Project Update

P9c: Adding value to dairy waste

July 2024

What a waste

In Australia, about 8% (about 710,000 tonnes/year) of total on-farm milk production is discarded as waste. Most of this wastage occurs post farm gate, for example at processing, distribution, food service and consumer stages of the supply chain.

The effect of this wastage is not just economic; it also has an impact on the environment and food security.

Although some efficiency could be gained by reducing total waste, it is also possible to turn what would be wasted into a valuable product. For example, dairy waste can be recycled and repurposed using existing methods such as reverse osmosis, drying, hydrolysis, ultrafiltration, and electrodialysis.

Fermentation

The Dairy UP team is investigating fermentation opportunities to convert dairy wastes into value-added products with an existing commercial market. Fermentation uses microbes such as yeasts to convert dairy wastes into valuable products.

Getting more from milk

Milk underpins the dairy industry. Getting more from this precious commodity has the potential to increase its value throughout the supply chain.

The Dairy UP team is investigating novel ways to get more value from milk.

There are three elements to this research:

P9a: Producing milk with less lactose

P9b: Milk as an indicator of heat load

P9c: Adding value to dairy waste

This document provides an overview of P9c.

Fermentation is cost-effective, can generate new income streams for farmers and processors as well as reducing waste.

Fermentation can produce a range of compounds, including stockfeed supplements.

Research approach

The project involves four key activities:

- **Review** dairy food wastes in Australia and overseas and identify those with the greatest opportunity for reduction; identify potential products that could be made using microbial fermentation.
  Progress status: in progress.
- **Pilot studies** to develop yeast strains capable of producing valuable compounds from dairy waste.
  Progress status: in progress.
- **Determine the viability** (technical and economic) of achieving products in the quantities required by commercial markets.
  Progress status: in progress.

- **Upscaling the process** for commercial implementation.
  Progress status: not started.

Opportunities

The review identified a wide range of wastage occurring along the production chain. It also identified promising opportunities to use fermentation to reduce wastage.

On farm opportunities

There are opportunities to use fermentation to create value added products from excess colostrum, milk with abnormal composition, and milk from cows treated with antibiotics (e.g. for mastitis).

For example, waste milk could be used to produce microbial protein (also called single-cell protein) as an animal feed or ration additive to improve digestive efficiency.

It may also be possible to use yeast to degrade antibiotics present in waste milk, and then feed the antibiotic-free milk or by-product to calves, thus preventing the development of antibiotic resistance.

Processing/manufacturing

Manufacturing waste makes up 70% of all dairy food waste in the supply chain (Dairy Australia, 2023). The main sources are by-products of milk processing, especially cheese whey, and waste generated during start-ups, shutdowns, equipment cleaning, accidental spills, and wastewater sludge. Additionally, finished products that do not meet specifications or lack sufficient shelf life also contribute to manufacturing waste.

There's potential to use microbial fermentation to convert expired milk, cheese whey and other by-products into bioenergy, enzymes, organic acids, biopolymers and biomass.

The initial lines of investigation are:

- Onfarm: milk from antibiotic treated cows.
- Processing: whey waste.

Yeasts

The Dairy UP team is focussing on fermentation using brewer's or baker's yeast (*Saccharomyces cerevisiae)* which is safe for humans and animals. Yeast is already widely used for fermentation so processes and equipment are readily available. There are also existing paths to market for the end products.

Lactose is a key component of dairy wastes, so the focus is on developing yeast that can grow on lactose.

The team has identified opportunities to use yeast fermentation of lactose in dairy waste to produce:

- Functional milks that are high in specific compounds that could be used as dietary supplements in the cow's diet.
- Enzymes and binders that reduce human and animal health risks such as mycotoxins in stockfeed.
- enzymes and organic acids that improve stock feed quality.
- supplements that optimise cow nutrition (e.g. proteins, amino acids and probiotics).
- Production of ethanol as a biofuel.

Determining the viability

Researchers at Macquarie University's Genome Foundry are using state-of-the-art synthetic biology technology to develop yeast capable of efficiently fermenting lactose to produce valuable compounds.

As a proof-of-concept, yeast strains engineered to produce provitamin A from lactose. Provitamin A is a precursor of vitamin A, has antioxidant properties and is widely used as a dietary supplement for humans and stockfeed.

The next step is to develop yeast that grows directly on milk (rather than lactose which was used in the proof-of-concept study).

Results to date have been encouraging, indicating that it should be possible to refine the approach to fermenting directly from whey.

DairyUP
Unlocking potential

Next steps

Once the approach is validated it can be used to develop a range of yeasts capable of transforming dairy waste into a range of valuable products.

Collaborators

The P9c project is a collaboration between Dairy UP, Macquarie University's Australian Genome Foundry and NSW DPI.

Read more

Dairy Australia 2023; Dairy sector food waste action plan.

More info

Juan Gargiulo
NSW DPI
juan.gargiulo@dpi.nsw.gov.au

Briardo Llorente
Australian Genome Foundry, Macquarie University
briardo.llorente@mq.edu.au

Delivery organisations

The University of Sydney Dairy Research Foundation | NSW Department of Primary Industries | Scibus | Dairy Australia

Partner organisations

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