Scientific Papers. Series D. Animal Science. Vol. LXV, No. 1, 2022
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

# DYNAMIC OF RECTAL TEMPERATURE OF GOAT KIDS OF DIFFERENT TYPE OF BIRTH IN THE FIRST HOUR AFTER BIRTH

**Svetoslava STOYCHEVA, Tsvetomira BANCHEVA, Lora MONDESHKA, Tsvetelina DIMITROVA, Miroslav HRISTOV, Nikolay MARKOV**

Agricultural Academy - Sofia, Research Institute of Mountain Stockbreeding and Agriculture, 281 Vasil Levski Str., 5600, Troyan, Bulgaria

Corresponding author email: lora.mondeshka@abv.bg

***Abstract***

*Rectal temperature dynamic was studied in newborn kids of different type of birth during the first hour of postnatal life. The study involved 37 goat kids of Bulgarian White Dairy breed and its crossbreeds with Anglo-Nubian and Togenburg - 19 single kids and 36 twins kids. Rectal temperature of the newborns kids was recorded at birth, at 15, 30, 45 and 60 min after delivery. The dynamic of the rectal temperature during the first hour after birth did not differ significantly in single and twins. In both singles and twins, the rectal temperature began to decline, with singles it reached its minimum on the 45th minute and on the 30th in twins. The difference between the highest and the lowest value of the indicator was 0.94ºC in the singles and 0.77ºC in the twins. The established values indicated activation of appropriate thermoregulatory responses responsible for the kid's ability to maintain the body's homeotherm within normal physiological limits during the early postnatal period.*

***Key words**: goat, newborn, singles, thermoregulation, twins.*

## INTRODUCTION

According to Arfuso et al. (2021), the transition from the fetal state, protected and nourished within the uterus, to the free-living neonate is probably the most profound change the newborn have to face.

Along with changes in the immune status, behavior, and physiology (Dwyer et al., 2016), thermoregulatory changes occur. This transition period is of paramount importance, as newborns have limited energy reserves and, in order to maintain their homeothermy and survive, they must be weaned in a timely manner (Piccione et al., 2013).

The homeostasis temperature is based on a complex of physiological and biochemical mechanisms that ensure the variation of body temperature within limits, optimal for the course of biochemical reactions and the functioning of various tissues and organs (Mellor, 1988). The adaptive changes in the thermoregulatory system include morphological and functional changes, manifestation of which requires different periods of time (Brück & Zeisberger, 1987).

The main factor influencing the survival rate of newborn kids in countries with extensive breeding systems is hypothermia accompanied by late weaning, which are often caused by difficult births (Kumar et al., 2010; Chauhan et al., 2019).

Mortality in Merino kids in Australia reaches 20-30%, and in twins 30 to 40% depending on the environmental conditions at birth (Walker et al., 2003).

Melado et al. (2000) report that newborn kids are more sensitive to cold stress, compared to newborn lambs (Muller & McCutcheon, 1991) because of a higher heat production capacity per unit of body weight and a lower surface area to body weight ratio (reviewed by Mellor & Stafford, 2004).

At ambient temperatures lower than 4°C, during the first 5 days after birth, the survival of the kids was significantly lower than that of the kids born at temperatures higher than 4°C (Melado et al., 2000).

According to Binns et al. (2002), neonatal mortality among newborn lambs in the United Kingdom is around 10%, and 50% of pre-weaning mortality occurs on the first day after birth (Singh et al., 2008; Dwyer et al., 2016). This can have a significant negative effect on both the farm's reproductive performance and income (Shiels et al., 2022).

Most animal species require time to activate the processes of protection against cooling, and this largely depends on the accumulated reserves of adipose tissue (Plush et al., 2016).

The ability to rapidly activate adaptive mechanisms related to heat production, heat loss reduction and prevention of hypothermia were indicators that influence early survival of the infant (Morris et al., 2000; Southey et al., 2001).

The generation of endogenous heat was accomplished by non-contractile and contractile thermogenesis, both mechanisms being activated immediately after birth, contributing respecttively to the formation of 46 and 31% of the total heat production at the maximum level of metabolism - the highest possible metabolic activity that can is achieved by cold exposure of the newborn (Eales & Small, 1981).

Műller & McCutcheon (1991), however, found that in newborn kids the metabolism rate per unit of live weight was significantly lower than in newborn lambs. The authors believe that it was precisely the combination of low heat production capacity, lower birth weight and less efficient peripheral insulation that caused the lower cold resistance of the kids compared to the newborn lambs.

The aim of this work was to study the rectal temperature dynamic in newborn kids in different type of birth (singles, twins) during the first hour of postnatal life.

## MATERIALS AND METHODS

The study was conducted in the goat farm of the Research Institute on Mountain Stockbreeding and Agriculture in the town of Troyan, Bulgaria.

The facility is located at an altitude of 380 m, (42° 53' 39" N / 24° 42' 57" E).

The study involved 37 goat kids of Bulgarian White Dairy breed (BWD) and its crossbreeds with Anglo-Nubian (AN) and Togenburg (TG) - 19 single kids and 36 twins kids. All goats were housed and cared for under the same conditions. During the winter period animals were kept in a barn and fed with a ration containing of 2 kg hay, and 0.8 kg concentrated fodder per head.

There was free access to water and salt. In the spring months (May-November) goats were grazing. Goats were vaccinated against enterotoxemia, treated for parasites, and given vitamins A, D, and E (Vialiton, Biovet).

Kidding of goats took place in February and March. Before kidding goats were separated in individual pins and were under surveillance.

The study included term-born, clinically healthy kids. The kids' were weighed right after birth.

Rectal temperature was recorded by digital clinical thermometer Microlife MT 16C2 inserted in a depth of 6 cm after delivery. The first rectal temperature measurement was made within a few minutes of birth, immediately after expulsion of the kid.

The second rectal temperature measurement was taken at 15 min of birth when the newborn were already located in the pen. The next measurements were performed at 30 min, 45 min and 60 min after delivery.

Environmental parameters, including air temperature, relative humidity and air velocity were monitored at various locations in the barn at 07.00 h, 14.00 h, and 21.00 h, using thermometers, whirling psychrometer and katathermometer respectively.

All environmental measurements were conducted within kid height. During the campaign, the room's electric lights were turned on at dusk and turned off in the morning around 7-8 p.m.

One-way ANOVA was used for statistical comparison. The differences were tested by Student t-test.

## RESULTS AND DISCUSSIONS

The dynamics of rectal temperature in the first hour after birth did not differ significantly between singles and twins (Figure 1).

From birth, the temperature dropped, reaching the same values in 15 minutes in singles and twins ($P>0.05$).

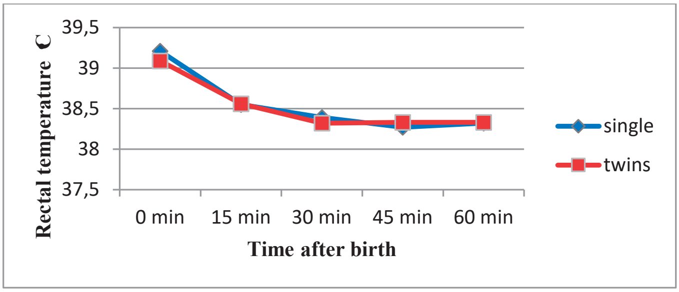


Figure 1. Rectal temperature dynamic in male and femae kids during the first hour of postnatal life

After a drop at around the 30th minute in the twins, the rectal temperature curve remained the same until the end of the first hour

In singles, the rectal temperature dropped until the 45th minute, after which it began to rise and at the end of the first hour the temperature equalized with that of the twins.

The difference between the highest and the lowest value of the indicator was 0.94ºC in the singles and 0.77ºC in the twins .

The increase in rectal temperature up to the 60th minute after birth can be explained by an increase in the metabolism of brown adipose tissue, an increase in heat production and an improvement in peripheral insulation (Cannon & Nedergaard, 2004).

In addition, during this period, the kids exhibited increased locomotor activity when attempting to stand up and seek the udder, whereby the heat generated in the muscles also contributed to the thermal status of the newborn (Aleksiev et al., 2009; Plush et al., 2016).

A similar pattern in the dynamics of rectal temperature has been found in newborn lambs (Aleksiev et al., 2007) and kids (Aleksiev, 2009a; Aleksiev, 2009b) of different breeds, in which the increase in rectal temperature after the initial decrease after birth, occurred, as in our experiments, after 45 minutes of postnatal life. The results obtained in both animal species suggested that genetic control exists over the implementation of mechanisms corresponding to the maintenance of homeothermia in newborns.

The live birth weight of the kids in our study did not differ significantly between singles (3.63 ± 0.12) and twins (3.42 ± 0.10).

In their study, Fazio et al. (2016) found that heavier singles have a lower rectal temperature after birth compared to lighter twin kids. According to the authors, this is probably due to the weaker use of the thermogenesis of shivering, as well as insufficient cold stimuli to induce metabolic over secretion.

In a study of lambs of different birth types, Stafford et al. (2007) found that the difference in rectal temperature measured at birth and at 1, 2, 3 and 6 hours after birth was due to the size of the lamb itself and not to its type of birth. This is confirmed by the findings of Chnite et al. (2013), who reported that regardless of liter size, heavier lambs have a higher rectal temperature at 1-12 hours, 24-36 hours and 48-69 hours after birth compared to lighter lambs.

Taking into account the specificity of the timing of the deliveries, it can be assumed that births occurred at the hours when the ambient temperatures were close to the maximum values for the day, which to some extent facilitates the adaptation of the newborns.

The low intensity of the air currents recorded during the experiment also contributed to a significant reduction in the level of heat loss.

Minimum barn temperature values ranged from -1 to 8ºC. Maximum temperatures ranged from 4 to 16ºC (Figure 2).

The relative humidity varied from 53 to 74% and the intensity of the air circulation in the different areas of the room ranged from 0.04 to 0.12 m/s.

The observed changes in rectal temperature indicated the initiation of thermogenesis due to separation from the placenta, removal of placental inhibitors from circulation, and sympathetic stimulation of brown adipose tissue upon cooling of the skin (Ball et al., 1995; Symonds et al., 1995; Clarke & Symonds, 1998).

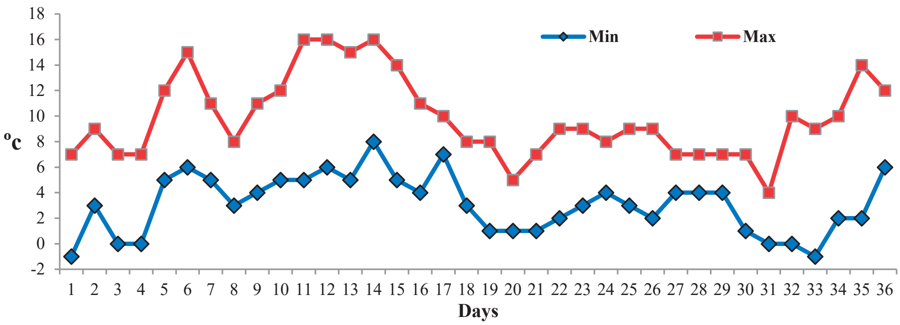


Figure 2. Minimum and maximum values of ambient temperatures during the birth period

Due to thermal inertia, the recorded rectal temperature values did not reflect the rapid changes in temperature of the various tissues and organs, but indicated that activation of non-contractile thermogenesis began within minutes after birth (Aleksiev, 2009a). Therefore, changes in body temperature lagged behind changes in the level of heat production in brown adipose tissue. According to Darwish & El-Bahr (2007), singles lambs and higher weight lambs have higher plasma concentrations of T3 and T4 at birth and higher thermoregulatory capacity (Symonds et al., 1995; Dwyer & Morgan 2006; Sawalha et al., 2007).

Improvement of peripheral isolation resulted from the activation of vasomotor activity and partly to the reduction of moisture content in the hair coat due to maternal care and evaporation (Darcan et al., 2009; Mota-Rojas et al., 2021).

The thermoregulatory mechanisms in lambs are well developed at birth (Faurie et al., 2004), but continue to be refined, reaching maximum efficiency by 4-5 days of age (Mercer et al., 1979).

According to authors (Mercer et al., 1979; Clarke et al., 1994), the process can take up to several weeks, depending on the maturity of the effectors at birth, and during this period, thermoregulatory, cardiovascular, respiratory and metabolic homeostatic mechanisms complete their development.

The dynamics of rectal temperature, especially the recorded increase after 30 minutes after birth in twins, was also influenced by the activation of mechanisms of contractile thermogenesis as an additional source of heat generation.

In a number of cases, in the newborn kids, tremors with different intensity of muscle groups in different parts of the body have been observed.

Likewise, differences in rectal temperature found between singles and twins may indicate variations in the degree of physiological maturation of homeothermic mechanisms at birth and their ability to activate heat production and/or heat conservation mechanisms, which ultimately affect heat retention (Aleksiev, 2009a; Giannetto et al., 2017).

## CONCLUSIONS

No significant differences were observed in the values of rectal temperature recorded at birth of singles and twin goat kids.

The rectal temperature of singles and twins during our study was within normal physiological norms.

The established values indicated activation of the appropriate thermoregulatory responses responsible for the kid's ability to maintain body homeothermia in temperate climates and facilitated adaptation to environmental conditions during the early postnatal period.

## REFERENCES

Aleksiev, Y. (2009a). Rectal temperature dynamic in Bulgarian white kids during the first day of postnatal life. *Bulgarian Journal of Agriculture Science*, *15*, 177-182.

Aleksiev, Y. (2009b). A note on rectal temperature behavior in Toggenburg kids during the first 36 hours of postnatal life. *Biotechnology in Animal Husbandry*, *25*(5-6), 985-991.

Aleksiev, Y., Gudev, D., & Dimov, G. (2007). Thermal status in three breeds of newborn lambs during the first 24 hours of postnatal life. *Bulgarian Journal of Agriculture Science*, *13*, 563-573.

Arfuso, F., Giannetto, C., Giudice, E., Assenza, A., & Piccione, G. (2021). Daily dynamic changes of blood acid-base status and vital parameters in lambs and goat kids over the first seven days after birth. *Small Ruminant Research*, *197*, 106340.

Ball, K., Gunn, T., R.,. Power, G., Asakura, H., & Gluckman, P., D. (1995). A potential role for adenosine in the initiation of nonshivering thermogenesis in fetal sheep. *Pediatric Research*. 37(3), 303-309.

Binns, S., Cox, I., Rizvi, S., & Green, L.E. (2002). Risk factors for lamb mortality on UK sheep farms. *Preventive Veterinary Medicine*, *52*, 287-303.

Brück, K., & Zeisberger, E. (1987). Adaptive changes in thermoregulation and their neuropharmacological basis. *Pharmacology & Therapeutics*, *35*(1-2), 163-215.

Cannon, B., & Nedergaard, J. (2004). Brown Adipose Tissue:Function and Physiological Significance, *Physiological Reviews, 84*(1), 277-360.

Chniter, M., Hammadi, M., Khorchani, T., Sassi, M.B., Hamouda, M., & Nowak, R. (2013). Aspects of neonatal physiology have an influence on lambs' early growth and survival in prolific D'man sheep. *Small Ruminant Research*, *111*(1–3), 162-170.

Chauhan, I., Misra, S.S., Kumar, A., & Gowane, G.R. (2019). Survival analysis of mortality in pre-weaning kids of Sirohi goat. *Animal*, 13(12), 2896–2902.

Clarke, L., Darby, C., Lomax, M., & Symonds, M. (1994). Effect of ambient temperature during 1 st day of life on thermoregulation in lambs delivered by ceaserian section. *Journal of Applied Physiology*, *76*(4), 1481 – 1488.

Clarke, L., & Symonds, M.E. (1998). Thermoregulation in newborn lambs: influence of feeding and ambient temperature on brown adipose tissue. *Experimental Physiology*, *83*(5), 651-657.

Darcan, N.K., Cankaya, S., & Karakok, S.G. (2009). The Effects of skin pigmentation on physiological factors of thermoregulation and grazing behaviour of dairy goats in a hot and humid climate. *Asian-Australasian Journal of Animal Sciences, 22*(5), 727–731.

Darwish, R.A., & El-Bahr, S.M. (2007). Neonatal lamb behaviour and thermoregulation with special reference to thyroid hormones and phosphorous element: Effect of birth weight and litter size. *Journal of Veterinary Medical Research*, *18*(1), 120-127.

Dwyer, C.M., & Morgan, C.A. (2006). Maintenance of body temperature in the neonatal lamb: Effects of breed, birth weight and litter size. *Journal of Animal Science*, *84*(5), 1093–1101.

Dwyer, C.M., Conington, J., Corbiere, F., Holmøy, I.H., Muri. K., Nowak, R., Rooke, J., Vipond, J., & Gautier, J.M. (2016). Invited review: improving neonatal survival in small ruminants: science into practice. *Animal*, *10*(3), 449–459.

Eales, F., & Small, J. (1981). Determinants of heat production in newborn lambs. *International Journal of Biometeorology*, *24*(2), 157-166.

Fazio, F., Arfuso, F., Giudice, E., Giannetto, C., & Piccione, G. (2016). Physiological differences between twin and single-born lambs and kids during the first month of life. *Archives Animal Breeding, 59*, 201–207.

Faurie, A., Mitchell, D., & Laburn, H. (2004). Peripartum body temperatures in free ranging ewes (ovis aries) and their lambs. *Journal of Thermal Biology*, *29*(2), 115-122.

Giannetto, C., Arfuso, F., Fazio, F., Giudice, E., Panzera, M., & Piccione, G. (2017). Rhythmic function of body temperature, breathing and heart rates in newborn goats and sheep during the first hours of life. *Journal of Veterinary Behavior*, *18*, 29-36.

Kumar, U., Sharma, S.K., Nagda, R.K., & Rajawat, B.S. (2010). Replacement index and mortality pattern of Sirohi goats under field condition. *Indian Journal of Small Ruminants*, *16*(2), 274-276.

Melado, M., Vera, T., Meza-Herera, C., & Ruiz, F. (2000). A note on the effect of air temperature during gestation on birth weght and neonatal mortality in kids. *Journal of Agrcultural Science, 135*(1), 91-94.

Mercer, J., Andrews, J., & Szekely, M. (1979). Thermoregulatory responses in newborn lambs during the first thirty six hours of life. *Journal of Thermal Biology*, *4*(3), 239-245.

Muller, S., & McCutcheon, S. (1991). Comparative aspects of resistance to body cooling in newborn lambs and kids. *Animal Production*, *52*, 301-309.

Morris, C.A., Hickey, S.M., & Clarke, J.N. (2000). Genetic and environmental factors affecting lamb survival at birth and through to weaning. *New Zealand Journal of Agricultural Research*., 43(4), 515-524.

Mellor, D.J. (1988). Integration of perinatal events, pathophysiological changes and consequences for the newborn lamb. *British Veterinary Journal*, *144*(6), 552-569.

Mellor, D.J., & Stafford, K.J. (2004). Animal welfare implications of neonatal mortality and morbidity in farm animals. *The Veterinary Journal, 168*(2), 118–133.

Mota-Rojas, D., Titto, C.G., de Mira Geraldo, A., Martínez-Burnes, J., Gómez, J., Hernández-Ávalos, I., Casas, A., Domínguez, A., José, N., Bertoni, A., Reyes, B., & Pereira, A.M.F. (2021). Efficacy and Function of Feathers, Hair, and Glabrous Skin in the Thermoregulation Strategies of Domestic Animals. *Animals*, *11*(12), 3472.

Plush, K.J., Brien, F.D., Hebart, M.L., &. Hynd, P.I. (2016). Thermogenesis and physiological maturity in neonatal lambs: a unifying concept in lamb survival. *Animal Production Science*, *56*, 736–745.

Piccione, G., Arfuso, F., Monteverde, V., Vazzana, I., Zumbo, A. & Faggio, C. (2013) Monitoring of some metabolic parameters in comisana lambs during the neonatal period. *Large Animal Review,* 19, 133–137.

Sawalha, R., Conington, J., Brotherstone, S., & Villannuela, B. (2007). Analisis of lamb survival of Scottish blackface sheep. *Animal*, *1*(1), 151-157.

Singh, M.K., Rai, B., & Sharma, N. (2008). Factors affecting survivability of Jamunapari kids under semi-intensive management system. *Indian Journal of Animal Sciences*, *78*(2), 178–181.

Southey, B.R., Rodriguez-Zas, S.L & Leymaster, K.A. (2001). Survival analysis of lamb mortality in a terminal sire composite population. *Journal of Animal Science*, *79*(9), 2298-2306.

Stafford, K.J., Kenyon, P.R., Morris, S.T., & West, D.M. (2007). The physical state and metabolic status of lambs of different birth rank soon after birth. *Livestock Science*, *111*(1-2), 10–15.

Symonds, M., Bird, J., Clarke, L., Gate, J., & Lomax, M. (1995). Nutrition, temperature and homeostasis during perinatal development. *Experimental Physiology*, *80*(6), 907-940.

Shiels, D., Loughrey, J., Dwyer, C.M., Hanrahan, K., Mee, J.F., & Keady, T.W.J. (2022). A Survey of Farm Management Practices Relating to the Risk Factors, Prevalence, and Causes of Lamb Mortality in Ireland. *Animals, 12*, 30.

Walker, S.K., Kleemann, D.O., & Bawden, C.S. (2003). Sheep reproduction in Australia – Current status and potential for improvement through flock management and gene discovery. *Meat and Livestock,* Australia, Sydney, NSW.

# NUTRITION