Changes in bite mass and bite rate during grazing

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Abstract

Changes in bite mass and eating rate were measured in cows as pasture mass declined during a grazing event. Four groups of 20 Holstein-Friesian cows were fitted with jaw movement recorders (Rumiwatch Noseband Sensor, ITIN+HOCH GmbH, Switzerland). Over three days in spring, when cows were in early lactation, grazing behaviour was monitored in each of the four groups in separate paddocks during a 5-hour grazing period after the morning milking. The initial mass of the perennial ryegrass pasture was 4400 kg DM/ha (to ground level) and this was re-measured each hour using a rising plate meter. Pasture disappearance was used to calculate bite mass. Bite mass in the first hour of grazing averaged 1.2 g DM but declined to a low of 0.4 g DM thereafter. Similarly, bite rate declined from 3116 to 780 prehension bites/h, grazing time declined from 58 to 20 min/h and intake rate declined from 3.6 to 0.4 kg DM/h after the first hour of grazing. In contrast, ruminating time increased from 1 min/h in the first hour of grazing to a high of 20 min/h thereafter, while idle time increased from 2 min/h to 22 min/h. Information such as this could enable on-cow sensors to be used to estimate pasture intake in grazing cows in near real time.

Introduction

The measurement of dry matter intake (DMI) in grazing dairy cows has been a challenge for farmers and researchers alike for many decades. Understanding the dry matter and nutrients that cows receive from pasture is essential for determining the nutrient supply required from supplements for optimal milk production. A commonly used method for measuring DMI in a research context is the n-alkane technique (Dove and Mayes, 1996), however it is labour intensive and requires complex and lengthy chemical analyses of pasture and faeces, rendering it useless for day-to-day management of cow diets.

To address the need for a near-real time estimation of DMI in grazing cows, previous researchers have attempted to use on-cow activity meters to measure grazing time as a surrogate estimate of DMI. These methods have proved imprecise because they fail to take account of variations in total number of bites per day and the amount of herbage dry matter harvested with each bite (Barrett et al. 2001). More recently, on-cow sensors have been developed that can measure the number of jaw movements each cow makes per day, and which can distinguish between prehension bites and jaw movements related to rumination and mastication. These sensors take a step closer to being able to measure DMI of grazing cows, but intake is a product of number of bites and bite mass (Allden and Whittaker, 1970), and measuring bite mass in the field is problematic (Stobbs, 1973).

The study reported here had the aim of generating information about the variation in bite mass in grazing cows, and how bite mass changes as pasture mass declines during grazing, as the first step to assessing whether bite mass and number of bites could be used to estimate DMI.
Materials and methods

The current experiment was part of a larger, early lactation experiment in which 80 Holstein-Friesian cows grazed perennial ryegrass pasture supplemented by 9 kg DM/cow.d of a mixed ration containing canola meal, wheat grain, barley grain and maize grain (the ration was split into two equal parts and fed in the dairy after each milking).

The 80 cows were allocated into four groups of 20 cows. Grazing behaviour was monitored using jaw movement recorders (Rumiwatch Noseband Sensor, ITIN+HOCH GmbH, Switzerland) in one group at a time on three consecutive days each. On each day, measurements were made during a 5-hour grazing period after the morning milking.

At each grazing, cows entered a fresh paddock of pasture, the initial mass of which averaged 4400 kg DM/ha (to ground level). Pasture mass was re-measured each hour using a rising plate meter; pasture disappearance was used to calculate bite mass.

Data were analysed using GenStat 18 (2015). Differences between mass data and grazing behaviour parameters were determined by general ANOVA, with treatment hour blocked by replicate, and Duncan’s multiple range test conducted. Differences of $P < 0.05$ were considered significant.

Results

Time spent eating was greatest in the first hour after cows reached the paddock when cows spent nearly their entire time grazing. Grazing time per hour declined thereafter, with concurrent increases in both ruminating time and idle time ($P < 0.001$; Figure 1).

![Figure 1](Image)

Figure 1. The average time cows spent grazing, ruminating or idle each hour.

Pasture mass decreased as grazing progressed and the total amount of pasture removed each hour progressively decreased (Table 1). After 5 hours' grazing only 68% of available pasture
remained. Intake rate, bite rate and bite mass were greatest in the first hour and decreased thereafter (trend only for bite mass, P = 0.063).

Table 1. Pasture mass, intake rate, bite rate and bite size after the first hour of grazing. Data are means of three days for four reps over a 5-h grazing session.

<table>
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<tr>
<th>Hour</th>
<th>Pasture mass (kg DM/ha)</th>
<th>Pasture mass/plot (kg DM)</th>
<th>Pasture removed/h (kg DM)</th>
<th>Intake (kg/cow. h)</th>
<th>Prehension bites/cow. h</th>
<th>Bite mass (g)</th>
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Discussion

These data indicate a substantial variation in average bite mass as grazing progressed. Numerically, average bite mass during the first hour of grazing was two to three times greater than for the rest of the 5 hours. After the first hours’ grazing, average bite mass was much more consistent, ranging only between 0.4 and 0.5 g/bite. The trend for a reduction in bite mass after the first hour was accompanied by a decline in pasture mass as pasture was consumed. The largest drop was during the first hour after the cows returned to the paddock, during which time 23% of available pasture was removed and the pasture mass was reduced from 4400 to 3450 kg DM/ha. Thus the results of the current experiment were in accordance with the previous experiment of Laca et al. (1992), which showed that bite mass in grazing dairy cows was related both to the mass and density of the pasture on offer, and that bite mass increased with taller, sparser swards than shorter denser swards. Laca et al. (1992) also reported that the initial bites of cows grazing ‘reconstructed’ grass pasture ranged in mass between 1.6 and 1.9 g DM. This is also in agreement with the average bite mass in the first hour of the current experiment.

The rate of intake of pasture in the current experiment was also markedly greater in the first hour after the cows returned to the paddock than for the rest of grazing. This can be explained by the greater bite mass described above, in combination with the bite rate (number of bites per hour) also being markedly greater in the first hour than during the rest of the grazing. Given that all cows had consumed approximately 4.5 kg DM of mixed ration in the dairy during milking, it is perhaps not surprising that the time they spent grazing and bite rate both dropped off rapidly after the first hour.

Overall these data provide an indication that plant factors related to initial pasture mass and cow factors related to time since the commencement of grazing could have important influences on the
mass of grass harvested by cows with each bite. Barrett et al. (2001) concluded that the plant factors related to pasture mass were more important, but a greater understanding of these relationships will be required to predict bite mass with sufficient accuracy for the assessment of the DMI of grazing cows. Presumably the variation in bite size between individual cows will be even greater than for the group averages reported here; understanding this individual cow variation would be an appropriate starting point for further research.

References
GenStat 18 (2015). VSN International Ltd. 5 The Waterhouse, Waterhouse Street, Hemel Hempstead, HP1 1ES, UK