

Changes of locomotion activity in the Holstein cows during estrus

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The objective of this study was the evaluation of the locomotion activity in heifers and Holstein dairy cows during estrus. We have analysed the locomotion activity using the Heatime RuminAct device on 99 dams (68 dairy cows and 31 heifers) and we evaluated a total of 213 estrus cycles during the reference period of 3 days before estrus, 3 days after estrus and on the day of the estrus occurrence. The data was analysed using the DataFlow™ II program. The locomotion of cows was expressed in the units of locomotion activity in 24 hours (u/24h). During the reference period, 3 days before estrus the cows showed locomotion activity 602.7 u/24h, with an increase in the locomotion activity on the day of estrus of 876 u/24h and during the reference period 3 days after estrus the level of locomotion activity decreased to 566 u/24h, what is the similar locomotion activity to the reference period before estrus.

Keywords: dairy cows, estrus, locomotion activity, Heatime RuminAct

1 Introduction

Searching the cows in estrus in herd means one of the important activities in the management of the herd reproduction. The attention of breeders and researchers is concentrated on the precise estrus identification according to the outer symptoms because as a result of the missed estrus the considerable economic losses generate to the breeders (López-Gatius, 2000). The completed experiments show that the estrus period of cows is characterized by the increased locomotion activity, which is the reliable tool for the accurate estrus detection (Firk et al., 2002) and at the same time it is the prerequisite for the required insemination results. The most probable reason of the increased activity in the period of estrus can be the gradual increase of estrogen concentration (17 β -estradiol) in the cows' blood in the period before the estrus (proestrus). Lopez et al. (2004) point out the important relationship between the estradiol concentration in the cows' blood and the estrus length ($r = 0.57$) and estradiol concentration and the changes of cows' behaviour in the estrus period ($r = 0.7$).

In order to increase the detection effectiveness of estrus several electronic technologies have been developed (Rorie et al., 2002) and similar other additional equipment measuring the changes in cows' behaviour in the period of estrus (Firk et al., 2002). Recently there is the widespread utilization of the different systems of electronic evaluation of the locomotion activity and other systems which are targeted at the evaluation of the cattle estrus behaviors (Rorie et al., 2002). According to the authors the commercially available electronic equipment for the estrus detection is aimed at the recording of changes of locomotion activity which is measured by pedometer placed on the leg (Roelofs et al., 2005), and at the cows' neck (Elischer et al., 2013).

Nowadays, one of the most modern technologies of the estrus detection is the system Heatime RuminAct which takes into consideration the biological principles of cows' behaviour in the period of estrus when the locomotion activity is being increased. Based on the evaluation of this indicator the system is able to provide to a breeder the basic information about the animal behaviour, their well-being and health 24 hours a day, 7 days a week in real time. Therefore the system Heatime RuminAct means for a breeder the modern and unique tool which allows to achieve up 95% accuracy of estrus retrieval, including the identification of the cows' silent estrus (without outward exhibit sings), (Silper et al., 2015).

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The objective of this study was the evaluation of the locomotion activity in heifers and Holstein cows during estrus.

2 Material and methods

We analysed the locomotion activity of heifers and cows on the dairy farm by using the system Heatime RuminAct. We received the basic data of 99 Holstein dams (68 cows and 31 heifers). Totally we evaluated 213 cows estrus cycles by using collars with the sensor of the locomotion activity and rumination in the system Heatime RuminAct. We carried out the evaluation every day in the reference period 3 days before estrus, on the day of estrus and every day in the reference period 3 days after the estrus. The estrus day was considered to be the day of the insemination. The locomotion activity was given in the units of locomotion activity index in 24 hours (u/24h). Apart from that we also analysed the impact of the daily milk production (less than 35.43 kg and more than 35.43 kg of milk) on the level of the cows' locomotion activity.

3 Results and discussion

When evaluating the estrus impact on the changes of cows' locomotion activity we detected the average activity 603 u/24h in the reference period (3 days before estrus). The values of the locomotion activity were increased gradually in the period before estrus, when one day before estrus the daily locomotion activity was significantly higher 663 u/24h. This fact was apparently influenced by the beginning of estrus itself with the progressive increase of intensity of the outer estrus symptoms caused by the increasing oestrogen concentration in blood. The beginning of estrus itself resulted in the statistically significant growth ($P < 0.001$) of the cows' locomotion activity to 876 u/24h, which meant the increase by +273 u/24h in comparison with the reference period before estrus (by +32.2 %). After the estrus we recorded the immediate and significant decrease of the cows' locomotion activity to 569 u/24h on the first day after the estrus ending. In the reference period 3 days after the estrus the values of the cows' locomotion activity were considerable the same (from 561 to 569 u/24h) (Tab. 1). Our research results did not confirm 2 even 4 times increase of the cows' locomotion activity in the estrus period in comparison with the period before estrus, as stated by Kiddy (1977).

Table 1 Locomotion activity of the Holstein cows in the reference period and during estrus

		Locomotion activity (u/24h)						
		Reference period			Estrus			
Factor		3 rd day before estrus	2 nd day before estrus	1 st day before estrus			1 st day after estrus	2 nd day after estrus
Locomotion activity (n=213)	\bar{x}	568	577	663	876	569	561	568
Milk production								
< 35.43 kg (n = 80)	\bar{x}	576.1	585.3	680.8	893.0	579.8	575.1	583.3
	s.d.	110.7	112.0	185.8	222.9	126.4	119.5	117.6
≥ 35.43 kg (n = 75)	\bar{x}	553.0	562.0	629.2	844.9	549.0	535.5	541.3
	s.d.	125.3	124.4	165.6	211.9	124.0	117.4	120.2

n – number of estrus cycles

Similarly, Reith et al. (2014) affirmed the increase of cows' locomotion activity related to the estrus beginning of the Holstein and Fleckvieh breed on average by 38 %. The comparable results of the increased locomotion activity of Holstein dairy cows in the estrus period in comparison with the reference period before estrus were detected also by our research (32.2 %). Significantly higher differences in the locomotion activity, when comparing the period before estrus with the values of this indicator in the estrus period, expressed by the level of the locomotion activity in the interval of two hours (u/2h), were recorded by Favero (1984) and Silper et al. (2015) at the level of (77.3 u/2h), or Madureira et al. (2013) who detected the average cows' activity in the estrus period at the level of 72.8 u/2h. Fundamentally different results, based on their experiments, are stated by Firk et al. (2002) who did not confirm the significant growth of the cows' locomotion activity in the estrus period.

From the aspect of the milk production evaluation impact on the level of locomotion activity we divided all the milking cows into 2 groups – the first group with the daily milk production less than 35.43 kg and the second group with the daily milk production more than 35.43 kg of milk – this group was indicated as high milk producing dairy cows. The average daily milk production was calculated in the time period 10 days before the estrus beginning (35.43 kg of milk) in order to eliminate any impact of the nearing estrus on the changes of milk production.

In the reference period before estrus the evaluated groups of dairy cows - the dairy cows of less daily milk production (less than 35.43 kg) and highly productive dairy cows (more than 35.43 kg of milk) proved the comparable level of the locomotion activity, which was from 576,0 to 585.3 locomotion units (u/24h) 3 days and 2 days before estrus, or from 533 to 562 u/24h and one day before estrus, which can be considered as the beginning of estrus, there was a slight increase of the cows' locomotion activity of the particular groups to 680 or 629.2 u/24h (Tab. 1).

In the estrus period there was the expected considerable growth of the dairy cows' locomotion activity 893 and 844.9 locomotion units per 24 hours (u/24h), where the difference between the evaluated groups of dairy cows represented 5.38%. Based on the results a higher locomotion activity was proved with the dairy cows of a less milk production (less than 35.43 kg) in the reference period before estrus and also during estrus comparing with the growth of the locomotion activity one day before estrus by +212.2, or 215.7 u/24h. Similarly, after the estrus in the reference period 3 days after estrus we recorded a higher locomotion activity of the dairy cows of lower milk production (from 575 to 583.2 u/24h) in comparison with high yielding dairy cows (from 535.5 to 548.9 u/24h), (Tab. 1). A lower level of the locomotion activity of high yielding dairy cows could be explained by a higher need of lying and rumination of these animals, predominantly because of the requirement of a higher milk production.

Based on our research we can state that the dairy cows with a higher milk producing (more than 35.43 kg) proved lower level of the locomotion activity in the reference period and also during estrus (by + 48.13 u/24h, or 5.38%), which was also confirmed by Lopez et al. (2004) and Lopez – Gatius et al. (2005). Lopez et al. (2004) recorded a lower locomotion activity of high milk producing dairy cows (more than 39.5 kg of milk), and these dairy cows had a lower estradiol concentration in blood on the estrus day. This fact led to less noticeable estrus symptoms in comparison with the dairy cows of a lower milk production. According to Lopez – Gatius et al. (2005) each increase of efficiency by 1 kg decreases the locomotion activity during estrus by – 1.6 %. Similarly, Reith et al. (2014) claim that the increase of activity of high milk producing dairy cows (with the daily production more than 40 kg of milk) was less noticeable in comparison with the dairy cows of a lower milk production. However, based on the experiments Arney et al. (1994) did not detect a significant impact of the milk production on the level of the dairy cows' locomotion activity during estrus. The negative correlation between the milk production and intensity of locomotion activity during estrus was recorded by Lopez et al. (2004) who confirmed that milk production has the significant impact on the estrus duration and estradiol concentration in blood of milk cows.

4 Conclusions

The results of our experiment confirmed that the main indicator of cows' behaviour during the estrus is an increase in the locomotion activity. Our research brings new original results of monitoring locomotion activity using the Heatime RuminAct device.

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