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# Evaluating Heart Rate and Lying Behaviour to Predict Calving of Dairy Cows

*Within an experiment at the Federal Agricultural Research Centre (FAL), predecessor of the vTI, lying behaviour and heart rate of cows was evaluated in order to predict calving.*

*In the experiment lying behaviour and heart rate of 28 cows was monitored and analysed 7-10 days prior to parturition.*

*The time 24 hours before calving was characterised by significant changes in lying behaviour. Heart rate increased as well close to calving, particularly 60-90 min before calving.*

Gestation time of dairy cows varies between 263 and 294 days. The beginning of calving is indicated by a hormonal signal which is not visible for the herd manager [1, 4, 6].

A regular calving process does not require any human assistance. A premature or unnecessary assistance at parturition could have an adverse effect [6, 2].

Despite that it is useful to supervise calving without disturbance of the process in order to recognize problems or abnormal position at an early stage [2, 5].

Thus monitoring of calving can be a useful way to reduce mortality of calves. Together with an increasing herd size, automatic management tools may reduce labour intensive observations.

## Materials and methods

15 consistently designed calving pens were available in an experimental dairy barn of the Institute of Production Engineering and Building research. The size of each single calving pen was 12 m<sup>2</sup>.

28 pregnant German Holstein cows were used for the experiment. Two cows were excluded from the experiment with the ALT-Pedometer due of improper data acquisition. 15 cows were primiparous and 11 cows multiparous with a mean value of 3.7 lactation periods.



Fig. 1: Belt with two electrodes and heart rate monitor

In the experiment data acquisition problems occurred with the heart rate monitors. Therefore only data of 9 heifers and 6 cows were analysed.

Cows were brought to the calving barn 3 to 4 weeks prior to the theoretical calving date.

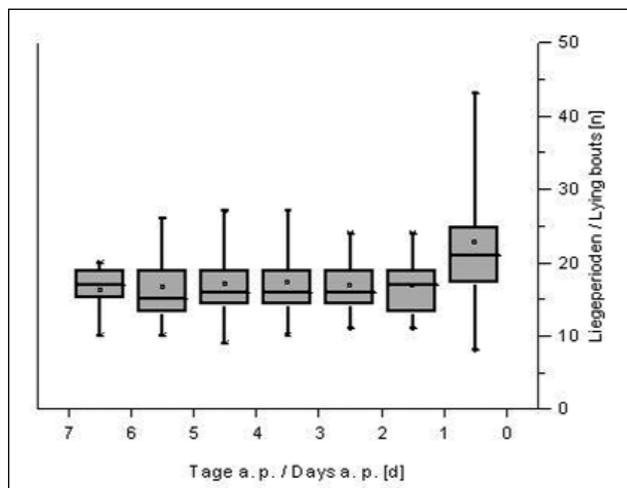
The objective of our study was to evaluate lying behaviour and heart rate regarding its

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## Keywords

Dairy cow, prediction of calving, heart rate, lying behaviour

Fig. 2: Boxplot of the number of lying bouts per day from day 7 until day 1 a. p.



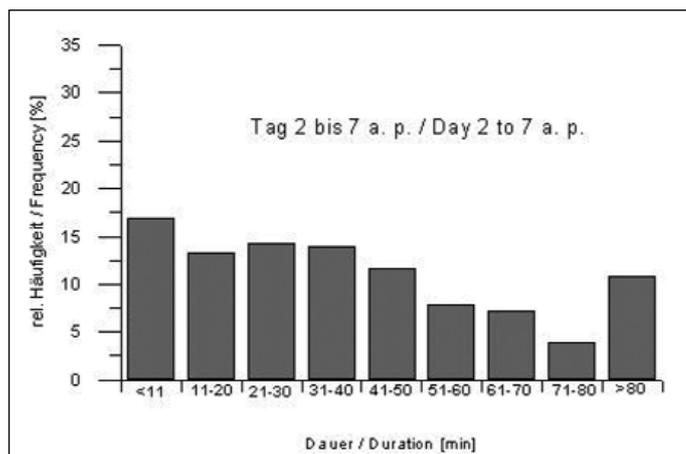


Fig. 3: Distribution of the duration of lying periods per 24 hours (mean value of day 2 to 7)

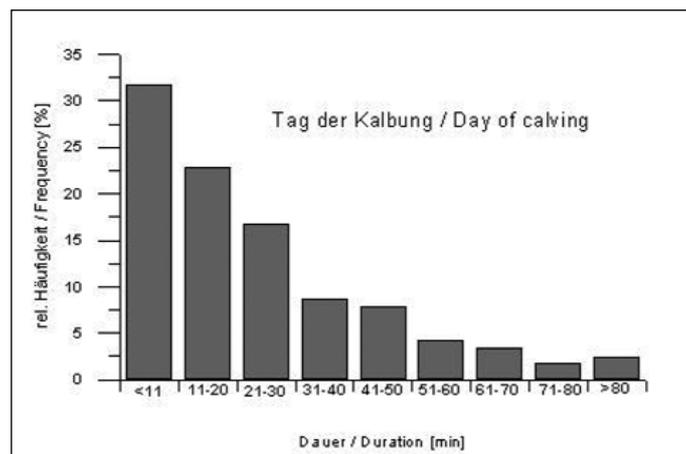


Fig. 4: Distribution of the duration of lying periods per 24 hours at the day of calving

validity to predict time and date of calving.

Lying behaviour and activity was automatically recorded using ALT-Pedometer (Holz engineering [4]). To assist the behavioural measurements by the ALT-Pedometer and as a control and backup system, cows were observed parallel using time-lapse video recording (Panasonic VCR AG-6040), a multiplex system (Panasonic WFS-416) and black and white CCD-cameras. The videos were recorded in the 24 hour record mode. The cameras were sensitive in the infrared wavelength so that a minimum illumination could be used as an emergency light at night.

Heart rate measurements were done using the Polar® heart rate monitors S810i and equine electrodes fixed with a customized elastic belt. The electrodes were placed on the left part of the cow's body, right behind the withers.

The routine work like measuring rectal temperature and scoring of pelvic ligament relaxation was done two times per day at the same time, even on weekends.

Statistical analysis was performed using SAS 9.12 statistical package. Depending on the test of normality, test statistics were done using the Wilcoxon test and correlations were calculated according Kendall's

Table 1: Heart rate measurements prior to calving

Parameter	heart rate [bpm]	
	cow primipar.	cow multip.
Basic value	93	88
day of calving	101	93,5
4 - 1 h a. p.	108	98
2 h a. p.	104	98
1 h a. p.	119	106

tau-b, which does not require normality. The data sets of heart rate and lying behaviour were shifted to the time of calving as zero point. This implies that day 7 means 7 days before calving.

### Results

A total lying time of 9 hours one day ante partum (a. p.) was significantly lower compared to the days before indicating 12 hours of total lying time. Separated analysis of data considering primiparous and multiparous cows showed that heifers lay 2 hours less than multiparous cows ( $p \leq 0.001$ ).

Regarding the duration of lying periods, it was lower one day before calving for both, multiparous and primiparous cows ( $p \leq 0.05$ ).

The number of lying periods per day was significantly higher at the day of calving with 21 compared to the days before with 15 to 17 periods (Fig. 2). Multiparous cows tend to have more lying periods than heifers.

The duration of lying periods decreased significantly on the last day before calving ( $p \leq 0.001$ ), short lying periods of less than 11 minutes could be measured more often with a percentage of 31.8 % in contrast to the days before with a percentage of 16.8 % (Fig. 3, Fig. 4).

The mean value of the heart rate of primiparous cows at 93 bpm was significantly higher compared to multiparous cows with 88 bpm regarding the week before calving ( $p \leq 0.001$ ).

The heart rate increased slightly 24 hours prior to calving, an evident increase could be observed 6 h before calving (Table 1).

### Conclusions

It is obvious that significant changes of the lying behaviour indicate the approaching of calving. Particularly the change of lying behaviour 12 h before calving could be used to predict calving. The augmentation of the heart rate just 60 up to 90 minutes prior to calving could be an appropriate short term indicator.

Results imply the necessity of further experiments regarding the accuracy of prediction, which will be done in the outcoming calving season 2008/2009.

### Literature

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