathogen can survive for days in its natural environment (food, water, slaughterhouses), but it dies within hours when artificially grown in the laboratory, making it difficult to study.

The researchers have found, however, that when *Campylobacter* is grown in the presence of another microbial species such as *Pseudomonas*, it can develop a protective biofilm and survive in the lab for up to three days. They believe it’s possible that similar mixed-culture biofilms play an important role in the survival of *Campylobacter* in food-processing environments.

The team is also looking at non-culturable and difficult-to-detect bacteria in biofilms. During regular quality-assurance checks in the food industry, swab samples are normally taken from processing equipment and grown on common growth media to detect bacteria. But some culturable bacteria in biofilms can switch to a non-culturable state, in which they remain alive and infective but don’t grow on common media. This enables some bacteria to slip through conventional detection techniques.

To find ways to quantify non-culturable bacteria, the researchers are studying *Listeria monocytogenes*, a food-borne bacterium found in some heat-treated deli meats. They’re using a fluorescence labelling technique to accurately determine the percentage of non-culturable bacteria in *Listeria* biofilms. So far, they’ve shown that in six-day-old *Listeria* biofilms, about 10 per cent of the bacteria are viable but non-culturable.

The next step will be to understand how and why some bacteria make the transition from a culturable to a non-culturable state.

“It’s crucial to understand how biofilms form and operate,” says Schraft. “Once we can establish that, we can use the knowledge to improve microbial detection and elimination techniques even further.”

This research is supported by the Natural Sciences and Engineering Research Council, the Ontario Ministry of Agriculture, Food and Rural Affairs Food Program, and the Ontario Cattlemen’s Association. 🍎

**“Once we establish how biofilms form and operate, we can use the knowledge to improve microbial detection and elimination techniques.”**

# Fish could get a longer life . . . on the shelf

*Researchers target better quality through oxidation control*

BY CHRISTINA CLARK

North Americans have been eating more fish over the last few decades, and the aquaculture industry would like to see that trend continue. But as fresh fish products age on store shelves, “off” odours and flavours arise that can discourage consumers from future purchases.

To keep the industry competitive, U of G researchers are trying to increase the shelf life of fresh fish products. Profs. Yukio Kakuda and Richard Moccia and graduate student Katherine Tozer are studying the factors involved in initiating a chemical reaction called oxidation, which leads to changes in both odour and flavour that can decrease product palatability.

## CONSUMERS: KEEP THEM COMING BACK

“We hope to increase the shelf life of fresh fish products by up to several days,” says Moccia. “Significantly extending the shelf life and quality of aquaculture products will keep consumers coming back and will eventually increase the per-capita consumption of fish.”

Fish contains a relatively high amount of unsaturated fatty acids (a type of lipid), which are particularly susceptible to oxidation. By studying oxidation reactions in fresh fish, the researchers hope to eventually develop procedures that will inhibit or slow down this degradative reaction.

“Determining the extent of post-processing lipid oxidation is one of the goals of this project,” says Kakuda. “This information will tell us how significant lipid oxidation is in limiting the shelf life of fresh fillets and other fish products.”

## GAINING A GREATER MARKET SHARE

In most cases, fresh fish products become unpalatable before they’re unfit for consumption. But there’s a pivotal point where the “off” flavours and textural changes caused by oxidation decrease the products’ appeal, even though they’re still safe to eat. For the fish

industry, it’s a major obstacle to gaining a bigger share of the meat market.

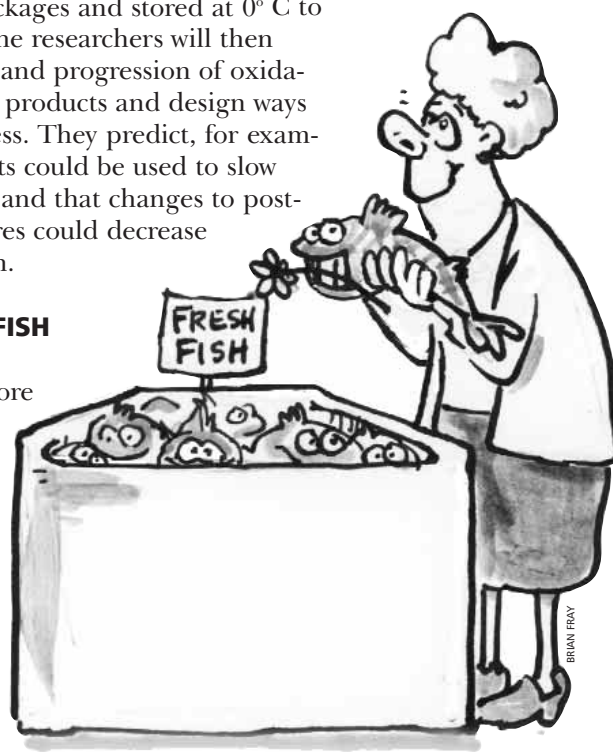
To understand the extent and progression of oxidation, the researchers will study fresh fillets from three popular aquaculture species — rainbow trout, arctic char and tilapia — as well as deboned trout meat. The fillets will be placed in plastic packages and stored at 0° C to -4° C for 20 days. The researchers will then compare the extent and progression of oxidation in the different products and design ways of slowing the process. They predict, for example, that antioxidants could be used to slow down the reactions, and that changes to post-processing procedures could decrease the rate of oxidation.

## CHALLENGES TO FISH FRESHNESS

Under optimal store display conditions, fresh fish products have a shelf life of only a few days, which is significantly shorter than for other fresh meat commodities. In addition, fish meat is more susceptible to changes in storage temperatures that don’t affect other meats as quickly. This makes the marketing of Ontario’s high-quality aquaculture products a challenge and directly affects the long-term competitiveness of the industry.

Moccia says extending the shelf life of fresh fish will greatly benefit the aquaculture industry, both by aiding market expansion and by enhancing customer satisfaction. Together, these could help increase consumer demand for fresh fish even further.

This research is sponsored by the University of Guelph/Ontario Ministry of Agriculture, Food and Rural Affairs agri-food and rural research program.



# Moroccan food for markets afar

BY MARGARET BOYD

Morocco is rich in fish, seafood, citrus and olive oil, but is unable to meet its export potential because of inconsistent quality. The University of Guelph is co-ordinating a three-year, \$1.2-million project to help the Moroccan food industry boost sales abroad and meet international standards for quality assurance.

Guelph's expertise in food research and its affiliation with the francophone Collège d'Alfred (Morocco is a French-speaking country) was pivotal in securing the project, which will be administered by Collège d'Alfred. Laboratory Services, the Guelph Food Technology Centre (GFTC) and the Department of Food Science are involved in training and consultation.

"The goal is to help Morocco lead the way in international standards," says Charles Goubau, head of client-based training and services at Alfred. "There were concerns that Morocco would lose export markets because it wasn't meeting international standards for quality assurance."

## PROGRAM GOALS

The Guelph-Morocco project has three phases:

- teaching trainers to train food-industry personnel;
- helping the food industry achieve Hazard Analysis Critical Control Point (HACCP) and International Standards Organization (ISO) certification, international standards for quality assurance management that are demanded by today's global market; and
- establishing HACCP and ISO training and certification programs in Morocco.

The first phase of the project is already under way. In June, Moroccan food scientists Dalila Demnati and Amar

Kaanane of the Institut agronomique et vétérinaire Hassan II in Rabat attended training programs at the GFTC to learn about quality assurance man-

agement. They spent the month attending HACCP and ISO workshops and visiting local food-processing plants that had recently implemented HACCP.

The GFTC is Canada's largest HACCP training facility for the food industry. It provides comprehensive courses

*Guelph makes international connections in quality standards*



in English and French for food plants and the retail and food-service sector. The Institut agronomique et vétérinaire Hassan II has 2,000 students and conducts widespread extension work.

Demnati and Kaanane plan to take the knowledge they gained back to Morocco and use it to develop courses to meet local food-industry needs.

## TRAVELLING FOR TRAINING

The second phase of the project began last fall. GFTC personnel will travel to Morocco to initiate a year of training with a select group of food processors. This group will receive training in HACCP and ISO implementation.

Once the Morocco-based pilot project is completed, the third phase of the project will be implemented to provide comprehensive HACCP training and certification throughout Morocco and, eventually, in other African countries.

"The main goal is to train people," says Kaanane. "There is no organized centre to help implement HACCP now in Morocco. In the future, we hope the institute will become a service like the GFTC, providing research, development and training for the food industry."

This project is sponsored by the Canadian International Development Agency through the PRICAM project (Programme de renforcement institutionnel Canada-Maroc), which is jointly administered by the Association of Universities and Colleges of Canada and the Association of Community Colleges of Canada. 🍷

***"The goal is to help Morocco lead the way in international standards."***

# Monitoring milk

*New test identifies specific antibiotic residues*

BY CAROL PILLEY

Antibiotic residues in milk will be easier to pinpoint because of a new test developed by the University of Guelph's Laboratory Services.

Laboratory Services is responsible for all milk testing in Ontario, including the screening of antibiotic residues in milk samples from dairy farms. It tests about 7,000 raw milk producer samples a month for antibiotics.

Although current screening methods detect the presence of antibiotics, they don't identify exactly *which* antibiotic triggered the positive test result. Trace amounts of antibiotics have been known to cause allergic reactions in humans, and there is concern that repeated consumption of milk containing antibiotics could result in the accumulation of antibiotic-resistant bacteria in humans.

This is where the new test will come in. It's based on sensitive analytical technology called high performance liquid chromatography, which can detect and quantify cephapirin (a commonly used antibiotic in the dairy industry) in milk samples at extremely low levels.

"Pinpointing antibiotics is essential to ensure consumer trust in the safety of milk," says researcher John Lynch, who is developing the test with colleague Louise Spilsbury.

Laboratory Services screens all milk samples in Ontario for beta-lactam antibiotics, a popular family of antibiotics that includes penicillin G, cephapirin and many others. Cephapirin is used to treat dairy cows suffering from mastitis, an inflammation of the udder most often caused by bacterial infection. Mastitis can affect the appearance of milk and can also result in reduced milk yields.

When cephapirin is used to treat mastitis, the producer is not allowed to market milk from the treated cows for several days after treatment. This ensures there will be no traces of antibiotic left in the milk. But sometimes producers don't wait long enough to start marketing milk again. They often don't know exactly when all the antibiotic has left their cow's system.

**"Pinpointing antibiotics is essential to ensure consumer trust in the safety of milk."**



Louise Spilsbury and John Lynch screen for specific antibodies in milk supplies.

If antibiotic residues are detected in milk samples during screening and are above the maximum residue limit, producers face a financial penalty. They can choose to pay the fine or appeal it to the Dairy Farmers of Ontario (DFO) appeal tribunal, a quasi-judicial body that manages such cases in the agri-food industry.

Spilsbury says this test will be useful for the DFO when a producer appeals a penalty. It's more difficult to dispute a case if the DFO can provide information on exactly which antibiotic was above the limit. If the producer's cows were recently treated with cephapirin — and the new test provides accurate confirmation — the DFO could be confident citing the source.

The test might also be useful for veterinarians trying to resolve problems for producers concerned about their antibiotic treatment program.

"Accurately identifying and quantifying specific antibiotics such as cephapirin will support dairy inspection programs," says Spilsbury. "This will make producers accountable and, most of all, keep our milk safe."

This research is sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs.

# New centre ensures clean water for quality food production

Research and Technology  
Section Alfred College

Anna Crolla is helping develop new technologies that clean waste water and reduce operating costs for the food industry.



an Water Agency



BY MARGARET BOYD

Everything — including food production — depends on clean water. And ensuring the wise use of treated waste water in areas without sewers is a key element of the new Ontario Rural Wastewater Centre (ORWC), located at the University of Guelph and Collège d'Alfred.

The research and training centre, created with support from the Ontario Ministry of Economic Development and Trade and the Ontario on-site waste-water treatment industry, works with rural sectors to devise innovative new on-site treatment systems for waste water.

Keeping up with the challenge of treating unsewered waste water produced in Ontario will have a positive impact on food production and the environment, says Claude Weil, research director at Collège d'Alfred and general manager of the centre.

"You can't produce food without clean water, and you must also control the quality of the waste water resulting from food production and farming activities," he says. "We're working with agri-food industries, including dairy, swine and slaughterhouses, to develop water-treatment systems that are efficient and environmentally friendly."

Areas of active research and development include:

- a flocculation and adsorption reactor to treat dairy-barn wastes;
- in-situ methods of disinfecting maple-sap tubing;
- methods of treating swine manure; and
- membrane filtration systems.

Slaughterhouse waste systems have the potential to reduce disposal and treatment costs. Studies by Alfred researchers and the National Research Council's Institute for Environmental Research and Technology show that treating chiller-tank effluent by membrane filtration can produce potentially recyclable water. For slaughterhouses looking to increase production, this technology can be an economical alternative to paying for haulage or increasing the capacity of the septic system, the two traditional methods of disposal.

The technology developed by Alfred researchers Ian Malcom, Anna Crolla and William Kollaard can also be used to discharge waste water into an open watercourse. The system is based on high-pressure membrane-based filtration of waste water after prefiltration has removed large particles. The pilot system has the capacity to handle 200 litres of waste water every 15 minutes.

Crolla says their studies show that the system removes 98 per cent of organic carbons and bacteria from chicken abattoir chiller waste water and up to 90 per cent of organic carbons and bacteria from red-meat slaughterhouse waste water. "If the volume of waste can be reduced, it will reduce operating expenses," she says.

If studies prove the membrane filtration system can treat slaughterhouse waste water on a large-scale basis, says Weil, the food industry will have a new economical method of wastewater disposal or — even better — reuse. 🍓

**"We're working to develop water-treatment systems that are efficient and environmentally friendly."**

# Dealing with veggie vulnerability

*Greenhouse growers adopt food-safety program*

BY JUHIE BHATIA

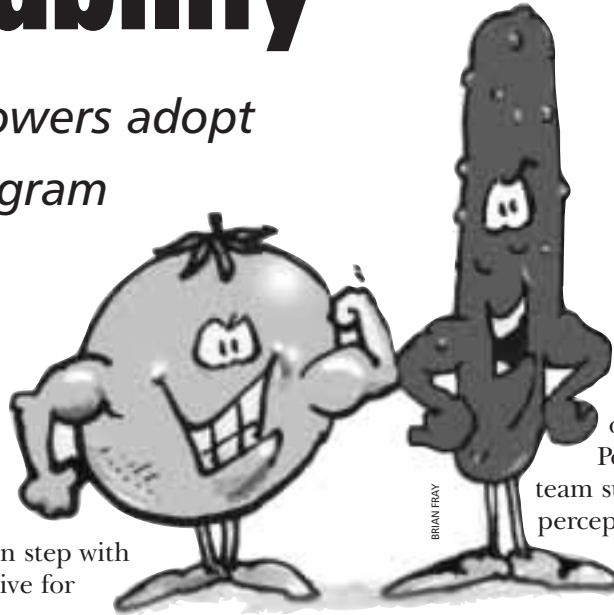
**G**reenhouse growers are right in step with Canada's drive for safe food.

The Ontario Greenhouse Vegetable Growers' Association has joined forces with Prof. Douglas Powell, Plant Agriculture, and graduate students Mauricio Babadilla-Ruiz and Amanda Whitfield to help develop and launch an on-farm food-safety program.

Whitfield is visiting the 220 greenhouses and packing sheds in Ontario to help implement and educate growers on various strategies for on-farm food safety.

"The plan is to help Ontario growers decrease the risk of microbial contamination of greenhouse-grown tomatoes and cucumbers," says Powell. "This will aid in the delivery of a safer, high-quality product."

Greenhouse vegetables are generally less susceptible to food-safety problems than other sectors of primary production because of their protected growing environment. And although they're not troubled by external hazards such as manure runoff, wildlife contact or spray drift, other risks remain. Potential contamination sources are endless, from bacteria in the water supply to poor sanitation practices. Powell says these risks must be identified and controlled from the farm to the consumer's kitchen table, especially because vegetables are often eaten raw.



While developing the on-farm safety program, Powell and his research team surveyed growers on their perceptions of greenhouse food safety. Then they developed guidelines specific for Ontario greenhouses

that were modelled after food-safety programs of several U.S. producer groups and government agencies. These guidelines outline preventive measures to identify and control microbial threats following Hazard Analysis and Critical Control Points (HACCP) principles. HACCP is a multi-step, proactive food process control system used to ensure food quality.

Success of the food-safety program will depend on growers' understanding of how the guidelines work. As part of his

research, Powell also conducted baseline microbial testing of dump-tank water and end-product quality in Ontario greenhouses last year.

Microbial data will be collected again after the program is implemented to see if the guidelines are being followed. If results

suggest the program isn't effective in increasing greenhouse vegetable safety, the problems will be identified and changes will be enacted. Surveys will also be redistributed to see if changes have occurred in growers' perceptions of food safety.

This work is sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs and the Ontario Greenhouse Vegetable Growers' Association. 🍅

**"Risks must be identified from the farm to consumers' kitchens because vegetables are often eaten raw."**

# Skilled, certified and state-of-the-art

Canada's food inspection arm beefs up research and education



BY CAROL PILLEY

Courtesy of CFIA  
**C**onsumers expect their food to be safe, and a new partnership between the University of Guelph and the Canadian Food Inspection Agency (CFIA) is designed to help meet those expectations.

In January, the University and the CFIA formally joined forces to advance skills and knowledge in food-safety regulation. University of Guelph president Mordechai Rozanski and CFIA president Ron Doering jointly announced the initiative, which includes:

- creation of the Canadian Institute for Food Inspection and Regulation based at U of G and a joint research committee to co-ordinate the institute's research program;
- creation of a CFIA regulatory chair at the institute;
- support for the Students Promoting Awareness of Research Knowledge (SPARK) student research writing program;
- establishment of a CFIA President's Scholarship program for three graduate students and jobs for up to 10 co-operative education students at the agency.

The ultimate goal of this effort is to further strengthen Canada's food-safety system. Canadians already have one of the best food inspection systems in the world; the CFIA is committed to a strong regulatory program and food-safety system.

"Food safety for Canadian consumers, and animal and plant health are our top priorities," says Doering.

"They will be enhanced through our partnership with the University of Guelph as we build on common goals and strive for excellence."

Participants in the new institute will be involved in research, education, communications and program support. The institute will increase the scope of research for both the University and the CFIA on issues such as food safety and policy formation.

CFIA officials are close to new problems and issues affecting Canada's food system. Having a direct connection to Canada's most research-intensive university in the agri-food arena will enhance the agency's scientific, regulatory and policy work, says Doering.

Adds Rozanski: "This new institute will enhance the country's research base, attract bright minds, initiate careers and improve our food regulation and inspection capabilities, to the benefit of all Canadians."

**T**he CFIA was created in 1997 after the Canadian government consolidated all federal food inspection and quarantine programs into a single agency. The agency deals with inspection services in Canada related to food safety, consumer protection, economic fraud, marketplace-related requirements, and animal and plant health programs.

The minister of agriculture and agri-food is responsible for the management and operation of the agency. The CFIA administers and enforces a number of federal acts, including the Canada Agricultural Products Act and the Health of Animals Act.

BY CAROL PILLEY

# A winning platform:

## *New approach identifies nasty food-borne bacteria*

New advances in rapid detection and typing of toxin-producing

bacteria are on the horizon at U of G's Laboratory Services.

The University and Health Canada have signed an agreement with Third Wave Technologies of Madison, Wisconsin, to use the company's patented platform technologies to find better ways of discovering and identifying *Shiga* (a bacterial toxin) toxin-producing *Escherichia coli* (STEC) bacteria.

### **MORE THAN 100 TYPES EXIST**

There are now more than 100 different types of STEC bacteria. Infection of humans by these micro-organisms can cause symptoms such as diarrhea and kidney failure and, in severe cases, can even cause death. The 0157:H7 *E. coli* is the most commonly reported — it's the culprit known to cause "hamburger disease." In recent years, there have been outbreaks of 0157:H7 infection from contaminated meats, non-pasteurized apple juice and alfalfa

sprouts in Canada, the United States and Japan. They're certainly not common, but when they do surface, they can be deadly.

Various methods are available for detecting these bacteria in food, but none can simultaneously detect and type STEC bacteria. If bacteria are found, they must be isolated in an expensive pure culture to determine what type they are, a process that can take weeks.

That's where the collaborative research project of Health Canada, Laboratory Services and Third Wave differs. It will enhance a current Laboratory Services fluorescent detection technology by allowing it to simultaneously detect and type different kinds of STEC bacteria without using pure culture. This improved method should take only 36 hours.

"With Third Wave's platform technologies, we believe we can provide faster, less expensive and more accurate detection and typing of STEC bacteria," says Shu Chen, who heads up new-technology development at U of G's Molecular Supercentre. 🍷

Kahntact ad

# Flax . . . the ultimate functional food?

*Lab tests show oil from flaxseed sparks improved immune development*

BY CRYSTAL NORRIS  
AND MIKE WEST

*A* gri-food industry veterans sometimes shake their heads at the term “functional foods,” the catch-all describing commodities with new and unique health or nutritional properties. Isn’t all food “functional,” they ask? After all, it provides nourishment and the very basics of life.

But here’s an unexpected function of a food that’s been around for ages. University of Guelph nutritional sciences professor Bill Woodward has found that oil from flax — a staple Canadian prairie crop for decades — may improve immune defences. It’s worked in preliminary studies with laboratory mice, and further research is planned.

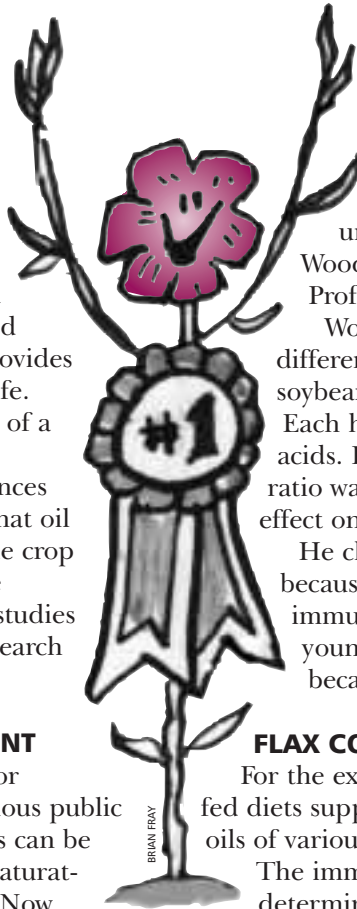
## BOOSTING IMMUNE DEVELOPMENT

This finding could be significant for Canadian farmers. The health-conscious public is highly aware that heart health risks can be reduced by consuming foods low in saturated fats and high in unsaturated fats. Now, Woodward believes it’s possible that immune development could also be stimulated by consuming oils with specific characteristics.

“I think there’s a definite possibility of being able to use flaxseed oil in a diet to improve immune defences,” he says. “The next step will be to apply this research to humans.”

Flax, which is well adapted to Canadian growing conditions, could play a leading role in this new frontier. Canada produces about 40 per cent of the world’s 2.78 million tonnes of flaxseed. Developing flax to boost immune development would greatly add value to the crop.

For his research, Woodward looked at two types of unsaturated fatty acids in plants, n-3 and n-6. The n-3 fatty acid — commonly known as



omega-3 — has gained fame recently for its role in reducing the incidence of heart disease and improving mental and visual functions in humans (a leader in the understanding of omega-3s is Woodward’s departmental colleague Prof. Bruce Holub).

Woodward chose to test diets with six different types of plant oils: safflower, corn, soybean, canola, flaxseed and olive oil. Each have varying ratios of n-3 to n-6 fatty acids. His goal was to determine which ratio was optimal for creating a positive effect on immune response.

He chose to look at weanling mice because — as with all animals — the immune response is developing in the young, and mice are good subjects because they mature quickly.

## FLAX COMES IN FIRST

For the experiments, groups of 20 mice were fed diets supplemented with each of the six plant oils of various concentrations and proportions.

The immune response of the mice was then determined.

Woodward’s results consistently showed flaxseed oil had the most positive effect on the development of immune competence. He believes the level of n-3 fatty acids in flax oil is partly responsible for the improved immune response, although an even more important feature may be a low level of n-6 fatty acid. Other oils — olive, canola and soybean, in that order — fared well, too.

Woodward is nearing the end of his three-year study. The major funding sources for this research were the Ontario Soybean Growers’ Marketing Board and the Ontario Ministry of Agriculture, Food and Rural Affairs. Oil samples were provided by Omega Nutrition Canada Inc. of Vancouver. 🍓

# A sweet solution



*Genetics and traditional pest-control methods are recruited to fight migratory mites*

BY LAURA LEVAC



As honeybee colonies slumber through the harsh winter season, two potentially devastating parasitic mites are threatening their survival — and the future of Ontario agriculture.

The problem is actually two parasites — the tracheal and varroa mites — that have migrated from the United States and are making a new home in Ontario beehives. These mites have the potential to devastate the province's bee population, causing not only a shortage of honey but also major problems for fruit and vegetable producers who rely on bees to pollinate their crops. It's estimated that honeybees account for 80 per cent of all pollination and are responsible for ensuring about one-third of the food supply.

But a research program at the University of Guelph is stemming the potential devastation with an integrated program that uses genetics and traditional pest-control methods. Led by Medhat Nasr, a technology transfer specialist for the Ontario Beekeepers' Association based at U of G, the program has achieved an 80-per-cent drop in mortality rates in bees infected with mites and increased the production of queen bees — which are crucial for commercial beekeeping — from 2,500 in 1990 to about 15,000 in 1999.

"Bees are mainly used for crop pollination in Ontario, not for honey production," says Nasr. "If these parasitic mites take over, we'll see a drastic decline in crop yields over the next few years."

Varroa mites infect bees at an immature stage in their development, leading them to grow into adults with deformed wings, low weight and a greatly reduced lifespan. Equally devastating is the tracheal mite, which lives inside the bee's trachea (breathing tube). Once inside, tracheal mites breed and reproduce, filling the bee's trachea with their offspring and inhibiting breathing capacity. If an infected bee doesn't suffocate, its ability to fly long distances to pollinate crops is hindered.



***"If these parasitic mites take over, we'll see a drastic decline in crop yields."***

Nasr is using integrated pest-management (IPM) techniques to control

the mites. Rather than relying solely on chemicals for pest control, IPM integrates other methods such as breeding and special management practices to keep pest populations at bay.

Recently, Nasr successfully bred bees that are attractive to the tracheal mites for a shorter span of their life, decreasing the opportunity for mites to infect young bees.

Nasr has also studied the effectiveness of formic acid as a means of repelling mites. Formic acid is a natural product produced by ants and is also found in honey. Nasr found formic acid to be 90- to 95-per-cent effective against both tracheal and varroa mites, and it leaves no residue in the honey or wax.

Part of Nasr's mite-control program involves alternating the use of Apistan — a chemical currently used to control mite infestations — with formic acid. Generally, Apistan is applied to hives twice a year, but by alternating it with formic acid, beekeepers need to apply it only once. This reduces chemical use and delays the emergence of Apistan-resistant mites, which Nasr says have already emerged in the States.

"IPM doesn't lead to the complete eradication of the mites," he says, "but it does reduce the likelihood of beekeepers becoming over-reliant on a pesticide. It's more effective in the long run."

This research is sponsored by Agriculture and Agri-Food Canada through the CanAdapt program (administered by the Agricultural Adaptation Council), the Ontario Ministry of Agriculture, Food and Rural Affairs and the Ontario Beekeepers' Association.



Medhat Nasr is giving bees a helping hand.

# Good food, from the ground up

*Start with the best for uncompromised results*

BY MARIANNE CLARK

Food quality is reaching unprecedented heights, thanks in large measure to food research. The food industry is determined to get research and development information into the hands of hungry consumers and show people what a superb food system we have.



**Marianne Clark**

Jeff Stewart, an instructor in the University of Guelph's School of Hotel and Food Administration — and a culinary enthusiast — says knowing where our food comes from only makes it better. He believes Canadians aren't as aware as we could be — or should be — about the food we buy and eat.

He wants to see this change. And it's reflected in his classroom, which is also his kitchen, and the restaurant in which he instructs.

Stewart teaches Guelph's fine-dining course. It involves students in all aspects of running their own restaurant — from designing the menu to preparing the foods — complete with paying customers who routinely look forward to the array of foods the students present. The restaurant, in fact, is one of eight area eateries to win an inaugural award from the Wellington-Dufferin-Guelph Health Unit, recognizing healthy food choices, food safety and non-smoking seating.

Stewart stresses the importance of ingredients and brings a new dimension to the food Canadians eat. He challenges his students to think about ethical and labour issues that may be associated with certain foods and hopes consumers outside the University will do this, too.

Often shopping is based on price alone. Little consideration is given to other factors. But really, we should think about where the product comes from, the labour involved and its history.

Stewart's interested in the many processes food goes through before it reaches our plates. Fine food starts, appropriately, at the start — with good soil or feed, proper care and the right fit between the product and the environment.

When consumers buy food at the local grocery store or dine at a fancy restaurant, they rarely stop to consider this. Farmers are the unsung heroes of the culinary world, says Stewart. When we eat a fine meal at a restaurant, the

chef's talent is highly and appropriately praised, but a dish is only as good as its ingredients. If you don't start with the best, the end results will be compromised.

Another aspect of the food chain that's often overlooked is the research involved in food development. The University conducts front-line research that contributes to the quality and growing potential of food crops ranging from cherries, berries and beans to pork, beef and fish.

Food research developments appear on the following pages, in the Guelph Food Inventory. Last fall, the University of Guelph became the first educational institution to launch its own inventory, consisting of foods researched, developed and enhanced during more than 100 years of campus-related research.

Stewart sees this as an invaluable tool that can be used to increase consumer awareness of how research contributes to Canada's food supply. We have all this great

food, but its origins are a mystery to some people. The Guelph Food Inventory can help change that and motivate people to take pride in our culinary heritage.

I think knowledge makes food taste better because you're more at ease knowing where it came from. And for me, there's a certain comfort knowing it came from Guelph.

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*Marianne Clark is a fourth-year applied family and social relations student.*



**Jeff Stewart at home in his "classroom."**