Irish Journal of Agricultural and Food Research **44:** 195–204, 2005

Post-weaning performance and carcass characteristics of steer progeny from different suckler cow breed types

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In two experiments a total of 44 steer progeny of spring-calving Charolais (C) and Hereford × Friesian (HF) suckler cows and C sires were slaughtered at approximately 2 years of age. Following weaning they were offered silage and 1 kg of concentrate per head daily during a 5 month winter after which they spent 7 months at pasture. In Experiment 1, animals were given a silage/concentrate diet during a finishing period of either 95 or 152 days. In Experiment 2, steers were offered either a daily diet of silage plus 6 kg of concentrates or concentrates to appetite plus 5 kg of silage (fresh weight) during the final 140-day finishing period. Following slaughter, an 8-rib pistola from each animal was dissected. For the two experiments combined C and HF progeny had carcass weights of 372 and 385 (s.e. 6.1) kg, proportions of carcass as pistola of 467 and 454 (s.e. 2.8) g/kg and pistola meat proportions of 676 and 642 (s.e. 5.1) g/kg, respectively. All fat traits were lower for the C than HF progeny but there was no difference in carcass conformation score. Increasing slaughter weight increased carcass weight ($P < 0.001$), kidney plus channel fat weight ($P < 0.001$), and pistola fat proportion ($P < 0.001$) and decreased the proportions of carcass as pistola ($P < 0.05$), pistola meat ($P < 0.01$), and bone ($P < 0.05$). In conclusion, breed type had no effect on carcass growth but the C progeny had higher meat yield than the HF. Increasing slaughter weight increased fatness and reduced meat yield.

Keywords: Carcass composition, carcass growth, dam breed type

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Introduction

Suckler cows account for 50% of the total cow herd in Ireland (Central Statistics Office, 2003). In the past, beef × Friesian heifers from the dairy herd were an important source of suckler herd replacements but increasingly replacements are retained from within the suckler herd (McGee, Drennan and Caffrey, 2005a). This breeding policy is leading to an increasing proportion of Charolais genes (as Charolais is the most widely used sire breed) in the suckler herd. McGee, Drennan and Caffrey (2005b) found that upgraded Charolais cows had milk production levels which were only two-thirds that of beef × Friesian (BF) and their progeny had significantly lower pre-weaning live-weight gain. Miller, Wilton and Pfeiffer (1999) reported that increased milk yield was significantly associated with increased pre-weaning gain and increased carcass weight but had no significant effect on carcass weight per day of age at slaughter despite a positive trend. They obtained a response of 21.5 g of live weight per day per 1 kg increase in daily milk yield during the pre-weaning period but only an extra 3.7 g carcass per day of age per 1 kg increase in daily milk yield. Milk yield was, however, positively and significantly associated with gross margin from birth to slaughter. Lewis *et al.* (1990) found that increased weaning weight due to increased milk production had no effect on post-weaning performance in either intensive or extensive finishing systems. Increased milk yield increased weaning weight and efficiency to weaning in the cow-calf sector (Marshall, Parker and Dinkel, 1976; Freking and Marshall, 1992) but conflicting results were obtained when efficiency through to slaughter was considered. In fact, increased milk yield has been shown both to decrease (Cartwright, 1970; Montano-Bermudez and Nielsen, 1990) and increase (Brown and Dinkel, 1982) efficiency to slaughter. The studies of Notter *et al.* (1979), Bourdon and Brinks (1987) and Miller *et al.* (1999) showed that the optimum level of milk yield increased as feedlot feed costs increased relative to cow herd feed cost.

The objectives of the present experiments were (1) to compare the growth and carcass composition of the steer progeny of Charolais and Hereford × Friesian cows taken to slaughter at 2 years of age, and (2) to examine the effects of slaughter weight, obtained either by altering the duration of the final finishing period (Experiment 1) or the level of concentrate feeding during this period (Experiment 2), on carcass composition.

Materials and Methods

Animal management

In each of two years upgraded Charolais (C) cows and Hereford × Friesian (HF) cows were bred using two C sires each year. The calves were spring-born and grazed with their dams at pasture until weaning at 7 to 9 months of age (McGee *et al.*, 2005b). They were offered grass silage to appetite plus 1 kg of concentrates per head daily during the winter period, from about 8 to 13 months of age, following which they were put to pasture for a second grazing season of about 7 months. At the end of the second grazing season the animals were offered either grass silage/concentrate or high concentrate diets during a final finishing period. The composition (g/kg) of the concentrate offered on all occasions was rolled barley (915), soyabean meal (70) and minerals/vitamins (15). Animals were weighed regularly throughout their lives and at the start and end of the finishing period.

Experiment 1

During the finishing period the steers were offered grass silage to appetite plus concentrates for either 95 days (S) or 152 days (L) giving two breed types and by two slaughter weights (resulting from different finishing periods).

The number of animals was 4, 4, 7 and 3 in treatments CS, CL, HFS and HFL, respectively. At housing the steers were offered grass silage to appetite and the daily allowance of concentrates was gradually increased to 6 kg/head. The animals were accommodated in a slatted floor shed. Fresh silage was offered daily and refusals were discarded twice weekly. A number of different grass silages were used during finishing but all animals received the same silage at the same time. Prior to the first slaughter date the progeny of each cow breed type were paired according to live weight from which they were randomly assigned to the short (S) or long (L) finishing period.

Experiment 2

During the final 140-days of the finishing period the steers were offered either a grass silage/concentrate (6 kg concentrates per head daily = M) diet or concentrates to appetite (H) plus 5 kg of silage per head daily resulting in two breed types and two (M or H) feeding levels. The number of steers in treatments CM, CH, HFM and HFH was 6, 5, 8 and 7, respectively. Within each cow breed type the progeny were paired according to sire used and live weight with one of each pair randomly assigned to each feeding treatment. They were accommodated according to feeding treatment in a slatted-floor shed. Following housing the animals were offered grass silage (208 g/kg dry matter (DM), 673 g/kg *in vitro* dry matter digestibility (DMD) and pH 3.7) *ad libitum* and the daily concentrate allowance was gradually increased to 6 kg per head. The animals were then assigned to their experimental diets with Treatments CM and HFM remaining on silage plus 6 kg of concentrates per head daily while the daily concentrate allowance was gradually increased and silage decreased until those in Treatments CH and HFH were receiving concentrates to appetite and 5 kg (fresh weight) of silage per head daily. Fresh silage was offered daily and refusals (for those offered silage to appetite) were weighed and discarded twice weekly. The daily concentrate allowance for M was given in one feed. Animals receiving concentrates to appetite were offered fresh concentrates daily with refusals weighed and discarded weekly.

Concentrate DM intakes averaged 7.7 and 8.5 kg DM daily for C and HF progeny, respectively. Corresponding values for silage DM were 2.7 and 2.5 kg. Steers offered the H and L diets had concentrate DM intakes of 11.0 and 5.2 kg per day and silage DM intakes of 0.9 and 4.2 kg daily, respectively.

Carcass evaluation

Hot carcass weight was recorded and cold carcass weight was estimated as 0.98 of hot carcass weight. Kill-out rate was calculated as cold carcass weight relative to pre-slaughter live weight. Carcass weight gain over the finishing period was estimated assuming that initial carcass weight was initial live weight × 0.53. Carcass produced per day of age was calculated by dividing cold carcass weight by the age of the animal. Kidney and channel fat weights were recorded for each animal. Carcass conformation and fat scores were assessed, according to the EU Beef Carcass Classification Scheme (Commission of the European Communities, 1982), by trained staff of the Department of Agriculture, Food and Rural Development.

After a 24-h chilling period (4 °C), the right side of each carcass was sectioned to provide an 8-rib pistola hind quarter. This was divided into four joints – distal pelvic limb, proximal pelvic limb, lumbar area and ribs, each of which was then separated into subcutaneous fat, intermuscular fat, bone, meat and other tissue (Williams and Bergstrom, 1980). The subcutaneous and intermuscular fats were combined and the other tissue included with bone in the statistical analyses.

Statistical analysis

The data from both years were analysed as a single experiment using PROC GLM (SAS, 1999). The effects included in the model were year, breed, slaughter weight, breed × slaughter weight, breed × year and slaughter weight × year interactions. Least squares means are reported with standard errors.

Results

The progeny of C cows had lower ($P < 0.01$) weaning weight and lower ($P < 0.05$) slaughter weight than the HF progeny (Table 1). However, the C progeny had higher ($P < 0.01$) kill-out rate so there was no significant difference in carcass weight between the progeny of the two cow breed types. Total lifetime daily live-weight gain of the C progeny was lower ($P < 0.05$) than that of the HF progeny but there was no effect on carcass produced per day of age. Progeny of C cows had lower ($P < 0.001$) kidney plus channel fat weight and lower ($P < 0.01$) fat score than HF progeny. There was no effect of cow breed type on carcass conformation score. The progeny of C cows had a higher ($P < 0.01$) proportion of pistola in the half carcass, a higher weight ($P < 0.05$) and proportion ($P < 0.001$) of pistola meat and a lower weight ($P < 0.001$) and proportion ($P < 0.001$) of pistola fat than the HF progeny (Table 2). There was no effect of cow breed type on the weight of individual joints within the pistola or meat distribution in the pistola. While there were significant interactions between cow breed type and slaughter weight for kidney plus channel fat weight and meat distribution in the distal and proximal pelvic limbs these were of little commercial importance. Likewise, interactions between cow breed type and year for pistola bone proportion and meat distribution in the distal and pelvic limbs were small and of little commercial significance.

Animals which were heavier at slaughter, due either to extending the finishing period (Experiment 1) or providing a higher feeding level during finishing (Experiment 2), had heavier ($P < 0.001$) slaughter weight and carcass weight, higher ($P < 0.001$) kidney plus channel fat weight, higher ($P < 0.001$) live-weight and carcass weight gain during the finishing period, a lower ($P < 0.05$) proportion of carcass as pistola, a lower ($P < 0.01$) proportion of meat, a higher ($P < 0.001$) proportion of fat and a lower ($P < 0.05$) proportion of bone in the pistola, more ($P < 0.001$) meat in the lumbar area and less ($P < 0.001$) in the proximal pelvic limb than those lighter at slaughter. There was no effect of slaughter weight on carcass fat or conformation scores.

There were interactions between slaughter weight and year for weights and weight gains which was largely attributed to the different feeding programmes imposed in the two years. Delaying slaughter date in Year 1 increased slaughter weight but reduced weight gain per day both for the finishing period and for the entire lifetime of the animal.

Discussion

In the present study carcass produced per day of age was similar for the progeny of

Table 1. Least squares means for growth and carcass traits of the steer progeny of Charolais (C) and Hereford × Friesian (HF) cows slaughtered at two weights

Variable	Breed of dam (B)		Slaughter weight (S)		s.e.	Significance[4]				
	C	HF	Moderate	Heavy		B	S	Year (Y)	B × S	Y × S
Birth weight (kg)	49.0	48.4	49.4	48.0	1.57					
Weaning weight (kg)	304	330	316	317	7.1	**				
Start of finishing weight (kg)	597	602	600	599	4.7					
Slaughter weight (kg)	677	710	670	718	10.1	*	***			*
Carcass weight (kg)	372.2	384.6	363.3	393.5	6.1		***			*
Kill-out rate (g/kg)	550	542	543	549	2.1	**				
Kidney + channel fat (kg)	10.1	15.1	11.0	14.3	0.56	***	***	*	*	
Carcass fat score[1]	3.57	4.01	3.74	3.84	0.110	**				**
Carcass conformation score[2]	3.53	3.39	3.33	3.58	0.120			*		*
Finishing period variables										
Duration of period (days)	132	132	118	146						
Live-weight gain (kg)	115.1	127.5	94.7	147.8	6.0		***	***		*
Live-weight gain (g/day)	876	953	816	1023	45.9		**	**		***
Carcass gain (kg)[3]	74.6	76.0	59.0	91.6	3.45		***	***		**
Carcass gain (g/day)	568	580	515	633	27.0		**	*		***
Total lifetime variables										
Age (days)	729	733	717	745	4.7		***	*		***
Live-weight gain (g/day)	861	903	865	899	13.6	*				***
Carcass produced (g/day of age)	511	525	507	529	8.3					***

[1]Scale 1 to 5 (5 = fattest).
[2]Scale 1 to 5 (5 = best conformation).
[3]Calculated by assuming a kill-out rate of 530 g/kg at the start of the finishing period.
[4]There was no significant B × Y interaction.

Table 2. Least squares means for pistola weight, composition and meat distribution for the steer progeny of Charolais (C) and Hereford × Friesian (HF) cows slaughtered at two weights

Variable	Breed of dam (B)		Slaughter weight (S)		s.e.	Significance[4]					
	C	HF	Moderate	Heavy		B	S	Year (Y)	B × S	Y × S	B × Y
Pistola weight (kg)	87.0	87.5	84.5	90.0	1.22		**				
Pistola weight relative to carcass weight (g/kg)	467	454	464	456	2.8	**	*				
Weight of pistola joints (kg)											
Distal pelvic limb	11.0	10.8	10.4	11.3	0.19		***	**			
Proximal pelvic limb	50.0	50.1	49.0	51.0	0.82					*	
Lumber area	16.0	16.1	15.0	17.1	0.22		***				
Ribs	9.5	10.0	9.3	10.2	0.19		*				
Pistola composition											
Meat (kg)	58.3	55.6	56.1	57.8	0.98	*				*	
Fat (kg)	13.1	15.8	12.8	16.2	0.51	***	***				
Bone (kg)	14.8	15.2	14.8	15.2	0.19						*
Meat (g/kg)	676	642	670	648	5.1	***	**				
Fat (g/kg)	151	182	153	181	5.2	***	***				
Bone (g/kg)	172	176	178	171	2.3		*				*
Meat distribution in pistola (g/kg)											
Distal pelvic limb	98	99	97	100	1.4				*		**
Proximal pelvic limb	621	618	627	612	2.5		***		*	**	*
Lumber area	182	181	177	186	1.7		***				
Ribs	100	102	99	102	1.5						

the two cow breed types despite the fact that the late maturing C have greater growth potential than the earlier maturing HF (Southgate, Cook and Kempster, 1982; Keane *et al.,* 1990). Considering the heavy carcass weight of the HF progeny (385 kg) and their high fat score it would be expected that their growth rate would have declined during the latter stages of the finishing period which should be advantageous to the later maturing C animals. Numerous studies have shown that milk yield is the most important factor influencing pre-weaning gain of the calf and consequently weaning weight (Drennan, 1971; McGee *et al.,* 2005b). The fact that the superior weaning weight of the HF progeny was not subsequently compensated for by the higher growth potential of the C progeny was probably due to the ability of animals to retain a high proportion of the extra live weight gained early in life in these production systems (Drennan and Harte, 1979). Furthermore, crossbred progeny have a growth benefit, due to hybrid vigour, over the purebreds (Simm, 1998). Miller *et al.* (1999) obtained no significant effect of milk intake during the suckling period on subsequent average daily gain in the feedlot which suggests no compensatory growth, although the recorded trend appeared to be negative (–6.2 g/day in feedlot per 1 kg increase in daily milk yield). Brown and Dinkel (1982), using Angus, Charolais and reciprocal-cross cows and their two- and three-breed cross calves, reported favourable relationships between feed energy per unit output (weaning weight, slaughter weight, retail product yield) and milk production but there was no effect of cow breed type on calf weaning weight or post-weaning gain. The higher kill-out rate of the progeny of the C cows agrees with other investigations which show higher rates for the later maturing breeds than for the earlier maturing breeds and Friesians (Kempster, Cook and Southgate, 1982; More O'Ferrall and Keane, 1990). Although carcass gains of the C and HF progeny were the same during the final finishing period, the C progeny were apparently more efficient as they had lower daily concentrate intake in Experiment 2 than the HF progeny while silage intakes were similar.

Carcass conformation score, while tending to be higher for the C progeny, was not significantly different between the breed types. Similarly, More O'Ferrall and Keane (1990) have shown that conformation score increased with increasing fatness and weight but found no difference in conformation between Hereford × Friesian and Charolais × Friesian steers. These authors attributed the absence of any difference to heavy slaughter weight which resulted in Hereford × Friesian having a very high level of subcutaneous fat. Kempster *et al*. (1982) reported better conformation scores for the suckler herd progeny of C sires than those of Hereford sires when slaughtered at the same fat class which agrees with the greater muscularity of the Charolais breed. In the present study all fat measurements clearly indicated the greater fatness of the progeny of HF compared to that of the progeny of C cows. These results are in agreement with the findings of numerous studies (e.g. Geay and Robelin, 1979; More O'Ferrall and Keane, 1990). The pistola is up to three times more valuable than the forequarter and therefore a high proportion of pistola in the carcass is desirable. The C progeny had a greater proportion of the carcass as pistola which concurs with the results of Kempster *et al*. (1982). The lower proportion of hindquarter in the more mature Herefords would be expected considering the work of Keane and More O'Ferrall (1992), who reported that the hindquarter weight as a proportion of side weight, decreased with increasing maturity as reflected in its allometric regression coefficient of 0.85. The latter authors showed that Simmental × Friesians had a greater proportion of their muscle in the hindquarter than either Friesians or Hereford × Friesian. Newman *et al*. (1994) reported that the progeny of Charolais and Simmental cross dams had a higher proportion of preferred cuts with more lean in the preferred cuts than those from British breed dams. In the present study there was no major effect of breed type on the weight of the various joints of the pistola or the distribution of meat in the pistola. Despite the lower carcass weight (12.4 kg) of the C progeny they had 5.3 kg more pistola meat and 5.4 kg less pistola fat in the total carcass than the HF progeny.

Increasing slaughter weight increased pistola meat and fat weights by 3.4 and 6.8 kg, respectively, showing that in this study two-thirds of the additional boneless weight gain in this final period was fat. There was an interaction between the slaughter weight and experiment in that increasing carcass weight by increasing the duration of the finishing period (Experiment 1) resulted in fat accounting for most of the additional gain while increasing carcass weight by increasing the level of concentrates offered during the finishing period (Experiment 2) resulted in meat accounting for more of the additional gain than fat. Keane and More O'Farrell (1992) reported that extending the finishing period of Friesian and Friesian-cross steers from 121 to 225 days increased side weight by 22 kg of which 10 kg was fat. In agreement with the results of the present study, Steen and Robson (1995) found that a high-concentrate diet resulted in a greater proportion of the extra gain deposited as meat and a lower proportion deposited as fat than with a grass silage/concentrate diet. Although, there is evidence from several studies showing that diets based on grass silage lead to greater fat deposition at a given rate of gain, this effect has not been apparent in all studies (Drennan and Keane, 1987; Steen and Moore, 1988; Keane and More O'Ferrall, 1992; Steen *et al*., 1998).

In the present study increasing slaughter weight reduced the proportion of pistola meat in the proximal pelvic limb and increased the proportion in the lumbar area. This is in general agreement with the findings of Keane *et al*. (1990) who showed that with increasing weight of muscle, the proportion in the limbs and loin decreased while the proportion in the flank, ribs and thorax increased. Despite the large difference in carcass weight there was no effect of diet during the finishing period on the distribution of meat in the pistola.

Conclusions

There was no effect of cow breed type on carcass growth of their progeny but the C progeny had a higher proportion of pistola and a higher meat yield than the HF progeny. The main effect of increasing slaughter weight was to increase the various fat traits while reducing meat yield.

Acknowledgements

Thanks are due to Mr. B. Davis, Mr. T. Darby, and Mr. M. Greally for valuable technical assistance, to Mr. T. Hegarty for statistical analysis, to the staff of Grange Laboratories for feed analysis.

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Received 8 May 2003