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food australia

JANUARY – MARCH 2026

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January – March 2026

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OFFICIAL PUBLICATION OF AIFST

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Food for Thought

Welcome to the Summer edition of *food australia*, our first journal for 2026.

As Australia's agrifood system faces increasing complexity, the role of food science and technology has never been more critical. From ensuring food security and safety, to supporting innovation, sustainability and public trust, food scientists and technologists sit at the centre of the decisions that will shape our food future.

Looking ahead, several strategic challenges will continue to influence AIFST's focus in 2026 and beyond. These include accelerating innovation for a sustainable future; strengthening food safety, trust and regulatory confidence; advancing health and nutrition outcomes; deepening engagement with our regional neighbours; building a capable and future-ready workforce; and lifting awareness of the essential contribution of food science and technology across industry, government and the community.

These challenges are not isolated — they are interconnected and global in nature. Addressing them will require strong technical capability, systems thinking, and collaboration across disciplines, sectors and borders. Food science and technology provide the evidence base and practical solutions that enable the agrifood sector to respond effectively, adapt to change, and deliver long-term value for consumers and society.

Central to this capability is a commitment to continuous professional development. In an environment of rapid scientific advancement, evolving regulation and increasing scrutiny, Continuing Professional Development (CPD) is no longer optional — it is fundamental. CPD underpins professional credibility, supports ethical and evidence-based decision-making, strengthens regulatory compliance, and enables innovation across the food system. It also plays a critical role in workforce resilience, leadership development and career progression.

AIFST remains committed to supporting the profession through an expanded and strategic CPD offering. Our 2026 program is designed to equip members and the broader agrifood science community with the skills, knowledge and networks required to lead with confidence in a changing environment. We will continue to focus on delivering relevant, high-quality opportunities that support learning, connection and professional excellence.

As we begin the year, I encourage you to make a deliberate investment in learning — for yourself, your teams and the future of the profession. Let 2026 be a year to **Learn, Grow and Lead** through food science and technology.

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Foodbank Hunger Report 2025 offers a vital snapshot of our country's hunger problem

Words by Sarah Pennell

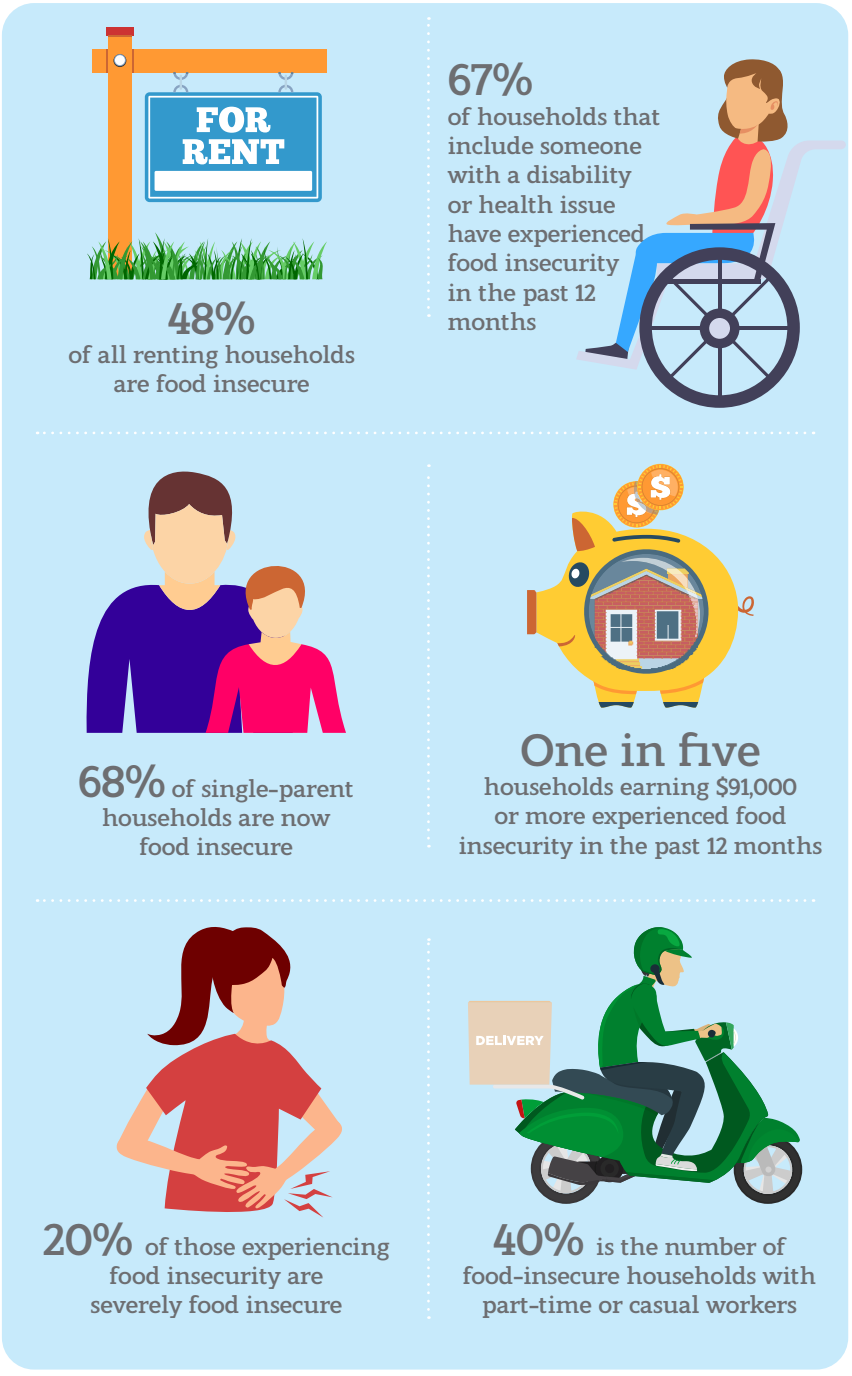
One in three Australian households, or 3.5 million households, experienced food insecurity in the past 12 months, according to the *Foodbank Hunger Report 2025*, released late last year. The report paints a stark picture of widening food insecurity across the nation, debunking the myth that hunger only affects the unemployed or homeless.

"While we dismiss hunger as something that only impacts the most vulnerable in our community, the 2025 *Foodbank Hunger Report* shows households of all stripes are reporting food insecurity as a fact of life – from those that are employed, are renting or have mortgages to those raising children, or living with disability, to our neighbours, friends and family.

"This is not a fringe issue. Appallingly, hunger is mainstream in Australia right now. Our federal government must act," said Foodbank Australia CEO, Kylea Tink.

The *Foodbank Hunger Report 2025* reveals that cost-of-living pressures remain the number one concern for 91% of food-insecure households, followed by housing and the broader economy. Behind the data are the real stories of families forced to skip meals so children can eat, workers going hungry to pay rising rents, and people living with disability or illness struggling to put food on the table.

Sarah Pennell is General Manager Research and Advocacy at Foodbank Australia.



Source: Foodbank, Foodbank Hunger Report 2025 https://reports.foodbank.org.au/foodbank-hunger-report-2025

Kylea Tink joins Foodbank Australia as new CEO

The Foodbank Australia Board welcomed Kylea Tink as the new Chief Executive Officer at Foodbank Australia on 27 October 2025.

Kylea joins Foodbank Australia at a pivotal time for the food relief entity as it sets out to pursue an ambitious new commitment to ensure anyone in Australia experiencing the uncertainty of food insecurity – man, woman or child, of any age, cultural or socioeconomic background, has access to the support they need, immediately and reliably.

"As the 14th largest economy in the world, it is inconceivable that nearly a third of all Australian households currently report experiencing food insecurity," said Kylea. "Quite simply, no Australian should go hungry."

Kylea joins the food relief organisation with an impressive professional track record spanning federal politics, commercial operations and the not-for-profit sector. As the former Independent Member for North Sydney, Kylea was the first woman elected to represent the seat, which was abolished by the AEC in March 2025 as part of their boundary redistribution. At the time, Kylea announced that rather than contest another seat, she would retire from politics alongside her community.

The former Managing Director for Edelman Australia, Kylea brings to Foodbank extensive leadership experience alongside a deep knowledge of the not-for-profit sector. She served as the inaugural CEO of the McGrath Foundation, where she played a pivotal role in conceiving and successfully establishing one of the most iconic sporting events in the world – the Sydney Pink Test. She then went on to lead Camp Quality as CEO, focusing on helping children facing cancer to simply be kids again.

Kylea replaces outgoing CEO, Brianna Casey AM, who announced her resignation in July 2025 after steering the organisation through the 2020 Black Summer Bushfires, COVID-19, supply chain disruption and the cost-of-living crisis.

Inside Out Nutritious Goods Pty Ltd convicted and fined by the NSW Supreme Court for selling food that was labelled in a manner that contravened a provision of the Food Standards Code

Between 24 October 2022 and 12 January 2023, Inside Out Nutritious Goods Pty Ltd sold 46,494 incorrectly labelled 1 litre bottles of its Products (JS x Inside Out Unsweetened Almond Milk Collagen + Calcium + Prebiotics; JS Health x Inside Out Unsweetened Oat Milk Collagen + Calcium + Prebiotics; and JS Health x Inside Out Barista Oat Milk Collagen + Calcium + Prebiotics) to Woolworths Limited.

The Products were labelled in a manner that contravened a provision of the Food Standards Code. The conditions in accordance with which the Products had to be stored were as follows:

- The Products must be kept refrigerated at all times (below 5 degrees Celsius).
- Contrary to this requirement, the Products had been labelled as follows: Once opened, keep refrigerated and consume within 5 days.

In February 2023, Inside Out Nutritious Goods Pty Ltd carried out a national recall of the Products.

On 31 October 2025, the NSW Supreme Court sentenced Inside Out Nutritious Goods Pty Ltd for 10 offences against s 21(3) of the Food Act 2003 for selling food that was labelled in a manner that contravened a provision of the Food Standards Code, and ordered it to:

1. Pay fines totalling $120,000;
2. Pay the prosecutor's legal costs in the amount of $75,000;
3. Place a notice in this industry publication advising of the commission of the offences and pay for the placement of this notice

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AIFST awards program – 2026

Each year, AIFST celebrates members and industry colleagues through a range of national awards that recognise those who lead and excel across a range of disciplines and career paths.

Why are AIFST awards important?

AIFST awards play a vital role in recognising and celebrating excellence, innovation, leadership and impact across the agrifood sector. They are important for several key reasons:

1. Recognition of excellence
Awards highlight outstanding achievements by individuals, teams, or organisations. They provide formal recognition for hard work, talent, and contributions to the agrifood industry

2. Credibility and reputation
Being nominated for or winning an AIFST award enhances credibility. It signals to peers and stakeholders that the recipient is a leader in their field

3. Motivation and morale
Awards boost morale and motivation by acknowledging efforts and encouraging continuous improvement. They foster a sense of pride within organisations and among professionals

4. Promotion and visibility
Awards shine a light on individual or team achievements through media coverage, industry events, and professional networks. This increased visibility can lead to new opportunities, partnerships, and career advancement

5. Benchmarking and inspiration
These awards set standards of excellence, helping others understand what success looks like. They inspire innovation and improvement by showcasing best practices and emerging trends

6. Networking and community building
The AIFST Award program brings professionals together at conferences and ceremonies, strengthening industry networks and fostering collaboration. It also helps elevate the profile and standards of the industry as a whole.

AIFST 2026 AWARDS

1. Service and Leadership Awards

AIFST Keith Farrer Award of Merit
The Keith Farrer Award of Merit is the Institute's highest honour, recognising a person's remarkable contribution to the Institute and the Australian agrifood sector through advancements in food science and technology.

This Award was established to honour the legacy of Dr Keith Farrer, a pioneering scientist and author, who was involved in the formation of the AIFST in 1967. Dr Keith Farrer OBE FAIST FIIFST (UK) FNZIFST FTSE FIAFoST was the second President of AIFST (1969-1971) and the second winner of the IFT Australian Award (1959). Originally known as the AIFST Award of Merit, the award dates back to 1967 and was renamed in Dr Farrer's honour in 2006. Dr Farrer was one of Australia's foremost food scientists, spending 43 years with Kraft Foods Ltd before retiring in 1981 as Chief Scientist. He was the author of more than 140 scientific and technological papers as well as several books on food history in Australia, including *A settlement amply supplied: food technology in nineteenth century Australia* (1980) and *To feed a nation: a history of Australian food science and technology* (2005). In recognition of his service to science and industry, he was awarded an OBE in 1979.

AIFST President's Award
This award recognises an individual who has provided exceptional, ongoing support to the Institute.

AIFST Emerging Leader Award
This award celebrates the accomplishments, leadership potential and commitment of an early-career food scientist and/or technologist within the Australian agrifood sector.

AIFST Foodbank Hunger Hero Award
This award acknowledges extraordinary efforts to address food insecurity in Australia.

Whether championing a new initiative within a company or volunteering time and expertise in the community, this award recognises an individual or team's contribution and serves as an inspiration to others.

2. Science Awards

AIFST Jack Kefford Award
This award recognises the publication of an outstanding original research paper judged to have provided a significant contribution to building knowledge in the field of food science and technology. The award is named in honour of Mr Jack Kefford, who provided enormous input to the science and technology of food as Officer-in-Charge of the CSIRO Food Research Laboratory, Assistant Chief of the CSIRO Division of Food Research, as a scientist of international repute, as AIFST President (1971-1973) and as a Technical Editor of *food australia*.

AIFST Bruce Chandler Award
This award recognises the authorship of books or substantial reviews deemed to have made a significant contribution to food science and technology. The award is named in honour of AIFST Past President, Bruce Chandler, who had a long association with the journal *food australia*, first as an Associate Editor and then a member of the Editorial Board between 1969 and 1978. Notably, he served as Literature Editor for 12 years from 2001, a function he performed with extreme dedication.

AIFST John Christian Young Food Microbiologist Award
This award celebrates excellence in food microbiology by early-career professionals and underscores the critical role of food microbiologists in ensuring a safe and sustainable

food supply. The award is given in honour of Dr John Christian, Chief of the CSIRO Division of Food Science and Technology from 1979 to 1986, and Chairman of the International Commission for Microbiological Specifications for Foods from 1980 to 1991. John Christian was elected a Foundation Fellow of the Australian Academy of Technological Sciences & Engineering in 1976. He was awarded the Officer of the Order of Australia in 1986 in recognition of his services to science, in particular microbiology.

AIFST Sensory Solutions Anthony (Tony) Williams Sensory Award

This award is for early-career members of AIFST, recognising contribution to the advancement of the food sensory field. The AIFST Sensory Award is sponsored annually by Sensory Solutions in honour of Dr Anthony (Tony) Williams. Dr Williams was one of the pioneers of the sensory research industry in the United Kingdom and a world authority in sensory and consumer science. Tony's enthusiasm and passion helped establish sensory research in Australia.

AIFST Student Research Poster Award

This award recognises a postgraduate student poster presentation of recent work that shares knowledge, fosters collaboration, recognises innovative thinking, and engages a scientific audience.

The challenge for students is to effectively communicate and justify the key learnings from their work to an audience of their peers.

3. Industry Awards

AIFST Peter Seale Innovation Award

This award celebrates a significant Australian technological advancement in the agrifood sector that has achieved tangible results in the market. The award is given in honour of AIFST Past President, Peter Seale, who held that role from 1973-1975.

AIFST Food Safety Award

This award celebrates a significant Australian contribution to advancing food safety. The award celebrates individuals, teams or organisations that have made significant contributions to improving food safety through research, education, advocacy, or practical application. It highlights leadership and commitment to ensuring a safer food supply for all Australians.

How to apply or nominate a colleague for an award

Applications and nominations for the 2026 AIFST Awards are now open. Visit the AIFST website for all guidelines and nomination forms.

Winners will be announced at the Awards ceremony held during the AIFST 2026 Convention (AIFST26) in Melbourne on Monday, 27 July 2026.

AIFST members are at the forefront of food science and technology innovation in Australia. We want to celebrate these achievements and encourage members to consider applying and championing applications or nominations from colleagues who may be reluctant to showcase their own success.

New AIFST Fellows

Karen Ferres

Karen has been approved as a Fellow of the Australian Institute of Food Science and Technology (AIFST) as an outstanding leader in Australian food safety, recognised for more than three decades of significant and sustained contribution to the field. After graduating with a Bachelor of Applied Science in Chemistry and Microbiology, Karen began her career as a Technical Officer in a major bakery, developing strong foundations in laboratory operations and quality assurance. Her early HACCP training at Western Sydney University in the early 1990s shaped what would become a lifelong commitment to rigorous, risk-based food safety management.

Karen's passion for cook chill technology emerged during her time as Quality Assurance Manager at Qantas Catering, where she was responsible for ensuring the safety of thousands of meals produced daily for hospitals, rail services and airlines. This role gave her deep practical insight into large-scale production systems and the complexities of managing high-risk foods across diverse service environments.

In 2007, Karen transitioned to regulatory leadership at SA Health, where she strengthened the implementation of Food Safety Standard 3.3.1 across food services supporting vulnerable populations. Her longstanding engagement with the Institute of Hospitality in Healthcare enabled her to champion safe practice and provide expert guidance to operators in aged care, hospitals and other institutional kitchens.

Across 18 years in industry and 19 years as a regulator, Karen has become a nationally respected authority in food safety. She has led state and national committees dedicated to improving public health outcomes, including significant work on the development and rollout of Food Safety Standard 3.2.2A. Her clear advocacy for building strong food safety culture has influenced policy, industry behaviour and regulatory frameworks across Australia.

Karen Ferres.

Karen has been a committed AIFST member since 1996 and has made a significant professional contribution through her role as co-editor, with Gary Kennedy, of the landmark 2024 *Cook Chill for Foodservice and Manufacturing: Guidelines for Safe Production, Storage and Distribution* ('Blue Book'). Her career reflects the expertise, leadership and service befitting an AIFST Fellow.

Professor Constantinos (Costas) Stathopoulos

Costas has been approved as a Fellow of the Australian Institute of Food Science and Technology (AIFST) in recognition of his exceptional and sustained contributions to food science, academic leadership and professional service across the global agrifood system. With more than two decades of research and academic achievement, Costas has established an international reputation for excellence, demonstrated through an extensive publication record of more than 100 peer-reviewed papers and more than 5,000 citations, alongside more than 60 presentations at international scientific conferences. His pioneering work in food waste utilisation — particularly the recovery and stabilisation of bioactive compounds — has significantly advanced knowledge in an area strongly aligned with global sustainability priorities and the UN Sustainable Development Goals.

Professor Constantinos (Costas) Stathopoulos.

Costas' leadership roles across multiple countries further reinforce his standing in the profession. He has led and overseen academic programs in Australia, the UK, the UAE, and Europe, including serving as Head of Division (Food and Drink) in the UK, Vice Dean of the College of Food and Agriculture at UAE University, and ERA Chair in Czechia, where he successfully established a new Food Technology department. These roles illustrate his capability in shaping educational quality, accreditation, curriculum innovation and institutional development.

His service to the profession extends beyond academia, including scientific outreach, community engagement, and participation in Scotland's parliamentary advisory group on food. He has also contributed significantly to professional bodies most notably as a long-standing Fellow of IFST, a member of accreditation panels, and, more recently, an active participant in AIFST's WA Branch and Scientific & Technical Advisory Committee.

Collectively, these achievements demonstrate Costas' outstanding service, leadership, and impact, making him highly deserving of AIFST Fellowship.

10 key insights from the International Symposium on Food and Feed Extrusion

Words by Dr Jordan Pennells

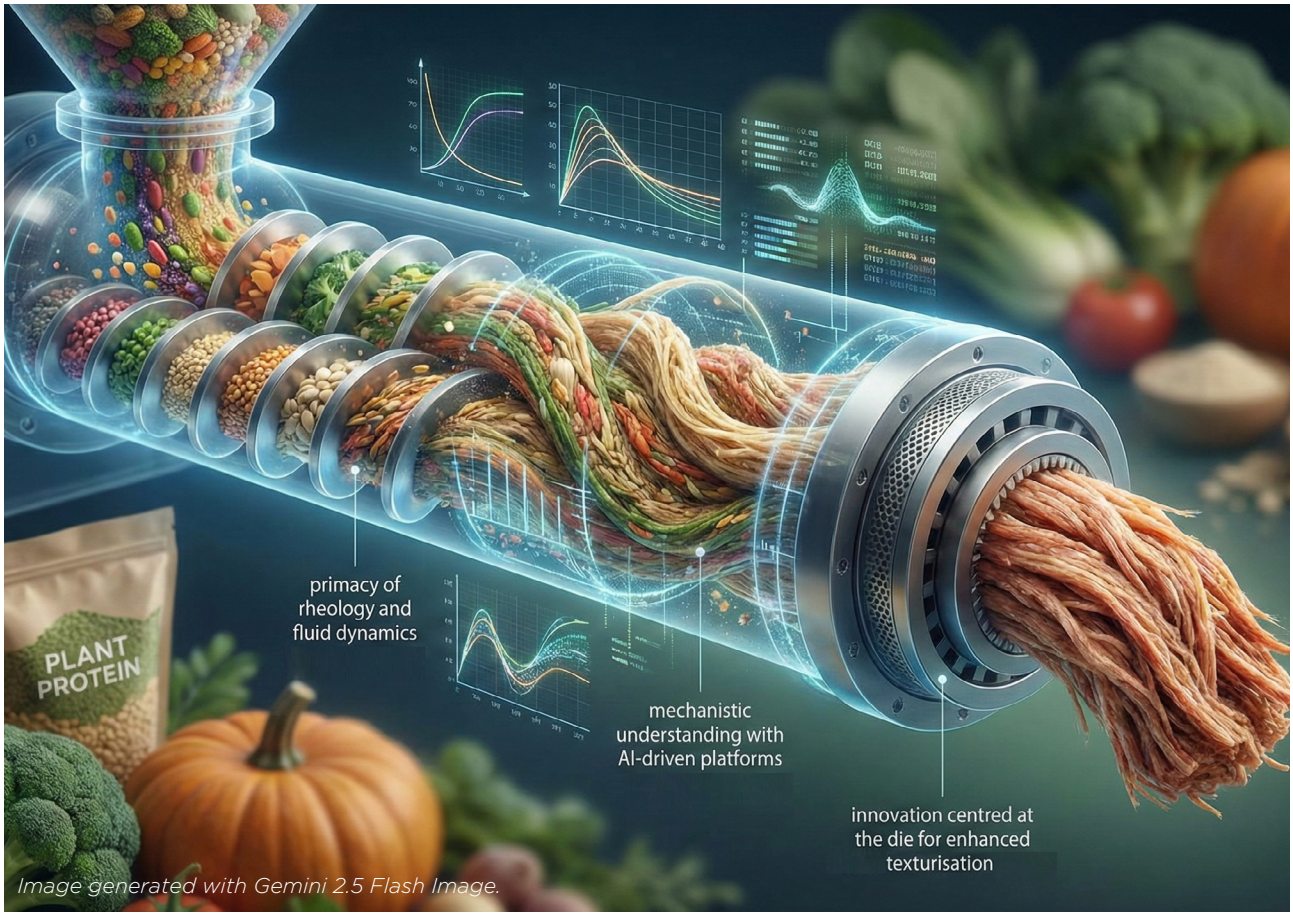

Image generated with Gemini 2.5 Flash Image.

Over two days in August 2025, a global cohort of researchers, industry professionals and technology providers convened to discuss the state and future of food and feed extrusion. The International Symposium on Food & Feed Extrusion, the first of its kind in over two decades, highlighted the technology's evolution from a simple product-shaping tool to a sophisticated platform for creating nutrient-dense foods, functional ingredients and sustainable feed solutions. The discussions revealed a series of powerful, transdisciplinary insights that define the field's current challenges and future trajectory. This article summarises 10 key insights, spanning research, industry and technology themes.

Research: advancing the fundamental science

1. The primacy of rheology and fluid dynamics

A dominant theme across numerous presentations was the critical, non-negotiable importance of understanding rheology and fluid dynamics. This was positioned not as an academic exercise, but as the fundamental prerequisite for controlling the extrusion process and predicting product outcomes. As emphatically stated in the first keynote address delivered by expert extrusion consultant Dennis Forte, "*understanding extrusion requires understanding rheology and fluid dynamics... if you don't understand these basic fundamentals, you will never understand extrusion*". The material inside the extruder behaves as a complex, non-Newtonian, thermomechanically evolving viscoelastic melt, and its rheological properties dictate the velocity profiles, shear forces, and energy transformations that occur. Changing any ingredient alters the system's rheology, which in turn changes the process and the final product. This principle was shown to be the key to addressing challenges in everything from plant protein texturisation and starch conversion to process scale-up.

2. Moving beyond the 'black box' to mechanistic understanding

There is a strong, collective push to move beyond the traditional 'trial-and-error' or 'black box' approach to extrusion. The consensus is that meaningful progress requires a deep mechanistic understanding of the process, linking raw material

properties to processing conditions and final product structures. This involves meticulously studying material properties like rheology, reaction kinetics, and phase behaviour under extrusion-relevant conditions. As Dr Azad Emin noted, the industry has been hindered by "slow, inefficient progress" because scaling up from a successful lab trial often fails without this fundamental knowledge. New analytical tools like closed cavity rheometers and computational fluid dynamic (CFD) simulations are being employed to deconstruct the process, providing insights into what is happening inside the barrel and enabling a more targeted, predictive approach to innovation.

3. Extrusion as a high-intensity bioreactor

The Symposium framed the modern extruder as far more than a shaping or cooking device; it is a high-intensity bioreactor where irreversible physical and chemical changes occur in seconds. The concept of 'reaction extrusion' was central, describing the process of optimising conditions to achieve specific cooks, flavours, textures, and colours. This was supported by research demonstrating molecular-level transformations, including the shear-induced degradation of starch (specifically amylopectin) and the aggregation of proteins. This perspective shifts the focus from simple gelatinisation and denaturation, processes requiring excess water and long times, to understanding the unique transformations driven by the combination of short time, elevated temperature, high pressure, and intense shear. This view is critical for functionalising ingredients, modifying textures, and even reducing allergenicity.

Industry: navigating market and operational realities

4. Ingredient variability as a core operational challenge

A universal pain point expressed by industry practitioners is the significant variability of raw materials. It was repeatedly stressed that incoming specification sheets cannot be trusted, as ingredients with identical specs from different suppliers (or even different batches from the same supplier) can perform drastically differently in the extruder. This variability in protein, starch, and fibre directly impacts functionality, process stability, and final product quality, forcing operators to constantly tweak parameters. This challenge is driving a need for better in-house ingredient characterisation tools (eg., RVA, protein dispersibility) and is a primary motivator for the adoption of more sophisticated, responsive process control systems, including AI-driven platforms that can adapt to these fluctuations in real time.

5. The plant-based protein reckoning: learning from failure to define the future

A candid and critical assessment of the first wave of plant-based meat analogues was a major topic of discussion. The prevailing view was that the industry overpromised and underdelivered by marketing products as direct replacements for meat. As one expert stated, "We promised that we were going to replace meat. We never were... It's not meat. It's an alternative to meat, just like tofu". The failure of many products was attributed to this positioning, combined with a lack of fundamental processing knowledge among some new market entrants. The path forward, it was argued, involves repositioning these products as 'textured vegetable protein' and focusing on creating high-quality, versatile and cost-effective ingredients. The consensus was that economics and sustainability will ultimately drive consumer adoption, but the industry must first deliver products that are excellent in their own right, not inferior imitations.

6. The ascendancy of sustainability and circular solutions

Sustainability has emerged as a powerful driver of innovation across the extrusion landscape. This is most evident in the broad shift toward plant-based proteins to feed a growing global population, but it extends deep into processing and ingredient sourcing. The Symposium highlighted 'whole food no waste' as a key future direction, with case studies on the successful upcycling of agricultural side streams. One company (NutriV) detailed its process of taking surplus or 'ugly' farm vegetables (broccoli, cauliflower, pumpkin), dehydrating them into nutrient-dense powders, and using extrusion to create value-added snacks. This circular approach not only reduces food waste but also creates new revenue streams and addresses consumer demand for sustainable products.

7. The dual challenge of modern pet food and aquafeed: complexity and cost

The pet food and aquafeed sectors have evolved dramatically, moving from simple formulations to highly complex recipes driven by marketing, cost pressures, and nutritional science. Formulations that were once simple '80/20' mixes of fish meal and cereals now draw from databases of thousands of raw materials. This complexity is driven by the push for high-protein, low-starch diets, the inclusion of fresh meats and slurries, and the use of novel plant proteins. These changes create significant processing challenges, requiring more advanced preconditioning, finer grinding, and sophisticated extrusion controls to manage functionality and ensure product quality (eg., pellet density, durability and oil absorption). This increasing complexity, coupled with the immense capital cost of a modern production facility (often exceeding $100 million), presents a high barrier to entry and demands continuous technological innovation.

Technology: the evolution of equipment and control

8. Artificial intelligence (AI) transitions from concept to commercial tool

AI and machine learning, a topic of academic interest in extrusion since the 1990s, is now being implemented in practical, commercial applications. The Symposium showcased how AI is being used to create 'digital twins' of the entire production line to optimise quality parameters in real time. One

commercially available system, EXPRO AI™, launched by Wenger and Extru-Tech, links real-time process data to final product quality checks (eg., moisture, bulk density) and prescribes ideal set points back to operators. This technology helps bridge the operator skill gap, with Jay Pokorny from Wenger noting it is "*like taking a B operator and turning them into an A operator*". These systems reduce process variation, minimise waste, and allow producers to run closer to their optimal targets, demonstrating a clear transition of AI from a theoretical model to a valuable operational tool.

9. Innovation centred on the die for enhanced texturisation

While the fundamental design of the extruder barrel is well-established, significant innovation is now focused on the cooling die and post-extrusion systems to achieve finer control over texture, particularly for high-moisture meat analogues. Clextral presented its 'Galaxy Texturization Technology', a dynamic rotating die designed to create a softer, more nuanced texture compared to a static die. Dr Danyang Ying from CSIRO also presented our Hi-MAX cooling die technology, which uses a pulling mechanism to decouple the texturisation process from the extruder's back pressure, pushing the melt out compared to conventional dies, allowing for higher throughput and greater flexibility with challenging formulations. This focus on the final texturisation step highlights a key area of technological advancement aimed at creating the next generation of food structures.

10. Process control becomes more granular and data-driven

Alongside AI, the fundamental tools for process control are becoming more sophisticated, allowing for greater on-the-fly adjustments. Technologies like mid-barrel valves and adjustable die valves give operators levers to manipulate shear and mechanical energy within the process without having to stop and change the screw configuration. However, a critical gap remains in sensor technology. Multiple speakers emphasised the urgent need for better inline sensors, particularly to measure the true product temperature in the melt, rather than the less accurate barrel temperature. Conventional thermocouples often provide incorrect readings, measuring "more the barrel temperature than the material temperature", because only the tip is in the material. This difference can be significant, up to 40-50°C. Bridging this data gap is seen as essential for developing more accurate process models and achieving the next level of precision control.

For further details about this event, please refer to the website of the 2025 International Symposium on Food and Feed Extrusion: https://wp.csiro.au/extrusion-symposium/

Dr Jordan Pennells is a Research Scientist at CSIRO Agriculture & Food, specialising in food extrusion, process modelling and AI-enabled innovation to support the next generation of sustainable food and feed processing.

FOOD FILES

Dr Djin Gie Liem, Simone Lewin, Dr Dan Dias and Dr Andrew Costanzo

Trust matters: how confidence in science and technology drives consumer acceptance of cultivated meat

Cultivated meat, produced by growing animal cells rather than raising and slaughtering animals, offers significant environmental and ethical advantages. However, consumer acceptance remains uncertain. This study explored the role of trust in shaping attitudes toward cultivated meat among Australian adults and examined how perceptions of benefits and risks mediate this relationship. The findings reveal that trust is not a single concept but consists of distinct domains, each influencing acceptance differently. Trust in technology oversight emerged as the strongest predictor of willingness to buy cultivated meat, followed by epistemic trust in the science behind the technology. Institutional trust in authorities also played a role, but only indirectly through its effect on perceived benefits. Interpersonal trust, in contrast, showed little influence on acceptance.

Perceived benefits, such as environmental sustainability and animal welfare, were more powerful drivers of acceptance than reducing perceived risks. Younger consumers and those living in urban areas were significantly more open to cultivated meat compared to older adults and rural residents, suggesting that demographic factors will shape early adoption.

For the food industry, these findings underscore the importance of strategic communication. Building consumer trust requires more than general reassurance; it demands transparency about safety standards, regulatory oversight and the scientific basis of the technology. Marketing should focus on highlighting the societal and environmental benefits of cultivated meat rather than concentrating solely on risk mitigation. Educational campaigns that explain how the technology works in clear, accessible language can strengthen epistemic trust and reduce perceptions of risk. Partnerships with credible institutions, such as universities and health authorities, can further enhance trust and legitimacy.

Industry should also consider targeted approaches for different consumer segments. Younger, urban consumers are likely to be early adopters and may respond well to messages emphasising innovation and sustainability. Older consumers may require reassurance about safety and regulatory compliance to overcome scepticism. Overall, the study suggests that increasing perceived benefits and reinforcing trust in technology oversight will be the most effective strategies for improving acceptance of cultivated meat in Australia.

Source: Harrison, P., & Liem, D. G. (2025). Consumer trust facilitates acceptance of cultivated meat. *Food Quality and Preference*, 136, 105733. https://doi.org/10.1016/j.foodqual.2025.105733

Raw, golden or black? How garlic type changes the aroma, flavour and consumer acceptance

Garlic rice is a simple comfort dish, but the choice of garlic – raw, golden or black – can change its aroma and consumer enjoyment. A study compared the volatile aroma compounds of the three garlic types and then evaluated consumer acceptance of garlic rice prepared with varying garlic levels and rice bran oil.

Using solid-phase microextraction coupled with gas chromatography–mass spectrometry, the study identified 26, 20 and 32 volatile compounds in raw, golden and black garlic, respectively. Raw garlic showed a strong presence of pungent sulfur-containing volatiles such as diallyl disulfide, while golden and especially black garlic developed additional compounds formed during thermal processing and Maillard reactions, including furan derivatives and organic acids that contribute sweet, roasted and fruity aromas. When incorporated into garlic rice, only a subset of these sulfur compounds carried through, with diallyl disulfide consistently present at higher levels in rice made with raw garlic, particularly when higher garlic and oil levels were used.

Consumer testing with 88 participants across 13 garlic rice samples showed that garlic type and amount were the key drivers of overall liking. Samples containing 8% raw garlic received the highest overall liking scores and the strongest purchase intent. In contrast, samples prepared with golden and black garlic had a milder garlic flavour and lower acceptance. Sensory analysis suggested that using more than 8% golden or black garlic may be necessary to improve flavour intensity and increase consumer acceptance.

Together, these findings highlight the importance of selecting both the appropriate garlic type and quantity to achieve desirable garlic flavour and maximise consumer acceptance in garlic rice products.

Source: Pakakaew, P., Dias, D. A., Lewin, S., Nolvachai, Y., Utama-Ang, N., & Keast, R. S. (2025). Volatile profiles of raw, golden, and black garlic and their sensory impact in garlic rice. *Journal of the Science of Food and Agriculture*, 10. https://doi.org/10.1002/jsfa.70309

What's that smell? Sensomics-based characterisation of off-flavour compounds in reheated roasted catfish

Channel catfish is a high-quality freshwater species well suited for commercial processing. Its meat is flavorful, rich in lipids and essential nutrients, characterised by a distinctive taste, and free from intermuscular bones. Currently, channel catfish is commonly processed into products such as frozen fillets, catfish balls, and ready-to-heat (RTH) roasted catfish. The RTH roasted form is a semi-finished product produced through a series of pretreatment steps, including open-back curing, roasting, and rapid freezing, enabling convenient consumption after simple reheating. Owing to this convenience, together with its consistent flavour and high nutritional value, the product has gained substantial consumer acceptance. However, during reheating, roasted catfish frequently develops an undesirable "off-flavour" which includes fishy notes and "warmed-over flavours." The emergence of these off-flavours markedly diminishes the product's sensory appeal and presents a key challenge to the further growth of the prepared food industry.

Zhou et al. applied gas chromatography–electronic nose (GC-E-nose), gas chromatography–ion mobility spectrometry (GC-IMS), and gas chromatography–olfactometry–mass spectrometry (GC-O-MS), combined with odour recombination and omission assays to characterise the off-flavours that developed in commercially available RTH roasted catfish following reheating.

The authors found that after reheating, the RTH roasted catfish developed a pronounced off-flavour, primarily characterised by fatty, grassy, hard-boiled egg, metallic, and fishy notes. Through a sensomics-based analysis, key off-flavour compounds were identified, including hexanal, heptanal, (*E*)-2-hexenal, octanal, 3-methyl-1-butanol, 1-octen-3-ol, and (*E,E*)-2,4-heptadienal. The authors stated that these compounds, largely derived from lipid oxidation, may serve as potential markers of off-flavour formation in reheated RTH roasted catfish, and compounds such as sulfides, allyl methyl, D-limonene and linalool may act as potential masking agents, modulating the perception of undesirable aromas. Consequently, the increase in lipid oxidation products, protein degradation, and the introduction of exogenous aroma spices, along with their interactions, may significantly contribute to off-flavour formation. The authors concluded that further research is required to clarify the underlying mechanisms of off-flavour formation, as well as the strategic use of masking agents to improve the overall flavour quality of prepared fish products.

Reference: Zhou M, *et al*. (2025). Characterization of off-flavor compounds in ready-to-heat roasted catfish after reheating by sensomics approach. *Food Chemistry X*: 30, 102872.

Omics labelling may shape consumer perceptions of fresh produce

Omics technologies (eg., genomics and metabolomics) are emerging as tools to verify a product's origin, including whether it is truly organic. It works by identifying unique biomarkers to verify the traceability and authenticity of a product. This technology can be costly, and there is a need to understand if there is a benefit to consumer perceptions from this kind of certification. A recent study by a research group in Italy explored this, using apples.

Researchers recruited 129 consumers to evaluate identically sourced apples presented under three different labels: conventional, organic, and omics-certified. Explanations of each label were also presented so consumers were aware of what omics-certified meant. Participants rated each apple on visual appeal, liking of taste and purchase intent.

There were no statistically significant differences in how people rated the look or taste of any of the apples. In other words, knowing an apple was omics-certified didn't make it taste or look better (or worse). However, both omics-certified and organic apples scored significantly higher in purchase intent than conventional apples. This suggests that while the omics label didn't change sensory expectations, it did improve consumers' willingness to buy.

These results suggest that omics certification may be as effective as traditional organic labels, especially for consumers who value authenticity and traceability. Further research is needed to see if companies can leverage omics-based traceability to build trust with consumers and differentiate products in the marketplace.

Source: Castellini, G., et al. (2025). Omics labeling and consumer preferences: understanding aesthetic and taste evaluations in apple purchases. *Food Quality and Preference*, 105574. https://doi.org/10.1016/j.foodqual.2025.105574

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Unlocking innovation: technical tools driving new macadamia applications

Words by Kerridyn Hooker

Application Solutions Guide – chocolate macadamia spread (Image courtesy of Australian Macadamia Society).

Global macadamia production is rising rapidly, with supply projected to double over the next five years[1] as new orchards mature and on-farm productivity improves. This growth presents major opportunities for food manufacturers and Australia's macadamia industry – a leading supplier of premium-quality kernels.

While demand for whole kernels and large halves continues to dominate established markets, the anticipated surge in production will increase the supply of smaller kernel pieces, known in the industry as ingredient styles (styles 4S to 8). Ingredient-style macadamias deliver distinctive texture, flavour and visual appeal to sweet or savoury applications, offering a broad scope for product innovation across all meal occasions.

Recognising the need to unlock this potential, the Australian Macadamia Society (AMS) partnered with the Queensland Department of Primary Industries (QDPI) Food Innovation team and Hort Innovation to develop a range of cornerstone resources: the *Australian Macadamias Technical Guide*[2] and 13 *Application Solutions Guides* (ASGs).[3]

Designed as practical tools for the food sector, the guides provide a structured framework for food technologists and product developers to incorporate macadamias into diverse applications – from bakery and confectionery to savoury snacks, chocolates, dips and spreads. Together, they streamline product development and support the creation of high-value macadamia-based foods. By combining robust technical data with applied product development concepts, the guides enable manufacturers to reduce innovation risk, fast-track raw material approvals, shorten development timelines, accelerate speed-to-market and elevate premium product positioning.

Australian Macadamias Technical Guide: a foundational resource

The *Australian Macadamias Technical Guide* was designed to equip food professionals with an accessible, comprehensive reference on the technical properties of macadamias. Developed through an iterative, evidence-based process involving extensive desktop research, stakeholder consultation and multiple rounds of refinement, it provides a robust foundation for industry use. The guide consolidates essential technical information to support food technologists in confidently introducing macadamias into food production facilities while ensuring safety and quality.

Key sections include:

- **Macadamia industry overview** – a summary of the Australian industry, including seasonality, nut life cycle, anatomy, crop management practices and quality standards
- **Kernel specifications** – detailed descriptions of grades, styles and processing options, including nutritional profile, quality attributes, shelf-life and compliance requirements
- **Storage and handling** – best practice guidelines for maintaining kernel integrity during processing and storage
- **Application considerations** – guidance on the suitability of macadamias across various value-added foods, supported by a matrix linking styles to specific product categories, and highlighting their functional and sensory contributions.

The guide provides food industry professionals with clear, reliable technical data to inform risk assessments, storage and handling protocols, and quality compliance prior to the approval and utilisation of macadamias in food manufacturing.

Application Solutions Guides: incorporating macadamias in food innovation

Building on the foundational knowledge provided in the *Australian Macadamias Technical Guide*, the 13 ASGs take a more targeted and application-focused approach. They were designed for food technologists, quality teams and brand managers seeking practical, step-by-step solutions for incorporating macadamias into value-added foods.

Developed through extensive market analysis, concept definition, product development, process optimisation and technical validation, the ASGs translate industry insights into ready-to-implement product concepts. Each ASG focuses on a specific product category, providing detailed technical direction tailored to real-world manufacturing environments. These guides translate macadamia functionality into actionable solutions, facilitating the creation of category-relevant, commercially viable end products.

The development began with a review of more than 600 macadamia-containing products, which QDPI consolidated into 60 concepts of interest. Through collaborative industry workshops, the concepts were prioritised based on their alignment with consumer trends and market needs, the likelihood of commercial uptake, technical and operational complexity, and gaps in publicly available information.

From this process, five high-potential focus areas were identified: nut pastes, dips, bakery, praline fillings, and snacks. These categories were refined to develop the 13 ASGs, each showcasing technically robust product concepts designed for depth, relevance and practical utility across Australian and Asian markets. Each ASG includes base formulations, detailed processing flowcharts, shelf-life considerations and recommendations for macadamia format, dosage rate and pre-treatments. They also outline key functional attributes, specific manufacturing considerations and flavour suggestions for line extensions and related products.

Macadamia nut mini tarts (Image courtesy of Australian Macadamia Society).

Macadamia pesto (Image courtesy of Australian Macadamia Society).

Throughout the project, QDPI drew on their extensive industry and innovation experience to ensure the solutions were consumer-relevant, technically feasible, reproducible and aligned with food safety and quality standards. The concepts in the ASGs are versatile and can be readily adapted to meet end-user, consumer and market needs. By integrating guidance on formulation, processing and sensory optimisation, the ASGs provide a framework for developing and adapting macadamia-based products across varied manufacturing environments.

Applications and innovations

Ingredient-style macadamias demonstrate remarkable versatility, as demonstrated by the product concepts explored in the ASGs. They are well suited to both sweet and savoury applications, across all parts of the day, meal occasions and market sectors. Macadamia products also align closely with current consumer trends for nutritious yet indulgent foods, convenient snacking,

Sweet raspberry coated macadamia pieces on cheesecake (Image courtesy of Australian Macadamia Society).

balanced nutrition, global flavours, premiumisation and transparent provenance.[4,5,6]

Nut pastes, for example, showcase macadamias' ability to deliver creaminess, richness and natural indulgence, making them ideal for spreads or fillings. Smooth and chunky variations offer flexibility for different applications, while chocolate macadamia spreads highlight compatibility with premium, decadent ingredients. Such products cater to the growing demand for clean-label, plant-based options that maintain strong sensory appeal. From a technical perspective, macadamias perform well in paste applications due to their naturally high monounsaturated oil content, which imparts a smooth, creamy texture and rich mouthfeel. The high fat content and fine particle size achieved through milling promote excellent spreadability and emulsion stability, while maintaining a clean, decadent sensory profile.

Dips, such as macadamia-based pesto and hummus, provide another avenue for innovation. Inspired by mainstream favourites, the incorporation of macadamias elevates product positioning by adding a creamy texture, new flavour dimension and favourable nutritional profile. The ASGs outline precise formulations and processes to support shelf-life stability, offering manufacturers solutions tailored to both fresh and extended shelf-life products.

In bakery applications, macadamias enhance both functionality and presentation. The ASGs provide market-specific solutions for Australian and key Asian markets, addressing processes where macadamias are exposed to direct or indirect heat. Products like cookies, brownies, and crumbles benefit from the nut's ability to add crunch and richness, while smaller kernel styles enhance the visual appeal and perceived quantity of inclusions. Regional specialities, such as Taiwanese mini tarts and mooncakes demonstrate macadamia's adaptability to cultural preferences, blending premium positioning with traditional formats.

Praline fillings, whether used in chocolate or bakery products, leverage the macadamia's rich flavour and smooth texture to deliver high-quality, stable formulations. Their mild, buttery flavour complements a wide range of sweet bases – from caramel and chocolate to spice blends – enhancing formulation flexibility across product types. Technically, macadamias perform well under both thermal and mechanical processing, supporting stable emulsions and reliable performance throughout extended shelf-life. These attributes make macadamia pralines highly adaptable for both pre- and post-bake use, combining sensory indulgence with process reliability.

Snack applications represent a rapidly expanding market segment where macadamias excel. Coated macadamia snack concepts were developed with both wet and dry coating systems, showcasing their versatility. Seasoning options such as Korean Bulgogi and salted maple illustrate the nut's ability to align with global flavour trends while maintaining textural integrity and flavour balance. The ASGs provide detailed guidance on coating processes and ingredient interactions to ensure the macadamias retain their distinct crunch and buttery flavour throughout production and storage.

Across all applications, the ASGs offer comprehensive, practical guidance on processing techniques to preserve macadamia quality and ensure consistent performance during industrial-scale production.

Implications for the food industry

The *Australian Macadamias Technical Guide* and ASGs mark a significant advancement in supporting industry to utilise smaller macadamia styles effectively. By providing clear, scientifically grounded guidance, these resources enable food technologists to optimise formulations, shorten development timelines and improve operational efficiency. Detailed recommendations on kernel selection, processing methods, and sensory optimisation equip manufacturers

with the confidence to incorporate macadamias into both existing and novel food products.

The guides also foster innovation by demonstrating macadamias' multifunctionality across diverse applications. Whether enhancing creaminess in a dip, adding crunch to a bakery filling or elevating the flavour profile of a praline, macadamias offer a unique combination of functional and sensory benefits. By increasing the utilisation of ingredient-style kernels, manufacturers can diversify product offerings, meet consumer expectations for premium and clean-label foods, and respond to the growing global supply of macadamias. For the macadamia industry, this translates to greater market demand, improved grower returns and enhanced resilience in an increasingly competitive landscape.

In summary, as global macadamia supply continues to expand, innovative approaches to utilising smaller kernel styles are increasingly important. Often overlooked, these smaller kernels hold considerable potential to drive value-added innovation. The *Australian Macadamias Technical Guide* and ASGs provide a robust framework to help product developers overcome technical challenges and unlock the full potential of macadamias as a versatile food ingredient.

By bridging technical knowledge and practical application, the guides enable food technologists to explore macadamias' versatility and functionality with confidence. Whether developing a new bakery product, a snack, or savoury dip, macadamias offer a distinctive ingredient capable of transforming formulations and creating unique consumer experiences. Equipped with these resources, the food industry is well-positioned to harness the opportunities presented by macadamias and drive innovation in a dynamic, evolving market.

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Food security: Australia's forgotten strategic asset

Words by Andrew Henderson

In a rapidly shifting global landscape, the consequences of geopolitics and climate volatility are accelerating the evolution of our operating environment like never before. This demands that we, as food system stakeholders, move beyond passive observation and into action to prepare for the future and play our role in Australia's national security. We must assert that our ability to produce, process, manufacture, and distribute safe, high-quality food is not merely an economic contribution; it is one of our greatest strategic advantages and is fundamental to Australia's national security.

The Department of Agriculture's discussion paper on the *National Food Security Strategy*[1] has provided a long-overdue opportunity for the food system to step up and ensure this strategy is fit for purpose in our increasingly conflicted world, understanding that reform requires persistence, particularly in the absence of a visible crisis. The decades-long policy vacuum is no longer defensible in the face of escalating strategic risk.

Our national conversation often ignores the profound contradictions in our domestic food reality. While we waste enough food to fill the Melbourne Cricket Ground (MCG) ten times every year, Foodbank data confirms that one in three Australian households experienced moderate to severe food insecurity last year. Focussing on the fundamental intersection of food security, food insecurity, and food loss and waste is now more critical than ever, especially given that a well-fed population is the foundation of social cohesion and national stability.

Australia's defence and national security agencies are preparing for a future that none of us assumes to be true: a world defined by concurrent and cascading crises and the potential for major power conflict in our region. The assumption that Australia will always be food secure is, in this context, a dangerous fantasy. This strategic naivety is compounded by the fact that the psychosocial imperative of food security preparedness – the cultural and psychological shift required to support any policy framework – is currently missing from the national discourse. We have been conditioned by decades of uninterrupted prosperity, leading to a dangerous normalcy bias that underestimates the likelihood of systemic disruption.

This is not merely an issue of consumer panic, which we witnessed during the early stages of COVID-19 with empty supermarket shelves, or during the Darwin flood crisis, which momentarily cut off a regional capital; it is a fundamental threat to social cohesion. If citizens lose faith in the ability of the state and the supply chain to feed them, political and social instability follows. We have to be able to walk and chew gum at the same time, dealing with threats that have both sudden, catastrophic front-of-house outcomes as well as long-term, systemic back-of-house failures.

The urgency of this preparedness imperative is dictated by our geography. Our prosperity is fundamentally embedded in the Indo-Pacific, which the 2023 Defence Strategic Review claimed is the world's most important geostrategic region.[2] As an inherently trade-reliant economy, with nearly half of our GDP dependent on two-way trade, we cannot afford to be passive. Of the 80% of global trade transported by sea, 60% passes directly through the Indo-Pacific. This reliance presents an existential vulnerability for the food system, not just because we export 70% of what we produce, but because we are critically dependent on imported inputs that facilitate our productive capacity, including fertilisers, liquid fuels, chemicals, technology, machinery, and workforce. With over 95% of Australia's trade flowing through our maritime ports, every near-miss in the Indo-Pacific, every

conflict in the Middle East, and every shipping disruption, like the Suez Canal blockages, is a direct threat to the resilience of our food system. If things feel different, it is because they are; the intensity of great power strategic competition has become, in the words of defence, the defining feature of our time.

Since the end of the Second World War, we have enjoyed the immense benefits of a relatively stable, rules-based, Western-influenced world, but that world is changing and evolving, defined by a consequential strategic realignment of global influence. As early as the 2020 Defence Strategic Update, the then Prime Minister and Defence Minister used language that truly piqued the interest of strategic thinkers, confirming that our region was amidst *the most consequential strategic realignment since the Second World War, driven by trends including military modernisation and the risk of state-on-state conflict*. This shift confirms that the world created by the victorious powers of that conflict no longer exists in the way we've come to know it.

Richard Fontaine of the Centre for New American Security rightly noted that Russia and China have articulated a vision of an international order deeply at odds with the liberal post-war arrangements. We are witnessing a clear transfer of geopolitical power and global influence from west to east, reinforced by the cohesion of frameworks like BRICS, where emerging powers seek a greater say in the rules of world trade than previously afforded. The comparison of military posture across the Indo-Pacific, as illustrated by the Lowy Institute's Asia Power Index, confirms that the region is a tinderbox, fundamentally driving the preparedness activities of our defence and national security agencies. The 2023 Defence Strategic Review doubled down on this narrative, pointing to China's ambitious military buildup – occurring without transparency or reassurance –and stating that the assertion of sovereignty in the South China Sea threatens the global rules-based order, adversely impacting Australia's national interests. The Review makes it clear that for the first time in 80 years, we face the prospect of a major conflict that directly threatens our national interest, demanding a first-principles approach to managing our strategic risk.

This strategic reality must be internalised by every player in the food system. The challenge is direct: how reliant is your business, your organisation, or your household on critical imported inputs? How long can you survive if you lose access to any number of those things for a day, a week, a month, or six months?

When the varroa mite was detected in 2022, many outside the horticultural industry misinterpreted it as a nuisance isolated to a small corner of the agriculture industry. This was a dangerously naive assessment that ignored the fact that biosecurity failures are food security failures. This is the precise type of systemic shock that quickly cascades through the entire system, from production to pollination to processing. A nation that cannot feed itself cannot defend itself. Our collective inability to grasp that food security doesn't just happen and that it is a fundamental input to Australia's defence capability has resulted in a staggering policy chasm.

The announcement of a National Food Security Strategy is welcomed, as is the $3.5 million to accompany it. However, maintaining perspective is critical. The 2024 Integrated Investment Program accompanying the National Defence Strategy comes with a $330 billion funding envelope to 2033–34, which includes $50 billion in new money over the coming decade. The fundamental truth remains: you cannot eat nuclear-powered submarines.

If our strategic situation is so tenuous that it demands this level of investment and preparedness from defence, then it equally demands a commensurate, whole-of-nation cultural and psychological shift to support and empower those responsible for feeding and clothing the nation. Since the 2008 global financial crisis, there have been at least 18 government-related reports, inquiries, or initiatives touching on this problem, yet we remain inherently vulnerable. Our inaction or passive observation as food system stakeholders is not an option; we must adopt a preparedness mindset immediately.

To bridge this policy gap, the *National Food Security Preparedness Green Paper*[3] proposes feasible solutions to move Australia toward real resilience. Its policy options support a deliberate shift in how we perceive and manage the sector, beginning with the concept of the food system as an interdependent Food Security Ecosystem. One that requires central coordination to identify and prioritise vulnerabilities and decentralised delivery of preparedness activities across public and private-sector stakeholders. This model proposes that all stakeholders across the ecosystem adopt a national security-inspired threat and risk assessment methodology – tools that allow us to objectively measure strategic vulnerability against the likelihood of systemic failure.

Crucially, we must also move away from the ad-hoc, siloed government intervention of the past and adopt an economic policy framework that guides significant investment strategically and with the greatest effect. This requires using mechanisms such as the *Future Made in Australia Act*, National Reconstruction Fund, the Regional Investment Corporation and others, to invest strategically to mitigate high-priority vulnerabilities, one by one. The *Green Paper* offers case studies across three critical inputs to demonstrate this process.

Australia's strategic circumstances ultimately demand that we, across civil society and particularly across the food security ecosystem, prepare on the same terms as our defence and national security agencies. This requires strategic leadership that can only be achieved by elevating the Minister for Agriculture into the National Security Committee

of Cabinet and amending the administrative arrangements orders of that portfolio, making it responsible for the entire food system as well as food security preparedness. This is the only way to ensure coherent decision-making and genuine whole-of-government alignment and prevent the siloed approaches that have plagued previous efforts. We must also incorporate over-the-horizon threat and risk capability of the Office of National Intelligence, specific to the food system, to prepare for threats to which we might not otherwise be privy.

Finally, lessons from the past are simple but salient: our geography is both an advantage and a strategic risk. Supply chain resilience requires shortening those long, just-in-time supply chains on which we have become overly reliant. This can be addressed through a concept of regional self-reliance, deepening our economic and security partnerships within the Indo-Pacific, and using food as a greater tool of our statecraft. Our food production capacity is a non-coercive lever for regional stability, offering a counterpoint to the coercive economic statecraft practised by others. By fostering regional food security, we contribute directly to regional stability, and therefore, to our own national stability and security.

Ultimately, our preparation must secure the critical inputs required to operate as close to business as usual as possible, even in a conflicted environment, to enable us to produce, process, store, manufacture, and distribute food to where it needs to be when it is needed. This effort protects society's most vulnerable, maintains our domestic stability, and critically, maintains the social cohesion of our neighbours across the region. This is what delivers real resilience and the ability to withstand shocks and coercion in all its forms.

We must think and prepare, and we must push decision-makers to prepare. Reform takes a long time, particularly in the absence of a crisis, so we have to stay the course on the food security strategy and make it mean something. There is a massive opportunity in our near region, and the coming years will bring a deepening of relationships with our near neighbours unlike anything we've experienced before – if we act now. Every stakeholder across the Australian food security ecosystem needs to stand proud. You are part of something much more powerful and meaningful than you might think, simply because the role of food in maintaining national security is fundamental to Australia's national defence.

Hungry people are not content, and discontent breeds instability. Food unites us where hunger divides.

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Expressions of Interest open for new Central Coast Food Manufacturing Innovation Hub

Expressions of Interest (EOIs) are open for tenancy at the Central Coast Food Manufacturing Innovation Hub, a state-of-the-art facility set to open in March 2026 in Ourimbah (NSW). With only eight tenancy lots available, this represents a rare and highly sought-after opportunity for food and beverage SMEs to secure a foothold in the region's first purpose-built innovation and production hub.

Backed by a $17.14 million investment, the Hub is being delivered by Central Coast Industry Connect (CCIC) with the support of the Australian government, University of Newcastle, Central Coast Council and Regional Development Australia Central Coast. Designed as a catalyst for growth, innovation and collaboration, the Hub will provide a unique environment where food and beverage businesses can scale, innovate and commercialise new products more efficiently than ever before.

Situated at the heart of the Central Coast's $2 billion food and beverage sector, the Ourimbah facility will bring together production-ready spaces, pilot-scale manufacturing equipment, integrated training areas and expert support services under one roof. Tenants will gain access to food-grade spaces designed specifically for scalable, flexible manufacturing, making it easier to refine processes, test prototypes, increase production capacity and develop new product lines.

Shared infrastructure is a core feature of the Hub, helping reduce overhead costs and remove barriers that often prevent SMEs from expanding. Pilot equipment will support agile innovation, allowing businesses to experiment with new formulations, packaging solutions and production techniques without the need to invest heavily in additional machinery.

The Hub's Manufacturing Advancement Centre will further strengthen tenant capability through tailored mentoring, technical guidance and commercial advice. Businesses will have access to experts across compliance, sustainability, export readiness, workforce development and market access. These services aim to give SMEs the confidence and capability to grow quickly and enter new markets.

Importantly, the Hub has been designed as a collaborative ecosystem rather than simply a production facility. Manufacturers, researchers, educators, students and service providers will work side-by-side, creating a connected community that fosters innovation, shared learning and joint projects. This collaborative model will accelerate product development, enhance supply chain efficiencies, support packaging innovation and strengthen organisational capability across the region.

"With its combination of advanced facilities, tailored programs and a strong culture of collaboration, the Food Manufacturing Innovation Hub is set to transform how our region's food and beverage sector operates," Executive Director of CCIC, Mr Sammut said. "We are seeking high-potential businesses who share our vision and are ready to scale quickly to reach new markets."

The Hub will also play a major role in building the region's future workforce. Modern training facilities, delivered in partnership with CCIC and industry experts, will provide practical, hands-on learning opportunities for students, jobseekers and current employees. These activities build on CCIC's successful Interim Skills Hub model launched in 2024, which is already preparing a strong talent pipeline for local manufacturers.

Once operational, the Hub is expected to become a nationally significant centre of excellence in food and beverage manufacturing. By levelling the playing field and giving SMEs access to resources and expertise typically out of reach, it will help high-potential businesses commercialise more rapidly, increase production capability, and compete on a larger scale. For established manufacturers, the Hub will offer opportunities to accelerate product and packaging development and explore innovation in a low-risk environment.

With construction due for completion in January 2026 and doors opening in March, the timeline for tenancy selection is tight. CCIC is calling for ambitious, low-risk food and beverage manufacturers with clear growth plans, strong financial capability and a willingness to contribute to a collaborative, innovation-driven community.

Businesses meeting the eligibility criteria are encouraged to submit their Expressions of Interest now to secure one of the limited tenancy spaces.

EOIs can be submitted via: https://centralcoastindustryconnect.com.au/food-manufacturing-innovation-hub/

Enquiries: admin@centralcoastindustryconnect.com.au

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Harnessing yeast diversity to make flavoursome and delicious Australian cider

Words by Louise Li, Camilla Humphries and Dr Kate Howell

The Australian cider market has grown over the last 10 years, now accounting for around 4% of the local beverage market. Cider Australia, the national industry body, is responsible for maintaining the integrity of the Australian cider brand. It defines Australian Craft Cider as that made from 100% Australian-grown fruit, whether from Australian juice concentrate or Australian fresh fruit. Currently, most of the cider available in Australia is made from the juice concentrate of foreign-grown fruit from New Zealand, the United Kingdom and France, with only 10% made from Australian-grown fruit.

Food Standards Australia New Zealand regulations allow cider to contain water, sugar and other ingredients such as juice concentrate (Standard 2.7.3). Most commercial cider on the Australian market has sugar levels within the 25-40g/L range, with the medium sweet to sweet class being the highest represented category.[1] This significant representation of cider in the medium–sweet class is due to the high amount of juice concentrate used in the market. Most commercial cider undergoes pasteurisation to ensure consistent product, reduce microbial load and stop fermentation to ensure alcohol is within the appropriate alcohol by volume (ABV) range (FSANZ, Standard 2.7.1).

The portion of Australian fruit utilised for cider production includes culinary fruit such as familiar varieties Pink Lady (41%), Royal Gala (23%) and Granny Smith (18%), which make up the 285 tonnes of annual apple production.[2] Only 1% of apple production in Australia is cider cultivars, which have been selected for distinct flavour attributes. This is because different apple varieties vary in their composition and concentration of polyphenols, which are secondary metabolites in apple fruit[3] that contribute to the organoleptic parameters of colour, bitterness, astringency and colloidal stability of cider.[4] Culinary fruit, in contrast to specific cider cultivars, is low in endogenous polyphenols – an important biochemical component contributing to the cider quality.

Cider quality is agreed to have several dimensions: appearance, aroma, mouthfeel and flavour. Each of these dimensions can be evaluated by trained judges or a panel of consumers, and can be supported by chemical analyses. Chemical analyses focus on measurable determinants, including water, sugar content, ethanol level, organic acids, aroma compounds, and phenolic content. Indeed, it has been stated that cider makers should focus on low pH, higher titratable acidity and polyphenol content to ensure high-quality cider.[5] Using these factors, apples for cider making are classified into sharp, bitter-sharp, bitter-sweet and sweet. These classifications underpin the distribution of sugar (measured in degrees Brix), acidity and total phenolic content, and thus the effect on flavour can be predicted by investigating the fruit.

The Australian cider industry uses cultivated wine-making yeasts in inoculated ferments, which

impart wine flavour and aroma characteristics. In this project, we investigated how different yeasts found in wild cider fermentations metabolise polyphenols to impart a unique aroma and flavour profile for cider.

Boutique cider producers in Australia have adopted winemaking approaches, fermenting with wine yeast strains (typically *Saccharomyces cerevisiae*) that impart "wine-like" characteristics to cider.[6] While this approach yields clean and consistent fermentation, it can limit the expression of unique cider aromas and flavours. In fermentation, yeasts do far more than convert apple sugars to alcohol; they release a host of secondary metabolites such as esters, higher alcohols, carbonyls and volatile acids, which shape the cider's aroma, taste, and mouthfeel.[7] Notably, different yeast species and strains interact with cider chemistry in different ways. For example, yeast strain selection can influence how apple polyphenols (tannins) behave during fermentation, with certain yeasts binding or precipitating tannins, which alters the cider's astringency and mouthfeel.[8] Therefore, choosing the right yeast is recognised as crucial for crafting a cider's sensory profile and quality.

In traditional cider-producing regions (England, France, Spain), cider fermentations are not inoculated and rely on indigenous 'wild' yeasts that arise spontaneously.[9,10] This practice can imbue ciders with a sense of regional character, or terroir, since local yeast populations contribute distinctive flavours. Non-*Saccharomyces* yeasts (wild yeast species other than the usual brewer's yeast) are naturally present on fruit and in un-inoculated fermentations, and they offer a means to increase aroma and flavour diversity in fermented beverages.[7] Consequently, the choice of yeast strain can lead to strikingly different flavour outcomes even when fermenting the same apple juice, as demonstrated by Way and colleagues.[11] Wei and coworkers demonstrated that the deliberate application of non-*Saccharomyces* yeasts, applied in a combination of strains, could affect the main quality determinants of acidity and polyphenols at the end of the fermentation.[12] It could be that attempting to replicate a non-inoculated fermentation with a deliberate consortium of yeasts could allow cider-makers to fine-tune the flavour outputs of fermentation.

Camilla Humphries assessing cider quality.

Yeasts are a powerful tool to forge a distinctively Australian cider identity. One challenge is that Australia's cider apples are often ordinary culinary varieties which have higher sugar but lower tannin (polyphenol) content than traditional European cider apples.[10] This can mean less body and complexity in the cider, a gap that yeast choice might help bridge. By selecting yeast strains known to enhance aroma complexity or preserve polyphenols, cider makers can compensate for less tannic fruit and still achieve rich flavour and mouthfeel. For example, certain non-*Saccharomyces* yeasts have been reported to produce extra glycerol and polysaccharides, which improve mouthfeel, or to release bound aroma precursors from apples, boosting fragrance.[7] Seeking novel and effective yeasts that ferment Australian apple juice efficiently will allow unique sensory traits to emerge. Whether it is a distinctive floral note, a native spice hint, or an extra tannin lift, selected yeasts could be applied to give Australian craft ciders a signature twist.

We propose that harnessing yeast diversity is key for Australia's cider industry to produce distinctive ciders. By moving away from one-size-fits-all wine yeasts and embracing specialised or native yeast strains, Australian cidermakers can create original ciders that reflect both the local fruit and the local microbial partners.

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Growing ideas, growing industry: inside the FaBA Training Centre

Words by Justin Nugent and Charlotte Duniam

Australia's Food and Beverage Accelerator (FaBA) has a remit to accelerate innovation in the nation's food and beverage industry.

In support of this goal, the FaBA Training Centre is simultaneously upskilling the food and beverage workforce and supporting university researchers to become effective industry collaborators. With a multifaceted approach that includes a research and development funding scheme, training courses, researcher development and start-up incubation programs, the FaBA Training Centre is leading the way in sector development.

FaBA Kickstarter Program

The FaBA Training Centre is building a more innovative future for the Australian food and beverage sector through the Kickstarter Voucher program. Small- to medium-sized enterprises (SMEs) can apply for up to $50,000 to invest in a university-based research project designed to deliver commercial outcomes, such as new products, ingredients or market opportunities. Research partners can be from any of the FaBA partner universities: The University of Queensland (UQ), Queensland University of Technology or the University of Southern Queensland. This allows small companies to receive targeted support and expertise from globally recognised researchers – UQ, for example, is consistently ranked in the top 30 globally [2025 Shanghai Global Ranking of Academic Subjects – Food Science and Technology].

According to FaBA Training Centre Program Lead Professor Nidhi Bansal, SMEs have long been recognised for their inherent drive for innovation, yet they face hurdles that prevent them from capitalising on these strengths.

"Enabling funding for R&D in a world-class research facility is a privilege we are proud to support," Professor Bansal said.

"Sixteen Kickstarter projects have already been approved, with many more in the application pipeline. These projects represent the full breadth of the industry, including research on native foods, beverages, sustainability solutions and functional food products.

"Already, our Kickstarter Industry Partners are seeing promising results."

The increasing popularity of functional beverages and the unique flavour and nutritional benefits of Australian native fruits present an opportunity to develop a premium,

Research-industry collaboration workshop at UQ.

Students in Food Manufacturing Technology Short Course completing a practical component at Fareshare.

market-attractive product. Native Oz Bushfoods is a trailblazing business with a flair for innovative products, committed to advocating for the protection of native species through education, connecting people to the land, demonstrating sustainable practices and providing authentic bushfood experiences.

Native Oz Bushfoods has developed four unique flavours of 'Bush Bubbles' sodas: Kakadu Plum, Davidson Plum, Quandong-Native Peach and Native Tamarind. They were paired with a multidisciplinary team of research experts from UQ's Queensland Alliance for Agriculture and Food Innovation.

Native Oz Bushfoods, described the experience: "Being part of the FaBA Industry Kickstarter project gave us a deeper insight into product quality behaviour and processing decisions, and strengthened our confidence in Bush Bubbles' stability and shelf life."

Dr Maral Seididamyeh led the project on the FaBA side.

"We believe that supporting research for Indigenous-owned Australian native food enterprises enhances their products' credibility, promotes a broader recognition of Australia's unique food heritage, and thereby enables increased access to both domestic and global markets," Dr Seididamyeh said.

"This research helped to strengthen the scientific evidence around native bushfoods, helping to drive the industry forward."

FaBA is committed to maximising value for industry. Under this scheme, all IP generated within the project scope is owned by the industry partner.

Comprehensive training

The FaBA Training Centre is committed to developing successful relationships between industry and universities, and providing dedicated opportunities to assist researchers in developing the skills needed to ensure productive, mutually beneficial partnerships with industry. These modules include comprehensive training in food safety and regulation, industry-focussed project management and navigating industry engagements to fulfil the commercial needs of industry partners.

Professor Bansal explained that working with industry was very rewarding for researchers and provided insights into the practical challenges they were facing every day.

"The work we do in the Training Centre is focussed on envisaging and paving the way for a future where industry and universities collaborate more effectively to fast-track innovation," Professor Bansal said.

"Through the Training Centre, we guide both SMEs and researchers on leveraging the benefits of these collaborative relationships, while avoiding the potential pitfalls."

To support skill acquisition and development in the workplace, the FaBA Training Centre has collaborated with UQ Skills and industry to identify and address current gaps in the sector. There is a comprehensive and flexible catalogue of courses, covering topics including workplace sustainability, leadership and team building, creating a culture of innovation, food manufacturing, preservation and packaging.

Doris Wong recently undertook the Food Manufacturing Technology Short Course.

"This course gave me the chance to turn what I'd learned in theory into hands-on experience, deepening my understanding of the real challenges and considerations involved in developing a food product," Ms Wong said.

"From experimenting with techniques such as sous vide and retorting, to benchtop testing and creating my own protein product, every step was a learning adventure.

"A particular highlight was visiting FareShare – seeing how they transform surplus food into nutritious meals for communities in need was incredibly inspiring and reminded me of why I'm passionate about making a meaningful impact through food."

Entrepreneurial opportunities

The FaBA Training Centre sponsors and assists in the delivery of several entrepreneurial programs, awards and events. The aim of these programs is to foster entrepreneurial thinking and build capability for commercialisation.

The Food Innovation Challenge (FIC) empowers university students to transform their food- and beverage-related projects into viable businesses. Through a series of workshops, individualised coaching and exposure to industry experts, FIC supports students in business design while building and validating their innovation skillsets.

The 2025 FaBA GrowthHub was a truly exciting program to deliver to the 12 competitively selected participants. By dedicating one full day per week over a 12-week period, SME founders can access skills development tailored to their real and varied needs, creating a practical pathway for commercial growth. They are guided in de-risking and advancing their business to position themselves to secure the partners or capital needed for expansion.

Program participants represent the full spectrum of businesses in the sector, including beverages, ready meals, apps, ingredients, cooking oils, and fermented products. Delivered in collaboration with UQ Ventures, the FaBA GrowthHub has demonstrated how targeted entrepreneurship training and mentoring can accelerate market readiness.

Program participant Agnes Pennay, of Fresh Meats in Maroochydore, joined the FaBA GrowthHub with a brand-new line of ready-made fresh meals that was almost ready to launch.

FaBA GrowthHub founders and organisers on Pitch Night.

Food Innovation Challenge teams pitch their product for a chance to win a $2000 prize.

"The FaBA GrowthHub Program was exactly what I needed at this point in time. It helped me to refine our initial assumptions and close out on unfinished tasks - the weekly structure and community support created momentum and accountability. We launched our product with greater focus and gained access to new strategic opportunities," she said.

The FaBA Training Centre is set to continue leading the way in sector development. There are plenty more exciting plans for 2026, not least the much-anticipated launch of the state-of-the-art food laboratory facility, the Makerspace.

Justin Nugent is Alliance Operations Manager in the FaBA Training Centre, and Charlotte Duniam is Administration Officer in the FaBA Training Centre.

Made and grown: the future of biotechnology and biomanufacturing in Australia

Words by Jessica Freitag

Australia stands at a pivotal moment in shaping the future of its agrifood system. How Australia collectively responds to a number of pressures, vulnerabilities and associated opportunities will shape our agrifood system for decades to come.

Multi-year droughts are affecting both the traditional crop and livestock sectors.[1] The dairy industry is grappling with changing climatic conditions, leading to an expected 30 million tonne global milk shortage by 2030.[2] Meanwhile, the 2024–25 avian influenza outbreaks and subsequent egg shortages demonstrated how rapidly animal disease can destabilise supply chains.[3] And looking ahead, global decarbonisation efforts will expose deep dependencies within food and agricultural systems that have long relied on petrochemical inputs.

The report, *Made & Grown – The future of food biotechnology & biomanufacturing in Australia* – outlines how Australia can address these challenges by building sovereign capability in food biotechnology and biomanufacturing.[4] It was authored by Cellular Agriculture Australia, ANU Agrifood Innovation Institute, Australian Strategic Policy Institute and ANU National Security College.

A strategic opportunity to build resilience

A resilient, sovereign, and future-proof food system is essential – not only to drive economic growth and regional development, but also to safeguard national security. Building sovereign capability to produce and innovate domestically is essential to reduce external dependency and protect against supply disruptions.

Food biotechnologies such as precision fermentation, plant molecular farming, plant synthetic biology, and cell cultivation enable the controlled, scalable production of a range of foods and ingredients. Innovative companies are working to integrate ingredients, such as proteins, fats and flavours across the food system.

Importantly, these novel production systems are significantly less vulnerable to external environmental shocks. Furthermore, by onshoring production, shortening supply chains, and reducing exposure to volatile global markets, they can enhance food system resilience while supporting emissions-reduction goals.

Australia's position and opportunity

Food biotechnology and biomanufacturing can play a complementary role alongside Australia's existing agricultural sectors, providing powerful value-add and diversification opportunities.

Existing agricultural sectors already provide feedstock inputs for biomanufacturing – such as sugarcane for precision fermentation – whilst creating opportunities for co-located facilities that convert raw materials into higher-value ingredients.

Biotechnology companies are also exploring how to integrate biomanufacturing within existing dairy processing infrastructure to diversify protein production and improve resilience to supply variability.[5] These regional development opportunities can diversify revenue, create skilled regional jobs, and increase the value captured onshore for Australia's conventional agricultural industries.

At a national level, Australia is exceptionally well-positioned to capture a significant share of the food biomanufacturing market, estimated to a once-in-a-generation opportunity worth USD$100 billion by 2040.[6] Our highly-regarded food safety and quality standards, abundant high-quality feedstock, and world-class research capability provide strong foundations, complemented by an emerging start-up ecosystem that is advancing commercial partnerships, regulatory approvals, and progress toward cost parity. Australia has a clear opportunity to build new bio-industries that create jobs, economic growth, and new export opportunities.

What needs to happen

The *Made & Grown* report highlights that Australia is at risk of losing its early-mover advantage in food biotechnology and biomanufacturing. A lack of coordinated policy direction and limited government investment

is creating barriers to translating research into commercial outcomes. This challenge is becoming more pronounced as other leading jurisdictions, such as China, India and the United States, move swiftly to build infrastructure, incentivise private investment and embed biomanufacturing within their national priorities

In response, the report sets out 25 recommendations to build sovereign capability and realise Australia's potential to be a global leader in food biotechnology and biomanufacturing. The challenges and opportunities in key priority areas are outlined below.

Clear national direction

A unified national vision is urgently needed to highlight the economic potential of food biotechnology and biomanufacturing and strengthen the case for public investment. The report recommends undertaking economic modelling to build the evidence base required to guide this vision and its associated investment. Alongside this, national policy frameworks should be reformed to explicitly recognise both 'made' and 'grown' food production models and their role in driving both food and national security, with the forthcoming Feeding Australia national food security strategy providing an ideal starting point. It also calls for a national bioeconomy strategy to be developed in parallel with Feeding Australia to ensure alignment, whilst firmly positioning bioeconomy investment as a national priority.

Research and technical innovation

While significant cost reductions have been achieved for biomanufactured ingredients, closing the gap to cost parity requires sustained foundational and translational research. The sector's current challenges centre around infrastructure and process optimisation, strain engineering and cell line development, and the development of food-grade inputs (eg., culture media). The report highlights the importance of dedicated R&D funding mechanisms prioritising open-access, cross-disciplinary research in these critical areas. Encouragingly, the National Research Infrastructure Roadmap is under review, with both biomanufacturing and cellular agriculture referenced in its *Issues Paper*[7] – potentially informing future National Collaborative Research Infrastructure Strategy (NCRIS) priorities and funding for research translation.

A future-proof regulatory system

Australia's regulatory system is robust and trusted, but under-resourced, reactive, and not adequately future-proofed to appropriately assess some novel biomanufactured products. The report advocates for additional funding for FSANZ to enable faster assessments of novel foods without compromising safety. It also calls out inconsistencies in definitions across regulators, as well as discrepancies in how FSANZ applies GM food labelling requirements to precision-fermented ingredients based on end-product type. As such, the report recommends that earmarked funding be provided to FSANZ to raise a Proposal to review and update the Australia New Zealand Food Standards Code to ensure it keeps pace with new and emerging industries and technologies.

Access to shared scale-up and commercial infrastructure

The most immediate barrier to scaling biomanufactured food products is the lack of pilot and commercial-scale infrastructure. Critically, shared facilities are scarce and expensive, and Australia currently lacks large-scale commercial manufacturing capacity. To address this bottleneck, the report advocates for government support to subsidise access to existing infrastructure, establish multi-user scale-up hubs, and align funding programs with the capital needs of early-stage biomanufacturers. The Future Made in Australia initiative could enable this, with a sector assessment recommended to identify suitable public funding mechanisms. The $15 billion National Reconstruction Fund is also flagged as a major opportunity for investment in scale-up and commercial facilities – but only if investment guidelines and risk tolerance appropriately support emerging industries.

A closing window of opportunity

Australia has the foundations to position itself as a global leader in food biotechnology and biomanufacturing, but we are losing ground to global competitors. Building sovereign capability will require bold action, clear national policy and catalytic investment.

If Australia acts now, emerging food biotechnologies can enhance national resilience, secure food supplies and foster a globally competitive bioeconomy.

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Smarter milk-tea design: unlocking the role of dairy proteins and carbohydrate modifiers

Words by Dr Dilema Wijegunawardhana, Dr Mayumi Silva, Dr Tuyen Truong and Dr Jayani Chandrapala

Milk-tea has rapidly gained worldwide popularity, establishing itself as a staple beverage in both cafes and households. Its irresistible balance of creaminess and aroma, coupled with perceived health benefits, has fuelled its growing global appeal. Yet behind every silky sip lies complex food chemistry, one driven largely by the delicate interplay of milk proteins and carbohydrates. The nutritional and sensory qualities of milk are largely defined by its protein composition, which is dominated by casein and whey proteins in an 80:20 ratio. These proteins behave very differently, where whey proteins such as β-lactoglobulin and α-lactalbumin are highly bioavailable and quickly digested, while casein breaks down more slowly, offering prolonged satiety. Adjusting this protein balance can change the behaviour of milk systems, affecting solubility, stability, and even how the body absorbs nutrients.

Researchers are now exploring how such protein adjustments could optimise various formulations. Studies show that increasing whey protein can enhance reconstitution, emulsification, and overall stability of emulsion systems.[1] However, heat treatment, a key step in milk-tea preparation, challenges the stability of whey proteins. At around 70°C, they unfold and aggregate, potentially altering texture and flavour. This is further complicated by the polyphenols of tea, which interact differently with casein and whey proteins, affecting their bioavailability. To counter some detrimental effects on various milk systems, food technologists are adding carbohydrate modifiers such as maltodextrin. Maltodextrin improves solubility, viscosity and bulk density, while protecting sensitive compounds such as tea polyphenols during heating and drying.[2] Combining maltodextrin with carefully tuned protein ratios may hold the key to achieving both functional stability and desirable sensory qualities in milk-tea products.

Our recent research investigates this balance by examining how varying casein-to-whey ratios, lactose-to-maltodextrin proportions and tea concentrations influence the physicochemical and structural properties of milk-tea, in both liquid and concentrated forms. By understanding how these components interact under real processing conditions, we aim to pave the way for next-generation milk-tea formulations that deliver improved nutrition, texture, and shelf stability.

Varying lactose to maltodextrin ratios

Balancing ingredients for stability

In the fast-growing milk-tea market, achieving consistent stability and smoothness is key to delivering a premium drinking experience. A key finding from the study is that milk-tea made with full milk (FM-T) is naturally more stable than skim milk-tea (SM-T). The fat in full milk contributes to a stronger charge around particles, helping them stay evenly dispersed and preventing separation or sedimentation. In simple terms, fat acts as a natural stabiliser that keeps milk and tea mixed over time.

When maltodextrin was added, stability in SM-T dropped slightly because it diluted the charged particles that help hold the mixture together. However, adding whey protein restored this balance, improving uniformity and giving a smoother finish. This highlights a key takeaway for manufacturers: that combining proteins and carbohydrates in the right ratio is essential to maintaining good suspension stability, especially in reduced-fat or plant-based milk-tea products. During concentration, such as in the production of milk-tea bases or powders, full milk formulations showed even greater stability. The interaction between milk proteins and sugars formed a strong hydration network, helping to preserve texture during heating and concentration. However, adding too much whey protein created some stickiness and aggregation, reminding processors that balance, not excess, delivers the best performance.

Managing texture, mouthfeel, and crystallisation

Texture and mouthfeel are central to consumer satisfaction. Full milk-tea naturally showed larger, well-dispersed fat droplets that provided the desired creamy and smooth sensation. When lactose and whey protein were balanced, particle sizes became smaller and more uniform, leading to improved consistency and

a luxurious mouthfeel.

Skim milk–tea behaved differently. Without fat, the proteins tended to clump during concentration, producing a heavier texture but less creaminess. This suggests that for low-fat variations, adjusting the fat-to-protein ratio and using carbohydrates such as maltodextrin strategically can help replicate the creamy body consumers expect. Microscopic analysis confirmed that ingredient ratios also affect how lactose crystallises, which is critical for product smoothness, especially in concentrated or powdered milk–tea. In FM-T, lactose formed fine, evenly distributed crystals that maintained a silky texture. In contrast, skim milk–tea produced larger, uneven crystals when whey levels were high, leading to a slightly gritty mouthfeel. Adding maltodextrin helped reduce this crystallisation by binding with lactose and proteins, keeping the mix smooth and stable. For manufacturers, this is particularly useful when designing milk–tea concentrates or instant mixes where graininess is undesirable.

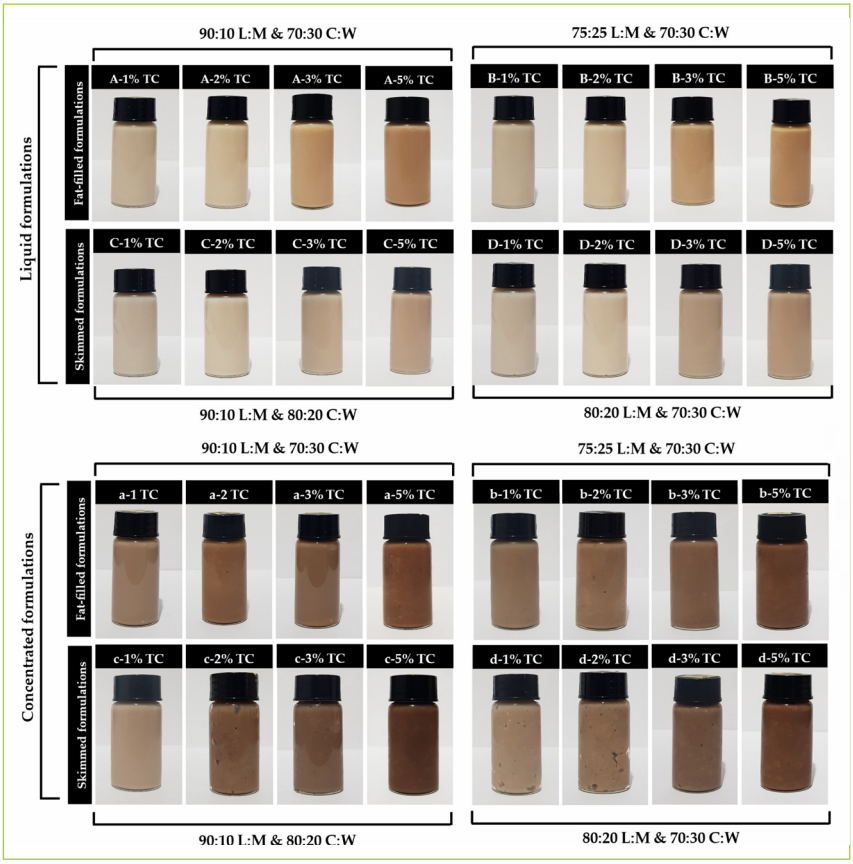

Figure 1: Different milk–tea liquid (A–D) and concentrated (a–d) formulations prepared with varied tea concentrations and different L:M and C:W ratios.

Protecting flavour, colour and overall appeal

Tea polyphenols, responsible for the signature flavour and antioxidant properties of milk–tea, are sensitive to heat. The study found that SM-T retained more of these compounds after pasteurisation, as milk proteins helped protect them. In full milk–tea, adding maltodextrin provided similar protection by forming a shield around these valuable molecules.

When concentrated, both types of milk–tea showed an increase in total phenolic content, likely due to stronger interactions among proteins, carbohydrates, and tea components. For industry, this means that adjusting ingredient ratios can not only improve mouthfeel but also preserve flavour and nutritional value during processing. However, the study also observed greater browning during concentration, caused by natural heat reactions between sugars and proteins. While mild browning can enhance the product quality, too much may indicate overprocessing. Fine-tuning heat treatment and lactose content helps achieve the ideal colour and flavour balance consumers expect from premium milk–tea.

Varying tea concentration

Tea concentration plays a defining role in shaping the texture, stability and flavour profile of milk–tea products. As the concentration of tea extract increases, so does the level of tea polyphenols, key compounds responsible for antioxidant capacity, flavour and colour. However, these compounds are also highly reactive and can easily bind with milk proteins and sugars during heating, affecting both flavour and product consistency. The study showed that optimising ingredient ratios can help manage these interactions, resulting in smoother, more stable milk–tea with enhanced antioxidant retention.

Full milk–tea formulations achieved up to a 160% increase in total phenolic content during concentration, especially those with lactose-to-maltodextrin (L:M) ratios of 90:10 and 75:25, and casein-to-whey (C:W) ratios of 70:30. This boost was largely due to the stabilising effect of fat, which promotes even dispersion and protects antioxidants under heat. Fat also helps maintain uniform particle size, reducing clumping and sedimentation, which is key to producing consistent UHT or concentrated milk–tea bases with smooth mouthfeel and long shelf life.[3]

In contrast, skim milk–tea systems with L:M ratios of 90:10 and 80:20 and C:W ratios of 80:20 and 70:30 achieved TPC improvements of 135.7%, 99.5%, and 90.7%, respectively. These results show strong potential, but without fat's protective role, formulation fine-tuning was needed to prevent darker colour or graininess during processing. In these lower-fat systems, tea polyphenols interact more directly with milk proteins, intensifying browning and slightly increasing body thickness. Maltodextrin and whey protein played crucial roles here, where maltodextrin created a hydration layer around

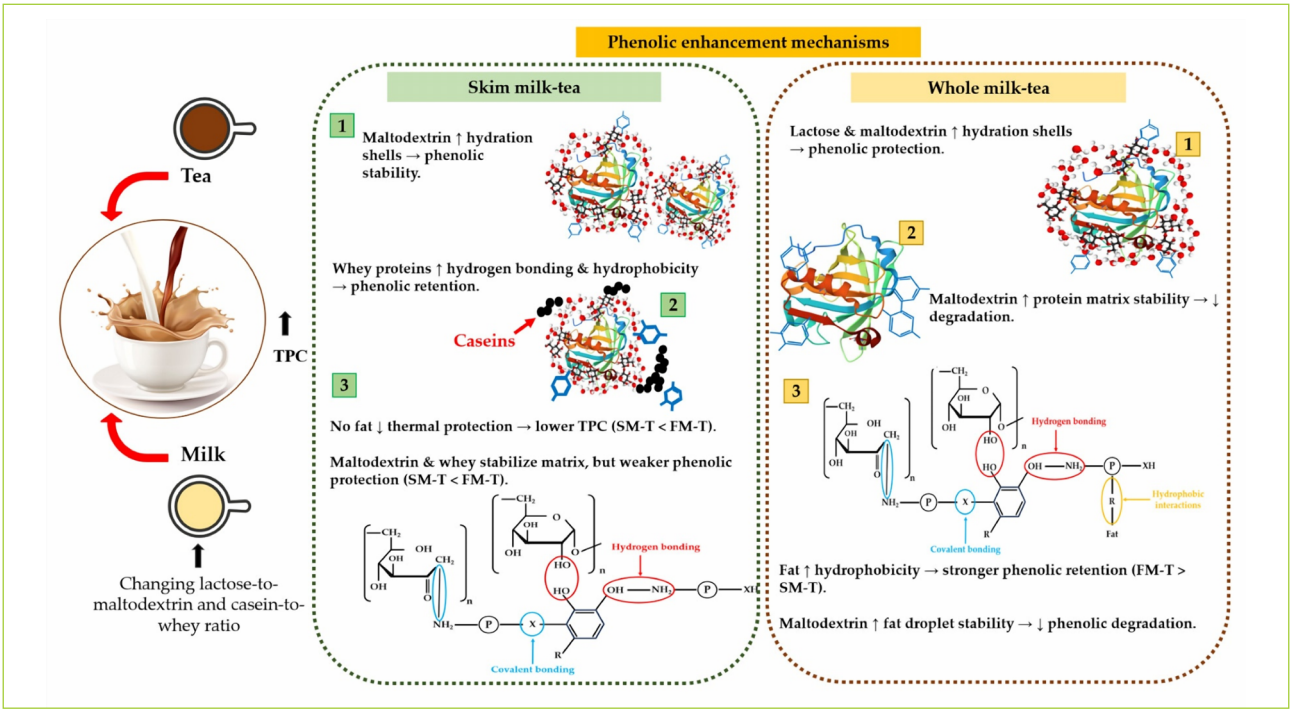

Figure 2: Mechanism of stabilising tea polyphenols in fat filled milk-tea (A) and skim milk tea (B) with varying L:M and C:W ratios.

proteins and tea compounds, while whey proteins enhanced the structural network through hydrogen bonding and hydrophobic interactions. Together, they provided a stable matrix that preserved flavour and smoothness, even at higher tea concentrations.

Colour control is another key consideration for processors. While higher tea levels naturally deepen the colour, excessive browning may signal overprocessing. FM-T formulations benefited from fat's moderating role, maintaining a rich golden tone. In SM-T, adjusting lactose or maltodextrin levels effectively controlled colour intensity and maintained visual appeal. At an optimal tea level of 5%, ingredient interactions became particularly critical. Fat in FM-T supported even lactose crystallisation, producing smaller, more uniform particles that contributed to the silky, creamy texture consumers expect. In comparison, SM-T showed more uneven crystallisation at high whey content, though increasing tea concentration helped reduce particle size and improve smoothness when properly balanced.[4]

Pasteurisation plays a key role in shaping the flavour and aroma of milk-tea. In full milk-tea, especially with balanced lactose-to-maltodextrin (90:10) and casein-to-whey (70:30) ratios, heat treatment triggered the formation of desirable fruity, floral and nutty notes. These developed through natural reactions between fats, proteins, and tea compounds, mainly lipid oxidation and Maillard browning. Key aroma contributors included 2-heptanone, linalool, nonanal, and benzaldehyde, which together created a creamy, sweet and slightly fruity character that enhances consumer appeal. In skim milk-tea, similar compounds formed but at lower intensities, leading to a lighter, more floral aroma profile. With the absence of the buffering effect of fat, Maillard and oxidation reactions were more pronounced, influencing aroma balance. For manufacturers, this means optimising milk-tea formulations and pasteurisation conditions can unlock richer, more appealing flavour profiles while maintaining product stability and brand consistency.

Conclusion

This study demonstrates how ingredient ratios and fat content shape the stability and antioxidant retention of milk-tea. Full milk-tea benefits from fat, which enhances surface charge, promotes protein–fat–maltodextrin interactions, and forms protective complexes that safeguard phenolics during heating, achieving up to a 160% boost in total phenolic content at optimal lactose-to-maltodextrin (90:10, 75:25) and casein-to-whey (70:30) ratios. Skim milk-tea, though lacking fat, still improves total phenolic content up to 99%, through added whey protein and maltodextrin, which restore charge balance and prevent aggregation. At higher tea levels (5%), FM-T showed stronger protein–polyphenol and fat–protein interactions, leading to larger but more stable aggregates. After concentration, FM-T particle size decreased due to stabilising fat–protein complexes, while SM-T increased from reduced structural stability. Both versions showed enhanced total phenolic content after concentration, though gains levelled off at higher tea levels due to binding site saturation. FM-T also developed richer aroma profiles driven by Maillard reactions and lipid oxidation, while SM-T's aroma remained simpler. Overall, the synergy between fat, lactose, whey protein, casein,

polyphenols and maltodextrin produces a more stable and uniform matrix that effectively locks in flavour and antioxidants.

Casein provides strong binding sites that keep antioxidants stable, while lactose forms a hydration layer that shields them during pasteurisation. Polyphenols reach saturation, leaving more 'free' antioxidants in the systems. Fat acts as a stabiliser, anchoring polyphenols close to proteins and preventing them from clumping or degrading during heating. In skim versions, polyphenols tend to form larger, less stable aggregates, but still protect antioxidants from breakdown.

These findings provide clear guidance for beverage and dairy manufacturers aiming to optimise milk–tea formulations. A well-balanced combination of lactose, maltodextrin, and milk proteins enhances stability, maintains a smooth texture, and preserves flavour through processing. For ready-to-drink, UHT, or powdered milk–tea products, fine-tuning ingredient ratios allows producers to deliver consistent quality, creamy mouthfeel, and long shelf life. As consumer demand for milk–tea continues to grow, understanding these ingredient interactions helps manufacturers stay ahead in developing stable, indulgent, and market-ready products. Achieving the perfect balance between flavour, stability, and nutritional value in milk–tea comes down to how ingredients interact during processing.

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From risk to resilience: strengthening the safety of agrifood systems for the future

Words by Deon Mahoney

A forum for the future of food safety

The 2025 AIFST–SQF Institute Food Safety Forum, held in North Sydney, brought together food industry professionals, regulators, and researchers to explore one of the most pressing challenges facing our sector: how to move from managing risk to building resilience in food safety systems.

Food safety remains a cornerstone of consumer trust and public health. As the global population is projected to reach 10 billion by 2050, the food industry must adapt to increasingly complex risks – including climate change, global trade dynamics and technological disruption.

Under the theme *From risk to resilience: strengthening the safety of agrifood systems for the future*, the forum featured a full day of presentations and panel discussions covering the future of food safety, artificial intelligence (AI), allergen management, food fraud, regulatory trends and quality assurance. This paper synthesises insights from the forum, reflecting on current challenges, emerging opportunities and strategies to build resilience in agrifood systems.

Looking back to look ahead

The forum opened with a keynote presentation from Gary Kennedy, who reflected on the evolution of food safety over the past four decades. Kennedy traced major developments – from improved testing methodologies and the rise of global food standards to the emergence of new pathogens – and reminded attendees that history offers important lessons for the future.

Quoting Spanish-American philosopher George Santayana, he cautioned: *those who cannot remember the past are condemned to repeat it*.

Looking ahead, Kennedy identified several critical challenges: the effects of climate change, packaging reforms, the growing threat of food fraud, and the accelerating influence of artificial intelligence. His message was clear — the next generation of food professionals must be ready to adapt and innovate.

Economic pressures and the cost of safety

Speakers from the retail sector discussed the growing economic pressures facing the food industry. The need to contain costs, they warned, has led some businesses to reduce product testing or substitute ingredients – a trend linked to increasing numbers of product withdrawals.

An analysis of recent withdrawals showed that more than 50% were related to labelling issues, while 36% stemmed from quality problems. These figures underline the importance of maintaining robust quality systems, even when budgets are tight.

Environmental and allergen management: getting the basics right

Several technical presentations focused on operational resilience. A deep dive into environmental monitoring programs highlighted their critical role in detecting and eliminating pathogens before they enter the food chain. Effective programs rely on careful mapping of test sites, targeting relevant organisms and maintaining strong communication between technical and operations teams.

The Allergen Bureau reinforced that undeclared allergens remain the leading cause of food recalls in Australia. The speaker emphasised compliance with the Australia New Zealand Food Standards Code, the Therapeutic Goods Administration

and Australian Consumer Law, noting that allergen incidents can erode both consumer trust and brand reputation.

The Voluntary Incidental Trace Allergen Labelling (VITAL) Program was recognised as an industry best-practice tool for assessing cross-contact risks and providing consistent precautionary labelling. Strong policies, documentation and staff training remain central to effective allergen risk management.

A highlight came when Rachael Telfer from Arnott's Group shared a case study on developing a gluten-free version of an iconic Australian product. The project demanded strict segregation, supplier auditing and rigorous application of VITAL principles – proof that innovation and safety can coexist.

Culture: the cornerstone of food safety

Culture emerged as a recurring theme throughout the day. Reed Stephens of Primo Foods described the company's journey to embed a food-safety culture within its meat processing facilities. Success, he explained, came through visible management commitment, empowering frontline leaders, and celebrating positive behaviours.

By shifting from a compliance mindset to one of shared ownership, Primo created an environment in which employees understand their role in keeping food safe. The cultural shift described in the presentation could become a model for other food businesses.

Regulators and technology in a changing landscape

From the regulatory perspective, Andrew Davies of the NSW Food Authority addressed the challenges regulators face in keeping pace with innovation. The rise of alternative proteins, precision fermentation, and e-commerce, coupled with sustainability expectations and AI-driven systems, is reshaping how food is produced, distributed and regulated.

Davies stressed that regulatory frameworks must remain flexible and science-based, supported by rigorous monitoring, audits and traceability programs to maintain public confidence.

Artificial intelligence: promise and prudence

Dushyant Sanathara from BSI explored the emerging role of artificial intelligence in food safety. While current uptake across food and farming remains limited, AI offers enormous potential to improve efficiency and foresight – from monitoring crops and livestock to predicting contamination events and improving supply-chain traceability.

However, Sanathara cautioned that governance, ethics and oversight are essential to ensure responsible use. The challenge will be balancing innovation with accountability.

Food fraud, auditing and continuous improvement

Food fraud remains an ongoing threat to product integrity and consumer safety. A presentation highlighted the need for vigilance, transparent supply chains, and robust verification systems. While another speaker addressed the identification and management of hazards when using compressed air.

Damien Alexander from SQF Institute.

Third-party auditing also featured prominently in the discussion. Rather than viewing audits as box-ticking exercises, speakers advocated for a shift toward continuous improvement. When audits are well-designed and transparent, they can help businesses identify opportunities, strengthen systems, and demonstrate a genuine commitment to quality.

The future of quality assurance

The final panel turned its attention to the future of quality assurance (QA). There was strong consensus that QA programs must remain science-based, dynamic and focused on continuous improvement in order to be future-proof. Automation and data-driven decision-making will increasingly shape assurance activities, but technically skilled people will remain essential to interpret results and drive outcomes.

Given its strategic importance, panellists agreed that the QA function should report directly to the CEO – a sign that food safety and quality are core business priorities, not backroom processes.

Key insights from the forum:

- ***Collaboration matters.*** From farm to fork, effective food safety relies on open communication and partnerships across the supply chain
- ***Culture drives performance.*** Engaged, trained, and accountable personnel are the foundation of safe food systems
- ***Future challenges persist.*** Climate change, supply-chain complexity, and shifting trade patterns demand new thinking
- ***Resilience is essential.*** Food safety systems must adapt to changing environments and recover effectively from disruption
- ***Auditing is evolving.*** Expect a shift from compliance to real-time verification and continuous improvement
- ***Future professionals need new skills.*** Tomorrow's food scientists and technologists will require data literacy, systems thinking, and collaboration across disciplines
- ***Engagement and mentorship are vital.*** Students and early-career professionals should seek mentors, stay connected and remain curious.

Conclusion

The 2025 AIFST–SQF Food Safety Forum left participants with renewed purpose and optimism. As the agrifood sector faces unprecedented change, the path forward will rely on building resilience – in systems, in people and in culture.

Feeding the future safely will require more than compliance; it will demand adaptability, collaboration and the courage to innovate.

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The Planetary Health Diet revisited: what the 2025 update really changes – and what it doesn't

Words by Dr Anneline Padayachee

When a global diet becomes a global assumption

The EAT-Lancet Planetary Health Diet (PHD) has enjoyed a reputation that few nutrition frameworks ever achieve. Since its original release in 2019,[1] it has been woven into global health narratives with an ease usually reserved for UN declarations or major WHO recommendations. To many policymakers, academics and sustainability advocates, the PHD has become the default answer to the question, "What should the world eat to save the planet from impending doom?" Its arrival felt almost like redemption: the answer to all our simplest fears in the form of an elegant mixture of chronic disease prevention and climate pragmatism, wrapped in a unified global menu.

With that level of influence, the release of the 2025[2] update carried an unspoken expectation. If the first version was bold and provocative, the second was expected to be sharper, more robust, scientifically tighter, and perhaps most importantly, more grounded in the physiological realities and cultural diversity of the people it aims to nourish.

The updated PHD does sound different. It is more sensitive to justice, more attentive to equity, and more aware of the uneven terrain of global food access. But sounding different is not the same as being different. A shift in tone is not a shift in evidence. This article focuses on the scientific and nutritional foundations of the PHD – because before a diet can claim to be "planetary," it first has to succeed at the simplest test: Does it nourish the human body?

2019: Ambition built on an uneven foundation

When the 2019 PHD was introduced, it was hailed as a once-in-a-generation roadmap linking human health to the limitations of planet Earth, focusing on population growth and the impact of changing temperature on human survival (also referred to as planetary boundaries). It positioned dietary change as a central lever for reducing environmental degradation and slowing climate change. More plant foods, less animal foods, fewer dietary excesses – it was the type of advice that landed smoothly in wealthy nations already embracing plant-forward trends. Consequently, it received immediate support in policy circles.

But the diet's scientific foundation was uneven. The 2019 PHD leans heavily on epidemiological associations while giving comparatively little attention to nutrient bioavailability, metabolic pathways, or the biochemical differences between plant and animal foods. It treats food composition tables and nutrient content equal to physiological absorption in the human body. It uses global environmental averages when there are marked differences between individual countries (eg. Australia vs Indonesia vs England vs Nigeria vs China vs India). It also assumes that the world behaves in the same way as northern Europe, with equal access to refrigeration, infrastructure, food diversity and affordability.

The 2019 PHD was visionary, but its

universality was more rhetorical than realistic. For that, it was criticised strongly. That tension – between global aspiration and physiological reality – is where the 2025 update had the greatest work to do.

The 2025 version has tried to address these concerns.[2] It includes a more extensive discussion of equity, labour rights, affordability, the burden of food insecurity and the importance of biodiversity. These refinements matter. They show that the Commission heard some of the concerns raised over the past six years. The updated environmental modelling is more sophisticated, and the epidemiology is more expansive, drawing on new cohort studies that reinforce long-standing relationships between diets rich in plant foods and reduced chronic disease risk.

The nutrient adequacy test: where the PHD meets physiology

The most rigorous analysis of the PHD's micronutrient adequacy was conducted not by its creators, but by independent nutrition scientists. A landmark 2023 paper published in *The Lancet Planetary Health* evaluated whether the original PHD met globally harmonised nutrient reference values for key micronutrients, including iron, zinc, calcium, vitamin B12, folate and vitamin A.[3] Their findings were unequivocal. Even when the PHD was followed perfectly – no deviations, no compromises, full adherence to the recommended intakes – the diet failed to meet requirements for several critical nutrients. Adults achieved only 93% of the recommended daily B12, 86% of calcium, 90% of iron and 78% of zinc. More concerning still, women of reproductive age – a group already vulnerable to iron deficiency anaemia – achieved only 55% of their daily iron requirement under the PHD model.

These are not marginal deficits, they represent meaningful physiological risks:[4]

- Iron deficiency affects cognitive performance, mood, immunity, fatigue, workplace productivity, and pregnancy outcomes
- Zinc deficiency compromises immune function and wound healing
- Calcium and B12 shortfalls increase the risk of bone demineralisation, neurological issues, and metabolic disruption.

A diet intended to be "planetary" cannot afford to undermine the health of the very populations it claims to protect. The deeper question, then, is not whether the PHD includes nutritious foods — it does. The issue is whether the nutrients it contains are absorbable.

Why the PHD falls short: bioavailability is not optional

The PHD treats nutrients the way a spreadsheet does: as static numbers that add up neatly to an ideal total. But the human body is not a spreadsheet. It distinguishes between heme and non-heme iron,[5] absorbs calcium from dairy differently than from leafy greens,[6] and responds to zinc differently depending on the presence of phytates – compounds found in wholegrains, legumes, nuts and seeds that inhibit mineral absorption.[7]

The PHD is structured around foods that are rich in these inhibitors, and simultaneously low in enhancers such as heme iron and animal-derived zinc. In the Beal *et al*. analysis,[3] the PHD's phytate load placed it in the lowest possible category for mineral bioavailability. This single characteristic – the combination of low animal-source foods and high phytates – is enough to undermine the diet's nutritional adequacy, even when total nutrient intake appears sufficient. This is foundational biochemistry. Nutrients that are inaccessible to the body cannot be considered nutritionally sufficient.

Adjustments required to make the PHD nutritionally adequate without relying on supplements or fortified foods include increasing intake of animal-source foods. That means more eggs, more dairy, more fish, and yes – more red meat – alongside reductions in high-phytate plant foods.[3] The diet that reached adequacy looked materially different from EAT-Lancet's prescription. This exposes a core contradiction: the diet proposed as ideal for planetary health does not meet human nutrient needs unless it includes more animal foods than the PHD recommends. While the 2025 update acknowledges concerns around nutrient sufficiency, the updated diet has not provided modelling to suggest this has improved.

In other words, the nutritional adequacy of the 2025 PHD is not established. It remains an assumption, not an evidence-based conclusion.

2025: Global reference diet should be globally applicable

The 2025 report[2] notably widens the gap between its messaging and its recommendations. The narrative now acknowledges that diets are shaped by culture, economics, geography, and history, and that universal adoption is neither simple nor equitable. Yet, when it comes to its dietary proposal, it continues to present a singular dietary structure as if global variability can be solved by a unified global aspiration. While the intention may be inclusive, it lacks inclusion of diverse cultures, peoples, and geographies, and the model remains structurally rigid. This matters because nutritional adequacy is not simply a matter of reaching recommended intakes; it is a product of how diets interact with people's bodies, environments, and lived realities.[8] A diet that appears nutritionally adequate under idealised, average conditions cannot claim universal relevance in a world that is anything but average. If the PHD is to be a global reference, it must be tested against global physiological diversity — and that includes populations with differing iron needs, differing access to seafood, differing dairy tolerance and differing baseline health risks for example. This level of testing has not yet happened. What we have instead is a more polished version of the same model, still awaiting the evidence needed to justify its universality.

But the central dietary prescription remains almost unchanged. The 2025 PHD still recommends very low intakes of red meat, limited dairy, modest amounts of poultry and fish, and a heavy reliance on legumes, wholegrains, nuts, seeds and vegetables as the primary vehicles for essential nutrients. The foundational structure of the diet — high in phytate-rich foods and low in animal-source foods — is essentially the same model presented in 2019.[1]

And because the architecture is the same, the scientific question at the heart of global critiques remains the same: is the PHD nutritionally adequate for the world's population?

Culturally inclusive language, culturally exclusive application

Recent assessments of EAT-Lancet's nutritional completeness were conducted in Rwanda,[9] eight Latin American countries[10] and Sweden.[11] Although all studies assess the 2019 EAT–Lancet diet, given that the 2025 version is structurally very similar, their findings remain relevant. Across these regions, the same issue appears: the dietary pattern does not perform consistently when applied in real populations. In Rwanda, older adults already eating largely plant-based diets only met more micronutrient targets when they ate more total calories, and once energy intake was controlled for, most improvements disappeared and riboflavin intake worsened.[9] Across the Latin American countries, populations simply could not meet the required food-group pattern because the recommended balance of plant foods versus animal-source foods does not match regional eating patterns, affordability, or food supply.[10] These two regions represent very different contexts, yet both show that the PHD does not translate well outside the theoretical model.

The Swedish study[11] shows a different but equally important limitation. Using the same population and the same dietary intake data, the nutritional results changed depending on the scoring method used to define "PHD adherence." In some methods, higher adherence was associated with lower intakes of B12, riboflavin, zinc and niacin, and in several cases, women had a higher risk of anaemia.[3] Because the diet's micronutrient performance changes with the scoring approach, this indicates that the diet's adequacy is not stable. Taken together, these three papers show that the PHD is not culturally or operationally adaptable, and that its nutritional performance is inconsistent across settings.

What has not changed between 2019 and 2025 and why it matters

Although the 2025 PHD arrives with broader rhetoric and expanded global ambition, the underlying dietary model remains largely untouched. This matters because the scientific criticisms raised in 2019 were not just about tone or communication; they were about the architecture of the diet itself, which is nutritionally and culturally flawed.

One of the most striking consistencies is the PHD's ongoing reliance on epidemiological associations as its foundational evidence base. The updated Commission continues to draw primarily from large observational cohorts, many from Europe and North America, whose dietary patterns, food environments, and baseline micronutrient profiles differ markedly from those in the Asia-Pacific, Africa or Latin America. Crucially, the 2025 update still does not meaningfully incorporate mechanistic evidence around iron, zinc and calcium absorption, nor does it integrate the extensive body of biochemical literature demonstrating that nutrient bioavailability in high-phytate, plant-heavy diets is substantially lower than nutrient tables suggest.

Equally unchanged is the Commission's treatment of animal-source foods as universally reducible and environmentally burdensome. Despite the criticisms levelled at the 2019 PHD – particularly the homogenisation of global livestock systems into a single emissions profile – the updated model continues to assume that reducing red meat and dairy is optimal everywhere. This assumption ignores region-specific life-cycle assessments demonstrating that ruminant systems in Australia, sub-Saharan Africa and parts of South America function very differently from the intensive operations that dominate the global environmental datasets. The 2025 PHD does not address these regional discrepancies; it simply reiterates global averages.

The updated report also preserves the original's assumption that a diet high in diverse fresh plant foods is operationally feasible across all geographies. While it highlights equity, labour and justice, it does not offer credible pathways for implementation in communities where refrigeration is inconsistent, food costs are high, or supply chains are fragile. This includes remote Aboriginal and Torres Strait Islander communities, many low- and middle-income countries, and areas experiencing climate volatility. This is not a trivial operational gap; it reflects a structural incompatibility between the PHD and food environments outside affluent urban centres.

Together, these unaltered assumptions – universal applicability, plant-dominant adequacy, global environmental generalisations, and operational feasibility – reveal that the PHD has been rhetorically refined but not scientifically strengthened. The 2025 version, like its predecessor, remains as aspirational and as disconnected from the lived realities of many regions of the world. Without structural change, the diet's universality remains a hypothesis – not evidence.

Why this matters for Australia

Australian bodies have Australian needs. Our population is ageing, our iron-deficiency burden is rising, and our climate, geography and agricultural landscape look nothing like the northern European contexts the PHD most closely reflects. We already rely on fortified foods for key nutrients such as folate, iodine and several B-vitamins. Reducing nutrient-dense animal foods without demonstrating compensatory adequacy is not a neutral decision – it has consequences for public health.

This is not an argument against including more plants in the Australian diet. It is an argument for evidence-based proportionality and context-specific modelling. When global diets are adopted uncritically, they can obscure rather than illuminate the path to genuinely sustainable nutrition.

The Planetary Health Diet is an important global narrative. It has elevated the conversation about how diet affects both human and planetary health. But influence is not the same as accuracy, and aspiration is not the same as adequacy. Based on the strongest available evidence, the PHD – both in its original and updated forms – has not yet demonstrated nutritional sufficiency for key population groups. Until the 2025 PHD is accompanied by rigorous nutrient modelling that accounts for bioavailability, physiological diversity, and population-specific needs, it remains an interesting public health resource but not a template for Australia to copy.

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Food safety risk assessment: part 3 – exposure assessment

Words by Deon Mahoney and Dr Dipon Sarkar

In this third article in the series, we explore the critical issues and approaches for assessing exposure to a hazard in order to objectively inform a risk characterisation that describes the risk to consumers from contaminated food.

Exposure assessment is one of the four components of risk assessment within the risk analysis framework. The Codex Alimentarius Commission defines exposure assessment as *the qualitative and/or quantitative evaluation of the likely intake of biological, chemical, and physical agents via food as well as exposures from other sources if relevant*.[1]

Exposure assessments provide an estimate of the frequency, magnitude, and duration of exposure to specific hazards and other risk factors through the consumption of food, beverages, drinking water and even dietary supplements.

While an exposure assessment may be undertaken as part of a formal risk assessment, in the food industry it usually involves a stand-alone process, where the objective is to quantify the health risk to consumers or determine ways to minimise their exposure. In this situation, information on the identification and characterisation of a hazard has been established, and the exposure assessment seeks to determine the extent to which consumers may be exposed to an identified hazard. This step typically requires the most investigation, involving data collection, scenario calculations and interpretation, and is crucial in identifying situations where consumers may be exposed to potential hazards and in executing targeted control measures designed to safeguard consumer health.

Exposure assessment scenarios

In the food processing environment, there may be a range of situations where an exposure assessment is vital for establishing the risk associated with an identified hazard. Table 1 provides examples of scenarios.

Microbiological versus chemical exposure assessments

Where the hazard is microbiological, there is a need to monitor contamination levels. This may involve incoming raw materials, in-process foods, or finished products. The assessment then seeks to determine whether the level of contamination is likely to increase or decrease during storage, preparation and transport. When assessing finished products, there is a need to consider how the consumer handles the food, confirm typical serving sizes and establish the frequency of consumption. For certain pathogens, there will be a need to ascertain if the consuming public includes vulnerable consumers.

The exposure assessment of microorganisms can be expressed using the ICMSF mass-balance equation,[2] which states that the changes in a hazard from the initial level (H_0), minus the sum of reductions (R) plus the sum of the increase of the hazard through growth, concentration, or re-contamination (I) across the entire food chain is the final exposure concentration of the hazard.

$$H_0 - \sum R + \sum I = Exposure\ Assessment$$

The outputs from the micro-biological exposure assessment indicate the extent of exposure to a pathogen. This information can then be evaluated against microbiological limits in the Australia New Zealand Food Standards Code, guidance in codes of practice, and dose-response curves where they are available (this step is the last step of risk assessment, known as risk characterisation). This will inform decisions on whether to release a product to the marketplace, with a food business's risk appetite a key factor in the decision-making process.

SCENARIO	FACTORS THAT NEED TO BE ASSESSED
Finished product testing confirms the presence of *Listeria monocytogenes* within the legal limit in a ready-to-eat deli food that will not support the growth of the organism	• Potential for the food to be mishandled (including further contamination) in the supply chain • Impact of refrigerated shelf-life on the contamination (time and storage temperature) • Could pathogen level exceed 100 cfu/gram before the end of shelf-life • Potential consumption by vulnerable consumers
Finished product testing shows pesticide contamination in a frozen vegetable product	• Source of the contamination • Contamination levels in finished product • Potential exposure of consumers to the pesticide
Assessing the potential use of river or dam water for the irrigation of leafy green crops	• Background levels of contamination – microbiological, chemical, and particulate • Temporal variations in water quality

Table 1: Exposure assessment scenarios in the food industry.

INFORMATION	SOURCES
Dietary intake	• National Nutrition Survey • Australian Health Survey (AHS): 2011-12 National Nutrition and Physical Activity Survey • New Zealand National Nutrition Survey for adults • EFSA Comprehensive Food Consumption Database
Pathogen growth models	• Pathogen Modelling Program (US Department of Agriculture) • Combase (US Department of Agriculture) • Refrigeration Index Calculator (Meat and Livestock Australia) • Shelf Stability Predictor (University of Wisconsin – Madison)
Databases	• Scientific literature • Public health databases • Challenge studies
Risk assessment tools	FDA-iRISK: Web-based system analysing data on microbial and chemical hazards in food

Table 2: Sources of information.

In the case of chemical contamination, many of the usual hazards are introduced during agricultural production eg., agricultural chemicals, veterinary medicines and environmental contaminants, with little change in levels as the food is further processed. But there are exceptions, contamination levels may increase eg., where fruit is dehydrated, or a juice is concentrated. Alternatively, the level of contamination may decrease through unit operations, such as peeling and washing, or as a result of dilution procedures. Hence, a good understanding of processing operations is essential. Outputs from monitoring chemical contamination are typically evaluated against maximum limits described in the Australia New Zealand Food Standards Code, and a more detailed exposure assessment is often not warranted.

See part two in this series for more details on the type of information required for an exposure assessment.[3]

Sources of data

A dietary exposure assessment requires an estimate of how much of a food a population, or population subgroup, consumes. National nutrition surveys provide detailed data on consumption of foods and beverages and can be accessed to support assessment of the dietary exposure to food additives, pesticide residues, chemical contaminants, nutrients, food ingredients and microbial contaminants.[4] Dietary exposure is then estimated by combining food consumption data (portion size) with hazard concentration data.

Aside from monitoring data obtained during food processing, dietary exposure assessments for microbial hazards require detailed information on food-handling and storage conditions (times and temperatures), as well as food preparation practices in the home. The ability to predict microbial growth and/or survival during food processing, storage, and distribution is important for exposure assessment.

In many cases, access to data on times and temperatures during transport and storage of a specific product is not directly available. Hence, it is often necessary to use databases or surrogate data from other food products. For example, use of temperature profiles along a meat supply chain (Refrigeration Index Calculator),[5] or supermarket cool room monitoring data.

Microbiological modelling programs are useful tools for food manufacturers seeking to model the effects of storage and handling conditions on the growth and/or death of pathogens in a food along the food supply chain. Such programs are a cost-effective alternative to undertaking expensive laboratory experimentation.

Uncertainty and variability

Variability in exposure assessments refers to variability in susceptibilities, contaminant concentrations, and human exposure factors. While uncertainty is related to a lack of knowledge regarding components of the assessment process. Identification of the sources and extent of variability and uncertainty is key to reducing their impact and to the utility of the assessment.

Summary

A thorough exposure assessment strives to portray a real-world situation, depicting possible exposure of consumers to an identified hazard. The assessment can indicate scenarios ranging from most likely to conservative to worst-case, and will support the identification of risk management strategies.

Identification of uncertainty and variability is critical in understanding the limitations of the exposure assessment and in utilising the final exposure estimate.

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AltProteins 25: thinking the unthinkable to catalyse emerging proteins

Words by Megan Redmond

Held in October last year, AltProteins 25 took a new approach to address the challenges of catalysing the emerging alternative proteins sector.

Sponsored by the NSW Government and Investment NSW, AltProteins 25 gathered leaders from across the alternative proteins ecosystem in Sydney for the first time, with a single challenge: to think the 'unthinkable'.

Recognising the need to move beyond the traditional conference format, while still delivering useful new data and insights, the Food Frontier team crafted an agenda that facilitated challenging conversations focused on the solutions the sector needs.

Event 'Sorcerer of Ideas' Nik Gowing, a former BBC journalist and the founder of Thinking the Unthinkable, led a dialogue focused on questions, considerations and potential solutions throughout the day. The aim? To leave delegates from all corners of industry, government and research with both insights and inspiration to act.

Throughout the event, exciting themes emerged and 'unthinkable' insights took shape, each pointing to new ways the sector can drive forward.

Moving from ambition to action

The case for 'why' alternative proteins are critical for a sustainable food system is well-trodden ground, so, at AltProteins 25 we wasted no time restating the facts. Instead, the focus was on the 'how': how to embed alternative proteins into sustainable food systems, particularly through policy.

We hosted a debate amongst the authors of three of Australia's most influential food policy papers. Their papers represented three approaches - industry-led growth, national security, and systems-based governance.[1,2,3] The authors shared insights on key issues such as supply chain resilience, health and sustainability and offered advice on what the alternative proteins sector needs to do to ensure it is represented in future policy. It was clear that Australia urgently needs a more coherent, coordinated and forward-looking approach to food policy.

What was the 'unthinkable'?

Stop talking about 'low emission' alternatives individually. Genuine government support will come when the sector as a whole can clearly and succinctly demonstrate its impact in driving economic growth, sovereign manufacturing, agricultural value addition, circular economies, and other leading policy agendas.

Big opportunities for regional Australia

Biomanufacturing is foundational to the US$4 trillion global bioeconomy and it can breathe new life into our agrifood system, creating new, more resilient value streams, driving regional economic growth, and partnering with traditional industries to bolster Australia's food sovereignty. The plant protein ingredients industry – set to reach US$69 billion by 2032 – offers similar opportunities globally to regional Australia.

For traditional agriculture, biomanufacturing technologies, such as precision fermentation and plant molecular farming, offer new value streams. For example, sugar produced in Queensland is currently a feedstock for precision fermentation companies exploring dairy proteins and specialty ingredients. Often, the inputs required for biomanufacturing represent waste or by-products from traditional industries, building sustainability and greater commercial value into the supply chain.

What was the 'unthinkable'?

Emerging food biomanufacturing technologies aren't here to replace traditional agricultural systems; instead, they offer added value by bolstering and securing production and supply chains in an increasingly turbulent world.

R&D and collaboration at the heart of moving from lab to launch to scale

Australia's advanced research capabilities in areas such as crop breeding, ingredient innovation, synthetic biology and nutrition research provide a strong foundation for growing the nation's alternative protein sector.

At the heart of moving from lab to launch are new industry-academia partnerships that are progressing early-stage science breakthroughs into commercial outcomes. At the University of Technology Sydney, the Climate Cluster is partnered with plant-based meat company v2food to use red algae as a natural colourant. At the Food and Beverage Accelerator (FaBA), hosted by The University of Queensland, leading gas fermentation experts are partnering with industry to transform their greenhouse gases into new food and feed options.

Scaling innovation was also a key theme, with industry proponents such as CSIRO discussing their transition from a focus on supporting individual companies and new technology commercialisation to a broader emphasis on building whole-of-industry and food system capability. To that end, leaders from CSIRO's Australian Food Innovation Network held a working session with food manufacturers as their first stop in a national consultation tour that will inform the design of a shared R&D

Food Frontier Interim Executive Chair, David Bucca, catches the 'catchbox' mic at AltProteins 25 in a session led by 'Sorcerer of Ideas' Nik Gowing.

and innovation agenda that reflects the sector's needs.

What was the 'unthinkable'? *Short-term thinking leads to siloed progress. When faced with an increasingly tightened funding landscape, collaboration across value chains is critical to unlocking transformative R&D into innovation at scale. Both industry and academia can benefit when they're prepared to imagine ambitious and long-term partnerships.*

Plant protein ingredients on the rise – but leadership is needed

As articulated in Food Frontier's recent report, *Unlocking Australia's potential: the case for a national plant protein ingredient industry*, Australia remains primarily a raw commodity exporter of its protein-rich grain crops, leaving high-value ingredient manufacturing to other nations. In one recent annual comparison, Australia exported 40.9 million tonnes of its protein-rich source crops, unprocessed, yet imported an estimated 118 thousand tonnes of plant protein ingredients.[4] The nation stands at a crossroads – will we capture our share of the growing global protein ingredients sector?

At the conference, ecosystem leaders such as the La Trobe Institute for Sustainable Agriculture and Food and Agriculture Victoria considered how Australia can ensure Australian science translates into a competitive advantage in global plant protein markets. The NSW Government bolstered the conversation around support for exports and investment, launching its new prospectus[5] for plant protein manufacturing in NSW in conjunction at the event. Meanwhile, in the Tasting Hall, attendees experienced Australia's growing plant-protein opportunity first-hand, with more than 40 delicious plant-protein-powered products from local producers.

What was the 'unthinkable'? *Australia has the crops, capability and credibility to move beyond bulk commodity exports and become a preferred supplier of value-added, diversified plant protein ingredients to answer growing global demand. What is needed is coordinated leadership, strategic investment and whole-of-government action, starting with a national taskforce.*

Food Frontier's final takeaways

AltProteins 2025 was designed to move the conversations happening across the sector from inward-looking problem solving to an outward view of the shared impact its industries can deliver – and how clearly articulating that impact is critical to strengthening the market for their products.

The 'unthinkable'? *While the sector includes organisations at both early stages and those with a strong commercial foundation – and produces products with sustainability, health and economic benefits at their core – alternative proteins must move beyond their role as an 'alternative'. What's required is a cohesive narrative and a clear value proposition that demonstrates alternative proteins' role in building Australia's food security, diversifying the economy, bolstering supply chains, and adding value to traditional sectors. Greater collaboration can help the sector articulate a narrative that captures public and private investment – and critically, consumer spend – to take it to the next level.*

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