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Effects of dry period length and concentrate protein content in late lactation on body condition score change and subsequent lactation performance of thin high genetic merit dairy cows

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ABSTRACT

Improving body condition score of thin cows in late lactation is necessary, as cows that are thin at drying off exhibit decreased fertility postpartum and are at increased risk of disease and of being culled in the subsequent lactation. Offering a diet low in crude protein (CP) content in late lactation may offer potential to improve body condition score (BCS) at drying off, whereas imposing an extended dry period (EDP) has been advocated as another way to increase BCS at calving. To test these hypotheses, 65 thin cows (mean BCS 2.25 at 14 wk precalving) were managed on 1 of 3 treatments between 13 and 9 wk prepartum: normal protein control {NP; grass silage + 5 kg/d of a normal protein concentrate [228 g of CP/kg of dry matter (DM)]}, low protein [LP; grass silage + 5 kg/d of a low-protein concentrate (153 g of CP/kg of DM)], or EDP (cows dried off at 13 wk precalving and offered a grass silage-only diet). Both NP and LP cows were dried off at wk 8 prepartum, after which all cows were offered a grass silage-only diet until calving. After calving, all cows were offered a common diet (supplying 11.1 kg of concentrate DM/cow per day) for 19 wk. Between 13 and 9 wk prepartum, LP cows had lower DM intake, milk yield, and body weight than NP cows. Whereas EDP cows had lower serum β-hydroxybutyrate and fatty acid concentrations than those of NP cows, BCS at wk 9 prepartum did not differ between treatments. Cows on the LP treatment continued to have lower DMI and BW than those of NP and EDP cows between 8 wk prepartum and calving, but only EDP cows had a higher BCS at calving. Treatment did not affect calving difficulty score or calf birth weight. Although all cows were offered a common diet postpartum, cows on the LP treatment had lower DM intake and milk fat + plus protein yield than cows on any other treatment during the 19-wk period postpartum, but we found no differences in any postpartum indicator of body tissue reserves. The treatments imposed from wk 13 to 9 prepartum had no effect on any fertility or health parameters examined postpartum. Extending the dry period for thin cows improved their BCS at calving but did not allow these cows to achieve the target BCS of 2.75, and we found no beneficial effects of this treatment on cow performance postpartum. Offering a lower-protein diet to thin cows in late lactation did not improve BCS at calving above that of cows on a normal protein diet, but had unexplained long-term negative effects on cow performance.
Key words: thin cows, body condition, dry period, late lactation diet

INTRODUCTION

Most dairy cows experience a period of negative energy balance (**NEB**) early postpartum (**pp**) when their energy intake is inadequate to service the energy demands of lactation. Even well-managed cows may mobilize up to 40% of their fat reserves at this time (Chilliard et al., 2000), whereas cows that are underfed relative to requirements may incur even greater losses. Postpartum NEB is more pronounced in cows of higher genetic merit (Pryce et al., 2001) and may also be more protracted, such that cows already in poor condition in early or mid lactation can end their lactation visibly thin (i.e., with a low BCS).

Thin cows are common on many dairy farms. In a recent study of 10 dairy farms in Northern Ireland, Law et al. (2016) found that 88% of the 1,217 cows entered the dry period (**DP**) in low body condition (BCS <2.5 on a 1–5 scale). They also found that thin cows (BCS <2.25) that were offered no concentrates during the dry period were at increased risk of being culled during the

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subsequent lactation. Markusfeld et al. (1997) observed that multiparous cows with a higher BCS at calving were less likely to be culled. Thin cows are more prone to peripartal health problems, including dystocia, endometritis, and retained placenta (Heuer et al., 1999; Hoedemaker et al., 2009; Roche et al., 2015), that afflict many cows at a time when their immune-competence is impaired (Sordillo, 2016). Experimental evidence has shown that thin cows are more difficult to rebreed (Pryce et al., 2000; Hoedemaker et al., 2009; Roche et al., 2009). Moreover, thin cows that do become pregnant are more susceptible to peripartal disease (Heuer et al., 1999), bringing added veterinary costs and, often, an extended calving-to-conception interval (Borsberry and Dobson, 1989). Improving the BCS of thin cows before calving is a key management objective in many dairy herds, with Garnsworthy (2007) recommending 2.75 as the optimum calving BCS for high-yielding cows.

Improving the body condition of higher-yielding cows during an 8-wk DP is challenging within Northern Ireland's grassland-based dairy systems (Law et al., 2016; Little et al., 2016a,b, 2017). Likewise, the appropriateness of a 50 to 60 d DP that evolved to suit lower-yielding cows of a previous era, but is still widely used across the United States and Europe today, is questionable for contemporary high-genetic merit cows, and is perhaps in need of review. Consequently, interest exists in developing strategies to improve the body condition of cows in late lactation.

High-yielding cows offered additional concentrates of standard protein content in late lactation tend to partition much of the extra energy intake to milk production (Ferris and Mayne, 2003). However, in a previous study at the Agri-Food and Biosciences Institute (Hillsborough, UK), offering a low-protein diet (144 vs. 173 g of CP/kg of DM) to high-yielding cows in early lactation, the authors found reduced milk production and improved energy balance (**EB**) over the first 150 d of lactation without an effect on DMI (Law et al., 2009a). In a follow-up study, Gilmore et al. (2011) found that the EB of cows in early lactation was improved by short-term reductions in protein intake. Building on this, Law et al. (2011a) showed that lower-protein diets and a slower build-up of concentrates promoted a return to a positive EB by wk 7 pp, whereas cows offered normal allocations of a standard protein concentrate took 18 wk to attain positive EB. However, no substantial evidence has shown that offering cows diets low in protein and high in energy in late lactation can improve BCS.

Extending the DP, as is commonly practiced in New Zealand's grazing-based dairy systems, is an alternative option for improving cow condition in late lactation. Whereas it is axiomatic that a longer DP reduces milk yield in that lactation, thus allowing the diversion of dietary energy to tissue gain, there is an expectation also of a higher milk yield in the next lactation. Indeed, Weber et al. (2015) found that cows given a 90-d DP produced more milk to 200 DIM in the next lactation than cows given a 28-d DP. However, cows allocated to the notional 90-d DP treatment in that study were selected because their milk yield had fallen to <15 kg/d. In contrast, Pinedo et al. (2011) found both shorter (<31 d) and longer (77–250 d) DP to be negatively associated with early lactation and 305-d milk yields. However, their study also was confounded in that data were taken from retrospective herd records rather than generating data through controlled experiments. Few authors have attempted to systematically evaluate the use of planned extended DPs for dairy cows.

Few controlled studies have evaluated the effects of varying DP length or DP nutrition on cow BCS at calving and subsequent lactation performance, and fewer still have focused exclusively on cows that are already thin at drying off. The benefits for cow BCS at calving and for subsequent lactation performance, of offering thin cows a lower-protein diet in late lactation or of extending the DP markedly, are essentially unresearched and were the twin focuses of the current study.

MATERIALS AND METHODS

All animal procedures were approved by the animal research ethics committee at the Agri-Food and Biosciences Institute, Hillsborough. The experiment was conducted at Agri-Food and Biosciences Institute Hillsborough under an experimental license granted by the Department of Health, Social Services & Public Safety for Northern Ireland, and in compliance with the United Kingdom Animals (Scientific Procedures) Act (UK Government, 1986).

Pre-Experimental Management

Commencing in mid-July 2014, a dynamic group of mid- to late-lactation, autumn-calving, Holstein-Friesian dairy cows (new cows being added as the season progressed) was managed with the objective of achieving a mean BCS of 2.25 (target range: 2.0–2.5) at wk 13 before expected calving date. Cows were grazed tightly (target postgrazing sward height <4.5 cm) and offered 3.0 kg concentrate each per day (1.5 kg at each milking) through an in-parlor concentrate feeding system until 13 wk before their expected calving date. Cows remaining within this dynamic group on November 5 were moved indoors and offered medium-quality grass silage (ad-libitum) plus 5.0 kg of concentrate daily (2.5 kg at each milking) via an in-parlor feeding system until 13 wk before their expected calving date.