Dynamic of rectal temperature of goat kids of different sex in the first hour after birth

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Citation: Stoycheva, S. (2021). Dynamic of rectal temperature of goat kids of different sex in the first hour after birth. *Zhivotnovadni Nauki*, *58*(4), 19-23 (Bg).

Abstract

Rectal temperature dynamic was studied in newborn goat kids of different genders during the first hour of postnatal life. Goats were kept in a barn and rectal temperature of the newborns goat kids was recorded at birth, at 15 min of birth, at 30 min, 45 min and 60 min after delivery. The dynamic of the rectal temperature during the first hour after birth did not differ significantly in male and female kids. The rectal temperature established at the indicated intervals was: in female kids (39.11 °C, 38.47 °C, 38.21 °C, 38.10 °C, 38.22 °C) and in male kids (39.14 °C, 38.55 °C, 38.49 °C, 38.55 °C, 38.51 °C), respectively. After lowering the rectal temperature of both sexes after 15 minutes, the female kids maintained a stable, almost unchanged temperature until the end of the first hour after birth. The lowest temperature measured in males was on the 45^{th} minute and in females – on the 30^{th} minute. At the time of birth, the kids had a well-developed thermoregulatory potential and were able to maintain homeothermia with existing goat nurturing technology during the barn period.

Key words: newborn, rectal temperature, goats kid, male, female, sex

Динамика на ректалната температура на козлета от различен пол през първия час след раждането

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Резюме

Динамиката на ректалната температура е изследвана при новородени ярета от различен пол през първия час от постнаталния живот. Ректална температура на новородените ярета е отчитана при раждането, на 15 минути от раждането, на 30 минути, 45 минути и 60 минути след раждането. Динамиката на ректалната температура през първия час след раждането не се различава значително при мъжките и женските ярета. Ректалната температура, установена на посочените интервали, е: при женски ярета (39,11 °C, 38,47 °C, 38,21 °C, 38,10 °C, 38,22 °C) и при мъжки ярета (39,14 °C, 38,55 °C, 38,49 °C , 38,55 °C, 38,51 °C). След понижаване на ректалната температура и при двата пола след 15 минути женските ярета поддържат стабилна, почти непроменена температура до края на първия час след раждането. Най-ниската температура, измерена при мъжките, е била на 45-ата минута, а при женските – на 30-ата минута. По време на раждането яретата са имали добре развит терморегулаторен потенциал и са успели да поддържат хомеотермията си със съществуваща технология за отглеждане на кози през оборния период.

Ключови думи: новородено, ректална температура, яре, мъжко, женско, пол

Introduction

The ability of animals to maintain a constant body temperature is a basic prerequisite for their independence from environmental factors and their displacement in different climatic zones and habitats. More significant deviations from the optimal body temperature can have a negative impact on the functioning of the biological systems, which is why animals have developed a variety of adaptive strategies – physiological, biochemical and behavioral, aimed at maintaining homeothermia.

In sheep (Faurie et al., 2004) and goats (Faurie et al., 2001), the fetal temperature has been found to be close to that of the mother, with fetal temperatures lowering by about 0.5 ºC in the last weeks of pregnancy compared to that of the mothers. Even with significant changes in ambient temperature and, accordingly, in the mother's body temperature, this gradient did not change significantly. According to Faurie et al. (2004) this so-called "thermal protection of the fetus" is not a passive mechanism due to the thermal inertia of the fetus, but is carried out actively through various mechanisms, including the change in the intensity of placental blood circulation. In this way, the intensity of heat transfer and, respectively, the level of heat transfer from the fetus to the maternal tissues are influenced (Laburn, 1996). In some goat breeds under conditions of cold stress, thermal protection of the fetus may not be sufficiently effective (Wentzel et al., 1979).

Birth is a process of transition from a thermally stable medium in the womb to an environment in which the temperature values are far from the thermo neutral zone, which in the newborn kids is 32–37 °C depending on their live birth weight (Young, 1985).

According to Giannetto et al. (2017) the maturation of the circadian system is almost complete in newborn, but there is subject variability in its manifestation in the early hours after birth.

In extensive nurturing systems, hypothermia and starvation, along with difficult births (which are actually the cause of the delay of the sucking and development of hypothermia) are among the main factors in reducing the survival rates of newborns. 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).

Studies in sheep (Slee et al., 1990) indicate that, at birth, the thermoregulatory mechanisms of kids are well developed and are able to rapidly activate endogenous heat production mechanisms to maintain homeothermia at ambient temperatures close to 0 °C.

Information on thermoregulation in the kids during the early postnatal period is extremely scarce.

The aim of this work was to study the rectal temperature dynamic in newborn goat kids in different sexes 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 65 goat kids of Bulgarian White Dairy breed (BWD) and its crossbreeds with Anglo-Nubian (AN) and Togenburg (TG) – 34 male kids and 31 female 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 at different age 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 Discussion

Minimum barn temperature ranged from -2 to 10 ºC (Figure 1). Maximum temperatures ranged from 3 to 16 ºC. The relative humidity varied from 53 to 74% and the intensity of the air circulation in the different areas of the barn ranged from 0.04 to 0.12 m/s.

The minimum and maximum values of ambient temperatures were far lower than the critical for the newborn kids 37 °C and 32 °C, at live birth weight of 6 kg and 4 kg respectively (Young, 1985). The low intensity of the air currents recorded during the experiment also contributed to a significant decrease in the level of heat loss.

The dynamics of rectal temperature during the first hour after birth did not differ significantly in male and female kids (Figures 2). At the 15th minute of postnatal life, rectal temperature recorded a decrease ($P < 0.05$), compared with values recorded at birth of 0.64 °C in males and 0.59 °C in females.

Over the next 15 minutes, the rectal temperature of male and female kids decreased by 0.26 and 0.06 °C, respectively ($P > 0.05$).

In the period between 30 and 45 min after birth, the male animals showed a decrease of another 0.11 °C, while in the female animals there was an increase in rectal temperature compared to the values registered at 30 min, corresponding to 0.06 °C ($P > 0.05$). In the last 15 min of the observed period, in males, the temperature increased by 0.10 °C and in females there was a

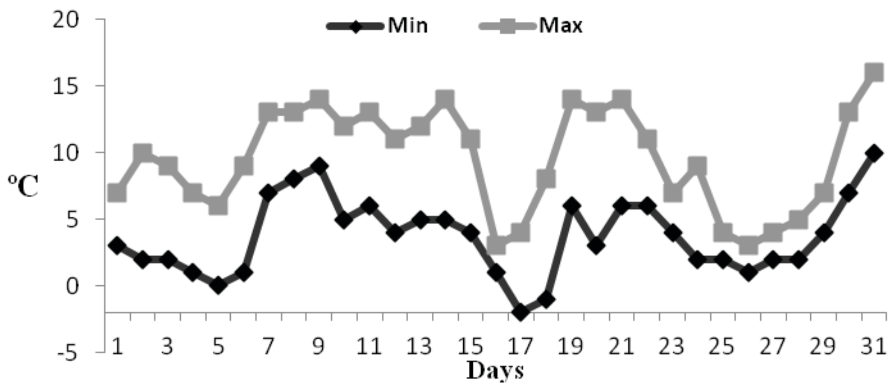

Fig. 1. Minimum and maximum values of ambient temperatures during the birth period.
Фиг. 1. Минимални и максимални стойности на околната температура през периода на раждане.

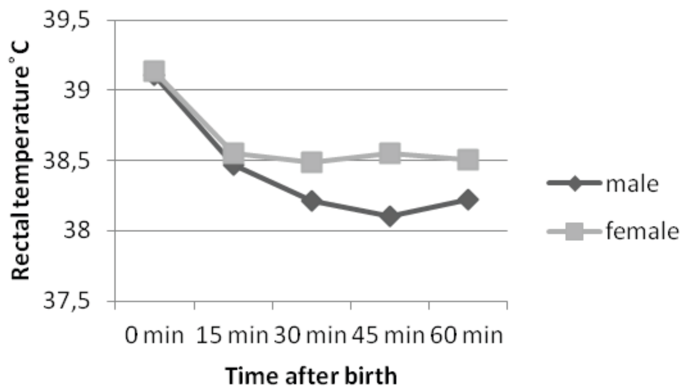

Fig. 2. Rectal temperature dynamic in male and femae kids during the first hour of postnatal life
Фиг. 2. Динамика на ректалната температура при мъжки и женски ярета през първия час от постнаталния живот

slight decrease of 0.04 °C (P > 0.05). From the graph, we can clearly see that after a decrease in rectal temperature in both sexes at the 15th minute, the female kids maintain a stable almost unchanged temperature until the end of the first hour after birth. In males, the lowest temperature was measured at the 45 minute – 38.10 °C, while in females it was 38.55 at the 30th minute. Similar results to our findings have reported (Aleksiev, 2008, 2009) for kids of the Togenburg breed and the Bulgarian white dairy breed.

The live birth weight of the kids in our study did not differ significantly between the male (3.49 kg ± 0.11 kg) and female (3.38 kg ± 0.10 kg) kids. Although it may correspond to the amount of energy reserves, it could not affect the levels of heat production and heat loss during the first 15 minutes of postnatal life. Live weight was essential for maintaining homeotherm only when heat loss exceeded the newborn's capacity to increase heat production. It can be assumed that in our case the fluctuation of rectal temperature was a consequence of the genetically determined differences in the capacity of the mechanisms related to the generation and storage of heat. The advantage of having a higher birth weight was related to body surface area / body mass values, which correlated with the level of heat loss, especially at low ambient temperatures and intense air circulation.

In goats, the metabolic and endocrine responses of the fetus to cold exposure develop during the uterine period and are capable of responding around the 100th day of pregnancy (Nobuya et al., 1998). The newborn kid, however, is in a state of metabolic instability, which makes it difficult to maintain homeothermia during the first hours of the postnatal period.

The slowdown in the rate of decrease of rectal temperature on the one hand indicated that the metabolically generated heat was still insufficient, but the activation of heat-related effectors had begun. Generation of heat in newborns occurs in brown adipose tissue. It's activity is depressed until birth by placental adenosine and PGE2 inhibitors, which have a strong antilipolitic effect (Ball et al., 1995; Gunn et al., 1995; Gunn and Gluckman, 1993).

Differences in the dynamics of rectal temperature in newborn kids of different sexes during the first hour of their postnatal life (Figures 2) may be related to the physical and physiological characteristics of the kids, such as live weight, hair type, skin thickness, endocrine activity and thermogenic potential. In our experiment, differences in birth weight of kids of different sexes were unreliable and may not be a significant cause of the observed rectal temperature fluctuations during the first hour of postnatal life. Obviously, other factors than those mentioned above, which were not recorded in our experience, also played a role, alone or in combination, in postnatal adjustment. Miller et al. (2010) also do not establish a relationship between rectal temperature and sex of newborn kids. Maturation of fetal adipose tissue is accompanied by an increase in the concentration and activity of UCP 1 (Thermogenin) and plasma levels of catecholamines, thyroid hormones, cortisol, leptin and prolactin at birth (Symonds et al., 2003). Therefore, individual differences in the characteristics of this tissue may affect the timing and degree of activation of non-contractile thermogenesis during the first minutes of postnatal life, accounting for differences in rectal temperature dynamics.

The absence of significant differences in the rectal temperature values recorded at birth of males and females indicates that fetal temperature is a function of mainly the thermal environment in the womb. In the subsequent measurement periods (15, 30, 45, and 60 min after birth), the difference in rectal temperature values between them increased compared to that observed at birth, which can be seen as a consequence of individual differences in the thermoregulatory capacity of newborns.

Conclusion

The dynamics observed by us in the values of rectal temperature during the first hour after birth reflected the sequence and the degree of activation of effector mechanisms, corresponding to the maintenance of temperature homeostasis. The results show that at the time of birth, flocks, regardless of their sex, have a well-developed thermoregulatory potential and are able to maintain homeothermia with existing goat nurturing technology during the barn period.

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