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Concentrate feeding for growing and finishing cattle

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Summary

- Small improvements in feed (cost) efficiency can have a relatively large influence on farm profitability.
- Increasing the level of concentrates in the diet reduces forage intake and increases live weight and carcass weight gains, although at a diminishing rate.
- Subsequent compensatory growth at pasture diminishes the advantage of concentrate supplementation of young cattle.
- High digestibility grass silage with moderate concentrate supplementation can sustain a large proportion of the performance achieved on high concentrate diets.
- Feeding management is more important when feeding concentrates *ad libitum* than as a supplement.
- Comparisons of feedstuffs should be based on their energy and protein values.

Introduction

Due to the considerably lower comparative cost of grazed grass as a feedstuff, beef production systems should aim to increase animal output from grazed grass. Nevertheless, the main feed costs on beef farms relate to indoor (winter) feeding periods, and especially feeding of finishing cattle. This means that even small improvements in feed (cost) efficiency at these times has a relatively large influence on farm profitability. For example, within grass-based, suckler calf-to-beef steer systems on research farms, grazed grass, grass silage and concentrates account for 66%, 27% and 7% of the annual feed budget, respectively. When this feed budget is expressed in terms of cost (land charge included), the outcome is very different: grazed grass, silage and concentrates account for 44%, 39% and 17% of the total annual feed costs, respectively. Economic sustainability of beef production systems therefore depends on optimising the contribution of grazed grass to the lifetime intake of feed, and on providing silage and concentrate as efficiently and at as low a cost as feasible.

Feeding concentrates: key principles

The role of concentrates is to make up the deficit in nutrient supply from forages in order for cattle to reach performance targets. Indeed, in situations where there is a shortage in winter supplies of forage, it may be better to buy concentrates and feed less forage rather than to purchase expensive low-quality forage. Comparisons on feedstuffs should always be based on their net energy (& protein) values on a dry matter (DM) basis. It is important to ensure that adequate levels of an appropriate mineral/vitamin mix are included in the ration.

Dry matter digestibility (DMD) is the primary factor influencing the nutritive value of forage and consequently, the performance of cattle. Low DMD forage means higher levels of concentrate supplementation have to be used to achieve the same growth rates or performance (Table 1). Increasing the level of concentrates in the diet reduces forage intake (substitution rate) and increases live weight and carcass weight gains, although at a diminishing rate. Production response to concentrate supplementation is higher with forages of lower DMD and in high growth potential animals. Animal response to concentrate supplementation at pasture primarily depends on the availability and quality of pasture and level of supplemented concentrate. Increasing concentrate supplementation reduces the importance of forage nutritional value, especially so when feeding concentrates *ad libitum* (to appetite). The optimal level of concentrate supplementation primarily

depends on animal production response (kg gain/kg concentrate), forage substitution rate and the relative prices of animal product and feedstuffs.

Concentrate feeding: indoors

Weanling cattle

To minimise feed costs and exploit subsequent compensatory ("catch-up") growth at pasture during the following grazing season, live weight gains of 0.5-0.6 kg/day through the first winter is acceptable. Due to compensatory growth, there is little point in over-feeding weanlings during the first winter. However, cattle growing too slowly (<0.5 kg/day) during winter will not reach target weights. This target animal performance level can be achieved on grass silage supplemented with concentrates as outlined in Table 1.

Finishing cattle

Efficiency of feed utilisation by finishing cattle primarily depends on weight of animal (decreases as live weight increases), potential for carcass growth (e.g. breed type, gender, compensatory growth potential) and duration of finishing period (decreases as length increases). Even high quality grass silage is incapable of sustaining adequate growth rates to exploit the growth potential of most cattle so concentrate supplementation is required. Each 1 unit decline in DMD of grass silage requires an additional ~0.33 kg concentrate daily to sustain performance in finishing cattle. Concentrate supplementation rates for finishing steers to achieve ~1.0 kg live weight/day with grass silage varying in DMD are shown in Table 1. Correspondingly, the supplementation levels recommended in Table 1 should be reduced by about 1.5 to 2.0 kg for finishing heifers (lower growth potential) and increased by about 1.5 to 2.0 kg for finishing bulls (higher growth potential). Where silage DMD is poor (e.g. 60%) and/or in short supply, and animal growth potential is high, feeding concentrates *ad libitum* should be considered. However, when feeding concentrates *ad libitum*, particularly cereals, there is a risk of acidosis. Therefore, it is critical to ensure; (i) gradual adaptation to concentrates, (ii) minimum roughage inclusion (~ 10% of total DM intake) for rumen function, (iii) meal supply never runs out and, (iv) a constant supply of fresh water is provided.

Table 1. Concentrate supplementation (kg/day) necessary for weanlings to grow at ~0.5 kg and for finishing steers (600 kg) to grow at ~1.0 kg live weight/day, when offered grass silage of varying dry matter digestibility (DMD) to appetite.

Grass silage DMD (%)	~60 (9.6ME)	~65 (10.4ME)	~70 (11.2ME)	~75 (12.0ME)
Weanlings	2.0-3.0	1.5-2.0	1.0-1.5	0-1.0
Finishing steers	*Ad lib*	7.0-8.0	5.5-6.5	4.0-5.0

Concentrate type

Energy is the most important nutrient required by growing-finishing cattle. In addition to cereals, a wide variety of feed ingredients is available and used extensively in beef rations. Indoor feed costs could be reduced through utilisation of alternative (more cost effective) feed ingredients.

Supplementing grass silage for growing cattle

Two recent experiments at Teagasc, Grange examined the effects of replacing rolled barley (i.e., starch-based feed) with soya hulls (Experiment 1) or citrus pulp (Experiment 2), (i.e. digestible fibre-based feeds) in a concentrate supplement on intake and performance of young growing suckler-bred male weanling cattle offered grass silage to appetite. In Experiment 1, they were offered 1.7 kg DM, once daily, of one of two concentrate supplements: barley/soyabean-based (862 g rolled barley, 60 g soya bean meal, 50 g molasses, 28 g minerals and vitamins/kg) and soya hulls-based (933 g soya hulls; 50 g molasses; 17 g minerals and vitamins/kg). In Experiment 2, they were offered 1.6 kg DM, once daily, of one of two concentrate supplements; barley/soyabean-based (same formulation as above) and citrus pulp-based (855 g citrus pulp, 80 g soya bean meal, 53 g molasses, 12 g minerals and vitamins/kg). Concentrates were prepared as coarse mixtures and formulated to have similar concentrations of protein (PDIE) on a DM basis. Concentrate supplement type did not significantly affect daily grass silage intake, live-weight gain, final live weight, ultrasonically assessed body composition or measurements of skeletal size. In conclusion, at the levels of supplementation used in these experiments, soya hulls and citrus pulp can replace barley in concentrate supplement for growing cattle offered grass silage, without negatively affecting performance. Implications are that

beef farmers have the opportunity to source alternative (cost-effective) feed ingredients as supplements to grass silage.

Concentrate feeds for growing-finishing cattle
Studies at Teagasc, Grange showed that carcass weight gains and efficiency of feed conversion to carcass were similar for rolled barley and wheat offered as supplements to grass silage. In addition to cereals, a wide variety of other feed ingredients are available.

Research at Teagasc, Grange has also shown that cattle offered concentrates formulated to have similar energy and protein levels but contrasting feed ingredients had similar intake, growth, feed efficiency and carcass traits. Ingredients ranged from, rapidly fermented starch (barley-based), to slowly fermented starch (maize-based), to rapidly fermented starch + fibre or fibre only (pulps-based) and, were offered either as a 5 kg/day supplement to grass silage or *ad libitum* (plus 5 kg fresh weight grass silage daily). This means that net energy (and protein) levels of beef rations are more important than ingredient content *per se.*

Processed maize grain is usually included in cattle rations to increase performance and, mainly due to anecdotal evidence, to increase the rate of fat deposition, and thus achieve earlier 'finish'. The effect of replacing half the barley in a barley-based concentrate ration with maize meal (plus sufficient soyabean meal to ensure adequate dietary protein) on the performance of young dairy bulls and suckler bulls offered concentrates *ad libitum* over 170 and 86 days, respectively, was evaluated at Grange. In the dairy bull study, intake was higher for the maize meal-based ration but there was no difference in carcass weight between the two rations. Conversely, in the suckler bull study, intake was similar between the two rations but carcass weight was higher for the maize meal-based ration. Maize meal inclusion in the diet did not enhance carcass fat deposition in either study. Additionally, flaked-toasted maize was evaluated in the suckler bull study; animal intake, growth and carcass traits did not differ from the barley-based control ration.

Intake and performance of beef cattle offered a barley-based ration with increasing levels of inclusion of maize or wheat dried distillers grains as a supplement to grass silage ('growing phase') and, subsequently, to appetite ('finishing phase') were evaluated. The concentrates assessed were: a barely-soya 'control' ration (862 g/kg rolled barley, 60 g/kg soya bean meal, 50 g/kg molasses and 28 g/kg minerals and vitamins), and barley-soya based rations where the barley (plus all soya bean meal) was replaced with 200, 400, 600 and 800 g fresh weight maize dried distillers or wheat dried distillers grains/kg. Steers were individually offered 3 kg DM of the respective concentrates as a supplement to the moderate DMD grass silage offered to appetite over a 7—day growing phase and, following a 26-day dietary adaptation period, were offered the same concentrates *ad libitum* plus 3 kg fresh weight grass silage during an 86-day finishing phase. Results showed that maize dried distillers grains had a superior feeding value (based on dietary feed conversion ratio) to wheat dried distillers grains at both concentrate feeding levels. Both maize and wheat dried distillers grains had a superior feeding value compared to the barley-soya based control ration when offered as a supplement; however, this superiority was not evident when the concentrate was offered to appetite. Under the conditions of this study, results indicated that the optimal inclusion level of dried distillers grains in the concentrate was about 800 g/kg when the concentrate ration was offered as a supplement to grass silage and about 200 g/kg when the ration was offered *ad libitum.* Thus, the feeding value of dried distillers grains was a function of their inclusion level in the concentrate and whether the concentrate was offered as a supplement to grass silage or offered to appetite with restricted grass silage. These latter findings imply that the relative economic value of by-product feed ingredients is contingent on the feeding system.

Protein supplementation
Weanling and finishing, steers and heifers, generally do not require protein supplementation when fed barley-based concentrates and high DMD grass silage, but for suckler bull weanlings, recent research at Grange showed a small response to protein supplementation. However, all cattle are likely to respond to supplementary protein in barley-based concentrates when grass silage has moderate to low DMD and /or low protein content, especially weanling heifers and steers, and young bulls.

Concentrate feeding: grazing
Carcass growth response to concentrate supplementation at pasture is higher where grass supply is low and where grass quality if poorer and, usually declines as concentrate supplementation level

increases. Studies at Grange have shown that at adequate (~20 g DM/kg live weight) grass allowances in autumn, feeding ~0.50-0.75 kg of concentrate per 100 kg live weight resulted in carcass growth response in steers between 30 and 110 g carcass per kg concentrate. In practice, feeding this moderate level of concentrates will likely result in carcass growth responses at the upper end of this range.

For grazed grass, dietary energy rather than protein is the limiting factor and supplementation with concentrate energy sources is required. Three studies at Grange showed that cattle performance was similar for starch-based (barley) or fibre-based (pulp) concentrates as supplements to autumn grass.

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