



Impact Statements Overview

Overview of the impact of DIAL projects undertaken throughout 2007/08

Dairy Innovation Australia Limited (DIAL) was established in 2007 to be a catalyst for innovation in the Australian Dairy Industry. DIAL provides leadership through a cost-effective, responsive and integrated dairy manufacturing R&D effort.

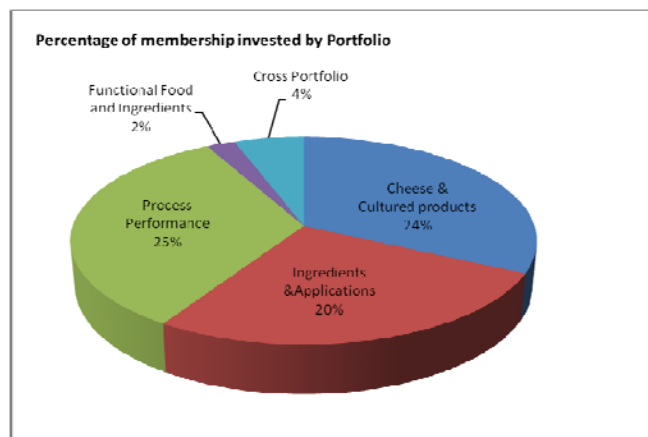
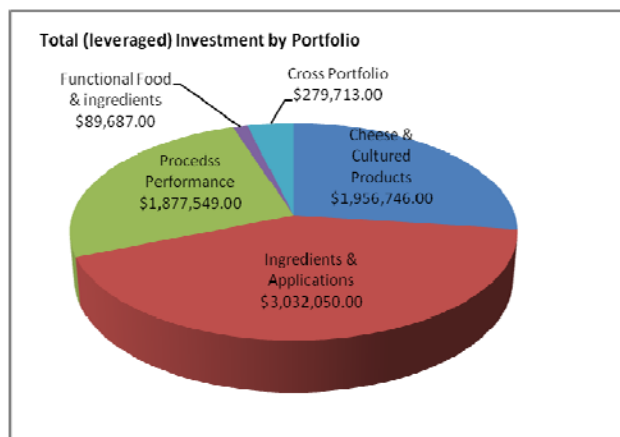
Our strategic objectives in establishing DIAL are to:

- Create high-returning products and markets faster.
- Create smarter manufacturing processes.
- Capture and develop innovative capability.

Our goals are delivered through pre-competitive research as directed by our members, knowledge management and technology transfer, commercial services, and the provision of bulk starter cultures.

This booklet provides members with a snapshot of DIAL pre-competitive research projects.

In 2007/08 membership contributions of \$5.17m were received. More than 75% of this (\$3.93m) was invested directly in competitive research projects.



Overall, R&D investments totalled \$7.24m with \$3.31m (45%) leveraged from non-membership sources.

DIAL operates in four key areas/portfolios:

1. Cheese and Cultured Products/Production.
2. Functional Foods and Ingredients/ Dairy Health and Nutrition
3. Dairy Components, Ingredients and Applications.
4. Process Design and Performance.

1. Cheese and Cultured Products

Strategic intent

To develop knowledge and innovative technologies to allow creation of higher-returning products for markets faster and create smarter manufacturing processes for the cheese and cultured products area.

Expected benefit

The development of technologies and identification of opportunities to significantly improve;

- cheese yield
- flavour and texture to optimise salt utilisation
- optimise culture and cheese safety
- underpin the development of new products or extend current product design and markets
- consistency and characterisation of cultures.

The four concept areas for research investment are: Culture Science and Genomics, Flavour Applications, Microstructure of Dairy Products and Cheese Process Technology.

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Combating phage infections

(Project 06202C - Phage Origins)

This study into phage biology uses state-of-the-art genomic sequencing technologies and bioinformatics resources to understand the epidemiology of the phage infecting Australian dairy manufacturers.

Impact:

- Novel phage management strategies and protocols for the Australian dairy industry.
- New perspective on infectious diseases of industrial fermentations.

Revolutionising assessment of new starter strains

(Project 07211C - Starter Genomics Part 2)

This project will devise more efficient procedures for the derivation of bacteriophage resistance starter strains.

Impact

- Improved product consistency of cheese and of bulk starter inoculums.
- Improved strain selection methods and criteria to revolutionise the assessment of new starter strains.
- Metabolic potential for starter strains better understood.

A unique culture collection for current and future products and processes

(Project 07201C - CC1 – Culture Collections and Resource Development)

This project maintains the culture collection asset by managing and collecting biodiversity.

Impact

- Well characterised collection of bacterial cultures applicable to a range of fermented products.
- Bacterial strains for immediate and future commercial application in cheese flavour control or in investigation of

novel product or process options.

Increasing safety and certainty in culture use

(Project 07202C - CC2 – Implementation of DNA-based Technologies Underpinning Culture Characterisation)

This project supports future development of culture technology within DIAL, with all culture-related projects benefitting from greater certainty in bacterial identification.

Impact

- Precise investigation of product contamination issues and traceability of contamination sources through DNA analysis in a forensic context.
- Adoption and application of DNA-based techniques.

Increasing efficiency and throughput in phage assessment

(Project 07203C - CC3 – Scoping High-Throughput Technologies)

This project independently assesses methods currently used for strain selection, assessment and phage monitoring through data management and bioinformatics; automation and miniaturisation; and sample library format.

Impact:

- New assessment methodologies enabling knowledge-based utilisation of the DIAL culture collection.

Cost-effective, consistent bulk starter cultures

(Project 07205C - FT1 – Improving Bulk Starter Inoculum
Project 07206C - FT2 – Reducing the Cost of Bulk Starters)

These projects will improve preparation of bulk starter inocula evaluation through incorporation of growth additives, neutralising agents and other alterations to growth, leading to more cost-effective growth of cultures with consistent acid production rates, ability to grow to high levels in bulk starter media and improved cheese quality during maturation.

Impact

- Improved product consistency and continued viability and profitability of the industry.
- Establishment of optimal conditions for maximising yield and performance of starter species/strains.
- Reduction in capital costs associated with establishing or upgrading bulk starter preparation facilities through improved bulk starter activity.

Effective culture quality control

(Project 07207C - FT3 – Quantitative Analysis of Mixed Cultures)

This project will develop a rapid and reliable test to differentiate *Lactococcus lactis* subsp. *cremoris* strains found in cheese manufacture.

Impact

- Effective monitoring of culture composition (culture quality control), as part of progress towards consistent culture performance and targeted product flavour.
- Tools to determine culture component ratios.



New product and process options

(Project 07204C - Flavour Technology Transfer)

This study engages member companies to determine the most appropriate areas for flavour technology applications with pilot scale cheese manufacture testing the medium throughput flavour screening predictions.

Impact

- Delivery of new product and process options to cheese and other fermented dairy product manufacturers.

Influencing dairy food structure and texture

(Project 07208C - Curd and Dairy Microstructure)

A collaboration with Melbourne University and the National Food Imaging Centre at Moorepark Food Research Centre, Ireland, this project aims to identify physical properties of curd that can determine cheese and curd microstructure.

Impact:

- Delivery of methods that can influence dairy food structure and texture at a molecular level.
- Next generation processes for functional foods.
- Improved product consistency through control over manufacturing processes.

Flavour control

(Project 07210 - Differentiation and Quantification of lactobacilli in Dairy Systems)

This project develops methods to monitor and evaluate the effectiveness of a range of lactobacilli species used as adjunct organisms in contributing to flavour development during cheese and other dairy product maturation.

Impact:

- Tools to assess and control of adjunct and NSLAB flora in cheese and other fermented dairy products.
- Product consistency.

Tools to predict process changes

*(Project 07212C - The Salting Model
Project 07213C - Prediction Indices)*

A theoretical model to track the movement of salt into cheese in a dry salting situation will be used to predict how changes in cheese making parameters affect salt uptake. Indices will be used to establish if the functional attributes of cheese which determine moisture, salt and 24hr pH during ripening match the predicted attributes.

Impact:

- A unique modelling tool to study and predict the impact of small process changes during dairy product manufacture.
- Reduction in the environmental impact of salty whey disposal.
- Improved product assessment, characterisation and product consistency.

2. Functional Foods and Ingredients

Strategic intent

To develop capability and technologies to allow the creation of new products and markets faster.

Expected benefit

The development of technologies and increased capabilities to;

- understand and maintain the functionality of dairy foods and ingredients.
- substantiate the health benefits and physiological function of the dairy foods and components.

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Links between dairy and cognitive health explored

(Project 07217F - Cognitive Scoping Study)

In its first six months the Functional Ingredients and Food Portfolio undertook a scoping study to assess research into a relationship between cognitive function and health and dairy food consumption. The study identified Australian and overseas research organisations and a number were contacted in the first funding round of the Dairy Health and Nutrition Consortium. The activities of the Functional Foods and Ingredients portfolio have been amalgamated into the consortium's Innovation Stream. The project seeks to demonstrate links to cognitive development, function and health.

Impact:

- Provision of high value background information to implement a new strategic research direction.
- Contribution to the rapid development of a data supporting a hitherto unexplored link between dairy food consumption and cognitive health.

Substantiation of health benefits

(Project 07216F - Dairy Health and Nutrition Consortium)

This project investigates pre-competitive work towards substantiation of the health benefits of dairy, innovation supporting scoping and feasibility studies, and competitive research providing support to member companies.

Impact

- R&D networks in health and nutrition for use by Australian dairy manufacturers.
- New health claims about dairy products, and new methods and biomarkers to measure health benefits of dairy products.

3. Dairy Components, Ingredients and Applications

Strategic intent

To develop knowledge and capability in the functionality, manipulation and application of dairy components and ingredients.

Expected benefit

To provide technologies that deliver a significant increase in dairy industry profit by creating;

- innovative value-add products.
- processes and markets.

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Integrated specialist drying resource

(Project 07101B: Smart Drying)

A collaboration between DIAL, Monash University, INRA, France and University of Queensland to engineer a steep change in the international competitiveness of Australia's dairy powders industry, understanding and predicting optimum drying conditions in spray dryers for existing and new products. This project will examine aspects of spray-drying and fluidised bed efficiency in milk powder manufacture, and develop new strategies for process-mediated control of powder functionality.

Impact

- Improved powder drying technologies.
- An integrated specialist drying resource for the Australian dairy industry and research community.
- Strong links with and between local and international drying research groups.
- Development of high quality students with specialist skills for future positions within the dairy industry.

Model food systems to enhance ingredient functionality

(Project 04201B: Ingredient Functionality in Food Systems)

This project investigates model food systems that use dairy ingredients to develop and maintain knowledge and capability in chemistry, analysis and applications technology.

Impact:

- Enhanced awareness of model food system capabilities, expertise and resources.
- Greater understanding of dairy ingredient functionality in model food systems.
- Access to resources and capabilities and ability to benchmark dairy ingredients in appropriate model food systems.

Strategies to overcome heat stability issues

(Project 05203B - Protein Aggregation in Liquid Dairy Systems)

The application of advanced analytical methods for the molecular behaviour of dairy proteins during heating in complex liquid systems to a build detailed knowledge and understanding of the influence of the molecular environment of milk proteins on their response to thermal processing.

Impact:

- Strategies to overcome heat stability issues associated with processing of fresh and reconstituted dairy products.
- A science platform for improved performance and development of new applications for dairy-based food ingredients.

Processing and formulation strategies

(Project 06202B - Protein Stability in Dairy Powders)

A combined biochemical and materials science approach will be used to determine molecular basis of protein instability in high-protein dairy powders, examining effects of storage, powder solubility and other key functionality attributes, to develop options for new protein-based powdered ingredients and expand collaboration with the University of Queensland.

Impact

- Processing and formulation strategies to prevent the deterioration of physical functionality during powder storage.
- Improvements in the performance and shelf-life of dried dairy powder systems.

- Novel, multidisciplinary approach involving a combination of material science and protein chemistry.



Improved products through strategies to modulate dairy protein functionality

(Project 07117B – Milk Protein Denaturation and Stabilisation at Surfaces)

This project involves the application of nanoscale technologies to understand the key functionality governing protein reactions at the molecular level, in both emulsions and protein films, leading to better performing dairy liquid products, concentrates and powders. The project builds new capability in interfacial science of dairy proteins and develops collaborative links with ANU and Monash University.

Impact:

- Better-performing dairy products through strategies to modulate dairy protein functions in emulsions and powders.
- Increased understanding of the science underpinning the physical functionality of dairy ingredient systems.

Fouling and heat stability of milk products

(Project 05101B - Ionic Calcium and Heat Stability)

This project examines the role of calcium and other minerals in the thermal stability of milk to help solve problems related to fouling and heat stability in milk products. The project will build new collaborative links with the Centre for Dairy Research and the Institute of Food Biosciences at the University of Reading, UK.

Impact:

- Improved understanding of the role of ionic calcium and other minerals on casein micelle stability.
- Control of fouling of heat exchangers, sedimentation and poor heat stability.
- Insight into factors affecting reconstitution properties of milk powders and heat stability of products made from powders.

Improved processing efficiency and ingredient performance

(Project 05202B - Ultrasonic Processing of Dairy Ingredients to Control Protein Aggregation and Promote Heat Stability)

The feasibility of using sonochemical treatments to modulate the physical functionality of dairy ingredients, particularly the transformation of the sulphur-containing dairy proteins, is examined in this project with the view to overcome difficulties currently encountered in thermal processing of whole milk and whey proteins.

Impact:

- Pre-eminent positioning of the Australian dairy industry for the development of valuable, heat-stable and uniquely functional ingredients based on ultrasonic processing and sonochemistry.

Dynamic light scattering for improved physical functionality

(Project 05102B - Powder Rehydration)

This project uses dynamic light scattering and other technologies to develop a better understanding of wetting, dispersion, rehydration and solubilisation processes characterising solubility of skim milk powder and high-protein dairy powders.

Impact:

- New processing and formulation strategies to improve the physical functionality of dairy powders and of reconstituted dairy products.
- Fundamental understanding of dynamic light scattering to produce milk powders with better reconstitution properties.

Greater heat stability for whey protein concentrates

(Project 06201B - Stable Whey Protein Ingredients)

The role of heat and shear processing in the modification and aggregation of whey proteins in industrial processing streams is examined in this project to produce greater heat stability in whey protein concentrates.

Impact:

- New processing strategies for whey protein concentrates manufacture with improved heat stability under UHT processing conditions.

Physical and nutritional functionality modification of dairy proteins

(Project 05201B – Glycation of Dairy Proteins)

This project aims to determine the chemistry of dairy protein glycation in pure solutions and industrial processing streams.

Impact:

- Industrial use of controlled glycation reactions to modify the physical and nutritional functionality of dairy proteins.

4. Process Design and Performance

Strategic intent

To develop knowledge and technologies to create smarter manufacturing processes.

Expected benefit

To deliver innovative solutions to world's best practice processing performance in the dairy manufacturing industry via;

- Significant operational cost reductions.
- Improved utilisation of dairy processing infrastructure.

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Efficiency of milk powder manufacture

(Project 07102P - Target 35)

This project challenges barriers to producing functional powders from high solids concentrates by maximising total solids of evaporator concentrate prior to drying, significantly impacting energy efficiency and powder manufacture productivity.

Impact:

- Increased efficiency of milk powder manufacture by reduced spray drying costs with an expected benefit of \$2m/year.

Tools to drive incremental increases in evaporator efficiency

(Project 07115P - Optimisation of Heat Treatment with NIZO Premia)

To identify opportunities to increase plant total solids, reduce fouling or increase run length this project will evaluate modelling tools developed by NIZO food research for applicability in optimising production processes.

Impact:

- Incremental increases in evaporator efficiency, initially targeting 55% concentrate total solids.

Improved yield and consistency

(Project 07222P - NIZO Understanding Cheese Yield)

The NIZO Premia platform will be used to identify and demonstrate heat treatment impact on cheddar cheese yield and control the degree of whey protein denaturation to improve cheese consistency and increase cheese yields by up to 1%.

Impact:

- Optimised cheese plant preheat treatment to improve product consistency and drive yield improvements.

Strategies for increasing pasteuriser run length

(Project 07218P - Run Length Extension by Biofilm Management in Pasteurisers)

Implementing a novel processing strategy in this study will increase the run length of cheese milk pasteurisers to 20 hours, avoiding the need for a mid-run CIP or duplex equipment.

Impact:

- Control of biofilm growth of thermotolerants in cheese milk pasteurisers.



Alternative technologies for safer milk products

Project 07221P - Scoping Next Generation Preservation Process)

This project will evaluate several technologies that have been or are being developed with the potential to replace or augment traditional heat treatments used in the destruction of pathogenic and spoilage bacteria in milk.

Impact:

Evaluation of a range of non-thermal and alternative thermal technologies for production of milk with equivalent or better safety and quality than conventionally pasteurised or higher heat-treated milk.

Product flavour, functionality and convenience drive new innovations

(Project 07225P - Thermal Processing Technologies)

This project is focused on developing process and product knowledge to support thermal processing of liquid milk formats.

Impact:

- Improved understanding of UHT processes and products and alternatives.

Alternative product safety strategies

(Project 07223P - Evaluation of PEF Technologies)

The feasibility of Pulsed Electric Field (PEF) technology in combination with conventional heat pasteurisation for more effective microbial control in dairy processes is examined in this project.

Impact:

- Additional process to enhance microbial inactivation at mild temperatures while maintaining product functionality.

Food safety capability maintained and strengthened

(Project 07220P - Gap Analysis of Food Safety Requirements)

This project seeks to establish and maintain food safety issues awareness within DIAL and its member companies by maintaining regular contact with food safety organisations, industry conferences and literature reviews.

Impact

- Building capability for member companies on food safety issues and food safety expertise/capability.

Water Savers

(Project 07226P – Water Recycling Guidelines for Dairy Processors)

This project seeks to work with the dairy manufacturing industry to develop a risk management framework and technical guidelines to encourage the use of recycled water that is fit for purpose.

Impact:

- Technical guidelines on fit-for- purpose water reuse.
- Best practice benchmark established.
- 25% reduction in potable water use across the industry.
- Increase in recycled water applications.
- Positive, proactive image of the dairy industry presented to regulators and government.



Energy Savers

(Project 07219P – Energy Efficiency Advisor to the Dairy Industry)

This project provides DIAL member companies with a technical resource to support collective energy assessment requirements, to help identify priority areas for energy-efficiency projects and provide a cost-benefit analysis of options.

Impact

- Expertise and leadership to identify and quantify energy-efficiency opportunities using the EEO program framework.