Efficient beef production from temperate grasslands in north-western Europe

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Introduction

Ireland's cool temperate maritime climate is conducive to grass growth and, as a result, ruminant livestock systems have evolved that maximise both grazed pastures and conserved grassland forage as winter feed. Most Irish pastures are permanent, capable of achieving high herbage production (Keating and O'Kiely 2000) and, accordingly, supporting intensive livestock production systems. Most male progeny from the 1.1 million Irish dairy herd are reared as steers, typically slaughtered at 24-26 months of age. Approximately 85% of dairy calves available for beef production are spring-born, usually in February/March (AIMS 2011). The progeny of Holstein-Friesian (Ho/Fr) sires account for 0.5-0.6 of the calf crop, with 0.6 and 0.4 of the remainder being sired by early-maturing (EM; *e.g.* Aberdeen Angus, Hereford) or late-maturing (LM; *e.g.* Limousin, Belgian Blue, Charolais) sires, respectively. This paper summarises some of the main grassland-based steer beef production systems applicable to Ireland.

Material and methods: systems description

Grass-based, dairy calf-to-beef steer production systems, using Ho/Fr, EM or LM sired calves, developed and evaluated at Teagasc, Grange Beef Research Centre (53°30'N, 6°39'W) are used. Calves are artificially reared with an inputs of 25 kg milk replacer, and concentrates inputs of 80 kg in the indoor rearing period and, typically 60 kg at pasture in the first grazing season, 110 kg in the first winter and 750 kg in the finishing winter. Grazed swards (>25 years old) were predominantly *Lolium perenne* with grass silage being harvested from newer (5-10 years old) *Lolium perenne* pastures. The grazing season for yearling animals was from mid-March (start of grass growing season) to mid-late October, and for weaned calves from mid-May to mid-November. Calves graze ahead of the yearling animals in a leader-follower grazing system (Keane et al., 2007). At the end of the grazing season all animals are housed indoors. Grass silage harvested within the production system is the sole winter forage and is supplemented with 1-2 kg of concentrate daily during the first winter and, depending on the animal slaughter age, 300-900 kg concentrates during the finishing period. In less intensive, lower stocking rate systems (<170 kg organic N/ha) grass silage is provided in one harvest where 0.50-0.55 of the farm is cut in early-June. Intensive systems of production require two silage harvests, with approximately 0.45 and 0.30 of the farm being cut in early-June and late-July, respectively. Animal manures produced during the housing periods are recycled to the areas used for silage production. Four beef production systems are described conforming to the European Union Nitrates Directive that limits organic nitrogen (N) outputs to less than 170 kg N/ha. A further system is described where organic N output exceeds 170 kg N/ha. The BEEF Greenhouse gas (GHG) Emissions Model (Crosson *et al.* 2011) was used to estimate emissions.

Results and Discussion

Target live weights of steer systems slaughtering Ho/Fr at 24- and EM at 22-months of age are 80, 230, 300, 490 and 620 (Ho/Fr) or 570 (EM) kg when calves are first turned out to pasture, housed in November, returned to pasture as yearlings, rehoused in October and at slaughter, respectively. For LM steers, corresponding live weights are 90, 240, 320, 510, and 650 kg. When slaughtering at 21-months the equivalent target live weights are 100, 240, 330, 490 (in mid-September when concentrate supplements are added) and 550-570 kg at slaughter and the system is more suited to calves born early in the season. Inputs and outputs for the different systems described are presented in Table 1. Grazed grass amounts to 2.45-2.55 t DM/animal unit (AU) (calf plus yearling). Winter grass silage accounts for 0.6 t DM/AU (for 21-month finishing) to 1.46 t DM/AU (24-month finishing of LM steers). Depending on the production system concentrate input ranges from 620-1150 kg/AU. Stocking rates vary from 1.8 AU/ha for more extensive systems, to almost 2.9 AU/ha for more intensive systems, with corresponding organic N outputs of 146 to 232 kg/ha. Chemical N application rates range from 93-217 kg N/ha/year.

Overall lifetime daily live weight gain approximates to 0.8 kg and carcass output ranges from 576 to 1000 kg/ha. The greenhouse gas (GHG) emissions from dairy beef production systems ranged from 13 to15 kg CO_2e/kg beef carcass.

Table 1. Inputs and outputs for a range of dairy calf-to-beef steer systems

	24-Mts LM	21-Mts LM	24-Mts Ho/Fr	24-Mts EM	Intensive 24-Mts LM
Concentrate input (kg/animal unit(AU; AU = calf to slaughter))	1000	620	1000	670	1150
Grazed grass (kg DM/AU)	2450	2550	2450	2450	2450
Silage usage (kg DM/AU)	1460	600	1460	1050	1100
Land (ha/animal unit)	0.55	0.40	0.55	0.47	0.35
Animal units/ha	1.8	2.5	1.8	2.1	2.86
Organic Nitrogen output (kg/ha/year)	146	167	146	149	232
Chemical Nitrogen (kg/ha/year)	114	93	114	105	217
Age at slaughter (days)	730	637	730	667	730
Daily gain; birth to slaughter (kg/day)	0.82	0.79	0.79	0.79	0.81
Slaughter weight (kg)	650	570	620	570	640
Carcass weight (kg)	350	300	320	295	350
Carcass output (kg/ha)	630	750	576	620	1000

Conclusions

Well managed permanent pastures are capable of high animal output/unit area. Production systems operating within EU Nitrate Directive limits are capable of producing ca.580-750 kg carcass/ha, while more intensive grassland-based systems have the capacity to produce up to 1000 kg carcass/ha. GHG emissions for these production systems were typically 13-15 kg CO_2e/kg beef carcass produced.

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