

Application of grass and cow sensor data to support grazing management in high output systems

Zom R.L.G., Holshof G., Ipema A.H. and De Mol R.M.

Wageningen UR Livestock Research, Animal Nutrition, De Elst 1, 6708 WD Wageningen, the Netherlands

Abstract

An experiment was conducted with the objective of evaluating whether the combined data from grazing and rumen pH sensors could be used to support grazing management. Data were collected during the 2014 grazing season from a 60-cow herd. The average milk yield was 26.1 kg milk cow⁻¹ day⁻¹. The cows were housed during the night (16:00-06:00 h) and received 8.4 kg dry matter (DM) of conserved forage cow⁻¹ day⁻¹. During the daytime (06:00-16:00 h) the cows were strip-grazed. Daily, the cows were given an edible herbage allowance of approximately 8 kg DM above 5 cm stubble height cow⁻¹. Automatic milking system visits and milk yields were collected per cow. Concentrates were fed during milking with a transponder-controlled concentrate dispenser. Each cow was equipped with a grazing sensor to measure grazing time. Eight cows were equipped with boluses to measure rumen pH. Milk yield was recorded for each milking and milk composition was recorded weekly. Pre- and post-grazing sward height and herbage composition were recorded daily. Relationships between grass and sensor data and cow performance were derived on the basis of retrospective analysis of milk performance, grazing behaviour and rumen pH data. Rumen pH sensors appear to be of little value. There was no clear relationship between grazing activity and pasture characteristics.

Keywords: grazing, sensor, feeding, dairy cows

Introduction

In the Netherlands, dairy farming is characterized by a high milk output per cow. High milk yield requires high nutrient intake from well-balanced rations with little daily variation in composition. With grazing, feed allowance and diet composition are under less control than in confinement systems. This limited control over feed intake and diet composition is an important driver for dairy farmers to abandon grazing. However, recent technical developments have yielded a number of different sensors to measure cow behaviour (cow activity meters, grazing monitors) and rumen indwelling devices to record rumen pH. These sensors are potentially helpful for improving grazing management by providing farmers with information on changing grazing conditions and by giving better control over dry matter (DM) intake, nutrient intake and rumen function. It is widely recognized that the intake of highly digestible pasture herbage with low effective fibre and high concentrations of rapidly fermentable water soluble carbohydrates (WSC) may cause a depression of the rumen pH, resulting in sub-acute rumen acidosis (SARA). Based on a meta-analysis, Zebeli and Metzler-Zebeli (2012) proposed to define SARA as rumen pH <5.8 during 6 hours per day.

Low rumen pH and SARA are often associated with a reduced DM and fibre digestibility. Rumen pH sensors may help farmers to avoid these risks and adjust the feeding strategy by providing fibrous forage or concentrate supplements.

Sward structure (sward height and sward density) affects grazing behaviour of cattle. Within certain limits an animal is able to adjust its grazing time response to the structure of the sward (height and density) in order to maintain dry matter (DM) intake. Grazing activity sensors may provide information indicating whether available grazing time or grazing activity could be limiting for herbage DM intake at grazing.

This pilot study focusses on the potential of grazing activity and rumen pH data recorded with commercial sensors in conjunction with grassland data (composition, pre-grazing sward height) as tools to assist farmers with their grazing management.

Materials and methods

An experiment was conducted at the 'dairy campus' experimental farm in Leeuwarden, the Netherlands. The herd consisted of 60 Holstein-Friesian dairy cows, which were milked with a DeLaval automatic milking system (AMS). Between 16:00 and 6:00 h the cows were housed in a cubicles shed with a concrete slatted floor, a self-lock feeding fence and a computer-controlled concentrates feeder. At 16:30 h, the cows were fed a mixture of 30% grass and 70% maize silage on a DM basis at a rate of 8.4 kg DM cow⁻¹ day⁻¹. The feed mixture was accessible until 6:00 h. Between 6:00 h and 16:00 h the cows were outside and strip grazing was used. The size of the grazed strips was adjusted daily to create a pasture allowance of 8 kg DM cow⁻¹ day⁻¹. Measures of milk production (yield and frequency) were recorded at the AMS. All cows were equipped with a sensor which was attached at the neck and was able to record activity and intake behaviour. The sensor recorded total grazing time in 15-minute periods. Eight multiparous cows were equipped with indwelling systems (boluses) for monitoring reticulo-ruminal pH. Rumen pH was measured at intervals of 1 minute and averaged every 15 minutes, providing 96 recordings per day. During two measurement periods (Period 1 from 16 June – 26 July and Period 2 from 11 August – 14 September); the daily pre- and post-grazing DM yields of the pasture sward were estimated using a rising plate meter. In addition, the grazed herbage was sampled daily and analysed for the concentrations of DM, crude protein (CP), WSC, crude fibre, neutral detergent fibre (NDF), ash and organic matter digestibility (OMD%). The rising plate meter measurements were calibrated weekly, using the double sampling technique (Lantinga *et al.*, 2004).

Results and discussion

During the measurement periods there was considerable daily variation in the concentration of CP, WSC, and NDF (Figure 1). Higher grass heights were associated with lower concentrations of CP and NDF and higher concentrations of WSC. During Period 2, data transmission of five out of eight rumen pH boluses failed, and pH measurement of one bolus showed a large drift. Therefore, only rumen pH data for Period 1 are presented (Figure 2). Mean rumen pH differed among cows, but the diurnal pattern of rumen pH was very similar. In all cows, the nadir occurred shortly after feeding of the supplementary forage. Thereafter, rumen pH increased gradually and remained constant during the daytime at pasture. None of the measurements of rumen pH during the daytime were below the threshold value of pH 5.8. This suggests that the common advice (www.deweideman.nl, April 4, 2014) to provide cows which graze with high WSC pastures with supplementary forage in order to avoid low rumen pH, needs reconsideration. During Period 1, higher grass heights were associated with increased grazing time (not shown). However, the opposite was expected. Shorter swards are more difficult to graze, and cows can compensate for this by increasing their grazing time. The lower milk yields (Figure 3) when the cows were on shorter swards may

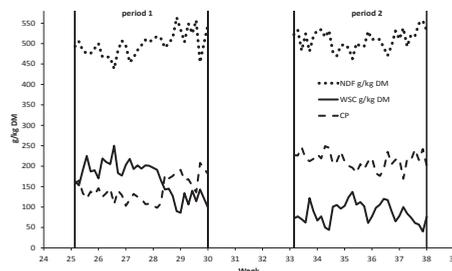


Figure 1. Concentrations (g kg⁻¹ dry matter (DM)) of neutral detergent fibre (NDF), crude protein (CP), and water soluble carbohydrates (WSC) in the grazed grass.

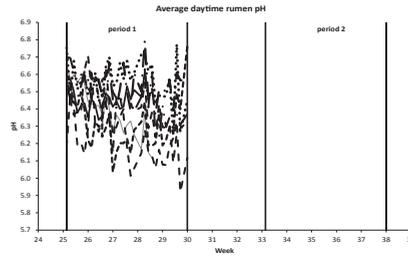


Figure 2. Mean daily rumen pH measured between 06:00 and 16:30 h.

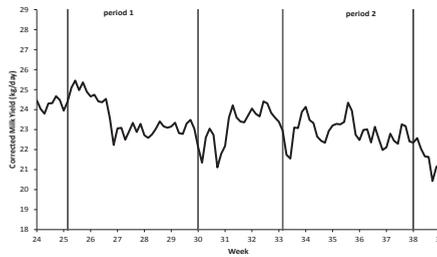


Figure 3. Milk yield ($\text{kg cow}^{-1} \text{ day}^{-1}$) (all cows).

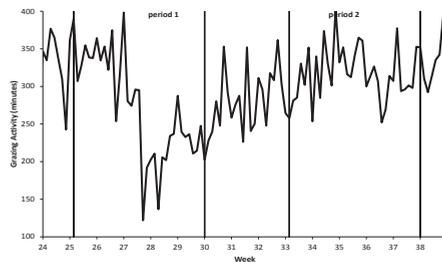


Figure 4. Mean grazing time measured between 06:00 and 16:30 h (all cows).

suggest that the cows reduced their DM intake. During Period 2 the relation between sward height and grazing time was less evident (Figure 4). In a grazing situation, factors such as the quality and growth of pasture herbage, weather conditions (rainfall, temperature, heat stress), day length and grazing behaviour are confounded. Further research on the role of these factors and their interactions would be desirable.

Conclusions

Rumen pH sensors are of little value as tools for grazing management because high WSC grass does not seem to be a risk factor for low rumen pH. Grazing activity sensors alone provide insufficient information as a support tool for grazing management.

Acknowledgements

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