Pasture feeding improves the nutritional composition of milk

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Summary

- Pasture feeding has a beneficial effect on the nutritional composition of milk and dairy products.
- A total mixed ration diet (TMR) increases milk yield.
- Pasture feeding resulted in milk with increased concentrations of true protein and fat, with increased content of Omega-3 fatty acids and other beneficial nutrients.
- TMR feeding resulted in milk with increased contents of Omega-6 fatty acids and palmitic acid; the latter increases the hardness of high fat products such as butter.
- Fresh pasture feeding produced butter with a characteristic "golden" yellow colour due to increased intake of ß-carotene in fresh grass.

Introduction

It is estimated that 10% of the global bovine milk supply is derived from pasture-based feeding systems. This allows Irish dairy manufacturers to capitalize on recent consumer trends for healthier more natural food products. There has been a recent surge in the availability of "Grass-fed" dairy products, often commanding a premium price. Recent research has shown that the typical Irish cow diet is composed primarily of pasture, accounting for 96% of the diet on a fresh matter basis and 82% on a dry matter basis. The objective of the *"Profiling Milk from Grass"* project carried out at Teagasc Moorepark was to compare milk and dairy products derived from cows fed pasture (perennial ryegrass and perennial ryegrass with 20% white clover) and total mixed ration diets.

Experimental design

Fifty four spring calving Friesian cows were allocated to one of three experimental treatments (n = 18 per treatment):

- Cows were housed indoors and fed a total mixed ration diet (TMR).
- Cows were maintained outdoors and grazed a perennial ryegrass (*Lolium perenne* L.) only pasture (GRS).
- Cows were maintained outdoors and grazed a perennial ryegrass/white clover (Trifolium repens L.) pasture (CLV).

Cows on the TMR were offered, on a DM basis, 7.15 kg of grass silage, 7.15 kg of maize silage and 8.3 kg concentrates daily. Cows on the two pasture-based systems were stocked at 2.74 cows/ha and were offered a pasture allowance of ~18 kg DM per day (> 4 cm). The CLV sward contained an average of 20% white clover across the grazing season. Milk fat and protein concentrations were determined weekly from one successive evening and morning milking. Milk solids yield (kg) was calculated as the yield of milk fat plus the yield of milk protein. Bulk milk samples were collected after the morning milking weekly throughout lactation. Bulk milk samples were also collected for the production of mid-lactation sweet cream butter and at the beginning of late-lactation for Cheddar cheese. In order to obtain a representative sample of milk, the cows in each of the three feeding systems were milked separately into designated 5,000 L refrigerated tanks.

Results and Discussion

Total mixed ration feeding resulted in higher annual milk yield and MS yield than the GRS and CLV treatments (Figure 1). Clover inclusion in the diet increased MS yield by 39 kg MS per cow compared with the GRS treatment. The TMR treatment had greater daily MS yield than both the GRS and CLV treatments.

The GRS feeding system produced milk with greater concentrations of fat (4.65% *v.* 4.39%) and crude protein (3.65% *v.* 3.38%) compared to the TMR system (Figure 1). Moreover, the GRS feeding system produced milk with increased true protein concentrations compared to the TMR system (3.46% *v.* 3.19%). The inclusion of CLV appeared to produce milk with comparable compositional concentrations to that of GRS, but CLV had greater non-protein nitrogen (NPN) compared with GRS and TMR.

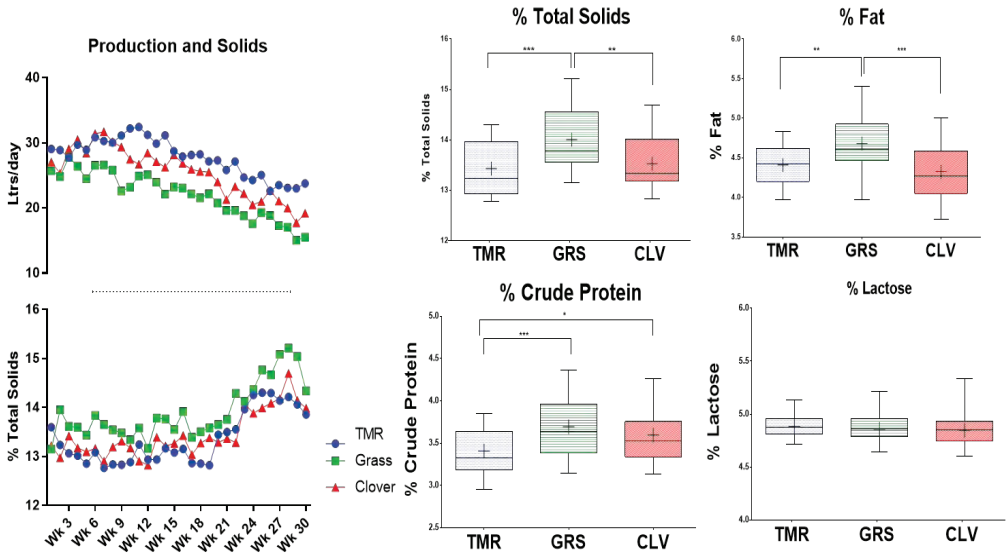

Figure 1. *Milk production and composition from pasture and TMR cows throughout an entire lactation*

The impact of pasture vs TMR feeding on the fatty acid profile of milk is presented in Figure 2. Pasture feeding beneficially altered the nutritional status of milk, with approximately double the concentration of the healthy fatty acid cis-9, trans-11 conjugated linoleic acid (CLA). In addition, pasture feeding systems resulted in significantly greater contents of Omega 3 fatty acids and significantly lower contents of Omega 6 fatty acids than that of TMR milk. The collective changes in fatty acid composition resulted in pasture-derived milk samples having a more favourable thrombogenic index (an indicator of likely impact on human health) compared with TMR derived milk. Feeding system resulted in similar changes in the fatty acid (FA) composition of sweet cream butter. These alterations contributed to differences in textural, thermal, sensory and volatile properties of butter. Pasture-derived (GRS and CLV) butter had more favourable nutritional characteristics, including lower thrombogenecity scores and significantly greater concentrations of CLA and β-carotene.

Sensory panellist data for butter derived from the different feed systems identified several favourable attributes for the GRS butter, including "liking" of appearance, flavour and colour. The nutritional composition of Cheddar cheese was also improved through pasture-based feeding systems, with significantly lower thrombogenicity index scores and a greater than two-fold increase in the concentration of vaccenic acid and CLA, wheras

TMR derived cheeses had significantly greater palmitic acid content. Pasture derived Cheddar cheese had greater Omega 3 fatty acid content, while TMR cheeses had greater Omega 6 fatty acid content. The consumption of CLA has been associated with several potential health benefits, with recommended intake of 0.8 g CLA d per day. Adjusting for the mean fat content of the cheese derived from the different feeding treatments, 100 g of Cheddar cheese from TMR would provide 0.15 g of CLA, 100 g of CLV cheese would provide 0.35 g of CLA whereas 100 g of GRS derived Cheddar cheese would provide 0.44 g of CLA. The alterations in the FA profile also resulted in pasture derived cheese having reduced hardness scores at room temperature. Both feeding system and ripening time had a significant effect on the volatile and sensory profile of Cheddar cheese.

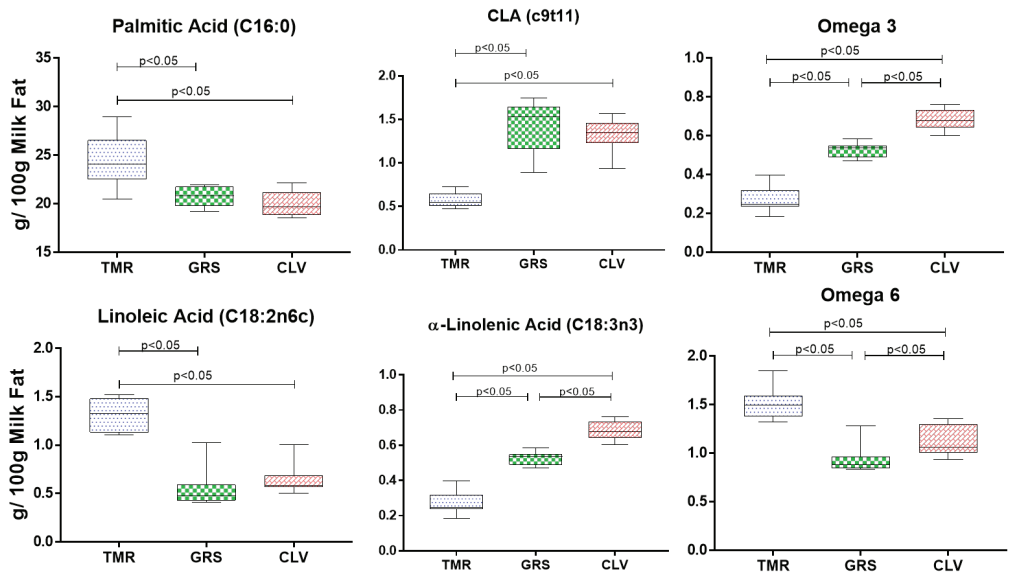

Figure 2. *Impact of pasture vs TMR feeding on the fatty acid profile of milk*

Conclusions

Cow feeding system has a significant effect on milk yield and milk solids yield. Pasture derived milk has significantly higher concentrations of total solids, driven by increased levels of fat and true protein. Pasture feeding has a beneficial effect on the nutritional profile of milk, with significantly higher concentrations of Omega-3 fatty acids, CLA, ß-carotene and other beneficial nutrients.