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Producer Research Support

Meat Sheep 2000 Advanced Reproductive/Genetics Technologies

Working closely with Peter Speck, Simon Walker, Jenny Kelly, Katrina Hartwig and David Kleeman at the SARDI Turretfield Research Station in South Australia, the Meatsheep 2000 Advanced Reproductive/ Genetics Technologies group set out to test the Juvenile Invitro Embryo Transfer (JIVET) technology commercially.

JIVET has been successfully moved from research to a commercially viable artificial breeding technology as a result of this Producer Research Support project.

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The project

The JIVET technology, pioneered through the South Australian Research and Development Institute (SARDI), involves the harvesting of eggs from young female sheep and then fertilising them with semen from elite rams.

Juvenile females can show a big ovarian response to hormones. This response occurs within a narrow time frame (optimally 6–8 weeks of age). The result is a massive increase in ovarian follicle growth and development. Unlike adult sheep, however, these follicles seldom ovulate and immature eggs (oocytes) are harvested in a small surgical procedure.

The collected eggs are matured and fertilised in a laboratory. The resulting embryos are transferred to synchronised recipient ewes.

The technology has major implications for genetic improvement and 'genetic recovery programs' in flocks affected by disease.

The idea behind JIVET is to speed genetic gain and reduce disease risk, both of which are limited by current reproductive technologies that are at times unreliable and expensive, with the benefit confined to a small population of animals. This was exacerbated by geographical isolation from technology centres.

"The dissemination of diverse, superior genetic material to the industry is presently slow and the vehicle for it is localised and limited by present breeding programs," said group member Neil Weichert, Bethelrei, Kapunda, South Australia.

Neil said the problem faced was one of logistics in collecting genetic material and then being able to apply the technology to multiply that genetic material in sufficient quantities. At the time of this Producer Research Support project, the JIVET technology was not available commercially and its viability as a breeding option had not been proven.

Objectives

1. Train all members in running a successful JIVET program;
2. Determine the commercial viability of a JIVET program as a means of rapidly increasing genetic gain (20+ index points) as compared to existing industry best practice, currently 10–12 index points per annum and breed average annual gain of 4;
3. Increase the input from elite females within individual contributor flocks. Through using JIVET the breeding potential of these elite performing ewes can be extended from a maximum of 10 progeny to 20+ progeny within 12 months;
4. Establish cost benefits of JIVET in the open marketplace and measure by dollar cost to the sheep seedstock industry and subsequent take up of this new technology; and
5. Fully utilise genetically elite animals by decreasing the generation interval. The aim is to use rolling JIVET techniques to produce three generations for every one generation under existing breeding programs. Measured in months of reduced genetic interval.

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Key points

- Genetic recovery programs in flocks affected by disease is now possible.
- Improved understanding of the logistics needed to implement a major artificial breeding program.
- JIVET hailed as an exciting and practical breeding tool through its potential to produce large numbers of elite progeny, rapid genetic gain and disease risk management.
- With more refinement JIVET has the potential to provide batches of consistent sires for direct commercial production.

What was done

Donor ewes were identified from high accuracy elite ewes in participating flocks. Progeny for oocyte (egg) collection were identified in April–May 1999 on mid-parent EBVs, genetic diversity and birth weight through the LAMBPLAN database, and then visually appraised. Sires were chosen on performance and visual traits.

Two days of oocyte collection from 30 lambs, six to 12 weeks of age at time of collection, was scheduled for New South Wales. The logistics of organising and time-tabling the transfer of oocytes from collection on-farm to the fertilising laboratory in South Australia via connecting flights included contacting airline security for transporting live oocytes without going through security x-ray scanners. The collected oocytes must be fertilised within 18 hours of collection.

What happened?

Mr Weichert said among the many positive outcomes from the project was the development of mating reallocation strategies for the varying number of oocytes collected per donor lamb. This included multiple sires to one donor and a huge breakthrough in redefining performance accuracies in females.

"The potential progeny numbers, genetic gain achievable, and the disease risk management provided by JIVET makes this technology an exciting and practical breeding tool for future use by the sheep industry," explained Mr Weichert.

The project produced more than live lambs – it resulted in the training of vets in NSW and SA in JIVET technology; identified many key areas requiring further research into breeding technology and provided industry with a practical example of genetic 'rescue' technology; and it also added a new dimension to Total Genetic Resource Management (TGRM) – enhancing the rate of genetic gain.

The group used TGRM to select candidates - a tool they had not previously used.

"We challenged the application of this technology to adapt to JIVET, with multiple births to different sires and varying ovulation rates from candidates."

Despite the successes, there were downsides. Mr Weichert said about 10% of JIVET donors did not recover properly from the stresses of surgery associated with JIVET. About 15% of donors may not conceive a natural pregnancy as a result of their JIVET surgery.

In this early stage of the technology, of about 800 oocytes collected, 350 turned into embryos of varying quality. Of those implanted, 120 turned into lambs. This equates to four lambs per donor.

"We expect to see vast improvements in survivability as the technology is finetuned."

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Producer Research Support

MLA Producer Research Support offers support funding of up to $15,000 over three years for groups of producers keen to be active in on-farm research and demonstration trials.

These activities include:

- Producer Initiated Research and Development
- More Beef from Pastures demonstration trials
- Prime Time Wean More Lambs demonstration trials
- Sustainable and productive grazing grants.

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Discussion

The biggest limiting factor in the commercialisation of JIVET was the cost of the procedure. Mr Weichert said the collection of weight and scan data essential for LAMBPLAN was also difficult because:

- the lambs were only eight weeks old at surgery;
- some donor weights and scans after JIVET collection were affected by the lamb's ability to recover from surgery and its associated side effects; and
- the recipient ewes that carry and birth the progeny are considered an equal group in their ability to mother the lambs. Participants do not believe this is the case.

He said the project had immediate benefits for the Australian lamb industry by providing LAMBPLAN with an intensive resource and data collecting point. This allowed the leading edge genetic profile to refine its predictive accuracies and correlate defined breeding traits.

"This will be an important benchmarking area in supply chains and widen the role this agency now plays in the seedstock area," said Mr Weichert.

Mr Weichert said the project proved the technology could be used anywhere, with fertilisation still being carried out at a central point. The group found that initial harvest rates of oocytes were variable, as well as the fertilisation rates of embryos. The ability to test for quality semen was also variable and needed refinement.

"In subsequent work we have endeavoured to address these problems. The commercial application of JIVET required the ability to freeze embryos. This would allow implanting and birth of lambs during optimal seasonal conditions."

The group found that using JIVET as a tool to promote genetic merit and promote a group of animals with genetic diversity surpassed expectations.

"We achieved the expected outcomes," said Mr Weichert, "and in addition, we promoted JIVET as an artificial breeding (AB) technique within the stud community and identified the capacity of JIVET to play an important role in genetic recovery programs in flocks affected by OJD and other diseases."

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Next steps

The group has continued to develop a nucleus flock using JIVET techniques.

"With each round of JIVET, protocols are scrutinised and developed. As producers, we have worked closely with the technical staff in identifying weaknesses in the technology and refining its commercial application," said Mr Weichert.

He said some of these problems were inherent in all AB systems, particularly the variation of ovulation rates from donors and the performance of semen.

"Today, JIVET is commercially accessible. Without the cooperation of all parties, JIVET would still be research only. The lamb industry would gain from the acceleration of genetic merit achievable through JIVET.

"With more refinement, JIVET, coupled with professional breeding programs, will provide larger numbers of diverse lines of elite sires to stud breeders. It has the potential to provide batches of consistent sires for direct commercial production."

MLA also recommends

Sheep Genetics Australia

Sheep Genetics Australia (SGA) is the national genetic evaluation service for the Australian sheep industry. It is built around the world's most comprehensive sheep genetics database, and will deliver genetic information on a fee-for-service basis.

Tel (02) 6773 2493 or
www.sheepgentics.org.au

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