

ABSORPTION OF IMMUNOGLOBULINS IN THE COLOSTRUM BY ARTIFICIALLY-NOURISHED LAMBS

ARMAȘ ANA GINA¹, VĂLUȘESCU DANIELA¹, MARÎTESCU MARIUS¹,
PETROMAN IOAN^{*1}, ȚIBRU IOAN^{*1}

¹ *Development Research Station for Raising Sheep and Goats,
S.C.D.C.O.C. Caransebeș, Romania*

*Corresponding author's e-mail: tibru_ioan@yahoo.com, i_petroman@yahoo.com

Abstract: *The purpose of this study was to investigate the body mass and the immune state of the lambs raised in natural conditions and artificial feeding conditions with two different quantities of colostrum. In this study, 60 lambs were randomly divided into groups according to treatment: 20 lambs remained with their mothers (the natural growth group G1), 20 lambs were taken from their mothers post-partum and were fed from the bottle with 150 g of collection milk (G 2) equivalent of 4g of IgG, and 20 lambs were fed with 200 g colostrum (G3) equivalent of 8 g IgG. The total colostrum amount was equally divided into three rations 2, 14, and 24 h post-partum. Naturally raised lambs (G1) had a larger body mass than G2 and G3 during breastfeeding, while G2 and G3 had a larger body mass than G1 upon weaning. G3 and G1 had plasma concentrations of IgG higher than G2 during breastfeeding. G2 and G3 presented similar concentrations of IgG, but higher than G1 lambs. The lambs that were breastfed with 200 g colostrum (8 g of IgG/kg) presented immune values similar to those of the lambs grown in natural conditions, with a higher weight. This proves that not only the amount of colostrum, but also its management during the separation of the mother, the quality of the milk, and the frequency of breastfeeding can affect the final immune status of the lambs. Regarding the study of factors influencing the absorption of colostrum immunoglobulins from recently-born lambs, 60 lambs belonging to the Țurcană breed were separated from their mothers before breastfeeding and fed with the bottle with 10 measures of colostrum from their mothers and 10 from colostrum collection.*

Key words: *sheep, colostrum, IgG, breastfeeding.*

INTRODUCTION

The relationship between colostrum and the survival of newly born lambs has been characterized for a long time. In fact, colostrum contains a complex mixture of proteins that actively participate in the protection of newly born lamb by passive immune transfer (PIT) against pathogens and other post-partum environmental challenges. [9,17,25] Moreover, colostrum has various components, such as fat, lactose, vitamins, or minerals that have an important high nutritional level [11,13,23,24]. In particular, colostrum plays an important role in lambs because they are hypogammaglobulinemic because of the complexity of the placenta in ruminants, which is syndesmo-epithelial, which does not allow sufficient transfer from mother to foetus. In addition, it has been described that lambs who did not benefit from colostrum in the first hours of life are more susceptible to diseases and mortality. Nowadays, there is an increase in the number of high-production dairy farms, where the lambs are raised in an artificial feeding system. In such cases, the lambs are fed with colostrum bottle then with milk replacement to increase the amount of milk available for processing. [12,15,16,19,26] As described by several authors, the lambs need to receive an amount of colostrum equivalent to 4 g of IgG/kg divided into three rations within the first 48 h post-partum to reach an appropriate immunological transfer. Because it is essential to reach a concentration of appropriate immunoglobulin in the blood, it is mandatory for it to be followed and achieved for the survival of the lambs. [5,7,10,21]

Although the transfer of immunoglobulins (IgG and IgM) is a key factor for the host's defence against pathogens, a wider range of colostrum components, such as the system protein complement, it has been suggested that it has a role in the early protection

of newly born lamb. [20,22,25] The system of activating the total complement and alternative complement also plays an important role in the defence of the host to the mechanisms of the infectious agents, because it is involved in the specific and non-specific immunity. There are few studies on the activity of the complement system in sheep and lambs. [1,2,8,14,27]

The purpose of this study was to investigate the body mass and the immune state of the lamb raised under natural conditions and the lamb raised in the bottle with two different quantities of colostrum (150 g equivalent to 4 g IgG/kg upon calving and 200 g equivalent to 8 g IgG/kg upon calving). [3,4,6,18]

MATERIALS AND METHODS

The present study was conducted at the SCDCOC Caransebeş on 45 lambs of the Țurcană breed with single gestation. All the lambs were born in the same period (February-March 2025). The health of the animals was monitored during the experiment and the lambs were healthy throughout the experimental period.

Upon calving, the animals were divided equally by sex and then divided randomly into three different groups. The natural growth group (G1) was composed of 15 lambs, which sucked colostrum directly from their mothers. The other two lots of 15 lambs were housed in separate pens, providing 0.4 m² for each lamb and a heat source (infrared lamp) to ensure 20°C.

RESEARCH RESULTS

The lambs were fed from the bottle with a mixture of sheep colostrum, previously heated to 38°C. The artificially raised lambs received 150 g of colostrum equivalent to 4 g of IgG/kg upon calving (G2) or 200 g equivalent 8 g of IgG/kg (G3) distributed in three rations at 2, 14, and 24 h post-partum. The IgG concentrations in the colostrum (64.37 mg/ml) were determined in a laboratory based on an ELISA kit (Montgomery, TX, USA), using a purified IGG as a standard curve.

During the milk feeding period (from calving up to 10 kg body mass), the lambs of G1 were raised in special areas and had free access to their mothers until weaning. Lambs breastfed (G2 and G3) received collection milk. These groups were breastfed twice a day (8:00 and 17:00 o'clock) with milk fed at 37°C.

The lambs of the three lots were weaned when they reached 10 kg body mass at 31 and 35, and 34 days post-partum for G1, G2 and G3, respectively. After weaning for a period of 30 days in the lots taken in the study, they had free access to feed with 18% raw protein and 3.4% fat provided from alfalfa and water.

The lambs in G1 were separated from the females and placed in a pen for 30 days. The sheep were milked once a day at 9:00 o'clock. From day 0 to 8 post-partum, the lambs had access to their mothers twice a day (10:00 o'clock after milking and 17:00 o'clock), reducing this access to once a day (17:00 o'clock) from day 9 to 15:00 o'clock. After that, the lambs did not have access to their mothers. The G2 and G3 lots received 0.250 l of collection milk twice a day from day 0 to day 8 (at 10:00 o'clock and 17:00 o'clock), after which the contribution was reduced to once a day (from day 9) at 17:00 o'clock.

Registration of body mass (kg) was done by weighing before each blood collection, with a specific platform (precision 5 g). During the milk feeding period, blood samples were collected 2 h post-partum (day 0) and then blood samples were collected on days 1, 2, 3, 4, 5, and 20 post-partum.

Another sample was taken when each animal reached 10 kg of live weight. During the weaning period, blood samples were collected every five days until the end of the experimental period. The blood samples were collected before breastfeeding in the

morning in the jugular vein in 2.5 ml tubes with K3EDTA. The blood was centrifuged at $2190 \times g$ for 5 minutes, and the plasma was stored at -80°C until the analysis.

To determine the plasma concentrations of IgG, the samples were sent to a laboratory where ELISA commercial kits were used (Bethyl Laboratories) using purified IgG as a standard curve. The results were expressed in mg immunoglobulin/ml plasma.

Statistical analyses were performed using the SAS version 9.00. All groups (G1, G2, and G3) had a very low IgG value in blood plasma upon calving, which was expected, a value explained by the placenta of the mum. After the first colostrum intake, this concentration increased rapidly in lambs from all lots until the second day from calving: 16.79, 5.81, and 17.74 mg of IgG/ml ($p < 0.05$). After that, the IgG concentration decreased until the end of the milk feeding period (5.22, 2.18, and 5.62 mg of IgG/ml, ($p < 0.05$). In the rest of the milk feeding period (0-8 days), the concentration of IgG was lower in the lambs of the G2 group ($P < 0,05$).

Analysing the body mass of the lambs in the three lots, it was found that there were no differences, although the lambs in G2 and G3 were heavier than the lambs in G1 on day 25 (15.75, 15.60, and 14.50 kg, $p < 0.05$) and on day 30 (16.90, 17.00, and 15.25 kg, $p < 0.05$). The values were similar to those obtained to lambs raised separately from their mothers (they suffer greater stress during the weaning period).

As for the concentration of IgG, lambs in G1 and G3 showed slight decreases ($p < 0.05$) of plasma IgG. However, both groups showed an increase in values at the end of this period: 7.11 IgG/ml in G1 and 5.62 IgG/ml in G3 ($p < 0.05$). In contrast, values in G2 did not decrease, reaching the maximum value in 30 days. Regarding the differences between the groups, the lambs in G1 and G3 showed higher concentrations of IgG than the animals in G2 at the beginning of weaning (5.20, 2.10 and 5.61 mg/ml ($p < 0.05$), respectively. There are no differences between groups during the period after weaning. Reducing colostrum intake in G2 could cause an earlier synthesis of the IgG in comparison than in G1 and G3. This could explain the growth of the IgG in the lambs in G2 during this period.

CONCLUSIONS

The lambs that received an amount of colostrum equivalent to 8 g of IgG/kg body mass equally divided into three rations at 2, 14, and 24 h post-partum could reach similar IgG concentrations in the blood. At the end of the weaning at 60, 65, and 66 days post-partum, respectively, the lambs had a weight of 16.90, 17.00, and 15.25 kg, respectively. However, this study shows that not only the amount of colostrum but also the management during breast-feeding until weaning (the stress produced by the separation from the mother sheep), the quality of the milk, and the frequency of breastfeeding can affect the final immune status of the lambs. This study reveals important information about the amount of colostrum needed for newly born lambs under more delicate (artificial) conditions to reach a similar immunity for those raised in natural (normal) conditions.

REFERENCES

- [1]. **AGENBAG B., SWINBOURNE A.M., PETROVSKI K., VAN WETTERE WHEJ**, 2021, Lambs need colostrum: A review, *Livest Sci.*, 251, 104 -124.
- [2]. **ALVES A.C., ALVES N.G., ASCARI I.J.**, 2015, Colostrum composition of Santa Ines sheep and passive transfer of immunity to lambs, *J Dairy Sci.*, 98 (6), 3706–3716.

- [3]. **BANCHERO G.E., MILTON J.T.B., LINDSAY D.R., MARTIN G.B., QUINTANS G.**, 2015, Colostrum production in ewes: a review of regulation mechanisms and of energy supply, *Animal*, 9 (5), 831–837.
- [4]. **BINNS S.H., COX I.J., RIZVI S., GREEN L.E.**, 2002, Risk factors for lamb mortality on UK sheep farms, *Prev Vet Med.*, 52 (3-4), 287–303.
- [5]. **BRAMBELL F.W.R., NEUBERGER A., TATUM E.L.**, 1970, *Frontiers of biology*. In: Neuberger A, Tatuni EL, eds. North Holl, Amsterdam, 18, 189
- [6]. **CHAARANI B., ROBINSON R.A., JOHNSON D.W.**, 1991, Lamb mortality in Meknes province (Morocco), *Prev Vet Med.*, 10 (4), 283–298.
- [7]. **CHRISTLEY R.M., MORGAN K.L., PARKIN T.D.H., FRENCH N.P.**, 2003, Factors related to the risk of neonatal mortality, birth-weight and serum immunoglobulin concentration in lambs in the UK, *Prev Vet Med.*, 57 (4), 209–226.
- [8]. **CSIZMADIA BIANCA, ISDRARIU I., HERMAN V., VADUVA LOREDANA, PETROMAN CORNELIA, PETROMAN I.**, 2023, Influence of foot diseases on welfare and economic balance in sheep, *Revista Română de Medicină Veterinară*, 33(3).
- [9]. **CSIZMADIA ANDREA STEFANA, VADUVA LOREDANA, PETROMAN CORNELIA**, 2023, Implementation of good nutritional practices to stimulate meat production in sheep using same horticultural species, *Scientific Papers-Series B-Horticulture*, Volume 67.
- [10]. **DWYER C.M., CONINGTON J., CORBIERE F.**, 2016, Invited review: Improving neonatal survival in small ruminants: science into practice, *Animal*, 10 (3), 449–459.
- [11]. **DWYER C.M.**, 2008, The welfare of the neonatal lamb, *Small Rumin Res.*, 76 (1-2), 31–41.
- [12]. **GREEN L.E., MORGAN K.L.**, 1993, Mortality in early born, housed lambs in south-west England, *Prev Vet Med.*, 17 (3-4), 251–261.
- [13]. **HINDE D., WOODHOUSE M.**, 2019, Ewe nutrition and colostrum, *Livestock*, 24 (2), 9–14.
- [14]. **KESSLER E.C., BRUCKMAIER R.M., GROSS J.J.**, 2019, Immunoglobulin G content and colostrum composition of different goat and sheep breeds in Switzerland and Germany, *J Dairy Sci.*, 102 (6), 5542–5549.
- [15]. **KESSLER E.C., BRUCKMAIER R.M., GROSS J.J.**, 2021, Short communication: comparative estimation of colostrum quality by Brix refractometry in bovine, caprine, and ovine colostrum, *J Dairy Sci.*, 104 (2), 2438–2444.
- [16]. **MELLOR D, MURRAY L.**, 1986, Making the most of colostrum at lambing, *Vet Rec.*, 118 (13), 351–353.
- [17]. **NOWAK R., POINDRON P.**, 2006, From birth to colostrum: early steps leading to lamb survival, *Reprod Nutr Dev.*, 46 (4), 431–446.
- [18]. **PETROMAN CORNELIA, SAVA CIPRIANA, RISTEA I., MARIN DIANA, VADUVA LOREDANA, PETROMAN I.**, 2018, Methods of improving the demand and offer in the agrotourist farms, *Quaestus, Multidisciplinary Research Journal*, Vol. 13.
- [19]. **PETROMAN CORNELIA, SAVA CIPRIANA, BOLD MARINELA LIDIA, MARIN DIANA, VĂDUVA LOREDANA, PETROMAN I.**, 2019, Considerations regarding the development of rural and farm tourism, *Quaestus, Multidisciplinary Research Journal*, Vol. 14.
- [20]. **PETROMAN CORNELIA, VĂDUVA LOREDANA, SAVA CIPRIANA, PETROMAN I.**, 2022, Research regarding spending leisure time at the agrotourist farm, *Quaestus Multidisciplinary Journal*, Vol. 19.
- [21]. **RABASH J., BROWNE W.J.**, 2001, Non-hierarchical multilevel models In: Leyland AH, Goldstein H, eds. *Modeling non-hierarchical structures*, University of Bristol.

- [22]. SHUBBER A.H., DOXEY D.L., BLACK W.J.M., FITZSIMONS J., 1979a, Colostrum production by ewes and the amounts ingested by lambs, Res Vet Sci., 27 (3), 280–282.
- [23]. SHUBBER A.H., DOXEY D.L., BLACK W.J.M., FITZSIMONS J., 1979b, Immunoglobulin levels in ewe colostrum and in lamb serum, Res Vet Sci., 27(3), 283–285.
- [24]. TORRES-ROVIRA L., PESANTEZ-PACHECO J.L., HERNANDEZ F., 2017, Identification of factors affecting colostrum quality of dairy Lacaune ewes assessed with the Brix refractometer, J Dairy Res., 84 (4), 440–443.
- [25]. VĂDUVA LOREDANA, ȚÎRLEA IOANA CRISTINA, NEAMȚU A., SUCIU A. M., PETROMAN CORNELIA, 2023, Possibilities for improving the production and consumption of meat and meat preparations in Timiș county, Romania. SGEM Vienna GREEN 2023 "Green Sciences for Green Life".
- [26]. VĂDUVA LOREDANA, PETROMAN CORNELIA, MARIN DIANA, PETROMAN I., 2023, Authenticity in farm agritourism. Lucrări Științifice Management Agricol, ISSN print 1453-1410, 25(1).
- [27]. WOODING F.B.P., FLINT A.P.F., HEAP R.B., MORGAN G., BUTTLE H.L., YOUNG I.R., 1986, Control of binucleate cell migration in the placenta of sheep and goats, Reproduction, 76 (2), 499–512.