Do different breeds of dairy cow differ in their ability to digest perennial ryegrass?

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Introduction

Grazed grass is the cheapest feed source available for ruminant production systems in temperate climates (Finnernan *et al.* 2010) accounting for 70% and 90% of the diet of dairy cows in Ireland and New Zealand, respectively. Successful operation of grass-based dairy systems is based on achieving large intakes of high quality grass and efficiently converting it into high value milk solids (Prendiville *et al.* 2010). Prendiville *et al.* (2009) identified production efficiency differences between Holstein Friesian (HF) and Jersey (J) cows. They found that J had higher milk solids output per 100 kg bodyweight than HF. The aim of this study was to identify if HF, J and crossbred (J×HF) cows differ in their ability to digest perennial ryegrass.

Methods

During the summer of 2010, *in vivo* digestibility trials on 16 HF, 16 J and 16 J×HF lactating cows (197 days in milk, SD 27) were conducted in a 3 × 2 factorial design, with three breeds and two grass allowances. There were four consecutive measurement periods (commencing 11 Aug, 15 Aug, 29 Aug and 12 Sep), each balanced for breed and grass allowance. Cows were housed in individual stalls allowing for total collection of urine and faeces. A six-day acclimatisation period was followed by a six-day measurement period. Fresh cut perennial ryegrass from an established sward was offered twice daily. Holstein Friesian and J×HF were offered a high (20 kg DM/cow/day) or low (16 kg DM/cow/day) grass allowance. The corresponding grass allowances for the J were 17 and 14 kg DM/cow/day, respectively. During the measurement period total daily intake and faeces and urine produced were recorded for each cow. Representative grass and faecal samples from each cow was taken daily. Grass samples were dried at 40°C for 48 hours and faecal samples were dried at 60°C for 48 hours. All samples were analysed for ash content by placing them into a Gallenkamp muffle furnace size 3 (Thermo Fisher Scientific INC., 81 Wyman St., Waltham, MA, USA) for 16 h at 500 °C. The crude protein (CP) concentration of the samples was analysed using a Leco N analyser (Leco FP-428; Leco Corporation, St., Joesph, MI, USA). The samples were analysed for neutral detergent fibre (NDF) and acid detergent fibre (ADF) using the Ankom Fibre Analyser (Ankom Technology Corporation, NY, USA) using the method of Van Soest *et al.* (1991). Sample organic matter digestibility (OMD) was analysed using the *in vitro* neutral detergent cellulase method of Morgan *et al.* (1989) (Fibertec™ Systems, FOSS, Ballymount, Dublin 12, Ireland). Individual *in vivo* dry matter digestibility (DMD), OMD, neutral detergent fibre digestibility (NDFD), acid detergent fibre digestibility (ADFD) and nitrogen digestibility (ND) over the 6-day measurement period was determined using the following equation: digestibility = (x-y)/x, where x and y, respectively, are equal to the intake in grass and the output of the relevant component in the faeces. The data were analysed using PROC MIXED in SAS (2002) with cow as a random variable, and breed group, measurement period, grass allowance and all interactions as fixed effects in the model.

Results and Discussion

There were no significant interactions and no effect of grass allowance on any of the digestibility parameters examined. There was a breed effect for all the digestibility parameters. The digestibility values observed in the present study were similar to those reported in other studies offering perennial ryegrass to dairy cows (Stakelum and Connolly 1987; Mackle *et al.* 1996). Jersey had a higher DM digestibility value than both HF and J×HF (Table 1; $P < 0.01$). For all other digestibility parameters J had a higher digestibility value than the HF, and the J×HF were intermediate to J and HF (not significantly different). Similarly Aikman *et al.* (2008) found that J were better at digesting NDF than HF, when offered a total mixed ration diet. The higher digestibility exhibited by the J may be explained by their greater number of mastications and greater rate of mastications compared to HF (Prendiville *et al.* 2010). This may have resulted in reducing particle size leading to faster digestion and overall improved digestibility. This, combined with smaller ruminating boli (Prendiville *et al.* 2010) and greater weight of gastrointestinal tract per kg liveweight (Lewis *et al.* 2011) of the J compared to HF, may help explain the higher

Table 1. Apparent total tract digestibility of perennial ryegrass by Holstein-Friesian (HF), Jersey (J) and J×HF cows.

	Breed Group				
	HF	J	J×HF	SEM	*P*-value
DM digestibility	0.79 a	0.81 b	0.79 a	0.006	**
OM digestibility	0.79 a	0.82 b	0.80 ab	0.004	***
N digestibility	0.81 a	0.83 b	0.82 ab	0.005	***
NDF digestibility	0.81 a	0.83 b	0.82 ab	0.005	*
ADF digestibility	0.70 a	0.74 b	0.72 ab	0.01	**

digestibility in the J. Increased gastrointestinal tract size means there is a larger area available for absorption of nutrients, allowing for greater nutrient absorption and thus increased digestibility.

Conclusion

The J and HF breeds do differ in their ability to digest perennial ryegrass. The results of this study therefore suggest that a proportion of the production efficiency differences reported by Prendiville *et al.* (2009) are attributable to small differences in the propensity to digest herbage.

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References

Aikman PC, Reynolds CK, Beever DE (2008) Diet Digestibility, Rate of Passage, and Eating and Rumination Behavior of Jersey and Holstein Cows. *Journal of Dairy Science* **91**, 1103-1114.

Finnernan E, Crosson P, Shalloo L, Foristal D, O'Kiely P, Wallace M (2010) Simulation modelling of the cost of producing and utilising feeds for ruminants on Irish Farms *Journal of Farm Management* **14**, 95-116.

Lewis E, Thackaberry C, Buckley F (2011) Gastrointestinal tract size as a proportion of liveweight in Holstein, Jersey and Jersey-cross cows. In 'Agricultural Research Forum. 14 and 15 March, Tullamore, Ireland'. pp. 104.

Mackle TR, Parr CR, Bryant AM (1996) Nitrogen fertiliser effects on milk yield and composition, pasture intake, nitrogen and energy partitioning, and rumen fermentation parameters of dairy cows in early lactation. *New Zealand Journal of Agricultural Research* **39**, 341-356.

Morgan DJ, Stakelum G, Dwyer J (1989) Modified Neutral Detergent Cellulase Digestibility Procedure for Use with the 'Fibertec' System. *Irish Journal of Agricultural Research* **28**, 91-92

Prendiville R, Lewis E, Pierce KM, Buckley F (2010) Comparative grazing behavior of lactating Holstein-Friesian, Jersey, and Jersey x Holstein-Friesian dairy cows and its association with intake capacity and production efficiency. *Journal of Dairy Science* **93**, 764-774.

Prendiville R, Pierce KM, Buckley F (2009) An evaluation of production efficiencies among lactating Holstein-Friesian, Jersey, and Jersey x Holstein-Friesian cows at pasture. *Journal of Dairy Science* **92**, 6176-6185.

Stakelum G, Connolly J (1987) Effect of Body Size and Milk Yield on Intake of Fresh Herbage by Lactating Dairy Cows Indoors. *Irish Journal of Agricultural Research* **26**, 9-22.

Van Soest PJ, J.B. R, B.A. L (1991) Methods for dietary fibre, and non-starch polysaccharides in relation to animal nutrition. *Journal of Dairy Science* **74** 3583-3597.