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# Sheep reproduction RD&A alert

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

The National Sheep Producer Survey has been extended. This biennial survey of sheep producers' benchmarks and tracks the key metrics that underpin the [Sheep Sustainability Framework \(SSF\)](#).



The survey is begin undertaken by kynetec and *should take about 25 minutes*. Producers completing the survey will enter a draw for 1 of 4 \$500 gift cards.

Click [here](#) to access the survey.

For more information on the National Sheep Producer Survey please contact Courtney Nelson, Manager Sheep Sustainability Framework ([cnelson@mla.com.au](mailto:cnelson@mla.com.au)).

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.

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## Review papers

### Developmental programming of the ovarian reserve in livestock

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Animal Reproduction Science, Volume 264, May 2024

DOI <https://doi.org/10.1016/j.anireprosci.2024.107458>

### Highlights

- The size of the ovarian reserve and reproductive tract are positively correlated.
- Developmental programming influences follicle number and reproductive tract size.
- Developmental programming may change how the ovarian reserve influences fertility.

### Abstract

Mammalian females are born with a finite number of follicles in their ovaries that is referred to as the ovarian reserve. There is a large amount of variation between females in the number of antral follicles that they are born with, but this number is positively correlated to size of the ovarian reserve, has a strong repeatability within a female, and a moderate heritability. Although the heritability is moderate, numerous external factors including health, nutrition, ambient temperature, and litter size influence the size and function of the ovarian reserve throughout life. Depletion of the ovarian reserve contributes to reproductive senescence, and genetic and epigenetic factors can lead to a more rapid decline in follicle numbers in some females than others. The relationship of the size of the ovarian reserve to development of the reproductive tract and fertility is generally positive, although some studies report antagonistic associations of these traits. It seems likely that management decisions and environmental factors that result in epigenetic modifications to the

genome throughout life may cause variability in the function of ovarian genes that influence fecundity and fertility, leading to differences in reproductive longevity among females born with ovarian reserves of similar size. This review summarizes our current understanding of factors influencing size of the ovarian reserve in cattle, sheep, and pigs and the relationship of the ovarian reserve to reproductive tract development and fertility. It provides strategies to apply this knowledge to improve diagnostics for better assessment of fertility and reproductive longevity in female livestock.

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## Factors affecting the success of laparoscopic artificial insemination in sheep

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### Highlights

- Artificial insemination with frozen semen is performed via intrauterine laparoscopy.
- Fertility success is governed by male, female and environmental factors.
- In vitro semen assessment is required to determine sire fertility.
- Reducing pregnancy variation will increase adoption, genetic and production gains.

### Abstract

Successful artificial breeding underpins rapid genetic and production gains in animal agriculture. In sheep, artificial insemination with frozen semen is performed via intrauterine laparoscopy as frozen-thawed spermatozoa do not traverse the cervix in sufficient numbers for high fertility and transcervical insemination is anatomically impossible in most ewes. Historically, laparoscopic artificial insemination has always been considered reasonably successful, but recent anecdotal reports of poor fertility place it at risk of warning adoption. Understanding the male, female and environmental factors that influence the fertility of sheep is warranted if the success of artificial insemination is to be improved and genetic progress maximised for the sheep industry. This review details the current practice of laparoscopic AI in sheep. It explores the effects of semen quantity and quality, the ewe, her preparation, and environmental conditions, on the fertility obtained following laparoscopic artificial insemination.

## Scientific papers

### Genetic parameters for ewe lifetime productivity traits in Central Anatolian Merino sheep

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Small Ruminant Research, Volume 233, April 2024

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### Highlights

- Ewe's productivity alters the profitability and efficiency of production systems.
- Heritability for ewe lifetime productivity traits were observed between 0.19 and 0.42.
- Genetic correlations were ranged between -0.56 and 0.99.
- Phenotypic correlations were found to be between -0.12 and 0.94.
- Genetic parameters enable informed mating and herd genetic enhancement for farmers.

### Abstract

Rapidly increasing population size, recent breaks in production and supply chains, due to pandemics, and those further expected because of climate change emphasize the compelling importance of animal productivity. Traits associated with the productivity of ewes have a direct impact on the overall productivity,

profitability and efficiency of sheep farms. Therefore, the objective of the current study was to estimate the variance components, heritabilities as well as genetic and phenotypic correlations, for traits associated with the lifetime productivity of Central Anatolian Merino ewes. Birth and weaning records of lambs for each ewe as well as environmental factors such as sex and birth type were utilized for deriving ewe lifetime productivity traits. Genetic parameter estimations involved observations from 3101 Central Anatolian Merino ewes, encompassing mean and total lamb birth weight per ewe (MBW and TBW), mean and total lamb weaning weight per ewe (MWW and TWW), and the mean and total number of lambs weaned (MNLW and TNLW). This analysis utilized a pedigree comprising 13229 animals. Average Information Restricted Maximum Likelihood (AIREML) based Animal Linear Mixed Model estimations for the decomposition of (co)variance components were implemented based on pedigree-derived numerator relationship matrix by also accounting for the number of parities as a fixed factor. Low to moderate heritability estimates, ranging between 0.29 and 0.42, were observed for the lifetime productivity traits of the breed. A wide range of genetic and phenotypic correlations (between  $-0.56$  and  $0.99$ ) was observed among the traits of interest. The outcomes of the study are anticipated to significantly enhance the global sheep production systems by uncovering the essential parameters for incorporating ewe's lifetime reproductive performance and productivity into the selection indices. This will also benefit Central Anatolian Merino farmers, who form a large proportion of sheep producers in Turkey.

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### Differences in colostrum components of Katahdin ewes varies with post-weaning FEC EBV

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#### Highlights

- Parasite resistant Katahdin ewes had 2.5-fold higher IgG in colostrum.
- Parasite resistant Kathadin ewes had elevated IgG in milk for 60 days post parturition.
- Brix values for Katahdin ewes challenge previous sheep colostrum quality thresholds.
- Parasite resistant Katahdin ewe colostrum was darker and more yellow in color.

#### Abstract

Variation in post-weaning fecal egg count (PFEC) estimated breeding values (EBV) has revealed effects beyond the reduction of parasitism. Previous work demonstrated lambs with a PFEC of  $< -50$  (Low-PFEC) have higher survivability to weaning than lambs with a PFEC of  $> +50$  (High-PFEC). In response to clostridial vaccination, Low-PFEC lambs also generate a more robust and rapid antibody response. These findings prompted curiosity of the maternal influence underpinning differences observed in lamb survivability based upon PFEC genotype. Thus, this study aimed to assess the impact of dam PFEC EBV on IgG concentration, Brix values, and color within colostrum. For Year 1 (YR1), Katahdin ewes from the Virginia Tech SWAREC were selected based on the following criteria: age (3–6 years), have a Katahdin Hair Index EBV ( $>104$ , pre-genomic EBV), and be twin bearing. Ewes fitting those criteria were sorted by their PFEC EBV into two groups: Low-PFEC (PFEC  $< -50$ ;  $n=20$ ) and High-PFEC (PFEC  $> +50$ ;  $n=18$ ) and sampled at three distinct time points, early (within 24-hr post-partition), mid (30-d post-parturition) and late (60-d post-parturition) lactation. For Year 2 (YR2), all lactating ewes at the SWAREC were analyzed and were sorted into three groups: Low-PFEC (PFEC  $< -50$ ;  $n=39$ ), Mid-PFEC ( $-49 < \text{PFEC} < +49$ ;  $n=38$ ), and High-PFEC (PFEC  $> +50$ ;  $n=23$ ) and colostrum samples were taken within 6-hrs post-partition. All colostrum and milk samples were collected by milking 10 mL from each half of the ewes' udder. Total IgG within colostrum and milk was measured using an ovine-specific enzyme-linked immunosorbent assay (ELISA). In YR1, main effects of ewe genotype revealed that Low-PFEC

ewes had a greater concentration of IgG across all lactation time points (631 ng/mL vs 222 ng/mL;  $P < 0.0001$ ). This was primarily driven by IgG differences within colostrum, where a 2.5 fold difference in IgG were observed between Low-PFEC and High-PFEC groups (937 ng/mL vs. 319 ng/mL,  $P < 0.0001$ ). In YR2, a stepwise decrease in average colostrum IgG concentration from Low-PFEC to High-PFEC groups was observed (825 ng/mL, 513 ng/mL, and 258 ng/mL, respectively;  $P < 0.0429$ ). Likewise, a stepwise decrease in yellow to blue hue or  $b^*$  value occurs from Low-PFEC to High-PFEC groups (18.97, 16.91, and 15.22, respectively;  $P < 0.0459$ ). No correlations were found between IgG and Brix values within the Low-PFEC and High-PFEC grouping; remarkably, Mid-PFEC ewes have a slightly positive correlation between IgG and Brix ( $r = 0.34$ ,  $P = 0.0334$ ). These data indicate that Low-PFEC Katahdin ewes generate colostrum with greater antibody concentration and more yellow color. Lambs born to these ewes would have a significant advantage in passive immunity from their dams, which may explain some component of the enhanced lamb survivability observed pre-weaning.

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### A single administration of carbetocin before electroejaculation increases the insemination doses produced from each ejaculate in rams

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#### Highlights

- Carbetocin administration before electroejaculation enhanced volume and sperm concentration in rams.
- The number of insemination doses was doubled following carbetocin administration.
- Percentage of membrane-intact sperm also increased with carbetocin.
- Carbetocin use can be a complement in semen collections with electroejaculation.

#### Abstract

The aim of the study was to determine the effect of carbetocin administration (a long-acting analog of oxytocin) 20 or 10 min before electroejaculation (EE) on the duration of semen collection procedure, quantitative and qualitative characteristics of the ejaculate, and stress biomarkers in rams. Semen was collected from 12 Corriedale rams (age, 2.5–5.5 years old) with EE, in a Latin-square design, administering carbetocin (0.2 mg/100 kg of body weight i.v.) 20 or 10 min before EE, or without carbetocin administration (CB-20, CB-10, and CON treatments, respectively). Each treatment was applied to different rams every 3–4 days, allowing all the rams to receive all three treatments. Carbetocin administered 20 or 10 min before EE increased the number of sperm ejaculated ( $P = 0.01$ ), the semen concentration ( $P = 0.02$ ), the number of insemination doses collected in a single collection ( $P = 0.01$ ), and the number of insemination doses collected/electrical pulses administered ( $P = 0.05$ ) compared to control rams. Carbetocin administered 20 or 10 min before semen collection prolonged the time required for EE and the number of pulses administered during EE compared to CON rams ( $P < 0.03$  for both). The CB-10 rams required the administration of more electrical pulses during ejaculation than CON rams ( $P = 0.001$ ), and CB-20 treatment tended to require more electrical pulses than CON rams ( $P = 0.06$ ). The volume of the ejaculate was greater in CB-10 than in CON rams ( $P = 0.01$ ), and that of CB-20 treatment tended to be greater than CON rams ( $P = 0.08$ ). The percentage of sperm with intact membrane was greater in CB-20 than in CON rams ( $P = 0.01$ ). Total protein, albumin, and globulin concentrations were lower immediately after carbetocin administration 20 or 10 min before EE. The treatments did not affect cortisol concentration, glycemia, rectal and surface temperatures, heart rate, and facial expressions. Carbetocin administration before EE of rams improved the quantitative and

qualitative characteristics of the ejaculate, duplicating the number of insemination doses collected. It can be a promising treatment to obtain a greater quantity of doses to inseminate with a lower frequency of semen collections, reducing the negative impacts of EE on animal welfare.

## Uterine tone influences fertility of Merino ewes following laparoscopic artificial insemination

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DOI <https://doi.org/10.1016/j.theriogenology.2024.04.002>

### Highlights

- Uterine tone scores of 4 and 5 greatly increases the chance of successful pregnancy.
- Program environment and the sire used for insemination can further modify pregnancy results.
- Assessing uterine tone at AI can indicate oestrus synchronisation, ovulation onset and optimal timing of semen deposition.
- Reducing pregnancy variation will enhance the uptake of AI, accelerating genetic and production gains in the sheep industry.

### Abstract

Artificial insemination (AI) plays a critical role in facilitating rapid genetic and production gains within the sheep industry. However, variable rates of AI success remain a concern for the industry and a barrier to adoption. Furthermore, the degree to which female factors influence the success of intrauterine laparoscopic AI rather than natural mating remains unknown. As such, this study investigates the effect of several factors collected during the time of AI, on the success of intrauterine laparoscopic AI. Data was generously donated by artificial breeding companies and stud breeders during routine commercial AI operations. AI data was collected over 3 breeding seasons during commercial AI programs (N = 24 programs) using Merino ewes (N = 24,700). Sire ID (N = 253), time of AI following progesterone removal (approx. 43–59 h post removal), uterine tone and intra-abdominal fat (both scored 1–5) as well as age of the ewe were all recorded at the time of AI. Transcutaneous ultrasound subsequently determined pregnancy rate approximately 55 days post-AI. A multivariate regression analysis was performed and revealed pregnancy success to increase when semen was inseminated into a ewe with a uterine tone score of 4 or 5 ( $P < 0.001$ ). The remaining factors fell short of significance within the multivariate model. An interclass coefficient variation matrix was also used to determine the proportion of variation contributed to AI success by random factors allocated in the model; site, sire, AI date and breeding season (45.99 %, 29.94 %, 15.15 % and 8.92 %, respectively). These results highlight the influence of uterine tone on ewe fertility following laparoscopic AI, but also that program location and the sire used can further modify this influence on pregnancy rate. These factors must now be considered in combination with semen factors per individual sire used during AI to ascertain the contribution of several factors to the success of laparoscopic AI in Australia.

## Upcoming events

Date	Event	Location
08 May 2024	<a href="#">Maximising Dorper reproductive performance in challenging environment</a>	Webinar
29 May 2024	MLA's Productivity & Profitability Series <a href="#">MLP New England Field Day</a> CSIRO, AMSEA & AWI	Uralla, NSW