

The effect of claw disorders on the locomotion activity of dairy cows

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The purpose of the work was aimed at determining changes in locomotion activity of dairy cows with healthy claws, as opposed to cows suffering from claw disorders. To achieve this goal, Heatime RuminAct technical equipment was used. Data gathering took place at the dairy farm of University of Agriculture in Nitra, where locomotion activity was measured via Heatime RuminAct hardware with DataFlowTMII software. This data came from 87 dairy cows, whose locomotion activity was monitored during a period of 21 days. This period consisted of 10 days of monitoring before the claw trimming, monitoring during the day of the trimming, and afterwards, another 10 days of monitoring after the trimming was complete. Units of locomotion activity in 24 hours (u/24 h) were used to formulate the locomotion activity of the dairy cows. Health conditions of claws of the dairy cows were recorded and based on the presence of claw disorders, the cows were divided into two groups – cows with observed claw disorders formed a group of 33 cows, and cows exhibiting no claw disorder related symptoms formed a group of 54 cows. Conclusions based on results from the data gathered confirm a crucial difference in locomotion activity between healthy cows and cows afflicted by claw disorders.

Keywords: dairy cow, Heatime RuminAct, locomotion activity, claw health, claw disorders

1 Introduction

Husbandry of dairy cattle breeds is mostly carried out in Slovakia on larger farms, where various dairy housing systems are used. These housing systems create different requirements for dairy cows to cope with environmental conditions, with one of the important factors also being the health condition of the claws.

The most significant claw disorders, such as laminitis, digital dermatitis, interdigital dermatitis, heel erosion, interdigital hyperplasia or sole ulcer form mainly due to insufficient hygienic conditions of the environment, as well as the type of floor used in the housing facility. The type of floor significantly affects the wear of the claw horn as well as the overall quality of the claw. Excessive wear affects the thickness of the claw horn and thus its sensitivity, and insufficient grinding of the claw leads to excessive horn growth and thus increased pressure on some parts of the claw. The resulting rate of wear of the claws in relation to the floor in the housing facility is an increased risk of claw diseases, which can be reduced by regular claw trimming (Stoddard and Cramer, 2017).

Regular claw trimming positively affects production and reproduction parameters, has a preventive effect on diseases of the limbs, reveals initial stages of diseases and last but not least, increases the level of welfare of cattle. The routine adjustment and treatment of claws is executed according to the requirements and situation in a particular farm at least twice a year, but when circumstances require it, even three times a year. The most important objective of claw treatment is to adjust the pressure distribution on the claw wall. It has been proven, that regular treatment of claws has several demonstrable and positive effects, but we still record diseases of claws even when regularly treated, because the health of claws is also affected by many other factors (Stoddard and Cramer, 2017).

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Cows are rather stoic, they express pain rarely, unless the severity of the stimulus becomes severe enough (Anil et al., 2005; Hudson et al., 2008). However, cows suffering from lameness show signs of behavioural changes, as such, cows inflicted with pain stemming from lameness change their behaviour in order to reduce discomfort (Hudson et al., 2008). Such behavioural changes include, for example a decrease in movement activity, decrease in locomotion activity, decrease in feed intake, reduced mental responsiveness, lessened interaction with other animals, grinding of teeth, and posture changes and changes in gait. In reality though, cows suffering from lameness are often insufficiently identified and insufficiently treated (Bruijnis et al., 2010).

The health condition of claws also significantly affects the locomotion activity of dairy cows. Claw disorders can be most generally characterized as a behavioural manifestation of limb and claw diseases, which causes the animal to feel pain, and can be observed in the animal's impaired movement. Impaired movement of the affected animal has a negative effect on the animal's movement on slippery floors, when lying down, as well as moving. A claw disease is the first sign of worsened welfare, before it negatively affects the ability of the cow to move to the feeding trough, watering trough, resting place (box) and thus significantly affecting the performance and overall health of the animal (Bruijnis et al., 2010).

Claw disorders afflict up to 25% of animals in common herds. In herds with neglected claw care, up to 70% of dairy cows can be affected. Depending on the degree of affliction, milk yields decrease by 5 to 50% and weight loss occurs by up to 1 kg per day. The decrease in productivity usually manifests itself as early as two to four months before the diagnosis of the disease, i.e. before the onset of clinical symptoms. This means, that the initial changes in the physiological state leading to lameness need to be detected as soon as possible. In the Netherland it has been calculated, that the average cost of claw diseases ranges from € 55 to € 79 per dairy cow per lactation. The calculus included losses in milk production, treatment costs, decommissioning costs, reduced fertility and the occurrence of other diseases. Care for limbs and claws needs to be given the required attention, when the price for treatment of healthy claws is around € 3.5 per piece. (Strapák et al., 2013).

2 Material and methods

2.1 Cows and housing

The core measurements were performed in the dairy farm in University of Agriculture in Nitra, with a herd consisting of the Holstein dairy cows, where the average productivity reaches 10,300 kg of milk. The dairy cows were housed in a free stall barn with cubicles, which were bedded with recycled manure solids (RMS). The floors of the stall were made of concrete with rubber mats. Animals were fed TMR (total mixed ratio) *ad libitum* throughout the whole lactation.

2.2 Data collection

The farm was equipped with a comprehensive technological device Heatime RuminAct with DataFlowTMII software installed. All dairy cows were equipped with Heatime RuminAct collars. We monitored the locomotion activity of 87 dairy cows during 10 days before the claw trimming (days -10 to -1), on the day of claw trimming (day 0) and 10 days after the day of the claw trimming (days 1 to 10). Locomotion activity of dairy cows was expressed in units of locomotion activity in 24 hours (u/24 h). We recorded the health condition of the claws and based on the presence of claw disorder, divided the dairy cows into two groups. Dairy cows without the presence of claw disorders formed a group of 33 animals and dairy cows in which we recorded the presence of claw disorders formed a sample of 54 animals. We performed a basic statistical analysis and tested the differences in locomotion activity between the group of dairy cows with healthy claws and the group of dairy cows with claw disorders using a Student's *T*-test to determine if the mean values of two data sets are significantly different.

3 Results and discussion

The most common claw diseases we observed were interdigital dermatitis (ID), digital dermatitis (DD) and sole ulcer (SU). The percentage of these diseases in the group of sick dairy cows was as follows: DD 40.7%, SU 31.5%, ID 27.8%. Based on the performed analysis, we recorded a lower locomotion activity of dairy cows with claw diseases by 3 to 61 u/24 h on all evaluated days, while the most significant difference was found on the 7th day before the claw trimming. On the day of claw trimming (d0), the average difference in locomotion activity was between affected and unaffected cows 9 u/24 h. According to our findings, we recorded a statistically significant difference in movement of healthy dairy cows compared to movement of dairy cows suffering from one of the claw diseases ($P < 0.01$). Dairy cows

inflicted with claw disorders exhibited less locomotion activity during the days before claw trimming, as well as after the trimming, compared to dairy cows without claw disorders (Table 1, Figure 1).

Table 1 Mean values of locomotion activity of dairy cows with detected claw disorders and dairy cows without detected claw disorders

Day of claw trimming	Unaffected (u/24 h)		Affected (u/24 h)	
	\bar{x}	SD	\bar{x}	SD
-10	630	163	604	134
-9	632	135	597	129
-8	610	138	595	130
-7	667	189	606	120
-6	627	164	592	123
-5	610	159	606	165
-4	625	160	589	105
-3	657	180	651	191
-2	647	202	631	156
-1	568	156	563	115
0	587	138	578	120
1	592	156	574	113
2	573	140	553	116
3	585	138	561	120
4	582	143	574	114
5	622	225	590	144
6	584	164	581	139
7	603	163	573	127
8	589	159	557	115
9	583	150	557	127
10	576	151	552	133

unaffected – cows without detected claw disorders, affected – cows with detected claw disorders

Our findings are affirmed by multiple authors. O’Callaghan et al. (2003) observed the daily activity level of 345 dairy cows over a period of 7 months with the use of pedometers and discovered significant impact of lameness on activity. In comparison to healthy cows, lame cows displayed lower daily activity levels ($P < 0.001$). Nechanitzky et al. (2016) discovered in their experiment, that lame cows spent substantially more ($P = 0.049$) time lying (6.48 ± 1.32 h/12 h) and less time ($P = 0.049$) standing and walking (5.52 ± 1.32 h/12 h), respectively, than cows not afflicted by lameness (5.50 ± 1.40 and 6.51 ± 1.40 h/12 h). They also found out, that the lying time at night of lame cows was drastically longer compared to cows not suffering from lameness. King et al. (2017) compared the daily locomotion activity of dairy cows and found, that healthy dairy cows (402.9 ± 121 u/24 h) move more, than lame cows (378.0 ± 126 u/24 h). Weigele et al. (2018) found, that the average locomotion activity and the locomotion activity during 1 hour after delivering food were lower in lame cows as opposite to healthy cows. Beer et al. (2016) have in their work discovered, that lame cows have longer lying bouts, shorter standing time, fewer standing and walking bouts, fewer and shorter strides and an overall lower walking speed. Thorup et al. (2015) also came to similar conclusions, where lame Holsteindairy cows had lower total activity and activity per second in terms of walking, walking duration and step frequency. Multiple authors confirm, that an accelerometer combined with the newly developed and validated algorithm, when taking into consideration extended characteristics of locomotion behaviour, can be useful for accurately detecting lameness in dairy cows, and that in cows with cases of slight lameness (Flower et al., 2006; Shepley et al., 2017; O’Leary et al., 2020).

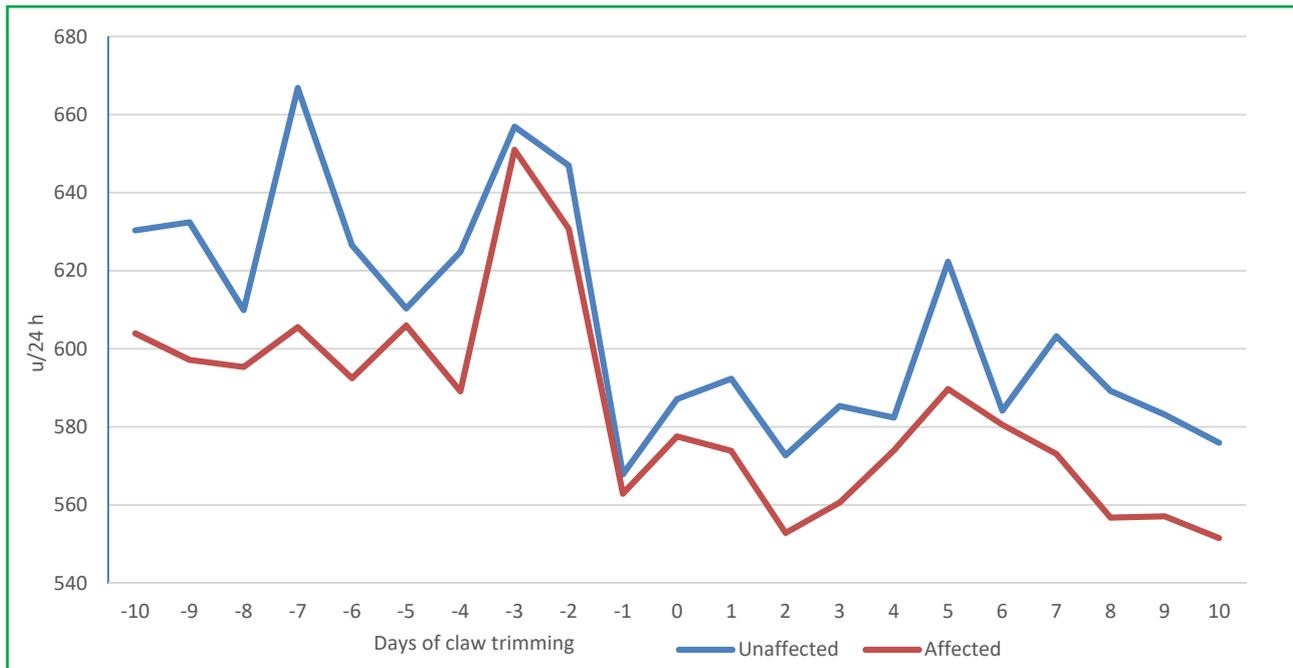


Figure 1 Locomotion activity of dairy cows with and without claw disorders

4 Conclusions

In order to improve animal welfare, detection of lame cows is vital. Lameness in cows can result in reduced fertility, reduced milk yield, increased risk of culling, increased costs of treatment, and added expenses from additional labour. Scoring of locomotion is a time-consuming process and as such is not commonly conducted on dairy farms. Farmers also have a tendency to underestimate lameness prevalence in their herds. This knowledge gap disrupts lameness management. This knowledge gap could be addressed by automation of lameness detection and lead to improved lameness management. Earlier detection and automation of detection could reduce the time from onset to treatment, inhibiting lameness cases from becoming severe, accelerating recovery, increasing production and improving welfare. Monitoring the return to normal locomotion after treatment would also be facilitated.

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References

- Anil, L. et al. (2005). Pain detection and amelioration in animals on the farm: issues and options. *Journal of Applied Animal Welfare Science*, 8, 261–278. https://doi.org/10.1207/s15327604jaws0804_3
- Beer, G. et al. (2016). Use of extended characteristics of locomotion and feeding behavior for automated identification of lame dairy cows. *PLoS One*, 11, e0155796. <https://doi.org/10.1371/journal.pone.0155796>
- Brujinis, M. R. et al. H. (2010). Assessing economic consequences of foot disorders in dairy cattle using a dynamic stochastic simulation model. *Journal of Dairy Science*, 93(6), 2419–2432. <https://doi.org/10.3168/jds.2009-2721>
- Flower, F. C. et al.(2006). Effect of hoof pathologies on subjective assessments of dairy cow gait. *Journal of Dairy Science*, 89, 139–146. [https://doi.org/10.3168/jds.S0022-0302\(06\)72077-X](https://doi.org/10.3168/jds.S0022-0302(06)72077-X)
- Hudson, C. et al. (2008) H. Recognition and management of pain in cattle. *Practice*, 30, 126–134. <https://doi.org/10.1136/inpract.30.3.126>
- King, M. T. M. et al. (2017). Cow-level associations of lameness, behavior, and milk yield of cows milked in automated systems. *Journal of Dairy Science*, 100(6), 4818–4828. <https://doi.org/10.3168/jds.2016-12281>
- Nechanitzky, K. et al. (2016). Analysis of behavioral changes in dairy cows associated with claw horn lesions. *Journal of Dairy Science*, 99(4), 2904–2914. <https://doi.org/10.3168/jds.2015-10109>

O'Callaghan, K. A. et al. (2003). Subjective and objective assessment of pain and discomfort due to lameness in dairy cattle. *Animal Welfare*, 12, 605–610.

O'Leary, N. W. et al. (2020). Invited review: Cattle lameness detection with accelerometers. *Journal of Dairy Science*, 103(5), 3895–3911. <https://doi.org/10.3168/jds.2019-17123>

Shepley, E. et al. (2017). Validation of the ability of a 3D pedometer to accurately determine the number of steps taken by dairy cows when housed in tie-stalls. *Agriculture (Basel)*, 7, 53. <https://doi.org/10.3390/agriculture7070053>

Stoddard, G. C. and Cramer, G. (2017). A Review of the Relationship Between Hoof Trimming and Dairy Cattle Welfare. *Veterinary Clinics of North America: Food Animal Practice*, 33(2), 365–375. <https://doi.org/10.1016/j.cvfa.2017.02.012>

Strapák, P. et al. (2013). *Cattle Breeding*. Nitra: Slovak University of Agriculture. In Slovak.

Thorup, V. M. et al. (2015). Lameness detection via leg-mounted accelerometers on dairy cows on four commercial farms. *Animal*, 9, 1704–1712. <https://doi.org/10.1017/S1751731115000890>

Weigle, H. C. et al. (2018). Moderate lameness leads to marked behavioral changes in dairy cows. *Journal of Dairy Science*, 101(3), 2370–2382. <https://doi.org/10.3168/jds.2017-13120>