

JULY 2026

Sheep reproduction RD&A alert

This sheep reproduction RD&A alert is an initiative of the Sheep Reproduction Strategic Partnership (SRSP).

The [May 2026 MLA and AWI Sheep Producer Intentions Survey](#) indicates that sheep producer confidence has rebounded strongly, supported by high sheepmeat prices and improving wool markets.



Sentiment towards sheepmeat remains exceptionally strong, while confidence in the wool sector has undergone a dramatic turnaround after several years of weaker outlooks.

Despite ongoing challenges such as dry conditions in parts of southern Australia and rising input costs, producers appear more optimistic about the next 12 months and are showing greater confidence in the profitability of both wool and sheep production.

The improved outlook is being reflected in flock intentions. Sheep producers are forecasting a modest increase in breeding ewe numbers over the coming year, reversing the decline anticipated in last year's survey.

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Wether numbers are also expected to grow, with producers signalling stronger retention and rebuilding intentions. Overall, the survey suggests the industry is moving from a period of caution and contraction towards one of stability and gradual flock growth, underpinned by favourable market conditions and renewed producer confidence.

The SRSP aims to help sheep producers to profitability and sustainably increase lamb production through increasing lamb survival and weaning rates and will coordinate a national approach to improving sheep reproductive performance.

Review papers

The current status of artificial reproductive technologies in sheep

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Journal of Reproduction and Development, Volume 72, Issue 3 **OPEN ACCESS**

DOI <https://doi.org/10.1262/jrd.2026-012>

Abstract

Artificial reproductive technologies (ARTs) are central to genetic improvement strategies in livestock, yet adoption remains inconsistent across species. In sheep, uptake has lagged behind that of cattle due to species-specific reproductive biology, variable oocyte and embryo competence following use of exogenous

hormones, economic feasibility and inconsistent success rates. This review synthesises the principles, methodological development, and contemporary performance of semen collection and cryopreservation, artificial insemination (AI), multiple ovulation embryo transfer (MOET), and in vitro fertilization and embryo production (IVF) in sheep, and integrates insights from a global survey of commercial sheep artificial breeding providers (68% response rate; N = 41) on the current size and scale of the industry. It also collates data on optimisation studies working to improve success rates in these technologies. Survey data reveal marked heterogeneity in semen processing practices, cryopreservation method, extender use, insemination dose preparation, and oestrus synchronisation protocols. Laparoscopic intrauterine AI remains the predominant technique, yielding a global weighted pregnancy rate of 71%, despite substantial site, sire, and operator-dependent variation. MOET is widely implemented, producing an average of 6–8 transferable embryos per donor, with fresh embryo transfer outperforming frozen–thawed embryos across global regions. In contrast, IVF in sheep continues to face technical and commercial constraints related to oocyte recovery, in vitro maturation, and blastocyst development. Collectively, this review highlights critical opportunities for standardised semen assessment, optimised hormone protocols, advanced predictive analytics, and targeted commercialisation of ovine IVP systems to enhance reproducibility, efficiency, and genetic gain within the global sheep artificial breeding industry.

Glycine as a metabolic regulator of reproductive function in livestock: From gametes to early embryos

Yuxin Teng, Chenjun Wang, Yingjie Wu, Chang Yan and Yinghe Qin

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Simple Summary

Glycine is a simple amino acid that performs many essential jobs in the animal body. Although its roles in maintaining general health are well known, its importance for animal fertility is often overlooked. Poor oocyte quality, reduced sperm function, and early embryonic death are major causes of reproductive failure in pigs, cattle, sheep, and poultry, leading to substantial economic losses in livestock farming. This review summarizes current evidence on how glycine may influence reproductive cells and early embryos. Available studies suggest that glycine can help maintain redox balance, mitochondrial function, osmotic stability, and metabolic signaling, especially in in vitro culture or preservation systems. However, much of the current evidence comes from laboratory models, and responses may differ among species, doses, and experimental conditions. Further in vivo studies are needed before glycine-based nutritional or culture strategies can be reliably applied to improve livestock reproductive performance.

Abstract

Reproductive inefficiency associated with impaired oocyte competence and embryonic loss remains a major limitation in livestock production. Although glycine is classified as a non-essential amino acid, its endogenous synthesis is often insufficient to meet increased metabolic demands during gestation and early embryonic development. This suggests that glycine has a conditionally essential role in reproductive physiology. However, the mechanisms through which glycine integrates metabolic and signaling processes to regulate reproductive outcomes are not fully understood. This review summarizes the recent advances in understanding glycine's role in animal reproduction, emphasizing its function as a metabolic regulator rather than merely a structural component. Glycine contributes to reproductive processes by maintaining redox homeostasis, supporting mitochondrial function and stabilizing cellular environments as part of its osmolyte function during critical developmental stages. Additionally, glycine participates in one-carbon metabolism, influencing nucleotide synthesis and epigenetic regulation. Furthermore, emerging evidence suggests that

glycine may modulate key signaling pathways, including the AMP-activated protein kinase (AMPK)-mechanistic target of rapamycin complex 1 (mTORC1) pathway. Consistent with these mechanistic roles, glycine supplementation has been associated with improvements in oocyte maturation and embryonic development, particularly in vitro. These findings highlight the potential of glycine as a dietary or culture medium supplement to enhance reproductive performance in livestock. However, most current evidence is derived from in vitro systems, and the translation of these findings into livestock production strategies requires validation through well-designed in vivo studies.

Sexed semen: current state-of-the-art in small ruminants

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Abstract

The rising global demand for animal products, driven by population growth and limited agricultural land, necessitates more sustainable and efficient livestock production systems. Flow cytometric sperm sex-sorting remains the only reliable technology available to control offspring sex ratios, thereby enhancing productivity in food-producing mammals. While the technology was originally developed and widely adopted in cattle, its application in small ruminants, particularly sheep and goats, remains comparatively limited and is largely confined to research and early-stage commercial use. This review examines the use of sperm sex-sorting in small ruminants, summarizing outcomes from experimental and field trials. Special attention is given to biological and technical constraints affecting performance, including sperm sensitivity to sorting and cryopreservation, fertility of sexed versus conventional semen, and logistical and economic considerations for implementation. Understanding these factors is essential for advancing the commercial adoption of sexed semen and optimizing reproductive efficiency in small ruminant production systems.

Towards cervical AI of sheep with stored semen: latest insights and future developments

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Journal of Reproduction and Development, Volume 72, Issue 3 July 2026 **OPEN ACCESS**

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Abstract

Artificial insemination (AI) is widely used in sheep breeding; however, fertility obtained with frozen-thawed ram semen following cervical (vaginal) insemination remains markedly low compared with fresh semen. This limitation contrasts with the high fertility achieved after laparoscopic intrauterine insemination, highlighting the central role of the ewe cervix as a selective barrier for frozen spermatozoa. This review examines current knowledge on the mechanisms underlying reduced fertility after cervical AI with frozen semen and proposes research avenues to improve reproductive outcomes. Despite cryotolerance of ovine sperm comparable to other ruminants, cryopreservation induces molecular and functional alterations that impair interactions with the female reproductive tract. While advances in semen freezing—such as antioxidant supplementation, lipid incorporation, and manipulation of seminal plasma—enhance post-thaw survival, they do not fully restore fertility, emphasizing the importance of female-side factors. Cervical morphology, uterine contractions, immune responses, and particularly cervical mucus properties influence sperm transport. Variations in mucin composition, glycosylation patterns, metabolite profiles, and microbiota composition are associated with breed-dependent differences in sperm survival and passage through the cervix. Emerging evidence suggests

that targeted modulation of cervical mucus—potentially through dietary, oral, or local interventions—may represent a novel strategy to enhance fertility. Recent advances in imaging, 3D reconstruction, microfluidics, and organ-on-chip technologies provide unprecedented opportunities to model sperm–cervix interactions under physiologically relevant conditions. Integrating these tools with optimized cryopreservation strategies and a deeper understanding of cervical physiology is essential to overcome current barriers and improve the efficiency of cervical AI with frozen semen in sheep.

Male germ cell technologies in large animals

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Abstract

The manipulation of male germ cells presents significant opportunities for introducing heritable genetic changes in large animal species. As the foundation of lifelong spermatogenesis, spermatogonial stem cells (SSC) provide a unique target for stable genetic modifications that can be passed to future generations and produce genetically modified offspring. Recent progress in gene editing and transplantation techniques has improved the value of germ cells as a platform for transgenerational genetic inheritance in large animals. Yet, substantial challenges remain, including the lack of robust SSC culture systems, species-specific differences, and technical difficulties for gene editing and SSC transplantation. Additional concerns, such as editing efficiency, off-target mutations, immune rejection, and regulatory acceptance, may further limit translation. This review summarizes the current state of male germ cell technologies in large animals, focusing on tools, methodologies, and applications. We also highlight critical limitations and ethical considerations and outline future directions of the field. Overall, germ cell technologies are positioned as a promising approach at the interface of reproductive biology, biotechnology, and translational science.

Scientific papers

Do ewes that grow faster have greater embryo and lamb survival?

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Animal Production Science, Volume 66, Issue 10, July 2026 **OPEN ACCESS**

DOI <https://doi.org/10.1071/AN26049>

Abstract

Context Embryo survival, lamb survival and lamb growth rate are key factors in achieving peak performance of a sheep flock.

Aims We used monthly ewe lamb growth records from approximately 400 ewes born over three successive years to test the hypothesis that mature ewes with greater relative growth rate as a lamb have greater embryo survival, lamb survival and lamb growth rate.

Methods The Brody growth model was used to describe the nonlinear ewe lamb growth in their first year, and the estimated Brody model parameters were used as covariates in models for embryo survival, lamb survival and lamb growth rate as an adult ewe.

Key results Ewes with greater relative growth rates as a lamb had greater embryo survival ($P = 0.0002$), lamb survival ($P = 0.02$) and lamb growth rate ($P = 0.001$) as an adult ewe. For example, over the measured range of ewe lamb relative growth rate, the expected embryo survival for ewes with a single embryo when they were pregnant as an adult ranged from 0.80 to 0.94, the expected probability of the survival of single lambs

when they lambed as an adult ewe ranged from 0.92 to 0.97 and the expected single lamb growth rate when they lambed as an adult ewe ranged from 0.31 to 0.33 kg day⁻¹.

Conclusions Ewes with greater relative growth rate as a lamb had greater embryo survival, and offspring survival and growth rate as an adult ewe.

Implications This new positive association between ewe lamb growth and embryo survival, lamb survival, and lamb growth rate as an adult ewe can potentially be exploited to improve flock performance.

Lambing outcomes with provision of parturient and neonatal assistance: 8 Evidence from a longitudinal study in Australian Merino ewes

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Animal Production Science, Volume 66, Issue 10, July 2026 **OPEN ACCESS**

DOI <https://doi.org/10.1071/AN26070>

Abstract

Context Improving lamb and ewe survival during the lambing period is a priority for the Australian sheep industry.

Aim To determine main causes, predictors, and intervention effects associated with neonatal lamb mortality in an extensive production system with supervised and assisted lambing.

Methods A longitudinal study was conducted using the New England flock of the Merino Lifetime Productivity (MLP) project (n = 1350 ewes), whereby records of birth, neonatal mortality, and lamb necropsy examination were collected over a 5-year period with 5475 lambing events and 7798 lambs born. Where needed, ewes and lambs were provided assistance during parturition and/or in the neonatal period. Lamb mortalities were categorised as ‘actual’ and ‘theoretical’ deaths to determine ‘predicted’ mortalities. Predicted mortality represents an informed estimate of lamb mortality in the absence of assistance and intervention.

Key results Actual lamb survival to marking was 88%, and predicted survival in the absence of interventions was 80.5%. Assistance at parturition was provided at 215 lambing events and was more likely required for triplet births (12.5%) than single or twins (4.2% and 3.2% respectively). Year, dam age, lamb sex, chill index at birth, and birthweight were all predictors of lamb survival (P < 0.05). Collectively, the predictor variables and random effects (parentage) explained approximately 50% of the variation in lamb mortality. Notwithstanding the provision of assistance, the major causes of lamb mortality were dystocia/birth difficulty (38%) and the starvation–mismothering–exposure (SME) complex (30%), with severe weather events and disease outbreaks affecting lamb survival in certain years.

Conclusion Despite potential biases associated with the lambing system and associated protocols, the findings were consistent with other observations in extensive Australian production systems. Outcomes from lambing systems that incorporate intervention during lambing can, therefore, be generalised to commercial systems conditional of record keeping that captures interventions that constitute theoretical death and the inclusion of necropsy protocols to confirm proportional death causes.

Implications This study reinforces the impacts of dystocia and SME on lambing outcomes, the need for targeted management for high-risk groups such as ewes carrying multiples, and the value of veterinary diagnostics in identifying infectious disease outbreaks.

MERINO LIFETIME PRODUCTIVITY PROJECT SPECIAL COLLECTION

The genetic relationship between feed efficiency and host resistance to parasites: insights from experimental infections in ewe lambs from divergent lines

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Animal, Volume 20, Issue 7 **OPEN ACCESS**

DOI <https://doi.org/10.1016/j.animal.2026.101849>

Highlights

- Balancing disease resistance with feed efficiency is a challenge for breeding.
- We tested for genetic trade-offs using divergent selection lines.
- Correlated responses between resistance and efficiency were unclear.
- We suggest effect sizes for planning future experimental studies.
- We highlight methodological challenges in detecting trade-offs.

Abstract

Breeding for disease resistance or for feed efficiency can support sheep farm strategies to reduce reliance on feed or medical inputs. However, genetic improvement in those two types of traits may be hampered by trade-offs. Based on the resource allocation theory, immunity-conferring host resistance may use feed nutrients at the expense of production processes and then lead to reduced feed efficiency. Conversely, a high feed efficiency may reduce the nutrient budget for immunity and then lead to increased susceptibility. Finally, direct infection costs due to high susceptibility should compromise feed efficiency during infection. We investigated this theory using the same standardised protocol of artificial infection with the gastrointestinal parasite *Haemonchus contortus* in two independent experiments. The first experiment (Exp. 1) included ewe lambs from lines divergently selected for residual feed intake (RFI), whereas the second (Exp. 2) included ewe lambs from divergent lines on host resistance. In each experiment, about two-thirds of the animals were infected while the others were kept uninfected as controls. Our results were consistent with each divergent selection: in the control treatment of Exp. 1, the efficient line (LRFI) had a lower RFI than the inefficient line (HRFI), while in the infection treatment of Exp. 2, the resistant line (R) had a lower parasite faecal egg count than the susceptible line (S). However, our results were inconclusive regarding the expected trade-off, as neither comparison of host resistance between infected ewe lambs from HRFI and LRFI lines, nor of RFI between controls from the R and S lines, revealed a consistent pattern. In both experiments, evidence for a deterioration in the feed efficiency of infected animals relative to controls was also inconclusive. Our findings do not constitute evidence for the absence of a genetic relationship between feed efficiency and host resistance to parasites, but it provides effect sizes for planning future studies of the trade-off between those traits. The challenge conditions required to detect trade-offs and simultaneously measure feed efficiency warrant further investigation.

Supplementing organic zinc enhances growth and blood parameters to preserve ovarian function of Awassi lambs raised in a high summer temperature environment

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Abstract

The effects of organic zinc supplementation on performance, whole blood parameters, and ovarian function of heat-stressed female Awassi lambs raised under high summer ambient temperature was determined. Twenty-four female lambs (~10 months of age; live weight = 27.7 kg) were randomly assigned to one of two dietary treatments: 1) a control diet (including zinc oxide 10 mg/kg dry matter (DM); $n = 12$) or 2) a control

diet supplemented with 30 mg/kg DM of organic zinc ($n = 12$) for 5 weeks during natural summer conditions (ambient temperature range = 25–46°C and temperature humidity index (THI) range = 72.6–92.2%). Relative to control, organic zinc supplementation improved growth performance (higher final live weight, $P = 0.01$; greater weight gain, $P \leq 0.001$) and carcass characteristics (increased carcass weight, $P \leq 0.001$; higher dressing percentage, $P \leq 0.001$), along with better thermoregulation (lower rectal temperature (RT) by 1.7°C, $P \leq 0.01$). Whole blood analysis revealed that organic zinc supplementation increased red blood cell count ($P = 0.02$), concentration of hemoglobin ($P = 0.01$), albumin, total protein, and glucose ($P \leq 0.01$) while decreasing white blood cells ($P = 0.02$) and lymphocyte counts ($P = 0.02$). The organic zinc supplementation group had 1.5-fold greater follicular fluid estradiol concentrations ($P \leq 0.001$) and elevated mRNA expression of key genes (*StAR*, *FSHR*, *CYP19A1*, and *FOS*; $P \leq 0.001$) involved in steroidogenesis. The organic zinc supplementation also enhanced follicle development, increasing surface antral follicle counts ($P \leq 0.001$) and number of secondary ($P \leq 0.05$). Additionally, it reduced ovarian fibrosis ($P \leq 0.001$) and increased ovarian size ($P = 0.01$) and weight ($P = 0.01$). In summary, organic zinc supplementation effectively mitigated the high summer ambient temperature in Awassi female lambs by improving thermoregulation and ovarian function, thereby benefiting production and reproductive performance.

Shifts in the vaginal microbiota of nulliparous ewe lambs following initial reproductive handling and estrus synchronization

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Journal of Animal Science, Volume 104, July 2026 **OPEN ACCESS**

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Abstract

Current knowledge of the ovine vaginal microbiota is limited to adult ewes, leaving the bacterial community of nulliparous ewes and its dynamics during their first reproductive handling undefined. This study aimed to characterize the vaginal microbiota of ewe lambs prior to their first breeding and to evaluate the changes caused by routine handling and estrus synchronization. A total of 66 vaginal samples were collected from 22 nulliparous Latxa ewe lambs at three time points: baseline, post-handling, and post-estrus synchronization using intravaginal devices containing oxytetracycline. Bacterial composition was characterized by sequencing the V3–V4 hypervariable regions of the 16S rRNA gene. Data were processed using DADA2 to infer Amplicon Sequence Variants, and ecological shifts were evaluated through beta and alpha diversity metrics, alongside differential abundance analysis with ANCOM-BC2. A baseline community was revealed, with high diversity and inter-individual variability. This initial state was dominated by the phylum Firmicutes and showed a strong connection to the gut microbiota, including enteric genera such as *Fibrobacter*, *Rikenellaceae* RC9 gut group, and *Lachnospiraceae* NK3A20 group. The first physical examination caused a significant shift in community structure (beta diversity $P = 0.001$), marked by a rapid drop in these gut-associated bacteria and an increase in opportunistic genera such as *Trueperella* ($\log_2FC = 2.18$; $P_{adj} < 0.05$). The subsequent synchronization treatment further reduced both alpha and beta diversity, creating a uniform environment where genera such as *Aerococcus*, *Corynebacterium*, *Fingoldia*, and *Trueperella* increased, while *Alistipes*, *Acinetobacter*, and *Jeotgalicoccus* decreased ($P_{adj} < 0.05$). Despite these changes, the cohort achieved an 89% pregnancy rate via natural mating. Routine handling and synchronization protocols induce temporary shifts in the vaginal microbiota, decreasing diversity and promoting some opportunistic genera. Crucially, the high fertility rate achieved suggests that these ecological alterations are compatible with successful conception under natural mating conditions.

Distinct metabolic strategies drive variation in mass motility longevity between rams

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Reproduction, Fertility and Development, Volume 38, Issue 11, July 2026 **OPEN ACCESS**
DOI <https://doi.org/10.1071/RD26033>

Abstract

Context Motility longevity offers valuable insights into sperm function and metabolic resilience; however, the extent of inter-individual variation and its mechanistic underpinnings remain poorly defined.

Aims This study aimed to characterise variation in mass motility duration in rams and determine whether differences in motility longevity are associated with distinct metabolic profiles.

Methods Successive ejaculates (n = 314) were collected and assessed from 23 Merino rams. Seminal plasma from ejaculates exhibiting the shortest and longest motility duration was analysed immediately post-collection and at motility cessation using targeted mass spectrometry to characterise changes in metabolite abundance over time.

Key results Mass motility duration varied markedly between rams, ranging from 11 min to over 20 h. Although mass motility duration, ejaculate volume, and sperm concentration were influenced by sequential ejaculate collection, mass motility duration was not strongly correlated with ejaculate volume or sperm concentration, indicating that variation in motility longevity is not simply explained by these traits. Rather, distinct metabolic strategies appear to drive variation among phenotypes. Short-lasting ejaculates showed rapid depletion of fructose and marked lactate accumulation, consistent with heavy reliance on glycolysis and limited mitochondrial engagement. In contrast, long-lasting ejaculates maintained stable fructose levels while exhibiting increased hexose phosphate abundance and substantial pyruvate utilisation, suggesting more controlled glycolytic flux and sustained mitochondrial oxidation. Accumulation of α -ketoglutarate and 2-hydroxyglutarate was exclusive to short-lasting ejaculates, indicating mitochondrial bottlenecks and redox imbalance.

Conclusions These findings highlight metabolic regulation, rather than substrate availability alone, as a key determinant of motility longevity in ram spermatozoa.

Implications Understanding how long-lasting ejaculates maintain coordinated glycolytic and mitochondrial activity provides a framework for developing metabolically informed strategies to prolong sperm survival during processing and storage.

Upcoming events

Date	Event	Location
7 August 2026	MLP Results seminar Australian Wool Innovation	Armidale, NSW
11 August 2026	Implementing and optimising genomic prediction tools MLA PDS, SheepMetriX and Sheep-Trax	Cavendish, Vic
12 August 2026	MeatUp Forum Meat & Livestock Australia	Northam, WA
13 August 2026	Smart Yards, Smarter Flock! Leading Sheep	Goondiwindi & Yelarbon, Qld
19 August 2026	Livestock Advisor Updates Meat & Livestock Australia	Bendigo, Vic
19 August 2026	Building better lambs NSW Local Land Services (Riverina)	Eurongilly, NSW
20 August 2026	Livestock Advisor Updates – Understanding Genetics workshop	Bendigo, Vic

26 August 2026	Meat & Livestock Australia Data driven sheep management	Lockhart, NSW
26 August 2026	NSW Local Land Services (Riverina) BredWell FedWell sheep workshop	Bordertown, SA
26 & 27 August 2026	Meat & Livestock Australia Livestock Advisor Updates: building blocks of business	Sydney, NSW
27 August 2026	Meat & Livestock Australia BredWell FedWell sheep workshop	Croxtan East, Vic
	Meat & Livestock Australia	