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Milk production responses to different strategies for feeding supplements to grazing dairy cows

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ABSTRACT

Milk production responses of grazing cows offered supplements in different ways were measured. Holstein-Friesian cows, averaging 45 d in milk, were allocated into 8 groups of 24, with 2 groups randomly assigned to each of 4 feeding strategies. These were control: cows grazed a restricted allowance of perennial ryegrass pasture supplemented with milled wheat grain fed in the milking parlor and alfalfa hay offered in the paddock; FGM: same pasture and allowance as the control supplemented with a formulated grain mix containing wheat grain, corn grain, and canola meal fed in the parlor and alfalfa hay fed in the paddock; PMRL: same pasture and allowance as the control, supplemented with a PMR consisting of the same FGM but mixed with alfalfa hay and presented on a feed pad after each milking; and PMRH: same PMR fed in the same way as PMRL but with a higher pasture allowance. For all strategies, supplements provided the same metabolizable energy and grain:forage ratio [75:25, dry matter (DM) basis]. Each group of 24 cows was further allocated into 4 groups of 6, which were randomly assigned to receive 8, 12, 14, or 16 kg of DM supplement/cow per d. Thus, 2 replicated groups per supplement amount per dietary strategy were used. The experiment had a 14-d adaptation period and a 14-d measurement period. Pasture allowance, measured to ground level, was approximately 14 kg of DM/d for control, FGM, and PMRL cows, and 28 kg of DM/d for the PMRH cows, and was offered in addition to the supplement. Positive linear responses to increasing amounts of supplement were observed for yield of milk, energy-corrected milk, fat, and protein for cows on all 4 supplement feeding strategies. Production of energy-corrected milk was greatest for PMRH cows, intermediate for FGM and PMRL cows, and lowest for control cows. Some of these differences in milk production related to differences in intake of pasture and supplement. Milk fat concentration decreased with increasing amount of supplement for all feeding strategies, but the decline was most marked for the control cows. Milk protein concentration increased for all groups as the amount of supplement increased, but was greater for FGM, PMRL, and PMRH cows than control cows. It is concluded that when supplements are fed to grazing dairy cows, inclusion of corn grain and canola meal can increase milk production even at similar metabolizable energy intakes, and that it does not matter whether these supplements are fed as a PMR or in the parlor and paddock.

Key words: partial mixed ration, pasture, milk response, supplements

INTRODUCTION

Grazed pasture is a major source of nutrients for dairy cattle in many parts of the world because of its inherent low cost (Doyle and Stockdale, 2011). In southeast Australia, pasture is commonly supplemented with cereal grain or pelleted concentrates, fed in the milking parlor, along with conserved forage fed in the paddock (Doyle et al., 2000). Below average rainfall, reduced availability of irrigation water and reduced pasture DM production in recent years have led to increased reliance on these supplements to meet the nutritional requirements of the milking herd (Wales et al., 2013).

Milk production often increases when cereal grain is fed in the parlor (Walker et al., 2001; Leddin et al., 2009), but the immediate marginal milk response decreases as the amount of grain increases (Stockdale et al., 1987; Walker et al., 2001; Kellaway and Harrington, 2004). Reductions in marginal milk production responses have been reported after as little as 5 kg of DM of grain is consumed (Stockdale et al., 1987; Walker et al., 2001). Such diminishing returns are due in part to inefficiencies in rumen fermentation when high levels of grain are ingested quickly (Dixon and Stockdale, 1999; Wales et al., 2000). Feeding high amounts of grain in the parlor can increase the variation in ruminal fluid pH and the time each day that it is below 6.0 (Wales and Doyle, 2003), which can impair NDF digestion (Mould et al.,

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1983; Leddin et al., 2010), reduce DMI (Auldist et al., 2013), and reduce milk production (Doyle et al., 2005).

An alternative method of feeding supplements to grazing cows is to feed them as a partial mixed ration (**PMR**), defined as a TMR fed on a feed pad in between periods of grazing (Bargo et al., 2002). Dairy cows grazing a restricted pasture allowance supplemented with corn and canola-based PMR have shown greater milk production responses than cows offered similar amounts of supplementary energy as cereal grain in the parlor and conserved forage in the paddock (Auldist et al., 2013, 2014). It is possible that some of the increased milk production responses were due to the corn grain component providing a more slowly digestible source of starch than wheat grain (Khorasani et al., 2001), leading to less variable ruminal fluid pH, and more stable and efficient rumen fermentation. Further, despite low pasture allowances, cows consuming PMR also grazed further into the pasture sward, substituted less pasture for supplement, and refused less supplement than cows at the highest rates of the other treatments. Thus, some of the production advantage of the PMR could also be due to increased DMI of both pasture and supplement.

One aim of the current experiment was to test whether the milk production advantage observed for cows fed PMR could be similarly realized by feeding the grain components in the parlor as a formulated grain mix. If so, the results would be relevant to a larger proportion of Australian dairy farmers, the vast majority of whom do not own mixer wagons or feed pads (Dairy Australia, 2015). A second aim was to determine the milk production of cows fed PMR and offered a generous pasture allowance, as opposed to the restricted allowance of previous experiments (Auldist et al., 2013, 2014). The hypotheses tested were that (1) feeding increasing amounts of a control diet of wheat grain in the parlor and lucerne hay in the paddock to cows grazing a restricted pasture allowance will increase ECM production; (2) feeding increasing amounts of a diet that is isoenergetic with the control diet, but which contains wheat grain, corn grain, canola meal, and alfalfa hay, and is fed to cows as a PMR on a feed pad after milking, will also increase ECM production in cows grazing restricted pasture, and that ECM production will be greater than for the control diet; (3) feeding increasing amounts of the same wheat grain, corn grain, and canola meal as in the PMR diet, but feeding it as a grain mix in the parlor with alfalfa hay fed in the paddock, will also lead to an increase in ECM production, and that ECM production will not be different from the PMR diet fed with the same restricted pasture allowance; and (4) when cows graze a high pasture allowance (~25 kg of DM/cow per d, measured to ground level) supplemented with PMR, ECM production will be greater than for cows grazing a restricted pasture allowance supplemented with the same PMR.

MATERIALS AND METHODS

The experiment was conducted in the spring at the Department of Economic Development, Jobs, Transport and Resources (**DEDJTR**), Ellinbank, Victoria, Australia (38°14′ S, 145°56′ E). All procedures were conducted in accordance with the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes (National Health and Medical Research Council, 2004). Approval to proceed was obtained from the DEDJTR Agricultural Research and Extension Animal Ethics Committee.

The experiment used 192 multiparous seasonally calving Holstein-Friesian dairy cows, including 16 rumen-fistulated cows. All cows were in their second to fifth lactation and were milked twice daily at approximately 0700 and 1500 h. Cows had calved in late winter/early spring and were, on average, 45 DIM (Table 1). All cows were weighed and their BCS assessed according to the 8-point scale of Earle (1976) immediately before the experiment.

The experiment was conducted over 28 d. This included a 14-d pre-experimental period during which

Table 1. DIM, BW, BCS, and yields of milk, fat, and protein in the previous lactation for cows in the control, formulated grain mix (FGM), partial mixed ration, low pasture allowance (PMRL), and partial mixed ration, high pasture allowance (PMRH) groups at the start of the experiment[1]

Item	Control	FGM	PMRL	PMRH
DIM	45 (±16.6)	46 (±18.3)	43 (±17.7)	46 (±18.3)
BW (kg)	595 (±51.1)	597 (±61.1)	591 (±52.9)	588 (±51.2)
BCS[2]	4.6 (±0.27)	4.5 (±0.27)	4.5 (±0.22)	4.6 (±0.28)
Milk yield[3]	7,370 (±1,394)	7,140 (±1,282)	7,270 (±1,160)	7,280 (±1,282)
Fat yield (kg)	303 (±55.5)	303 (±61.2)	300 (±48.7)	302 (±58.1)
Protein yield (kg)	240 (±40.7)	235 (±40.0)	239 (±33.2)	240 (±39.6)

[1]Data are means (±SD) for the 48 cows in each group.

[2]BCS was assessed using the 8-point scale of Earle (1976).

[3]Yields of milk, fat, and protein are expressed as total yields in kilogram per cow for the preceding lactation.