Riddet Institute
KAI | WHAKAAUAHA | HAUORA

APRIL:17
IMPACT CASE: 01

FRONTIER

OUR INNOVATIONS FOR A HEALTHIER FUTURE

SECURING THE FULL MEASURE OF DIETARY PROTEIN

NEW ZEALAND MAY BE SMALL IN GLOBAL PRODUCTION TERMS BUT DOMINATES INTERNATIONAL TRADE IN SOME SECTIONS INCLUDING DAIRY, RED MEAT & KIWIFRUIT, AND SPECIALISING IN "PROTEIN" FOODS PRODUCING ENOUGH PROTEIN TO FEED 45 MILLION PEOPLE WORLDWIDE.

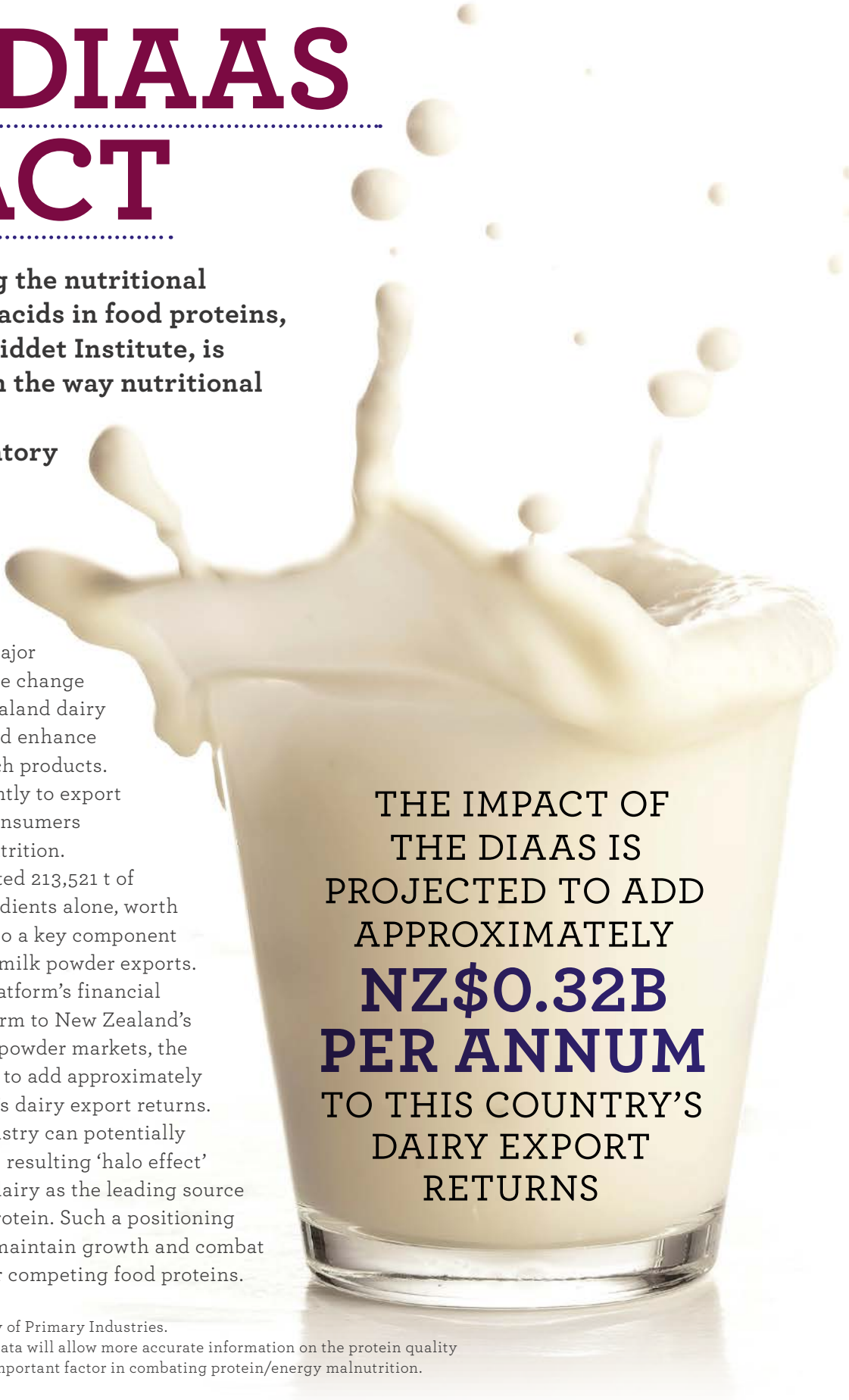
THE DIAAS IMPACT

Research establishing the nutritional availability of amino acids in food proteins, spearheaded by the Riddet Institute, is leading to a change in the way nutritional quality of protein is determined by regulatory agencies world-wide.

Digestible Indispensable Amino Acid Score (DIAAS) has demonstrated that milk proteins are of higher nutritional value than their major competitors in the market. The change to DIAAS will enable New Zealand dairy businesses to grow market and enhance premiums for their protein-rich products. This will contribute significantly to export revenues while also giving consumers greater confidence in their nutrition.

In 2016, New Zealand exported 213,521 t of casein and milk protein ingredients alone, worth $2b per annum*. Protein is also a key component of New Zealand's annual $6b milk powder exports. Applying the Global Dairy Platform's financial projections for the medium term to New Zealand's protein ingredients and milk powder markets, the impact of DIAAS is projected to add approximately NZ$0.32b p.a. to this country's dairy export returns.

The New Zealand dairy industry can potentially reap further benefits from the resulting 'halo effect' the methodology confers on dairy as the leading source of highly nutritious dietary protein. Such a positioning aids the industry's efforts to maintain growth and combat market share erosion by other competing food proteins.



THE IMPACT OF THE DIAAS IS PROJECTED TO ADD APPROXIMATELY **NZ$0.32B PER ANNUM** TO THIS COUNTRY'S DAIRY EXPORT RETURNS

* Export data sourced from the Ministry of Primary Industries.
Of more profound relevance, DIAAS data will allow more accurate information on the protein quality of foods in developing countries, an important factor in combating protein/energy malnutrition.

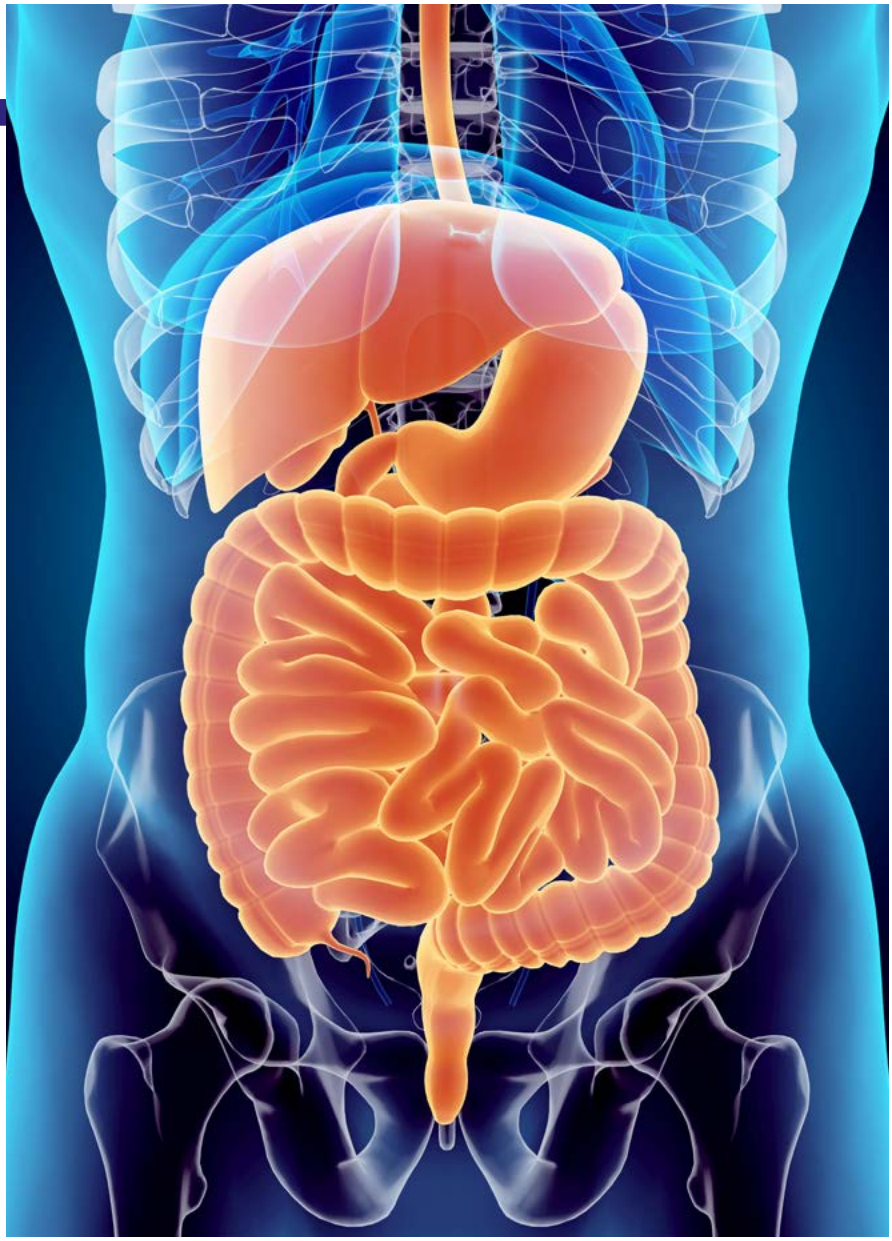
A NEW METHODOLOGY, DEVELOPED IN PART, BY NEW ZEALAND'S RIDDET INSTITUTE IDENTIFIES WITH GREATER ACCURACY WHICH FOOD SOURCES OFFER THE HIGHEST NUTRITIONAL VALUE FROM DIETARY PROTEIN.

It's an advancement that positions New Zealand as a lead producer of high value food to meet the needs of the expanding global population. Food protein is a key nutritional building block. Protein is so fundamental to wellbeing that a significant lack of it can cause failure to grow, weakened immunity, and can compromise the heart and respiratory system.

International food regulators recommend that humans need a daily dietary protein allowance of 0.8 grams per kilogram of body weight, per day. But how do we know how much protein is accessed by the human body - and thus the nutritional value gained - from different food sources? Having an accurate means to measure the value is ever more critical in addressing the need to invest in producing food sources that offer the greatest nutritional value within the context of limited resources and a growing world population.

› The measurement challenge

Measuring food protein in order to differentiate the nutritional value derived from different food sources is a technically challenging task. Food proteins are complex. The amino acids that aid the synthesis of protein by our bodies exist in different combinations in different food proteins. Measurement involves determining the net absorption of these amino acids during the complex process of digestion. As an added complexity, not all amino acids are nutritionally equivalent. Nine amino acids cannot be synthesized by the body. Known as the indispensable - or essential - amino acids (IAAs), these IAAs can only be sourced from food and are the focus of measuring food protein quality levels.



› The PDCAAS

In 1991 the FAO adopted as its protein measurement methodology the Protein Digestibility-Corrected Amino Acid Score (PDCAAS). Since its introduction, PDCAAS has become the foundation for global national food regulatory systems and for food product marketing.

The PDCAAS measures the absorption of amino acids at the end of the hind gut (the last section of the large intestine). In other words, the measurement is taken after food is completely digested (faecal digestibility). The results are expressed as a ratio, relative to the estimated amount of amino acid required by humans.

The methodology presents some accuracy challenges. Only minimal absorption occurs in the hind gut. Additionally, the metabolic activities of microbes in the gut can affect the presence of proteins in the faeces. Both these factors can lead to erroneous results.

A further limitation of the PDCAAS in accurately presenting the relative values of different food sources is that the methodology only measures amino acid absorption up to the level of protein that the human body is considered to need. Food sources scoring higher than this level are automatically classed as having a score of 1.0 or 100%. By truncating – limiting – the values in this way, the PDCAAS offers no distinction between food sources that score exactly 1.00/100% and those for which the nutritional value is higher than this level.

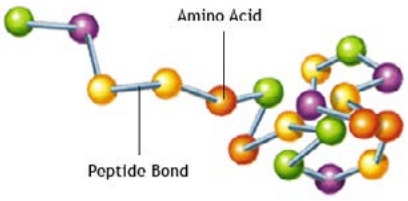
› Finding a clearer measure

New Zealand's Riddet Institute has undertaken research that forms a large part of the knowledge foundation for a new measure addressing the limitations of the PDCAAS.

The new scoring methodology is called the Digestible Indispensable Amino Acids Score (DIAAS). The Institute's research definitively demonstrates that a more accurate assessment of protein levels can be achieved by measuring amino acid absorption earlier in the digestion process – at the ileum (ileal digestibility), before the large intestine.

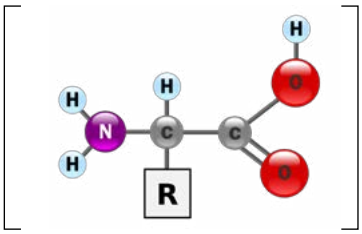
However, the testing of ileal digestibility in humans is challenging. Instead, ileal digestibility is measured using the growing pig as an appropriate animal model. Because ileal digestibility is being used, corrections are also needed to identify amino acids that are of host cellular origin rather than dietary origin.

› The Riddet Institute's world-leading research that underpins the DIAAS methodology addresses:



the origins of the amino acids

factors influencing protein digestion in the gastrointestinal tract



a robust means of separating the amino acids from complex protein mixtures to ensure measurement is accurate.

An important part of the research is centred on gaining a clearer understanding of the influence of individual amino acids and their structures on nutritional availability – just because an amino acid may be absorbed, it is not necessarily in a form that can be synthesized into protein by the body.

In addressing these factors, the Riddet Institute and colleagues elsewhere have demonstrated the advanced accuracy of ileal over faecal digestibility. This gave the FAO the confidence to support the move to the DIAAS method and the use of an appropriate animal model to measure DIAAS. The FAO also recommends to treat and list individual amino acids as distinct nutrients and to not truncate the nutritional value scores for DIAAS. This will provide the vital information needed to identify optimal vegetable/animal protein mixtures. The result will be a much truer picture of the nutritional value of different food proteins.

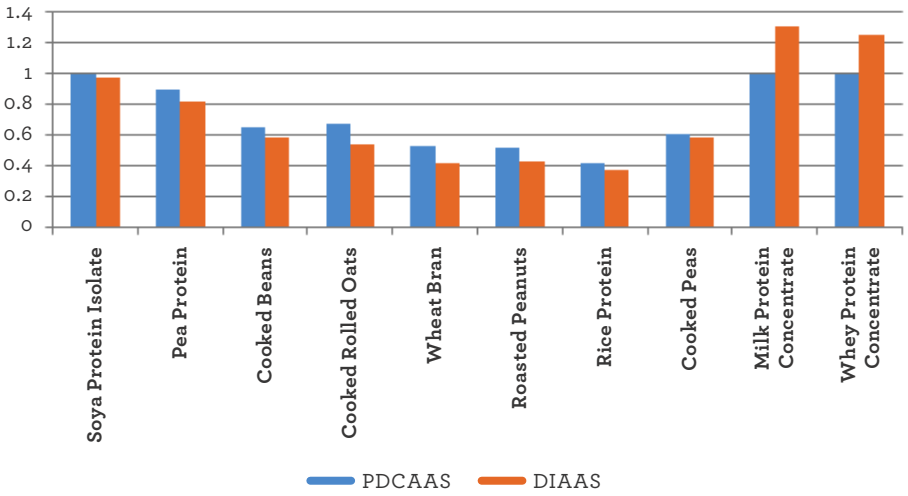
› Dairy - the superior dietary protein source

The new DIAAS clearly demonstrates the superior quality of dairy proteins when compared to plant proteins. Under the truncated scores generated by PDCAAS, the quality of soya protein and of dairy protein are represented as equal in value. When scores are shown at their actual value - as in the new DIAAS - the superiority of the quality of dairy is clearly evident.

The introduction of DIAAS as the standard means of measuring food protein is of significant benefit to the global dairy industry. When fully adopted by the FAO and national regulatory bodies, DIAAS will support the marketing of dairy products as superior in quality and nutritional value over soya and other plant-based proteins. This provides a solid platform for a stronger 'sell' message for dairy.

"As a methodology, DIAAS offers a more accurate view of the protein quality of foods than PDCAAS. Dairy proteins are high quality and it is important to the industry to be able to showcase this. The work at the Riddet Institute in New Zealand has been central to progressing the development of the DIAAS method and to using the pig model for determining true ileal digestibility in particular. Paul Moughan and the team are to be commended for their long-term commitment to ensuring nutritional protein quality is based on robust science".

Dr Judith Bryans,
President, International Dairy Federation.

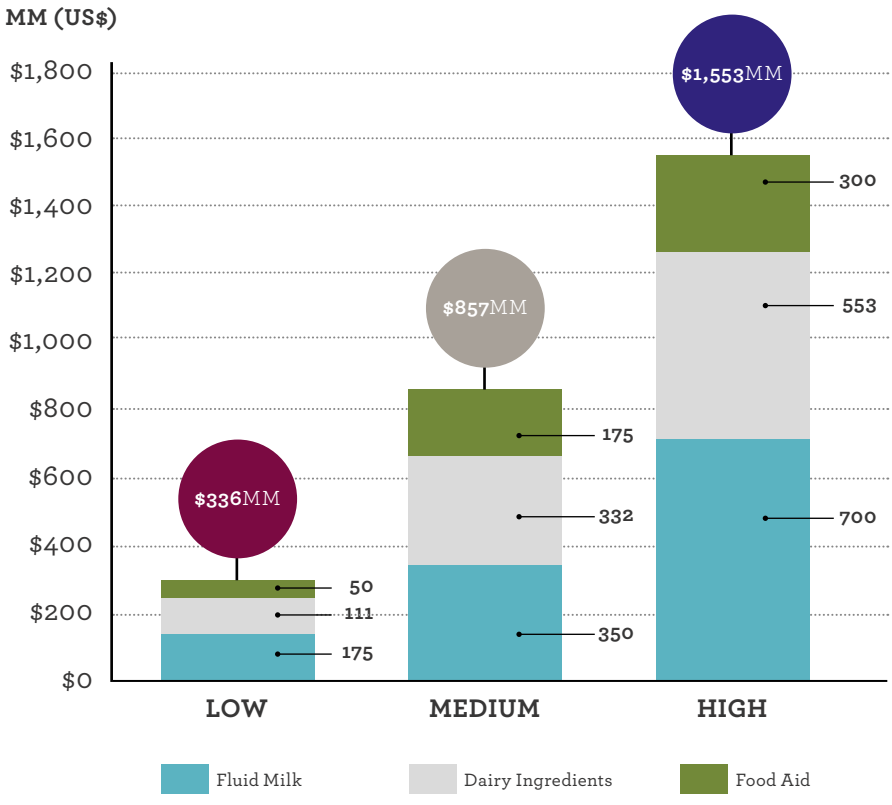


In a business case developed for the Global Dairy Platform*, the impact of DIAAS is suggested to be worth US$1b per annum in the long term.

The business case was based on just three categories of milk product manufacturing – the US Fluid Milk market, the international Dairy Ingredients market and global Food Aid sector. Potentially, the commercial impact will be even greater when all market opportunities are included.

*The Global Dairy Platform is an international collaboration of organisations that includes Dairy Farmers of America, Fonterra, Royal Freisland-Campina, Arla Foods, Land-o-Lakes and the International Dairy Federation. The business case analysis was based on research conducted by the McCully Group for Global Dairy Platform and Dairy Management Inc, October 2014.

› Scenarios for Potential Benefit from DIAAS



"The quality of the proteins in dairy products underpins the value Fonterra is able to obtain from the market. Being able to scientifically demonstrate that milk proteins are nutritionally superior to competitor food proteins – especially soya proteins - will support Fonterra both strategically and in the market place. It will help us sell dairy, grow market share, hold and potentially increase margins. The DIAAS method will be a pillar for dairy going forward and the critical role played by the Riddet Institute team is fantastic – it helps the overall credibility of the New Zealand and Fonterra dairy business".

Gillian Munnik, *NZMP Marketing Director, Global Ingredients, Fonterra*

› The Riddet Institute leading the way

The Riddet Institute is at the forefront of research on defining the nutritional value of food proteins and has been since its inception in 2007.

Director and Distinguished Professor Paul Moughan and Associate Professor Shane Rutherford (Massey University) have built a reputation for outstanding scholarship in this field. The Institute's standing internationally enables it to influence the setting of rules for trade and regulation of food protein quality or nutritional value based on rigorous science.

In 2011, Professor Moughan was invited by the FAO to chair the Expert Consultation Panel on Dietary Protein Quality Evaluation in human nutrition. The Panel, which comprised a team of world-leading scientists in their field, conducted an extensive review of the published evidence which led to the FAO recommendation to replace PDCAAS with DIAAS.

Distinguished Professor
Paul Moughan

Associate Professor
Shane Rutherfurd

Currently, the Institute is working as part of a multinational programme, applying the DIAAS method to characterize the quality values of the world's food proteins. Professor Moughan is leading the $7m research programme, which is funded by an international consortium of food industry sectors.

The project will produce a global dataset of protein quality assessments sought by the FAO to enable the use of DIAAS as a worldwide gold standard for assessing dietary protein quality.

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 international network. Partners include Massey University (host partner), AgResearch, Plant & Food Research, The University of Auckland and University of Otago.

The Institute's research programme is focussed 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 Te Whare Wānanga o Otāgo NEW ZEALAND

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