Use of the Lifecorder+® sensor to assess grazing time of dairy cows

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Abstract

The Lifecorder+® is a uniaxial neck-mounted activitymeter. It was tested to assess grazing time in two French experimental automatic milking system farms (20 cows equipped on the Derval farm, 14 cows equipped on the Trévarez farm). The Lifecorder+ raw signal (from 0 to 9) was converted into a grazing yes/no information over a certain threshold. The data from the sensors were compared with visual observations as reference: trained observers recorded activity with a scanning every 10 minutes in the pastures. The recorded activities were as follows: grazing/ruminating and standing/lying/walking. Observation sessions were performed on the Derval and Trévarez farms. Finally, 20 recordings were available for the Derval farm (121 h of cumulated observation time in pasture) and 91 for the Trévarez farm (336 h of cumulated observation time in pasture). The results show a high correlation of grazing time between the visual observations of activity and the information from the sensor (R^2=0.93 on the Derval farm and 0.82 on the Trévarez farm) with a mean prediction error of 18 min (9%) for the Derval farm and 29 min (20%) for the Trévarez farm. Some slight biases related to the recording of walking in the pathways were noticed. Lifecorder+ appears to be a possible cheap, easy and precise tool to record grazing time at pasture.

Keywords: grazing time, accelerometer, Lifecorder+

Introduction

Assessing grass dry matter intake is a difficult task when cows are grazing. Many farmers would like to know if cows are really eating grass when grazing outside, even at night. A first step to reassure farmers is to assess the time spent grazing by cows, though it remains difficult to establish a relation between grazing time and grass dry matter intake. Recently, Ueda *et al.* (2011) and Delagarde and Lamberton (2015) showed that a human activitymeter, named 'Lifecorder+', could be used to assess cows' grazing time. Within the Autograssmilk European programme (http://www.autograssmilk.eu), a work package was dedicated to the use of new technologies to optimize the integration of automatic milking systems (AMS) with cow grazing. Therefore, it was decided to check the possibility of using this sensor to record grazing behaviour in this situation. This paper summarizes the test of the Lifecorder+ in two French experimental AMS farms.

Material and methods

The Kenz Lifecorder+® (LC+; Suzuken Co. Ltd., Nagoya, Japan), a device for monitoring uniaxial acceleration, has recently been developed as a commercially available tool for the management of and research on human health. The LC+ not only provides a step count per minute and estimates energy expenditure, but it also records the intensity of physical activity at 4-s intervals. The raw data are summarized into 2-min average activity levels ranging from 0 to 9. To assess the grazing time of dairy cows, the sensors were mounted on neck collars on cows from two AMS experimental farms (20 cows were equipped on the Derval farm, 14 cows equipped on the Trévarez farm). The data from the sensors were then converted into grazing time by an MS Excel tool when the activity level exceeded a certain threshold (configurable – different thresholds were tested on the Derval farm). Intra-meal intervals

(≤4 min) are included in the grazing time and inter-meal parasite activities (≤4 min) are excluded from grazing time (see Figure 1 of Rook and Huckle (1995)). The sensor data when the cows are in the barns are also excluded. After treatment, the data from the sensors were compared with visual observations as reference: trained observers recorded activities with a scanning every 10 min in the pastures. The recorded activities were as follows: grazing/ruminating and standing/lying/walking. One observation session was performed on Derval and 12 observation sessions were performed on Trévarez on 7 days. Finally, 20 recordings were available for the Derval farm (121 h of cumulated observation time in pasture) and 91 for the Trévarez farm (336 h of cumulated observation time in pasture). The accuracy of the LC+ device was studied by calculating the coefficient of determination of the regression between observed and predicted (LC+) grazing time and the mean prediction error (MPE), which is the square root of the mean squared prediction error (MSPE).

Results and discussion

The results of the comparison between measured and observed grazing time are presented in Table 1. The average grazing times observed were 196 min on the Derval farm (65 h of cumulated time) and 147 min on the Trévarez farm (222 h of cumulated time), which represent, respectively, 50 and 66% of the observed access time to pasture. For Trévarez farm, this rate is higher than is usually observed (Kaufmann *et al.*, 2009), mostly because one part of the observation sessions was done just after a paddock change. The results show a high correlation of grazing time between the visual observations of grazing activity and the information from the sensor. For the Derval farm, the best correlation was found when the activity level of 0.3 was used as the threshold (R^2=0.93). In this case, the average bias was 3 min (1.5% of the observed grazing time) and the MPE was 18 min (9%). For the Trévarez farm, with a threshold of 0.3, the R^2 of the correlation was 0.82, the average bias was 6 min (4.1%) and the MPE was 29 min (20%). The positive biases were mostly related to walking in the pathways that sometimes generated a signal on the LC+ sensors (Figure 1). For the Derval farm, the correlations were lower and the MPE higher with higher thresholds (0.5, 0.7 or 1). These results confirm, with a lower accuracy, the good results obtained by Delagarde and Lamberton (2015) with the same sensor but with a threshold of 0.5. In a previous study, Ueda *et al.* (2011) observed that the best results were obtained with a threshold of 1. The differences between these studies concerning the best threshold can probably be explained by environmental effects

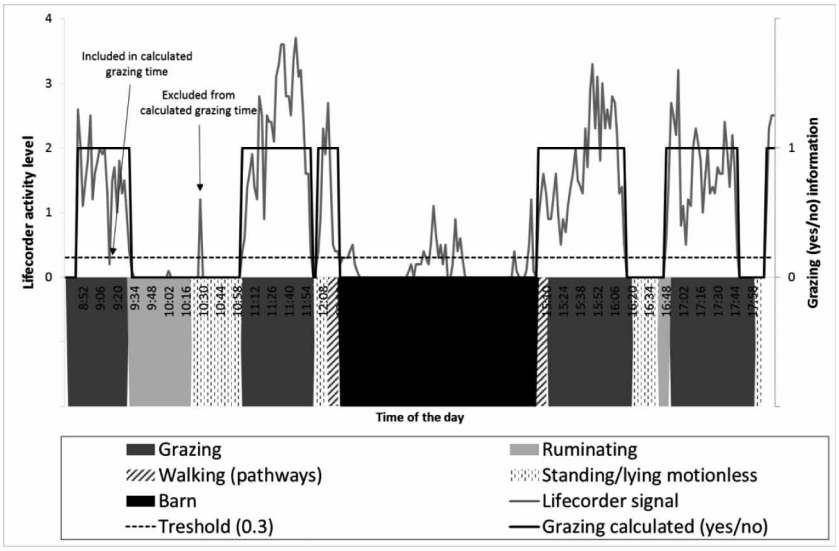

Figure 1. Example of conversion of the LC+ signal (grey line) into grazing information (black line) and comparison to observed behaviours (coloured stripes) for cow 3439 on Derval farm.

Table 1. Results of the comparison between observed and measured grazing time.

Farm	n	Threshold	Observed grazing time (min)	LC+ grazing time (min)	Ave. bias [a] (min)	R^2 [b]	MPE [c]	
							min	% obs
Derval	20	0.3	196	199	3	0.93	18	9
		0.5		188	-8	0.84	27	14
		0.7		177	-19	0.75	37	19
		1		162	-34	0.69	49	25
Trévarez	91	0.3	147	153	6	0.82	29	20
All data	111	0.3	155	161	5	0.84	27	17

[a] Average bias = observed – LC+ grazing time

[b] R^2 = coefficient of determination of the regression.

[c] MPE = mean prediction error in min and % of the observed grazing time.

and especially the position of the neck collar. This involves that the use of the LC+ sensor to record grazing time needs an adjustment to each farm situation.

Conclusions

LC+ appears to be a possible cheap, easy and precise tool to record grazing time at pasture for applied research purposes. In the scope of AutoGrassMilk project, the LC+ will be used to establish grazing kinetics in order to describe grazing behaviours of cows on AMS farms. However, the approach is still a long way from being able to assess dry matter intake.

References

Delagarde R. and Lamberton P. (2015) Daily grazing time of dairy cows is recorded accurately using the Lifecorder Plus device. *Applied Animal Behaviour Science*, in press.

Kaufmann L.D., Muenger A., Rerat M., Junghans P., Goers S., Metges C.C., Dohme F. (2009) Dépense énergétique, activité physique et comportement alimentaire de vaches laitières au pâturage ou consommant la même herbe à la crèche. *Rencontre de la Recherche sur les Ruminants*, 2009, 16.

Rook A.J. and Huckle C.A. (1995) Criteria for identifying meals from continuous recordings of the behaviour of grazing dairy cows. *Annales de Zootechnie* 44 Suppl., 105-105.

Ueda Y., Akiyama F., Asakuma S. and Watanabe N. (2011). Technical note: the use of a physical activity monitor to estimate the eating time of cows in pasture. *Journal of Dairy Science* 94, 3498-3503.