Duration of Regrowth of Ryegrass (*Lolium perenne*) Swards: Effects on Rumen Fermentation of Lactating Dairy Cows

P. Chilibroste
Universidad de la República, Uruguay

S. Tamminga
Wageningen Institute of Animal Science, The Netherlands

H. Boer
Wageningen Institute of Animal Science, The Netherlands

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DURATION OF REGROWTH OF RYEGRASS (*LOLIUM PERENNE*) SWARDS: EFFECTS ON RUMEN FERMENTATION OF LACTATING DAIRY COWS.

P. Chilibroste[1], S. Tamminga[2], and H. Boer[2]

[1]Facultad de Agronomía, EEMAC, Ruta 3 km 363, CP 60000, Paysandú, Uruguay.

[2]WIAS, Wageningen Institute of Animal Science, Animal Nutrition Group, Marijkeweg 40, 6709 PG, Wageningen, The Netherlands.

Abstract

The relative importance of duration of sward regrowth and rumen fill and fermentation on the control of grazing time and intake rate during the first grazing session of the day were studied. Four lactating dairy cows were allowed to graze ryegrass (*Lolium perenne*) swards, with five different regrowth periods after mowing (6, 9, 16, 22 and 30 d). The cows were allowed to graze until they stopped voluntarily. Samples of rumen liquid were taken at approximately 0, 30, 60, 120 and 240 min after the grazing session was finished. Concentration of volatile fatty acids (VFA) followed a significant quadratic trend with a maximum concentration observed at approximately 110 min after cessation of grazing. In this study, rumen fill, VFA (either total or major components) and ammonia concentration as individual variables were not correlated with grazing time or dry matter intake.

Key words: Cattle, Grazing, Rumen fill, Rumen Fermentation

Introduction

The mechanisms that control DMI in ruminants have received much attention since feed intake is the predominant factor determining animal performance. If DMI is seen as the summation of individual discrete meals (Forbes, 1995), understanding what causes an animal to start and stop eating would lead to a better understanding and prediction of daily DMI. Concentration of fermentative end products (Van Vuuren, 1993) have been postulated as controlling DMI in the grazing ruminant. Reduction in DMI due to the infusion of volatile fatty acids (VFA), either into the rumen or the blood stream, has been extensively studied (e. g., Faverdin et al., 1995; Forbes, 1995). In general, a dose response relationship has been observed between the level of VFA infused and the reduction in DM intake (Faverdin et al., 1995; Forbes, 1995), which would suggest effects of VFA over a wide range of concentrations. This study was undertaken to examine the relative importance of fermentation end products on the control of grazing time during the first grazing bout after a.m. milking.

Material and Methods

The experiment was carried out from May 13 to June 30, 1996 at the experimental farm "De Ossekampen" of the Wageningen Agricultural University. Four lactating Holstein-Friesian cows previously fitted with a 10 cm rumen cannula (Bar Diamond, Lane, Idaho, USA) in the dorsal rumen sac were used. During the measurement days, cows grazed individually tethered within a circular plot.

The treatments comprised 6 different periods of regrowth. At day 0 (May 13) the whole pasture was cut with a mowing machine (cutting height 4-cm) and the cuttings removed. On d 6, 9, 13, 16, 22 and 30 after cutting (referred to as measurement days) the cows grazed whilst tethered (Chilibroste et al., 1998) during their first grazing bout of the day. In the measurement days, rumen evacuation of the four cows was conducted between 0900 and 1100 h a.m. At 1100 h the four cows were placed in their respective grazing plots and

allowed to graze until they stopped voluntarily. Immediately after grazing, each cow was removed to the barn and the rumen was evacuated again. After replacement of this second rumen evacuation, the cows were fasted until the next morning when a third rumen evacuation was carried out. Samples of rumen fluid (approximately 250 ml) were collected using a 85 cm plastic tube (2.5-cm diameter), closed at the bottom and with about 270 holes (1.5-mm diameter) drilled in the lower 27 cm. This tube was inserted into the rumen through the cannula and positioned in such a way that the bottom of the tube reached the liquid phase in the ventral rumen sac. The collected rumen fluid was sieved through a sieve with apertures of 0.04 mm^2, and samples were taken for ammonia, and VFA determinations.

Statistical Analysis

Linear and quadratic effect of sampling time on VFA and ammonia were tested with the GLM procedure of SAS as follows:

$$Y_{ijk} = \mu + cow_i + day_j + (cow \times day)_{ij} + TL_k + TQ_k + (TL \times day)_{jk} + (TC \times day)_{jk} + e_{ijk}$$

where:

Y_{ijk} = dependent variables,

μ = general mean,

cow = cow effect (class variable), i = 1 to 4,

day = day effect (class variable), j = 1 to 5,

cow × day = interaction term,

TL = linear effect of time of sampling, k = 1 to 5,

TQ = quadratic effect of time of sampling, k = 1 to 5,

(TL × day) and (TC × day) = interaction terms, and,

e_{ijk} = error term (0, s^2).

To test day and cow effect the interaction (cow × day) was used as the error term.

Results and Discussion

In Figure 1, the time course of the fermentative end products are shown. There was a significant cow effect for all measured variables reflecting high individual variability. The inclusion of a quadratic term was highly significant ($P < 0.01$) for all the fermentative end-product concentrations indicating the presence of a maximum or minimum within the 4-h period of sampling. Except for rumen ammonia concentration, there was no significant interactive effect of day and sampling time, either linear or quadratic, on the concentration of fermentation products. The change in VFA concentration after grazing followed a quadratic ($P < 0.01$) trend with time (Figure 1). Maximum rumen liquid VFA concentrations (either total or major components) were observed at approximately 110 min after grazing. If the animals were able to sense rumen VFA concentration or VFA rumen pool sizes (Faverdin et al., 1995; Forbes, 1995) they interrupt the grazing session before this maximum level had been reached. The maximum VFA concentration observed was lower than values reported for grazing cattle (Rearte and Santini, 1989; Van Vuuren et al., 1986). Chilibroste (1996, unpublished) studying the fermentation pattern during the first grazing session in the morning of lactating dairy cows, found that ammonia concentration in the rumen liquor increased linearly with grazing time while VFA concentration exhibited a plateau during approximately 1 h of grazing and then sharply increased. Irrespective of the mechanism leading to these differences, these results suggest that perhaps ammonia is more important than VFA level in regulating meal size under grazing. Short term imbalances in the supply of ammonia and VFA, as our results suggested, should be considered in further research (Illius and Jessop, 1996). Rumen liquid ammonia concentration after grazing did not follow a clear trend (Figure 1) with day of regrowth.

Ruminal VFA and ammonia concentration taken in isolation, are unlikely to be the responsible for the observed differences in DMI and grazing time in this experiment. For all

regrowth periods evaluated, the cows stopped grazing before a maximal ruminal capacity was reached.

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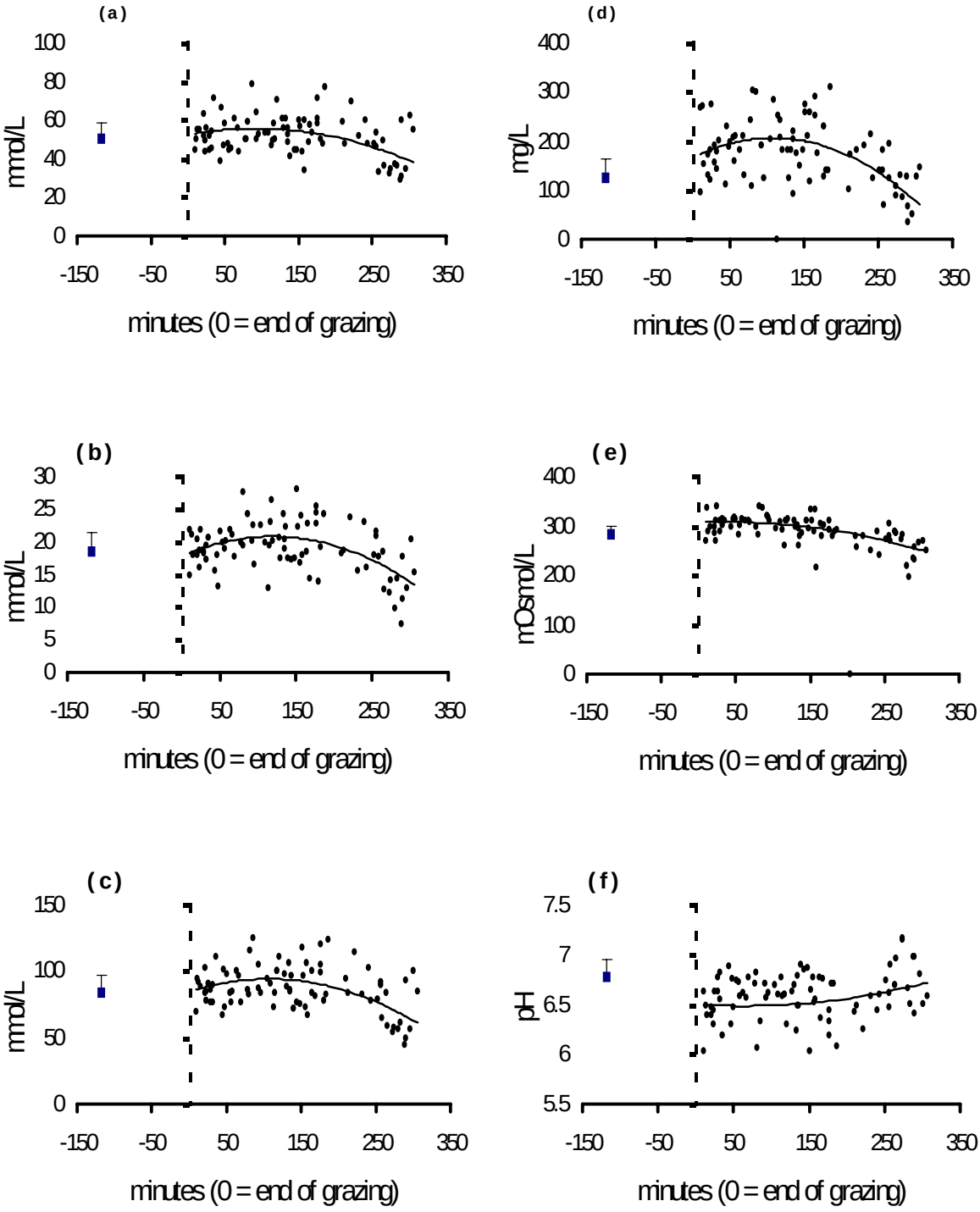

Figure 1 - Fermentative end-product concentration (a, acetic; b, propionic; c, total VFA, d, ammonia) and rumen environmental variables (e, osmotic pressure; f, pH) before (filled square) and after grazing (dots, observed values; lines, predicted values).