Effects of feeding barley grain on dry matter intake and apparent total tract digestibility of mid-lactation dairy cattle fed pasture-based diets

Michael Dineen[1,2], Brian McCarthy[2], Pat Dillon[2], S.W. Fessenden[1] and Michael E. Van Amburgh[1]

[1]Cornell University, Ithaca, New York, U.S.A; [2]Teagasc, Animal & Grassland Research and Innovation Centre, Moorepark, Fermoy, Co. Cork

Summary

- Energy intake, due to the low amount of starch, is typically cited as the first limiting factor to milk solids production in pasture-based diets.
- In this experiment, barley grain supplementation caused a large substitution effect and reduced apparent total tract digestibility of dry matter and neutral detergent fibre.
- The lack of milk response and a high substitution of perennial ryegrass for barley grain suggests that under these experimental conditions, energy supply might not have been the limiting factor of the pasture only diet.

Introduction

The population of the world is projected to surpass 9.6 billion by 2050. With this growth trajectory, humankind will have to produce the same amount of food in the next 50 years as has been produced to date. In temperate regions, pasture-based diets are an important source of nutrients for the production of animal products and an appropriate and beneficial use of the resource. Whilst well-managed pasture is highly digestible, energy intake is typically reported as first limiting milk solids production. There is a large amount of research investigating the effect of providing energy dense supplements to grazing dairy cows however, wide variation in milk response and substitution effects exist with little explanation of how or why different responses to these supplements occur. Therefore, more data on ruminal digestion kinetics and nutrient flows are required to understand these variable outcomes. This will help determine how to complement and further capitalise on highly digestible, nutrient dense grass swards.

Experimental design

A study was conducted to evaluate the effects of barley grain supplementation on milk production, rumen metabolism, and omasal flow of nutrients in lactating dairy cattle fed mechanically cut fresh perennial ryegrass indoors. The techniques implemented in this experiment, such as rumen evacuations and omasal sampling, provide the ability to quantify the digestion and metabolism of feed by the microbial population in the cow's rumen. This paper will focus on the intake and apparent total tract digestibility (TTD) outcomes of dry matter (DM) and Neutral Detergent Fibre (aNDFom). Ten ruminally cannulated Holstein cows averaging 70 DIM and 513 kg BW were assigned to one of two treatments in a switchback design. Treatments were (on a DM basis) 100% perennial ryegrass (PRG) or 80% PRG and 20% rolled barley (PRG+B). Swards of PRG were cut twice and offered across six meals daily with barley grain being fed at milking as two equal meals. The trial consisted of three 29 day periods where each period consisted of 21 days of diet adaptation and eight days of data and sample collection. Faecal samples were collected during three eight-hour intervals on day 24, 26 and 27 to encompass every two hours of a 24 hour cycle. Apparent total-tract digestibility of DM and aNDFom was determined using

the faecal composite with indigestible NDF (uNDF) as an internal marker. Daily dry matter intake (DMI) was determined by weighing the feed offered and refused with samples being analysed daily for DM content.

Results

Supplementation with barley grain reduced PRG intake (Table 1) resulting in a substitution of PRG for barley (0.88 kg/kg), however, treatment did not affect total DMI. Apparent TTD of DM and aNDFom were reduced when cows were supplemented with barley grain (Table 1). The reductions in TTD are in agreement with previous experiments. However, this reduction is typically offset by an increase in total DMI, which was not achieved in this experiment. It has been suggested that when fermentable carbohydrates are fed to cows on pasture-based diets, rumen pH and the ability of the microbial population in the rumen to digest fibre can be reduced. In this experiment, barley starch digestibility was high (98% starch TTD). The concentration of uNDF was higher in the barley grain compared with PRG (6.3% v 3.5% uNDF (% DM) respectively) as the grain contained hull material, which might have also contributed to the reduction in TTD. Energy corrected milk was not effected by treatment (24.5 vs. 24. kg/cow per day for PRG and PRG+B, respectively).

Table 1. Effects of barley grain on intake and apparent total tract digestibility (TTD) in lactating dairy cattle fed pasture-based diets

Item	PRG	PRG + B
Pasture intake (kg DM/day)	15.94	13.02
Barley intake (kg DM/day)	-	3.32
Total intake (kg DM/day)	15.94	16.34
Apparent TTDMD[1] (g/g)	0.83	0.80
Apparent TTaNDFomD[2] (g/g)	0.83	0.75

[1]TTDMD = total tract dry matter digestibility [2]TTaNDFomD = total tract aNDFom digestibility

Conclusions

Despite providing energy dense barley grain to cows fed a pasture-based diet, the lack of milk response and a high substitution effect suggests that energy supply might not have been the limiting factor for milk production. Reductions in TTD of DM and aNDFom might have been caused due to an altered rumen environment, low rumen nitrogen content for microbial growth, changes in the animal's microbial population or due to a greater contribution of uNDF in the barley grain supplement. Sample analysis is on-going to provide a more complete understanding of the biological mechanisms involved in these experimental outcomes.