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Texel and Dohne Merino Highlight Preweaning Growth in the High Andean Highlands of Peru: A Comparative Study of Six Sheep Breeds

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ABSTRACT

Sheep production in the high Andean regions of Peru faces several challenges, including low productive performance, particularly during the pre-weaning stage. Therefore, the appropriate selection of breeds adapted to these conditions could significantly improve growth indicators and increase the profitability of the production system. The study aimed to compare the behavior of preweaning growth criteria in male and female lambs of six sheep breeds (Dohne Merino, Corriedale, Texel, Poll Dorset, Finnish Landrace, and East Friesian) raised in the high Andean conditions of Peru. A total of 199 live weight records of lambs were evaluated at birth, 25, 60, 90 days, and weaning. The analysis of variance revealed significant differences between breeds, separated by sex, and the Principal Component Analysis examined patterns of variation among variables and breeds. The results showed that males of the Texel breed had a higher average weight at 60 days, while the Dohne Merino breed stood out in terms of birth weight. In females, Texel and Dohne Merino were the breeds with the highest weights at 90 days and weaning. PCA analysis revealed a positive correlation between 60-day, 90-day, and weaning weights, although no clear grouping by breed or sex was evident. However, Texel and Dohne Merino showed better performance compared to the other breeds, suggesting their potential for inclusion in genetic improvement programs under high-altitude conditions, which could contribute to strengthening livestock systems in the high Andean regions of Peru.

Key words: Sheep breeds, High Andean Sierra, Preweaning growth, Liveweight performance

INTRODUCTION

Sheep or also called domestic sheep (*Ovis aries*) are cosmopolitan animals that produce wool, meat, milk, skin, leather and manure. These animals are used by producers because of their fecundity and adaptability to new environments (Torrel-Pajares et al. 2022), due to their versatility to survive in different climates, from the coldest to the warmest. Their optimal production depends on environmental conditions and their genetic potential. Because of these characteristics, sheep breeding is widespread in the coast, highlands and jungle of Peru, due to its economic, social and ecological importance in the regions of Peru (Salamanca et al. 2018; van Wettere et al. 2021). There are approximately 1,173 million head of sheep in the world and of this 7.1 % are in the Americas (FAOSTAT 2018), in Peru it is about 10 million sheep between ewes, rams and lambs (INEI 2013), of which 80.5% are Criollos, 11.3% Corriedale, 2.3% Hampshire Down, 0.9% Blackbelly and 4.1% of other breeds (INEI 2013), these animals represent an important subsistence resource in the high Andean regions of the country (Rivera et al. 2015), as they are raised extensively, on natural pastures and with little management technology and genetic improvement (MINAGRI 2024). However, the sheep population in the 1960s was 23 million head and currently stands at 9.5 million (Jurado et al. 2020), this population decrease is due to various technical factors, such as the decrease in the price of wool, presence of diseases and others (Jurado et al. 2020; MINAGRI 2024).

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Producers in general have criollo animals that show low productivity yields (Montesinos et al. 2015; Poma et al. 2021), with live weights of 26 to 27kg and fleece weights below 2kg (Bustinza et al. 2024). There are genetic improvement works with the objective of improving productive yields in meat, milk and wool, with the introduction of specialized breeds of sheep through embryo transfer (Cardona et al. 2020; Pantoja et al. 2022), which exist in different production systems and environmental conditions. Then, the purpose of this work is to evaluate the liveweight performance in the preweaning growth of six sheep breeds in high Andean highland conditions of Peru.

MATERIALS AND METHODS

Location of the Study

This work was carried out in the sheep genetic nucleus, situated in the experimental centers of Casaracra and Alpaicayán at the Universidad Nacional Daniel Alcides Carrión (UNDAC) (Fig. 1). The sites present a temperature range from -5 to 10°C in the dry season and reaching 15°C in the wet season, with an annual precipitation of 850mm, located in a life zone Tropical Montane Humid Forest for Casaracra and for Alpaicayán Very Humid Tropical Subalpine Paramo (Aybar & Lavado-Casimiro 2017; Pantoja et al. 2022).

Animals

Lambs born from embryos imported from Australia were used, which were obtained by embryo transfer in Creole ewe lambs by Corriedale, six breeds were used: Corriedale-C (Male=1, Female=6), Dohne Merino-DM (Male=20, Female=26), East Friesian-EF (Male=24, Female=30), Finnish Landrace-FL (Male=16, Female=14), Poll Dorset-PDt (Male=15, Female=17) and Texel-TX (Male=14, Female=16). Where C and DM are dual purpose meat and wool (medium and fine), EF is milk and meat, FL is characterized by prolificacy and fertility, PD and TX are fast growing, muscle developing and lean carcasses, besides being hardy and strong (Liu et al. 2015; Canaza-Cayo et al. 2017; Hernandez et al. 2018; Dlamini et al. 2019; Pantoja et al. 2022; Li et al. 2022; Canaza-Cayo et al. 2024; Theron et al. 2024; Gudra et al. 2024; You et al. 2024).

Data Collection

Liveweight data of lambs, in study, were taken; at birth (PN), 25-days after birth (P25), 60-days after birth (P60), 90-days after birth (P90) and at weaning (PD) 110-days past birth.

Statistical Analysis

Statistical analysis was performed using R version 3.8 (R Core Team 2020). The variables PN, P25, P60, P90 and PD of the six breeds of lambs under study were tested with ANOVA, followed by the Limit difference test (LSD) with a significance level of 0.05. In addition, a principal component analysis (PCA) was applied to examine the adequacy of the data, which was used to identify possible matching of the sheep breeds and the variables evaluated.

RESULTS

Table 1 and 2 show the mean and standard deviation (SD) of the preweaning growth criteria, studied in male and female lambs for live body weights at birth, 25, 60 and 90 days after birth, as well as weaning weights for 199 records of lambs from six breeds. In Table 1, the DM mean birth weight is higher than the PDt mean showing significance ($P<0.05$) between them, however, no significance with the C, EF, FL and TX breeds for both means. Also, there is significance in the P60, where the mean of TX is statistically superior ($P<0.05$) to DM, but equal to the other breeds (Table 1).

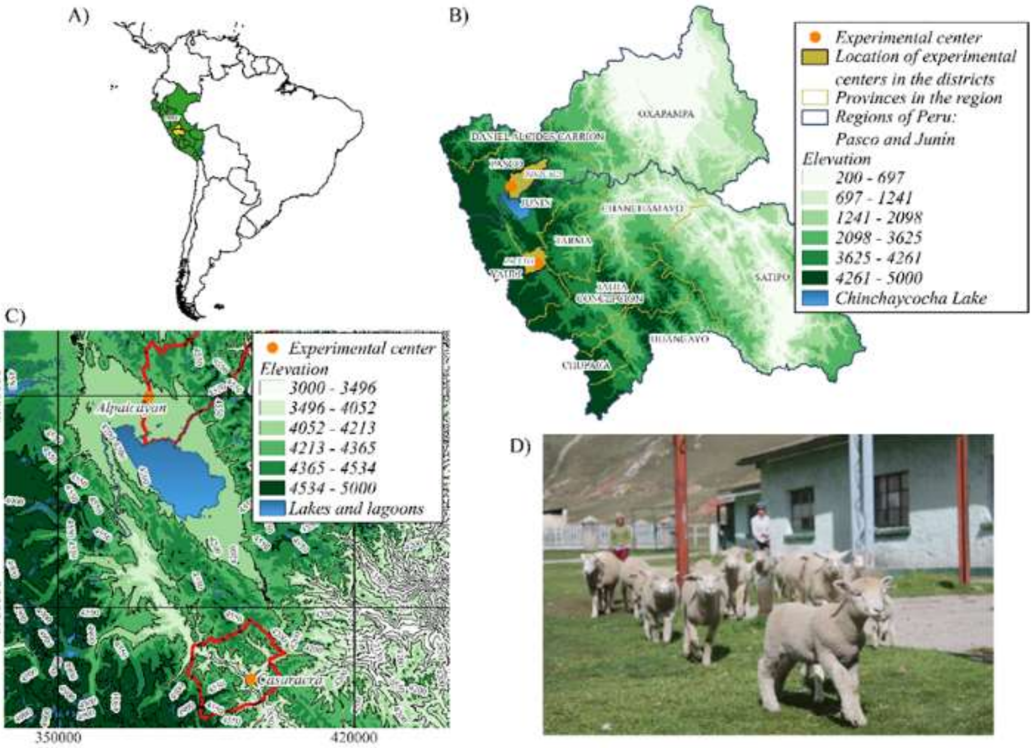

Fig. 1: A) and B) Geographical position of the sheep lambs; C) Location of the experimental centers in the Puna region; and D) Sheep lambs from different breeds studied.

Table 1: Liveweight performance of six male sheep breeds from birth to weaning

Breed	Birth weight	Birth weight at 25 days	Birth weight at 60 days	Birth weight at 90 days	Weight at weaning
C	3.94±0.00ab	5.50±0.00a	13.6±0.00ab	14.20±0.00a	16.30±0.00a
DM	4.01±0.70a	7.41±2.39a	10.6±3.00b	14.44±3.47a	16.28±3.60a
EF	3.87±0.95ab	6.99±1.82a	11.87±3.81ab	14.18±3.29a	15.94±3.91a
FL	3.67±0.41ab	6.24±1.25a	12.39±2.93ab	13.37±2.70a	14.57±2.96a
PDt	3.45±0.53b	6.38±1.27a	12.09±3.31ab	12.97±3.13a	14.69±3.34a
TX	3.79±0.68ab	6.78±1.42a	14.08±3.71a	14.89±4.09a	16.68±4.44a

Values (Mean±SD) in the same column with different alphabets differ significantly (P<0.05).

Table 2: Liveweight performance of six female sheep breeds from birth to weaning

Breed	Birth weight	Birth weight at 25 days	Birth weight at 60 days	Birth weight at 90 days	Weight at weaning
C	4.22±0.35a	6.60±1.69abc	10.68±3.30bc	11.30±3.05c	12.03±3.09c
DM	3.85±0.59ab	7.93±2.00a	11.35±2.45bc	15.37±2.94ab	17.12±3.15ab
EF	3.76±0.61abc	6.42±1.71c	9.95±2.66c	13.28±2.38c	14.88±2.80c
FL	3.50±0.61bc	6.15±1.16c	11.38±3.16bc	12.75± 2.93c	14.08±3.55c
PDt	3.42±0.83c	6.49±1.44bc	12.61±2.34ab	13.91±1.92bc	15.37±2.30bc
TX	4.13±0.64a	7.63±2.08ab	14.37±4.28a	16.41±4.04a	18.22±4.36a

Values (Mean±SD) in the same column with different alphabets differ significantly (P<0.05).

Table 2 shows the results of the mean and SD of female lambs, where the mean PN of TX and C are statistically superior (P<0.05) to FL and PDt, but equal to the DM and EF breeds. At P25 the DM, TX and C breeds showed the highest means (P<0.05), at P60 the TX and PDt showed high means (P<0.05) compared to the other breeds and, finally, at P90 and PD the TX and DM breeds showed significantly higher means (P<0.05) than the other breeds

As for the females in the same graph (Fig. 2), it can be seen that the TX, DM and EF breeds have an almost constant live weight gain during the research period. As for the females in the same graph (Fig. 2), it can be seen that the TX, DM and EF breeds have an almost constant live weight gain during the research period. As for the females in the same graph (Fig. 2), it can be seen that the TX, DM and EF breeds have an almost constant live weight gain during the research period.

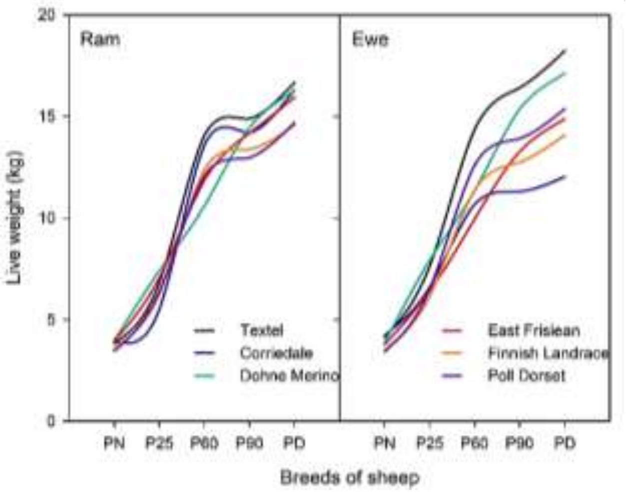

Fig. 2: Live weight behavior in male and female sheep; PN) mean birth weight, P25) mean weight at 25 days after birth, P60) mean weight at 60 days after birth, P90) mean weight at 90 days after birth and PD) mean weight at weaning.

Fig. 3 depicts a Biplot plot of principal component analysis (PCA), which reduces the dimensionality of the data to show the relationships between variables and observations in two dimensions (Dim1 and Dim2), where Dim1 explains 69.9% of the total variability of the data and Dim2 shows 17.9% of the variability. Together, these two principal components explain 87.8% of the data variability, also in the graph we observe the arrows representing the quantitative variables, where each one points the direction and magnitude of variables correlation with the dimensions, indicating that the arrows closer to each other mean that these variables are positively correlated. Another feature as the colored dots represent the different sheep breeds and the observations dispersion for each sheep breed in the two dimensions, where it is observed that there is no clustering of the evaluated data together with the breeds and sex, but with respect to the variables that are closer to each other, the P60, P90 and PD are positively correlated.

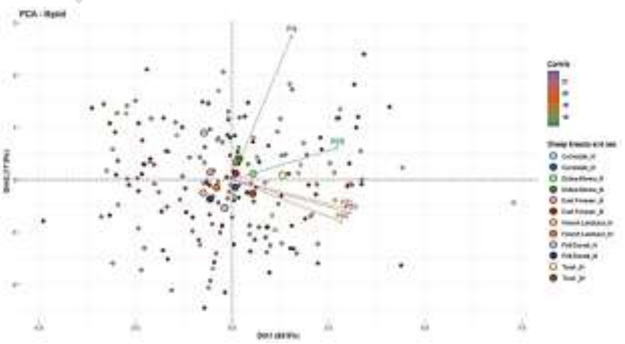

Fig. 3: Biplot graph of a principal component analysis (PCA) of weight behavior between sheep breeds and sex, from birth to weaning.

DISCUSSION

An important issue in the economic success of commercial sheep breeding is the growth potential of lambs, which depends on the genotype of the animal, the progeny and the environment in which they develop (Momoh et al. 2013; Valerio et al. 2015).

In Peru, more than 94% of sheep grow in the highlands and of this, 80.6% belong to the Criollo type (INEI 2013; Bustinza et al. 2024). In criollos, lambs born weigh less than 3kg at altitudes higher than 3885masl (Espinoza-Montes et al. 2022), due to low technology and even traditional management in breeding. In contrast, improved sheep breeds such as the Corriedale dual-purpose animal raised at over 4000masl reported birth weights of 4.28kg

(Trillo et al. 2019), which is due to the quality of the pastures they consume and the technical management. In addition, the experience and adaptation of this breed, which was introduced in Peru by the 1930s (Snyder 1959; Carhuaricra et al. 2022), imply a better adaptability to the area. Other research, such as that of Cutipa Sacaca (2022) in the southern Peruvian altiplano at an elevation of 3824 to 4000masl, with artificial insemination techniques, reported birth weights of 3.50 to 3.89kg in Corriedale lambs. On the other hand, in Uruguay at 78masl, it was found birth weights of 4.20kg for Corriedale, 3.60kg Finnish Landrace x Corriedale, 4.35kg East Frisiean x Finnish Landrace, 4.74kg East Frisiean x Corriedale and 4.93kg in East Friesian (Banchero et al. 2016), values that are within the range of the study. In Brazil, live birth weights of Texel lambs were evaluated with means of 4.74kg for males and 4.5 kg in females (Canaza-Cayo et al. 2024). Regarding the Corriedale in temperate conditions as in India, weights of 3.69kg of lambs born are reported (Baba et al. 2020). In contrast, in South Africa Dohne Merino had weights of 5.24 to 5.74kg (Sedupane et al. 2023), similar weights for the Poll Dorset between 4 and 7kg in Australia (Sawyer et al. 2022). In another study for the same breed, Mota et al. (2017) reported birth weight averages of 4.6kg in Brazil. As for Balami and Uda breed sheep raised for their meat, in Nigeria at 517masl, in a semi-intensive production system, they report values in birth weight of male lambs of 3.52kg and in females' weights of 3.11kg (Momoh et al. 2013). These differences found in birth weights of sheep lambs from different breeds and locations can be attributed to different aspects. Sawyer et al. (2022) mentions that in sheared ewes' lambs are heavier and have larger litters, also says that lambs born by natural mating are heavier, but with smaller litter sizes compared to lambs born by artificial insemination. The season also has effects on the birth weights of lambs, in spring they are heavier compared to autumn when they are lighter (Menant et al. 2022) and birth weight was related to different biological and management factors, measurable in the breeding centers (Sveinbjörnsson et al. 2021). Furthermore, birth weight was significantly related to lamb survival, and finally, changes in birth weight could be predicted from the live weight of the mother ewe (Behrendt et al. 2019).

Another point of importance is quantitative traits, such as pre-weaning growth, which are expressed as a result of genetic and environmental effects (Behrem 2021).

Body weight is one of the most important traits to evaluate productive efficiency in livestock species, especially in meat production (Canaza-Cayo 2024). The study found that there was no effect of breed on weights at P25, P90 and PD for males, but P60 showed Texel with higher value; in females. However, there was a greater variability of the effect of breeds on the weights taken (PN, P25, P60, P90 and PD), where the Texel has shown its superiority in weight on the dates sampled, which is influenced by its genetic aspect, growth traits and muscle development (Canaza-Cayo et al. 2024). There are few studies on weight control; at P25, P60 and P90, but the weaning weight (DW) is evaluated in different cases, with time adjustments (days) according to the breeding system, technical aspect and environmental conditions. For example, in Peru, in the breeding of Creole sheep, PD is not evaluated (Poma et al. 2021), but in sheep such as the Corriedale, weights between 33.6 and 35.44kg at 142 ± 23days (PD) are found (Trillo et al. 2019). On the other hand, in India Corriedale sheep have a weaning weight of 12.16kg (Baba et al. 2020), in South Africa the Dohne Merino has PD between 28.1 to 29.5kg at 115 days (PD) (Sedupane et al. 2023), sheep considered dual purpose (wool and meat). For fast growth sheep and muscle development, such as the Texel reported PD of 34.72kg for males and for females the weight is 31.59kg (Canaza-Cayo et al. 2024) in Brazil, and in Poll Dorset the PD (90 days) is 23.35kg in Mexico (Horacio et al. 2011), in sheep crossed with East Frisiean x Romanov weaning weights of 18.7kg were achieved in twin births in Mexico (Juárez et al., 2023). On the other hand, in sheep such as Blackbelly, Pelibuey and Katahdin, weaning weights are 8.83, 9.64 and 10.18kg (Gómez-Hernández et al. 2022). The different weaning weights (DW) found in the studies are influenced by the genetic potential of each sheep breed, environment and conditions in the production system, as mentioned by Kramarenko et al. (2021) who concludes that the environmental effects, interaction of the year at lambing x sex and genotype of the ram x type of lambing influences the weaning weight of the lamb. In turn, weaning weights of lambs are affected by the body weight of dams, then better reproductive performance and better growth rate of lambs can be achieved by heavier dams. (Aktaş et al. 2015), growth rate is an economic trait of interest in domestic animals, as the growth of lambs reflects the adaptability and economic viability of the animal. A rapid growth rate determines its meat production capacity until the age of commercialization (Lalit et al. 2016), then the body weight allows evaluating the general condition of the animal, which serves as a selection criterion in breeding programs (Canaza-Cayo et al. 2024). In summary, the phenotypic expression of traits in the offspring is affected by the direct genetic effect and optimal breeding conditions (Behrem 2021).

Then, the results found in the study encourage to keep on genetic improvement programs, because the results of PN, P25, P60, P90 and the PD are in the ranges provided by different studies worldwide. The study also shows that the lambs born have not shown a negative effect due to the environmental conditions in which they have been growing, and therefore, being a viable option for small producers to breed and multiply them for commercial purposes, which will improve the economic income of producers in the high Andean highlands of Peru.

Conclusion

This study provides a valuable contribution to the understanding of the behavior of preweaning growth criteria in six sheep breeds in high Andean conditions, which is crucial for improving productivity in rural regions of Peru. The findings reveal that the Texel and Dohne Merino breeds have superior performance in terms of growth during the early stages of life, especially in the parameters of birth, 60-day and weaning weights, which highlights their potential in genetic improvement programs and production systems aimed at increasing productive efficiency in high altitude areas.

In general terms, the choice of breeds with greater preweaning growth capacity is essential to optimize the profitability of the sheep production system in the high Andean highlands. The study shows that the Texel and Dohne Merino breeds could be especially useful in these systems due to their superiority in key growth parameters compared to the Corriedale, Poll Dorset, Finnish Landrace and East Friesian breeds. This is due to their better adaptation and ability to generate higher weight gains in high altitude conditions, where environmental factors can be limiting for animal development.

The practical implications of these findings are considerable for producers in the high Andean region of Peru. The raise of breeds such as Texel and Dohne Merino can significantly improve yields in the early life stages of lambs, which, in turn, can translate into higher profitability for sheep producers. In addition, the results of principal component analysis (PCA) allow inferring that these breeds have a relatively uniform growth behavior, which could facilitate their integration into breeding systems where uniformity in animal growth is a key factor for system efficiency.

Finally, this study underscores the importance of genetic sorting to optimize sheep meat production in the high Andean zones, contributing to the sustainability and strengthening of local livestock systems. It is suggested that further research should continue with the analysis of other variables, such as genetic adaptation and disease resistance, which also influence the profitability and sustainability of sheep production in these ecosystems.

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Data Availability: Data supporting this research will be available from the authors upon request.

Ethics Statement: Ethical approval was not required for this study because it involved analysis of publicly available data/anonymized datasets/literature review (cite relevant guidelines if applicable).

Author's Contribution: AA-A: study conception, experimental design, data collection, analysis of results, and writing of the manuscript. CPA: resource allocation, supervision and writing. JCL: Supervision of experimental part and writing. MLR: assistance in data collection and methodology. WB: resources and assistance with graph preparation. EM: resources and methodology. HSV: Supervision and support in writing up results. RS-A: Critical review of the manuscript, assessment of the consistency of the results and discussion, and assistance in the final interpretation of the results. All authors read, reviewed, and approved the final manuscript.

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REFERENCES

Aktaş AH, Dursun Ş, Doğan Ş, Kiyma Z, Demirci U and Halıcı İ, 2015. Effects of ewe live weight and age on reproductive performance, lamb growth and survival in Central Anatolian Merino sheep. Archives Animal Breeding 58(2): 451-459. https://doi.org/10.5194/aab-58-451-2015

Aybar CCL and Lavado-Casimiro W, 2017. Atlas de zonas de vida del Perú: Guía explicativa. Nota Técnica Nº 003 SENAMH-DHI-2017. Repositorio Institucional - SENAMHI. http://repositorio.senamhi.gob.pe/handle/20.500.12542/259

Baba MA, Ganai TaS, Alam S, Rather MA and Hamadani A, 2020. Effects of non-genetic factors on growth traits and age at first lambing in Corriedale sheep. The Indian Journal of Animal Sciences 90(6): 104995. https://doi.org/10.56093/ijans.v90i6.104995

Banchero G, Vázquez A, Irarí N, Ciappesoni G and Quintans G, 2016. Preliminary Study of Prolificacy and Maternal Ability on Six Sheep Biotypes in Uruguay. Agrociencia Uruguay 20(1): Article 1. https://doi.org/10.31285/AGRO.20.1.12

Behrem S, 2021. Estimation of genetic parameters for pre-weaning growth traits in Central Anatolian Merino sheep. Small Ruminant Research 197: 106319. https://doi.org/10.1016/j.smallrumres.2021.106319

Behrendt R, Edwards J EH, Gordon D, Hyder M, Kelly M, Cameron F, Byron J, Raeside M, Kearney G and Thompson AN, 2019. Offering maternal composite ewe's higher levels of nutrition from mid-pregnancy to lambing results in predictable increases in birthweight, survival and weaning weight of their lambs. Animal Production Science 59(10): 1906-1922. https://doi.org/10.1071/AN18505

Bustinza CAV, Paucara Ocsa V, Machaca AD, Machaca Machaca V and Cano Fuentes V, 2024. Caracterización del ovino criollo en las comunidades del distrito de Lambrama (Apurímac, Perú). Revista de Investigaciones Veterinarias del Perú 35(2): Article 2. https://doi.org/10.15381/rivep.v35i2.25422

Canaza-Cayo AW, Beltrán Barriga PA, Gallegos Rojas E and Mayta Quispe J, 2017. Zoometría y estimación de ecuaciones de predicción de peso vivo en ovejas de la raza Corriedale. Revista de Investigaciones Altoandinas 19(3): 313-318. https://doi.org/10.18271/ria.2017.296

Canaza-Cayo AW, Churata-Huacani R, Çakmakçı, C, Rodríguez-

Huanca FH, Filho JS de SB, Fernandes TJ and Cruz YCRDL, 2024. Use of machine learning approaches for body weight prediction in Peruvian Corriedale Sheep. Smart Agricultural Technology 7: 100419. https://doi.org/10.1016/j.atech.2024.100419

Canaza-Cayo AW, Silveira FA, Churata-Huacani R and Bueno Filho JS de S, 2024. Genetic parameter estimates for growth traits in Texel sheep of Brazil. Reproduction and Breeding 4(3): 174-178. https://doi.org/10.1016/j.repbre.2024.07.001

Cardona Tobar KM, López Álvarez DC and Álvarez Franco LÁ, 2020. Genome-wide association studies in sheep from Latin America. Review. Revista Mexicana de Ciencias Pecuarias 11(3): 859-883. https://doi.org/10.22319/rmcp.v11i3.5372

Carhuaricra HD, Orozco-TerWengel P, Rosadio AR, Rojas DF and Maturrano HL, 2022. Diversidad genética y estructura poblacional del ovino Junín mediante el uso de microarreglos de alta densidad de marcadores polimórficos de nucleótido simple (SNP). Revista de Investigaciones Veterinarias del Perú 33(1): e21459. https://doi.org/10.15381/rivep.v33i1.21459

Cutipa Sacaca LM, 2022. Natalidad, peso al nacimiento y merito económico en borregas inducidas con progesterona a nivel de pequeños criadores de ovinos de la region sur de puno. Revista de Investigaciones 11(1): Article 1. https://doi.org/10.26788/riepg.v11i1.2874

Dlamini NM, Visser C, Snyman MA, Soma P and Muchadeyi FC, 2019. Genomic evaluation of resistance to *Haemonchus contortus* in a South African Dohne Merino flock. Small Ruminant Research 175: 117-125. https://doi.org/10.1016/j.smallrumres.2019.04.020

Espinoza-Montes F, Saavedra Peña E, Ballardo Matos C, Núñez Rojas W and Córdova Zorrilla A, 2022. Causas y factores asociados con la mortalidad de neonatos en rebaños de ovino criollo. Revista de Investigaciones Veterinarias del Perú, 33(5): 5. https://doi.org/10.15381/rivep.v33i5.23789

FAOSTAT (Organización de las Naciones Unidas para la Alimentación y la Agricultura), 2018. Base de datos de estadísticas (2018). https://www.fao.org/faostat/en/#data

Gómez-Hernández LE, González-Reyna A, Zárate-Fortuna P, Faustino-Lázaro B, Hernández-Meléndez J and Martínez-González JC, 2022. Comportamiento pre-destete del cordero, producción y calidad de la leche en ovejas de pelo. Ciencia Agropecuaria 34: Article 34.

Gudra D, Valdovska A, Kairisa D, Galina D, Jonkus D, Ustinova M, Viksne K, Kalnina I and Fridmanis D, 2024. Genomic diversity of the locally developed Latvian Darkheaded sheep breed. Heliyon 10(10): e3145530. https://doi.org/10.1016/j.heliyon.2024.e31455

Hernandez DG, Mucha S, Banos G, Kaseja K, Moore K, Lambe N, Yates J and Bunger L, 2018. Analysis of single nucleotide polymorphisms variation associated with important economic and computed tomography measured traits in Texel sheep. Animal 12(5): 915-922. https://doi.org/10.1017/S1751731117002488

Horacio Montaldo H, Flores-Serrano C, Sulaiman Y, Osorio-Avalos J, Ortiz-Hernández A and Angulo-Mejorada RB, 2011. Crecimiento y comportamiento reproductivo de ovinos Poll Dorset y Suffolk bajo condiciones intensivas. Revista Mexicana de Ciencias Pecuarias 2(4): 359-369.

INEI, 2013. Resultados definitivos IV Censo Nacional Agropecuario 2012 (Biblioteca SIGRID). https://sigrid.cenepred.gob.pe/sigridv3/documento/906

Juárez Núñez L, Cuéllar Ordaz JA, Cadena Villegas S and Tórtora Pérez JL, 2023. P-097 Productive evaluation pre-weaning of Romanov and Romanov x East Friesian lambs. Animal - Science Proceedings 14(1): 280. https://doi.org/10.1016/j.anscip.2023.01.375

Jurado PJ, Navarro MD, Ramírez VM, Santiago C MA and Rivera GH, 2020. Detección de anticuerpos contra el virus de lengua azul en ovinos de dos localidades de Junín, Perú. Revista de Investigaciones Veterinarias del Perú 31(2): Article 2. https://doi.org/10.15381/rivep.v31i2.17850

Kramarenko AS, Markowska AV, Salamatina OO, Kravchenko OO and Kramarenko SS, 2021. Genetic and environmental factors influenced the birth and weaning weight of lambs. Ukrainian Journal of Ecology 11(2): 195-201. https://doi.org/10.15421/2021_99

Lalit Malik ZS, Dalal DS, Dahiya SP, Patil CS and Dahiya R, 2016. Genetic analysis of growth traits in Harnali sheep. Veterinary World 9(2): 128-132. https://doi.org/10.14202/vetworld.2016.128-132

Li X, Yuan L, Wang W, Zhang D, Zhao Y, Chen J, Xu D, Zhao L, Li F and Zhang X, 2022. Whole genome re-sequencing reveals artificial and natural selection for milk traits in East Friesian sheep. Frontiers in Veterinary Science 9: 1034211. https://doi.org/10.3389/fvets.2022.1034211

Liu N, He JN, Yu WM, Liu KD, Cheng M, Liu JF, He YH, Zhao JS and Qu XX, 2015. Transcriptome analysis of skeletal muscle at prenatal stages in Polled Dorset versus Small-tailed Han sheep. Genetics and Molecular Research 14(1): 1085-1095. https://doi.org/10.4238/2015.06.12

Menant O, Ungerfeld R, Lévy F, Pérez-Clariget R and Freitas-de-Melo A, 2022. Out-of-season breeding and ewe-lamb bond from birth to weaning in Corriedale sheep. Applied Animal Behaviour Science 247: 105542. https://doi.org/10.1016/j.applanim.2021.105542

MINAGRI, 2024. Anuario Estadístico de la Producción Pecuaria y Avícola 2023. Ministerio de Desarrollo Agrario y Riego. https://www.gob.pe/institucion/midagri/informes-publicaciones/2730346-compendio-anual-de-produccion-ganadera-y-avicola

Momoh OM, Rotimi EA and Dim NI, 2013. Breed effect and non-genetic factors affecting growth performance of sheep in a semi-arid region of Nigeria. Journal of Applied Biosciences 67: 5302-5307. https://doi.org/10.4314/jab.v67i0.95053

Montesinos IS, Catachura A, Sánchez J, Franco JL, Arnhold E, McManus C, Fioravanti M CS and Sereno J RB, 2015. Caracterización de ovinos en el litoral sur del Perú. Animal Genetic Resources/Resources Génétiques Animales/Recursos Genéticos Animales 56: 55-62. https://doi.org/10.1017/S2078633614000563

Mota D de A, Rosa BL, Oziemblowski MM, Melo TV and Carvalho DMG de, 2017. Desenvolvimento ponderal na estimativa de peso vivo em ovinos da raça Poll Dorset. Brazilian Journal of Veterinary Science 24(4): 184-188. https://doi.org/10.4322/rbcv.2017.035

Pantoja AC, Aliaga GJ, Trillo Zárate F, Bermúdez AW, Morales SE, Yali RF and Pariona CD, 2022. Parámetros tecnológicos de la lana de ovinos en razas importadas obtenidas mediante transferencia de embriones, criados bajo las condiciones de la sierra central del Perú. Revista de Investigaciones Veterinarias del Perú 33(3): Article 3. https://doi.org/10.15381/rivep.v33i3.21249

Poma CP, Jiménez E, Ordoñez N, Maguiña RM and Hidalgo YN, 2021. Componentes estructurales del sistema de producción ovina en la Comunidad Campesina de San Pedro de Pirca, Huaral, Perú. Peruvian Agricultural Research 3(1): Article 1. https://doi.org/10.51431/par.v3i1.659

Rivera JK, Maturrano HL, Aguilar JM and Rosadio AR, 2015. Detección del Gen PrP de Scrapie en Ovinos Junín. Revista de Investigaciones Veterinarias del Perú 26(1): Article 1. https://doi.org/10.15381/rivep.v26i1.10917

Salamanca Montesinos I, Gómez Urviola N, Soares Fioravanti MC and Bezerra Sereno JR, 2018. Caracterización de los ovinocultores y sus sistemas productivos en el litoral sur del Perú. Anales Científicos 79(1): Article 1. https://doi.org/10.21704/ac.v79i1.1161

Sawyer GJL, Doolan S, Roberts IJ, Imaz JA, Refshauge G, de Graaf SP and Gonzalez LA, 2022. Factors affecting lamb birth weight, gestation length, survival and litter size in Poll

Dorset sheep. Australian Association of Animal Sciences 34: 1.

Sedupane TA, Roux R ML, Fourie PJ, Sedumedi TA, Einkamerer OB and O'Neill HA, 2023. The effect of plant and animal-derived dietary oil supplementation on the reproduction performance of Dohne Merino ewes and the growth performance of their offspring. Tropical Animal Health and Production. https://doi.org/10.21203/rs.3.rs-3415686/v1

Snyder WK, 1959. Metas y Objetivos de la División Ganadera de Cerro de Pasco. Ganadería Andina y La Voz del Veterinario 9(3): 3-5.

Sveinbjörnsson J, Eythórsdóttir E and Örnólfsson EK, 2021. Factors affecting birth weight and pre-weaning growth rate of lambs from the Icelandic sheep breed. Small Ruminant Research 201: 106420. https://doi.org/10.1016/j.smallrumres.2021.106420

Theron PG, Brand TS, Cloete SWP and van Zyl JHC, 2024. Wool production and quality traits of pure- and crossbred Merino-type sheep. Tropical Animal Health and Production 56(2): 47. https://doi.org/10.1007/s11250-023-03870-3

Torrel-Pajares TS, Murga-Moreno CA, Infante-Mendo MS, Vargas-Rocha LA, Burga-León JEJ and Rojas-Moncada JD, 2022. Occurrence of paramphistomosis (Trematoda: Digenea) in sheep in northern Peru. Veterinary Parasitology: Regional Studies and Reports 34: 100763. https://doi.org/10.1016/j.vprsr.2022.100763

Trillo Zárate FC, Barrantes Campos C, Nuñez Delgado J and Zirena Arana N, 2019. Progreso genético mediante pruebas de rendimiento y de progenie en carneros Corriedale en la sierra central del Perú. Revista de Investigaciones Veterinarias del Perú 30(4): 1543-1551. https://doi.org/10.15381/rivep.v30i4.17185

Valerio D, Gutiérrez G and Chávez J, 2015. Efectos Genéticos Directo y Materno sobre el Crecimiento de Ovinos de la Raza Junín. Revista de Investigaciones Veterinarias del Perú 26(1): 28-35. https://doi.org/10.15381/rivep.v26i1.10921

van Wettere WHEJ, Kind KL, Gatford KL, Swinbourne AM, Leu ST, Hayman PT, Kelly JM, Weaver AC, Kleemann DO and Walker SK, 2021. Review of the impact of heat stress on reproductive performance of sheep. Journal of Animal Science and Biotechnology 12(1): 26. https://doi.org/10.1186/s40104-020-00537-z

You X, Fang Q, Chen C, Cao J, Fu S, Zhang T, Wang S, He X, He J, Zhou Y, Wang B, Wang L, Wang Z, Sun T, Yang X, Te R, Jian J, Zhou H, Dai Y and Liu Y, 2024. A near complete genome assembly of the East Friesian sheep genome. Scientific Data 11(1): 762. https://doi.org/10.1038/s41597-024-03581-w