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Effect of feed allowance at pasture on lying behaviour and locomotory ability of dairy cows

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ABSTRACT

In temperate climates where cows are primarily managed at pasture shortages of grass could result in nutritional deficits for the cow and thus pose a challenge to her welfare. This study investigated the effect of daily herbage allowance (DHA) on dairy cow lying behaviour, locomotory ability, and some aspects of hoof health. Ninety-six cows were randomly assigned to one of eight treatments in a 2 × 4 factorial design; experimental duration (2 week (2 W) or 6 week (6 W)), and nutritional levels (DHA) (60%, 80%, 100% or 120% of intake capacity). Cows were assigned to treatment on 25 March (36 ± 16 days in milk). Lying behaviour was recorded using modified voltage dataloggers over 7 × 24 h periods at approximately 4 d intervals for cows on the 6 W treatments. Locomotory ability (including overall locomotion, ab/adduction, tracking, speed, head carriage and spine curvature scores) was assessed four times at approximately 16 d intervals. Hoof health (heel erosion and dermatitis scores) were recorded in the milking parlour on four occasions at approximately 19 d intervals. Although there was no effect on daily lying time, DHA tended to affect the duration of lying bouts ($P = 0.1$). Cows allocated the highest DHA (120%) had shorter bouts than all other treatments ($P = 0.05$), whereas cows allocated the lowest DHA (60%) had fewer lying bouts than all other treatments ($P < 0.05$). In general, cows allocated a lower DHA took longer to lie down after milking than cows fed at or above intake capacity. The effect was greatest in the afternoon when there was an effect of DHA ($P < 0.05$); cows on the 60% DHA stood for longer after afternoon milking than all other treatments ($P < 0.01$). There was no effect of DHA on locomotory ability for either 2 W or 6 W cows. However, in the 2 W treatment, cows on the 120% DHA had the best spine arch scores ($P = 0.01$), and cows in the 60% treatment had the worst tracking ($P < 0.05$). Likewise in the 6 W treatment cows on the 60% DHA had the worst spine arch scores ($P < 0.05$), yet cows allocated a higher DHA tended to have worse ab/adduction scores ($P = 0.10$). There was no effect of DHA on hoof health. The differences in lying behaviour and locomotion do not imply impaired welfare per se. However, altered lying behaviour could indicate hunger, and impaired locomotion could be a result of a thin digital cushion, which is associated with lameness. This study provides valuable information about how DHA can affect the dairy cow, and can be used to formulate further hypotheses to investigate effects on hunger-satiety status and hoof health.

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1. Introduction

Milk quotas that have been in place in the EU since 1984 are due to be abolished in 2015. In Ireland, where seasonal pasture based dairying systems predominate, this change is expected to facilitate expansion of the dairy industry (Dillon et al., 2008). Indeed it is estimated that milk production in Ireland could increase by 50% by 2020 (Lips and Reider, 2005; DAFM, 2010). This increase will likely be achieved through earlier calving in the spring, higher stocking rates, and increased milk yield per cow (Dillon, 2011).

Pasture refers to land covered with grass and other low lying plants (herbage), which is suitable for grazing animals. Pasture based systems, where animals are fed by allowing them to graze herbage directly, are most efficient when herbage utilisation is maximised so that feed costs remain low (Finneran et al., 2010). Thus, for Irish dairy farms to remain sustainable in the context of increasing milk production, it is imperative that herbage remain the primary source of nutrition for the cow. It follows that in the post-quota era there will be greater demand for herbage in Ireland, in particular during spring. Moreover, keeping animals at pasture during early spring presents an opportunity not only to increase the proportion of grazed herbage in the dairy cow diet, but to improve pasture quality. Early grazed herbage will have subsequent improved quality and structure, resulting in improvements to grazing behaviour, increased dry matter intake, and consequently increased milk production (Kennedy et al., 2007). However, in northwest Europe, herbage growth can be low or extremely variable until late spring, with supply dependant on the prevailing climatic conditions of a given year (Hurtado-Uria et al., 2013). Thus in times of inclement weather, dependence on herbage during the spring in intensive grazing systems could result in nutritional deficits for the cow (Ganche et al., 2013).

Nutritional deficits in early lactation are likely to not only have an impact on production performance (Ganche et al., 2013), but to also have a negative effect on animal welfare because of increased feelings of hunger (Schütz et al., 2006), and risk of health disorders (Collard et al., 2000). Although management at pasture is often perceived as being beneficial for cows due to freedom of movement and a soft underfoot surface (Von Keyserlingk et al., 2009) these systems could yet pose a challenge to cow welfare if demand for herbage exceeds supply. Indeed recent studies have shown that the preference of cows themselves for pasture compared with indoors is partial, and influenced by environmental and/or nutritional factors (e.g. Charlton et al., 2011a, 2011b; Legrand et al., 2009). The ability of an animal to cope with either internal or external challenges is often expressed as a change in behavioural activity (Wechsler, 1995).

As a key animal based measure for assessing dairy cow welfare (Whay et al., 2003), changes to lying behaviour in response to a restricted feed allowance could provide insight into whether the welfare of the cow is affected (Schütz et al., 2013). There is conflicting evidence about how cows adjust lying behaviour in response to reduced feed allowance at pasture. Cows responded to a short term severe (75–50%) feed restriction in early lactation by decreasing time spent lying (Schütz et al., 2013), whereas immediately prior to drying off, a restricted feed allowance caused daily lying time to increase by 1 h (Tucker et al., 2009). During mid to late lactation, O'Driscoll et al. (2010a) found that daily herbage allowance (DHA) of cows at pasture did not affect daily lying time, but it did affect the pattern of lying. Cows allocated a lower DHA had an increased latency to lie down after morning milking than cows with a high DHA (O'Driscoll et al., 2010a), probably driven by longer grazing bouts at that time (O'Driscoll et al., 2010b).

As well as any immediate effects of nutritional restriction on lying behaviour, there are also potentially longer term consequences. Cows naturally lose condition in early lactation, and this can be exacerbated when they are fed below their nutritional needs. There is a positive association between time spent lying and BCS (Matthews et al., 2012). Thus even relatively minor nutritional deficits, which may only result in condition loss when applied for a relatively long period of time, could affect lying time if cows spend more time feeding (Matthews et al., 2012). It is possible that as well as changes to total daily lying time, nutritional deficits could result in changes to the pattern of lying over the course of the day.

As well as affecting animal behaviour, nutritional deficit in early lactation could have a negative effect on cow locomotory ability. A low feed allowance can lead to reduced body condition score (BCS; Meikle et al., 2014), which in early lactation (up to 10 weeks post-partum) is associated with a thin digital cushion (Bicalho et al., 2009). This in turn has been identified as a risk factor for lameness (Hoedemaker et al., 2009). Specifically, the prevalence of sole ulcers and white line disease are significantly associated with thickness of the digital cushion (Bicalho et al., 2009). Lameness has been identified as one of the most serious threats to dairy cow welfare in the EU due to its widespread occurrence, and the pain that the individual cow experiences (EFSA, 2009). Thus current or emerging management strategies that could pose a risk factor for lameness should be avoided where possible.

This experiment investigated how DHA affected dairy cow lying behaviour and locomotory ability. It was expected that cows provided with a range of DHAs would have similar daily lying times, but that the pattern of lying would differ. We hypothesised that this would be demonstrated by increased latency to lie after milking for cows on a low DHA, and more time spent lying per hour during the night and early morning after the allowance was consumed. This would drive a shift towards longer, but fewer, lying bouts as feed allowance decreased. We also expected that as feed allowance decreased, cows would exhibit signs of impaired locomotory ability. Finally, we expected that any changes to cow behaviour or locomotory ability would be more pronounced the longer dietary restrictions were imposed.

2. Materials and methods

The study animals were located at the 'Moorepark' research farm, part of the Teagasc Animal & Grassland