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Examination of heart rate, rectal temperature, and salivary cortisol levels in calves within the first two hours post-birth

Skúmanie srdcovej frekvencie, rektálnej teploty a hladiny kortizolu v slinách u teliat počas prvých dvoch hodín po narodení

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ABSTRACT

This study, conducted at SPU's agricultural research centre in Nitra, aimed to monitor vital signs in newborn calves, specifically focusing on heart rate, rectal temperature, and salivary cortisol levels. The research observed no significant gender differences in the measured criteria. Heart rate showed noticeable variability, influenced by external factors. The examined calves exhibited an average heart rate of 165.64 ± 17.61 bpm, rectal temperature of 38.80 ± 0.74 °C, and salivary cortisol levels of 2.52 ± 1.34 ng/ml. Rectal temperatures in calves showed a decreasing trend after calving. A negative correlation was found between heart rate and rectal temperature. Analysis of salivary cortisol levels revealed a trend of decreasing cortisol with increasing birth difficulty. Additionally, a positive correlation was observed between heart rate and salivary cortisol. This study underscores the importance of monitoring calf vital signs for health assessment and growth prediction.

Keywords: newborn calves, APGAR, agriculture, cows

ABSTRAKT

Táto štúdia, uskutočnená v poľnohospodárskom výskumnom centre SPU v Nitre, mala za cieľ sledovať životné funkcie novonarodených teliat, konkrétne srdcovú frekvenciu, rektálnu teplotu a hladiny kortizolu v slinách. Výskum neodhalil žiadne významné rozdiely medzi pohlaviami v sledovaných kritériách. Srdcová frekvencia vykazovala výraznú variabilitu, ovplyvnenú vonkajšími faktormi. U skúmaných teliat bola zaznamenaná priemerná srdcová frekvencia 165,64 ± 17,61 úderov za minútu, rektálna teplota 38,80 ± 0,74 °C a hladina kortizolu v slinách 2,52 ± 1,34 ng/ml. Rektálna teplota u teliat mala klesajúcu tendenciu po otelení. Bola zistená negatívna korelácia medzi srdcovou frekvenciou a rektálnou teplotou. Analýza hladín kortizolu v slinách ukázala tendenciu znižovania kortizolu so zvyšujúcou sa náročnosťou pôrodu. Navyše bola pozorovaná pozitívna korelácia medzi srdcovou frekvenciou a hladinou kortizolu v slinách. Táto štúdia zdôrazňuje dôležitosť monitorovania životných funkcií teliat pre hodnotenie zdravia a predikciu rastu.

Kľúčové slová: novonarodené teľatá, APGAR, poľnohospodárstvo, kravy

INTRODUCTION

Monitoring the vital signs of newborn calves allows breeders to assess their current health and anticipated growth quickly. Identifying deteriorating values enables early intervention and the provision of necessary care, thereby preventing further health decline and complications. Key indicators that are monitored include heart rate and rectal temperature. Changes in body temperature can be an early indicator of illness, such as respiratory issues (Bell et al., 2020). Measuring heart rate and its variability is often employed as a tool to evaluate the vitality of calves (Kovács et al., 2022). As a less invasive method of assessing adrenal gland activity, measuring cortisol levels in saliva is often favored over traditional blood tests in ruminants.

MATERIALS AND METHODS

Data were collected between August 2020 and November 2021 at the agricultural research centre of the Slovak University of Agriculture in Nitra (SUA) in Oponice. Observations were conducted over 37 nights and 38 days, focusing on anticipated births. Measurements (M1–M4) of heart rate, rectal temperature, and salivary cortisol levels were performed on a group of 25 calves, comprising 10 males and 15 females. Heart rate measurement, considered moderately challenging, was conducted using a stethoscope, requiring brief training and, ideally, assistance when timing measurements. Similarly, rectal temperature measurement presented moderate challenges, particularly with active calves, necessitating the presence of an additional assistant. Saliva samples were collected using common Sterilux ES swabs, sterilized, and manually taken by one person without any restriction on the calf, 15 minutes after delivery. Cortisol levels were analyzed using the ELISA method with the commercial DiaMetra Cortisol saliva kit. Optical absorbance was measured using a Microplate Reader Model DV 990BV4, UniEquip Deutschland. All analytical and graphical representations were created using IBM SPSS Statistics version 26. Correlations between various indicators were analyzed using Pearson's correlation coefficient r. We measured heart rate before taking rectal temperature to minimize animal stress during the measurement.

RESULTS AND DISCUSSION

In the examined sample of calves, no significant differences in the studied traits between genders were detected through testing, similarly to the findings of Bonelli et al. (2020), where no significant differences were identified either. The gestation length of the cows ranged between 266 and 289 days, with an average length of 276.36 days and a standard deviation of 5.60 days. According to Figure 1, the M2 measurements of heart rate show significant variability, with the difference between the lowest and highest recorded values reaching 96 beats per minute (bpm). This variability could have been caused by the values of calf no.3, which stood up during the measurement, and this could have affected the increase in heart rate. The overall average of recorded heart rates for all measurements M1–M4 was 165.64 bpm with a standard deviation of 17.607 bpm. The same values were also measured by Vannucchi et al. (2018) in their research on calves born within 2 hours of the onset of birth. According to Bohlen (2018), the heart rate should be in the range of 100 – 140 beats per minute. The maximum heart rate value reached 240 bpm, and the minimum value was 136 bpm.

No significant differences were observed between measurements M1–M4.

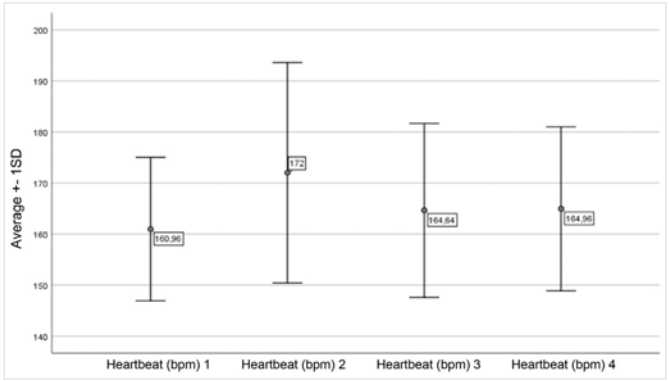

Figure 1. Graphical representation of heart rate measurement variability. Heart rate values are given in beats per minute (bpm). Individual measurements are depicted on the x-axis, and average values of the measurements are on the y-axis.

The results of Figure 2, rectal temperature measurements, show that the rectal temperature of calves decreases over time.

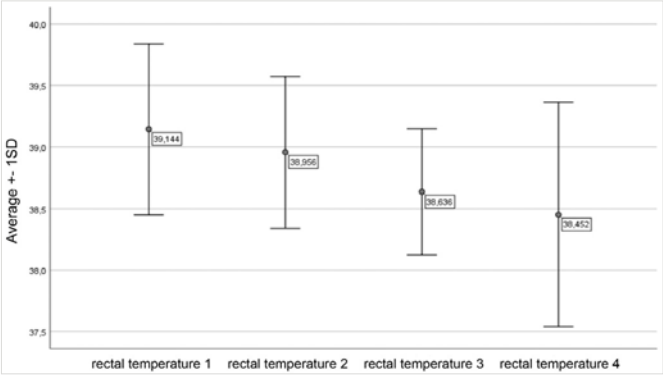

Figure 2. Graphical representation of rectal temperature measurement variability. Rectal temperature values are given in degrees Celsius (°C). Individual measurements are depicted on the x-axis, and average values of the measurements are on the y-axis.

Vermorel et al. (1983) similarly state in their study that temperature decreases depending on the time of birth and describe optimal values once stabilized, which range between 37.8 and 39.2 °C. After the initial measurements, an average temperature of 39.144 °C was recorded, and after 15 minutes from the first measurement, the temperature average increased to 38.956 °C. From the third measurement onwards (30 minutes after the first measurement), the temperature began to decrease, and the average temperature was 38.636 °C. A similar rectal temperature measured in calves on the first day after birth was also recorded by Vasseur et al. (2014), Aoki et al. (2020) and Santos et al. (2023). After the fourth and final measurement (45 minutes after the first measurement), the lowest average temperature point was recorded - 38.452 °C. The average measured value for measurements M1-M4 was 38.797 °C with a standard deviation of 0.739 °C. The maximum rectal temperature reached 40 °C. For comparison, Wenz et al. (2011) classify a rectal temperature above 39.2 °C as elevated, whereas Drilich et al. (2001) consider temperatures exceeding 39.7 °C to be elevated. The minimum recorded temperature was 34.9°C. The results indicate that the temperature of calves decreases after birth. A significant difference of 0.6920 °C ($P < 0.05$) was found between measurements M1 and M4. A negative correlation was identified between rectal temperature and heart rate in measurements M1 heart rate and M1 rectal temperature ($\rho = -0.449$, $P < 0.05$), as well as between measurements M4 heart rate and M2 rectal temperature ($\rho = -0.484$, $P < 0.05$). Thus, a higher heart rate was associated with a lower rectal temperature.

Figure 3 shows that the average cortisol level in saliva was 2.52 ng/ml with a standard deviation of 1.34 ng/ml. The highest recorded cortisol value was found in calf no. 20 with a value of 6.47 ng/ml, while the lowest value was in calf no. 13 with a value of 0.64 ng/ml. When investigating the relationship between cortisol and the difficulty of birth, no significant correlation was found. Cortisol exhibited a decreasing trend in comparison to the difficulty of birth; as the cortisol level in saliva increased, the score for the difficulty of birth decreased (lower scores indicated more challenging births). Kovácz et al. (2021) reported that cortisol levels decrease depending on the difficulty of birth. Calf no. 20 had the most challenging birth and the highest cortisol value, while calf no. 13 had an easier birth and the lowest cortisol value. Pearson statistical analysis indicated a positive correlation between heart rate and salivary cortisol in measurements M1 ($\rho = 0.53$, $P < 0.05$), M2 ($\rho = 0.41$, $P < 0.05$), and M3 ($\rho = 0.45$, $P < 0.05$), suggesting that higher heart rate values were associated with elevated cortisol levels in saliva.

Salivary cortisol values are given in nanograms per millilitre (ng/ml). Individual measurements are depicted on the x-axis, and average values of the measurements are on the y-axis.

Figure 3. Graphical representation of salivary cortisol level measurement variability

CONCLUSIONS

In conclusion, the study highlights the variability in heart rate measurements, which can be influenced by external factors such as calf movement, as observed in calf no. 3. Nevertheless, the average heart rate was generally consistent with previous research, although it exceeded the typical range indicated by other studies. No significant correlation was observed between cortisol levels and the difficulty of birth, but a downward trend in cortisol levels in relation to birth difficulty was noted. Furthermore, a positive correlation was found between heart rate and salivary cortisol levels, indicating that calves with higher heart rate values also tended to have higher cortisol levels. These findings provide valuable insights into the physiological responses of calves during the neonatal period, with implications for veterinary care and research.

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