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Effect of beef sire expected progeny difference for carcass conformation on live animal muscularity scores and ultrasonic muscle and fat depths, and on carcass classification and composition of their progeny

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The objective was to examine the effect of sire expected progeny difference (EPD) for carcass conformation score on the live animal and carcass traits of their progeny. In each of 4 years a Charolais sire of high and one of average EPD for carcass conformation score were mated to spring-calving suckler cows and the bull and heifer progeny were taken to slaughter at 455 (s.d. 25.2) and 607 (s.d. 29.5) days of age in 4 and 3 years, respectively. The difference in EPD between the sire EPD groups for carcass conformation and fat scores (scale 1 to 15), and carcass weight were, 0.45 units, –0.53 units and 9.7 kg, respectively. Muscularity scores were recorded at weaning (7 to 9 months of age) and pre-slaughter, and ultrasound measurements were recorded pre-slaughter. Carcass weight, and conformation and fat scores were recorded at slaughter and an 8-rib pistola from the right side of each carcass was dissected into lean, fat and bone. There was no significant effect of sire EPD group on live weight or carcass weight, but kill-out proportion, ultrasound muscle depth and the Irish Cattle Breeding Federation muscularity scores were greater ($P < 0.001$) for progeny of the high than the average EPD group. Bull progeny of high EPD sires had better ($P < 0.001$) Signet muscularity scores and carcass conformation scores than bull progeny from average EPD sires, whereas there was no effect of sire EPD group on heifer progeny. Compared to progeny of the average EPD sire group, those from the high EPD group had a lower weight of kidney and channel fat ($P = 0.06$) and carcass fat score ($P < 0.05$), lower proportions of fat ($P < 0.001$) and bone ($P < 0.01$) in the pistola, and higher weight of pistola, both absolutely ($P < 0.01$) and relative to carcass weight ($P < 0.05$), higher proportions of

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lean and high-value cuts in the pistola and higher carcass value (P < 0.001). Linear regression analysis showed that a 1 unit increase in sire EPD for carcass conformation score increased (P < 0.01) carcass lean proportion by 19.4 g/kg. In conclusion, although sire EPD for carcass conformation score was reflected in the conformation score of intensively-reared bull progeny and not in extensively-reared heifer progeny, carcass lean proportion and carcass value were higher for both genders.

Keywords: beef sire; carcass conformation; carcass traits; expected progeny difference

Introduction

In the European Union (EU), data recorded on beef carcasses include scores for conformation (EUROP scale, with E best plus an additional S, or superior class, for double-muscled carcass types) and fatness (scale 1 to 5, with 5 fattest), gender category (steer, heifer, young bull, cow, bull) and carcass weight. Conformation and fatness are based on visual examination of carcasses (Commission of the European Communities, 1982), which has recently been replaced by mechanical classifications in Ireland (Allen and Finnerty, 2000; Allen, 2007).

Fisher (2007) has pointed out that beef carcass classification plays an important role in Europe, as a marketing aid within and between countries and as a means of increasing the precision of price reporting for administrative purposes. While the advantages of having a common language to describe carcasses, even within a country, to improve marketing efficiency and transparency, seemed clear to academics it was initially resisted by many meat traders. Fisher (2007) also pointed out that farmers were traditionally paid on a flat-rate basis for a batch of animals where over-fat or poor-conformation animals received the same price per kilogram as animals which were leaner or had better conformation. However, it is noteworthy that price differences between carcass conformation categories still vary substantially between EU countries (Drennan, 2006).

Carcass price should reflect carcass value which is dependent on saleable meat yield and distribution of meat within the carcass (due to differences in value between cuts). Perry, Yeates and McKiernan (1993b) found that carcass weight alone, carcass weight with carcass muscle score, and carcass weight with carcass muscle and fat scores, accounted for 0.1, 37.9 and 46.7%, respectively, of the total variation in the percentage saleable meat in the carcass. In a study involving 134 steer carcasses, Drennan, Keane and McGee (2007) found (using the EU carcass classification scale of 1 to 5), that a 1 unit increase in carcass conformation increased carcass lean proportion by 42 g/kg and decreased the proportions of fat and bone by 18 g/kg and 23 g/kg, respectively. A 1 unit increase in carcass fat score resulted in changes in carcass lean, fat and bone proportions of –22, +30 and –7 g/kg, respectively. The estimated effect of a 1 unit increase in carcass conformation and fat score on carcass value were +22 and –9 c/kg, respectively.

The Irish Cattle Breeding Federation (ICBF) provide expected progeny difference (EPD) values for carcass weight, conformation and fat score for beef bulls. This information, in combination with other traits such as calving difficulty score, allows producers to select sires to suit their requirements. Using carcass data from purebred steer and heifer progeny of 15 Charolais sires to quantify the relationship between sire EPD and progeny phenotype, Crews (2002) obtained regression coefficients of 1.16, 1.27, 1.23, 1.26 and 0.84 for carcass weight, fat thickness, muscle area, marbling score and percent lean yield, respectively. This demonstrated that expected and realised progeny differences for carcass traits were consistent and it was concluded that selection for carcass merit using information in the EPD would be expected to be successful. Similarly, Crews, Pollak and Quaas (2004), using Simmental cattle, found that carcass EPD based on a combination of live and carcass data predicted differences in progeny phenotype at or near theoretical expectation.

The objective of the present study was to determine the relationship of sire EPD for carcass conformation score with live animal muscularity scores, ultrasonically scanned muscle and fat measurements, carcass classification scores, carcass composition, and carcass value of their progeny.

Materials and Methods

In each of 4 years beef suckler cows were mated to either a Charolais sire of high or one of average EPD for carcass conformation. The bulls used had high reliability (Table 1). The mean EPD for carcass conformation and fat score, and carcass weight for the high and average EPD sire groups are in Table 1. The corresponding mean values for Charolais AI sires in Ireland were 1.54 (s.d. 0.412) units, –0.47 (s.d. 0.265) units and 29.7 (s.d. 10.02) kg (ICBF, 2008). The bull progeny (n = 135) from the eight sires were slaughtered at 455 (s.d. 25.2) days of age, while the heifer progeny (n = 96) for the final 3 years were slaughtered at 607 (s.d. 29.5) days of age. The animals were the progeny of pure-bred (Charolais and Limousin) or cross-bred (Limousin × Friesian, Limousin × (Limousin × Friesian) and Simmental × (Limousin × Friesian)) cows. The calves were spring born and grazed with their dams at pasture until they were all abruptly weaned at 7 to 9 months of age. The bulls subsequently spent an average of 235 days indoors during which time they received a diet based on grass silage and an average of 4.2 kg of dry matter (DM) per head daily of a barley-based concentrate supplement. The heifers were offered grass

Table 1. Beef performance proofs for Charolais sires of high and average expected progeny difference (EPD) for carcass conformation score

Sire EPD group	Sire code	No. of progeny	Year	Expected progeny difference		
				Conformation score[2] (units)	Fat score[3] (units)	Carcass weight (kg)
High	IC27	16	1	2.18 (93)[4]	–0.47 (88)	30.0 (92)
High	MDO	33	2	2.14 (99)	–0.83 (98)	42.9 (99)
High	CF46	34	3	1.63 (93)	–0.41 (86)	32.1 (92)
High	HWN	32	4	2.19 (98)	–1.18 (97)	47.6 (98)
Mean[1]				*2.01*	*–0.75*	*39.2*
Average	CF44	15	1	1.46 (89)	–0.27 (80)	36.0 (88)
Average	CF47	25	2	1.42 (96)	–0.67 (92)	26.6 (95)
Average	CLS	39	3	1.70 (97)	–0.00 (96)	34.9 (97)
Average	BSK	37	4	1.56 (85)	–0.13 (74)	23.1 (83)
Mean[1]				*1.56*	*–0.22*	*29.5*

[1] Weighted for the number of progeny.
[2] Scale 1 (poorest) to 15 (best).
[3] Scale 1 (leanest) to 15 (fattest).
[4] Reliability.

silage plus 1 kg of concentrates daily during a 5 month winter period and then spent a second summer (average 204 days) at pasture. They received an average of 3.1 kg of concentrate DM per head daily in the final 96 days prior to slaughter; grazed grass was replaced by grass silage for the last 37 days of this period.

Visual muscularity scores were assigned to each animal at weaning and pre-slaughter, using both the ICBF (ICBF, linear scoring reference guide) and Signet scoring procedures (Collins, J.M.E., personal communication). The ICBF system involved assigning muscularity scores (scale 1 to 15) at six locations (width at withers, width behind withers, thigh width, development of hind-quarter, thickness of loin and development of the inner thigh). In the Signet procedure, muscularity scores (scale 1 to 15) were assigned at three locations (roundness of hind-quarter, width of rump and width and thickness of the loin). For each assessor, the scores over all locations were averaged to give one value per animal at weaning and again prior to slaughter. The animals were ultrasonically scanned pre-slaughter for eye muscle depth at the 3^{rd} lumbar vertebra and for fat depth at both the 3^{rd} lumbar (3 sites) and at the 13^{th} rib (4 sites) using an Aloka 500V (Animal Ultrasound Services Inc., Ithaca, New York, USA) in year 1 and a Dynamic Imaging Scanner (Concept/MCV Veterinary Ultrasound Scanner) in the remaining years. The values for fat depth at the two locations were averaged to give one figure per animal.

Hot carcass and kidney plus channel fat weights were recorded at slaughter. Cold weight was taken as 0.98 hot carcass weight. Carcasses were classified visually in years 1 and 2 and mechanically in years 3 and 4 according to the EU Beef Carcass Classification Scheme (Commission of the European Communities, 1982) but on a 15 point rather than a 5 point scale. This was achieved by assigning +, 0 or – to each score on the 5 point conformation and fat scales when visually classified while mechanical classification automatically provided this on a continuous scale.

Carcass lean, fat and bone proportions were obtained following dissection of an 8-rib pistola from the right side of each carcass. The pistola was dissected into 12 cuts (silverside, topside, striploin, rump, tail of rump, cube roll, cap of ribs, leg, knuckle, fillet, heel and eye of round). The weight of each lean cut (from which dissectible fat and, where applicable, bone had been removed) was recorded individually. Total weight of fat, bone and lean trim were recorded. The weight of lean was equal to the sum of lean cuts and lean trim weights. High-value cuts were defined as lean in the fillet, striploin and cube roll. Carcass value (c/kg) was taken as the sum of the commercial values of each boneless, fat-trimmed lean cut and lean trim (with a small deduction for bone) in the pistola plus the forequarter weight multiplied by 1.65 expressed as a proportion of the half carcass weight (Drennan *et al*., 2007; Drennan, McGee and Keane, 2008).

Data were analysed using Proc MIXED of SAS (2003). There were terms for sire EPD group, gender and their interaction, year, sire EPD group × year and dam genotype in the model. Sire within EPD group was a random variable. Calving day was included as a covariate. An additional series of analyses included the independent variables, sire EPD for carcass conformation (EPD_{CONF}), fat (EPD_{FAT}) or carcass weight (EPD_{CWT}), as continuous variables. These analyses were undertaken using fixed effect linear models in Proc GLM (SAS, 2003).

Results

The EPD differences in carcass conformation and fat scores (scale 1 to 15) and carcass weight between the four sires of high and the four sires of average EPD for carcass conformation were 0.45 units, –0.53 units and 9.7 kg, respectively (Table 1).

There was no significant effect of sire EPD group for carcass conformation score on birth weight, weaning weight, slaughter weight, carcass weight, live-weight gain or, carcass weight per day of age (Table 2). However, kill-out proportion was greater (P < 0.001) for progeny of the high than the average EPD sires.

Compared to the progeny of the average EPD sire group, those of the high EPD sires had greater muscular scores at weaning (P < 0.05) and at slaughter (P < 0.001) using the ICBF scoring procedure. There were sire EPD group × gender interactions for the Signet muscularity score at weaning (P < 0.05) and at slaughter (P = 0.06), whereby the bull progeny of the high EPD group had greater (P < 0.001) muscularity scores than the progeny of the average EPD group but there was no effect of sire EPD group on the heifer progeny. There was also a sire EPD group × gender interaction for scanned fat depth prior to slaughter, in that heifer progeny from the high EPD group had a lower fat depth than those from the average EPD group, but there was no difference between the EPD groups in the bull progeny. Scanned muscle depth was greater (P < 0.001) for progeny of the high EPD sires than those of the average EPD sires.

Bull progeny had heavier (P < 0.001) birth, weaning, slaughter and carcass weights, a higher (P < 0.001) kill-out proportion, live weight gain and carcass weight per day of age, and a lower (P < 0.01) ultrasound fat and greater (P < 0.05) ultrasound muscle depth than heifer progeny.

Table 2. Least square means for performance of the heifer and bull progeny of sires of high or average expected progeny difference (EPD) for carcass conformation score

Progeny trait	High EPD		Average EPD		s.e.[1]	Significance[2]		
	Bull	Heifer	Bull	Heifer		C	G	C × G
Birth weight (kg)	53.2	47.6	52.2	47.2	0.63		***	
Weaning weight (kg)	294	257	288	258	3.5		***	
Slaughter weight (kg)	598	540	597	541	4.7		***	
Carcass weight (kg)	350	299	344	296	2.9		***	
Kill-out proportion (g/kg)	584	553	572	544	1.9	***	***	
Live weight gain (g/day)								
Birth to weaning	1173	1015	1150	1021	16.1		***	
Weaning to slaughter	1239	723	1260	722	13.2		***	
Birth to slaughter	1209	823	763	824	9.5		***	
Carcass produced (g/day of age)	775	502	763	497	5.9		***	
Muscularity score (1–15)								
Weaning (Signet procedure)	7.7	6.6	6.9	6.6	0.13	*	***	*
Weaning (ICBF procedure)	8.1	7.2	7.6	7.0	0.11	**	***	
Slaughter (Signet procedure)	9.3	8.2	8.2	7.9	0.16	***	***	P = 0.06
Slaughter (ICBF procedure)	9.6	9.7	8.9	9.3	0.11	***		
Ultrasound measurements								
Fat depth (mm)	3.4	3.9	3.2	6.2	0.48		**	*
Muscle depth (mm)	85	82	80	80	0.70	***	*	

[1] For n = 115 (High EPD sire group) in this and subsequent tables.
[2] C = Sire EPD group; G = Gender; C × G = Interaction of C × G.

Table 3. Least square means for carcass traits for the heifer and bull progeny of sires with high or average expected progeny difference (EPD) for carcass conformation score

Variable	High EPD		Average EPD		s.e.	Significance[3]		
	Bull	Heifer	Bull	Heifer		C	G	C × G
Kidney and channel fat (kg)	5.8	6.2	6.3	6.7	0.20	P = 0.06		
Carcass fat score[1]	7.5	9.0	8.3	9.3	0.17	*	***	
Carcass conformation score[2]	10.8	9.4	9.7	9.2	0.14	**	***	*
Pistola weight (kg)	83.8	75.4	80.7	73.2	0.68	**	***	
Pistola weight relative to carcass weight (g/kg)	486	502	478	496	19.4	*	***	
Pistola composition (g/kg)								
Lean	759	746	743	729	2.6	***	***	
Fat	58	71	66	84	2.0	***	***	
Bone	182	183	190	187	1.4	**		
High-value cuts (g/kg carcass)	83	83	79	81	0.5	***		
Carcass value (c/kg)	293	296	286	292	0.92	***	***	

[1] Scale 1 (leanest) to 15 (fattest).
[2] Scale 1 (poorest) to 15 (best).
[3] C = Sire EPD group; G = Gender; C × G = Interaction of C × G.

Compared to progeny of the average EPD sire group, those from the high EPD group had a lower weight of kidney and channel fat ($P = 0.06$) and carcass fat score ($P < 0.05$), lower proportions of fat ($P < 0.001$) and bone ($P < 0.01$) in the pistola, and higher weight of pistola, both absolutely ($P < 0.01$) and relative to carcass weight ($P < 0.05$), higher proportions of lean and high-value cuts in the pistola and higher carcass value ($P < 0.001$). There was an EPD sire group × gender interaction for carcass conformation score, whereby bull progeny from the high EPD sire group had a higher score than those from the average EPD group, but carcass conformation score did not differ between the sire EPD groups for heifer progeny.

Compared to heifer progeny, bulls had a lower carcass fat score and fat proportion in the pistola, and a higher carcass conformation score, weight of pistola, but lower pistola weight relative to carcass weight and lower carcass value ($P < 0.001$).

Linear regression equations describing the relationship of sire EPD for conformation and fat scores and carcass weight, with carcass traits of their progeny are presented in Table 4. The EPD_{conf} was positively associated with carcass weight, kill-out proportion, pistola proportion ($P < 0.05$), lean proportion in the pistola and carcass value ($P < 0.01$). There were EPD_{conf} × gender interactions for carcass conformation score and the proportion of high-value cuts in the pistola, whereby with increasing EPD_{conf} there was a positive relationship ($P < 0.001$) in bulls and a non-significant relationship in heifers. There were no significant relationships between EPD_{conf} and carcass fat score, kidney plus channel fat or fat proportion in the pistola. However, the coefficients with all fat measurements were negative. The EPD_{conf} was negatively associated ($P < 0.05$) with bone proportion in the pistola.

Kill-out proportion was negatively related to EPD fat and carcass fat score was positively related to EPD_{fat} ($P < 0.05$). There were EPD_{fat} × gender interactions for the proportion of high-value cuts in the pistola and carcass value, whereby increasing EPD_{fat} had no effect in heifers and a negative effect ($P < 0.05$) in bulls.

Table 4. Regression coefficients (s.e.) for expected progeny difference (EPD) for carcass conformation (EPD_{conf}), fat (EPD_{fat}) and weight (EPD_{cwt}) on carcass related traits of the heifer and bull progeny[1]

Dependent variable	Independent variable		
	EPD_{conf}	EPD_{fat}	EPD_{cwt}
Carcass weight (kg)	15.1* (7.57)	–8.4 (7.40)	0.77** (0.285)
Kill-out proportion (g/kg)	11.0* (5.28)	–11.4* (5.09)	0.01 (0.202)
Carcass conformation score[2]	1.83*** (0.389), 0.01 (0.519)	–0.67 (0.392)	0.03 (0.015)
Carcass fat score[3]	–0.75 (0.439)	0.95* (0.423)	–0.03 (0.017)
Kidney & channel fat (kg)	–0.13 (0.549)	0.16 (0.531)	–0.02 (0.021)
Pistola proportion (g/kg)	11.8* (5.22)	–5.4 (5.09)	–0.1 (0.200)
Lean (g/kg)	19.4** (7.43)	–10.7 (7.27)	–0.2 (0.286)
Fat (g/kg)	–10.4 (5.53)	6.2 (5.38)	0.2 (0.211)
Bone (g/kg)	–9.1* (3.71)	4.6 (3.62)	0.0 (0.143)
High-value cuts (g/kg)	5.7*** (1.31), –0.5 (1.74)	–2.9* (1.30), 1.5 (1.42)	0.04 (0.052)
Carcass value (c/kg)	8.6** (2.60)	–5.2* (2.55), 2.1 (2.78)	–0.1 (0.101)

[1] Where the associations differed significantly by gender, the solutions are presented for bulls (left) and heifers (right).
[2,3] See footnotes to Table 3.

The relationship between EPD_{cwt} and carcass traits in the progeny was confined to an increase ($P < 0.01$) in carcass weight with increasing $EPD_{cwt.}$

Discussion

Initial selection of the sires was based on annual proofs available from the ICBF in each year of the study. The sire EPD values used in the analyses are based on the May 2008 proofs. In these proofs, the 2 sires used in year 3 have exchanged ranking in EPD for carcass conformation, resulting in similar EPD values. The animals used in the present study are part of the population making up the May 2008 sire EPDs. However, considering that these are widely used AI sires, as reflected in the high reliability values in EPD for carcass conformation (85 to 99%), this is considered to be of little consequence. Furthermore, due to the nature of the statistical methods utilised, the results of this study are confined to the set of sires used.

The difference in EPD for carcass weight between the high and the average EPD sires was only 9.7 kg and thus, as expected, there were no significant differences in growth of the progeny between the groups. However, carcass weight was numerically 4 kg greater for the progeny of the high EPD sire group compared to those of average EPD group due to a greater kill-out proportion for the progeny of the high EPD group. Studies examining phenotypic associations between slaughter and carcass traits have shown that animals of better carcass conformation have a higher kill-out proportion (Perry and McKiernan, 1994; Drennan *et al.*, 2008). The study of Drennan *et al.* (2008) found that kill-out proportion of bulls and heifers was increased by 9 and 8 g/kg, respectively, per 1 unit increase in conformation score (scale 1 to 15). Keane and Diskin (2007) reported that the progeny of sires of higher genetic merit for growth had significantly heavier carcasses due to a combination of numerically heavier live weight and better kill-out proportion than those from lower genetic merit sires. Clark, Moser and Williams (2004) using random regression coefficients reported values of progeny regression on sire EPD for birth weight and weaning weight of 1.03 and 0.66 kg/kg, respectively. Kemp and Sullivan (1995) using regressions of progeny weaning weight on sire EPD for post-weaning gain on a central test reported regression coefficients of 0.83, 0.35, 0.18, 0.10 and 0.10 kg/kg for Angus, Charolais, Hereford, Limousin and Simmental sires, respectively. Barkhouse *et al.* (1998) reported regression coefficients of progeny performance on EPD of sire of 1.25, 0.98 and 0.62 for birth weight, weaning weight and yearling weight, respectively. Corresponding figures obtained by Basarab, Milligan and Stitt (1994) were 1.06, 0.45 and 0.78. In their review, Thrift and Thrift (2006) concluded that for cattle growth, carcass and maternal traits, sire EPDs, were in general, reflective of realised progeny difference.

In the present study, the mean difference in EPD values for conformation score between the high and average EPD sire groups was 0.45 units, while the mean difference in their progeny was 0.65. However, this difference in carcass conformation score was only expressed in the male progeny. Similarly, Marsh and Pullar (2002), Marsh, Vickers and Wharton (2007) and (2008) evaluating the progeny of beef bulls differing in beef value, found that the difference in carcass weight for age in favour of superior bulls was almost twice as large in bull than in heifer progeny. These findings are consistent with breed comparison studies whereby, breed differences were more evident in intensively-reared males than in extensively-reared female progeny (Hoving-Bolink, Hanekamp and Walstra 1999; Drennan and McGee, 2004).

Scanned muscle depth was significantly greater for progeny from the high than average EPD sire groups. Studies have shown significant positive relationships between depth or area of the *longissimus dorsi* and carcass conformation score (Perry *et al.*, 1993b; Drennan *et al.*, 2007). The greater value for pistola proportion in the carcass, pistola meat proportion, proportion of high-value cuts and carcass value combined with lower proportions of fat and bone in the progeny of the high than average EPD sire group is in general agreement with other studies dealing with carcasses varying in conformation score (Perry *et al.*, 1993a and b; Drennan *et al.*, 2007).

Linear regression analysis showed that a 1 unit increase in sire EPD_{conf} significantly increased carcass conformation score by 1.8 units in bulls but had no effect in heifer progeny, whereas carcass lean yield increased by 19 g/kg in bulls and heifers combined. The increased lean proportion was offset by corresponding decreases in fat and bone. Therefore, averaged over bull and heifer progeny, lean yield was increased by 21 g/kg per 1 unit increase in conformation score. However, this value was not corrected for carcass fat score. Other studies (Drennan, 2006) showed that using regression analysis in which both conformation and fat scores were the dependant variables, a 1 unit (scale 1 to 15) increase in carcass conformation score increased lean yield in young bulls and steers by 12 and 14 g/kg, respectively. Similarly, in the study by Drennan *et al.* (2008), using late-maturing breed crosses, a 1 unit increase in carcass conformation score increased lean yield by 9 and 8 g/kg for bulls and heifers, respectively. In a study by Clarke *et al.* (2009a and b) with bull and steer progeny from 22 sires, the increase in carcass conformation score of the progeny per unit change in sire EPD for conformation was 0.94. The corresponding figures for fat score and carcass weight were 1.04 and 1.3, respectively. In that study, a 1 unit increase in EPD for carcass conformation score (not adjusted for fat score) resulted in improved muscularity scores, a 32 g/kg increase in carcass lean proportion and increased carcass value of 17 c/kg.

The 0.95 unit increase in carcass fat score per unit increase in sire EPD_{fat} is consistent with the value of 1.04 obtained by Clarke *et al.* (2009a).

In accord with previous studies (Drennan and McGee, 2004; McGee *et al*., 2005), because systems of bull and heifer production rather than discrete treatments were compared, there was inevitable confounding of gender with some production variables such as age and feeding regime. However, the results are consistent with comparisons of bulls reared more intensively and slaughtered at 16 to 18 months of age, and heifers reared extensively and slaughtered at 20 to 26 months (Hoving-Bolink *et al.*, 1999; Drennan and McGee, 2004). In these studies, significant differences between genotypes were shown in intensively-reared bulls but not in the more extensively-reared heifer progeny.

The higher proportion of pistola in the carcass and the higher carcass value per kilogram for heifers than bulls is as expected. The pistola contains the higher-priced cuts and studies have shown that steers have a greater proportion of pistola than bulls (Keane and Allen, 1998), while in turn, heifers have a greater proportion of high-priced cuts in the carcass than steers (Keane and Drennan, 1990). Similarly, Steen and Kilpatrick (1995) concluded that the proportion of saleable meat in high-priced joints was significantly lower for bulls than for steers, and for steers than for heifers.

In summary, although sire EPD for carcass conformation was reflected in the intensively-reared bull progeny, but not in the more extensively-reared heifer progeny there were improvements in important traits in both genders. Selection for higher EPD for carcass conformation resulted in a higher kill-out proportion, carcass lean proportion and carcass value.

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