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# 50 Years of Food Science Innovation

**Food science research spans a range of topics and issues from food safety and processing to product development.**
PHOTO: ARIANA LONGLEY

The University of Guelph's Department of Food Science has been at the forefront of innovation for 50 years, since the School of Dairy Science was renamed in 1968 and its scope transformed and broadened.

Today, researchers in the department are engaged in a broad range of topics and issues spanning food safety, processing and product development. They integrate physics, chemistry and biology to uncover the basics of food science and new advancements pertinent to agricultural commodities at home and abroad.

As a result of their efforts, the University of Guelph has risen to be one of the world's leading food research institutions, developing technologies and techniques that are used everywhere. They have been instrumental in helping U of G become widely recognized as Canada's Food University.

This newsletter highlights major research achievements that have emerged from the University of Guelph's Department of Food Science and gives a glimpse into new directions that influence how we create and consume food.

— *Malcolm Campbell*, vice-president (research)

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**The ice cream technology course is the only one of its kind in Canada.**
PHOTO: KAY NORWELL

## Managing ice crystal formation in frozen desserts

In ice cream circles, the University of Guelph is the go-to research institution, and **Prof. Doug Goff** is the recognized leader. Besides teaching the renowned annual ice cream science course, Goff researches how this sweet treat's ingredients give it a longer shelf life and stability. During distribution and storage, ice cream experiences temperature fluctuations, resulting in thawing and refreezing that cause ice crystal growth. That leads to lower-quality products. Goff studies how to prevent recrystallization by adding novel stabilizing ingredients like wheatgrass or banana fibres to change ice cream's freezing behaviour. His studies benefit consumers by determining which ingredients to use in mass-produced ice cream, as well as commercial distribution and freezer conditions.

## Examining starch complexity to improve food processing understanding

Starch's complexity can now be examined more thoroughly to learn more about various food processes. A multidisciplinary team from the University of Guelph — **Sanaa Ragaee** and Profs. **Massimo Marcone**, **Ian Tetlow** and the late **Koushik Seetharaman** — along with colleagues from Agriculture and Agri-Food Canada and the Swedish University of Agricultural Sciences unfolded the molecular structure of starch granules. They developed a model for the amylopectin structure of different starches, helping to explain starch properties such as gelatinization, retrogradation and annealing. Understanding structure and function of starches is key in food applications.

## Cryo-preparation promotes better imaging

A mosaic of microscopic compounds forms the structure of food. In 1988, **Prof. David Stanley** pioneered a way to look at these structures with a scanning electron microscope. Earlier, food samples required chemical hardening before viewing through the instrument. However, artifacts of the preparation process lingered in the images. Cryo-preparation addressed this issue by freezing samples, rather than chemically hardening them. Stanley optimized the technique through cold stage and cryo-preparation of the samples, allowing food products to maintain their structure and rigidity during imaging. This way, researchers could more easily analyze the fat, protein and water in foods such as chocolate and yogurt. Stanley's technique is used by the **Guelph Food Innovation Centre** to help answer questions about food structure and stability, and to help develop new food products.

## High-speed sensors determine meat quality

**Prof. Emeritus Howard Swatland** sparked a new field of applied research involving fibre optics and food science with his bright idea to use infrared and UV light fibre optics to evaluate meat. Swatland's system used novel light frequencies to detect the protein and fat composition of meats like chicken, beef and pork. Today, using computer-connected probes, this rapid and non-invasive approach to quality control has been shown to be more effective and wide-ranging than traditional, visible light fibre optic methods. Swatland's research has had impact on current meat processing research, such as that of **Prof. Shai Barbut**. Barbut's research focuses on factors affecting meat quality and the use of non-meat ingredients to enhance texture, acceptability and yield of meat products.

## A new system for decontaminating produce

After an *E. coli* outbreak devastated the spinach industry in 2006, **Prof. Keith Warriner** and his team developed a new system for decontaminating fruits and vegetables by killing bacterial pathogens with UV light and hydrogen peroxide, a method called the advanced oxidative process. In 2014, when listeria invaded the candy apple market, Warriner developed a complementary waterless system for decontaminating produce via forced-air ozone gas. Both technologies have been commercialized, helping to decontaminate produce while reducing pesticide use and extending shelf life.

## Increasing sensory perception, improving mealtime

To tackle nutritional issues that arise with age, particularly in individuals with swallowing difficulties, **Prof. Lisa Duizer** made pureed foods more palatable. Typically, texture-modified foods are poorly consumed, leading to malnourishment among those with compromised aging health. Duizer emphasizes food's sensory aspect and believes that mealtime should be enjoyable, regardless of the consumer's health. She hopes to improve quality of life through enhanced food intake, ultimately making mealtimes an engaging experience, including in long-term care homes.

## Self-assembly of nano-size particles

Food nanoparticle expertise has helped **Prof. Michael Rogers** attain the role of chair of edible application technologies for the American Oil Chemistry Society. As the University of Guelph expert on nanoparticle self-assembly in food, Rogers uses nanotechnology to research food from production to digestion. He and his team look at how solvents surrounding nanoparticles affect their assembly and breakdown. He aims to develop an ingredient to turn unsaturated oils into gels that could replace trans and saturated fats. Rogers also analyzes food manufacturing methods to see how nanoparticles break down after consumption.

## Automated milk analysis started in this lab

When looking for the father of modern-day milk analysis, look no further than **Prof. Del Biggs**. Before his research, determining the fat, protein and lactose composition of milk involved costly and drawn-out chemical methods. In 1966, Biggs developed the infrared milk analyzer, which cut sample processing time from hours and days to seconds, and at one-tenth of the cost of traditional quality analysis techniques. Research into farm management practices carries on in Food Science. For example, **Prof. Gisele LaPointe**'s research advancements are now used in multiple dairy analysis labs to assist in selective breeding programs, in testing the effects of farm management practices on milk production and in determining milk quality in dairy herds.

## The science behind exotic delicacies

Strange encounters with exotic food became a normal occurrence for **Prof. Massimo Marcone** on research ventures abroad to study the composition of foods. He initially wanted to identify counterfeit products and banned substances as they cross borders. But further collecting and analyzing foreign feasts earned him the nickname of the "Indiana Jones of Food." Marcone is credited as the first person to study Kopi Luwak coffee, a treasured product made from beans in the scat of the Asian palm civet.

## Food oleogels: Toward healthier, hard-edible fats

In the pursuit to reduce trans and saturated fats in foods, **Prof. Alejandro Marangoni** has become one of the foremost leaders in oleogelation, or manipulating oils to create hard-edible fats known as oleogels. Oleogels can be used to manufacture new food products like vegan steak and vegan cheese that have a lower carbon footprint than animal products and are better for consumer health. Replacement of trans and saturated fats with oleogels could help regulate triglycerides in humans. Marangoni has been named as a Fellow of the Royal Society of Canada, the U.K. Royal Society of Chemistry and the American Oil Chemists Society.

## Potatoes develop cold sweetening under low temperatures

Storage conditions influence potato quality. At low temperatures, potatoes undergo cold sweetening as their starches turn to sugar. This can result in an undesirable dark brown colour when fried. If storage temperatures are too high, unsightly sprouting occurs later at room temperature. **Prof. Rickey Yada,** former chair of the Department of Food Science at Guelph, and his team uncovered the science behind this temperature sensitivity problem. By changing enzyme pathways, they developed a cold-tolerant potato and helped explain the storage-quality anomaly. Temperature-related food processing conditions have been a focus of research for **Prof. Don Mercer.** Mercer has studied the impact of storage conditions on food microorganisms and enzymes, and has also looked at the general impact of time.

PHOTO: DEAN PALMER


## Electrospinning to encapsulate nutraceuticals and food compounds

Electrospinning for food research was mostly unknown until 2005, when **Prof. Loong-Tak Lim** joined the Department of Food Science. At Guelph, he established a research program to learn about the phenomenon in biopolymers and synthetic polymers. Today, his team continues to develop electrospinning, as well as electrospraying techniques, to encapsulate nutraceutical and food compounds. Their work also applies in active packaging applications. Lim works with researchers, including collaborators in Brazil, China, Chile, the United States and Europe.

**The Department of Food Science at the University of Guelph serves as the hub for local, national and international collaborations, and is one of the world's premier food science research departments..** PHOTO: ARIANA LONGLEY

## Biocontrol of food-borne pathogens

**Prof. Mansel Griffiths** and his research group have contributed to our knowledge on the benefits of dairy products through his discovery of proteobiotics, bioactive peptides produced by probiotic bacteria. Probiotics are live bacteria that help regulate the body's digestive system. The researchers found that proteobiotics can combat illness by preventing pathogens like *E. coli* from communicating with each other. This hindered communication disables virulence genes within harmful bacteria. Griffiths' research involving food safety, food-borne pathogens and microorganism detection has led to several products used to promote animal and human health. **Prof. Lawrence Goodridge** has joined the Department of Food Science as holder of the Leung Family Professorship in Food Safety

## Increasing wine quality by reducing acidity

Wines contain acids that contribute to distinct characteristics of the beverage. Malic acid gives wine a sharp apple flavour, but too much of it reduces quality. To reduce the malic acid content, vintners have traditionally done a secondary fermentation (malolactic fermentation) using a bacterium called *Oenococcus onei*. This effectively reduces malic acid in wine, but it's time-consuming and can increase the risk of spoilage. To solve both issues, **Prof. Ron Subden** removed the enzyme from *Oenococcus* that enables malolactic fermentation and inserted it into *Saccharomyces cerevisiae*, the commonly used wine and brewer's yeast. The resulting yeast strain could simultaneously produce ethanol and reduce malic acid in a single step. Subden's research accomplishments have greatly contributed to quality wine production in colder climate regions like Ontario, and helped open the door for next-generation wine and beer research, including that of **Prof. George van der Merwe**. His research focuses on understanding the molecular responses of yeast to environmental conditions.


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uoguelph.ca/research

Published by the Office of Research, University Centre, University of Guelph, Guelph ON N1G 2W1
Phone: 519-824-4120, Ext. 53781

Compiled by Ariana Longley and Mya Kidson, SPARK

Editorial Coordination: Owen Roberts and Amber Wood

Copy editing by Andrew Vowles

Design and Layout: Lind Design



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