Riddet Institute
Kōkiri - Te Hā o te Kai

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IMPACT CASE: 05

OUR INNOVATIONS FOR A HEALTHIER FUTURE

FRONTIER

FERRI-PRO™ TECHNOLOGY CHANGES THE WORLD OF AFFORDABLE NUTRITION

The game-changing ingredient known as Ferri-Pro™ is helping prevent the serious consequences of nutritional deficiencies in iron. The unique technology was developed by Riddet Institute scientists and has won several innovation awards and continues to impact vulnerable populations around the world.

THE IMPACT OF THE BREAKTHROUGH IRON SUPPLEMENT FERRI-PRO™

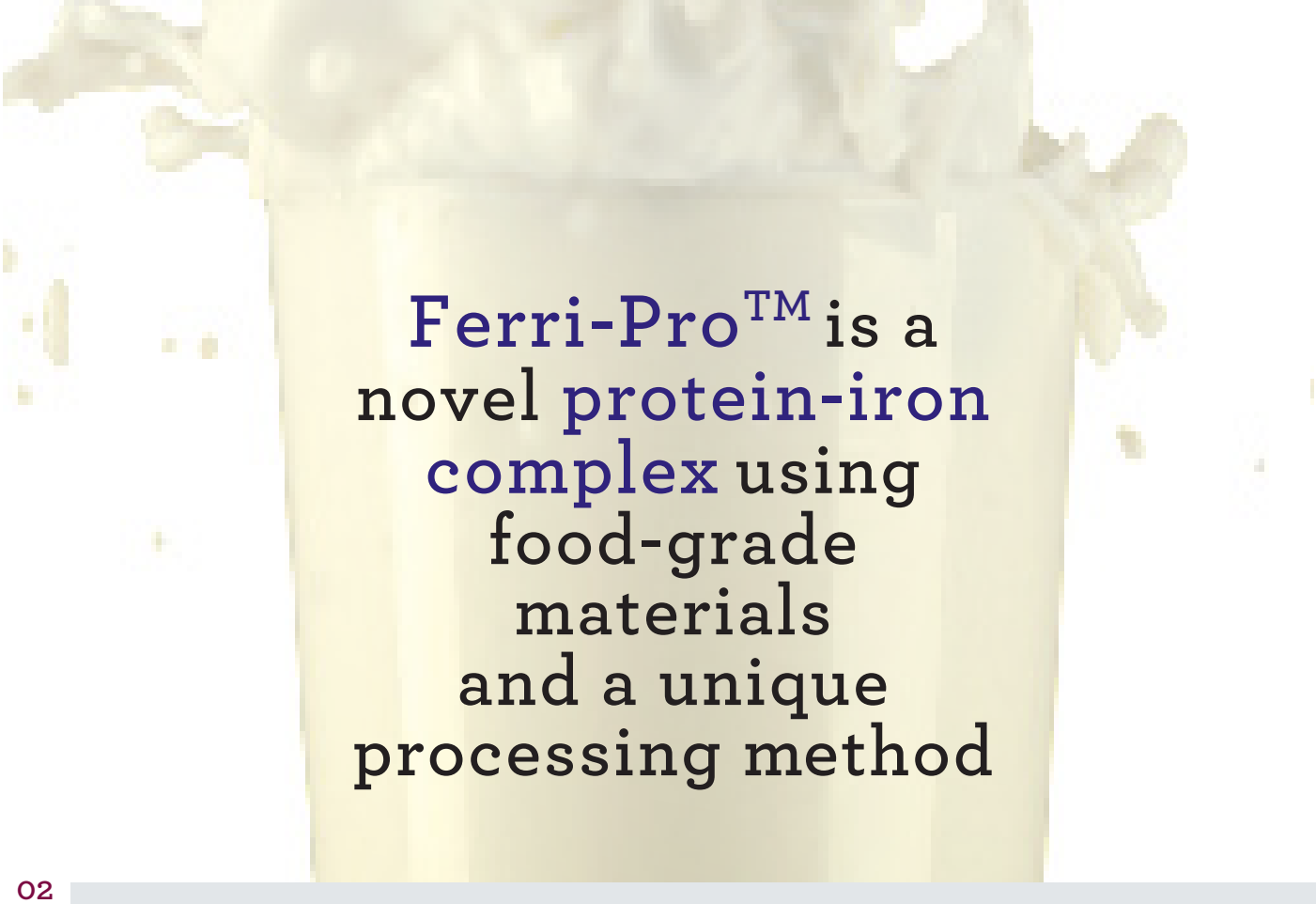
> THE NEED

Iron deficiency is a serious problem around the world, leading to birth defects and failure to thrive in countries where conventional food sources of iron, such as red meat, are too expensive or scarce. Iron deficiency is the most common micronutrient deficiency in the world, particularly in South Asia, leading to suboptimal pregnancy outcomes and infant development.

Malnutrition makes it even more challenging to obtain sufficient micronutrients from the diet. Iron is particularly critical because it is needed not just for children's physical growth, but it is also essential for normal brain development and cognition. The first 100 days in a child's life, from conception to nearly three years, is crucial for adequate nutrition.

More than 1.6 billion people suffer from iron deficiency anaemia around the world, particularly children and pregnant women. Anaemia effects 25-30% of the global population and about half of the cases are due to iron deficiency.

A new technology arising from Riddet Institute research is helping change all that. With Ferri-Pro™, Riddet Institute scientists at Massey University found a new way to make an iron ingredient that can easily and safely be added to foods or drinks, a feat that is technically challenging.



Ferri-Pro™ is a novel protein-iron complex using food-grade materials and a unique processing method

›The scientific challenge

There are many different sources of iron – ferrous sulfate, ferric pyrophosphate, ferrous fumarate – to name a few. It is not possible to just add iron to food or beverages as fortification will impact the sensory properties of the product – the taste and flavour – which may make it unpalatable. Fortification is also pointless if the iron cannot be absorbed, so the form of iron used must be one that is available to the human body.

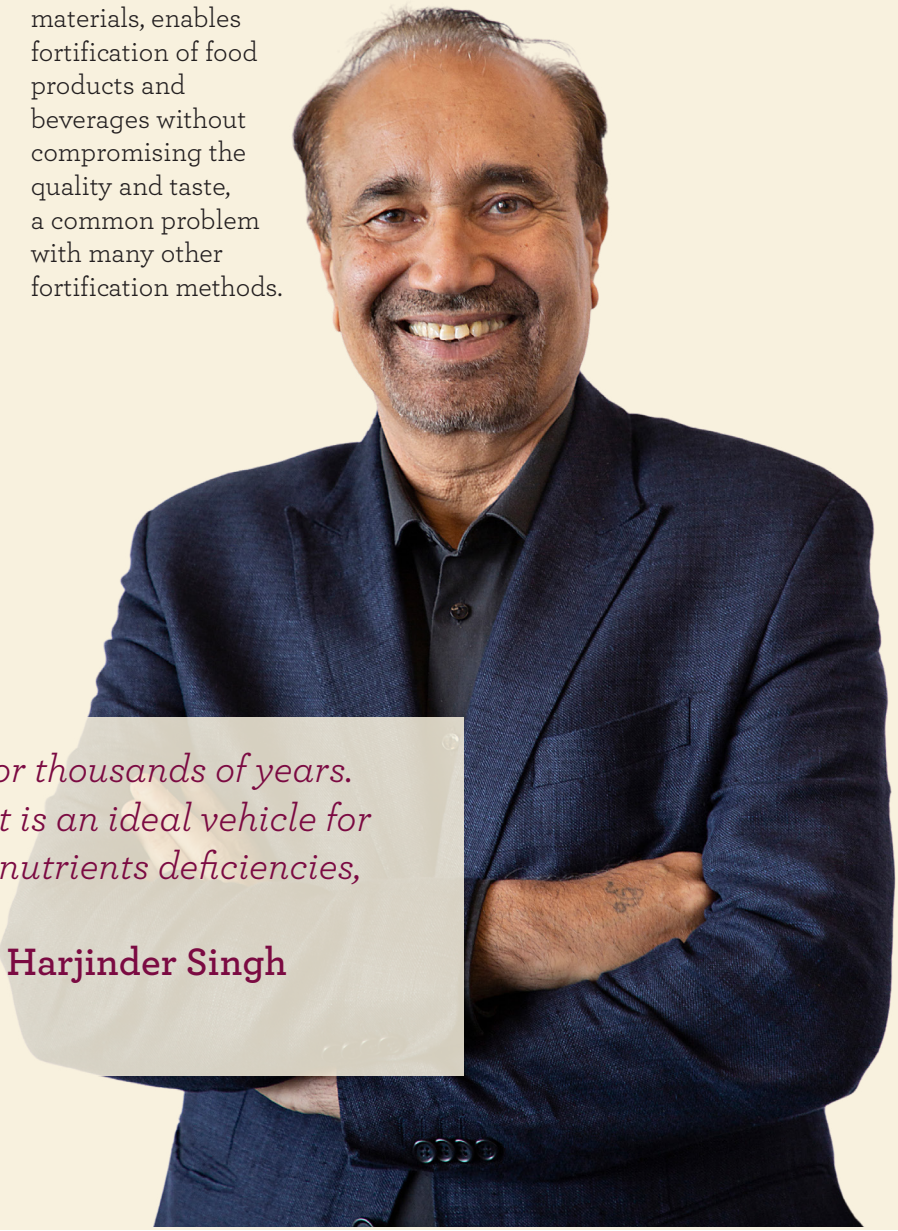
When iron is added to beverage-type products, such as milk, it interacts with proteins and lipids during processing, causing flavour changes, colour changes and sediment formation which are not acceptable to the consumer. Some sources of iron do not fully dissolve into the beverage at all and are therefore not able to be taken up by the body.

Distinguished Professor Harjinder Singh led the research team that developed Ferri-Pro™ and says this is where Ferri-Pro™ is different.

"Iron compounds that are used in fortification need to be fully bioavailable, but at the same time should have no impact on the sensory properties of the food product. This is, in fact, one of the biggest challenges we needed to solve."

Ferri-Pro™ is odourless, water soluble and tasteless. It is stable and highly bioavailable. The novel protein-iron complex, made using food-grade materials, enables fortification of food products and beverages without compromising the quality and taste, a common problem with many other fortification methods.

"This technology allows iron to be present in a form that's fully soluble, can be easily absorbed, and at the same time, it causes no defects in consumer products," says Dist. Prof Singh. "That's the invention."



"Milk has been consumed for thousands of years. Because it is so nutritious, it is an ideal vehicle for fortification to tackle micronutrients deficiencies, especially in children."

– Distinguished Professor Harjinder Singh
Director, Riddet Institute

Nestlé team's visit to the Riddet Institute

Dr Vikas Mittal

> The discovery: A science led-approach

A novel science discovery

Over the last three decades, Dist. Prof Singh's team has delved deep into understanding the intricate interplay between micronutrients and proteins. With a focus on calcium, zinc, iron, and vitamins, several PhD students have contributed to the team's exploration of this important area.

"In 2011, with the arrival of a new PhD student, Dr Vikas Mittal, we started to look at the binding of iron within milk systems," Dist. Prof Singh says. "Milk, known for its rich calcium content, predominantly locates calcium within casein micelles, the primary protein fraction in milk. We hypothesised that a portion of this calcium could be replaced with iron, while keeping the milk structure intact."

He says, unexpectedly, the addition of iron induced a major transformation in the structure of the casein micelles, providing novel insights into the creation of casein-iron interaction complexes.

In Ferri-Pro™ the iron is encapsulated into a complex along with two naturally occurring components of milk, casein and phosphorous. The iron is protected within the complex so does not interfere with the taste or sensory properties of the milk, while also being able to be fully digested and absorbed with the casein and phosphorous.

"The discovery led to filing of a patent, named Ferri-Pro™, describing how iron can be protected within the protein complex, preserving the taste and sensory properties of milk while facilitating optimal digestion and absorption alongside casein and phosphorus."

The method is cost-effective and easy to produce.

The Ferri-Pro™ technology was the result of ten years of research at the Riddet Institute, with a strong collaboration with global brand Nestlé.

› The road to commercialisation

Nestlé is the world's biggest global food brand, with powdered and liquid beverages as its largest product segment. It creates products such as Nescafe instant coffee, Milo, and infant formulas, aiming to apply its expertise in nutrition and wellness to produce products that enhance the life and health of people.

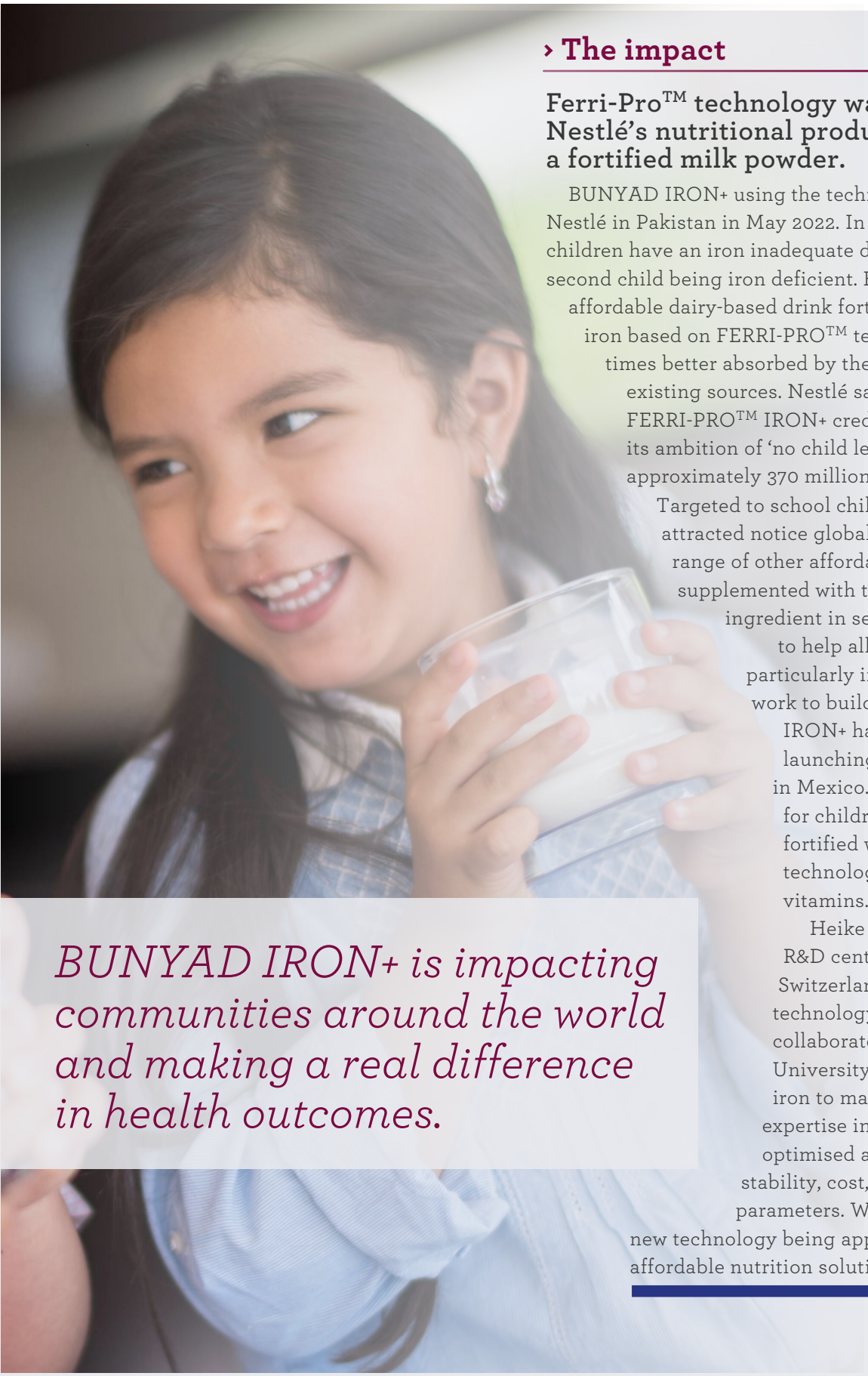
The Ferri-Pro™ technology was a good fit with its goal of supporting human nutrition.

The commercialisation process involved engaging with Nestlé headquarters in Switzerland, establishing an exclusive trial period and ultimately negotiating the sale of the intellectual property. The negotiation involved face-to-face meetings in Switzerland and regular video conferencing over an 18-month period.

The Nestlé R&D team and the Riddet Institute worked together for more than three years to develop a new, more bioavailable iron milk compound, known as iron milk proteinate. Dist. Prof Singh, together with the Nestlé team, generated a large amount of new technical and nutritional knowledge, which has also been published in a peer-reviewed scientific journal (Nutrients. 2020 Sep; 12(9):2776.). The compound achieved FDA GRAS and EFSA novel food status, which was crucial in eventually reaching a commercially viable solution to launching FerriPro™ as BUNYAD IRON+ in Pakistan. This information has been captured in several confidential reports submitted to Nestlé.

The novel technology was licenced to the global food giant in 2019 which represented the single biggest commercial deal to emerge from Massey University, both in terms of commercial impact and societal benefits. The deal not only provided for a commercial return to the Riddet Institute but represented a huge opportunity to showcase New Zealand food science to the largest global food company. This generated widespread media coverage internationally.

The close working relationship established with the world's largest food company through this collaboration provides significant on-going benefits to New Zealand.



› The impact

Ferri-Pro™ technology was used to create Nestlé's nutritional product BUNYAD IRON+, a fortified milk powder.

BUNYAD IRON+ using the technology was launched by Nestlé in Pakistan in May 2022. In Pakistan, nine out of ten children have an iron inadequate diet, resulting in every second child being iron deficient. BUNYAD IRON+ is an affordable dairy-based drink fortified with a new source of iron based on FERRI-PRO™ technology that is about three times better absorbed by the body compared with existing sources. Nestlé says, BUNYAD, with its FERRI-PRO™ IRON+ credentials, is striving towards its ambition of 'no child left behind' by offering approximately 370 million fortified servings annually. Targeted to school children, the product quickly attracted notice globally. Nestlé plans to launch a range of other affordable dairy products supplemented with the iron milk proteinate ingredient in several developing countries to help alleviate iron deficiency, particularly in children and women. This work to build the success of BUNYAD IRON+ has begun with Nestlé launching Nutri Rindes Fuerza Más in Mexico. This is a dairy-based drink for children aged 4-12 that is also fortified with FERRI-PRO™ technology, as well as minerals and vitamins.

Heike Steiling, Head of Nestlé's R&D centre for dairy Konolfingen, Switzerland, says after acquiring the technology, Nestlé continued to collaborate closely with Massey University to bring this new source of iron to market. "Using our R&D expertise in dairy products, we further optimised and improved the taste, stability, cost, as well as other key parameters. We are excited to see this new technology being applied for the development of affordable nutrition solutions around the world."

BUNYAD IRON+ is impacting communities around the world and making a real difference in health outcomes.

Key milestones

One of the key steps to commercialisation of Ferri-Pro™ technology was to obtain the GRAS status from Food and Drug Administration (FDA, USA) for the iron milk proteinate ingredient. Dist. Prof Singh's team worked with Nestle's Regulatory Experts and FDA panel members to successfully achieve this objective.

- **GRAS Notice for the use of iron milk proteinate in conventional food and beverage; https://fda.report/media/148686/GRAS-Notice-GRN-959-Iron-milk-proteinate.pdf**

Another significant achievement was the approval of the iron milk proteinate ingredient as novel food from the European Food Safety Authority (EFSA). This required extensive discussions and meetings with several experts in Europe, Canada and Nestle's Regulatory and Nutrition teams.

- **Scientific Opinion on the safety of iron milk proteinate as a novel food pursuant to Regulation (EU) 2015/2283 and bioavailability of iron from this source in the context of Directive 2002/46/EC. EFSA Journal 2022;20(9):7549, 16 pp. https://doi.org/10.2903/j.efsa.2022.7549 ISSN: 1831-4732; https://www.efsa.europa.eu/en/efsajournal/pub/7549**

Awards

The Ferri-Pro™ invention and its successful commercialisation has been recognised through various awards.

- 2020 PwC Commercial Impact Award, KiwiNet Research Commercialisation Awards, New Zealand
- Best Licensing Deal 2022 at the KCA Australasian Research Commercialisation Awards in Melbourne to Massey Ventures Limited for the sale of the technology to Nestlé.
- Innovation in Research & Development – Consumer Nutrition Award 2022 at the International World Dairy Summit (organised by International Dairy Federation), held in New Delhi, India, for the Ferri-Pro™ technology used in Nestlé's new BUNYAD IRON+ milk powder (see picture on right).

From left, Mayank Trivedi, Head of Strategic Business Unit Dairy, Nestlé; Heike Steiling, Head of Nestlé Product Technology Center Dairy, Nestlé R&D; Himanshu Gupta, Global Head of Regulatory and Scientific Affairs, Strategic Business Unit Dairy, Nestlé R&D.

› About the Riddet Institute

The Riddet Institute is a New Zealand government-funded Centre of Research Excellence. The Institute brings together New Zealand's leading scientists in food and nutrition in a collaborative, multidisciplinary national network. Partners include Massey University (host partner), the University of Otago, the University of Auckland, AgResearch, and Plant & Food Research. The Institute's research programme is focused on the effect of food structure on digestion and health, and through its work, it aims to be a catalyst for innovation to create sustained competitive advantage for New Zealand's food industry.

› The Riddet Institute Partners

MASSEY UNIVERSITY TE KUNENGA KI PŪREHUROA UNIVERSITY OF NEW ZEALAND

agresearch āta mātai, mātai whetū

Plant & Food RESEARCH RANGAHAU AHUMĀRA KAI

THE UNIVERSITY OF AUCKLAND NEW ZEALAND Te Whare Wānanga o Tāmaki Makaurau

University of Otago ŌTĀKOU WHAKAIHU WAKA

Riddet Institute ADVANCING FRONTIERS IN FOOD SCIENCE

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