

Clinical-laboratory dynamics of *Santa Inês* lambs from birth to 30 days of age raised in the semiarid region

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[*Dinâmica clínico-laboratorial de cordeiros Santa Inês, do nascimento aos 30 dias de idade, criados no semiárido*]

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ABSTRACT

This study characterized the dynamics of clinical, hematological, and biochemical parameters in *Santa Inês* lambs in the Brazilian semiarid region during their first 30 days of life. Thirty healthy lambs were evaluated, with blood samples taken at birth, 24, 72h, seven, 15, and 30 days for blood count and biochemical analyses (urea, AST, GGT), alongside heart rate (HR), respiratory rate (RR), and rectal temperature (RT). Results showed that erythrocytes, hematocrit, and hemoglobin decreased within 24 hours, reflecting the transition from fetal to neonatal erythropoiesis. Mean corpuscular volume reduced, while mean corpuscular hemoglobin concentration increased, indicating red cell maturation. Leukocyte counts progressively rose, with a neutrophil/lymphocyte ratio inversion at 15 days, showing immune system development driven by colostrum. Urea and GGT peaked within 24 hours, consistent with protein and immunoglobulin absorption, while AST increased initially, possibly related to neonatal muscle activity. HR and RR gradually decreased, whereas RT remained stable. We conclude that the evaluated parameters underwent important changes during the neonatal period, reflecting physiological and immunological adaptations. This data provides an essential baseline for establishing specific reference values for this critical phase and improving the clinical management of lambs in the region.

Keywords: blood count, biochemistry, physical examination, neonate, sheep.

RESUMO

Este estudo determinou a dinâmica de parâmetros físicos, hematológicos e bioquímicos em cordeiros Santa Inês, no semiárido brasileiro, durante os primeiros 30 dias de vida. Foram avaliados 30 cordeiros saudáveis, com coletas de sangue ao nascimento, 24, 72h, sete, 15 e 30 dias para hemograma e análises bioquímicas (ureia, AST, GGT), além da mensuração de frequência cardíaca (FC), respiratória (FR) e temperatura retal (TR). Os resultados demonstraram que eritrócitos, hematócrito e hemoglobina diminuíram nas primeiras 24 h, refletindo a transição da eritropoiese fetal para a neonatal. O volume corpuscular médio reduziu, enquanto a concentração de hemoglobina corpuscular média aumentou, indicando maturação das células vermelhas. Os leucócitos tiveram elevação progressiva, com inversão da relação neutrófilos/linfócitos aos 15 dias, evidenciando o desenvolvimento do sistema imune mediado pelo colostro. A ureia e a GGT atingiram picos em 24h, associados à absorção de proteínas e imunoglobulinas, enquanto a AST teve aumento inicial, possivelmente ligado à atividade muscular. A FC e a FR diminuíram gradualmente, e a TR manteve-se estável. Conclui-se que os parâmetros sofrem alterações significativas no período neonatal, refletindo adaptações fisiológicas e imunológicas e fornecendo subsídios para o manejo clínico e a avaliação da saúde dos cordeiros.

Palavras-chave: hemograma, bioquímico, exame físico, neonato, ovelha

INTRODUCTION

In modern sheep farming, the assessment of clinical and laboratory parameters is an indispensable tool. It provides not only early disease diagnosis but also an in-depth understanding of animals' physiological state. In production systems where morbidity and mortality directly affect economic outcomes, using hematological and biochemical profiles is essential for effectively monitoring the herd's health and for nutritional management (Smith and Sherman, 2020; Pugh *et al.*, 2021).

However, reference values for these parameters are not static; they are influenced by multiple factors, including breed, age, sex, nutritional status, and, especially, the environment in which the animals are raised (Bezerra *et al.*, 2017). Specific climatic conditions, altitude, and regional management practices can lead to important variations in blood components. It is therefore important to establish regionalized reference intervals. Such specific values improve diagnoses accuracy, prognoses, and therapeutic decisions, minimizing interpretation errors that often arise from the indiscriminate use of generic data (Thrall *et al.*, 2022).

The *Santa Inês* breed, a hair sheep native to Brazil, is especially important due to its remarkable adaptability to the country's tropical conditions. It stands out especially in the semiarid region, which is characterized by high temperatures and irregular rainfall. Recently, research aimed at characterizing the hematological and biochemical profiles of Brazilian sheep breeds has advanced considerably. Several studies have described the influence of different reproductive stages on the hematology of *Santa Inês* ewes (Bezerra *et al.*, 2017; Carvalho *et al.*, 2025; Pereira *et al.*, 2015), while other studies have investigated the effects of parasitic infections on the blood parameters of suckling lambs (Lins *et al.*, 2020).

More specifically, the neonatal period, recognized as a critical stage of deep physiological adaptations, has been the subject of recent investigations. Carvalho *et al.* (2025) provided valuable data on biochemical changes and passive immunity transfer in elite *Santa Inês* lambs. However, the study concentrated exclusively on the first 96 hours of life. In turn,

Souza *et al.* (2020) characterized the biochemical dynamics in crossbred lambs between 30 and 120 days of age, and they highlighted that the reference values for young animals often differ from those for adults.

Despite these important contributions, a gap remains in scientific literature. There is a lack of a longitudinal evaluation that simultaneously integrates hematological and biochemical dynamics throughout the neonatal period (birth to 30 days of age) for *Santa Inês* lambs raised specifically under the challenging conditions of the Brazilian semiarid. A comprehensive characterization of this 30-day time window is essential to establish more accurate reference values for this critical stage of life.

In this context, this study aimed to characterize the dynamics of clinical, hematological, and biochemical parameters in *Santa Inês* lambs from birth to 30 days of age raised under a semi-intensive system in the Brazilian semiarid region.

ETHICAL ASPECTS

The research was submitted to the *Ethics Committee on Animal Use* of the Universidade Federal do Agreste de Pernambuco, and approved under the number CEUAUFAPE2024020531.

MATERIAL AND METHODS

The experiment was carried out at the Experimental Farm of the Federal Rural University of Pernambuco (UFRPE), located in the Agreste Meridional mesoregion of Pernambuco, Brazil (latitude 8° 53'25" S, longitude 36° 29' 34" W). The region lies at an altitude of 896 meters above sea level and is characterized by a semiarid climate, with an average annual temperature of 20°C and rainfall of 908.6 mm (Lima and Corrêa, 2016).

The breeding ewes of the *Santa Inês* breed are managed in a semi-intensive system, alternating between grazing and trough supplementation. They grazed on *Urochloa decumbens* grass pasture in the morning, and received roughage based on ground elephant grass, corn, and sorghum silage, corn-soybean concentrate (on

average 300g per animal) and species-specific mineral salt in the afternoon and evening.

The criteria for selecting the breeding ewes were age and health parameters. Only clinically healthy females aged two to five years were included in the study. The herd's health is rigorously monitored every two months through physical examination and complementary exams, using the Famacha method (Molento *et al.*, 2004) and parasitological fecal tests to identify potential worms early. Additionally, the entire herd undergoes an annual vaccination protocol, including a booster dose, against rabies, clostridiosis, and caseous lymphadenitis.

The mating of the breeding ewes was performed naturally by the same sire, and the probable date of calving was estimated by rectal ultrasonography. The females were kept under close observation near the calving period, so the exact moment of calving could be monitored. After birth, 30 lambs (males and females) were included in the study.

Each lamb was immediately weighed after birth and before the first colostrum intake, using a digital scale. The first blood sample (M0) was then collected via jugular venipuncture, following strict antisepsis of the site with 70% alcohol. A 3mL syringe with a 30x0.7mm needle was used to collect a total of 3mL of blood. Blood was immediately transferred to two tubes: 1.5mL in a microtube containing EDTA for hematological analysis, and 1.5mL in a tube with a clot activator for biochemical analysis. Whole blood samples were kept in an ice-filled isothermal box and processed within two hours of collection. The serum was separated by centrifugation, transferred to microtubes, and frozen at -20°C until the biochemical analyses were performed.

After the initial blood collection, the quality of the colostrum was evaluated using a Brix digital refractometer, and only good-quality colostrum was collected in a volume of at least 10% of the lamb's weight via bottle as soon as possible. Four hours after colostrum ingestion, a physical examination was performed to measure heart rate (HR), respiratory rate (RR), and rectal temperature (RT).

Subsequent evaluations and sample collection were performed at 24, 72 hours, seven, 15, and 30 days of life. Physical examinations and hematological analyses were performed at all established times. Biochemical analyses were performed on samples collected at birth (M0), 24 hours, 15, and 30 days of life.

This study used an automated hematology analyzer (HumaCount 30T, HUMAN GmbH, Germany) to measure hematocrit (Ht), erythrocyte count, hemoglobin concentration, mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), and red cell distribution width (RDW). Total plasma protein (TPP) was measured using a portable optical refractometer. To count the differential leukocyte, blood smears were prepared, stained with rapid panoptic dye, and 100 cells were counted under a microscope, following the methodology described by Thrall *et al.* (2022).

Serum biochemical analyses for urea, aspartate aminotransferase (AST), and gamma-glutamyltransferase (GGT) were conducted. The analyses were performed using commercial reagent kits (Interkit, Intertek Katal Biotecnologica, Brazil) in an automated biochemical analyzer (SINNOWA SX-3000M, Sinnowa Brasil, Brazil), properly calibrated for each specific analyte.

Data was analyzed using SPSS software (IBM® version 25.0). Initially, the distribution of data regarding normality was verified using the Shapiro-Wilk test. The assumption of sphericity was tested with Mauchly's test. For normally distributed data, the effect of time (age) on the parameters was analyzed using a one-way repeated-measures analysis of variance (ANOVA), followed by Sidak's *post hoc* test for multiple comparisons. When the assumption of sphericity was violated, the Greenhouse-Geisser correction was applied. For variables that did not follow a normal distribution, Friedman's nonparametric test for related samples was used, followed by a paired *post hoc* analysis to identify differences between moments. A significance level of 5% ($P < 0.05$) was adopted for all statistical tests.

RESULTS AND DISCUSSION

The erythrocyte count, hematocrit, and hemoglobin concentration declined significantly ($P<0.05$) during the first 24 hours after birth, followed by gradual stabilization (Table 1). This initial decrease is a well-documented physiological adaptation to extrauterine life. Fetal erythropoiesis is stimulated by a relatively

hypoxic environment, which increases red blood cell mass at birth to ensure adequate oxygenation. After birth, as pulmonary respiration begins and oxygen availability increases, the stimulus for erythropoiesis temporarily decreases, leading to the reduction observed in these parameters (Thrall *et al.*, 2022; Cunningham and Klein, 2013).

Table 1. Hematological parameters (mean±standard deviations) of *Santa Inês* lambs from birth to 30 days of age raised in the semiarid region

Parameter	M0 (birth)	24h	72h	7 days	15 days	30 days	P
Erythrocytes ($\times 10^6/\mu\text{L}$)	9.85±1.23 ^a	8.42±1.15 _b	8.38±1.08 _b	8.45±1.12 _b	8.52±1.09 _b	8.61±1.14 _b	<0.001
Hemoglobin (g/dL)	12.4±1.8 ^a	10.8±1.6 ^b	10.7±1.5 ^b	10.9±1.4 ^b	11.1±1.5 ^b	11.3±1.6 ^b	<0.001
Hematocrit (%)	37.2±5.4 ^a	32.4±4.8 ^b	32.1±4.5 ^b	32.7±4.2 ^b	33.3±4.6 ^b	33.9±4.9 ^b	<0.001
MCV (fL)	37.8±3.2 ^a	38.5±3.1 ^a	38.3±2.9 ^{ab}	38.7±3.0 ^{ab}	39.1±3.2 ^b	39.4±3.3 ^b	0,032
MCHC (g/dL)	33.3±2.1	33.3±2.0	33.4±1.9	33.4±2.1	33.4±2.0	33.3±2.2	0,998
RDW (%)	18.2±2.4 ^c	18.9±2.6 ^c	19.4±2.8 ^{bc}	19.8±2.9 ^b	20.3±3.1 ^b	20.7±3.2 ^a	<0.001
TPP (g/dL)	4.2±0.8 ^c	7.8±1.2 ^a	7.2±1.1 ^{ab}	6.8±1.0 ^b	6.4±0.9 ^{bc}	6.1±0.8 ^c	<0.001
Leukocytes ($\times 10^3/\mu\text{L}$)	6.8±1.4 ^c	8.2±1.6 ^{bc}	9.4±1.8 ^{ab}	10.1±2.0 ^a	10.8±2.2 ^a	11.2±2.3 ^a	<0.001
Neutrophils (%)	68.4±8.2 ^a	65.2±7.8 ^a	58.6±7.1 ^b	52.3±6.8 ^c	45.7±6.2 ^d	42.1±5.9 ^d	<0.001
Lymphocytes (%)	28.1±6.4 ^d	31.2±6.8 ^{cd}	37.8±7.2 ^c	43.5±7.6 ^b	49.2±8.1 ^a	52.8±8.4 ^a	<0.001
Eosinophils (%)	2.1±0.8 ^c	2.3±0.9 ^c	2.4±0.9 ^c	2.8±1.0 ^{bc}	3.2±1.1 ^b	3.6±1.2 ^a	<0.001
Monocytes (%)	1.2±0.4 ^b	1.1±0.4 ^b	1.0±0.3 ^b	1.2±0.4 ^b	1.6±0.5 ^a	1.3±0.4 ^{ab}	0,045
Basophils (%)	0.2±0.1	0.2±0.1	0.2±0.1	0.2±0.1	0.3±0.1	0.2±0.1	0,156

Means followed by different letters on the same line differ statistically ($P<0.05$). MCV = mean corpuscular volume; MCHC = mean corpuscular hemoglobin concentration; RDW = red cell distribution width; TPP = total plasma protein.

This finding is particularly relevant to this study, given the detailed characterization of this transition in *Santa Inês* lambs specifically adapted to Brazil's semiarid conditions. Although the literature describes this phenomenon in a general way for sheep, few studies have accurately documented this dynamic in a tropical breed throughout the neonatal period. In addition, the natural dilution of blood volume through fluid intake and the short lifespan of fetal erythrocytes contribute to this decline (Smith and Sherman, 2020). Despite the

initial decrease, the mean values for these parameters remained within the reference ranges established for the sheep species (Brooks *et al.*, 2022), indicating a healthy physiological transition.

At the same time, MCV decreased over the evaluation period, while MCHC progressively increased ($P<0.05$) (Table 1). This pattern reflects the replacement of macrocytic fetal erythrocytes with smaller (normocytic) erythrocytes produced by neonatal

hematopoiesis. Thus, this study contributes to the precise documentation of this cellular transition over 30 full days, filling an important time gap in the literature. Fetal red blood cells are inherently larger to maximize oxygen-carrying capacity *in utero*. As they are replaced by adult-type cells, the average cell size of the circulating population decreases (Boyd and Bolon, 2010).

Such a corresponding increase in MCHC suggests more efficient packing of hemoglobin within maturing red blood cells. These findings are consistent with previous studies in lambs (Souza *et al.*, 2014, 2020; Santarosa *et al.*, 2021). However, this study offers, for the first time, an integrated and continuous view of cell maturation in the *Santa Inês* breed in the semiarid environment, confirming the red series' cell maturation during the lamb's first month of life.

The RDW, which measures the variability in the size of circulating erythrocytes (anisocytosis), showed a progressive increase over the 30 days ($P<0.05$) (Table 1). Such an increase was expected during the neonatal period, as it reflects the simultaneous presence of different erythrocyte populations: the initial macrocytic fetal cells, which are gradually being eliminated, and the newly produced, smaller, adult-type cells. This physiological anisocytosis, which is longitudinally documented in our study, is an important marker of the transition from fetal to adult erythropoiesis (Boyd and Bolon, 2010), providing specific reference data for this critical phase.

Total plasma protein (TPP) concentration showed a marked increase at 24 hours post-colostrum ingestion ($P<0.05$), followed by a gradual decline in subsequent assessments (Table 1). This dynamic is a direct and reliable indicator of successful transfer of passive immunity. Sheep have a syndesmochorial placenta, which prevents the transfer of maternal immunoglobulins in utero. Consequently, lambs are born agamaglobulinemic, with low TPP levels (Agenbag *et al.*, 2021).

The ingestion of colostrum, rich in proteins, especially immunoglobulins (IgG), leads to the rapid absorption of these molecules through the permeable intestinal epithelium in the first hours of life, causing the peak observed in TPP

(González and Silva, 2017; Smith and Sherman, 2020; Agenbag *et al.*, 2021; Carvalho *et al.*, 2025). The subsequent decline reflects the catabolism of these absorbed proteins and the dilution effect as the lamb grows. The observed values confirm effective transfer of passive immunity in the animals studied.

The total leukocyte count increased after birth, with the highest values observed after 72 hours ($P<0.05$) (Table 1). Although within the reference limits, this increase is a physiological response to the antigenic challenges of the extrauterine environment and to the maturation of the neonatal immune system. A key finding of special scientific relevance was the identification of the moment of inversion in the neutrophil:lymphocyte (N:L) ratio, which occurred between days seven and 15 (Table 1). At birth, lambs had a neutrophilic profile, characteristic of a stress response associated with calving, probably mediated by elevated cortisol levels (Brooks *et al.*, 2022).

This inversion of the N:L ratio, documented with temporal precision in this study, is a fundamental immunological milestone that had not been characterized in such detail for *Santa Inês* lambs. As the animal adapts and its immune system matures, stimulated by colostrum ingestion and environmental exposure, its profile shifts toward a lymphocytic one. This is the normal state for healthy adult ruminants. This inversion is a classic sign of immune development and has been similarly described for calves and other lambs (Turquino *et al.*, 2011; Novo *et al.*, 2015).

The eosinophil count showed a progressive increase over the 30 days ($P<0.05$) (Table 1). Eosinophils are primarily involved in the response to parasitic infections and allergic reactions. Its gradual increase is likely associated with immune system development and initial exposure to environmental antigens (Lins *et al.*, 2020; Brooks *et al.*, 2022). Monocyte dynamics showed a slight increase after 15 days ($P=0.045$), returning to initial levels by day 30. Such an increase may be related to the activation and general maturation of the innate and adaptive immune systems following colostrum intake (Smith and Sherman, 2020). On the other hand, basophil values remained the same throughout the period ($P=0.156$).

Serum urea concentration increased at 24 hours post-colostrum ingestion ($P<0.05$) (Table 2). This spike is directly attributed to the colostrum's high protein content. The digestion and catabolism of these absorbed proteins, especially caseins and immunoglobulins, increase urea production in the liver as a byproduct of amino

acid metabolism (González and Silva, 2017). Although physiologically expected, this finding is particularly relevant for *Santa Inês* lambs in the semiarid region, providing regionalized reference values that were previously unavailable in the literature.

Table 2. Biochemical parameters of *Santa Inês* lambs from birth to 30 days of age raised in the semiarid region

Parameter	M0 (birth)	24h	15 days	30 days	P
Urea (mg/dL)	28.4±6.2 ^c	45.8±8.9 ^a	38.2±7.1 ^b	32.6±6.8 ^c	<0.001
AST (U/L)	89.7±18.4 ^b	142.3±28.6 ^a	95.8±19.2 ^b	87.2±17.9 ^b	<0.001
GGT (U/L)	126.36±24.8 ^c	1,118.58±198.4 ^a	456.72±89.3 ^b	298.45±56.7 ^b	<0.001

Means followed by different letters on the same line differ statistically ($P<0.05$). AST = aspartate aminotransferase; GGT = gamma-glutamyltransferase.

This result is consistent with studies in lambs that also report post-colostral peak urea, confirming its usefulness as an indicator of protein intake in the immediate neonatal period (Souza *et al.*, 2014, 2020). However, this study advances by documenting this dynamic in an integrated way with other parameters throughout the critical neonatal period.

Similarly, AST activity showed an increase at 24 hours, followed by a decline in subsequent measurements ($P<0.05$) (Table 2). Although AST is a liver enzyme, it is also present in high concentrations in muscle tissue. The physical exertion and muscle activity associated with the birth process, as well as the lamb's first attempts to stand and move, can temporarily and physiologically increase serum AST activity (Smith and Sherman, 2020; Carvalho *et al.*, 2025). Therefore, this initial spike is more likely related to neonatal muscle metabolism than to liver injury.

The most dramatic and scientifically relevant change was observed in GGT activity, which increased almost ninefold from an average of 126.36U/L at birth to 1,118.58U/L at 24 hours (Table 2). This pronounced increase is a hallmark of adequate colostrum intake in ruminants. The epithelium of the mammary gland produces high concentrations of GGT, which is then transferred to the colostrum. When a lamb ingests and absorbs colostrum, this large enzyme molecule passes into the bloodstream,

resulting in a massive, albeit transient, spike in its serum activity (Latimer, 2011; González and Silva, 2017; Carvalho *et al.*, 2025).

An important aspect observed was that GGT activity remained elevated at 15 days and had not returned to baseline values at 30 days. This differs from the literature, which describes stabilization at 21 (González and Silva, 2017). Gokce *et al.* (2021) observed the stabilization of values in the fourth week of life of Akkaraman lambs. This prolonged elevation, documented in detail for *Santa Inês* lambs, highlights the critical importance of establishing age- and region-specific reference values. Interpreting these elevated neonatal values with adult reference intervals would erroneously suggest severe hepatobiliary disease. These findings are consistent with recent work by Carvalho *et al.* (2025) in *Santa Inês* lambs, who also reported a post-colostral GGT peak.

The lambs showed a progressive increase in body weight over the 30 days ($P<0.05$) (Table 3), consistent with a normal growth curve for the species and breed under adequate nutrition (Oliveira *et al.*, 2021). This documentation of growth alongside hematological and biochemical alterations provides an integrated view of neonatal development that was previously unavailable in the literature for this breed in semiarid conditions.

Table 3. Physical parameters and body weight of *Santa Inês* lambs from birth to 30 days of age raised in the semiarid region

Parameter	M0 (birth)	24h	72h	7 days	15 days	30 days	P
Weight (kg)	3.2±0.6 ^f	3.4±0.6 ^e	3.8±0.7 ^d	4.5±0.8 ^c	6.2±1.1 ^b	8.9±1.4 ^a	<0.001
HR (bpm)	142±18 ^a	138±16 ^a	132±15 ^b	125±14 ^c	118±13 ^d	112±12 ^e	<0.001
RR (mpm)	68±12 ^a	65±11 ^a	58±10 ^b	52±9 ^c	46±8 ^d	42±7 ^e	<0.001
RT (°C)	38.9±0.4	39.1±0.5	39.0±0.4	38.8±0.4	38.9±0.5	39.0±0.4	0,234

Means followed by different letters on the same line differ statistically ($P<0.05$). HR = heart rate; RR = respiratory rate; RT = rectal temperature.

Heart rate (HR) and respiratory rate (RR) showed a gradual decrease with age ($P<0.05$) (Table 3). Neonates have higher metabolic rates, smaller and less efficient cardiovascular and respiratory systems, and a higher body surface area-to-volume ratio. All these factors contribute to higher HR and RR to meet oxygen demands and maintain thermoregulation. As the lamb grows and these systems mature and become more efficient, resting rates naturally decline toward adult values (Sjaastad *et al.*, 2016; Smith and Sherman, 2020).

The observed values are consistent with those reported for other lamb breeds (Ulian *et al.*, 2014). However, this study provides, for the first time, specific data for *Santa Inês* lambs in the semiarid region, contributing to the establishment of regionalized reference values. The rectal temperature (RT) remained stable ($P=0.234$) and within the normal physiological range for the species throughout the study (Table 3), indicating that the lambs were able to maintain effective thermoregulation under the environmental conditions studied. This demonstrates the breed's adaptability to the challenging climatic conditions of the semiarid region.

CONCLUSION

The clinical, hematological, and biochemical parameters of *Santa Inês* lambs raised in the semiarid region undergo important changes during the first 30 days of life, reflecting a complex process of physiological and immunological adaptation to the extrauterine environment. This study confirms the predictable postnatal decline in the erythrocyte series and details the crucial reversal of the

neutrophil:lymphocyte ratio, a key indicator of immune system maturation. Additionally, the pronounced post-colostral peaks in total proteins, urea, AST, and especially GGT, serve as robust indicators of successful passive immunity transfer and metabolic adaptation.

By characterizing these parameters in an integrated, longitudinal way throughout the neonatal period, this study helps fill an important knowledge gap and establishes essential reference data for *Santa Inês* lambs in this specific production environment. These findings reinforce the importance of using age-specific reference ranges to support accurate clinical assessment and can help veterinarians and producers make more informed decisions about the health and welfare management of neonatal lambs.

CONTRIBUTORS

LCF Baptista Filho, BLN Pereira, TRR Ramos, KC Rocha: study conception, objective, laboratory analysis, data analysis, discussion, manuscript writing, and approval of the version to be published. MER Nascimento, ME Marques, PBM Oliveira, MM Araújo: Assistance in routine procedures for the development of the study, and laboratory analysis.

DATA AVAILABILITY STATEMENT

The research data are available within the article itself.

REFERENCES

- AGENBAG, B.; SWINBOURNE, A.M.; PETROVSKI, K.; VAN WETTERE, W.H. Lambs need colostrum: a review. *Livest. Sci.*, v.251, p.104624, 2021.
- BEZERRA, L.R.; OLIVEIRA, W.D.C.; SILVA, T.P.D. et al. Comparative hematological analysis of Morada Nova and Santa Inês ewes in all reproductive stages. *Pesqui. Vet. Bras.*, v.37, p.408-414, 2017.
- BOYD, J.W.; BOLON, B. *Pathology of domestic animals*. 5.ed. St. Louis: Elsevier, 2010. 2400p.
- BROOKS, M.B.; HARR, K.E.; SEELIG, D.M. et al. (Eds.). *Schalm's veterinary hematology*. 6.ed. Ames: John Wiley & Sons, 2022. 1456p.
- CARVALHO, J.S.; ULIAN, C.M.V.; MENEZES, H.C.O. et al. Parâmetros bioquímicos e avaliação da transferência de imunidade passiva em cordeiros Santa Inês de elite nascidos de partos simples e gemelar. *Cienc. Anim. Bras.*, v.26, p.e81436, 2025.
- CUNNINGHAM, J.G.; KLEIN, B.G. *Textbook of veterinary physiology*. 5.ed. St. Louis: Elsevier, 2013. 640p.
- GOKCE, E.; KIRMIZIGUL, A.H.; ATAKISI, O. et al. Passive immunity in lambs: Colostral and serum γ -glutamyltransferase as a predictor of IgG concentration and related to the diseases from birth to 12 weeks of life. *Vet. Med.*, v.66, p.45, 2021.
- GONZÁLEZ, F.H.D.; SILVA, S.C. *Introdução à Bioquímica Clínica Veterinária*. 3.ed. Porto Alegre: UFRGS, 2017. 504p.
- LATIMER, K.S. *Duncan and Prasse's Veterinary Laboratory Medicine: Clinical Pathology*. 5.ed. Ames: Wiley-Blackwell, 2011. 640p.
- LIMA, É.M.; CORRÊA, A.C.B. Mapeamento geomorfológico como ferramenta de caracterização ambiental do município de Garanhuns-PE. *Geosul*, v.31, p.35-56, 2016.
- LINS, J.G.G.; ALMEIDA, F.A.; AMARANTE, A.F.T. Haematological variables of Santa Inês and Ile de France suckling lambs: influence of *Haemonchus contortus* infection. *Pesqui. Vet. Bras.*, v.40, p.907-914, 2020.
- MOLENTO, M.B.; TASCA, C.; GALLO, A. et al. Método Famacha como parâmetro clínico individual de infecção por *Haemonchus contortus* em pequenos ruminantes. *Ciênc. Rural*, v.34, p.1139-1145, 2004.
- NOVO, S.M.F.; FREITAS, R.L.; SILVA, D.F.M. et al. Hematological adaptation in Holstein calves during the neonatal period. *Braz. J. Vet. Res. Anim. Sci.*, v.52, p.212-220, 2015.
- OLIVEIRA, E.J.; PEDROSA, V.B.; SANTANA JÚNIOR, M.L. et al. Genetic parameters for body weight and morphometric traits in Santa Inês sheep. *Small Ruminant Res.*, v.197, p.106323, 2021.
- PEREIRA, F.B.; BEZERRA, L.R.; MARQUES, C.A.T. et al. Perfil hematológico de ovelhas Santa Inês suplementadas a pasto no terço final de gestação e no pós-parto. *Cienc. Anim. Bras.*, v.16, p.364-377, 2015.
- PUGH, D.G.; BAIRD, A.N.; EDMONDSON, M.A. *Sheep, Goat, and Cervid Medicine*. 3.ed. St. Louis: Elsevier, 2021. 768p.
- SANTAROSA, B.P.; DANTAS, G.N.; FERREIRA, D.O.L. et al. Comparison of hematological parameters between single and twin pregnancies in Dorper ewes during gestation, lambing, and postpartum. *Ciênc. Rural*, v.52, p.e20201065, 2021.
- SJAASTAD, Ø.V.; AREIA, A.R.; HOVE, K. *Physiology of Domestic Animals*. 3.ed. Oslo: Scandinavian Veterinary Press, 2016. 768p.
- SMITH, B.P.; SHERMAN, D.M. *Large Animal Internal Medicine*. 6.ed. St. Louis: Elsevier, 2020. 2048p.
- SOUZA, D.F.; MONTEIRO, A.L.G.; DITTRICH, R.L. et al. Dinâmica pré e pós-colostral de parâmetros bioquímicos em cordeiros. *Cienc. Anim. Bras.*, v.15, p.438-444, 2014.

Clinical-laboratory...

SOUZA, D.F.; MONTEIRO, B.M.; ARAÚJO, S.A.C. *et al.* Dynamics of biochemical parameters in lambs during the first four months of life. *Rev. Bras. Zootec.*, v.49, p.e20190167, 2020.

THRALL, M.A.; WEISER, G.; ALLISON, R.W. *et al.* *Veterinary Hematology and Clinical Chemistry*. 3.ed. Ames: John Wiley & Sons, 2022. 1056p.

TURQUINO, C.F.; FLAIBAN, K.K.M.C.; BORGES, A.S. *et al.* Transferência de imunidade passiva em cordeiros de corte manejados extensivamente sob condições tropicais. *Pesqui. Vet. Bras.*, v.31, p.199-205, 2011.

ULIAN, C.M.V.; KOETHER, K.; LOURENÇO, M.L.G. *et al.* Physiological parameters in neonatal lambs of the bergamasca breed. *Acta Sci. Vet.*, v.42, p.1-8, 2014.

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