

CONSUMED

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New Zealand
**FOOD SAFETY SCIENCE
& RESEARCH CENTRE**

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FREE PUBLIC TALK

The New Zealand Food Safety Science & Research Centre invites you to this free public talk: To reserve a seat, contact info@nzfssrc.org.nz

PALMERSTON NORTH Globe Theatre, 24th October 2018, 7.00pm

CHRISTCHURCH Rolleston Lecture Theatre, Christchurch Hospital Campus, 30th October 2018, 7.00pm

DUNEDIN Hutton Theatre, Otago Museum Auditorium, 31st October 2018, 7.00pm

WELLINGTON Te Wharewaka o Pōneke, 2 Taranaki Street, 1st November 2018, 7.00pm

HIDDEN DANGERS PROTECTING OUR HEALTH BY MAKING FOOD SAFE

Food safety takes constant vigilance. The changing landscape of food production and changes in the microbes themselves offer regular challenges. Finding unsuspected disease outbreaks and fixing problems that led to them is an important part of public health. Now, advanced DNA sequencing is helping public health officials find and solve more outbreaks, and target control measures to stop them from happening again. Working with partners from farm to fork, we can make food safer for everyone.

Robert V. Tauxe, MD, MPH, USPHS (Ret.) is the Director of the Division of Foodborne, Waterborne and Environmental Diseases of the Centers for Disease Control and Prevention.





Dr Vivienne Hunt

INDUSTRY AND RESEARCH GO-BETWEEN

The Centre is fortunate to have the services of Dr Vivienne Hunt as a go-between linking industry and research. She and her husband are themselves somewhere between Singapore and Queenstown, where they will permanently reside from December. Vivienne has been President of the NZ Chamber of Commerce in Singapore, helping New Zealand companies penetrate the rather daunting Asian markets.

NZ Trade & Enterprise has been drawing on her invaluable experience by appointing her as beachhead adviser to provide support for New Zealand food companies seeking to access markets in South East Asia.

Vivienne lived in Singapore from 2012. For five years she worked at Abbott Nutrition R&D Asia Pacific, and previous to that was Deputy Director at the Singapore Institute for Clinical Sciences.

Vivienne has collaborated with health economists to estimate the economic burden of poor nutrition in countries including India, China and Indonesia. She says that around 45% of Indian women are anemic and in Indonesia, the data shows that at least a third are stunted (height for weight) by WHO standards. She set up a Singapore government-funded project to look at the nutritional status of elderly people there. Despite being a wealthy country, Singapore has high levels of malnutrition among the elderly, with many suffering from osteoporosis. Some of this is due to inadequate diets, in particular low consumption of dairy and protein-rich products.

Vivienne's PhD study was in Management and International Business, focused on the career trajectories for women. Her own trajectory has been notable. She managed commercial research for Auckland UniServices, at The University of Auckland, and had commercial and marketing roles with large companies such as Kraft Foods, Tegel Poultry, and the Auckland Milk Corporation (Dairy Foods), and in the UK for Provision Trade Federation, a large association representing meat and dairy imported into the UK.

She notes that the food industry in NZ is huge, representing around NZ\$35bn in exports per

year. Vivienne began her work for the Centre by scoping the size of our markets and their exposure to risk. The meat, dairy and kiwifruit sectors are so far participants in the Centre, but not seafood and poultry. Vivienne has been in discussion with representatives of the latter sectors about their interest in the Centre.

The food processing sector is worth NZ\$5bn, with around \$2bn in exports. Risk is relatively low when the exported food is frozen or there is very low water activity to support microbial growth. Some important players in the food processing sector that Vivienne plans to meet, or has met, include kiwifruit processing companies, chocolate producers and a number of other manufacturers making a wide range of products from chocolate to desserts, muesli bars and peanut butter.

The WHO report on the Global Burden of Foodborne Disease (2010) reported 600 million foodborne illnesses and 420,000¹ deaths in 2010². This puts mortality rates from foodborne diseases third after HIV and malaria³. The countries we export to are on high alert when it comes to food safety. She says, "Anything we can do to provide assurance that New Zealand has a systems approach to ensuring the supply of safe food is valuable. A Centre goal is to demonstrate our leadership in this capacity.

"American and European producers have well developed 'horizon scanning and mapping' programmes in place which encompass identification of superbugs, growing concerns about use of insecticides, bioterrorism,

food fraud, animal welfare attitudes, new technologies, as well as changing consumer habits and attitudes to food, which can be influenced by perceptions and misinformation. As a country in the business of supplying lots of food we need the same sort of telescope. It is important that we are in the forefront of technological developments that can improve food safety."

Vivienne has already talked to 45 stakeholders and 25 industry representatives, on behalf of the Centre, to find out about their research needs and to help them frame the questions that science and data can answer. For example, Vivienne says that many companies are interested in the role of whole genome sequencing to understand sources of potential pathogens but they need more information about how such work can help them manage their risks and what additional data will be provided through the research. She adds, "It is worth noting that Centre members also get the benefit of receiving matched funding for approved projects.

"Many of the people I'm meeting get the 'why' of the Centre, but not the 'what' or the 'how'."

Vivienne says that the key to engaging with industry is "communication, communication, communication." She is planning lots more meetings with individual companies, and is keen on having more specialist workshops and setting up WebEx forums to show them some of the research expertise that the Centre has access to through its extensive network of scientists working on food safety science research.

¹ At 95% Uncertainty interval UI 310,000–600,000,

² At the 95% uncertainty interval [UI] 420–960

³ Source: WHO ESTIMATES OF THE GLOBAL BURDEN OF FOODBORNE DISEASES;

Available http://apps.who.int/iris/bitstream/handle/10665/200046/WHO_FOS_15.02_eng.pdf;jsessionid=8E3673352C9D1016454CB09899AFB9A1?sequence=1

NO MORE HORSE MEAT PIE!

The Centre held its second annual meeting in the Waikato on 2 July. The packed room was a good sign of growing appreciation of what the Centre has to offer. The Centre's new Industry Account Manager, Dr Vivienne Hunt, attended the meeting (see profile). The themes of the meeting were 'omics' in food safety research, chemometric approaches to identifying and tracking chemical hazards in food, and data analytics.



There was also a session on the NZ China Food Protection Network which is allied to the Centre. Eddy Fang from Xi-an Jiaotong-Liverpool University (see profile in the last issue) talked about the role of social media and the diffusion of information in a real or perceived food scare. As we have experienced in New Zealand, perceived food scares are potentially just as much of a threat to our exports as real ones. In China, it takes much longer to reassure customers and win back their trust, Eddy warned.

Narelle Fegan, from CSIRO, Australia, opened the session on 'omics', focussing on the various sources of contamination of red meat with *E. coli* in particular (metagenomics). The genotypes of *E. coli* vary around the world, and cause different disease burdens. Transcriptomics is used to investigate the different survival and growth strategies of regional genotypes of *E. coli* O157 on meat. Some may be better than others at strengthening the defences of the cell wall, for example. Narelle explained how metabolomics is used to study the bacteria that spoil flavour and odour, and identify marker volatiles. Intelligent packaging is a way of detecting and preventing spoilage. In Australia, they are looking at two under-studied spoilage (aerobic) bacteria, *Pseudomonas fragi* and *P. lundensis*.

Dr Ravi Gooneratne from Lincoln University followed with a fascinating presentation on the "Gut microbiome, probiotics and food safety". He said the genes in our more than 10,000 species of resident gut organisms are our 'second genome'. The human gut communicates with the brain and immune system via over 100 million neurones channelled through the vagus nerve centre in the stomach. More and more diseases, including eczema, obesity and depression, are being linked to unhealthy or diminished populations of gut flora. Watch this space! The public have picked up on this and want to know what they can eat to improve gut flora diversity and overall health.

Helen Withers from the Ministry for Primary Industries talked about data overload from all the 'omics' going on. How is it going to be managed? Will it be made public or kept private?

Helen said there is a role for the Centre to guide discussions about the effect of genomics on regulations, and how to manage new developments. Of all the 'omics' (genomics, transcriptomics, proteomics, metabolomics), genomics is currently the technology most frequently applied to address food safety concerns. Data is used for source attribution and outbreak management, identifying antimicrobial resistance, virulence markers, biomarkers and risk assessment. The 'holy grail' is assessment of hazards in real time. Helen emphasised that her focus is anything that affects market access.

Greg McCullough of Fonterra took us through the history of food safety science from Louis Pasteur's 1861 discovery that heat kills pathogens in milk, lest we forget just how far we've come. In the year 2018, whole genome sequencing (wgs) is where it's at for both identifying and ruling out food poisoning suspects. The Centre can help producers understand how to apply the new technologies, and is currently working closely with the Fonterra R&D team.

The session on chemometrics showed that no one is going to be able to get away with horsemeat in pies any more. Mitochondrial DNA frequently survives cooking, which can allow scientists to distinguish one meat species from another in cooked products. Darren Saunders from ESR emphasised the incredible sensitivity of tests for commonly encountered toxins, which can potentially alarm consumers who do not understand or accept that toxicity is about the levels present, not whether or not they are present at all. The latest analytical techniques

can detect and quantify compounds of potential concern in foods, such as 'trans-fats', acrylamide, aspartame, cyanide compounds (commonly found in plants in the form of cyanogenic glycosides), food allergens including gluten, histamine (resulting from the bacterial decay of fish), heavy metals, caffeine and microplastics, to name a few.

Peter Varelis from Shimadzu talked about the importance of spectrometry to identify chemical contaminants in food. These constitute half of the reports his company does. The dominant one is for mycotoxins. He said regulations are driving the growth in the market for food safety testing, now worth \$22bn. He says the term 'limit of detection' is a misunderstood concept. There are four official definitions. What everyone wants is certainty. No false positives or negatives. It's about eliminating the noise, he said.

Andrew Pearson from MPI impressed delegates with the capacity we now have to regionally fingerprint food. For example, animal and plant proteins can be distinguished based on the difference in ratios of nitrogen isotopes. Different soils around the country contain different levels of elements like selenium, sulphur and lead. Hydrogen isotope ratios vary by region so you can identify which area milk comes from. They may even be able to tell you which side of the Buller River crayfish grew up on!

At the end of the forum, delegates went to the Dr John Gallagher Concert Chamber to hear broadcaster Kim Hill discuss, in her straight-talking way, the future of food and what it means for NZ producers and consumers, with Miranda Miroso (Otago University), Caroline Saunders (Lincoln University), Martin Cole (CSIRO) and Ray McVinnie (chef, food writer, and food safety adviser). This was recorded for broadcast by RNZ National and is available at (<https://www.nzfssrc.org.nz/node/118>). It's worth a listen. The next annual meeting will be in Christchurch on 1 July.



Dr Sonia Whiteman, NZFSSRC Board Member

I HEARD IT THROUGH THE KIWIVINE

Dr Sonia Whiteman is the new industry representative on the Centre's Board. She is the Innovation Team Leader for the Protect Supply Platform at Zespri International, which is one of the three founding members of the Centre. Sonia has experience in science, research management, governance, and risk assessment.



She has seen first-hand the effects of one of New Zealand's worst horticulture biosecurity incursions. Sonia was seconded to Kiwifruit Vine Health in 2011 to help respond to the Psa incursion. It was not a food safety issue, but the risk management challenges were analogous. "It was the best of times and the worst of times," Sonia says. "The most challenging thing was trying to support growers who were facing the loss of entire orchards; the most rewarding thing was being part of the solution and helping them work through the situation and come to terms with what needed to happen. Often that meant a chainsaw and starting again, but we showed them that it wasn't hopeless, that they could recover." She feels for the farmers going through the same grief process with *Mycoplasma bovis*.

The industry has learnt live to with Psa. The new Gold3 cultivar, which replaced Hort16a, is much more disease resistant and is going down very well in overseas markets. Sales of good old Hayward Green, which we mostly see in the shops, are at a record high. An unforeseen silver lining of Psa

has been an overall increase in production per hectare, which Sonia attributes to Psa bringing growers to focus on their management practices. "Growers are forward thinking individuals," Sonia says. "They're quick to pick up new ideas, and the cohesive nature of the industry helps propagate these." The industry ambition is to more than double production from NZ\$2.26bn (in 2016/17) to \$4.5bn by 2025.

Food safety risks are low with unprocessed fruit in the skin, but Zespri want to be on the front foot and take nothing for granted. They want to understand any possible risks.

"Just because nothing has happened in the past, doesn't mean you can rest on your laurels. The Centre lets us engage with a much wider field of researchers, and presents the opportunity to learn from other industries," says Sonia. "Chemical residues and food fraud are the main concerns for Zespri. Traceability of fruit is increasingly important. There are some amazing new smart technologies but these have to become practical, cost-effective, reliable and sensitive enough."

Sonia has a PhD in plant pathology. Her passion for science started with a high-school project on how marigolds grow at different temperatures. Her mother's keen interest in gardening was another influence. She was a "free range kid" on the family sheep and beef farm in Hunterville, near Taihape. Sonia has a first class honours degree in Horticultural Science from Lincoln, where she studied plant protection and viticulture and developed a fascination with mycology, and how to break the disease/host/environment triangle. Inspired by the bosses she had at Plant & Food Research, her goal was to work at Zespri. She has her wish.





Dr Sravani Gupta: Plant & Food Research

HIGH PRESSURE PROCESSING OF NZ MUSSELS

Dr Sravani Gupta has been with Plant & Food Research (PFR) for seven years now. She has a powerful complement of skills in engineering, microbiology and education, and can traverse academia and applied science. Together with her partner, she came to New Zealand in 2005 from her home in Kolkata, India, and completed a PhD in engineering at The University of Auckland.

She has a background in science and microbiology and did her Bachelor and Master's degrees at the University of Calcutta, and Bachelor in education at Jadavpur University where she was a Gold Medallist. Sravani had been teaching undergraduate students for four years before she left India for Auckland.

Working with Graham Fletcher (Team Leader, Food Safety & Preservation, PFR) she leads research on the processing of seafood and horticultural produce – mainly the effects on microbes, as well as shelf life and quality.

For her PhD, Sravani investigated ultra high pressure (UHP) versus the traditional heat processing of New Zealand Greenshell™ mussels.

A big advantage of UHP is that it also opens (shucks) the mussels, so this does not need to be done separately with a knife or by heat. And the mussels absorb some sea water, rather than losing it with heating, along with some of the nutrients. "Consumers want minimal processing," says Sravani.

*A key consideration was the comparative efficacy of UHP in destroying the usual suspects found in mussels, especially the hardy *Listeria monocytogenes*. With heat treatment, the heating and cooling process can provide warm, moist, protein-rich environments for bacteria to grow in.*

Sravani also researched the effect on the enzymes which can degrade protein structures in the mussels, and cause rancidity. Another aspect of her investigation was shelf life. "This is increasingly important as the world population heads towards 10 billion. We have to be able to preserve the food we produce," says Sravani.

Her thesis and book determined the potential to use UHP processes across the burgeoning mussel industry, and recommended optimum pressure and processing times.

Sravani points out that different food processing techniques result in a different product, which must be tested with consumers to see if they accept the changes in sensory qualities: taste, texture, density, and mouth feel. A new technique she is studying is pulsed UV light, which destroys pathogens, but maintains the nutritional integrity of the product. Again, there is the question of consumer acceptance.

After taking maternity leave in 2013 (she has two boys), Sravani was awarded a PFR Margaret Hogg-Stec memorial scholarship which allowed her to travel to the United States and observe practices in some of the best food safety laboratories. This was the beginning of a long-term relationship. In 2015, she was awarded

MBIE US International relationship funding to maintain her learning exchange with the US. She has been able to visit every year now, and regularly presents at relevant US Conferences (Institute of Food Technologists Conference, Conference of Food Engineering and the American Society for Microbiology Conference). Through an MFAT NZ Aid programme, Sravani also advises producers in Vietnam and Cambodia on food safety in horticulture.

Because they are dealing with *Listeria* in her laboratory at PFR, they have to be very risk averse. *Listeria* is a real danger to 'YOPIs' (the young, older people, anyone who is immune-compromised, or pregnant). There may be women working in the lab who are pregnant, or plan to be. The pathogen can be transmitted from the mother to the unborn baby across the placental barrier and cause miscarriage. *Listeria* is ubiquitous in the environment, in contaminated water, raw fruits and vegetables, and soil. It can form biofilms to hide under and it can survive low temperatures, which is why pregnant women are advised not to eat chilled delicatessen food.

Sravani is dealing with the same pathogens in her horticultural work, but often they behave differently in other environments, on other foods. For example, pH levels can affect their growth. She says, "There's not always a pattern."

Sravani is a 'New and Emerging Scientist' with PFR, straddling academic and applied science. She finds her work very "energising", even the routine parts, because so much hangs on the outcome.

In 2015, Sravani worked with Professor Nigel French during the establishment phase of NZFSSRC, to research the national food safety scenario and map our capability.

"New Zealand must do everything possible to preserve its reputation. If anything goes wrong, it will take many years to get it back," says Sravani.



Anna Beaven, Fonterra
Food Assurance Manager

FOOD ASSURANCE



Anna leads a team of 11 at the Fonterra Research & Development Centre in Palmerston North, which is over the road from NZFSSRC Headquarters. She has just been appointed Food Assurance Manager after acting in the position for a few months. Anna's previous positions include risk assessment and management positions within the health and tertiary sectors. Her most recent positions in Fonterra were Senior Research Technologist (within the Food Assurance Team) and Senior Food Safety and Quality Risk Advisor.

Her experience across sectors in risk assessment and management puts her in the ideal position to lead the team of Scientists to provide business relevant FSQ risk assessment and management solutions.

Anna was born and raised in Colorado. Her father was a geologist and they divided their time between Colorado and Virginia, where he worked for the US Geological Survey.

Her degree was in Environmental Health, from Colorado State University. Summer camp in upstate New York led to marriage with a kiwi volunteer, and a new life in New Zealand. Her sister also married a New Zealander and lives in Auckland. Their parents then retired to New Zealand to be closer to their girls.

The Food Assurance Team is not responsible for routine testing, which is carried out by various accredited labs around the country. It is a multidisciplinary team of food safety scientists and technologist that delivers Independent, solution-focused food safety and quality risk assessment across all of Fonterra, from the manufacturing business units to the new products and technologies developed by Fonterra. There is a strong drive to develop value-added products to increase profitability and cater to new markets and burgeoning consumer tastes and health imperatives.

The multidisciplinary nature of Anna's team, which includes specialists in chemistry, biochemistry, microbiology and allergens, allows them to solve complex problems and find the right solutions ensuring the products that Fonterra

makes and develops provide their customers and consumers with safe, good quality food.

There is a well characterised set of pathogens that can be present in raw milk – *Campylobacter*, *E. Coli*, *Listeria* – which are easily and reliably killed by pasteurisation. There are no reported cases of these infections as a result of consuming pasteurised milk, cheese or any other products sold by Fonterra. But there are also spoilage organisms to watch out for. These are not harmful but may spoil the taste and degrade nutritional values. Any new products must be clearly understood to ensure food safety and quality risks are managed. Sometimes the Food Assurance Team deliberately introduces spoilage organisms to trial products [not for human consumption] to see what effect they might have.

They use classic microbiological techniques and more advanced techniques as well, to see what organisms are present. Maldi-TOF mass spectrometry is commonly used to identify organisms from their protein 'fingerprint' emission wavelengths. Anna says their work with the NZ Food Safety Science & Research Centre on whole genome sequencing is "very exciting", and is set to become a key research tool in future. It will be valuable for understanding their products and processes to enable better risk management decisions.

Anna says the challenge is combining the science with practical, innovative business solutions. She is keenly aware of the responsibility on their shoulders to maintain the high reputation of Fonterra and all New Zealand producers.

A VIRTUAL CENTRE

The NZFSSRC pools the existing resources of partner organisations from across New Zealand. Current NZFSSRC partners are:

FUNDERS:



**MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT**
HĪKINA WHAKATUTUKI

Ministry for Primary Industries
Manatū Ahu Matua



COLLABORATING PARTNERS:



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**FOOD SAFETY SCIENCE
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