Original scientific paper
DOI: /10.5513/JCEA01/23.2.3444
Journal of Central European Agriculture, 2022, 23(2), p.261-266

# Evaluation of changes in behavior, heart rate and rectal body temperature in calves during two hours after birth

# Hodnotenie zmien správania, tepová frekvencia a rektálna telesná teplota teliat počas prvých dvoch hodín po narodení

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Received: October 17, 2021; accepted: January 17, 2022

## ABSTRACT

The present experiment focuses on the evaluation of the behavior of Holstein calves in the first two hours after birth. The research took place at the Slovak University of Agriculture Farm in Oponice. The calf sample consisted of 11 individuals. The lying, standing, moving were scored and number of attempts to lift head, latency to head lifting, number of attempts to stand up and latency to stand up, and the number of ears shaking. Behavior was evaluated by next traits: total duration of lying, standing and moving, average duration of one bout lying, standing and moving, percentage rate of lying, standing and moving, number of occurrence of bouts for all scored traits, mean duration inter-event interval for all scored traits. The basic physiological parameters (heart rate – HR and rectal temperature – RT) were measured in four 15 minute intervals during first hour after the birth (M15, M30, M45 and M60). Difference in behavior between first and second hour of observation was tested by non-parametric Kruskal Wallis test. Relation among measured and scored traits was analysed by Spearman rank correlation. The average duration of birth of the examined calf sample was 1 hour and 4 minutes (±0.33 seconds). Positive correlations ($P$<0.05) between the first and second hour were found in many signs measured after birth (total time of lying, standing and moving, attempts to stand up, latency of standing and ears shaking).

**Keywords:** calves, Holstein, heart rate, body temperature, behavior

## ABSTRAKT

Experimentálna práca sa zameriava na hodnotenie správania teliat holsteinského plemena v prvých dvoch hodinách po narodení. Výskum prebiehal na vysokoškolskom podniku Oponice. Vzorka teliat pozostávala z 11 jedincov. Pozorované bolo ležanie, státie, pohyb ako aj počet pokusov zdvihnúť hlavu, latencia zdvihnutia hlavy, počet trasenia ušami, počet pokusov postaviť sa a latencia postavenia. Správanie bolo hodnotené podľa nasledujúcich vlastností: celkové trvanie ležania, státia a pohybu, priemerná doba trvania jedného ležania, státia a pohybu, percentuálna miera ležania, státia a pohybu, počet períód pre všetky hodnotené vlastnosti, priemerné trvanie intervalu udalostí pre všetky bodované vlastnosti. Základné fyziologické parametre (tepová frekvencia - HR a rektálna telesná teplota - RT) boli merané 4 krát v 15 -minútových intervaloch počas prvej hodiny po pôrode (M15, M30, M45 a M60). Rozdiel v správaní medzi prvou a druhou hodinou pozorovania bol testovaný neparametrickým Kruskalovým Wallisovým testom. Vzťah medzi nameranými a skórovanými znakmi bol analyzovaný koreláciou Spearmanovho poradia. Priemerná dĺžka pôrodu skúmanej vzorky teliat bola 1 hodina a 4 minúty (±0.33 sekundy). Pozitívne korelácie ($P$<0.05) medzi prvou a druhou hodinou boli zistené u viacerých znakov meraných po pôrode (celkový čas ležania, státia a pohybu, pokusy vstať, latencia státia a trasenie ušami).

**Kľúčové slová:** teľatá, holštajn, tepová frekvencia, telesná teplota, správanie

## INTRODUCTION

The increased risk of disease and mortality in the perinatal and neonatal period mainly affects dairy cattle. For this reason, it is recommended to introduce optimal breeding procedures, especially during pregnancy. Morbidity and mortality are manifestations of impaired welfare in cow as well as calf breeding and are influenced by factors such as nutrition, hygiene, pathogen prevalence, rearing method and others (Villettaz Robichaud et al., 2016; Broucek et al., 2021).

Calving is often stressful for the calf and can affect the vitality of calves (Murray and Leslie, 2013). Dystocia is defined as a difficult birth and poses an increased risk of disease and death to the calf (Lombard et al., 2007). Calving with dystocia can cause tissue damage and its subsequent inflammatory response (Stilling et al., 2014). These factors due to dystocia may affect the vitality of calves after birth. Therefore, monitoring the vitality of calves after birth is important in terms of improving initial stress and possible first aid for calves (Murray and Leslie, 2013). Cooke et al. (2003) state 3 basic procedures that must be performed immediately after the birth of a calf: 1. Respiratory control - cleaning of the nostrils and subsequent test of ticking with a straw. 2. Treatment of the umbilical cord with a solution of iodine or chlorhexidine, especially if calves born in a dirty environment. 3. Administration of colostrum within 3 hours after birth.

The natural behavior of cows after parturition is to lick the calf. This automatic instinct serves to dry out the calf and is just as beneficial for his breathing. The cow should be monitored during licking so that the umbilical region is not disturbed and bleeding does not occur. If the cow is not interested in the calf, it is advisable to dry the calf with a towel, or dry with dry straw for proper circulation. In a short time, the calf tries to stand on its own feet and searches for the udder, during this time it is recommended to watch the calf, provide help in case of care and take care that a possible fall does not cause injury. It is important to give enough colostrum as soon as possible after birth for the calf to develop innate immunity.

When observing the activity of the calf after birth, Progressive Dairy (2012) observed as the first movements with respect to the time from birth. Poor calf activity indicates reduced vitality. The basic manifestations of reduced vitality manifestations include reduced standing ability. To determine vitality, she performed a test: if insert the straw into the nasal cavity of the calf, it should start moving the head or make another movement. When touching the eye, it should blink or close the eye. Poor responses to these tests would indicate poor vitality. Sufficient oxygenation is assessed visually by assessing the mucosa of the calves (the inside should be bright pink). A bluish tint indicates weak oxygenation (Progressive Dairy, 2012).

It is recommended to measure the body temperature in the calf rectally. Electronic thermometers are more suitable than mercury thermometers due to accuracy (Bohlen, 2018). The value of the rectal temperature of a calf is 0.8 °C higher than the temperature of a cow and at birth it is 39.5 °C. The temperature gradually decreases to 38.6 °C, later rises again and stabilizes at 38.8 °C. In the cold, the temperature is higher than 39.2 °C (Vermorel et al., 1983).

A New-born calf usually has twice the heart rate of an adult cow. There are distinguish two terms: heart rate, which measures the number of heart beats per minute, and pulse rate, which measures the number of pulses in an artery. Heart rate is measured with a stethoscope, while pulse rate is determined by placing your fingers on an artery. Stress and temperature affect both parameters (Bohlen, 2018).

Aim of study was evaluate and compare behavior in 1$^{st}$ and 2$^{nd}$ hour after birth in calves. Additional goal was analyse relation between behaviors and rectal body temperature and heart rate in calves during 1$^{st}$ hour after birth.

## MATERIALS AND METHODS

### *Animals and housing*

The study used 11 Holstein calves from 10 cows at Slovak University of Agriculture Farm in Oponice. Dry dairy cows were moved to loose housing pen approximately

3 weeks before planned calving according to the date of artificial insemination. The pen has size 3.5 m x 36 m, concrete floor with straw bedding, feeding rack and one floating ball valve watering point is in the pen. The calving pen is adjacent to the housing dry cows. The size of calving pen is 3.5 m x 9 m and has concrete floor with straw bedding. The cow was moved to the calving pen when the second phase of calving was recorded (amniotic fluid drainage). If calving seems to be complicated or takes too long, the dose of oxytocin was applied in injection form. In the case of dystocia calving was assisted.

### *Data collection*

Behavior of calves was recorded by two IP videocameras Planet ICA-HM316W connected to Planet NVR-401 network video recorder. Video records were analysed and behaviors were scored by BORIS software (Friard and Gamba, 2016). The coded behaviors were: attempt to lift head to first head lifting, first head lifting, attempt to stand up, first standing up to all four legs, ears shaking (all as point event), lying, standing, moving (all as state event). Behavior analysis by BORIS calculated next traits: total duration of lying, standing and moving, average duration of one bout lying, standing and moving, percentage rate of lying, standing and moving, number of occurrence of bouts for all coded traits, mean duration inter-event interval for all coded traits.

In addition, heart rate (HR) and rectal body temperature (RT) were measured in four 15 minute intervals with start 15 minutes after birth (M15, M30, M45 and M60). The rectal body temperature was measured with a Microlife digital waterproof thermometer to a depth of 2.5 cm in the rectum. Heart was measured using a stethoscope (Kruuse double tube) during 15 seconds. Heart rate measurement was performed before temperature measurement avoiding an increase of HR by manipulation stress.

### *Statistical analysis*

For all behavior as well as physiological traits were calculated basic descriptive statistics. Relation between evaluated traits was analysed by Spearman rank correlation. Difference in behavior between first and second hour of observation was tested by non-parametric Kruskal Wallis test. Statistical analysis was performed using a IBM SPSS 20 software.

## RESULTS AND DISCUSSION

### *Temperature*

Results of measuring the rectal temperature are in accordance with Vermorel et al. (1983) that the calf's rectal temperature decreases depending with time from birth. It also describes the optimal values after stabilization, which are in the range of 37.8 - 39.2 °C. The rectal temperature of the examined calves gradually decreased, the highest values were measured after M15 (39.31 °C, ±0.62 °C), the lowest at M45 (38.68 °C, ±0.50 °C). After 60 minutes, the average measured rectal temperature of calves stabilized at (38.73 °C, ±0.41 °C). The maximum average rectal temperature that was measured was at 39.31 °C, which according to Wenz et. al. (2011) who claim that a rectal temperature higher than 39.2 °C is consider an elevated temperature.

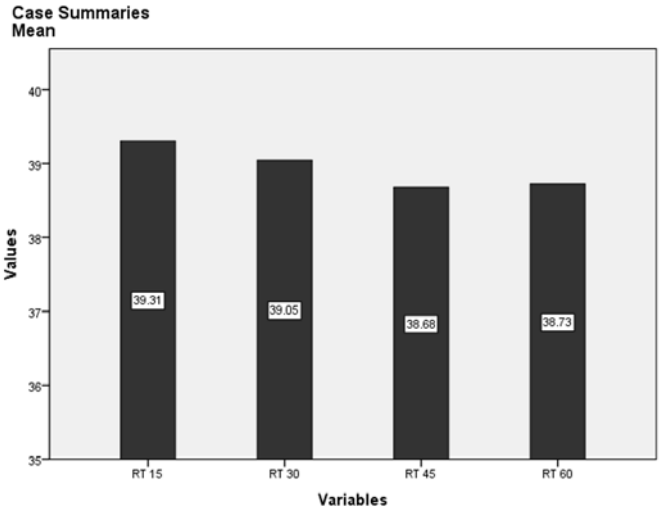


**Figure 1.** Changes of rectal temperature (RT) depending on the time from birth

### *Pulse*

Bohlen (2018) suggests normal heart rate should be in the range of 100 - 140 beats per minute, these recommended values did not measure in any of the measurements. The highest average heart rate values did measure when measuring M30 (163.27 BPM, ±13 BPM)

and the lowest when measuring M15 (160.36 BPM, ±12.45 BPM). The heart rate stabilized at 162.91 BPM after M45 measurement. In contrast to temperature, the heart rate increases with time.

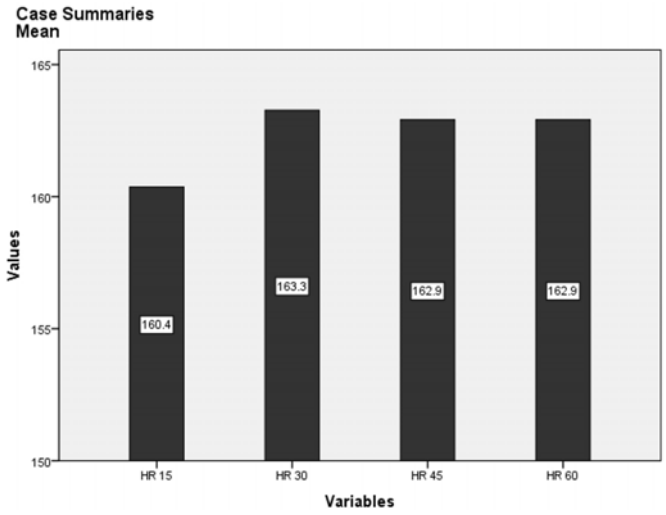


**Figure 2.** Changes of heart rate (HR) depending on the time from birth

### *Measuring the time of the first activity*

The average duration of birth of the examined calf sample was 1 hour and 4 minutes (±0.02 minute). The first activity that calves did after birth was to raise their heads. The fastest time was measured 1 second after birth and the average time of the first head lift for the examined sample was 1.52 minute (±0.93 minute). Subsequently, it was recorded the first attempts at standing up, on average, the calves were raised in 11.57 minutes (±22.53 minutes). Of the examined sample n=11, only 9 calves were raised by 2 hours after birth at an average time of 1 hour and 31 seconds (±46.45 minutes). Campler et al. (2015) report in their study that calves tried to stand 21 minutes after birth, but a successful standing occurred in an average of 51 minutes. Other authors report an average time of standing latency significantly longer - 88 to 152 minutes (Houwing, 1990).

### *Lying*

Total duration spent lying in first hour was on average 55.85 minutes (±6.68 minutes). During the second hour the recorded average time of lying was 41.36 minutes (±17.79 minutes). The difference in total duration of lying in 1st and 2nd hour was significant ($P<0.05$). Average duration of one bout of lying in first hour was 33.87 minutes (±22.03 minutes), in second hour 23.76 minutes (±23.68 minutes) difference is significant ($P<0.05$). Neja (2013) states in his study lying time 283.5 minutes (47.25 minutes per hour) in the first 6 hours after birth. Jensen and Rørvang (2018) report lying time 38.76 minutes in first hour and 32.53 minutes in second hour after birth.

### *Standing*

The examined sample of calves showed a greater intensity and also a greater standing time in the second measured hour. The average total standing time was 3.69 minutes in the first hour (±5.51 minutes) and 14.18 minutes in the second hour (±8.20 minutes). The average time per stand was measured in the first hour 0.25 minute (±0.32 minute) in the second hour the measured time per stand was higher, namely 0.40 minute (±0.54 minute). Similar results are reported by Neja (2013), where standing time of calves were 76.5 minutes (12.75 minutes per hour) in the first 6 hours after birth. Jensen and Rørvang (2018) measured standing time 4.28 minutes in first hour and 18.58 minutes in second hour after birth.

### *Movement*

As with standing, higher values of movement were in the second examined hour. The frequency of movement in the first hour was 15.36 times (±32.72 times) in the second 39.09 times (±35.30 times). The average measured time of the total movement of the examined sample in the first hour was 1.38 minutes (±1.99 minutes) in the second hour 8.60 minutes (±11.69 minutes). The length of one movement interval was 0.22 minute in the first hour (±0.57 minute) and 0.48 minute in the second hour (±1.11 minutes). According to Peter, the frequency of calf movements also increases with time. Barrier et al. (2012) in their study report that difficult births reduce the vitality of calves (movements) after birth and increase the standing latency time.

### *Correlations*

During the first hour, a significant trend was discovered between the number of periods of standing, movement

and heart rate of the M60 measurement. Calves had a higher heart rate with a more number of standing periods (r=0.691, *P*<0.05) and a period of movement (r=0.647, *P*<0.05).

Correlation analysis discovered relation between heart rate and total lying, standing and movement time in the second hour. Calves with a shorter lying time (r= -0.830, *P*<0.05) and calves with a longer standing time (r=0.813, *P*<0.05) and movement (r=0.691, *P*<0.05) had a higher heart rate in the M60 measurement.

There was a weak trend where the difficulty of calving negatively correlates with the standing latency (r= -0.348, P>0.05). Murray (2014) also states in his publication that calves born after severe or assisted care require a longer standing time. Barrier (2012) attributes a longer time to the first standing by the hypothesis that calves after a difficult assisted birth have reduced vitality due to stress and trauma from birth.

There was a significant trend in the standing latency with head movement (r=0.449, *P*<0.05). With a faster time of the first lifting of the head, the calves also got up faster.

The demonstrable trend in the length of calving with the total standing time is also interesting. The calves with the longer parturition time the longer stood during the first hour (r=0.667, *P*<0.05).

When observing attempts at standing latency during the first hour, there was found a proven correlation with shaking of the ears. More attempts at standing latency also meant a greater number of ears shaking (r=0.785, *P*<0.05)

Significant differences (*P*<0.05) in calf behavior between the first and second hour were revealed at the average time for one lying down and one standing. An inconclusive difference (P>0.05) was recorded at the mean time per movement. Measurements of total lying, movement and standing time showed significant differences (*P*<0.05) between the first and second hours. Measurement of the number of periods between the first and second hour revealed demonstrable rods (*P*<0.05) in movement, attempted standing latency, standing, shaking with ears. Only lying (P>0.05) recorded an insignificant difference in the number of periods.

**Table 1.** Significant differences (*P*<0.05) between signs

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|---|---|---|---|
| Total duration - standing | HR 60 | Correlation Coefficient | 0.813 |
| | | Sig. (2-tailed) | 0.008 |
| Total number of occurrences - standing | HR 60 | Correlation Coefficient | 0.691 |
| | | Sig. (2-tailed) | 0.018 |
| Total number of occurences - movement | HR 60 | Correlation Coefficient | 0.647 |
| | | Sig. (2-tailed) | 0.032 |
| 1. head movement | standing latency | Correlation Coefficient | 0.449 |
| | | Sig. (2-tailed) | 0.028 |
| difficulty of calving | standing latency | Correlation Coefficient | -0.348 |
| | | Sig. (2-tailed) | 0.07 |
| Parturition time | standing latency | Correlation Coefficient | 0.667 |
| | | Sig. (2-tailed) | 0.05 |
| Total number of occurences - attempts at standing latency | Total number of occurences - ears shaking | Correlation Coefficient | 0.785 |
| | | Sig. (2-tailed) | 0.004 |

## CONCLUSIONS

Positive correlations ($P$<0.05) between the first and second hour were found in the average time for one bout of lying and standing, the total time of lying, standing and moving, measuring the number of occurrence of bouts movement, attempts to stand up, latency of standing and ears shaking. It can be concluded that there is relation between signs of activity in calves in first hour after birth as well as relation between activity and heart rate. Increase of BPM is probably connected to higher activity at the end of the first hour after birth.

In the following study focused to assessment of vitality in calves after birth, will be analyse a bigger sample of calves, as well as a longer observation period after birth (4 hours). Other physiological traits will be added (mucous membrane colour, breathing, reaction to touch). Based on a larger amount of data, it will be possible to evaluate the differences more accurately in the vitality of individual calves after birth.

## ACKNOWLEDGEMENTS

The work and publication was supported by grant KEGA015SPU-4/2019 and VEGA 1/0572/22.

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