Project Update
P9a Producing milk with less lactose

February 2025

Unlocking the potential of cows

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 P9

Climate change is increasing pressure to produce food with less water. As milk is 87% water, producing milk with less water is an opportunity for the dairy industry to improve its carbon footprint, reduce energy costs and improve water use efficiency. This could create more value and profit along the supply chain.

This project aims to find ways to produce cows' milk with high concentrations of solids.

Lactose is the focus of this work as it plays a key role in determining milk's water content.

The project is investigating the theory that those cows that produce less lactose would produce milk with less water and higher concentrations of solids.

Potential benefits

Lactose has broad roles in the physiology of the dairy cow, which means the potential to influence lactose production has a wide range of potential benefits.

Animal performance, health and welfare
It takes a lot of energy for a cow to produce lactose so reducing the production of lactose could improve the energy balance of the cow, especially during the transition period. Improved energy balance could also have a role in reproduction and fertility.

Lactose is also associated with some animal health traits. For example, milk lactose content could be used to monitor or detect mastitis and ketosis in dairy cows.

Farm labour
If reducing lactose production means cows produce milk containing less water, it may be possible to reduce the frequency of milking. This could provide a labour-saving opportunity.

Processing and transport
A reduction in milk volume could also lead to more efficient transport – carting less water or volume overall – and gains in the processing sector.

This project

This project builds on earlier work in California led by Dairy UP collaborator Prof Russ Hovey that demonstrated it is possible to reduce the lactose

in milk production without negatively affecting the total milk solids output. To identify potential management interventions to reduce lactose production, DairyUP researchers are investigating the factors that influence lactose secretion in the cow, for example milk composition, genetics and environmental conditions.

There are two elements of this project. The first project is investigating the impact of genetics and other management or environmental influences. It involves analysing data from Dairy UP monitor farms, NSW herd test results and DataGene's Central Data Repository.

The second is research to better understand lactose synthesis in the dairy cow and how it is regulated. This work is being undertaken at the University of California, Davis, USA.

Genetic, management and environmental influences

Results to date show significant variations across breeds, lactation stages, parity (number of calvings) and seasonal conditions. Researchers have been able to identify cows that consistently produced milk with reduced lactose content or lactose yield while maintaining similar fat and protein levels.

These findings indicate there could be opportunities to improve milk production efficiency by enhancing milk composition and reducing water content.

Research approach

This work involved examining datasets of herd records, genetic data for dairy sires and meteorological records. Spanning 14 years (2008-2022) the dataset included 393,772 herd records from 33,280 cows in 85 herds, representing 5% of the NSW herd records.

The following summarises some of the high-level findings about the factors affecting lactose production in Australian dairy cows.

Parity (number of calvings)

The lactose percentage was higher for heifers throughout their lactation but their total lactose yield wasn't.

Stage of lactation

Stage of lactation had a strong impact on lactose output, peaking in early lactation and decreasing as the lactation progressed (similar to the milk yield curve).

Seasonal conditions

Hot, humid weather negatively affected yield of milk, lactose and milk solids but it did not affect lactose percentage or other milk components. A decline in milk yield lactose yield and protein yield coincided with severe drought conditions from 2016.

Breed

Holsteins had the highest lactose yields. Jerseys had the lowest lactose yields produced more milk solids per unit of lactose. This finding wasn't surprising given that Jerseys are well recognised for producing milk with higher concentrations of solids for a given volume of milk compared with other dairy breeds like Holsteins.

Genetic link

Building on these findings, DairyUP researchers uncovered a genetic link for the NSW cows that produce less lactose.

Investigation of bull Australian Breeding Values (ABVs) demonstrated low lactose producing cows were descendants from 13 sires (mostly Jerseys).

All the daughters (or descendants) of these sires produced a similar milk yield, but with more fat, and showed a trend towards lower protein production. There was no difference in daughter fertility.

Implications

These findings highlight the potential for selective breeding for cows that produce less lactose and more milk solids and less milk volume.

The findings also highlight the potential to develop management strategies to influence lactose production and enhance the milk production efficiency of cows and potentially reduce their environmental impact.

Lactose synthesis

A ‘proof of concept’ study has shown it is possible to change the proportion of lactose in milk without affecting fat and protein production.

The study involved Holsteins in a total mixed ration farming system that were on their second calf and at peak lactation.

It demonstrated that a single treatment with the drug dexamethasone temporarily reduced the amount of lactose in the cow’s udder. Fat and protein production increased in response to the treatment as milk volume decreased.

The team has uncovered a possible explanation for this finding. Advanced genetic testing pointed to a regulatory molecule involved in lactose synthesis (alpha-lactalbumin) that was suppressed by the dexamethasone treatment

This finding offers new insights for researchers to better understand the factors regulating milk yield (volume) relative to the fat and protein content which could lead to interventions. This work was published in Frontiers in Genetics (https://www.frontiersin.org/journals/genetics/articles/10.3389/fgene.2022.1072853/full)

Next steps

The next phase will involve working with Dairy UP farm data and additional data from NSW farms to conduct an in-depth analysis of cows that have shown reduced lactose production and milk volume and higher milk solids.

Collaborators

This project involves collaboration between Dairy UP researchers based at the University of California Davis (USA), DPI NSW and the University of Sydney. A large proportion of the herd records were provided by DataGene.

Read more

Gargiulo, J.I., S.C. Garcia, and R.C. Hovey (2025) Sources of Variation Underlying the Production of Lactose by Dairy Cows https://https://www.journalofdairyscience.org/article/S0022-0302(25)00068-2/fulltext

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