

OCTOBER 2025

# Sheep reproduction RD&A alert

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

Did you miss the SRSP October webinar **Merino ewe mortality, shedder reproductive performance & increased weaning rates**? The recording is now available to view from the [SRSP website](#). Simply click the link and scroll down to the recording.

The webinar featured four early career researchers who are part of the research teams tackling some key sheep reproduction issues:

1. **Understanding the prevalence and causes of Merino ewe mortality** - Bea Kirk, PhD Student, University of Melbourne, provided an overview of the Merino ewe mortality project and then focussed on her PhD research which is quantifying the impact of ewe condition score on Merino ewe mortality.
2. **Quantifying the reproductive performance of shedding breeds** - Bobbie Lewis-Baida, Postdoctoral Research Associate University of Adelaide, outlined the progress made to date to quantify the reproductive performance of shedding sheep breeds and shared some early results on scanning percentages of maiden and adult ewes.
3. **New approaches to increase sheep weaning rates** - Billie-Jaye Brogham and Megan Tscharke, Grant-Funded Researchers at University of Adelaide, jointly presented the three-stage approach used to increase sheep weaning rates and summarised the research conducted to determine the impact of betaine and melatonin on lamb survival.

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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

### Oocyte competence: A systematic review of omics studies and the state of art

Fernanda Amarante Mendes de Oliveira, Gabriela Rodrigues de Paula, Pamela Mara Celestino Soares, Amanda Fonseca Zangirolamo, Fábio Morotti, Anne Kemmer Souza, Fabiana de Andrade Melo-Sterza and Marcelo Marcondes Seneda ([marcelo.seneda@uel.br](mailto:marcelo.seneda@uel.br))

Theriogenology, Volume 249, January 2026

DOI <https://doi.org/10.1016/j.theriogenology.2025.117670>

### Highlights

- Integration of omics data improves the knowledge of the oocyte development mechanism.
- Transcriptomic analysis predominated and revealed important transcriptional patterns.
- NHBA, TNFAIP6, and TRIB2 were genes identified as regulators of oocyte maturation.
- Nucleotide metabolism was one of the pathways identified in final oocyte maturation.

- The ovulatory window was the focus of studies on oocyte competence.

### Abstract

Competent oocyte is a critical point for successful fertilization and early embryonic development. This systematic review aimed to synthesize scientific evidence from omics studies on oocyte development in cattle during the estrous cycle. Our systematic search followed the PRISMA guidelines, using three databases: PubMed, Scopus, and Web of Science Core Collection. After a critical appraisal of the literature using the Kmet scoring system, ten peer-reviewed articles were included. These studies involved analyses of follicular fluid, cumulus and granulosa cells, oocytes, and maturation media. Transcriptomics predominated among the studies and identified transcriptional patterns associated with oocyte competence in different cell types and stages of the estrous cycle, particularly around the LH surge. In addition, experiments focusing on the ovulatory window as the main theme were identified in the studies. Metabolomic analyses highlighted the role of amino acid turnover and purine metabolism in follicular fluid and maturation media, providing insights into potential biomarkers in oocyte development. The results emphasized the importance of nucleotide metabolism, extracellular matrix interactions, and hormonal signaling pathways, particularly involving genes such as INHBA, TNFAIP6, and TRIB2, in regulating oocyte maturation. This review underscores the power of integrating omics data to elucidate complex molecular mechanisms relevant to the acquisition of oocyte competence. Furthermore, it explores the identification of potential molecular markers that would aid the development of protocols and culture media, while aiming to improve oocyte quality and advance assisted reproductive technologies.

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### Early pregnancy detection in ruminants: challenges and innovations

Jakia Sultana, Sanjita Rani Paul, Md Sayaduzzaman Arafath, Md Hasanur Alam, Md Sharoare Hossain and Mohammad Moniruzzaman

Journal of Reproduction and Development, Volume 71, Issue 5 **OPEN ACCESS**

**DOI** <https://doi.org/10.1262/jrd.2025-048>

### Abstract

Precise and early pregnancy detection is crucial for better breeding management and enhancing the overall production of ruminant livestock. Throughout the years, numerous methods have evolved for pregnancy detection in ruminants, each possessing specific advantages and limitations. This review thoroughly discusses both traditional and emergent diagnostic methods, emphasizing their principles, implementation, merits and challenges. Behavioral observation, rectal palpation and ultrasonography are the traditional approaches widely used because of their accessibility and direct detection of pregnancy conditions. Progesterone measurement, pregnancy-associated glycoprotein detection, and estrone sulfate examination are the hormonal assays that provide biochemical proof at specific phases of gestation. Recently, the analysis of interferon-stimulated gene expression and circulating microRNAs has shown promising roles in early pregnancy detection at the genetic and transcriptomic levels. The investigation of volatile organic compounds is a novel approach in pregnancy diagnosis, though it is non-invasive, and further confirmation is required for regular application. This review highlighted the importance of incorporating multiple examination strategies to enhance the accuracy and reliability of pregnancy detection in ruminants. Future research should center on the refinement and field application of advanced technologies to ensure their proper implementation in diverse ruminant production systems.

### Scientific papers

**Increased growth rate post-weaning affects mammary gene expression of two-year-old ewes during their second pregnancy and lactation**

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Journal of Animal Science, Volume 103 **OPEN ACCESS**

DOI <https://doi.org/10.1093/jas/skaf320>

### Abstract

This study examined the long-term effects of increased growth rates between three and seven months of age on gene expression in the mammary gland of nondairy ewes during their second lactation. A total of 19 twin-bearing, two-year-old ewes that either had an increased growth rate between three and seven months of age (heavy;  $n = 9$ ;  $153 \pm 2.2$  g/d and  $47.9 \pm 0.38$  kg at breeding) or did not have an increased growth rate (control;  $n = 10$ ;  $127 \pm 1.9$  g/d and  $44.9 \pm 0.49$  kg at breeding) were selected. Mammary gland biopsies were collected at day 128 of pregnancy and day 30 of lactation to examine the expression of 37 genes involved in mammary cell development and milk fat metabolism using NanoString nCounter technology. Ewes in the heavy group tended to exhibit lower expression ( $P < 0.05$ ) of acyl-CoA synthetase short-chain family member 1 (ACSS1), a gene critical for mitochondrial acetyl-CoA synthesis, energy production, and milk fat synthesis, and a trend toward ( $P = 0.11$ ) lower expression of signal transducer and activator of transcription 5A (STAT5A), a regulator of mammary epithelial cell differentiation and survival. These lower expressions suggest potential carry-over effects of increased growth rate between three and seven months of age. However, no phenotypic differences were observed in lamb growth or live weight, and no differences were detected in the expression of downstream target genes or modulators of these pathways, suggesting limited functional impact on mammary gland development and lamb performance outcomes. Further investigations, including a functional assessment of lactation and use of comprehensive transcriptomic analyses, would be needed to understand the effects of increased growth rates between three and seven months of age on ewe mammary function and milk composition.

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### Investigating the impacts of poor maternal nutrition on ewe lamb reproductive capacity

Julianna Messina, Rachael M Stucke, Ryne D Haggard, Ellen Roberts, Alexandria P Snider, Terry E Engle and Caitlin N Cadaret

Journal of Animal Science, Volume 103 Supplement\_3, October 2025

DOI <https://doi.org/10.1093/jas/skaf300.285>

### Abstract

Extensively managed ewes are often grazed through winter, which coincides with gestation and producers often supplement ewes at the end when nutrient demands are the highest, to support maternal maintenance and fetal growth. However, it is likely that as range decreases in quantity and quality across winter months, ewes experience nutrient challenge prior to this traditional supplementation period. Thus, the objective of this study was to determine the impact of maternal nutrient challenge during gestation on indicators of reproductive capacity in ewe lamb offspring. At 30 days of gestation (dGA), pregnant ewes were blocked by bodyweight and assigned a diet based on National Research Council (NRC) requirements, that either met all nutritional requirements for gestation or a diet that simulates winter forage, meeting approximately 50% of protein and ~70% of total digestible nutrient (TDN) requirements, to create CON ( $n = 18$ ) and NC ( $n = 12$ ) lambs, respectively. Beginning at 6 mo of life, ewe lambs were bled bi-weekly and plasma was isolated. Plasma progesterone concentration were quantified by ELISA and used to determine puberty attainment. Puberty was considered attained when progesterone concentration exceeded 1 ng/ml in for two cyclic patterns. After puberty attainment, lambs were harvested, and reproductive weights and tissues were collected for histology and transcript analysis. There were no differences final live weight, hot carcass weight, or gross

weight of reproductive organs at harvest. Preliminary follicle classifications did not differ, however, there was a numerical increase in the primordial and total follicle populations of NC lambs compared to CON. Relative transcript abundance of  $Er\alpha$  tended ( $P < 0.10$ ) to be increased and  $Er\beta$  was increased ( $P < 0.05$ ) in NC lambs compared to controls, while PCNA and AMHr did not differ. Conversely, protein expression of  $Er\alpha$  and  $Er\beta$  was decreased ( $P < 0.05$ ) in NC lambs compared to CON lambs. Despite an increase in gene expression, there is a decrease in protein synthesis suggesting an issue with the translation of mRNA into protein. The selected gene code for synthesis of receptors for hormones that regulate folliculogenesis and reduced receptor presence could precede between animal variation in reproductive capacity. Our preliminary findings suggests that if range ewes experience nutrient challenge earlier than the traditional supplementation period, offspring ewe lambs may have impaired fertility.

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### Effect of season on testicular development and spermatogenesis in Hu sheep: Insights from antioxidant indices, oxylipins, and transcriptomics

Wanhong Li, Xinyue Zhang, Jie Shen and Xiuxiu Weng

Animals, Volume 15, Issue 19, October 2025 **OPEN ACCESS**

DOI <https://doi.org/10.3390/ani15192824>

#### Simple summary

Numerous studies have investigated the influence of season on spermatogenesis in adult rams. Heat stress during summer exerts adverse effects on spermatogenesis and semen quality. The pre-sexual maturity stage is the most important period for testis development in rams. However, little is known about the effects of seasonal factors on testicular development during the pre-sexual maturity in Hu rams. Therefore, this study investigated the sperm density, histology, antioxidant properties, oxylipins and differentially expressed genes in testicular tissues between winter-born and summer-born Hu rams at six months old. Compared with the winter-born group, the testicular tissues of summer-born rams showed stronger testicular antioxidant capacity and lower lipid peroxidation at sexual maturity stage, contributing to enhanced spermatogenesis.

#### Abstract

Numerous factors, including genetic, environmental, and nutritional, are involved in testicular development and spermatogenesis. However, little is known about the effects of seasonal factors on pre-sexual maturity testicular development in Hu rams, which are famous for their high fertility and year-round estrus onset. This study explored the effect of the birth season on testicular development and spermatogenesis in Hu sheep. Thirty-six 6-month-old male lambs born in summer ( $n = 18$ ) and winter ( $n = 18$ ) were selected for analysis. Results showed that summer-born lambs exhibited significantly higher cauda sperm density ( $102.65 \pm 9.56$  vs.  $16.86 \pm 2.02 \times 10^7/g$ ), antioxidant indices such as superoxide dismutase (SOD:  $6.29 \pm 1.01$  vs.  $4.09 \pm 0.25$  U/mgprot), and higher expression levels of glutathione peroxidase 3 (GPX3), glutathione peroxidase 4 (GPX4), and copper/zinc superoxide dismutase (Cu/Zn-SOD) than winter-born lambs. Conversely, the malondialdehyde content ( $1.08 \pm 0.32$  vs.  $2.13 \pm 0.34$  nmol/mgprot) was significantly lower in the summer-born group ( $p < 0.05$ ) than in the winter-born group. A total of 44 differential oxylipins and 326 differentially expressed genes (DEGs) were screened by ultra-performance liquid chromatography–tandem mass spectrometry and transcriptomics, respectively. An integrated analysis of oxylipins and transcriptomics revealed that these differential molecules were enriched in metabolic pathways. Notably, downregulated DEGs (e.g., UAP1L1 and NAT8L) were significantly correlated with upregulated differential oxylipins (e.g., epoxyeicosatrienoic acids and dihydroxyeicosatrienoic acids). These results indicate that compared to the winter-born group, the testicular tissues of summer-born rams showed stronger testicular antioxidant capacity and lower lipid peroxidation at the sexual maturity stage, which contributes to spermatogenesis.

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## Combined effects of the Booroola, Vacaria and Embrapa mutations on ovulation rate in a sheep flock with unique genetic background

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Reproduction, Fertility and Development, Volume 37, Issue 15, October 2025

DOI <https://doi.org/10.1071/RD25067>

### Abstract

**Context.** Improve lamb meat production in southern Brazil using genotype-assisted selection to enhance prolificacy.

**Aim.** To evaluate the effect of the combined presence of single-nucleotide polymorphisms in the BMP1R (Booroola) and GDF9 (Vacaria, Embrapa) genes on ovulation rate.

**Methods.** Ewes were genotyped using the tetra-primer amplification–refractory mutation system–polymerase chain reaction technique. Ovulation rate was assessed via laparoscopy following estrus synchronization with intravaginal progesterone sponges.

**Key results.** The presence of the Vacaria (FecGV), Embrapa (FecGE), and Booroola (FecBB) alleles in different possible combinations adds between two and three ovulations in the corresponding genotypes.

**Conclusions.** The effects of the FecGE, FecGV, and FecBB alleles on ovulation rate are additive and should be utilized individually or in pairs with the FecGE, avoiding excessive prolificacy when all three alleles are present in the same ewes.

**Implications.** Genotype-assisted selection enables the development of genetically distinct lines tailored for different production systems based on desired levels of prolificacy. This strategy can be integrated with the selection of other major genes affecting productive traits, such as increased carcass yield and spontaneous wool shedding.

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## Visfatin improves survival and promotes the activation of primordial follicles in cultured sheep ovaries

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Animal Reproduction Volume 22, Issue 4, October 2025 **OPEN ACCESS**

DOI <http://dx.doi.org/10.1590/1984-3143-AR2023-0163>

### Abstract

Visfatin is an adipokine involved in the regulation of female reproduction. However, there are no studies on the effects of visfatin on the in vitro culture of ovarian tissue in any species. Therefore, the aims of this study were to analyze the effects of visfatin on survival, primordial follicle activation, granulosa cell proliferation, and the immunostaining of tumour necrosis factor- $\alpha$  (TNF- $\alpha$ ) in preantral follicles after the in vitro culture of sheep ovarian tissue. Ovarian fragments were fixed for histological analysis (fresh control) or cultured in  $\alpha$ -minimum essential medium alone ( $\alpha$ -MEM+: control medium) or in  $\alpha$ -MEM+ supplemented with different concentrations of visfatin (1 or 10 ng/mL) for 7 days. Subsequently, ovarian tissue was destined to histology (morphology, activation and growth) and immunohistochemistry (granulosa cell proliferation and pro-inflammatory cytokine TNF- $\alpha$  immunostaining). The results indicated that treatments with visfatin (1 or 10 ng/mL) maintained the percentage of morphologically normal follicles at a level similar ( $P>0.05$ ) to the fresh control and significantly higher than of  $\alpha$ -MEM+. A significant increase in primordial follicle activation was also observed in tissue cultured for 7 days at both visfatin concentrations compared to the fresh control and

$\alpha$ -MEM+. In addition, only the treatment containing 10 ng/mL of visfatin significantly increased follicular and oocyte diameters, and granulosa cell proliferation compared to  $\alpha$ -MEM+, and attenuated inflammatory activity by reducing TNF- $\alpha$  immunostaining after in vitro culture. In conclusion, 10 ng/mL visfatin maintains survival, reduces immunostaining of TNF- $\alpha$  and promotes the activation of primordial follicles by stimulating granulosa cell proliferation after the in vitro culture of sheep ovarian tissue.

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### Immediate and late effects of long-term testicular heat stress on the number of seminiferous tubules and cellular content in Santa Inês rams

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Animal Reproduction Volume 22, Issue 4, October 2025 **OPEN ACCESS**

DOI <http://dx.doi.org/10.1590/1984-3143-AR2024-0134>

#### Abstract

Efficient spermatogenesis in mammals occurs when testicular temperature is approximately 2 to 8 °C below body temperature. Elevated testicular temperature can trigger oxidative stress and compromise sperm integrity during spermatogenesis, potentially resulting in damaged spermatozoa and male infertility. This study aimed to evaluate how heat stress affects the quantity of seminiferous tubules, and the abundance of germ cells within the seminiferous tubules. To this end, six Santa Inês rams were subjected to testicular insulation for 12 consecutive days, followed by two hemi-orchietomies, the first 24 hours after insulation period to evaluate the immediate effect, and the second 30 days after the first hemi-orchietomy to evaluate the late effect. Six Santa Inês rams composed the control group. Histological analyses were conducted to quantify the number of seminiferous tubules and the types of cells within them (spermatogonia, spermatocytes, and spermatids) in testicular fragments. Despite an increase in testicular temperature, no significant differences were observed in the number of seminiferous tubules. These findings probably reflect the resistance of Santa Inês rams to high environment temperatures. Regarding the abundance of cells, a decrease in spermatogonia ( $0.27\% \pm 0.06$ ;  $0.05\% \pm 0.03$ ,  $p = 0.005$ ) and an increase in spermatocytes ( $35.90\% \pm 1.58$ ;  $46.77\% \pm 4.33$ ,  $p = 0.028$ ) were observed immediately after the insulation period compared to 30 days after, the late effect. This result suggests an effect of the first hemi-orchietomy on the remaining testicle, probably an attempt to maintain sperm production.

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### Effect of N-Carbamylglutamate supplementation in late pregnancy on nutrient-restricted twin-bearing ewes on the pre-lambing maternal metabolome, colostrum quality and lamb birth weight

Francisco Sales, Susan McCoard, Pablo Alarcón, Camila Sandoval, Claudia Silva, Carolina Rojas and Víctor H. Parraguez

Animals, Volume 15, Issue 20, October 2025 **OPEN ACCESS**

DOI <https://doi.org/10.3390/ani15202998>

#### Simple Summary

Lamb mortality around birth, especially in twin lambs, is of major concern for producers. Under natural nutrient restriction, arginine, a conditionally essential amino acid for the fetus, is known to improve fetal growth and colostrum quality in restricted ewes. However, its use is limited in ruminants due to its high cost and degradation in the rumen. N-carbamylglutamate (NCG) can stimulate the body's own arginine production and may serve as an alternative. This study evaluated the effects of NCG supplementation during late pregnancy in undernourished twin-bearing ewes. Ewes received 60 mg/kg body weight of NCG daily from day 100 of gestation until lambing. Compared to unsupplemented controls, NCG did not improve ewe body



condition, placental traits, or lamb birth weight. However, NCG supplementation resulted in changes in maternal blood metabolites, including higher plasma urea and altered amino acid profiles. Importantly, colostrum from NCG-treated ewes had significantly higher protein and IgG content. While NCG did not reverse the negative effects of undernutrition on fetal growth, it did improve colostrum quality and immunoglobulin content, which may enhance immunity in lambs and contribute to reducing lamb mortality after birth, a key constraint in extensive sheep production systems.

#### **Abstract**

Arginine supplementation improves fetal growth and colostrum composition in nutrient-restricted ewes, but its high cost and ruminal degradation limit its practical use. N-carbamylglutamate (NCG), which stimulates endogenous arginine synthesis, and is not degraded in rumen, may be a viable alternative. This study evaluated the effects of oral NCG supplementation (60 mg/kg BW/day from day 100 of gestation to term) on undernourished twin-bearing ewes (~50% NRC requirements; NCG  $n = 20$ , Control  $n = 21$ ). Maternal body weight (BW), body condition score (BCS), blood metabolites, placental traits, lamb body measurements, and colostrum composition were assessed. BW increased and BCS decreased over time ( $p < 0.0001$ ), with no treatment effect. Lamb and placental traits were similar between groups. NCG supplementation resulted in a 15% higher plasma urea concentration ( $p < 0.03$ ) and altered 21 serum metabolites, with reduced levels of valine, leucine, isoleucine, glycine, proline, and phosphate, and increased serine, ethanolamine, urea, and 2-hydroxyhexanoic acid concentration compared to CON animals. Colostrum from NCG ewes had a 21% higher protein ( $p < 0.04$ ) and a 16% higher IgG content ( $p < 0.03$ ) compared to CON animals. Although NCG did not mitigate the negative effects of maternal undernutrition on fetal traits, it influenced maternal metabolism and improved colostrum quality.

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### **Regulatory of oleuropein on the in vitro maturation of oocytes and the development of parthenogenetic embryos in sheep**

Yue Zhang, Wenjuan Zhao, Zihao Ma, Zhenghang Li, Zhijiao Liu, Pengcheng Wan and Guangdong Hu

Animals, Volume 15, Issue 20, October 2025 **OPEN ACCESS**

DOI <https://doi.org/10.3390/ani15203011>

#### **Simple summary**

Oleuropein, as an antioxidant, can alleviate the oxidative stress phenomenon during the in vitro culture of sheep oocytes and early embryos, thereby improving embryo quality. This study found that the appropriate addition of oleuropein can increase the maturation rate of oocytes and promote the development of early embryos. Optimizing the embryo culture system is important for improving the success rate and quality of early embryo development.

#### **Abstract**

Oleuropein (OLE), as the main effective active component in olive leaves, is a natural cyclic ether terpene polyphenolic compound found in plants of the genus *Olea*. It has antioxidant, anti-inflammatory and anti-apoptotic properties, and can reduce damage caused by reactive oxygen species. These characteristics indicate that it can enhance the maturation rate of oocytes and the developmental capacity of embryos—two key indicators in animal breeding. This study evaluated the effects of OLE on the in vitro maturation and early embryonic development of sheep oocytes. 20  $\mu\text{M}$  OLE has the best promoting effect on the maturation rate of oocytes, and 30  $\mu\text{M}$  OLE has the best increasing effect on the blastocyst rate. Compared with the control group, glutathione (GSH) level and mitochondrial membrane potential (MMP) level were significantly increased, ROS level was significantly decreased, the expression of antioxidant genes SOD1 and GPX3 was significantly elevated, and the expression of anti-apoptotic gene BCL2 was significantly elevated in the experimental group. In addition, during the in vitro development stage of early embryos, the expression level

of the embryo development-related gene OCT4 significantly increased. The study has shown that OLE can effectively alleviate oxidative stress during in vitro culture, increase oocyte maturation rate and promote embryo development.

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### The maternal-offspring relationship in tailed and docked ewes and their lambs

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Applied Animal Behaviour Science, Volume 292, November 2025

DOI <https://doi.org/10.1016/j.applanim.2025.106775>

#### Highlights

- Neonatal tail docking did not affect maternal behavior later in life.
- Lambs of undocked ewes tended to lie down more than those of docked ewes.
- Docked and undocked ewes showed distress behaviors during lamb separation.
- Ewe-lamb interactions increased following reunion, regardless of tail docking.
- Eye temperatures remained stable before and after separation.

#### Abstract

Maternal behavior in the hours after lambing is critical for establishing the lamb–dam bond. In rodents, early-life pain alters maternal behavior, but it is unclear whether routine painful procedures like tail docking have similar long-term effects in sheep. We tested whether neonatal tail docking in female lambs altered (1) their maternal behavior and their offspring's behavior after lambing and (2) behavioral and physiological stress responses to separation. Polypay ewe lambs were tail docked using the rubber ring method between 24 and 36 h of age ( $n = 11$ ) or left undocked ( $n = 10$ ). At approximately 13 months of age, they gave birth to singleton ( $n = 6$ ) or twin ( $n = 15$ ) litters. Between 30 and 60 min after the last lamb's birth, the ewe and her lamb(s) were moved to an individual maternity pen, where behaviors were video recorded for 2 h. Between 6 and 12 h after lambing, the lambs were separated from their dam for 15 min, with video recordings taken from 15 min before separation until 15 min after reunion. Eye temperatures of ewes and lambs were assessed using infrared thermography immediately before and after separation as indicators of physiological stress. For all video recordings, we analyzed the duration the ewe spent eating, pacing, lying, and grooming her lamb(s), as well as the duration the lambs spent wagging their tail, nursing, and lying. Transitions from lying to standing were also recorded for ewes and lambs in the 2-hour postnatal period. All models included the dam's tail docking status as a fixed effect with litter size (singleton vs twin) as a factor covariate; separation models also included observation period (before, during, and after separation). We found no significant effect of the dam's tail docking status on maternal and offspring behavior following lambing or on their responses to separation. However, lambs of undocked ewes tended to spend more time lying in the postnatal period compared to lambs of docked ewes. Behavioral changes during and after separation – including increased pacing and reduced eating in ewes during separation, and increased grooming and nursing following reunion – suggest that separation was stressful, regardless of the ewe's tail docking status. No differences were observed in eye temperatures before and after separation. Overall, we did not find evidence to suggest that neonatal tail docking impairs the ewe's ability to bond with or care for her lambs later in life.

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### Plasma progesterone profiles in ewes using different injectable progesterone formulations

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Animal Production Science, Volume 64, Issue 16, November 2025



DOI <https://doi.org/10.1071/AN24182>

## Abstract

**Context.** The use of progesterone vaginal implants in sheep is frequently associated with vaginitis and adherences; and can hamper fertility in estrus synchronization programs.

**Aims.** The aim of this study was to characterize the plasma hormone profile induced by two injectable progesterone (iP4) formulations in ewes.

**Methods.** In Experiment 1, ewes received 20 or 40 mg of an iP4, with a third group as a control. In Experiment 2, 75 or 150 mg of a long-acting iP4 were administered, again with a control group.

**Key results.** In Experiment 1, progesterone concentrations remained at luteal levels for less than 24 h. The intervals from iP4 treatment to the onset of estrus and ovulation were greater in treated than in control ewes ( $P < 0.01$ ). The proportion of ewes that ovulated within 8 days after treatment was lower in ewes that received 40 mg iP4 than in control ewes ( $P < 0.05$ ). In Experiment 2, mean progesterone concentrations remained at luteal levels for 120 h. The interval from iP4 administration to estrus was longer in 150 mg treated ewes than in control ewes ( $P < 0.01$ ). The interval from treatment to ovulation was longer in ewes treated with 150 mg than 75 mg and control ewes ( $P < 0.05$ ). The proportion of ewes that ovulated was lower at 150 mg ( $P < 0.05$ ).

**Conclusions.** The iP4 formula used in Experiment 1 could not maintain luteal levels for more than 24 h. The use of long-acting iP4 maintained plasma progesterone concentrations above luteal levels for at least 5 days. The long-acting treatment can therefore be tested for estrous synchronization treatments.

**Implications.** The long-acting progesterone may be an alternative to short estrous synchronization protocols.

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## Assessment of loliolide extracted from *Biserula pelecinus*, present during in vitro oocyte maturation, on fertilisation and embryo development in sheep

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Animal Production Science, Volume 64, Issue 16, November 2025 **OPEN ACCESS**

DOI <https://doi.org/10.1071/AN24255>

## Abstract

**Context.** As a 'duty of care', it is important to test whether new forage plants for ruminants contain secondary compounds (PSCs) that affect reproductive performance. We have previously observed, a posteriori, that the presence of a methanolic extract of *Biserrula pelecinus* during maturation of sheep oocytes increased fertilisation rate and blastocyst development. This result needed to be verified a priori and, if the outcome was repeated, we needed to identify the plant secondary metabolite responsible.

**Aims.** To test whether PSCs from *B. pelecinus*, when added to the oocyte maturation medium, improve fertilisation rate and blastocyst development; to test whether loliolide is the active molecule produced by *B. pelecinus*.

**Methods.** Methanol–chloroform extracts of *B. pelecinus* were fractionated using rapid silica filtration and solvents of increasing polarity. Fractions at final concentrations of 0, 100 or 200  $\mu\text{g mL}^{-1}$  were added to the medium used to mature sheep cumulus–oocyte complexes (COCs) and effects were determined for maturation, subsequent cleavage rate, blastocyst rate, hatching rate, blastocyst efficiency and total blastocyst cell number (TCN).

**Results.** Fraction BP-6 at 100  $\mu\text{g mL}^{-1}$  reduced blastocyst rate ( $P < 0.05$ ), but had no effect when the dose was doubled to 200  $\mu\text{g mL}^{-1}$ . Further fractionation using semi-preparative high-performance liquid

chromatography showed loliolide as the most abundant compound in BP-6. Supplementation of the in vitro maturation medium with loliolide (0, 2.5, 5, 10 and 25 µg mL<sup>-1</sup>) did not affect any measure of embryo development. All COCs treated with B. pelecinus fractions reached the final stage of embryo development, blastocyst hatching. Total blastocyst cell number was not affected.

**Conclusion.** The presence of fractions of B. pelecinus extract during in vitro oocyte maturation can reduce embryo development.

**Implications.** In vitro techniques can detect potential effects of forages on reproduction. Some fractions from an extract of B. pelecinus when present during oocyte maturation can reduce embryo development. The abundant PSC, loliolide, was not responsible. There was no indication that a PSC in B. pelecinus improves outcomes.

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## Modelling the impact of increasing supplementary feed allowance on predicted sheep enterprise production, profit and financial risk across southern Australia

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Animal Production Science, Volume 64, Issue 16, November 2025 **OPEN ACCESS**

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### Abstract

**Context.** Supplementary feeding may alter sheep enterprise production and profit margin, but use may vary across regions, sheep breeds and mating seasons. Supplementary feeding is a means of ensuring adequate nutrition but increases operating costs. Modelling has previously indicated the most profitable sheep enterprises optimise stocking rate and target lamb production, whereas those that minimise supplementary feeding incur the least financial risk.

**Aims.** To explore the impact of increasing supplementary feed allowance on production, profit and financial risk.

**Methods.** Seventy-two sheep farm enterprises were simulated across eight southern Australian locations, including three breeds and three mating seasons. For each enterprise a low grain allowance (LGA) of 30 kg/head.year (threshold used in previous modelling) was compared to a high grain allowance (HGA) of 35 kg/head.year and 42 kg/head.year for Merino and non-Merino ewes (current industry recommendations), respectively. The financial risk of each enterprise was determined via Conditional Value at Risk of gross margins over 30 years, exploring downside risk in the worst 20% of scenarios.

**Key results.** A HGA increased production and profit in 32% of farm enterprises, but financial risk was often increased. Merino enterprises were generally the most profitable, least risky and consumed the greatest amount of supplementary feed, followed by Composite and then Maternal enterprises. Summer and autumn mating was often most profitable, but high supplement consumption in autumn-mated enterprises increased financial risk.

**Conclusions.** Increasing supplementary feeding may improve production and profit but may also increase financial risk using the parameters examined.

**Implications.** Producers may be able to improve the production, profit and financial risk of an enterprise through increased supplementary feeding, but this will be dependent on breed, input costs, commodity prices and location.

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## The impact of heat stress on growth and resilience phenotypes of sheep raised in a semi-arid environment of sub-Saharan Africa

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### Highlights

- The Red Maasai breed had a higher heat tolerance for growth.
- The F1 had the lowest growth decline per unit increase in Temperature and Humidity.
- Pre-weaning live weight gain was significantly affected by heat stress.
- Heritability estimates for resilience traits were moderate.

### Abstract

Sheep production in Arid and Semi-Arid lands face immense heat stress with the changing climate. This study assessed the effect of heat stress on growth and developed resilience phenotypes of sheep raised in a semi-arid environment. Heat stress was measured by Temperature-Humidity Index (THI). Live body weight records of 4078 animals, belonging to pure Red Maasai (RRRR), pure Dorper (DDDD), and their crosses: 50%Dorper-50%RedMaasai (DDRR) and 75%Dorper-25%Red Maasai (DDDR) collected between 2003 and 2024 were analysed. Random regression models fitted with reaction norm functions were used to develop two resilience phenotypes: Response and Stability, at THI 70 and THI 85 representing varying heat stress. Animal mixed models were used to estimate genetic parameters. The THI breakpoints were 78.75, 78.71, 78.42 and 77.93 with a decline rate of 0.06 Kgs, 0.09 Kgs, 0.05 Kgs and 0.15 in live weight gain per unit change in THI for RRRR, DDDD, DDRR and DDDR respectively. The breed, sex, type of birth, dams' parity and season of birth significantly ( $P<0.05$ ) affected the stability of growth at low and high heat stress. The heritability estimates of resilience traits ranged from 0.12 to 0.16. Genetic correlations of resilience phenotypes at THI 85 with pre-weaning live weight gain were antagonistic and significant ( $P<0.05$ ). With the changing climate, resilience phenotypes should be included in selection programs for sheep in the Arid and Semi-Arid lands for robust growth.

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## Citrulline supplementation does not reverse the effects of late gestation heat stress in ewes on feto-placental development

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### Highlights

- Heat stress shortened gestation. Citrulline and heat stress reduced birthweight.
- Heat stress increased cotyledonary vascular area.
- Female twins had more cotyledons and lower placental efficiency.
- Citrulline lowered rectal temp but did not prevent fetal growth reduction.
- Citrulline increased placental blood volume but reduced fetal vascular area.

### Abstract

Heat stress reduces fetal growth in late gestation in cattle, driven by shifts in placental form and function. Sheep are short-day breeders, but they are also bred off-season, allowing late summer lambing, which is associated with heat stress exposure in late pregnancy. Citrulline is known to induce nitric oxide release and vasodilatation and may not be degraded by the rumen, but its impacts on placental function are unknown. This study aimed to: 1) evaluate the effects of late gestation heat stress on placental/fetal development in

ewes; and 2) evaluate if citrulline supplementation mitigates heat stress impacts. To that end, 28 pregnant ewes were randomly assigned to each treatment in environmental chambers: control (CN; n = 14, 18 °C) or heat stress (HT; n = 14: 28 °C daytime and 25 °C nighttime) during their last month of gestation. Within temperatures, animals received citrulline (0.5 % dry matter intake (DMI), CT) or not (NO), resulting in a 2 × 2 factorial design: CNCT, CNNO, HTCT, and HTNO (n = 7/trt). Respiration rates (RR) and rectal temperature (RT) were measured once weekly and placental perfusion was estimated by quantitative power Doppler ultrasonography at the beginning and 15 days after the start of the experiment. Gestation length (GL) and lamb birth weight (BW) were recorded. Placentas were collected at spontaneous delivery (3 ± 0.66 h postpartum). Data analysis used the GLIMMIX procedure in SAS with fixed effects of ewe, lamb sex, category, treatments, and their interaction. In ewes, HT increased RR, whereas CT decreased RT in both treatments. HT decreased GL and lamb BW tended to be lower in the HTCT group. Placental morphology did not differ among treatments, but female twins had greater cotyledon number and lower placental efficiency. In conclusion, exposure of ewes to HT during late gestation reduced GL, confirming observations in cattle, and CT tended to reduce BW in heat stress conditions. Further investigations are ongoing in placental function and transcriptomics are currently being evaluated.

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### Recombinant equine chorionic gonadotropin for estrus and ovulation induction in ewes: effects on follicular growth, luteal function and fertility

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#### Highlights

- ReCG was effective in promoting follicular growth and ovulation in anestrus ewes.
- ReCG had similar effects of eCG on corpus luteum area and perfusion.
- In anestrus ewes, eCG promoted higher progesterone concentrations than reCG.
- Neither eCG nor reCG affected fertility during transition to the breeding season.

#### Abstract

This study aimed to evaluate the effects of conventional purified equine chorionic gonadotropin (eCG) and recombinant eCG (reCG) on fertility in ewes during anestrus and transition to breeding season. In Experiment 1, 27 ewes received intravaginal devices (IVD) containing progesterone (P4) for 7 d and were allocated to the control, eCG, or reCG groups. At IVD removal, all animals were administered 250 µg cloprostenol, while eCG and reCG groups also received 400 IU eCG and 105 IU reCG, respectively. After IVD removal, the follicular diameter was evaluated at 24, 36, and 48 h, and serum P4 levels were measured on days 7 and 12. In Experiment 2, 391 ewes were allocated to the same groups described in Experiment 1 to evaluate estrus, pregnancy, and conception rates after natural mating. In Experiment 1, eCG (1.07 ± 0.27 mm/day; 100 %) and reCG (1.05 ± 0.27 mm/day; 88.9 %) treatments increased follicular growth (P < 0.05) and percentages of females that ovulated (P < 0.001) compared to those of the control (0.01 ± 0.27 mm/day; 0 % ovulation). Serum P4 concentrations of animals with a single corpus luteum (CL) after treatment (eCG: n = 5; reCG: n = 6) were higher in the eCG than in the reCG group (P < 0.001). In Experiment 2, the estrus rate was higher in eCG (95.27 %) and reCG (88.97 %) than in the control (78.22 %) (P < 0.001). No effect of treatments was observed for pregnancy (P = 0.99) and conception rates (P = 0.37). In conclusion, reCG effectively promotes follicular growth and induces ovulation in anestrus ewes. During the transition to the breeding season, reCG

and eCG increased estrus rate, while pregnancy and conception rates remained unchanged compared with those of the P4 treatment.

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### Effects of different L-carnitine concentrations on post-thaw ram semen characteristics and fertilizing potential

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#### Highlights

- We analyzed the effects of L-carnitine (LC) as a cryo-additive for ram semen cryopreservation.
- Quality parameters illustrated the beneficial effects of LC during cryopreservation process.
- Using 5 mM LC resulted in greater quality parameters and reproductive performance.

#### Abstract

The main goal of the present study was to evaluate the effects of different L-carnitine concentrations on post-thaw ram semen characteristics and fertilizing potential. Five sexually mature Zandi rams (3–4 years of age), with confirmed fertility, were used in the six replicates of this experiment in the breeding season. Semen samples ( $n = 30$ , 6 samples per ram) were collected using an artificial vagina twice a week. Following the collection and initial assessment of ejaculates, all semen samples were pooled to eliminate individual variations. Plant-based freezing extender containing soybean lecithin was supplemented with varying concentrations of L-carnitine (0, 1, 2, 5, and 10 mM), and semen was diluted to a final concentration of  $100 \times 10^6$  spermatozoa/0.25-mL straw before freezing in liquid nitrogen. Sperm motility, viability, mitochondrial function, acrosome integrity, apoptosis, DNA fragmentation, reactive oxygen species accumulation, and fertilizing potential in vivo were assessed. Ram semen cryopreserved in a freezing extender supplemented with 5 mM of L-carnitine exhibited the highest ( $P \leq 0.05$ ) average path velocity and percentages of sperm with total/progressive motility, as well as the highest ( $P \leq 0.05$ ) proportion of sperm with intact mitochondria, plasma membranes, and acrosomes. This dose of L-carnitine was also associated with the lowest ( $P \leq 0.05$ ) levels of apoptosis, DNA fragmentation, reactive oxygen species accumulation, and lipid peroxidation as well as with the highest ( $P \leq 0.05$ ) pregnancy and lambing rates in artificially inseminated ewes. Therefore, supplementing the semen extender with 5 mM of L-carnitine is an effective method for preserving the quality and fertilizing potential of frozen-thawed ram semen.

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### Genetic trends for production and reproduction traits in ultrafine Merino sheep of Uruguay

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#### Abstract

Genetic trends were estimated for production and reproduction traits in an Uruguayan Merino genetic nucleus. Two consecutive periods with different selection objectives were studied. During the first period (1999–2010), the selection objective of this flock focused on reducing fibre diameter (FD), while allowing for a slight loss in clean fleece weight (CFW). From 2011 to 2018, the breeding objective was shifted and then focused on maintaining FD, while increasing both CFW and live weight (LW). Data from approximately 5380 yearling lambs and 2000 ewes born between 1999 and 2018 were analysed. Genetic trends were estimated

for yearling and adult FD (Y\_FD and A\_FD, respectively), yearling and adult CFW (Y\_CFW and A\_CFW, respectively), yearling LW (Y\_LW), 2-year-old ewe mating live weight and mating body condition score (2-yo\_LWM and 2-yo\_BCSM, respectively) and the number of lambs weaned per ewe joined (NLWEJ). Estimated breeding values were predicted to calculate genetic trends for the two periods of selection. From 1999 to 2010, yearling lambs showed significant reductions in FD ( $-0.210 \mu\text{m}/\text{year}$ , corresponding to  $-1.28\%$  of the mean of the trait for that period). Before 2010, yearling lambs showed reductions of  $-0.013 \text{ kg}/\text{year}$  ( $-0.62\%$ ) in CFW, whereas from 2011 to 2018, this trait increased by  $0.052 \text{ kg}/\text{year}$  ( $1.88\%$ ). The annual genetic gain for Y\_LW was greater in the second period than in the first period ( $0.286$  vs.  $0.091 \text{ kg}/\text{year}$ ). The genetic trends for FD, CFW and LW were affected by period ( $p < 0.001$ ), indicating that the change in the selection index applied in the genetic nucleus was effective. Over the entire study period (1999–2018), the total genetic responses for 2-yo\_BCSM and NLWEJ were near zero. These results indicate that the breeding programme utilised in the genetic nucleus improved the traits under selection (FD, CFW and LW) and had a marginal impact on 2-yo\_BCSM and NLWEJ. To also achieve relevant genetic gains in ewe reproductive performance, in the future, reproduction traits should be incorporated into the selection programme for Uruguayan fine-wool sheep. The results obtained in this study will be used to refine the breeding programmes for Merino sheep in Uruguay.

## Upcoming events

Date	Event	Location
3 November 2025	<a href="#">Twilight in the paddock</a> NSW Local Land Services	Armidale, NSW
7 November 2025	<a href="#">Boosting livestock performance with eID</a> Agriculture Victoria	Webinar
13 November 2025	<a href="#">Fencing and Fertility</a> Leading Sheep Qld	Bollon, Qld

## Funding calls

Program	Open	Close
<a href="#">Wean-a-Lamb: Improving weaning rates and system resilience in Western Australian Merino sheep enterprises</a>	14 October 2025	14 November 2025