

CASE STUDY



The cooperative at the cutting edge of livestock genomics

Livestock Improvement Corporation (LIC) is an agritech and herd improvement cooperative dedicated to the delivery of superior genetics to the dairy industry.

Headquartered in Hamilton, New Zealand, LIC is a world leader in pasture-based dairy cattle genetics and a driving force behind New Zealand's globally admired dairy industry.



1.5 million
animal samples
tested each year

To support its genetic improvement and herd health programmes, LIC laboratories analyse over 1.5 million animal samples each year, including milk, serum and ear punches.



500,000+
samples for
identification and
genomic evaluation

This includes over 500,000 samples for parentage identification and genomic evaluation tested by LIC's Genemark team using Illumina's Infinium chip-based genotyping technology.

In order to meet the growing needs of their clients, the Genemark team employs the latest automation equipment, including magnetic pillar-based DNA extraction instruments and high-capacity liquid handlers.

Operational, environmental and cost-control challenges in an evolving landscape



With the growing importance of herd efficiency, New Zealand's dairy industry has increasingly relied on cost effective genomic tools in it's farming practices.



This created pressure to increase laboratory sample throughput, while maintaining low costs for farmers in a challenging environment of inflation and a tight labour market.



Despite effort put into programmes such as washing and reusing of plasticware, the LIC laboratories continued to push for a reduced environmental footprint.

In order to address these challenges, LIC's scientific team identified three important **objectives**:

01

Boost operational efficiency to increase sample capacity without adding additional resources

02

Reduce the environmental impact of laboratory activities

03

Reduce the cost of laboratory workflows by increasing efficiency and reducing material costs

LIC spoke to Azora Biosciences to see if they could develop a custom DNA extraction kit

A custom kit development process focused on clearly defined goals

Discovery Phase

Bringing together leading scientists from Azora Biosciences and LIC to define the challenges, objectives and opportunities



During various levels of COVID restrictions, LIC and Azora Biosciences held discovery meetings via video conference. LIC shared a detailed overview of their operation from sampling through to data analysis and talked us through their goals and challenges.

LIC used the 2D barcoded, Allflex tissue sampling units (TSU's) for ear punch sampling of dairy cows. These allowed for reproducible sampling into liquid preservative.

They used automated reagent dispensers to prefill extraction plates and a combination of 96 and 384 position magnetic pillar extraction instruments to perform magnetic bead-based DNA extractions.

As part of an ongoing commitment to manage the environmental impact, LIC had validated a process of washing and reusing deep well DNA washing plates, allowing for reuse multiple times.

Purified samples were processed using custom DNA chips on the Illumina Infinium platform with automated liquid handlers to reduce manual handling and ensure repeatability. Genomic data was then checked and results, including parentage information, was loaded into MINDA, LIC's web-based herd management system.

Development Phase

The Azora Biosciences team develop a custom DNA extraction kit to deliver on LIC's objectives

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Project objectives were clear from day one, which was great. Performance parameters of DNA yield and purity, plastic use, reagent cost per extraction, and operational efficiency were front-of-mind during development. A highlight for me was developing and trialling numerous chemistries to identify a novel, single-wash buffer, that increases extraction speed and reduces plastic waste.”

Dr. Denver Britto
Development Scientist
Azora Biosciences



01

Development Phase 1: Mapping out the Project Objectives



Creation of an extraction system with fewer processing steps, therefore reducing the hands-on time of the technicians, cost and plastic waste.



Development of two workflow configurations allowing the processing of all sample types from the same reagents. This would simplify the process to increase operational efficiency.



Reducing the volumes of reagents used per extraction, thereby reducing the overall cost per extraction and minimising environmental impact.

02

Development Phase 2: Workflow Modelling



LIC's workflow was modeled in the Azora Biosciences laboratory with assays established to measure the performance characteristics of the DNA outputs.

Assays included micro-spectrophotometry, fluorescent DNA quantification and dilution PCR to estimate the purity of the eluted DNA sample.

Combined, this assay set provided a comprehensive profile of the extraction performance, which guided the development process.

03

Development Phase 3: Chemistry Development

Azora Biosciences' library of reagents, enzymes and magnetic beads was used to create a range of potential DNA extraction systems. By trialling each one with the model workflow and characterising the output DNA using the performance assays, the development team identified a guanidine-based system with 500nm silanol-grouped magnetic beads. These performed well for all of the sample formats received by the laboratory.

The Azora Biosciences team then focused on the challenge of reducing the number of steps in the extraction from five to three. This was achieved by developing a novel wash buffer that produced clean DNA from a single wash step, rather than the usual three.

Finally, a kit format was established to support LIC's objectives to reduce waste and improve operational efficiency. Kurt von Keisenberg, LIC's laboratory Team Leader, suggested pre-measured reagent volumes allowing the technicians to simply pour bottle A into bottle B, and then load into the plate dispensers, simplifying the process. The reagents were provided in glass bottles which would be returned to Azora Biosciences for reuse, reducing plastic waste.



A customised solution that delivers on the objectives

Azora Biosciences created a high-quality custom DNA extraction kit designed to improve operational efficiency, cost control and environmental impact outcomes. Specifically this helped the LIC's team by:



Producing high-quality DNA with high pass rates on the Illumina microarray platform.



Reducing DNA wash steps from three to one, without impacting DNA purity or yield.



Providing pre-measured buffer volumes to save manual liquid handling.



Providing fully prepared buffers, saving the need to add additional reagents.

DNA quality data for samples extracted with the custom kit

Measurement	TSU Sample
DNA concentration	380 ng/ μ l
Average 260:280 Ratio	1.88

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In a high-throughput lab such as ours, reduction or elimination of preparation and process steps soon adds up to significant time savings, especially where that time is hands-on.

Likewise, any reduction in plasticware going to recycling or landfill is a welcome addition to our carbon footprint reduction efforts. The custom kit from Azora Biosciences has enabled us to make significant improvements in both areas.

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**Mark Walker,
Genemark, LIC**

Measurable outcomes set a new standard for the laboratory



**260 HOURS OF
LABOUR SAVINGS
PER YEAR**

With innovations including reduced washing steps, pre-mixed and fully prepared reagents the custom kit provides an estimated 260 hours of labour savings per year



**565kg
PLASTIC
WASTE SAVING**

Customised, reusable product packaging, combined with reduced washing steps leads to a reduction of over 565kg of plastic waste to landfill



**5,719 kgs
OF CARBON
DIOXIDE**

Reductions in the total weight of kits, and local manufacturing is estimated to save 5,719 kg of Carbon Dioxide equivalent emissions



COST SAVINGS

Significant total cost savings across the extraction workflow, including reagent and labour costs

The Future

A number of innovations have been identified with the potential to further support LIC's objectives. These include lyophilisation of reagents and reduction in extraction volumes to allow for smaller volume plates and the removal of expensive deep well plates that make up a significant percentage of laboratory waste.

As LIC adapts to changes in their landscape, and new pressures and challenges are presented to the laboratory teams, Azora Biosciences will continue to use their custom development capabilities to support LIC in achieving its goals.



azora

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