

Rapid freezing for milk

TIM FULTON

INTEREST in non-bovine dairy is growing as farmers look for ways to reduce risk in their businesses.

Until recently most New Zealand sheep and goat milk platforms have tended to be far-flung.

Animal numbers and milk volumes are typically low in the early stages of a sheep or goat-milking operation, potentially making processing unfeasible.

As more farmers consider milk sheep or goats on a standalone basis or alongside bovine dairying there is growing interest in novel ways to store milk for processing and marketing further afield.

Smaller herd milkers typically supply local cheese-makers who might want to buy milk only once a week.

Some, wanting to stabilise their product, resort to freezing the milk, perhaps in pails or two litre bladders that are stored and transported for domestic use or exported to yoghurt and cheese manufacturers. Using the conventional method of freezing milk, done slowly and in bulk, its quality deteriorates when it is stored.

To help overcome issues with slow bulk freezing researchers at Massey University and GNS Science, led by Professor Richard Archer, have developed a rapid freezer to enable non-bovine milk to be stored for long periods without jeopardising quality.

This new rapid-freeze technology allows milk to be aggregated until



Milk from animals other than cows is giving people a chance to try new products.

Photo:
Chris Williams

“ Post freezing product applications include cheese, powder, yoghurt and ice cream. ”

volumes are large enough to be sold for processing.

Though the focus of the rapid freezing project is sheep milk, the technology is suitable for other non-bovine milks including goat and deer and also for non-dairy liquids such as fruit juice and smoothies.

Archer's team is investigating how and why freezing milk affects quality and is using the knowledge gained to design a simple, affordable freezer system suitable for on-farm use.

They have found the most important factors for thawed milk quality are the speed of freezing, final storage temperature and storage time.

Best quality is achieved when freezing is as fast as possible – within a minute or two – when the frozen milk is kept as cold

as possible, below -20C, and the storage time is minimised to weeks rather than months.

Rapid freezing followed by storage at temperatures below -20C can maintain high milk quality for months though some kinds of milk are more sensitive to freeze-thaw than others.

The unit being designed for on-farm or near farm use is likely to have a 1000-litre capacity. A day's production would probably fill half bins flat out.

Rapid freeze technology allows farmers to store milk for multiple days. It also makes it possible to take the freezer to the milk – it works well with a mobile milking platform – so two or three farmers could share a freezer and collect milk till they have sufficient volume to send to a drier such as the one at FoodWaikato.

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Post freezing product applications include cheese, powder, yoghurt and ice cream.

Now the rapid freezing technology is developed Archer's team is working with a New Zealand company to develop a freezer that is simple to operate, robust and requires minimal labour input. Ensuring the equipment complies with relevant regulations is also a major consideration.

It is hoped the new freezer will be available to buy in the next year.

How the speed of freezing affects milk quality

FREEZING milk creates ice crystals.

During storage, water molecules that normally lubricate proteins migrate from the proteins to the crystals.

That forces the proteins to stick together and lose solubility.

When you freeze milk fast you create lots of tiny ice crystals that trap proteins.

Even if those small bits of protein lose solubility over time they will make only tiny, soft flakes.

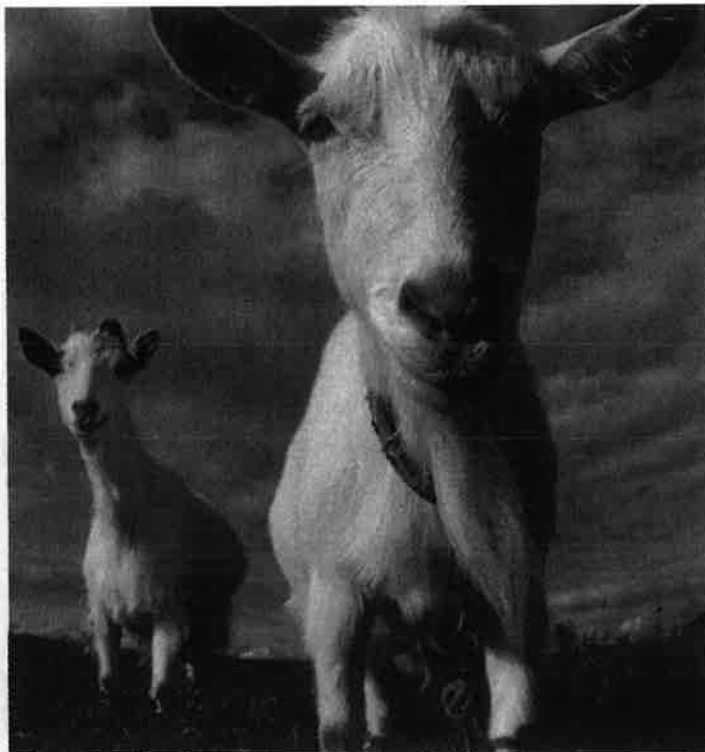
On thawing the liquid still behaves like fresh milk.

In contrast, freezing milk slowly produces a small number of big ice crystals, which crush all the proteins together. Once the proteins have stuck together in a big lump it might not be possible to completely reconstitute them during processing.

If milk has been frozen quickly, less damage is accumulated during storage.

Furthermore, the colder you store it and the shorter time you store it for means less damage accumulates. And, importantly, if you freeze and store the milk ice in small lumps it can be thawed really quickly, giving bugs little time to grow. Pails and bladders can take a long time to thaw.

The rapid freezing work is being done as part of the Food Industry Enabling Technologies project, funded by the Ministry for Business, Innovation and Employment.



The Rapid Milk Freezer Project led by Massey University to commercialise a milk freezing unit promises to expand the country's supply chain for goat, sheep and deer.

Gold for goat milkers

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DEVELOPERS of rapid milk freezing for aspiring goat-milkers have struck gold in their quest for on-farm storage to expand the industry.

Most producers rely on collection and processing by the Waikato-based New Zealand Dairy Goat Co-operative, which is brimming with milk and reluctant to accept new suppliers.

Blenheim-based engineering firm Cuddon Freeze Dry is working with technology pioneers to store frozen milk in small pellets till it can be thawed for further processing and sale.

The Rapid Milk Freezer Project led by Massey University promises to expand the country's supply chain for goat, sheep and deer milk. Cuddon has a licence with Massey and its partners to commercialise a milk freezing unit.

The key to a commercial roll-out is making the gear the right size for farms, Cuddon chief executive Andy Rowe said.

Cuddon does mechanical engineering work and has specialist irrigation, refrigeration and freeze dry divisions. Most of its driers are exported.

Rowe expects a commercial product to be ready for farmers in a few months.

Massey University research team leader Professor Richard Archer said all its work freezing and thawing milk has one

purpose: to develop a rapid freezer for use on or near farms in NZ. Cuddon is just the right partner for the work, he said.

"Here, we have struck gold.

"After prototyping several approaches we have found one which meets all our criteria. It is simple, compact and affordable."

Cuddon is designing and building the first commercial prototype for a particular sheep milk producer. Another potential 10 buyers are lined up for the next units.

Cuddon's system is also applicable to frozen goat and deer milk.

A number of companies and industries showed interest in the units as the Massey team's work became more public, Archer said.

"As people start to consider how they might reduce fossil fuel use in favour of renewable energy a switch from thermal drying to electrical freezing is starting to look more attractive to some."

The Rapid Milk Freezer Project is part of Food Industry Enabling Technologies (FIET), funded by the Ministry for Business, Innovation and Employment.

FIET supports new process developments that can add significant value to the economy.

The programme has six partners, Massey University (the host), Riddet Institute, Auckland and Otago Universities, Plant and Food and AgResearch. Funding is \$18m over six years until 2021 for pre-commercialisation activities.