

CONSUMED

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Professor Giselle Byrnes, Dr Philip Wescombe, Hon Dr Ayesha Verrall, Dr Catherine McLeod, Professor Nigel French



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

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INDUSTRY REPRESENTATIVES MEET TO UPDATE FOOD SAFETY AGENDA FOR 2021

Minister for Food Safety and Associate Minister of Health, Hon Dr Ayesha Verrall, attended part of the Industry Advisory Group (IAG) meeting on 3 February, the sixth such meeting, but only the second physical gathering. The Minister took the time to stay and hear reports from outgoing chair, David Jones, on the seafood industry; Anne-Marie Arts (The Agrichain Centre) and Leanne Stewart (Hort NZ) on the horticulture sector; and Michael Brooks (PIANZ) on the poultry industry. In her response, Minister Verrall, herself an infectious disease specialist, said that the *Campylobacter* research was a priority for government.

Centre director, Dr Catherine McLeod, gave the Minister an introductory rundown on the priorities for each sector: market access jitters are keeping everyone awake; whilst great in-roads have been made, poultry suppliers have a goal to further reduce *Campylobacter*; seafood companies are interested in cutting edge technology for monitoring algal blooms in the sea to supplement their excellent risk management approach; the meat industry is considering trialling whole genome sequencing as part of their stringent pathogen control programmes; the horticulture sector is progressing the development of a national food safety framework to guide their investment into food safety science and research; and the dairy sector is interested in improving our understanding of *Bacillus cereus*. There are cross-sector issues such as chemical risks around

the use of recycled packaging, the need for ongoing identification of new and emerging risks, common needs to increase food safety awareness and culture within the industry, and technical support related to Covid-19. The Minister thanked the Centre for its role in supporting industry during the Covid-19 pandemic, and advising them on PPE and processing hygiene protocols.

A number of industry speakers complimented the Centre on playing the unique role of bringing industry sectors together to catalyse research of common interest. Importantly, one industry commentator observed, the research is carried out in a safe and confidential zone, where risks, results and implications can be carefully considered as an industry, reducing the exposure of individual companies. The huge turnout for the meeting, both in person and by Zoom connection, seems the best demonstration of the Group's relevance.

Dr McLeod noted that there is still \$7M left in the pot to contribute to industry-driven food safety research projects. There are 10 significant projects underway, and more in the pipeline. The pace is quickening with the number of industry members increasing from 6 to 23 in just one year.

Dr Philip Wescombe, R&D Manager for the Yili Innovation Center Oceania Dairy Company, is the new chair of the Industry Advisory Group and Farzana Adams of Zespri will represent the IAG on the Centre's Governance Board.



DIRECTOR'S UPDATE: DR CATHERINE MCLEOD

NZFSSRC FOCUS FOR 2021/2022

Ehara taku toa i te toa takitahi, engari he toa takitini.
“success is not the work of one, but the work of many”

2020 has been a challenging year for the food sector with the global Covid-19 pandemic creating practical issues relating to reducing risk of person-to-person transmission in food premises, and economic and market access concerns. Centre scientists have worked hard over this period of time to support our industry members, both on providing technical support on Covid – which is not a foodborne concern – but also on many other real issues of genuine concern in the food chain.

In 2020, our scientists have conducted research on *Campylobacter* to assist the poultry sector to reduce risk, investigated the efficacy of blue LED technology for disinfection purposes, developed new test methods to support our industry in implementing best risk management practices, conducted numerous scientific reviews to evaluate the risk of various potential hazards, and helped the seafood, dairy, poultry and horticulture sectors to conduct pathogen tracing studies on a variety of bacteria using whole genome sequencing, with the ultimate aim of eliminating these harmful bugs from our foods. The Centre is very grateful to our science partners for the hard mahi in 2020 and for going the extra mile to support industry and government during the pandemic.

An exciting development for the Centre over this period of time has been the opportunity to partner with a wider variety of stakeholders, and we are now proud to have 23 food industry members. 2021 is shaping up to be a cracker year, with lots of exciting projects underway and in development. The following provides a snapshot of key focus areas for the NZFSSRC in the upcoming year.

SUPPORTING IWI AND MĀORI FOOD

BUSINESSES – Ensuring the safety of kai and supporting Māori aspirations are key goals of the Centre. NZFSSRC aims to become a trusted science advisor to iwi and the burgeoning number of Māori food companies, supporting the development and export of new products by providing the best food safety science.

NATIONAL RESEARCH STRATEGY – The Centre is about to embark on the development of a national research strategy for food safety, a collaborative process with the Centre’s seven research organisations, our government partners, Māori, and industry members. We aim to harmonise the industry and government-led food safety science and research initiatives and create efficiencies and opportunities for all.

INDUSTRY TASKFORCES – In the past 12 months the Centre has established three taskforces for the dairy, horticulture and poultry sectors. Each comprises key industry representatives, a representative from New Zealand Food Safety (MPI), and several science experts. This tripartite model is starting to show results, with each taskforce honing in on priority areas that companies are comfortable working together on. We look forward to these priorities developing into collaborative research efforts that underpin the safety of NZ food.

NATIONAL EMERGING RISK IDENTIFICATION

SYSTEM – Lastly, a national Emerging Risk Identification System (ERIS) for food safety will be launched in the next month – a partnership between MPI, the Centre and our industry members. The ERIS will provide companies and associations with intelligence on potential threats, and options on next steps to address these threats. We will be providing NZFSSRC members with more information on the benefits this system can offer them.

If you would like to discuss these initiatives or have new ideas for work the Centre could progress, please don’t hesitate to get in contact with me.

Nāku noa, nā, Dr Catherine McLeod

TESTING FOR THE CEREULIDE TOXIN

At the Centre/International Life Sciences Institute (ILSI) webinar on whole genome sequencing in November, Professor Vitali Sintchenko, University of Sydney, recounted the case of an Australian woman who recently died from multi-organ failure shortly after eating a meal of fried rice.

Her two sons who shared the meal were very sick, but fortunately survived. Analysis confirmed that rice was indeed the culprit. Sequencing revealed that the *Bacillus cereus* present contained the gene variants that typically produce the natural toxin, cereulide, under certain conditions.

Some bacteria, such as *B. cereus*, are similar to fungi in that they produce spores which can survive high temperatures, low pH levels, radiation, freezing and drying. So the hardy spores can persist in dried goods, such as rice and milk powder, and cooked foods, waiting for moisture and the right temperature range to reproduce. The Centre recently warned NZ consumers in a *Stuff* article to cover and refrigerate any left-over cooked rice straight away to avoid the possibility of cereulide poisoning. Importantly, once formed, you cannot destroy the toxin by reheating the rice or other host food.

A recent Centre research project led by the Cawthron Institute, resulted in the development of a validated test method for cereulide in a high fat dairy product. This new test method is



DR TIM HARWOOD

accredited by International Accreditation NZ (IANZ) and Cawthron is the only laboratory in New Zealand to offer this service to the dairy sector. It enables the dairy industry to perform additional verification tests within their risk management programmes and provide heightened assurances on product safety.

Bacillus cereus is ubiquitous in the environment, can contaminate food and is a concern for the food industry from time to time. Current food safety regulations are based on the presence of the bacterium and not the presence of toxin, which is the actual food safety issue. Centre deputy director Dr Tim Harwood says that “this new test method provides another option for companies wishing to go the extra mile to demonstrate the safety of products that may be at risk from cereulide contamination.”





JO TACKLES THE HARD ISSUES: COVID AND CAMPYLOBACTER

Food microbiologist Dr Joanne (Jo) Kingsbury is a Cantabrian, and gained her PhD in cellular and molecular biology at the University of Canterbury. She came to the Institute of Environmental Science and Research (ESR) in 2016, after 16 years at Duke University in North Carolina, switching from academia to a more applied research focus and the different working milieu of a Crown Research Institute.



In the process she also moved her focus from fungal pathogenesis and cell signalling to food microbiology. Although fungi are also relevant to the food industry, playing both beneficial (e.g. fermentation) and detrimental roles (e.g. producing mycotoxins and spoilage), Jo's work at ESR has a stronger focus on bacterial pathogens associated with food. While fungi and bacteria are fundamentally different life forms, a lot of the research techniques and principles are similar, she says.

Jo has worked with New Zealand Food Safety (NZFS, MPI) scientists and the Egg Producers Board on a project to survey the prevalence and types of *Salmonella* on New Zealand egg layer farms in order to better understand the exposure of New Zealand commercial eggs to *Salmonella*. The research was commissioned in part to review storage recommendations for eggs. Considerations around egg storage are guided by the likelihood of *Salmonella* contamination in and on eggs, the serotypes that might be present, and how the storage temperature affects the survival or growth of any *Salmonella* present, particularly within egg contents.

Salmonella Enteritidis is the main serotype that can infect the reproductive organs of chickens and contaminate eggs prior to laying. Outbreaks of salmonellosis caused by *S. Enteritidis* have beset egg industries in Europe, North America and recently, Australia. Although NZ egg laying flocks remain free of the *S. Enteritidis* it is possible that other *Salmonella* serotypes may enter eggs after laying. The main route of *Salmonella* contamination of eggs is thought to be from the external egg shell.

Jo and her colleagues found that the prevalence of *Salmonella* on New Zealand egg layer farms was very low compared with international surveys and, importantly, no *S. Enteritidis* was found. The NZ egg industry already has a lot of interventions in place to minimise *Salmonella* contamination of egg layer farms and eggs.

This project led to a second study to directly address egg storage recommendations. At the outset the rule was that the shelf life of eggs should be 35 days maximum at 15°C or 21 days if there was no temperature regulation. Jo and her colleagues artificially contaminated egg

“It was the right move to return to New Zealand. It's great to be home and I appreciate ESR taking a chance on me and facilitating my transition.”

surfaces with *Salmonella*, with or without added chicken faeces, and compared the survival of *Salmonella* when eggs were stored at 15°C and 21°C. *Salmonella* decreased over time at both temperatures, but survived for longer on egg shells at 15°C, particularly when there were faeces present. No *Salmonella* was found inside the eggs sampled at any temperature. They concluded that storage at 15°C was no more protective than storage at room temperature, provided the eggs were clean and uncracked. Guided by the evidence, MPI now recommends a shelf life for (clean, un-cracked) table eggs of 35 days, regardless of storage temperature.

Jo's relationship with the poultry industry continues through the Centre and the Poultry Industry Association of NZ (PIANZ). Now she is concentrating on the broilers - the chickens we eat - not the egg-laying kind. Her experience made her the perfect candidate for the major Centre-PIANZ research projects aimed at reducing levels of *Campylobacter* in poultry flocks and products - a worldwide problem. Foodborne campylobacteriosis is the most common notifiable infectious intestinal disease in New Zealand, and a recent study showed that 84% of cases are attributable to poultry consumption. Jo says the poultry industry is very proactive, and working cooperatively with MPI to address the challenge. She is involved in two different projects commissioned by PIANZ and the Centre, alongside industry, and ESR, Massey University and NZFS scientists.

The first project, which started in late 2019, looks at routes for *Campylobacter* infection of the broiler flocks - ideally it would be better to prevent colonisation of the farm in the first place. This will involve following two broiler sheds on one farm, including testing samples for *Campylobacter* from the previous flock, through hatching, until the final group of chickens are transported off the

farm for processing. Whole genome sequencing will help establish relationships between the different *Campylobacter* isolates and identify potential contamination vectors and sources.

The second project, which is also co-funded by NZFS, looks at the effectiveness of broiler processing steps at controlling the amount of *Campylobacter* on poultry carcasses. This project kicked off in January 2021 and will involve counting the numbers of *Campylobacter* on poultry at successive processing stages across three companies.

With thousands of *Campylobacter* infections reported in New Zealand each year, and affordable, versatile chicken now the most commonly consumed meat in NZ, the research is imperative.

Since March last year, Jo has also played a very important part in the Centre's urgent enquiry on behalf of the NZ food industry as to whether it would be possible for SARS-CoV-2 to survive on food or contaminated packaging and infect people ingesting it. Questions also centred on the management of potentially infected food production workers. Jo and Dr Rob Lake at ESR scoured the incoming data from other countries, but fortunately for New Zealand found that there is still no direct evidence of transmission from food or packaging. Jo concludes, “We consider that the risk of spread from food products or packaging is negligible. The main route for transmission is respiratory. Nevertheless, the Centre remains vigilant, and we have been producing updates based on emerging information and research.” <https://www.nzfsrc.org.nz/covid19>

Jo loves her diverse and meaningful portfolio, which also includes research into the impacts and mitigation of microplastics in the environment. “It was the right move to return to New Zealand. It's great to be home and I appreciate ESR taking a chance on me and facilitating my transition.”

CENTRE HELPS INDUSTRY APPLY WHOLE GENOME

Whole genome sequencing (WGS) came into its own in 2020, fast-tracked under extreme Covid-19 urgency. Institute of Environmental Science and Research (ESR) scientists knew at once that it could be the key to tracking, linking and containing the virus. They made the case to government and were granted money from a special MBIE Covid-19 fund to gear up their labs to process samples as quickly as possible. The ambitious aim was to sequence every single positive sample in NZ, once they got started. The low number of community cases has made that very manageable.

Ultimately, the super-speedy sequencing machines and high-powered computers are just tools. You need people. There were nail-biting challenges transporting samples to the labs, some steep learning trajectories, long nights, and no doubt many re-heated meals from the microwave. But here we are in 2021 – the envy of the western world. Thank you ESR and associated Massey lab staff.

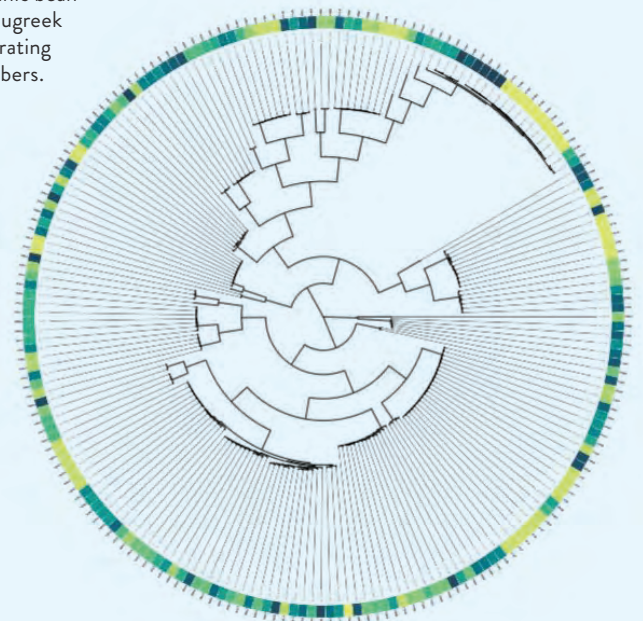
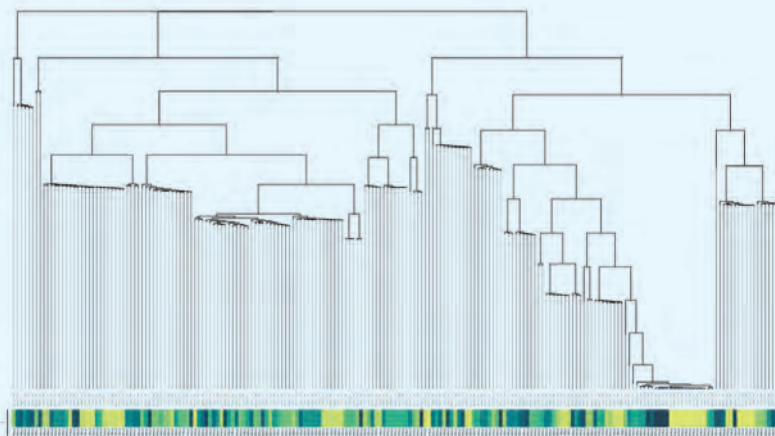
Long before SARS-CoV-2 emerged, Centre scientists, including ESR partners, knew that WGS was also a valuable tool to prevent, trace and limit food poisoning outbreaks. They had started helping a number of industries and companies learn how to apply it systematically in their particular circumstances. It is not necessary for people in the food industry to understand the detail of the lab process or the bioinformatics, but they do need to know how the information can help them understand how potential pathogens from the environment could affect food processing and the safety of final products. When it comes to disease outbreaks, genomic data still has to be intelligently combined with epidemiological information to get the full story.

In late October 2020, the Centre and the International Life Sciences Institute

(ILSI) ran a two-day trans-Tasman webinar that covered every aspect of WGS technology from a food safety viewpoint.

Presenters compared the sequencing capacities and speeds of different machines, outlined the lab processes, explained how to read those rather confusing phylogenetic (family) trees which track pathogen mutations over time, gave examples of the role of WGS in managing foodborne disease outbreaks, and discussed the advantages of, and confidentiality issues related to, the industry/national/global sharing of data.

Professor Martin Cole, University of Adelaide, introduced the well attended meeting and compared the food safety world before and after WGS. The first big outbreak where WGS was applied was the huge 2011 outbreak in Europe, mainly Germany, of 4000 E.coli O104:H4 infections from beansprouts. It spread to 16 countries and resulted in more than 50 deaths. Health costs were estimated at an astounding US\$3.5bn. DNA sequencing was able to connect cases and pin down the source – organic bean sprouts (grown in Germany from fenugreek seeds imported from Egypt) - exonerating the original suspects, Spanish cucumbers.



SEQUENCING

It cost the cucumber industry US\$200M, but WGS saved it from ruin and prevented many more illnesses and deaths.

Professor Vitali Sintchenko, University of Sydney, predicted that future foodborne disease outbreaks will increasingly occur over wider locations and time periods, and be more commonly associated with fresh and minimally processed food. The bean sprout case underlines the need to share data globally in as close to real time as possible. Without WGS, in many situations it would be almost impossible to make links between cases and find the source.

However, Dr Verlaine Timms, also at the University of Sydney, made the very important point that close or exact similarity between samples generates a hypothesis about an outbreak, and does not prove the source. But it can definitely rule out certain origins, like the Spanish cucumbers. WGS is powerful, but it's not magic.

Verlaine described how they generate millions of 'short read' sequences from samples and then assemble them into longer DNA sequences. By comparing them to a reference genome, DNA base differences (there are four bases - C, T, A or G) between samples can be identified. Every single unit of data (C, T, A or G) has an accuracy estimate attributed to its interpretation by the sequencing machine. The total of these scores must meet a certain minimum for the result to be of any use. Verlaine emphasised the importance of getting high quality samples in the first place.

Brian Astridge from Tegel NZ, and Philip Wescombe from Yili (pronounced ee-lee) Innovation Center Oceania, were on one of the two panel discussions at the end of the webinar. Both companies are "front-footing" the technology, and they were complimentary about the practical, customised help from the Centre. Brian said it had provided a "seamless operation", bringing together researchers from ESR, Massey and others in the network, as well as pulling in the bioinformatics specialists who could interpret and help communicate the data visually. "It was fantastic from an application view . . . through the Centre we have access to the best experts in New Zealand."

As a member organisation, the Centre is focussed on the specific immediate needs of

ULTIMATELY, THE SUPER-SPEEDY SEQUENCING MACHINES AND HIGH-POWERED COMPUTERS ARE JUST TOOLS. YOU NEED PEOPLE.

DR PHILIP WESCOMBE



Dr Philip Wescombe is R&D Manager for the Yili Innovation Center Oceania which works to provide support to Yili Group and Oceania Dairy Limited through open innovation collaborations with research institutes and companies throughout New Zealand and Australia.

He is based at Lincoln University, where he can work more easily with other scientists in relevant fields. Oceania Dairy has its factory located in rural Glenavy, 40 minutes' drive south of Timaru.

Philip grew up in the South Island and trained in microbiology at the University of Otago, then worked on probiotics at Dunedin's Blis Technologies prior to joining Oceania Dairy Ltd in 2013. The development and application of probiotics is still an aspect of his work, given their close association with dairy products.

He has become a leading industry advocate of whole genome sequencing, which is used across multiple fields within the wider company, the main application being pathogen control for improved food safety. It is also useful in developing probiotics - for example to prove their safety, and identify which genes may confer therapeutic effects.

Says Philip, "There is enormous interest in the power of probiotics in dairy products to boost general health, immunity, and maintain healthy intestinal function. Whole genome sequencing is a tool that can be used across many areas in the dairy industry and already we wonder how we ever managed without it."

different sectors, industries and companies. WGS can micro-map organisms from farm to factory, tell if there are any pathogens with genes resistant to certain sanitisers and anti-microbials, or a tendency to form biofilms. Are the pathogens new introductions or the same old population persisting despite cleaning regimes?

Global databases like the US FDA GenomeTrakr, which has now superseded PulseNet, and Denmark's Global Microbial Identifier (GMI), are accumulating sequence

data from around the world at pace and aim to share the data in real time. Vitali Sintchenko pointed out that DNA sequences are an easily shared universal language, aid compliance with international trade agreements and practices, but that sharing entails some sticky ethical and confidentiality issues.

WHEN IT COMES TO DISEASE OUTBREAKS, GENOMIC DATA STILL HAS TO BE INTELLIGENTLY COMBINED WITH EPIDEMIOLOGICAL INFORMATION TO GET THE FULL STORY.

It wouldn't be a WGS training session without Centre Chief Scientist, Distinguished Professor Nigel French FRSNZ. He presented a global to local rundown on the scope of WGS, including its value for SARS-CoV-2 tracking. Nigel serves on a Ministry of Health Covid-19 technical advisory committee and has co-authored publications on the genomics of SARS-CoV-2. He summarised the WGS applications to food safety:

MICRO-MAP PATHOGEN POPULATIONS IN PLANTS

BESPOKE DATABASES FOR THE FOOD INDUSTRY

ESTABLISH THE TIME AND ORIGIN OF INCURSIONS

ESTABLISH WHAT IS NORMAL AND ABNORMAL IN THE SUPPLY CHAIN

IMPROVE INTERVENTIONS, E.G. DISINFECTANTS AND SANITISERS USED

IDENTIFY THE ANIMAL RESERVOIR (MOST HUMAN DISEASES ORIGINATE IN ANIMALS, AND ARE DESCRIBED AS ZOOONOTIC DISEASES)

TRACK PATHOGENS ALONG THE PRODUCTION CHAIN, INCLUDING BETWEEN FARMS

PROBIOTIC ANALYSIS AND SAFETY

DETERMINE RELATIONSHIPS BETWEEN GENOTYPE AND PHENOTYPE (GENETIC VARIATIONS THAT RESULT IN CHARACTERISTICS SUCH AS ANTIMICROBIAL RESISTANCE OR RESISTANCE TO HEAT)

IDENTIFICATION OF SNPS (SINGLE NUCLEOTIDE POLYMORPHISM = A SINGLE CHANGE IN ONE OF THE DNA BASES WHICH MAY OR MAY NOT AFFECT ITS FUNCTION) AND ALLELES (A VARIANT OF A GENE – HUMANS HAVE TWO ALLELES OF EACH GENE, ONE FROM EACH PARENT), ALSO EPIGENETIC CONSIDERATIONS (WHAT EXTERNAL FACTORS THAT PROMPT GENES TO BE EXPRESSED/NOT EXPRESSED)

While the webinar format allows affordable access for everyone – and is the only possibility at present for trans-Tasman communication - you can't beat face-to-face communication. Director, Dr Catherine McLeod, will soon be issuing invitations to the annual symposium, date in Spring to be decided.

DR LUCIA RIVAS



Dr Lucia (Lucy to many) Rivas, 10 years at the Institute of Environmental Science and Research (ESR) now, has become an advocate for the use of whole genome sequencing (WGS) for food safety – helping to protect both the New Zealand public and food companies from risk. The advent of new sequencing technologies to determine the genetic makeup or ‘whole genome sequence’ has seen a step change in how scientists, like Lucia, can identify and trace illness-causing pathogens throughout the food chain. As a senior scientist, one of Lucia’s tasks is not only to analyse these genomes but also to make sense of the results and to communicate that back to the clients.

The Centre has been working with industry partners to find ways to apply WGS to their food safety problems and demonstrate the benefits of it. “Companies will do whatever it takes to get to the bottom of a contamination event,” says Lucia. “WGS is becoming a more cost-effective tool for tackling some serious

food issues and the cost benefits are worthwhile if a company is facing chronic contamination problems in its manufacturing processes.”

As a result, Lucia’s expertise has seen her working on more than one Centre project that uses this tool for industry applications. The main area of interest for industry partners is trying to track down contamination routes for bacterial pathogens, including *Listeria monocytogenes* and *Cronobacter sakazakii*, two bacteria that can cause serious illness and even death in vulnerable groups.

Lucia helps lead one flagship Centre research project that focuses on the use of WGS for *Listeria*. Together with other scientists from ESR, Massey University and Plant & Food Research, Lucia has brought together *Listeria* WGS data from many different sources into a database that Centre partners and members can use. Lucia says, “The database is composed of sequence data from some companies as well as clinical isolates and we will continue to populate it over time. It can be tricky as companies can be very private about their data and are concerned about the possible implications of sharing it, including concerns about its misuse. The database is designed to assure absolute anonymity and confidentiality, with no reference to company names or even types of food.”

Lucia says, “The intent of the database is not to use it as a public surveillance tool but a resource that can help scientists and industry to understand the state of play with *Listeria* in New Zealand.” It provides industry partners with a powerful resource to compare their isolates with many others from NZ. For Lucia and collaborators, the ultimate goal is to identify better ways to detect and combat *Listeria* in the food chain. As an example, the database can be examined to see what *Listeria* genes may be responsible for resistance to cleaners and sanitizers.

An exciting output of another Centre project, in partnership with Fonterra, has been

the use of a hand-held sequencing device called the MinION (by Oxford Nanopore Technologies). This is the same technology that is being used to sequence SARS-CoV-2 samples quickly in NZ. Scientists at ESR and Massey were able to work with Fonterra to achieve high-quality genome sequences for probiotic strains. Lucia says, “The MinION still needs quite a lot of expertise to operate it and analyse the data, and may not be the most cost-effective solution for a single isolate.” But Lucia and the team have demonstrated that with appropriate training and resourcing, the technology provides a real solution for Fonterra to do long-read sequencing in-house, rather than sending it abroad at a higher cost and waiting many months. Lucia is confident that the technology will continue to develop and will see it being used in-house by many other companies and laboratories in the future.

When Lucia is not involved in Centre research projects, she has another interesting detective assignment, the outcome of which is of great interest to the Centre. Why are the cases of yersiniosis skyrocketing in NZ? Yersiniosis is a type of gastroenteritis that is caused predominantly by the bacterium *Yersinia enterocolitica*. The number of notified cases of yersiniosis has been climbing over the last 5-10 years, with an excess of 1200 cases reported in 2019. But it is not clear as to how people are becoming infected in NZ. The study will attempt to identify risk factors such as certain foods or other possible sources (such as animals or water) that may explain the increase in illness. If it is proven to be a foodborne issue, then the Ministry for Primary Industries (NZ Food Safety) will be able to work towards devising some control measures for particular food sectors. The Centre will also be able to offer support to industry partners in this process.

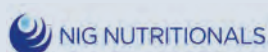
It’s not too late to pay the modest registration fee and access the presentations, which likely comprise the most efficient and relevant course you will find on the subject. The webinar was organised by Centre Industry Account Manager Dr Vivienne Hunt, together with food safety consultant, Dean Stockwell, who is Vice President of ILSI Australasia.

Contact Dr Hunt at v.hunt@massey.ac.nz for more information.

NZFSSRC ANNUAL SYMPOSIUM

SPRING 2021
DETAILS TO FOLLOW

WELCOME TO THE CENTRE:



Director Dr Catherine McLeod is pleased to welcome three new members to the Centre. NIG Nutritionals, Synlait and Westland Milk Products have in common a strong focus on science and innovation, a desire to demonstrate their commitment to the highest food safety standards, and learn about new technologies such as whole genome sequencing.

PROFILE:

ANNE-MARIE ARTS
HORTICULTURAL INDUSTRY CONSULTANT

Anne-Marie Arts is the NZ-born daughter of Dutch immigrants, who came in their thousands in the early 1950s. They quickly gained a reputation for hard work, creativity and business aptitude. As a young woman, Anne-Marie was already running a big garden in Christchurch when her perceptive father nudged her further in that direction by suggesting she study horticulture. On top of her Lincoln Bachelor of Horticultural Science, Anne-Marie acquired a Postgraduate Diploma in Business (Marketing), and an MBA.



She says the industry was “a tough gig for a woman to get into” back in the 80s when she emerged, though it clearly hasn’t held her back.

With 30 solid years of experience in all facets of the business, from exporting flowers and fruit to managing supermarket and industry quality control and food safety systems, Anne-Marie and her business partner Hans Maurer co-founded horticultural consultancy and service provider “The Agrichain Centre”. They provide a whole range of services to clients from food safety advice and strategic planning, to phytosanitary inspections. “We deal with all the curly questions and problems that come up, from standardising plastic pallet sizes to traceability standards – people in the industry are so busy just dealing with what’s in front of them, day to day.”

The Agrichain Centre has two offices in Auckland and one in Christchurch, employing up to 25 people, including several summer season students each year. Anne-Marie says recruitment and human resource management are by far the most challenging aspects of their work.

“The whole industry needs to ‘re-image’ to attract more students with appropriate horticulture or life science qualifications – there just aren’t enough coming out of university. There is a perception that horticulture is unglamorous, unchallenging intellectually, and low-paid, but in fact there are lots of opportunities,



“There is a perception that horticulture is unglamorous, unchallenging intellectually, and low-paid, but in fact there are lots of opportunities, and the industry is expanding, profitable, and complex. It’s often the education institutes themselves that have the wrong perceptions.”

and the industry is expanding, profitable, and complex. It’s often the education institutes themselves that have the wrong perceptions. We need to get creative and offer a whole smorgasbord of entry and early career opportunities, like internships. The Agrichain Centre employs quite a few recent immigrants to carry out phytosanitary and commercial fruit inspections – that

takes quite a lot of training, but they really apply themselves wholeheartedly.”

Anne-Marie is an important medium between the Centre and industry as it embarks on its new project with United Fresh to assess and rank food safety risks in fresh food, and then tailor a research framework in response. It depends on good industry data and Anne-Marie knows who and where to get it from. United Fresh is a member of the Centre and Anne-Marie manages their food safety interests. She applauds the Centre’s pivot towards industry-centric research projects – “a really important decision in getting industry engagement,” she says. Traceability is another pan-industry pressure that the Centre can help with.

Anne-Marie: “Over the last 20 years, regulations have increased in recognition that fresh produce has unique food safety challenges – it’s eaten raw, there are no kill steps, and there are question marks over potential cross contamination of water supplies and hygiene practices throughout the supply chain. The proximity of horticulture production to animals is an increasing concern.”

“Our kiwifruit and other export crops are benefiting enormously from the perception of New Zealand as clean and green, and Covid-free. There is strong demand for our cherries (the hailstorms in January(!) were a tragic blow for some growers who lost all or part of their crops) and blueberries, highly valued as a superfood.”

“The Māori production renaissance is fantastic. New Zealanders are beginning to realise that the first European settlers could not have survived without Māori horticultural skills. Horticulture fits well with Māori values, and tangata whenua increasingly have money to invest. Apart from the odd setback with the weather, I think it’s going to be the best year ever for hort.”

It’s a really intense time for The Agrichain Centre as successive crops come to fruition, but you may see Anne-Marie shedding her worries by serenely paddle-boarding around the North Shore’s beaches and bays.



PROFILE:

DR SHALOME BASSETT

PROGRAMME LEADER SCIENTIFIC AFFAIRS AND
PRINCIPAL SCIENTIST, FONTERRA AND AFFILIATED
RESEARCHER AT THE RIDDET INSTITUTE

Molecular microbiologist Dr Shalome Bassett is the Programme Leader Scientific Affairs and a Principal Scientist at Fonterra, applying her considerable experience to elucidate the exciting world of the gut microbiome. How does what we eat and drink, in particular dairy, interact with the microorganisms in our digestive tract, and affect our overall health such as our weight, immune system, and mood? We are certain dairy is good for us, but why exactly? What species of bacteria are fostered by dairy products, what genes do they express, what compounds do those genes code for, and what effect do they have on the body?



Shalome seeks to use this knowledge to develop highly targeted probiotics with specific health benefits. Then there's another major dimension to her gut microbiome studies – the urgent quest to reduce methane emissions from cattle and other ruminants. Can the rumen microbiota be modified using new dairy culture fermentations, to reduce the methane produced by cattle as a by-product of digestion? Whole genome sequencing is making these vital studies possible, and Shalome has worked with Centre Chief Scientist Nigel French and other Centre research partners to develop Fonterra's use of this technology across multiple applications.

Twenty years ago, it cost Fonterra over a million dollars per strain to sequence its two highly successful commercialised probiotic strains. With advances in sequencing technologies, the cost is now roughly equivalent to changing the tyres on your car. The article on Dr Lucia Rivas at ESR (pg 7) refers to Fonterra's adoption of a nifty handheld device, called a MinION, alongside other sequencing technologies, to quickly and cheaply sequence isolates that Fonterra hopes to use as new probiotics, thus making sure they are safe and meet in-market regulatory requirements. Fonterra has a huge collection of thousands of dairy isolates, which can now be precisely characterised.

Shalome says that 70% of the body's immune reactions occur in the gut. It is known that compositional changes to the bacteria present in the gut are associated with irritable bowel syndrome (IBS), anxiety and depression, all now so prevalent both globally and in New Zealand.

"That's why," says Shalome, "developing targeted food solutions to improve our health through modifying our gut microbiota, such as those containing elite strains of probiotics, is so critical."

"From birth, the microbes in your gut are helping to train your immune system, effectively programming it for life. They have an incredible influence on our long-term health and development, including digestion, metabolism, and the production of neurotransmitters that affect

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behaviour and cognitive function. There's even now evidence to suggest that this process can start in the womb. Our gut microbiome undergoes dynamic changes in its make-up and diversity over our lifespan, particularly in childhood. Some data suggest that alterations in the gut microbiome in young children can lead to an increased risk of developing diseases later in life, such as asthma and Crohn's disease. Diet is absolutely key to a healthy gut microbiome".

Shalome is particularly interested in developing food solutions that help keep us healthy as we age. More and more consumers want natural nutritional, rather than pharmaceutical, solutions. Her investigation into probiotics and other dairy ingredients is largely funded by Fonterra, with MBIE co-funding through the Centre, as well as via *Smarter Lives* - an Endeavour Programme led by AgResearch. The global market for new probiotic strains, with strong scientific evidence to support claims of their health benefits, is worth billions of dollars annually.

A native of rural Horowhenua, Shalome grew up on a dairy farm. Now she is back in Palmerston North, just across the road from Massey University, where she graduated with a first-class master's degree in microbiology, and then worked as a lab manager and research associate for three years. She never imagined when she set off for the University of Bristol to take up a position as a visiting researcher, that her career would ultimately bring her home. But opportunities for microbiologists abound in Palmerston North, which is such a major food science hub.

On returning from the UK, Shalome had 20 years with AgResearch, working across the agricultural value chain, first at Wallaceville (Upper Hutt) and then in Palmerston North. Her PhD research studied fungal

endophytes of grasses to understand how the two communicate with each other in order to maximise the usefulness of this special symbiotic relationship on-farm. For example, ryegrass staggers, a common problem with cattle grazing over the summer period, is caused by toxins produced by endophytes that grow in the plant leaves. AgResearch has spent many years developing new endophyte strains that don't produce staggers – but there's still more to do to boost pest resistance, drought tolerance and overall plant performance. After a further 10 years of research in the food, nutrition and health space, a secondment to the Riddet Institute four years ago, and then Fonterra, led naturally to a permanent shift from one side of the road to the other.

Reflecting on her different experiences in university, CRI and industry settings, Shalome says, "I'm very grateful for the breadth of research I've been able to undertake in my career which has positioned me well for my current role. I've also had some great mentors – some of whom I still have the privilege of collaborating with. That's why I'm always keen to encourage the next generation of budding scientists and help them develop the skills they'll need for the future."



PROFILE:

DR MEIKA FOSTER
NZFSSRC GOVERNANCE BOARD MEMBER

Independent board member, Dr Meika Foster (Te Ātiawa, Ngāti Mutunga and Irish heritage), was born in North Canterbury where both sides of her family have strong connections. She moved with her family to Queenstown when she was six years old, before returning to Canterbury for her high school years.



After studying and working in London and Sydney for 3 and 8 years respectively, she moved back to New Zealand for the birth of her son, Milan, in Nelson in 2012. Now, she and her husband have returned home to Rangiora to be near her husband's daughter and Meika's parents, who provide invaluable back up with the care of their young son, now 8 years old. They are in the process of building an energy-efficient house on a lifestyle block in Ohoka. Meika and her husband both have demanding jobs, and currently both work from home.

"It's hard to say no," says Meika, "when there are so many exciting opportunities at present. Work-life balance is an ongoing challenge."

Meika's experience and combination of qualifications make her one in a million, if not five million, and much in demand as a consultant - she set up her consultancy business Edible Research Ltd in 2015. Meika has degrees in Law and Māori Studies (University of Canterbury), and a BSc(Hons) and a PhD in nutrition science from the University of Sydney. She says she has always been interested in nutrition. Her particular research interests in science include "the development of high-value plant-based food products that are of excellent nutritional quality, beneficial for health, and able to sustain and regenerate our natural ecosystems." It is clear when talking to her that it's about so much more than the money.

"We're past the tick box stage. It's about having open conversations and being genuine, and recognising the validity of both systems of knowledge. It's quite critical to how we move forward as a country. The government's policy direction recognises the importance of the Māori economy for New Zealand."

One of her projects, for Wakatū Incorporation in Te Taihū (top of the South Island), focuses on the discovery, characterisation and legal protection of high value bioactive extracts from indigenous plants, for the benefit of Māori land owners and investors, and ultimately NZ Inc. The first job was to survey what plants and organisms are living in the Te Taihū rohe. An extension of this work, Te Anga Whakamua, seeks to establish a 'high value industry pathway' that supports Māori organisations to develop and protect food, beverage, therapeutic or other products that incorporate indigenous organisms. With her background in law, Meika has a particular interest in cultural and intellectual property.

This kind of experience is important to the Centre's Governance Board, which wants to support the burgeoning Māori-owned and -run food and nutraceutical businesses. Meika, for her part, is keen to learn more food safety science

and gain governance experience with "trusted colleagues". She likes the cross-disciplinary nature of the work, and believes the Centre is ideally placed to develop a coordinated national food safety strategy for New Zealand, which would save duplication of effort and give further validation to our exporters.

Meika sees herself as a bridge between western science and Mātauranga Māori. "We're past the tick box stage. It's about having open conversations and being genuine, and recognising the validity of both systems of knowledge. It's quite critical to how we move forward as a country. The government's policy direction recognises the importance of the Māori economy for New Zealand."

She cites some of the advantages of the Māori economy:

- **MĀORI ORGANISATIONS TAKE A HOLISTIC APPROACH AND FOCUS ON LONG TERM MANAGEMENT OF THE LAND**
- **BUSINESSES ARE VALUES-BASED, WHICH APPEALS TO CUSTOMERS IN OUR EXPORT MARKETS**
- **MĀORI ARE RECEPTIVE TO, AND SAVVY, ABOUT SCIENCE**
- **MĀORI ARE EXCEPTIONALLY GOOD AT RELATIONSHIP-BUILDING AND STORY-TELLING**

Says Meika, "To further realise these strengths, we need to support Whānau Māori enterprise and invest in the economic potential of regional New Zealand."

As well as her roles in Wakatū, Meika contributes to the High Value Nutrition National Science Challenge, the Liggins Institute, the Riddet Institute, the Pūhoro STEM Academy, and is involved in the New Zealand Singapore Future Foods Programme - as co-Principal Investigator on a consumer science project with Professor Joanne Hort at FEAST, and in an advisory capacity on a seaweed project with the Cawthron Institute. Zoom took a real thrashing in 2020.



MAKING SURE NOVEL FOODS ARE SAFE

The Centre hooked up with The Foodbowl in Auckland to organise a popular short seminar in early December on how to certify the safety of novel foods. Director Dr Catherine McLeod said that a big chunk of the Centre's work is risk assessment.

The first question to answer was what is and is not a novel food in the eyes of regulators, and if it is, what steps do you have to take before going to market. For example, kawakawa tea is not, as it has been in customary use since Māori first discovered its benefits. Likewise horopito, which Māori used as a peppery spice. Conversely, hydrolysed keratin (a tough protein in wool, hair and nails) from sheep's wool is classified as a novel food since there is no history of its safe use in Australia or New Zealand.

Ben Sutherland from FSANZ referred to the relevant sections of the Australia New Zealand Food Standards Code (Standard 1.5.1 Novel Foods and Schedule 25 Permitted novel foods) and talked about the FSANZ pre-market assessment process for novel foods. He used some case studies to give attendees an idea of the factors they look at during an assessment, including:

- **THE SAFETY OF THE NOVEL FOOD, INCLUDING TOXICITY, ALLERGENS, HEAVY METALS, ETC.**
- **SUBSTANTIATION OF THE BIOAVAILABILITY OF NUTRIENTS, EFFICACY, OR HEALTH CLAIMS IN RELATION TO NOVEL FOODS**
- **WHETHER THE LABELLING WILL MISLEAD THE CONSUMER IN ANY WAY**
- **THE PUBLIC CONSULTATION PROCESS FOR VARIATIONS TO THE FOOD STANDARDS CODE**

Ben referred people to the FSANZ application handbook for practical information on the procedure for making an application to FSANZ to vary the Code and outlined what pre-application assistance FSANZ can provide. Novel food enquiries should be directed to acnf@foodstandards.gov.au in the first instance.

Dr Chrissie Butts from Plant & Food Research (PFR) presented findings on their analysis of kawakawa. Whilst not a novel food, it served as a useful test case for their novel food assessment process, and at the same time helped to support some of the claims made for kawakawa. It was used by Māori to make tea and beer, as an insecticide (they burnt the leaves and branches), and a herbal tonic (wai rakau) with a myriad of alleged benefits from an energy booster to treating gonorrhoea. PFR analytical chemists found the plant contains significant amounts of piperine, used in traditional medicines all over the world, and myristicin, which has insecticidal properties. Researchers used a pure kawakawa tea to test for toxicity and overall safety.

Arepa CEO Angus Brown had everyone intensely focussed on his account of their collaboration with Swinburne University to develop a Nootropic (a substance that enhances brainpower) blackcurrant drink, Arepa. Angus says NZ blackcurrants are superior, rich in polyphenols and other nutraceuticals, which may offer health benefits to consumers.

Arepa commissioned NZ's Centre for Brain Research to test the formula on sportspeople and students experiencing physical and mental stress, and

found it significantly improved concentration, performance, and reduced nervousness and anxiety.

No one needed a shot of Arepa to keep them awake in the after lunch slot, though more than one had formed a resolution to try it after Angus Brown's presentation.

Paul Ryan of Trust Codes Limited gave a superb presentation on traceability technologies and brand assurance.

He said, "Consumers are looking for the truth about their food and beverages – but you must provide evidence and data behind the story or it's just storytelling. Consumers are increasingly aware of overpromised attributes . . . you need to be clear about what problem you are solving."

"Caring about each other has become the NZ brand – (we) got on top of Covid, and were good and decent about it. This is a real advantage to build on."

"Traceability gives a whole lot of confidence, but it has to be from end to end of the supply chain, not just one up one down."

He advocates the use of QR codes, which cannot be faked, and are familiar to consumers, and even more so now through the use of QR codes for Covid-19 tracing.

"While fraudsters can replicate websites, we have built technology that tracks down copy-cats and we go hunting for any fraudulent activity," he said. Paul also recommended that companies capture and keep all the data they can, as long as it is anonymized. "You can straighten it out and figure out what to do with it later. But keep it safe, secure and compliant with privacy rules."

The Centre hosted a shorter version of the conference via its Zoom 'Spotlight on Food Safety Science seminars' on 26 February.

PAUL RYAN



For more information call industry account manager Dr Vivienne Hunt v.hunt@massey.ac.nz

DR MATT MILLER



CAWTHRON TEST SAVES OIL AND INFANT FORMULA EXPORTERS LONG DELAYS

Manufacturers of vegetable and marine oils, such as sought-after Omega 3, were becoming more and more frustrated by the weeks of delay waiting for European labs to test their product for a group of contaminants called MCPDs. They can form when products are processed at high temperatures.

The long turnaround meant product sitting around in factories and warehouses, choking further production. Hearing their complaints, Dr Matt Miller, an expert in oil chemistry at Cawthron Institute, decided to develop an accredited lab test service here.

At a conference, he had also become aware that the test was necessary for all manufacturers of infant milk powders, so the service would have very wide application in New Zealand. About a year of intense work later, in 2019 Matt and his team at Cawthron attained separate IANZ accreditations for oils and infant milk powders, and throughput is now routine. Those delays previously experienced by exporters could have been so much worse in 2020.

Matt wants all producers to be aware of the service, which is the only one in Australasia. In true Anzac spirit, Cawthron Institute is helping Australian companies establish their own analytical capability.

In fact, these contaminants have never been an issue in New Zealand products and test results are consistently below the exacting limits set by the Europeans. Matt says the challenge in developing the lab test was in the detection of such tiny, tiny amounts. But they were able to adapt existing lab equipment for the test, which has made the service even more affordable for their customers.

Although the initiative pre-dated the arrival of coronavirus, Matt is excited by the way in which the pandemic has motivated and emboldened New Zealanders to innovate and become more self-reliant. "We are realising there is so much stuff we can do ourselves."



CONGRATULATIONS TO NZFSSRC SCHOLAR LAURA BIESSY ON SUBMITTING HER PHD THESIS

Elucidating the source and transmission of tetrodotoxin in NZ bivalves

The results of Laura's work are assisting the seafood industry to understand potential risk related to a natural toxin called tetrodotoxin, and its origins in the marine environment. We thank Laura for her excellent scientific contribution to supporting industry and wish her well in future endeavours.



A VIRTUAL CENTRE

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

INDUSTRY MEMBERS:

- AsureQuality
- DCANZ
- Eagle Protect
- Fonterra
- Food Bowl
- FSANZ
- Horticulture NZ
- Kono
- Meat Industry Association (MIA)
- NIG Nutritionals Ltd
- Nuku Ki Te Puku
- NZ Food & Grocery Council
- NZ King Salmon
- Oceania Dairy
- PIANZ
- Sanford
- Seafood NZ
- Synlait Milk Limited
- Tatua
- Trust Codes
- United Fresh
- Westland
- Zespri

RESEARCH PARTNERS:



GOVERNMENT SUPPORTERS:



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If you are interested in becoming a member of NZFSSRC, please contact, Dr Vivienne Hunt (v.hunt@massey.ac.nz) and find out what the Centre has to offer.