Sheep reproduction RD&A alert

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

The Managing Merino weaners to survive and thrive project is exploring cost-effective strategies for managing Merino weaners between weaning and their first joining to improve survival and maximise lifetime productivity. The project team is seeking input from Merino producers regarding priorities for managing Merino weaners and maiden ewes for lifetime performance.

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Use this QR code to access an anonymous survey to inform the project team of current management practices for Merino weaners and help shape the direction of the project. The project team is also recruiting producers to be involved by hosting either a study or demonstration sties. For more information, please contact Caroline Jacobson (C.Jacobson@murdoch.edu.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.

Feature project update

Quantifying and improving reproductive performance of shedding sheep

Background

Shedding sheep breeds are becoming increasingly popular in Australia. Shedding breeds are reported to have less seasonality in their reproductive cycle allowing them to lamb year-round and an ability to rear lambs from an early age. However, there is a lack of information regarding the current reproductive performance of commercially managed shedding sheep flocks nor the optimal reproductive management of shedding sheep breeds.

Aim

To quantify the reproductive performance of shedding sheep, identify the causes of reproductive wastage and determine management strategies to mitigate these causes across the range of agro-ecological zones.

Project objectives

- Quantify the current reproductive performance of commercial shedding sheep flocks across Australia,
- Understand the causes of reproductive wastage in shedding sheep and the opportunities for improvement, and
- Support producers to optimise the reproductive performance of shedding sheep through demonstrating successful commercial scale management practices and identifying and developing resources to support industry service providers and producers.

Current progress

The project team is seeking producers running a shedding sheep flock with at least 200 breeding ewes to register their interest in collaborating with the project by completing the shedding sheep reproduction project participation survey. Shedding sheep producers can get involved with the project via:

- hosting a core site - record individual ewe data, pregnancy scan and implement controlled joining strategies.
- participating as a self-reporting site – contribute individual ewe or flock level reproductive data.
- joining the mailing list to keep informed about the project.

For more information on the reproductive performance of shedding sheep project contact Assoc. Prof. Will van Wettere (william.vanwettere@adelaide.edu.au).

Review papers

The role of brown adipose tissue and energy metabolism in mammalian thermoregulation during the perinatal period

Cécile Bienboire-Frosini, Dehua Wang, Míriam Marcet-Rius, Dina Villanueva-García, Angelo Gazzano, Adriana Domínguez-Oliva, Adriana Olmos-Hernández, Ismael Hernández-Ávalos, Karina Lezama-García, Antonio Verduzco-Mendoza, Jocelyn Gómez-Prado and Daniel Mota-Rojas (dmota100@yahoo.com.mx)

Simple Summary

Brown adipose tissue (BAT) is a thermogenic tissue that greatly contributes to preventing neonatal hypothermia by activating biochemical and endocrine processes because of cold stress. The presence of uncoupling proteins and adrenergic receptors in the brown adipocyte initiates the metabolic pathway for heat production. However, the presence and absence of BAT, as well as its activation, location, and the degree of thermogenic response, are traits that depend on intrinsic and extrinsic factors of mammals. The present review aims to discuss the neuromodulation mechanisms of thermoregulation and the importance of BAT, emphasizing the analysis of the biochemical, physiological, and genetic factors that determine the distribution, amount, and efficiency of this energy resource in newborns of different species.

Abstract

Hypothermia is one of the most common causes of mortality in neonates, and it could be developed after birth because the uterus temperature is more elevated than the extrauterine temperature. Neonates use diverse mechanisms to thermoregulate, such as shivering and non-shivering thermogenesis. These strategies can be more efficient in some species, but not in others, i.e., altricials, which have the greatest difficulty with achieving thermoneutrality. In addition, there are anatomical and neurological differences in mammals, which may present different distributions and amounts of brown fat. This article aims to discuss the neuromodulation mechanisms of thermoregulation and the importance of brown fat in the thermogenesis of newborn mammals, emphasizing the analysis of the biochemical, physiological, and genetic factors that determine the distribution, amount, and efficiency of this energy resource in newborns of different species. It has been concluded that is vital to understand and minimize hypothermia causes in newborns, which is one of the main causes of mortality in neonates. This would be beneficial for both animals and producers.

Scientific papers

Prepartum nutrient intake and colostrum yield and composition in ruminants

Koryn S Hare, Amanda J Fischer-Tlustos, Katharine M Wood, John P Cant, Michael A Steele (masteele@uoguelph.ca)

Implications

- Many cattle and sheep do not produce enough colostrum for their offspring.
- Prepartum nutrient intake is an accessible strategy for producers to influence colostrum production.
- Greater prepartum starch intake can influence colostrum composition and increase colostrum yield for beef cattle and ewes.
- Colostrogenesis is sensitive to fat intake, dependent on the dietary fatty acid composition: greater linoleic acid intake often increases colostrum antibody concentration.
- Colostral bioactive compounds are frequently altered by a prepartum diet without changes in overall colostrum composition. Prepartum nutrient intake could be strategically used to maximize beneficial compounds for the newborn.

The importance of colostrum in maternal care and its formation in mammalian species

Craig R Baumrucker (crb@psu.edu), Josef J Gross, Rupert M Bruckmaier

Implications

- Colostrum formation is directed by placental structure and hormone signals
- Quality colostrum is defined by the concentration of immunoglobulin
- Quality colostrum formation in ungulates (hoofed mammals) is dependent on the Fc receptor of the neonate (FcRn)
- While the FcRn binds IgG1, IgG2, and albumin, only IgG1 is transported to colostrum
- FcRn IgG release into colostrum is pH dependent and lactoferrin likely facilitates it release

Development of the mammary glands and its regulation: how not all species are equal

Adam J Geiger and Russell C Hovey (rchovey@ucdavis.edu)

Implications

- Species-specific development of the mammary glands (MG) necessitates the use of appropriate animal models in research.
- The MG of livestock represent a unique model for modeling human breast development.
- The complexities of MG development reveal unique growth regulatory mechanisms.
- The MGs are responsive to nutritional intervention that increases their growth and lactational performance.

The melatonin system is expressed in the ovine uterus: effect of the day of the oestrous cycle and undernutrition

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Abstract

Context: Melatonin influences female reproduction, but expression of the melatonin system has not been characterised in the ovine uterus.

Aims: We aimed to determine whether synthesising enzymes (arylalkylamine N-acetyltransferase (AANAT) and N-acetylserotonin-O-methyltransferase (ASMT)), melatonin receptors 1 and 2 (MT1 and MT2), and catabolising enzymes (myeloperoxidase (MPO) and indoleamine 2,3-dioxygenase 1 and 2 (IDO1 and 2)), are expressed in the ovine uterus, and if they are influenced by the oestrous cycle (Experiment 1) or by undernutrition (Experiment 2).

Methods: In Experiment 1, gene and protein expression was determined in sheep endometrium samples collected on days 0 (oestrus), 5, 10 and 14 of the oestrous cycle. In Experiment 2, we studied uterine samples from ewes fed either 1.5 or 0.5 times their maintenance requirements.

Key results: We have demonstrated the expression of AANAT and ASMT in the endometrium of sheep. AANAT and ASMT transcripts, and AANAT protein were more elevated at day 10, then decreased to day 14. A similar pattern was observed for MT2, IDO1, and MPO mRNA, which suggests that the endometrial melatonin system might be influenced by ovarian steroid hormones. Undernutrition increased AANAT mRNA expression, but seemed to decrease its protein expression, and increased MT2 and IDO2 transcripts, whereas ASMT expression was unaffected.

Conclusions: The melatonin system is expressed in the ovine uterus and is affected by oestrous cycle and undernutrition.

Implications: The results help explain the adverse effects of undernutrition on reproduction in sheep, and the success of exogenous melatonin treatments in improving reproductive outcomes.

Management of body condition score between pregnancy scanning and lamb marking impacts the survival of triplet-bearing ewes and their lambs

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Simple Summary

Body condition score (BCS) is an assessment of the amount of fat and muscle covering the lumbar spine and short ribs of sheep. It is widely used as a management tool to assess the nutritional status of sheep. This study investigated whether managing triplet-bearing ewes at a higher or lower BCS between pregnancy scanning and lamb marking impacted the survival of the ewes or their lambs. Triplet-bearing ewes of Maternal (crossbred or composite) or Merino breed were allocated to one of two treatments at pregnancy scanning: 'High' or 'Low' BCS. The BCS of individual ewes was assessed at pregnancy scanning, pre-lambing and marking, and ewe and lamb mortality to marking, recorded for each mob. Survival of triplet-bearing Merino ewes and their lambs was greater when ewes were managed at the High BCS compared to the Low BCS. The BCS treatment had no effect on the survival of Maternal ewes or their lambs. Survival of triplet-born Merino but not Maternal lambs was greater when ewes had a greater BCS pre-lambing or gained BCS between pregnancy scanning and pre-lambing. Triplet-bearing ewes of Maternal and Merino breed that gained BCS between pregnancy scanning and pre-lambing had greater survival to marking. Producers should,

therefore, manage the nutrition of triplet-bearing Merino ewes so that ewes are in greater BCS at lambing and/or to gain BCS between pregnancy scanning and lambing to improve ewe and lamb survival. Triplet-bearing Maternal ewes should be managed to gain BCS between pregnancy scanning and lambing to improve ewe survival.

Abstract

This study evaluated the impacts of management of body condition score (BCS) between pregnancy scanning and lamb marking on the mortality of triplet-bearing ewes and their lambs at 19 research sites across Southern Australia. Triplet-bearing ewes of Maternal (crossbred or composite) or Merino breed were randomly allocated to treatment at pregnancy scanning at an average of 97 days from the start of joining: High or Low BCS. The BCS of individual ewes was assessed at pregnancy scanning, pre-lambing (average of 137 days from the start of joining) and marking (average of 165 days from the end of joining), and ewe and lamb mortality to marking, recorded for each mob. The average BCS at pregnancy scanning was 3.4 for Maternal ewes and 3.3 for Merino ewes. There were no breed by BCS treatment effects on the BCS of ewes at pregnancy scanning or lamb marking or on the change in BCS between pregnancy scanning and pre-lambing or between pre-lambing and marking. The change in BCS differed between the High and Low BCS treatments, between pregnancy scanning and pre-lambing (0.12 vs. −0.33; $p < 0.001$) and between pre-lambing and marking (−0.39 vs. 0.07; $p < 0.001$) but did not differ between breeds. The average BCS at marking for ewes managed at the High and Low BCS treatments was 3.1 and 3.0 for Maternals and 3.0 and 2.8 for Merinos. Survival of triplet-bearing Merino ewes ($p < 0.01$) and their lambs ($p < 0.001$) was greater when ewes were managed at the High BCS compared to the Low BCS. The BCS treatment did not impact the survival of Maternal ewes or their lambs. The survival of Merino but not Maternal lambs was higher when ewes were in greater BCS pre-lambing ($p < 0.01$) and when ewes gained BCS between pregnancy scanning and pre-lambing ($p < 0.01$). Ewe mortality was lower when ewes gained BCS between pregnancy scanning and pre-lambing ($p < 0.05$). Merino ewes were more likely to die than Maternal ewes for a given change in BCS between pregnancy scanning and pre-lambing ($p = 0.065$). Overall, our findings demonstrate that producers should manage the nutrition of triplet-bearing Merino ewes so that ewes are in greater BCS at lambing and/or to gain BCS between pregnancy scanning and lambing to improve ewe and lamb survival. Triplet-bearing Maternal ewes should be managed to gain BCS between pregnancy scanning and lambing to improve ewe survival.

Automatically identifying sickness behavior in grazing lambs with an acceleration sensor

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Simple Summary

Behavioral patterns of grazing lambs associated with sickness were evaluated using a model of infusion with the endotoxin lipopolysaccharide (LPS), which can lead to subclinical symptoms of disease. Acceleration sensors are validated to have the potential to identify behavioral patterns of farm animals, which can indicate a deterioration in health. However, there is limited research on automatic identification of sickness behavior of grazing lambs. In the present study, the commercial ear-mounted CowManager SensOor (Agis, Harmelen, The Netherlands) was used to detect the changes in behavioral patterns of grazing lambs and showed promising potential for accurately identifying the sickness behavior of grazing lambs.

Abstract

Acute disease of grazing animals can lead to alterations in behavioral patterns. Relatively recent advances in accelerometer technology have resulted in commercial products, which can be used to remotely detect changes in animals' behavior, the pattern and extent of which may provide an indicator of disease challenge and animal health status. The objective of this study was to determine if changes in behavior during use of a lipopolysaccharide (LPS) challenge model can be detected using ear-mounted accelerometers in grazing lambs. LPS infusion elevated rectal temperatures from 39.31 °C to 39.95 °C, indicating successful establishment of an acute fever response for comparison with groups ($p < 0.001$). For each of the five recorded behaviors, time spent eating, ruminating, not active, active, and highly active, the accelerometers were able to detect an effect of LPS challenge. Compared with the control, there were significant effects of LPS infusion by hour interaction on durations of eating (−6.71 min/h, $p < 0.001$), inactive behavior (+16.00 min/h, $p < 0.001$), active behavior (−8.39 min/h, $p < 0.001$), and highly active behavior (−2.90 min/h, $p < 0.001$) with a trend for rumination time (−1.41 min/h, $p = 0.075$) in lambs after a single LPS infusion. Results suggest that current sensors have the capability to correctly identify behaviors of grazing lambs, raising the possibility of detecting changes in animals' health status.

Reaction-norm analysis of neonatal lamb mortality suggests heritability varies with cold-stress: an example in the Elsenburg Merino selection lines

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Abstract

Context: Coping with high levels of cold stress should be beneficial to survival of lambs, given the high mortality rate associated with severe winter storms. The Elsenburg Merino selection experiment involved divergent selection for reproduction. Phenotypic results comparing the positively selected H-Lines and negatively selected L-Lines suggested that cold-stress adaption could have contributed to the favourable genetic trends for survival of H-Line lambs. However, observing the genetic merit of better adapted animals depends on the presence of cold stress at the time of recording. A genotype by environment component (G × E) could, thus, be important when assessing survival/mortality phenotypes.

Aim: This study proposed the genetic analysis of this possible G × E component and compared the H- and L-Lines in this regard.

Methods: The sire model allowed the use of progeny phenotypes for neonatal mortality recorded during different levels of cold stress, and the possible G × E could be investigated through the reaction-norm approach. Genetic parameters were evaluated as random regression components by implementing a Gibbs sampling approach. A data set of 5723 individual lamb records was analysed as the progeny of 213 sires.

Results: A modelled G × E component played an important role in mortality outcomes, with the mean estimate (and 95% confidence interval) for the slope (AN22464_IE1.gif) only marginally smaller than the corresponding estimate for the intercept (AN22464_IE2.gif). The reaction-norm model showed a higher heritability ($h2 \pm$ posterior standard deviation) for mortality at 3 days of age during high cold-stress (0.22 ± 0.16 at ~1100 KJm−2h−1) than during mild (0.13 ± 0.10 at ~960 KJm−2h−1) conditions, suggesting a greater ability to discriminate between sires at increasing stress levels.

Conclusions: Failure to account for this G × E component putatively contributes to the low h2 commonly reported for survival traits. The higher h2 at increased levels of cold stress could have played an important part in the higher survival of the H-Line progeny, who were better at coping with cold, wet and windy conditions.

Implications: Larger studies representing a wider environmental trajectory are recommended. This should be very feasible since cold stress can be derived from commonly available weather-station data.

The genetic and phenotypic associations between lamb survival outcomes and other traits recorded at lambing

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Abstract

Context: Australian sheep breeding values (ASBVs) for lambing ease (LE) are estimated by Sheep Genetics, by using a threshold animal model at the lamb level, in a tri-variate analysis that includes data on birth weight, gestation length and lambing ease score. The implications of these traits for lamb survival, or the use of other indirect traits to improve accuracy of ASBVs for LE, are not currently being considered. Ultimately, it is desirable to extend the analysis to outcomes for individual lamb survival.

Aim: The present study investigated implications of LE for lamb survival outcomes, accounting for litter size, and examined associations with other traits recorded at or shortly after lambing in maternal sheep breeds.

Methods: Equivalent linear models were used to compare lamb- and ewe-level models with various combinations of additional random effects. In particular, lambing ease was treated as a different trait for single-born and twin-born lambs, to identify changes in genetic correlations associated with litter size between LE and other traits. Other traits included lambs recorded dead at birth, survival to weaning, lamb birth weight, gestation length and maternal behaviour score.

Key results: Individual lamb survival outcomes inferred from field data and dead at birth lambs, are lowly heritable traits influenced by both direct and maternal effects. Lamb survival is positively correlated with birth weight, but negatively correlated with gestation length, lambing ease score (increasing lambing difficulty) and dead at birth lambs. Genetic and phenotypic correlations demonstrated that birth weight and lambing ease are antagonistic traits, more so for single-born lambs. Genetic correlations were moderate between dead at birth lambs and LE (0.40–0.45 singles; 0.15–0.36 including data from twins) or lamb survival (−0.63 to −0.81 singles; −0.00 to −0.23 including data from twins) and can add to the accuracy of genetic evaluation for these traits. In contrast, maternal behaviour score was predominantly an ewe trait, and will therefore add to accuracy of evaluation only for maternal effects. Lamb-level models appeared to underestimate heritability, sometimes compensated for by larger variance, and over-estimate genetic correlations for some traits relative to ewe-level models.

Conclusions: Expanding the current lambing ease analysis to include dead at birth records and lamb survival outcomes would provide more detailed options for breeders to develop breeding goals to improve outcomes for both ewes and lambs. Further work is required to expand analyses to include threshold and continuous traits and understand genetic contributions to ewe survival traits.

Implications: Relative selection emphasis on LE and birth weight must be considered in light of the expected litter size in which lambs will be born, to ensure favourable outcomes for lamb survival overall. Accuracy of genetic evaluation for LE can be improved using data on dead at birth. Equivalent ewe model analyses are possible. Completeness of pedigree, availability of informative lamb level data and integration with other traits are also factors to consider for the choice between operational lamb- versus ewe-level models for genetic evaluation systems.

Development and evaluation of an injectable slow-release progesterone formulation for estrus synchronization in ewes out of the breeding season

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Abstract

This study was aimed at developing a type of slow-release progesterone micro-particles useable in a single intramuscular injection for estrus synchronization in non-breeding season ewes. A total of 66 ewes were randomly assigned into four groups: CIDR (n = 16): exposed to intravaginal CIDR for 12 days, and three experimental groups, i.e., T100 (n = 16), T150 (n = 17) and T200 (n = 17), receiving a single intramuscular injection of 100, 150 and 200 mg slow-release progesterone, respectively. Blood sampling was performed on all ewes at five different times, and the ELISA method measured progesterone levels. No significant differences were observed in progesterone levels among the groups in each sampling time. More than 90% of ewes in the CIDR, T100 and T150 groups and all those in T200 showed estrus behaviour, and the rate was not significantly different between groups. The difference in the mean interval from progesterone treatment to estrus was also insignificant. The parturition rate declined by increasing the dose of injected progesterone; although it was similar in CIDR and T100 groups, it decreased significantly in T150 and T200. Since our injectable progesterone formulation was successful in the induction and synchronization of estrus in ewes out of the breeding season, it can be applied as an alternative to the conventional progesterone containing intravaginal devices.

Investigation of the effects of syringic acid supplemented to Tris semen diluent on ram semen freezability

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Abstract

To the best of our knowledge, no research has been conducted to test the effects of syringic acid (SA) on ram semen freezing within the scope of natural antioxidants added to semen extenders. Therefore, this study had two main objectives. First, to test whether adding SA to ram semen freezing extender has a protective effect and contributes positively to sperm kinetic, plasma and acrosome integrity, mitochondrial membrane potential, lipid peroxidation, oxidant and antioxidant and DNA damage parameters after thawing. Second, it was to determine at what concentration the SA supplemented to the extender could be applied by in vitro studies by preserving the fertilization ability of frozen semen at the highest level. In the study, six individuals of Sönmez rams were used. The semen was collected from the rams using an artificial vagina and pooled. The pooled semen was divided into five different groups and extended with 0, 0.5, 1, 2 and 4 mM SA (control C, SA0.5, SA1, SA2 and SA4, respectively). After dilution, the semen samples were kept at 4°C for 3 h, then loaded into 0.25 mL straws and frozen in liquid nitrogen vapour. The SA1 and SA2 groups were higher plasma membrane and acrosome integrity (PMAI), high mitochondrial membrane potential (HMMP), plasma membrane integrity and motility compared to other groups (p < .05). It was observed that SA supplemented to the Tris extender significantly reduced DNA damage, and the lowest values were obtained especially in the SA1 and SA2 treatments (p < .05). Also, lowest MDA level was determined at the SA1 and this was statistically significant compared to SA4 and C (p < .05). In conclusion, it was revealed that SA added to Tris semen extender at 1 and 2 mM treatment doses increased progressive and total motility and preserved PMAI, plasma membrane integrity, HMMP and DNA integrity.

Genetic benchmarking of maternal sheep flocks using genomic testing

D.J. Brown (dbrown2@une.edu.au), P.M. Gurman and A.A. Swan

Summary

This study aimed to examine the predictive ability of the "Flock Profile" genomic benchmarking method in maternal sheep flocks, estimated from the Maternal LAMBPLAN analysis. Data from this analysis was used in a validation study to test the accuracy of predicting mean flock performance for reproductive traits. For each validation flock, the pedigree, genotypes and performance data were removed for the entire flock and then its Flock Profile result was estimated from genomic predictions based on estimated SNP marker effects from single step genomic BLUP analyses (ssGBLUP). The Flock Profile results were then compared to the original Australian Sheep Breeding Values (ASBVs) from the full analysis. The accuracy of ranking of mean flock performance was high (r>0.85) for all traits except ewe rearing ability. However, the Flock Profile results were generally over-dispersed and thus had more variation compared to their ASBVs. Genomic predictions for individual animals were also highly correlated to the full ASBVs. This initial study supports further investment into the development of these products, with the potential to offer commercial producers new genetic tools to foster ongoing improvement in on-farm profitability.

Preliminary evaluation of the impact of visual traits on lifetime ewe performance

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Summary

Visual traits are considered valuable components within the breeding objectives of many Merino breeders. This paper aimed to estimate genetic and phenotypic correlations between visual traits and growth, body composition, reproduction and survival in adult ewes. The data were derived from Merino Lifetime Productivity (MLP) sites. Heritability estimates were high for body weight, eye muscle depth, fat depth, body wrinkle, breech wrinkle, breech cover and classer grade (0.32 – 0.64), moderate for urine stain (0.21) and legs score (0.23) and low for weaning rate (0.07) and ewe survival (0.06). Low to moderate negative (favourable) genetic correlations were estimated between the visual traits and body weight and composition, reproduction, and survival traits. Phenotypic correlations between the visual traits and adult body composition and weaning rate traits were negative and low. The genetic and phenotypic correlations estimated in this study were generally favourable hence consideration of visual traits in selection and classing may have beneficial effects on adult ewe performance.

Comparison of udder and teat traits in Merino ewes recorded at lambing and weaning

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Summary

In Australia, there is currently no standard system for assessing ewe udder traits for genetic improvement. The aim of this study was to provide preliminary genetic parameter estimates of four visually scored udder

and teat traits recorded at lambing and weaning, to inform recommendations about how and when to record udder and teat traits. Udder depth, teat size and teat placement were moderately heritable at both lambing and weaning (0.23 ± 0.08 to 0.36 ± 0.09) and the traits recorded at the two stages showed high genetic correlations (udder depth 0.75 ± 0.14; teat size 0.79 ± 0.12; teat placement 0.70 ± 0.16). Udder cleft, showed lower heritability, and lower genetic correlation across the two stages, with increased phenotypic variance from lambing to weaning. These results suggest that either stage is appropriate for recording udder depth, teat size and teat placement for genetic improvement of Australian Merinos.

Match birthweight ASBVs to flock fecundity for lamb survival

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Summary

Selection of sires with high growth rates may unintentionally reduce lamb survival via dystocia due to the genetic relationships between high growth rates and birthweight. A range of Australian Sheep Breeding Values (ASBVs), including birthweight, lambing ease and gestation length, can be used as selection criteria to genetically increase lamb survival. However, their impact on lamb survival is likely to vary between birth types. Relationships between lambing ease scores, birth weights, gestation length and lamb survival of crossbred lambs born to Merino ewes from the MLA Resource Flock were quantified. Across all birth types, lamb survival was greatest for unassisted lambs; assisted lambs were of low incidence and above average birthweight. Increased lambing ease scores (i.e. more lambing difficulty) were associated with longer gestation length, higher birthweight and poorer lamb survival. Higher birthweight ASBVs were associated with increased lamb survival, but this was dependent on litter size and the lamb surviving parturition. Less fecund commercial flocks that experience dystocia related issues should place an upper limit on birthweight ASBVs and include lambing ease and gestation length ASBVs in their ram selection decisions. These flocks will also need to management ewe nutrition during late pregnancy, to ensure their single bearing ewes do not produce heavy lambs.

Genome wide association study and heritability estimates for ram semen traits

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Summary

Ram semen traits influence conception outcomes, which in turn, may influence reproductive efficiency in sheep. As such, this study aimed to estimate genetic parameters and identify Quantitative Trait Loci (QTLs) associated with ram semen traits including volume (VOL), gross motility (GM), concentration (CONC), and percentage post thaw motility (PPTM) in a resource population consisting of five sheep breeds common to Australia. Over 11,000 semen collection records were used to estimate the heritability of semen traits (h2 = 0.081–0.170). Genome-wide association (GWA) analysis was subsequently performed using a subset of genotyped animals with 5,363 semen collection records. A total of 34 QTLs located on 16 chromosomes were found to be significantly associated with semen traits. Several candidate genes that have previously been linked to male fertility were identified within these QTLs.

Identification of biomarkers affecting cryopreservation recovery ratio in ram spermatozoa using Tandem Mass Tags (TMT)-based quantitative proteomics approach

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Simple Summary

Sperm cryopreservation is one of the key procedures in artificial insemination technology. With the continuous development of cryopreservation technology, the survival rate of frozen sperm has been greatly improved, and it is widely used in artificial insemination technology. However, the molecular regulation of sperm cryopreservation recovery ratio in rams remains poorly understood. The main objective of this study was to gain a better understanding of the biomarkers that play a role in sperm freezing tolerance in the proteome levels of the rams. Our results confirm that some proteins and pathways associated with high and low cryopreservation recovery ratios were identified. These findings related to sperm freezing tolerance improve our understanding of molecular mechanisms of sperm resistance to low-temperature environments, and are helpful for livestock breeding.

Abstract

Sperm proteins play vital roles in improving sperm freezing resilience in domestic animals. However, it remains poorly defined which proteins regulate the freezing resilience of spermatozoa in rams (Ovis aries). Here, we compared the proteome of ram sperm with a high cryopreservation recovery ratio (HCR) with that of ram sperm with a low cryopreservation recovery ratio (LCR) using a tandem mass tag-based quantitative proteomics approach. Bioinformatic analysis was performed to evaluate differentially expressed proteins (DEPs). A total of 2464 proteins were identified, and 184 DEPs were screened. Seventy-two proteins were higher in the LCR group. One hundred and twelve proteins were more abundant in the HCR group, and they were mainly involved in the regulation of oxidative phosphorylation and thermogenesis pathways. Proteins in high abundance in the HCR group included the S100A family, such as S100A8, S100A9, S100A14, and S100A16, effectively controlling for CA2+ and maintaining flagella structure; HYOU1 and PRDX1, which participate in antioxidant protection and anti-apoptosis to prevent cell death; and HSP90B1, which maintains cell activity and immune response. Our results could help illuminate the molecular mechanisms underlying cryopreservation of ram semen and expand the potential direction of cryopreservation of high-quality semen.

Body composition estimation in breeding ewes using live weight and body parameters utilizing image analysis

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Simple Summary

Monitoring animal condition is integral for maintaining a healthy flock, increasing ewe productivity, refining animal nutrition, and identifying suitable animals for slaughter. Accurate determination of the body compositions (the amount of fat, muscle, and bone) of ewes can be used to evaluate their conditions, which provides key information to make management decisions. Farmers currently rely on live weight (LW) and body condition score (BCS) to evaluate the health statuses of ewes. This research proposed the use of visual imaging to determine body dimensions, which are then used in combination with LW to predict the body compositions of ewes. The results showed a correlation between fat, muscle, and bone weight determined

by computerized tomography (CT) and the fat, muscle, and bone weight estimated by the live weight and body parameters calculated using the image processing application. The results showed an optimal fat of 9% of LW for ewes during the production cycle. If the percentage of fat is less than or more than 9%, farmers have to take action to improve the conditions of the animals to ensure the best performance during weaning and ewe and lamb survival during the next lambing.

Abstract

Farmers are continually looking for new, reliable, objective, and non-invasive methods for evaluating the conditions of ewes. Live weight (LW) and body condition score (BCS) are used by farmers as a basis to determine the condition of the animal. Body composition is an important aspect of monitoring animal condition. The body composition is the amount of fat, muscle, and bone; knowing the amount of each is important because the information can be used for better strategic management interventions. Experiments were conducted to establish the relationship between body composition and body parameters at key life stages (weaning and pre-mating), using measurements automatically determined by an image processing application for 88 Coopworth ewes. Computerized tomography technology was used to determine the body composition. Multivariate linear regression (MLR), artificial neural network (ANN), and regression tree (RT) statistical analysis methods were used to develop a relationship between the body parameters and the body composition. A subset of data was used to validate the predicted model. The results showed a correlation between fat, muscle, and bone determined by CT and the fat, muscle, and bone weight estimated by the live weight and body parameters calculated using the image processing application, with $r2$ values of 0.90 for fat, 0.72 for muscle, and 0.50 for bone using ANN. From these results, farmers can utilize these measurements to enhance nutritional and management practices.

QTLs and candidate genes associated with semen traits in Merino sheep

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Simple Summary

Ram semen traits including volume, gross motility, concentration, and percent post-thaw motility are routinely assessed prior to use in artificial breeding programs, as they have been shown to influence conception outcomes. Semen quality and associated traits are complex but heritable, and as such, identifying genes that underlie variability in these traits may help develop alternative means to improve conception outcomes and therefore reproductive efficiency in sheep. Therefore, the aim of this study was to identify genomic regions and associated genes that may significantly influence semen traits like volume, gross motility, concentration, and percent post-thaw motility in Merino sheep. Assessment of over 20 years' worth of semen collection data identified 35 genomic regions to be significantly associated with Merino ram semen volume, gross motility, concentration, and percent post-thaw motility. A total of 290 candidate genes were identified within genomic regions found to be significantly associated with Merino ram semen traits. All Merino ram semen traits were also found to be lowly heritable, affirming results from previous studies. Validation of candidate genes identified in the current study could provide novel insights into molecular mechanisms contributing to variability in semen associated traits.

Abstract

Ram semen traits play a significant role in conception outcomes, which in turn may influence reproductive efficiency and the overall productivity and profitability of sheep enterprises. Since hundreds of ewes may be inseminated from a single ejaculate, it is important to evaluate semen quality prior to use in sheep breeding

programs. Given that semen traits have been found to be heritable, genetic variation likely contributes to the variability observed in these traits. Identifying such genetic variants could provide novel insights into the molecular mechanisms underlying variability in semen traits. Therefore, this study aimed to identify quantitative trait loci (QTLs) associated with semen traits in Merino sheep. A genome-wide association study (GWAS) was undertaken using 4506 semen collection records from 246 Merino rams collected between January 2002 and May 2021. The R package RepeatABEL was used to perform a GWAS for semen volume, gross motility, concentration, and percent post-thaw motility. A total of 35 QTLs, located on 16 Ovis aries autosomes (OARs), were significantly associated with either of the four semen traits in this study. A total of 89, 95, 33, and 73 candidate genes were identified, via modified Bonferroni, within the QTLs significantly associated with volume, gross motility, concentration, and percent post-thaw motility, respectively. Among the candidate genes identified, SORD, SH2B1, and NT5E have been previously described to significantly influence spermatogenesis, spermatozoal motility, and high percent post-thaw motility, respectively. Several candidate genes identified could potentially influence ram semen traits based on existing evidence in the literature. As such, validation of these putative candidates may offer the potential to develop future strategies to improve sheep reproductive efficiency. Furthermore, Merino ram semen traits are lowly heritable (0.071–0.139), and thus may be improved by selective breeding.

Ewe udder and teat traits as potential selection criteria for improvement of Merino lamb survival and growth

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Highlights
- Udder and teat traits are moderately heritable in Australian Merinos.
- Genetic relationships among udder and teat traits are generally favourable.
- Lambs born to ewes with unsound udders are at increased risk of neonatal mortality.
- Including ewe udder traits in breeding programs could improve lamb survival and growth.

Abstract

Neonatal lamb mortality is a major economic and welfare issue for Australian sheep producers. The contribution of udder and teat traits of the dam to the survival and subsequent growth of the lamb is relatively unknown. This study aimed to estimate phenotypic and genetic parameters associated with objectively measured and visually scored udder and teat traits in Australian Merino sheep, and to evaluate the impacts of udder and teat traits of the dam on survival and growth of their lambs to weaning. Ewes from the New England Merino Lifetime Productivity flock (n = 1341 ewes) were assessed for udder and teat traits, and phenotypic and genetic parameters for individual traits and relationships among them were estimated using linear mixed models. Odds ratios were calculated to investigate the influence of udder soundness on lamb mortality. Further, the influence of udder traits on variation in lamb weaning weight was explored. Measured udder and teat size traits were estimated to have moderate to high heritabilities (0.32 (0.09) to 0.56 (0.10)), while the heritabilities of visually scored traits were lower (0.09 (0.05) to 0.17 (0.07)). Measured traits were highly correlated genetically with their equivalent visually scored traits. The odds ratio of mortality for lambs born to ewes with unsound versus sound udders was 1.54 (95 %CI 1.1–2.2, P < 0.05). The odds ratio of lamb mortality from starvation compared to all other causes of death for lambs born to ewes with unsound versus sound udders was 4.62 (95 %CI 2.4–8.9, P < 0.001). Dam udder and teat traits collectively contributed 8 % of the variation in lamb weaning weight observed. Results suggest that targeting optimal ewe udder and

teat characteristics in sheep breeding programs has the potential to significantly improve lamb survival and growth in extensive production systems.

Programmed parturition assistance (PPA) in primiparous wool-type ewes improves mother-lamb behaviour at lambing

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Abstract

The effect of programmed assistance at parturition on the behaviour of the mother and its offspring in primiparous ewes under extensive rearing was evaluated. Programmed parturition assistance was defined as the manoeuvres performed immediately after the beginning of the expulsion phase to shorten it. Twenty-eight 2-year-old Corriedale primiparous ewes (body condition score (BCS): 3.4 ± 0.1; body weight (BW): 35.5 ± 0.7 kg) with a single foetus were used. Before lambing and considering BW, BCS and sire, the ewes were randomly assigned to (i) Programmed-parturition-assisted (PPA; n = 14): ewes whose lambing was programmed to be assisted or (ii) Not-assisted (NA; n = 14): ewes that were not assisted and their lambs were born through natural labour. The duration of the foetus expulsion phase, maternal behaviour score (MBS, 1–5), onset of grooming, lamb/ewe BW ratio and lamb desertion were determined in the ewes. Birth weight, Apgar test (score 0–10), O_2 saturation, meconium-stained coat, latency to first bleat, success to stand and suck, were registered in the lambs. PPA ewes registered shorter duration of labour (19.2 ± 4.2 vs. 42.6 ± 7.8 min), earlier onset of grooming (1.2 ± 0.4 vs. 3.0 ± 0.6 min), higher MBS (4.5 ± 0.1 vs. 3.1 ± 0.4) and did not desert any lamb during the first 72 h from birth. The lambs born to PPA mothers registered higher O_2 saturation (97.6 ± 1.0 % vs. 93.4 ± 1.3 %), bleated earlier (2.4 ± 0.5 vs. 4.6 ± 0.8 min), stood up earlier (24.1 ± 4.2 vs. 36.8 ± 8.0 min) and recorded shorter time to suck (36.5 ± 6.7 vs. 71.0 ± 12.9 min). No effect of treatment on Apgar test or meconium-stained coat was observed, but regardless of treatment, meconium-stained lambs had a higher lamb/ewe BW ratio than unstained ones. The reduction of the duration of foetal expulsion phase, through programmed parturition assistance, positively affected the vigour of the lambs as well as the maternal behaviour of primiparous ewes, which in turn would increase the chances of lamb survival and ultimately, improve the welfare of the ewe-lamb unit.

Progressive weaning alters behaviour and biomarkers of stress in weaned lambs subjected to social isolation

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Abstract

The mother-young contact during suckling influences the development of the offspring and their stress-coping abilities. Progressive weaning reduces the stress response in lambs as the separation time increases gradually until permanent maternal deprivation. The aim of this study was to determine if repeated maternal deprivation in suckling lambs alters their behavioural, physiological and immunological responses to social isolation after weaning. Twenty-four Saint Croix single born-lambs remained with their mothers for their first 29 days of age. Thereafter, 12 lambs were temporarily separated from their mothers every day for 4 weeks, during 4 h/d the first week, increasing 4 h weekly until they were separated 16 h/day (progressive weaning

group: PW). During the progressive separation, PW lambs were moved to an enclosed pen, where they did not have visual or olfactive communication with their mothers. The other 12 lambs remained in permanent contact with their mothers until the definitive separation of both groups at 61 days old (abrupt weaning group: AW). At day 90 of age, all lambs were individually isolated for 10 min in a novel place, alternating one lamb from each group. Lambs' behaviour was video recorded during the test. Cortisol concentration and haematological measurements were determined before and after the test. The PW lambs crossed more lines (P = 0.007), attempted to escape more times (P = 0.009), displayed more freezing behaviour (P = 0.01) and tended to vocalise more than AW lambs (P = 0.054). The AW lambs tended to sniff more times (P = 0.09) than the PW lambs. Cortisol concentration and the percentage of monocytes were lower in PW than in AW lambs (P ≤ 0.04). In conclusion, lambs repeatedly deprived of their mother displayed a more intensive behavioural response to social isolation one month after the definitive separation from their mothers. Progressive weaning reduced the cortisol concentration and the percentage of monocytes. These results call attention to the importance of further studies being undertaken in reference to the short and long-term effects of different procedures applied in order to better improve mother and the lamb welfare before artificial weaning.

Level of feeding and stage of maturity affects diet digestibility and protein and fat deposition in cross-bred lambs

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Abstract

Metabolizable energy intake is the key determining factor for the expression of an animal's genetic potential for growth, and current predictive growth models are not capable of accounting for all the nutritional variation that is commonly observed. The current study was designed to investigate energy transactions as lambs grow using CT scanning to assess body compositional changes at two levels of intake and two stages of maturity, and compare results to predictive equations.

A pelleted diet was provided to cross-bred lambs (n = 108) at approximately 2.5 and 3.5% of liveweight (LW) in dry matter when the lambs were approximately four (31.8 ± 0.3 kg LW) and eight (40.5 ± 0.3 kg LW) months of age. A digestibility trial was run sequentially using 10 lambs of the same genetic and nutritional history fed at the same feeding levels to determine the digestibility of the diet.

In the first feeding period, metabolizable energy intake was 15.3 ± 0.03 and 9.5 ± 0.03 MJ ME/d for high and low feeding levels respectively, resulting in higher rates of empty body gain for high feeding level lambs (197.7 ± 7.8 vs. 72.8 ± 8.2 g/d; P < 0.001). In the second feeding period, metabolizable energy intake was 15.2 ± 0.01 and 12.0 ± 0.01 MJ ME/d for high and low feeding levels respectively, resulting in higher rates of empty body gain for high feeding level lambs (176.3 ± 5.4 vs. 73.9 ± 5.3; P < 0.001).

Lambs at later stages of maturity retained proportionately more energy as fat for every unit of retained energy compared to younger lambs (95.4 ± 0.40 vs. 90.0 ± 0.42%; P < 0.001). Lambs fed the lower feeding level in period two also retained proportionately more energy as fat for every unit of retained energy than lambs at the higher feeding level (97.1 ± 0.36 vs. 94.0 ± 0.37%; P < 0.001) which is hypothesized to be because of the rapid response of visceral lean tissue to changes in nutrition. There were no significant interactions between treatments in the first and second feeding periods, indicating an absence of a compensatory gain response to a nutritional restriction in the first feeding period.

This experiment highlights the significance of a changing feed supply and the subsequent effects on body composition and the partitioning of energy to lean and fat tissue deposition. For improvements in the

accuracy of predictive ruminant growth models it is necessary to gain a greater understanding of the different tissue responses over time to changes in nutrition.

Upcoming events

Date	Event	Location
2 August 2023	Winning with Weaners Sheep Connect NSW	Walcha, NSW
3 August 2023	Winning with Weaners Sheep Connect NSW	Guyra, NSW
6 August 2023	Sheepvention Rural Expo Hamilton Pastoral & Agricultural Society Inc.	Hamilton, Vic
8 August 2023	RAMping Up Repro Sheep Connect NSW	Eurongilly, NSW
10 August 2023	Meat Up Forum Meat & Livestock Australia	Cowra, NSW
10 August 2023	RAMping Up Repro Sheep Connect NSW	Henty, NSW
10 August 2023	EID & Preventative health workshop for sheep and goats NSW Local Land Services	Fitzroy Falls, NSW
11 August 2023	Facey: Knee Deep in Sheep WALRC & Facey Group	Wickepin, WA
11 August 2023	BredWell FedWell Sheep workshop Meat & Livestock Australia	Armatree, NSW
11August 2023	RAMping Up Repro Sheep Connect NSW	Goulburn, NSW
11 August 2023	BredWell FedWell Sheep workshop Meat & Livestock Australia	Mullengandra, NSW
17 August 2023	Winning with Weaners Sheep Connect NSW	Nyngan, NSW
24 August 2023	Winning with Weaners Sheep Connect NSW	Grenfell, NSW
28 August 2023	BredWell FedWell sheep workshop Meat & Livestock Australia	Keyneton, SA