BEEF SYSTEMS: PRODUCTION AND GENETICS

Intake and annual performance of Limousin × Holstein-Friesian and Simmental × Holstein-Friesian beef suckler cows, and pre-weaning growth of their calves

Beef cross dairy heifers remain a significant source of replacement breeding stock for the suckler herd in Ireland. Previous studies at this centre have compared Hereford × Friesian beef suckler dams with Charolais × Friesian and Limousin × Friesian. Feed is the primary variable cost on beef farms and cow winter feed costs are a substantial proportion of this. The objective of the present comparison was to compare the *pre-partum* intake and annual performance of Limousin × Holstein-Friesian (LF) with Simmental × Holstein-Friesian (SF) cows and pre-weaning growth of their calves.

Data were collected over two consecutive years using 21 and 19 spring-calving (March 26th (s.d. 25.9 days)) *primiparous*, LF and SF cows, respectively, in Year 1, and 16 and 15 of the same animals, respectively, in Year 2. The LF and SF cows were mated to Simmental and Limousin sires, respectively, in Year 1 and to Simmental sires in Year 2. Cows were offered grass silage *ad libitum* during the winter indoor period and an additional 2 kg of concentrate *post-partum* until turnout to pasture in Year 1. At pasture, both genotypes and their calves were rotationally grazed, together. Individual cow intakes were recorded *pre-partum* over 56 and 77 days in years 1 and 2, respectively. Cow live weight, body condition score (BCS) (Methods - A: Lowman *et al.*, 1976; B: Agabriel *et al.*, 1986), incidence of calving difficulty and calf live weights were recorded. Data were analysed using PROC MIXED of SAS with repeated measures. The model contained effects for dam genotype, year and genotype × year. Year was the repeated factor and the subject was cow within genotype. Data pertaining to the progeny had an additional term for gender. Calving day was included as a covariate in all models.

Dry matter intake (kg/day) was higher ($P<0.001$) for SF than LF cows both on an absolute basis and when expressed relative to weight (Table 1). Live weight of SF was significantly greater than LF on all occasions except in June and at weaning. Cow BCS did not differ ($P>0.05$) between the genotypes except at weaning when it was lower ($P<0.01$) for SF than LF using Method B and also lower in Year 2 but not in Year 1 using Method A. Incidence of calving difficulty and calf birth or weaning weight did not differ ($P>0.05$) between the genotypes. The 0.16 higher intake of SF than LF is consistent with results obtained comparing pedigree Simmental and Limousin bulls where at the same weight and growth rate, intake was 0.08 higher for the former.

In conclusion, live weight and *pre-partum* intake of grass silage was greater for SF than LF cows, whereas incidence of calving difficulty, calf birth weight and calf pre-weaning growth was similar for both genotypes.

Table 1: Intake, live weight, body condition score (BCS) and calving difficulty (s.e.m.) of Limousin × Holstein-Friesian (LF) and Simmental × Holstein-Friesian (SF) cows, and birth weight and growth of their calves pre-weaning

	LF	SF	Sig.
Dry matter (DM) intake pre-partum			
kg DM/day	7.7 (0.17)	8.9 (0.18)	***
g DM/kg live weight	14.6 (0.23)	15.8 (0.25)	***
Cow live weight (kg)			
Initial	515 (8.6)	547 (9.2)	*
Post-partum	493 (8.3)	533 (8.1)	**
Turnout to pasture (April)	468 (10.2)	507 (10.3)	*
June	510 (10.1)	538 (10.4)	P=0.07
Weaning (Oct)	547 (11.4)	568 (11.6)	
Cow BCS (0-5) (Lowman *et al.*, 1976)			
Post-partum	2.2 (0.07)	2.3 (0.07)	
Turnout to pasture (April)	2.3 (0.09)	2.2 (0.08)	
June	2.2 (0.08)	2.2 (0.08)	
Weaning (Oct)	2.3 (0.05)	2.1 (0.05)	Genotype × year *
Calving difficulty (1-5)	1.6 (0.15)	1.3 (0.16)	
Calf weight (kg)			
Birth	41.1 (0.84)	41.9 (0.86)	
Turnout to pasture (April)	72 (1.9)	69 (1.8)	
Weaning (Oct)	288 (5.0)	292 (5.0)	

McGee, M. and Drennan, M.J. *RMIS No. 5522*

Pre-partum intake and performance of Limousin × Holstein-Friesian and Simmental × (Limousin × Holstein-Friesian) beef suckler cows during the indoor winter period

Retention of cow replacements from within the suckler herd has resulted in a reduction in the proportion of dairy breeding in the suckler dam and consequently reduced milk yield, and calf weaning weight. Milk yield is an important factor driving the lifetime live weight performance in suckler calf-to-beef system where no creep feed is offered. Previous research at this centre has shown that incorporation of Simmental genetics is a within-herd breeding strategy for maintaining moderate milk production. Feed is the main variable cost on beef farms and cow winter feed costs are a major proportion of this. The objective of the current study was to compare the *pre-partum* intake and performance of Limousin × Holstein-Friesian (LF) and Simmental × (Limousin × Holstein-Friesian) (SLF) cows during the winter indoor period.

A total of 33 and 24 *primiparous* (PP) and, 33 and 18 *multiparous* (MP), spring-calving LF and SLF cows were compared over 3 and 2 years, respectively. Primiparous and MP cows were bred to Limousin and Charolais sires, respectively. Cows were offered grass silage *ad libitum pre-partum*. Individual intakes were recorded over 63, 56 and 32 days in years 1, 2 and 3, respectively. Corresponding silage dry matter digestibility was 670, 650/713 and 683 g/kg. Cow live weight, body condition score (BCS) (Lowman *et al.*, 1976), incidence of calving difficulty and calf birth weight were recorded, and first-milking colostrum immunoglobulin G_1 (IgG_1) and calf serum IgG_1 concentrations at 48 h post-partum were determined. Data were analysed for PP and MP cows separately using PROC GLM of SAS. The model contained effects for dam genotype, year and genotype × year. Data pertaining to the progeny had an additional term for gender. Calving day was included as a covariate in all models.

Dry matter intake (kg/day) did not differ between the genotypes for PP cows but was 0.10 higher ($P<0.05$) for MP SLF than LF cows (Table 2). When expressed relative to weight, intake was lower ($P<0.05$) for PP SLF than LF but did not differ between the genotypes for MP cows. For both PP ($P<0.001$) and MP ($P<0.01$) cows, live weight of SLF was greater than LF but live weight loss did not differ between the genotypes. There was no difference ($P>0.05$) between the genotypes in BCS for PP cows but BCS at the start of the winter ($P=0.09$) and post-partum ($P<0.05$) was lower for MP, LF than SLF cows. Incidence of calving difficulty was lower for SLF than LF in both PP ($P<0.01$) and MP ($P<0.05$) cows. Calf birth weight and colostrum IgG_1 concentrations did not differ ($P>0.05$) between the genotypes. There was no effect ($P>0.05$) of genotype on calf serum IgG_1 concentrations in PP cows. There was a genotype × year interaction for calf serum IgG_1 concentrations in MP cows, whereby concentrations were numerically higher ($P=0.22$) for LF than SLF in Year 2, whereas the reverse ($P=0.07$) occurred in Year 3.

In conclusion, the heavier SLF cows had a lower calving difficulty score but differences between the genotypes in absolute intake only occurred in MP cows.

Table 2: Pre-partum intake and performance (s.e.m.) of Limousin × Holstein-Friesian (LF) and Simmental × (Limousin × Holstein-Friesian) (SLF) cows

	Primiparous			Multiparous		
Genotype	LF	SLF	Sig.	LF	SLF	Sig.
Dry matter (DM) intake						
kg DM/day	6.2 (0.11)	6.3 (0.12)		7.4 (0.18)	8.1 (0.26)	*
g DM/kg live weight	12.2 (0.19)	11.3 (0.21)	**	12.1 (0.21)	11.9 (0.30)	
Live weight (kg)						
Initial	488 (6.3)	546 (7.0)	***	579 (11.6)	637 (17.6)	**
Post-partum	451 (7.1)	499 (7.9)	***	537 (12.0)	598 (17.9)	**
Change to post-partum	-36 (4.3)	-47 (4.8)		-43 (6.6)	-39 (9.8)	
Body condition score (0-5)						
Initial	2.8 (0.06)	2.8 (0.07)		2.1 (0.09)	2.4 (0.13)	P=0.09
Post-partum	2.2 (0.07)	2.3 (0.08)		2.0 (0.09)	2.4 (0.15)	*
Change to post-partum	-0.6 (0.08)	-0.5 (0.09)		-0.2 (0.11)	0.0 (0.18)	
Calving difficulty (1-5)	2.6 (0.18)	1.8 (0.21)	**	2.4 (0.20)	1.3 (0.37)	*
Calf birth weight (kg)	38.5 (0.76)	39.4 (0.89)		47.2 (1.05)	49.9 (1.59)	
Colostrum IgG_1 (mg/ml)	136 (7.8)	133 (10.7)		134 (11.6)	125 (15.4)	
Calf serum IgG_1 (mg/ml)	52 (4.9)	46 (6.3)		57 (4.1)	60 (5.2)	G×Y*

McGee, M., Drennan, M.J., Flynn, J. and O'Neill, B. *RMIS No. 5522*

Residual feed intake effects on:

(1) Body and ultrasound measurements, muscularity scores, blood physiology and behaviour in growing beef heifers

The biological efficiency of suckler beef production is low with the dam having a large cost, with feed being the largest variable cost in beef production, feed efficiency is consequently an important trait to consider when developing programmes to identify cattle that are more economically and environmentally sustainable to produce. Traditionally, feed efficiency was expressed as the ratio of weight gain to feed intake but selection using this measure leads to an increase in mature size and thus, maintenance requirements. An alternative measure of feed efficiency is residual feed intake (RFI) or net feed efficiency. This is defined as the difference between the actual and predicted animal intake (negative or low values being desirable) and is independent of growth and body size.

The effect of RFI on growth, body and ultrasound measurements, blood physiology and behaviour was determined in growing purebred Simmental and Simmental × Friesian-Holstein heifers (n=85; mean (± SD) initial age 299 ± 47 days and weight 311 ± 48.8 kg). They were individually offered grass silage *ad libitum* and 2.0 kg of concentrate once daily over 84 day period using a Calan gate system. Live weight (consecutive days), body (withers height, chest depth and girth, pelvis width and back length) and ultrasound fat (13th rib) and fat and muscle (3rd lumbar) depth measurements were taken at the beginning and end of the study. Additionally, a visual muscularity score was recorded at the end of the feeding period. Blood samples were obtained on four occasions for analysis of albumin, creatinine, β-hydroxy butyrate, globulin, glucose, non-esterified fatty acids, total protein, triglycerides, urea, aspartateaminotransferase, alkaline phosphatase, creatine kinase, fibrinogen, haptoglobin, anti-oxidant status and total bilirubin. Expected energy intake (EI) (UFL/d) was calculated by regressing average daily EI on average daily live weight gain (ADG) and mean live weight$^{0.75}$, with a model which included genotype. Within genotype, heifers were then ranked by RFI and assigned to low (efficient), medium and high RFI groups. At the end of the study, time spent lying and standing was determined using pedometers on nine heifers with the highest and lowest RFI. Overall mean (± SD), ADG (kg/d), DMI (kg/d), EI (UFV/d) and RFI (UFV/d) were, 0.52 ± 0.20, 5.81 ± 0.73, 5.17 ± 0.58 and -0.00 ± 0.35, respectively.

In conclusion, the RFI groups did not differ (P>0.05) in live weight, ADG, body and ultrasound measurements, muscularity score, blood variables or lying and standing time.

(2) Proportion of time spent lying, standing and active by grazing beef heifers differing in phenotypic residual feed energy intake

Cattle differing in feed efficiency may exhibit different behavioural activity. The effect of residual feed intake (RFI), on the proportion of time spent lying, standing and active at pasture was determined using 63 Simmental and 21 Simmental × Friesian-Holstein pregnant heifers. As weanlings during the winter indoor period, live weight and individual feed consumption records were used to generate RFI values (expressed as Unité Fourragère Lait (UFL) - feed units for lactation) within each genotype. The heifers were ranked on RFI and divided equally into either low (-0.32 UFL, efficient) or high (+0.27 UFL, inefficient). At the end of the indoor winter period, they were turned out to pasture (April) where the low and high RFI groups were rotationally grazed separately as 4 (2 replications) herds of 21 animals on predominantly perennial ryegrass swards. Mean paddock size was 1.02 (0.56 to 1.42) ha. The heifers were bred to Simmental sires. Time spent lying, standing and active was determined over 3 consecutive days (following one day adaptation) during September (mean live weight 515 kg) using pedometers (*IceTag 2.004, IceRobotics Ltd.*) positioned on the left back leg. Data were analysed using GLM, with a model that included RFI group, grazing herd and genotype. Birth day was included as a covariate. For low and high RFI groups the percentage of time spent lying, standing and active, and the number of steps taken daily (s.e.m.) were 47.8 and 48.0 (1.04), 46.4 and 46.2 (1.04), 5.8 and 5.8 (0.23), and 3926 and 3855 (203.8), respectively. Behaviour at pasture was similar (P>0.05) between the RFI groups.

In conclusion, the absence of a difference between the RFI groups indicated that energy requirements associated with standing and walking did not contribute to the differences in feed efficiency.

(3) The haematological profiles of pregnant beef heifers

Animals differing in residual feed intake (RFI), may differ in susceptibility to stress and immunological variables. The process of winter housing typically associated with reduced space allowance can be a stressful experience for cattle. Changes in haematological profiles are associated with indoor housing of cattle. The objective of the present study was to characterise the haematological profiles, following indoor housing at the end of the grazing season, in pregnant beef heifers differing in phenotypic RFI as weanlings.

A total of 85 heifers (6-12 months of age), comprising 64 purebred Simmental and 21 Simmental × Friesian-Holstein were used. They were purchased off farm in autumn 2006, subsequently housed and offered first harvest grass silage *ad libitum* at proportionately 0.10 in excess of the previous days intake and 2.0 kg of concentrate once daily. Following acclimatisation, individual intake was recorded over 84 days. Expected energy intake (EI) (feed unit for lactation - Unité Fourragère Lait (UFL)/day) was calculated by regressing average daily EI on average daily live weight gain (ADG) and mean live weight$^{0.75}$, with a model which included genotype. The RFI for each animal was calculated as actual EI minus the expected EI predicted from the regression model generated for each genotype. Within genotype, heifers were then ranked by RFI and separated into low (efficient), medium and high (inefficient) RFI groups. At the end of the indoor winter period, the heifers were turned out to pasture where they were rotationally grazed. The heifers were bred to Simmental sires. At the end of the grazing season they were housed in pens in a slatted floor shed and offered grass silage *ad libitum* plus a mineral/vitamin supplement. Blood samples were obtained via jugular venipuncture 5 days (d) pre-housing (d -5), at housing (d 0) and d 2 and 7 post-housing. Data were analysed using Proc MIXED for repeated measures with a model that included RFI group, blood sample day and their interaction, genotype and sire within genotype. Birth day was included as a covariate.

There was an effect of blood sampling time ($P<0.001$) on all blood variables measured but there was no effect ($P>0.05$) of RFI group or no RFI group × blood sampling time interaction ($P>0.05$) (Table 3). The results suggest that pregnant beef heifers differing in phenotypic RFI as weanlings do not differ in haematological profiles around housing.

Table 3: Effect of residual feed intake (RFI) group and blood sampling time on blood haematological profiles

Variable	RFI (UFL/day)				Sig.[1]	Blood sampling day					Sig.[1]
	L (-0.43)	M (0.01)	H (+0.42)	s.e.m.		-5	0	+2	+7	s.e.m.	
WBC[2] ($\times 10^3$cells/μl)	9.4	9.3	9.9	0.30	NS	9.1	9.8	9.3	10.2	0.29	***
RBC[3] ($\times 10^6$ cells/μl)	8.0	7.9	8.1	0.16	NS	7.9	7.7	8.1	8.2	0.11	***
Haemoglobin (g/dl)	13.2	13.1	13.1	0.19	NS	13.0	12.7	13.3	13.4	0.13	***
Haematocrit (%)	33.3	33.2	32.6	0.47	NS	32.5	31.6	33.7	34.1	0.32	***
Neutrophils ($\times 10^3$cells/μl)	2.7	2.6	2.9	0.14	NS	2.6	2.9	2.6	2.9	0.11	***
Lymphocytes ($\times 10^3$cells/μl)	5.5	5.4	6.0	0.20	NS	5.5	5.8	5.6	5.6	0.13	***

[1] No RFI × Blood sampling day interaction; [2] White blood cell number; [3] Red blood cell number

RMIS No. 5522

McGee, M., Lawrence, P.[1], Kenny, D.A.[2], Crews Jr., D.H.[3], Drennan, M.J. and Earley, B.
[1]Walsh Fellow, School of Agriculture, Food Science and Veterinary Medicine, Belfield, Dublin
[2]Supervisor, UCD School of Agriculture, Food Science and Veterinary Medicine, Belfield, Dublin
[3]Agriculture and Agri-Food Canada Research Centre, Lethbridge, Alberta, Canada

Grange Beef Research Centre

Effect of sire genotype for the beef production sub-index on feed intake and performance of their progeny

The beef carcass index (BCI) developed by the Irish Cattle Breeding Federation is a genetic index that ranks sires according to the expected performance in terms of profit of their progeny to slaughter. It is composed of (relative emphasis in parenthesis) weaning weight (24%), carcass weight (46%), feed efficiency (12%), carcass conformation (11%) and carcass fat (7%) scores. The objective of the current study was to examine the effect of sire BCI on feed efficiency, performance and carcass traits of their progeny.

A total of 107 progeny from 11 high and 11 low sires based on their BCI value were compared in either a bull or steer production system. Sire breed was balanced across genotype and consisted of Charolais (n=5), Belgian Blue (n=1), Limousin (n=3) and Simmental (n=2). Differences in expected progeny differences (EPD) between high and low genetic merit sires were 6 kg for weaning weight, -0.02 kg for dry matter intake, 13 kg for carcass weight, 0.24 for conformation and 0.44 for fat score. Weanling progeny were purchased from 28 beef herds in late 2005 and were offered grass silage *ad libitium* and supplementary barley-based concentrate. The concentrate proportion of the diet was gradually increased for the bulls reaching *ad libitium* in late January until slaughter on 26th June 2006 (mean of 480 days of age). Steers were offered silage and 2 kg of concentrates daily and were turned out to pasture on 18th April 2006. They were re-housed on 18th October and offered silage only until late December, following which offered concentrates were gradually increased and available *ad libitium* from late January 2007 until slaughter on the 13th or 27th of April 2007 (mean of 720 days of age).

Individual daily feed offered and refused was recorded for both bulls and steers during an *ad libitum* concentrate finishing period of 132 days and 87 days, respectively. Average daily live weight gain (ADG) was calculated by fitting a linear regression through live-weights during the finishing period for each animal separately. Net energy values (UFV) were assigned to the concentrates and silage and UFV intake was calculated. Carcass weight was recorded and the right side of each carcass was dissected into meat, fat and bone. For the finishing period, daily carcass gain was calculated by multiplying average daily gain by kill-out proportion and daily meat gain (kg/day) was calculated by multiplying daily carcass gain by carcass meat proportion. Expected energy intake (EI) was calculated by regressing average daily EI on ADG and mean live weight, and on average daily carcass gain and mean carcass weight. Residual feed intake (RFI) was calculated as actual EI minus expected EI predicted from the two regression models, respectively.

Live animal measurements, taken immediately prior to slaughter in both production systems, were muscular and skeletal (height at withers, length of back and pelvis) scores and ultrasonically scanned muscle (3rd lumbar vertebra) and fat (13th rib and 3rd lumbar vertebra) depth. EU carcass scores (scale 1 to 15) for conformation (15=best) and fatness (15=fattest) were obtained using mechanical grading. BCI (February 2008 genetic evaluation) and production system effects and their interactions were determined using PROC GLM. Sire breed, dam breed and age at the time of measurement centered within system were adjusted for in the model where significant. The results for the bull progeny were given in the 2006 research report and the combined results for the bulls and steers are presented in this report.

There was no system × BCI interaction for any of the variables measured ($P > 0.05$). The high BCI progeny were heavier ($P<0.05$) at slaughter but there was no difference between the progeny of high or low BCI sires for feed intake weight gain or feed efficiency during the finishing period (Table 4). Bulls were more ($P<0.001$) efficient than steers with the exception of RFI, which was however, confounded with age.

Table 4: Effect of BCI and system on feed intake and measures of feed efficiency during the finishing period

	BCSI			System			P-value[1]	
Trait	High	Low	sed[2]	Bulls	Steers	sed[2]	BCSI	System
NE intake (UFV/day)	11.3	11.1	0.26	10.4	12.1	0.26	NS	***
Average live weight (kg)	612	590	12.0	511	691	12.0	*	***
UFV intake/live weight (g/kg)	18.7	19.0	0.28	20.3	17.4	0.28	NS	***
Live weight gain (g/day)	1276	1292	57	1588	980	57	NS	***
Carcass gain (g/day)	749	736	33	935	550	32	NS	***
Meat gain (g/day)	524	533	25.0	676	382	25.0	NS	***
Live weight efficiency (g/UFV)	119	118	4.48	156	81	4.48	NS	***
Carcass efficiency (g/UFV)	66.8	68.8	2.77	90.9	44.8	2.76	NS	***
Meat efficiency (g/UFV)	48.3	49.8	2.26	66.3	31.7	2.25	NS	***
Live weight RFI (UFV/day)	-0.024	0.100	0.1437	0.059	0.017	0.143	NS	NS
Carcass weight RFI (UFV/day)	-0.008	251	0.1936	0.069	0.193	0.1937	NS	NS

[1] * * * P< 0.001 * P<0.05; [2]Standard error of the difference

There was no difference in muscular score between the progeny of the high and low BCI sires, but progeny of the high BCI sires had greater (P<0.05) skeletal scores, scanned muscle depth and carcass weight than progeny of low BCI sires (Table 5). There was no effect of BCI on carcass conformation score but the high BCI progeny had lower (P<0.05) fat score than the low BCI progeny. There was no effect of BCI on carcass meat and fat proportions. Mean EPD observed between the respective progeny was 14 kg for carcass weight, 0.10 for conformation score and 0.60 for fat score. All traits measured differed (P<0.001) between production systems although this was confounded with age.

Table 5: Effect of BCI and system on live animal measures and carcass traits

	Genotype			System			P-value[1]		
Trait	High	Low	sed[4]	Bulls	Steers	sed[4]	Genotype	System	G*S
ICBF muscular score[2]	9.8	9.6	0.19	10.0	9.3	0.19	NS	***	NS
Height at withers[3]	7.8	7.2	0.20	6.8	8.2	0.21	**	***	NS
Length of back[3]	7.9	7.6	0.17	7.2	8.3	0.17	*	***	NS
Length of Pelvis[3]	7.5	7.2	0.18	6.8	7.9	0.18	*	***	NS
Scanned muscle depth (mm)	77.0	74.3	1.10	72.7	78.5	1.10	*	***	NS
Scanned fat depth (mm)	3.2	3.4	0.29	2.0	4.6	0.29	NS	***	NS
Carcass weight (kg)	390	376	6.67	353	413	6.67	*	***	NS
Conformation score (scale 1-15)	10.4	10.3	0.25	11.0	9.7	0.25	NS	***	NS
Fat score (scale 1-15)	8.4	9.0	0.28	7.9	9.5	0.27	*	***	NS
Meat (g/kg)	718	713	6.55	726	705	6.55	NS	***	NS
Fat (g/kg)	107	112	5.78	94	124	5.79	NS	***	NS
Kill-out proportion (g/kg)	581	575	4.3	587	568	4.3	NS	***	NS

[1]* * * P< 0.001 * P<0.05; [2]Irish Cattle Breeding Federation muscular scoring system, an average of 6 locations, scale 1 (hollow, narrow conformation) to 15 (wide, thick muscled) [3]Skeletal scores, scale 1(short) to 10 (long) [4]Standard error of the difference

For each unit increase in sire EPD for weaning weight, DM intake, carcass weight, carcass conformation score and carcass fat score, progeny performance increased by 1.0 kg (SE = 0.53), 1.1 kg (SE = 0.32), 1.3 kg (SE = 0.31), 0.9 (SE = 0.32; scale 1 to 15) and 1.0 (SE = 0.25; scale 1 to 15) respectively, all of which did not differ from the theoretical expectation of unity. The expected difference between the progeny of the high and low BCI sires was €42 whereas the observed mean differences in the progeny was €52.

RMIS No. 5503

Drennan, M.J., Clarke, A.M.[1], McGee, M., Kenny, D.A.[2], Evans, R.[3] and Berry, D.P.[4]
[1]Walsh Fellow, UCD School of Agriculture, Food Science and Veterinary Medicine, Belfield, Dublin
[2]Superviser, UCD School of Agriculture, Food Science and Veterinary Medicine, Belfield, Dublin
[3]ICBF (Irish Cattle Breeding Federation) Shinagh House, Bandon, Co. Cork
[4]Teagasc, Dairy Production Research Centre, Moorepark, Cork

The relationship of live animal and carcass conformation and fat scores with carcass composition and value

The objectives of the study were to examine the relationship of (1) live animal muscular and skeletal scores and ultrasonically scanned muscle and fat depths, (2) carcass conformation and fat scores and (3) breed type, with carcass meat, fat and bone proportions, proportion of high-value cuts and carcass value in steers.

The total number of steers used was 336 representing the various sections of the carcass classification grid for conformation and fatness. The steers were mainly spring-born and were slaughtered at the end of a second winter period at approximately 2 years of age.

Animals (85 at 8 to 12 months of age and 146 pre-slaughter) were ultrasonically scanned for eye muscle depth (MD) at the 3rd lumbar vertebra and fat depth (FD) at the 3rd lumbar vertebra (3 sites) and the 13th thoracic rib (4 sites) using a Dynamic Imaging Real Time Scanner, (model – Concept MLV, with a 3.5 MHz linear probe). At weaning (n = 85) and pre-slaughter (n = 336) animals were also scored using the Irish Cattle Breeding Federation (ICBF) and Signet procedures. The ICBF procedure involved assigning muscularity scores on a scale of 1 (poor muscularity) to 15 (good muscularity) at six locations and skeletal scores (scale 1-10) at three locations. The Signet scoring system involved assigning muscular scores at three locations based on a scale of 1 (poor muscularity) to 15 (good muscularity). Carcass data collected included cold carcass weight (taken as 0.98 of hot carcass weight) and EU carcass classification scores for conformation and fatness using mechanical grading on a 15 point continuous scale. The right side of each carcass was split into an 8 rib pistola and fore-quarter, which were further split into 13 and 9 retail cuts, respectively. Where appropriate the bones from each cut were removed and scraped clean. All dissectible fat was removed from each cut. Each meat cut, lean trim, fat and bone were weighed separately with lean trim subsequently included with the meat cuts to give meat yield. Carcass value (c/kg) was calculated, as the sum of the commercial values of each fat trimmed boneless cut with a small deduction for bone, expressed as a proportion of the half carcass weight. Data were analysed using PROC CORR and PROC REG procedures.

Relationship of live animal scores/measurements with carcass traits

Animals were slaughtered at a mean age of 745 days having an average liveweight of 640 kg and a cold carcass weight of 342 kg (Table 6). Carcass conformation and fat scores were 7.1 and 8.5, respectively. Carcass meat, fat and bone proportions were 686, 119 and 195 g/kg, respectively. At 8 to 12 months of age and at slaughter the ICBF linear scoring system for muscular scores, Signet scores and scanned muscle depth were positively correlated with the proportion of meat and high-value cuts in the carcass and carcass value, while a high negative correlation was obtained for carcass bone and a low negative correlation for carcass fat (Tables 7 and 8). The ICBF linear scoring system for average skeletal score showed only a low significant relationship with the proportion of high-value cuts in the carcass at 8 to 12 months. At slaughter, skeletal scores showed low negative relationships with carcass meat proportion, the proportion of high-value cuts in the carcass and carcass value and low positive relationships with carcass fat and bone proportions. Scanning for fat depth at slaughter showed a significant positive correlation with carcass fat score.

In conclusion, ultrasound scanned muscle and fat measurements and visual muscular scores showed good correlations with carcass traits and could be useful in predicting carcass meat yield and carcass value. Correlations between visual average skeletal scores and carcass traits were generally poor.

Table 6: Mean, standard deviation and range for live animal and carcass scores and measurements of steers

	Mean	Standard Deviation	Minimum	Maximum
At 8-12 months of age				
[1]ICBF muscular score	6.5	1.69	2.6	9.4
[1]Signet muscular score	6.2	1.54	3.0	9.3
Scanned eye muscle depth (mm)	55	7.34	39.0	75.2
Scanned fat depth (mm)	0.95	0.269	0.25	1.45
Pre-slaughter				
[1]ICBF muscular score	7.8	1.89	1.8	11.0
[1]Signet muscular score	6.2	2.33	1.0	11.0
Scanned eye muscle depth (mm)	71.5	9.08	52.6	91.2
Scanned fat depth (mm)	3.5	1.78	0.3	9.1
Pre-slaughter weight (kg)	640	82.6	435	884
Post-slaughter				
Cold carcass wt. (kg)	342	53.6	234	501
Slaughter age (days)	745	55	437	915
[2]Conformation score (scale 1 to 15)	7.1	2.27	2.0	12.0
[3]Fat score (scale 1 to 15)	8.5	1.92	2.8	13.3
Meat (g/kg)	686	36.0	593	785
Fat (g/kg)	119	29.1	54	211
Bone (g/kg)	195	21.8	150	262
High-value cuts in carcass (g/kg)	70	6.42	52	87
High-value cuts in meat (g/kg)	103	7.26	77	112
Carcass value (c/kg)	293	19.8	244	347

[1]Scale 1 to 15 (best); [2]15 = best conformation; [3]15 = fattest.

Table 7: Correlations coefficients (r) between live animal scores at 8-12 months of age and carcass traits

	Meat %	Fat %	Bone %	% HVC[1]	Carcass Value (c/kg)
ICBF muscular score	0.31**	-0.09	-0.60***	0.26*	0.34**
Signet muscular score	0.46***	-0.23	-0.68***	0.40***	0.50***
ICBF skeletal score	-0.17	0.20	-0.02	-0.26*	-0.20
Muscle depth	0.31**	-0.08	-0.62***	0.23*	0.31**
Fat depth	-0.32**	0.37***	-0.01	-0.46***	-0.39***

[1]High-value cuts. ***P<0.001, **P<0.01, *P<0.05.

Table 8: Correlations coefficients (r) between live animal scores at slaughter and carcass traits

	Meat %	Fat %	Bone %	% HVC[1]	Carcass Value (c/kg)
ICBF muscular score	0.60***	-0.13*	-0.82***	0.30***	0.55***
Signet muscular score	0.63***	-0.17**	-0.81***	0.30***	0.59***
ICBF skeletal score	-0.32***	0.30***	0.13*	-0.38***	-0.38***
Muscle depth	0.52***	-0.08	-0.75***	0.31***	0.47***
Fat depth	-0.23**	0.59***	-0.50***	-0.34**	-0.32***

[1] High-value cuts. ***P<0.001, **P<0.01, *P<0.05.

Relationship of carcass conformation and fat scores with carcass traits

Correlations for carcass conformation score were positive with carcass meat proportion (r = 0.66), proportion of high-value cuts in the carcass (r = 0.29) and carcass value (r = 0.60), and negative with carcass bone (r =-0.84) and fat (r = -0.19) proportions (Table 9). Correlations for carcass fat score were positive with fat proportion (r=0.69) but correlations with all other traits were low and negative. Regression analysis (Table 10) showed that carcass scores explained 0.63, 0.76 and 0.60 of total variation in carcass meat and bone proportion and carcass value, respectively. The corresponding figures were 0.54 for carcass fat proportion and 0.28 for the proportion of high-value cuts in the carcass. Increasing carcass conformation score increased the proportion of carcass meat and high-value cuts and carcass value but decreased carcass fat and bone proportions. Increasing carcass fat score increased carcass fat proportion but decreased all other traits. A one unit (scale 1 to 15) increase in carcass conformation score increased carcass meat proportion by 11.2 g/kg and carcass value by 5.6 c/kg. A one unit increase in carcass fat score decreased carcass meat proportion by 8.2 g/kg and decreased carcass value by 5.1 c/kg.

Table 9: Correlation coefficients (r) between carcass conformation and fat scores and carcass meat, fat and bone proportions, proportion of high-value cuts (HVC) in the carcass and carcass value

	Carcass conformation	Carcass fat
Meat	0.66***	-0.37***
Fat	-0.19***	0.69***
Bone	-0.84***	-0.31***
HVC	0.29***	-0.41***
Carcass value (cents/kg)	0.60***	-0.43***

***P<0.001, **P<0.01, *P<0.05.

Table 10: Regression of carcass conformation and fat scores with carcass composition and value

	Intercept	Conformation Score	Fat Score	R^2
Meat proportion (g/kg)	675***	11.2(0.53)***	-8.2(0.629)***	0.63
Fat proportion (g/kg)	51***	-3.3(0.47)***	10.9(0.56)***	0.54
Bone proportion (g/kg)	273***	-7.9(0.26)***	-2.7(0.30)***	0.76
Proportion of high-value cuts in carcass (g/kg)	76***	0.96(0.131)***	-1.5(0.16)***	0.28
Carcass value (c/kg)	296***	5.6(0.30)***	-5.1(0.36)***	0.60

***P<0.001, **P<0.01, *P<0.05.

In conclusion, carcass conformation and fat scores obtained using mechanical classification of carcasses were good predictors of meat and bone yield, and carcass value, but were modest predictors of carcass fat. Although carcass conformation and fat scores were poor predictors of the proportion of high-value cuts the relationships was significantly positive with conformation score and significantly negative with fat score.

Carcass traits of progeny from the suckler herd and Holstein/Friesians
Included in the 336 progeny were 94 progeny from the suckler herd (about $^7/_8$ continental breeds) and 76 Holstein/Friesians. The carcass weights of the suckler herd progeny and Holstein/Friesians were 404 and 316 kg, respectively (Table 11). Corresponding conformation scores were U- and O- while both had similar fat scores of 3+ on a 5 point scale (= 9 on a 15 point scale). The progeny from the suckler herd had 62 (712 v 650) g/kg more meat, 17 (115 v 132) g/kg less fat, 45 (173 v 218) g/kg less bone, 6 (72 v 66) g/kg more high-value cuts and were valued at 36 c/kg more than the Holstein/Friesians.

In conclusion, the results showed that at similar carcass fat scores, conformation scores of U- and O- for the suckler herd progeny and Holstein/Friesians respectively, resulted in a substantial difference in meat yield of almost 10% in favour of the former. This agrees with the results of previous studies.

Table 11: Carcass and production traits for suckler herd progeny v Holstein/Friesian steers

	Sucklers	Holstein/Friesian
No.	94	76
Carcass weight (kg)	404	316
[1]Carcass conformation score	10 (U-)	4 (O-)
Carcass fat score	9 (3+)	9 (3+)
Meat (g/kg)	712	650
Fat (g/kg)	115	132
Bone (g/kg)	173	218
High value cuts (g/kg)	72	66
[2]Value (c/kg)	336	300

[1]Scale 1 to 15; [2]Based on meat yield (ex VAT)

Drennan, M.J., Conroy, S.[1], McGee, M. and Kenny, D.A.[2] *RMIS No. 5369*

[1]Walsh Fellow, UCD School of Agriculture, Food Science and Veterinary Medicine, Belfield, Dublin
[2]Superviser, UCD School of Agriculture, Food Science and Veterinary Medicine, Belfield, Dublin

Effects of supplementary concentrate level in winter and subsequent finishing system on performance and carcass traits of Friesian, Aberdeen Angus × Friesian and Belgian Blue × Friesian steers

The objectives of the present study were (i) to compare spring-born Friesian (HF), Aberdeen Angus × Friesian (AA) and Belgian Blue × Friesian (BB) steers reared extensively to the end of the second grazing season and slaughtered at about 28 months of age, (ii) to determine the effects of feeding level during the second winter on performance and slaughter traits, (iii) to compare finishing at pasture with finishing indoors on a high concentrate diet, and (iv) to ascertain if there were interactions between breed type, winter feeding level and finishing system.

Animals and feeds: Seventy-two (24 per breed type) calves, the progeny of at least five sires per breed type, were purchased on dairy farms and transferred to Grange Beef Research Centre at about 4 weeks of age. They were individually penned in a calf shed and offered a total of 25 kg milk replacer over a 56-day rearing period. Calf concentrates (750 g/kg coarsely rolled barley, 170 g/kg soya bean, 55 g/kg molasses and 25 g/kg mineral vitamin premix) were offered up to a maximum of 2 kg per head daily, and hay and water were available *ad libitum*. On June 6, the calves were turned out to a pasture sward deliberately managed to be of moderate quality and no supplementary feeding was offered. At 3, 8 and 13 weeks after turn out, the calves were injected with ivermectin (Qualimec, Janssen Animal Health) to control parasites.

On September 22, the calves were Burdizzo castrated and were subsequently housed for their first winter on October 28. They were accommodated in a slatted floor shed and were offered grass silage *ad libitum* [mean analysis : 206 g/kg dry matter (DM), 144 g/kg crude protein (CP) in the DM, 713 g/kg *in vitro* DM digestibility (DMD), pH 4.0] plus 1 kg (0.83 kg DM) cattle concentrates (875 g/kg rolled barley, 65 g/kg soya bean meal, 45 g/kg molasses and 15 g/kg mineral/vitamin premix) per head daily for 84 days to January 20. From then until turn out on April 18 the animals received silage only. During the second grazing season the sward was again deliberately managed to be of moderate quality. No supplementary feed was offered and the animals remained at pasture until late in the season. Housing for their second winter was on November 30.

The animals were then weighed on two consecutive days and blocked on the mean of these two weights to four equal groups of 6 animals each within breed type. These groups were assigned at random to four experimental treatments to give a 3 (breed types) x 2 (winter feeding levels) x 2 (finishing systems) factorial arrangement of treatments. The two winter feeding levels were silage (193 g/kg DM, 146 g/kg CP, 701 g/kg DMD, pH 3.9) *ad libitum* plus 1.25 (low; L) or 5.0 (high; H) kg cattle concentrates (840 g/kg DM) per head daily for 98 days followed by silage only or silage + 3.75 kg/day cattle concentrates for 15 days, respectively until March 23. The two finishing systems were (i) normal management at pasture, or (ii) cattle concentrates offered *ad libitum* in a slated floor shed.

Pasture management: No measurements were taken at pasture during the first and second grazing seasons but stocking rate was varied to maintain growth rates <0.8 kg/day. During the finishing period however, the animals at pasture rotationally grazed a fertilised, well managed sward. Sward heights were recorded by rising plate metre at entry to, and exit from, paddocks. Concurrently, 5 pre- and post-grazing strips (2.6 m^2) were taken to determine herbage yields and composition. Target post-grazing stubble height was 6 cm.

Silage and concentrate intakes: During the first winter, the animals were accommodated in mixed breed groups and no intakes were recorded. During the second winter, the animals were accommodated in pens of 6 (3 destined for pasture finishing and 3 destined for indoor finishing) by breed type, giving two replicates of each breed type x winter feeding level combination for silage intake measurement. Silage offered was weighed daily at an allowance of 1:1 times the previous intake and refusals were weighed back and discarded twice weekly.

During finishing, the animals were accommodated in pens of 3 (same pens as in winter) giving two replicates per breed type x winter feeding level combination for intake measurement. Concentrates were introduced and increased gradually to *ad libitum* availability after four weeks. Fresh concentrates were offered daily and refusals were weighed back and discarded twice weekly. The mean duration of the finishing period was 94 days.

Slaughter and carcass assessment: To facilitate carcass evaluation the cattle in every second block were slaughtered two weeks apart in a commercial meat plant. The final weight taken before any animals were slaughtered (June 16) is designated pre-slaughter weight. Cold carcass weight was estimated at 0.98 of hot carcass weight. Carcass grades for conformation and fatness, weights of perirenal plus retoperitioneal fat, and carcass measurements were recorded. After 48 h in a chill at 4^0C, the right side of each carcass was quartered at the 5th rib into a pistola hind quarter (the hind quarter to the 5th rib but without the flank) and a fore quarter that included the flank. The ribs joint (ribs 6 to 10) was removed from the pistola, *m. longissmus* area at the 10th rib was measured and the joint was separated into fat, *m.*

longissimus, other muscle and bone including *ligamentum nuchae.* A sample of *m. longissimus* at the 10th rib was vacuum packaged and frozen for chemical analysis later.

Statistical analysis: Data were statistically analysed using the general linear model least squares procedures of SAS. Animal live weights up to the start of the second winter were analysed for breed effects only. Otherwise, animal data were analysed as a 3 x 2 x 2 factorial with terms for block, breed type, winter feeding level, finishing method and their 2-way and 3-way interactions. Intake data for the second winter were analysed as a 3 (breed types) x 2 (feeding levels) factorial. Concentrate intakes during finishing were similarly analysed. Pasture data during finishing were analysed as 2 (pre- or post-grazing) treatments with (1st, 2nd or 3rd month) repeated measures. Where the overall F test for breed type was significant, the breed means were separated using the PDIFF statement in SAS.

Animal performance: Mean birth and arrival dates were about 2 weeks later for BB than for FR and AA which were similar (Table 12). Arrival weight was greater ($P<0.01$) for BB than for FR, but AA did not differ significantly from the other two. Thereafter, there were no significant live weight differences between the breeds up to the commencement of the experimental treatments. Mean first grazing season, first winter and second grazing season daily gains were 0.7, 0.5 and 0.8 kg/day, respectively, with an overall mean value from calf turn-out to the start of the experimental treatments (542 days) of 0.66 kg/day.

The effects of breed type, winter feeding level and finishing system on live weights and live weight gains to slaughter are shown in Table 13. There was no significant effect of breed type on live weight at any time. The higher winter feeding level increased ($P<0.001$) end of winter live weight by 38 kg and pre-slaughter live weight by 23 kg. Finishing method had no effect on end of winter live weight (none expected) but compared with pasture finishing, indoor finishing increased ($P<0.001$) pre-slaughter live weight by 55 kg. Live weight gain in winter was not affected by breed type but during finishing BB gained faster ($P<0.05$) than the other two breed types which did not differ. However, there was no significant effect of breed type on overall (winter plus finishing period) live weight gains.

Winter feeding level significantly affected live weight gain during winter, during finishing and overall. The higher feeding level increased ($P<0.001$) winter live weight gain by 341 g/day and reduced ($P<0.001$) finishing live weight gain by 150 g/day due to the expression of compensatory growth by those on the lower winter feeding level. However, overall (winter plus finishing period) live weight gain was still 118 g/day higher for the higher winter feeding level. Compared with pasture finishing, indoor finishing increased ($P<0.001$) finishing live weight gain by 666 g/day. There was a winter feeding level by finishing system interaction for overall live weight gain. This was due to a greater difference between pasture and indoor finishing for the animals on the higher winter feeding level.

Pasture measurements and feed intake: Pasture data for the finishing period are shown in Table 14. Mean pre- and post- grazing sward height and herbage mass were 14.9 and 6.5 cm, and 2.10 and 0.53 t DM/ha, respectively. The differences between the pre- and post-grazing values were highly significant. Pre-grazing sward height and herbage yield values were similar for May and June but were lower for April. There was no difference between months in post-grazing sward height or yield. Herbage DM concentration was higher, while crude protein and *in vitro* digestibility values were lower, post- grazing than pre-grazing, but the difference in ash concentration, which tended to be higher post-grazing, was not significant. Herbage DM concentration pre- and post-grazing increased, while pre-grazing *in vitro* digestibility decreased, with time. Crude protein concentration pre- and post-grazing tended to decline with time but the effect was not statistically significant. Overall, the pasture measurements indicate that the animals had adequate good quality herbage available at all times during finishing.

Silage and total DM intakes, expressed absolutely, and in g/kg live weight (LW), are shown in Table 15. Throughout the winter period intake was significantly higher for FR than for BB with AA intermediate and generally not significantly different from the other two breed types for silage intake or from FR for total intake. When expressed per kg LW, there was no significant intake difference (other than in the first 5 weeks when AA was higher) between AA and BB, but the FR values were always significantly higher (except in weeks 11 to 16 when the values for all breed types were similar) than for the other two breed types.

Feeding the higher concentrate level in winter significantly depressed silage intake at all times, both absolutely and per kg LW. The overall depression in silage intake due to the higher winter concentrate level was 1.62 kg DM/day or 3.9 g/kg LW. The corresponding increase in total DM intake was 1.47 kg DM or 2.1 g/kg LW. Over the entire winter period mean daily concentrate DM intakes were 0.91 and 4.0 kg for the low and high concentrate feeding levels, respectively. Corresponding total intakes were 103 and 452 kg concentrate DM. The end of winter response to the higher concentrate input was 38 kg live weight or 109 g live weight per kg extra concentrate DM.

Concentrate intake during finishing are shown in Table 16. Absolute and per kg live weight concentrate intakes were significantly lower for AA and BB than for FR. Generally the animals on the lower winter concentrate level had a higher concentrate intake during finishing than those on the higher winter feeding level, significantly so for the overall period, but the magnitude of the actual difference was small. On a per kg LW basis, the animals on the lower winter concentrate level had a significantly higher concentrate intake during finishing. Concentrate intake for the mean 94 day finishing period was 956 kg DM.

Slaughter and carcass traits: Slaughter weight did not differ significantly amongst the breed types but due to differences in kill-out proportion, carcass weight was significantly greater for AA than for FR, and for BB than AA (Table 17). Carcass conformation class was significantly higher for AA than FR, and for BB than AA. Carcass fat class was significantly higher for AA, and significantly lower for BB, than for FR. Perinephric plus retroperitoneal fat weight, and its proportion of carcass weight, did not differ between FR and AA but both values were significantly lower for BB.

The higher winter feeding level significantly increased slaughter weight and carcass weight but had no effect on kill-out proportion. It also tended ($P<0.06$) to increase carcass conformation class but had no effect on carcass fat class. Perinephric plus retroperitoneal fat weight, and its proportion of carcass weight, were significantly higher for the higher winter feeding level. Finishing indoors rather than at pasture significantly increased all the measured slaughter variables except carcass fat class where the numerical increase did not reach significance. There was a significant interaction between breed type and winter feeding level for carcass conformation class. For both FR and BB, winter feeding level did not affect carcass conformation class whereas for AA, the higher winter feeding level significantly increased it.

Carcass length, carcass depth and leg length were all significantly greater for FR than for AA, while carcass length and depth were significantly less for BB than for AA with no difference between these breed types in leg length (Table 18). Scaled for carcass weight, all carcass measurements were significantly greater for FR and significantly less for BB than for AA. Winter feeding had no effect on absolute carcass measurements but the higher level significantly decreased all measurements per kg carcass weight. Finishing system also did not affect absolute carcass measurements but indoor finishing significantly decreased all measurements scaled for carcass weight.

Carcass compositional traits: In line with the differences in carcass weight, pistola weight was significantly greater for BB than for FR and AA which did not differ (Table 19). As proportion of side weight the pistola was significantly greater for BB than for FR, and for FR than AA. *M. longissimus* area, both absolutely and scaled for carcass weight, did not differ between FR and AA but was significantly greater for BB. Ribs joint weight did not differ significantly between the breed types. There was no significant difference between FR and AA in ribs joint muscle proportion but AA had significantly less bone and tended to have more fat. BB had significantly lower fat and higher muscle proportions than both FR and AA, but bone proportion did not differ significantly between AA and BB.

Pistola weight was significantly greater for the higher winter concentrate level, but as a proportion of side weight it was not significantly affected by winter concentrate level. Similarly, *m. longissimus* area was greater for the high winter concentrate level but when scaled for carcass weight there was no significant difference. Ribs joint fat proportion was higher and bone proportion was lower for the higher winter concentrate level, with muscle proportion not significantly affected. Indoor finishing significantly increased pistola weight but significantly reduced it as a proportion of carcass weight. Indoor finishing also increased *m. longissumus* area but when scaled for carcass weight there was no significant effect of finishing system. Ribs joint fat proportion was significantly higher and muscle and bone proportions were significantly lower, for indoor finishing.

There was no difference between FR and AA in *m. longissimus* chemical composition but moisture and protein concentrations were significantly higher, and lipid concentration was significantly lower, for BB. Winter feeding level had no significant effect on *m. longissimus* chemical composition. Moisture concentration was significantly greater and lipid concentration was significantly lower for pasture than for indoor finishing but protein concentration was unaffected by finishing system.

Table 12: Birth and arrival dates, live weights and live weight gains up to the commencement of the experimental treatments for Friesian (FR), Aberdeen Angus × Friesian (AA) and Belgian Blue × Friesian (BB) steers

	FR	AA	BB	s.e[1]	Significance
Birth date	Feb 20	Feb 22	March 03	2.35[2]	**
Arrival date	March 13	March 16	March 28	2.13[2]	***
Live weights (kg) at:					
Arrival	51^a	55^{ab}	59^b	1.65	**
Calf turn-out (June 06)	84	86	83	2.25	NS
1st Housing (October 28)	184	184	184	5.24	NS
Yearling turn-out (April 18)	262	267	267	5.18	NS
Start of treatments (Nov 30)	435	442	440	4.66	NS
Live weight gains (g/day) for:					
Calf arrival to turn-out	401	384	359	27.4	NS
Calf turn-out to 1st housing	693	683	704	23.5	NS
1st Housing to yearling turn-out	453	486	479	29.2	NS
Yearling turn-out to start of treatments	764	774	766	14.3	NS
Calf turn-out to start of treatments	647	658	659	11.3	NS

[1] For n = 24; [2] Days after January 1. [a,b] Values without a common superscript differ significantly (P<0.05) in this and subsequent tables.

Table 13: Live weight and live weight gains of Friesian (FR), Aberdeen Angus × Friesian (AA) and Belgian Blue × Friesian (BB) steers offered low (L) or high (H) winter concentrate levels and finished at pasture (P) or indoors (I)

	Breed type (B)			Winter (W)		Finish (F)		s.e.[1]	Significance			
Live weights (kg) at:	FR	AA	BB	L	H	P	I		B	W	F	I[2]
End of winter[3]	535	543	529	517	555	536	536	6.19	NS	***	NS	NS
Pre-slaughter[4]	628	634	634	620	643	604	659	6.16	NS	**	***	NS
Live weight gains (g/day) for:												
Winter[5]	888	888	793	686	1027	836	876	29.2	NS	***	NS	NS
Finishing[6]	1048	1081	1201	1185	1035	777	1443	33.7	*	**	***	NS
Overall[7]	961	974	977	912	1030	809	1133	19.9	NS	***	***	W x F[8]

[1] For Breed type (n = 24); [2] Interaction; [3] March 23; [4] June 16 (last weight for all animals together before slaughter); [5] Nov 30 to March 23; [6] March 23 to slaughter (94 days); [7] Nov 30 to slaughter (207 days); [8] Values of 782, 1041, 836 and 1224 (s.e. 28.2) for LP, LI, HP and HI, respectively.

Table 14: Pasture measurements during finishing of Friesian (FR), Aberdeen Angus × Friesian (AA) and Belgian Blue × Friesian (BB) steers

	Pre-grazing				Post-grazing				Significance[1]
	April	May	June	s.e	April	May	June	s.e	
Sward height (cm)	12.6^{a}	16.2^{b}	15.9^{b}	0.83	5.8	6.5	7.1	0.59	NS
Yield (t/ha)	1.64^{a}	2.36^{b}	2.30^{b}	0.217	0.40	0.54	0.66	0.175	NS
Dry matter (DM) (g/kg)	160^{a}	181^{a}	256^{b}	13.6	202^{a}	243^{a}	372^{b}	15.5	***
Crude protein (g/kg DM)	232	222	217	15.2	177	168	163	14.5	***
Ash (g/kg DM)	106	111	122	8.7	132	135	123	14.7	NS
In vitro digestibility (g/kg DM)	778^{a}	756^{a}	711^{b}	16.5	691	682	660	27.5	***

[1] Pre-grazing v. Post-grazing; [a,b] Pre- or post-grazing values within a row without a common superscript differ significantly ($P<0.05$).

Table 15: Winter silage and total feed intakes for Friesian (FR), Aberdeen Angus × Friesian (AA) and Belgian Blue × Friesian (BB) steers offered low (L) or high (H) winter concentrate levels and finished at pasture or indoors

	Breed type (B)			Winter (W)		s.e	Significance	
	FR	AA	BB	L	H		B	W
Winter silage intake (kg/DM/day) for:								
Weeks 1 to 5	7.83^{a}	7.65^{b}	7.42^{c}	8.76	6.51	0.062	**	***
Weeks 6 to 10	7.13^{a}	6.87^{ab}	6.57^{b}	7.67	6.02	0.096	*	***
Weeks 11 to 16	7.10	7.21	7.03	7.67	6.57	0.096	NS	***
Weeks1 to 16	7.32^{a}	7.21^{ab}	6.98^{b}	7.98	6.36	0.050	**	***
Mean total intake[2]	9.82^{a}	9.71^{a}	9.48^{b}	8.89	10.36	0.050	**	***
Winter silage intake (g/kg LW) for:								
Weeks 1 to 5	18.01^{a}	17.31^{b}	16.89^{c}	19.97	14.84	0.144	**	***
Weeks 6 to 10	14.79^{a}	14.10^{b}	13.65^{b}	16.15	12.21	0.233	*	***
Weeks 11 to 16	13.46	13.55	13.44	15.00	11.97	0.213	NS	***
Weeks 1 to 16	15.21^{a}	14.81^{b}	14.50^{b}	16.80	12.88	0.139	*	****
Mean total intake[2]	20.33^{a}	19.86^{b}	19.64^{b}	18.91	20.98	0.161	*	***

[1] For Breed (n=2); [2] Silage and concentrate DM. There was no significant B x W interaction; LW = Live weight.

Table 16: Concentrate intakes during finishing for Friesian (FR), Aberdeen Angus × Friesian (AA) and Belgian Blue × Friesian (BB) steers offered low (L) or high (H) winter concentrate levels and finished at pasture or indoors

	Breed type (B)			Winter (W)		s.e[1]	Significance		
	FR	AA	BB	L	H		B	W	B x W
Concentrate DM intake (kg/day)									
Weeks 1 to 4[2]	6.29	6.27	6.33	6.27	6.32	0.041	NS	NS	NS
Weeks 5 to 8	12.73^{a}	12.12^{b}	11.88^{b}	12.43	12.06	0.143	*	P<0.06	NS
Weeks 9 to 12	12.75^{a}	12.56^{ab}	12.06^{b}	12.75	12.41	0.083	0.08	*	NS
Weeks1 to 12	10.39^{a}	10.11^{b}	10.01^{b}	10.28	10.07	0.068	*	*	NS
Concentrate DM intake (g/kg LW)									
Weeks 1 to 4[2]	11.91	11.69	12.06	12.24	11.53	0.104	NS	**	NS
Weeks 5 to 8	21.07^{a}	20.00^{b}	19.71^{b}	21.13	19.39	0.162	**	***	*[3]
Weeks 9 to 12	18.78	18.55	18.27	19.22	17.84	0.148	NS	***	NS
Weeks 1 to 12	17.21^{a}	16.68^{b}	16.61^{b}	17.48	16.19	0.086	**	***	NS

[1] For Breed type (n=2); [2] Adjustment to *ad libitum* intake; [3] Values for FRL, FRH, AAL, AAH, BBL and BBH of 21.62, 20.53, 21.35, 18.66, 20.44 and 18.99, respectively; LW = Live weight.

Table 17: Slaughter traits of Friesian (FR), Aberdeen Angus × Friesian (AA) and Belgian Blue × Friesian (BB) steers offered low (L) or high (H) winter concentrate levels and finished at pasture (P) or indoors (I)

	Breed type (B)			Winter (W)		Finish (F)			Significance			
	FR	AA	BB	L	H	P	I	s.e[1]	B	W	F	I[2]
Slaughter weight (kg)	634	644	642	628	652	609	672	8.07	NS	**	***	NS
Kill out (g/kg)	493^{a}	506^{b}	530^{c}	507	512	503	516	2.80	***	NS	***	NS
Carcass weight (kg)	313^{a}	326^{b}	340^{c}	319	334	307	346	4.70	***	**	***	NS
Conformation class[3]	1.95^{a}	2.54^{b}	3.17^{c}	2.46	2.65	2.36	2.75	0.089	***	P<006	**	B x W[5]
Fat class[4]	3.12^{a}	3.58^{b}	2.88^{c}	3.13	3.26	3.09	3.29	0.113	***	NS	NS	NS
Perinephric + retroperitoneal fat	9.83^{a}	9.65^{a}	7.89^{b}	8.44	9.80	7.51	10.74	0.389	**	**	**	NS
Perinephric + retroperitoneal fat (g/kg)	31.3^{a}	29.2^{a}	22.9^{b}	26.3	29.3	24.6	31.0	1.117	***	*	***	NS

[1] For Breed type (n = 24); [2] Interaction; [3] EU Beef Carcass Classification Scheme : scale 1 (poorest = P) to 5 (best = E); [4] EU Beef Carcass Classification Scheme: scale 1 (leannest) to 5 (fattest); [5] Values for FRL, FRH, AAL, AAH, BBL and BBH of 1.95, 1.96, 2.25, 2.83, 3.17 and 3.17, respectively.

Table 18: Carcass measurements for Friesian (FR), Aberdeen Angus × Friesian (AA) and Belgian Blue × Friesian (BB) steers offered low (L) or high (H) winter concentrate levels and finished at pasture (P) or indoors (I)

	Breed type (B)			Winter (W)		Finish (F)			Significance		
	FR	AA	BB	L	H	P	I	s.e[1]	B	W	F
Carcass measurements (cm)											
Carcass length	141.9^{a}	139.7^{b}	137.9^{c}	139.4	140.3	139.2	140.5	0.72	***	NS	NS
Carcass depth	51.2^{a}	50.3^{b}	48.9^{c}	50.1	50.1	50.5	49.8	0.34	***	NS	NS
Leg length	80.4^{a}	77.7^{b}	76.9^{b}	78.3	78.4	78.0	78.6	0.51	***	NS	NS
Carcass measurements (cm/kg)											
Carcass length	0.457^{a}	0.429^{b}	0.408^{c}	0.438	0.424	0.456	0.407	0.0055	***	*	***
Carcass depth	0.165^{a}	0.155^{b}	0.145^{c}	0.158	0.152	0.166	0.144	0.0026	***	*	***
Leg length	0.259^{a}	0.238^{b}	0.227^{c}	0.247	0.237	0.256	0.228	0.0034	***	*	***

[1] For Breed type (n = 24). There were no significant interactions.

Table 19: Pistola and ribs joint weights, and *m. longissimus* composition of Friesian (FR), Aberdeen Angus × Friesian (AA) and Belgian Blue × Friesian (BB) steers offered low (L) or high (H) winter concentrate levels and finished at pasture (P) or indoors (I)

	Breed type (B)			Winter (W)		Finish (F)			Significance			
	FR	AA	BB	L	H	P	I	s.e^{1}	B	W	F	I^{2}
Pistola weight (kg)	71.3^{a}	73.4^{a}	79.4^{b}	73.4	76.0	70.6	78.8	1.11	***	*	***	NS
Pistola (g/kg side weight)	454^{a}	450^{b}	467^{c}	458	455	460	454	1.51	***	NS	*	NS
M. *longissimus* area (cm^{2})	63.3^{a}	64.2^{a}	79.1^{b}	67.6	70.2	64.6	73.2	1.71	***	NS	***	NS
M. *longissimus* area (cm^{2}/kg carcass)	0.204^{a}	0.196^{a}	0.233^{b}	0.212	0.211	0.211	0.211	0.0051	***	NS	NS	NS
Rib joint weight (kg)	7.84	8.09	8.11	7.92	8.11	7.31	8.72	0.139	NS	NS	***	NS
<u>Rib joint composition (g/kg)</u>												
Fat	164^{a}	173^{a}	108^{b}	136	157	120	173	6.87	***	**	***	NS
M. longissimus	187^{a}	188^{a}	221^{b}	200	197	203	194	3.61	***	NS	*	NS
Other muscle	430^{a}	431^{a}	461^{b}	444	437	450	431	5.64	***	NS	**	B x W^{3}
Total muscle	617^{a}	619^{a}	681^{b}	644	634	653	625	5.83	***	NS	***	NS
Bone	220^{a}	209^{b}	213^{ab}	219	209	227	201	3.59	*	*	***	NS
<u>*M. longissimus* composition (g/kg)</u>												
Moisture	719^{a}	722^{a}	739^{b}	730	724	733	721	3.05	***	NS	**	NS
Protein	220^{a}	219^{a}	226^{b}	221	223	222	221	1.26	***	NS	NS	NS
Lipid	54^{a}	51^{a}	25^{b}	42	46	37	50	3.71	***	NS	**	NS

[1] For Breed type (n = 24); [2] Interaction; [3] Values for FRL, FRH, AAL, AAH, BB and BBH of 433, 427, 444, 417, 454 and 468, respectively.

Grange Beef Research Centre

Comparison of Holstein-Friesian, Piedmontese x Holstein-Friesian and Romagnola x Holstein-Friesian steers for muscle composition and colour traits

The Piedmontese and Romagnola Italian cattle breeds have been imported into Ireland and have been evaluated for beef production. In addition to general productivity, muscle composition and colour are commercially important traits especially for carcasses destained for export to the Italian market. The objective of this study was to compare Holstein-Friesian (HF), Piedmontese x Holstein-Friesian (PM) and Romagnola x Holstein-Friesian (RO) steers for muscle chemical composition and colour traits.

Over two consecutive years spring-born calves, mainly by artificial insemination (AI) from sires representative of the breeds being evaluated, and out of HF dairy cows, were sourced from dairy farms. They were purchased shortly after birth and moved to Grange Beef Research Centre where they were reared according to the norms for a two year-old dairy beef system. After calf rearing indoors they were turned out to pasture for their first grazing season.

At the end of the first grazing season animals were then housed and offered grass silage plus 1 kg concentrates per head daily during the first winter and afterwards were turned out to pasture for their second grazing season. At the start of the second winter, animals were blocked on weight within breed type, taking account of sire, and assigned from within blocks to a 3 (breed types - HF, PM and RO) x 2 (feeding levels) x 2 (finishing periods) factorial arrangement of treatments. The two feeding levels were 3 kg/day (low; L) and 6 kg/day (high; H) supplementary concentrates offered with grass silage *ad libitum*. The two finishing periods were 124 days (short; S) and 207 days (extended; E). Accommodation was in a slatted shed.

After slaughter in a commercial abattoir, cold carcass weight (0.98 x hot weight) and weight of perirenal plus retroperitoneal fat were recorded. Carcasses were graded for conformation and fatness. After a 24 h chilling period (4°C) the right side of each carcass was cut into a pistola hind quarter and remaining fore quarter. The hind quarters were transported to the meat laboratory in a refrigerated truck and placed in a chill (4ºC) for a further 24 h. The ribs joint (ribs 6-10) was removed from the pistola, and from the 10th rib end, 3 steaks each about 2.5 cm thick were cut from the *m. longissimus*. One was used to measure drip loss, the second was used for Hunterlab colour measurements immediately after cutting (0h) and after a 2 h blooming period (2h), and the third was frozen and later chemically analysed for moisture, protein, lipid and ash.

The data were analysed in SAS as a 3 (breed types) x 2 (feeding levels) x 2 (finishing periods) factorial with terms for block, breed type, feeding level, finishing period and the relevant interactions. Differences between breeds were separated using the PDIFF statement in SAS.

Carcass weights were similar for HF and PM but significantly heavier for RO (Table 20). Carcass fat class was significantly lower for PM than for HF and RO which did not differ. Both absolutely and scaled for carcass weight, perirenal plus retroperitoneal fat did not differ for HF and RO but was significantly lower for PM.

Muscle chemical composition and drip loss did not differ significantly between PM and RO but HF muscle had lower moisture and protein (not significant for RO) concentrations, and lower drip loss, and a higher lipid concentration than both beef crosses. Muscle colour values, immediately after cutting and after 2 h blooming did not differ between the breed types. Changes in colour as a result of blooming were small. L and hue values were similar before and after blooming while a, b and chroma values showed modest increases following blooming.

The higher feeding level increased carcass weight by 18 kg ($P<0.001$). There was no effect on carcass fat score or weight of perirenal plus retroperitoneal fat, but the latter scaled for carcass weight was lower for the higher feeding level. Muscle chemical composition was not affected by feeding level and neither was drip loss. There was no effect of feeding level on muscle colour traits at 0 h, but after 2 h blooming, the values for L ($P<0.08$), a, b and chroma were significantly lower for the higher feeding level.

Extending the finishing period increased carcass weight by 39 kg ($P<0.001$). This was associated with significant increases in carcass fat class, perirenal plus retroperitoneal fat weight and its proportion of carcass weight. Muscle moisture and protein concentrations, and drip loss, were significantly lower, and muscle lipid concentration was significantly higher, for extended finishing. At 0 h, L, a and chroma values were all lower and hue value was higher for extended finishing. After 2 h blooming, the L value was still significantly lower for extended finishing, but none of the other differences were significant though the trends were the same as at 0 h. Blooming had little effect on L and hue values, but a, b and chroma values were all higher following blooming.

There were feeding level x finishing period interactions for the L at both 0 h and 2 h. This was due in both instances to a greater decrease in L value with extended finishing for the higher feeding level. There was a breed x finishing period interaction for hue at 0 h because of a greater increase in hue value for extended finishing for HF than for the beef crosses.

The lower muscle moisture and protein contents and the higher lipid content of HF, reflect their higher carcass fat class and higher perirenal plus retroperitoneal fat weight and proportion. Drip loss reflected muscle moisture content, being higher for PM and RO. The small differences between the breeds in a and chroma values at 0 h disappeared with blooming indicating that on commercial display the bloomed muscle from the three breeds would be indistinguishable in colour.

While the higher feeding level did increase carcass weight, the effect (18 kg) was relatively small and had no effect on muscle chemical composition. However, the L value was lower both at 0 h and after blooming ($P<0.08$), and the a, b and chroma values were also lower after blooming. The higher carcass fat score and perirenal plus retroperitoneal fat weight and proportion following extended finishing were paralleled by lower muscle moisture and protein contents and an increased lipid content. The lower drip loss for extended finishing was associated with moisture content being lower, while the lower L value at both 0 h and 2 h following extended finishing might be expected from the greater age of the animals. Other than L value, muscle from the two finishing periods would be indistinguishable in colour following blooming.

It is concluded that HF had lower muscle moisture and protein contents and a higher muscle lipid content than PM and RO which were similar. There were no important muscle colour differences between the breeds. Feeding level during finishing, while increasing carcass weight and perirenal plus retroperitoneal fat proportion, had no affect on muscle chemical composition and only minor effects on colour. Extending the finishing period increased carcass weight and all indicators of fatness. It reduced muscle moisture, protein and drip loss contents and increased muscle lipid content. It also reduced L colour value both before and after blooming.

Keane, M.G. and Allen, P.[1] *RMIS No. 5216*

[1]Teagasc, Ashtown Food Research Centre, Ashtown, Dublin

Table 20: Slaughter traits, muscle chemical composition and muscle colour traits of Holstein-Friesian (HF), Piedmontese x Holstein-Friesian (PM) and Romagnola x Holstein-Friesian steers finished on low (L) or high (H) feeding levels and slaughtered after short (S) or extended (E) finishing periods

	Breed			Feed Level (F)		Finishing Period (P)			Significance			
Slaughter traits	HF	PM	RO	L	H	S	E	s.e.d[1]	B	F	P	I[2]
Carcass weight (kg)	324^{a}	326^{a}	341^{b}	321	339	311	350	5.44	**	***	***	NS
Fat score[3]	3.95^{a}	3.40^{b}	3.83^{a}	3.74	3.72	3.42	4.04	0.108	***	NS	***	NS
Perirenal + retroperitonal fat (kg)	15.0^{a}	12.8^{b}	15.1^{a}	14.6	14.0	11.7	16.9	0.53	***	NS	***	NS
Perirenal + retroperitonal fat (g/kg)	46.2^{a}	39.1^{b}	44.2^{a}	45.2	41.2	37.8	48.6	1.64	***	**	***	NS
Muscle chemical composition (g/kg)												
Moisture	706^{a}	718^{b}	718^{b}	716	713	722	706	3.38	***	NS	***	NS
Protein	218^{a}	223^{b}	221^{ab}	221	222	224	217	1.63	**	NS	***	NS
Lipid	63^{a}	44^{b}	49^{b}	49	54	40	63	4.55	***	NS	***	NS
Ash	11	11	11	11	11	11	11	0.20	NS	NS	NS	NS
Muscle drip loss (g/kg)	15.4^{a}	23.1^{b}	23.0^{b}	19.8	21.2	24.5	16.5	1.85	***	NS	***	NS
Hunterlap colour value (0 h)												
L	31.3	31.3	31.8	32.0	30.9	33.4	29.5	0.702	NS	*	***	F x P*[4]
A	13.3^{a}	14.7^{b}	14.6^{b}	14.1	14.4	14.8	13.6	0.492	**	NS	***	NS
B	8.2	8.3	8.5	8.1	8.5	8.2	8.5	0.281	NS	NS	NS	NS
Chroma	15.7^{a}	16.9^{b}	16.9^{b}	16.3	16.7	17.0	16.1	0.486	*	NS	*	NS
Hue	32.0	29.2	30.2	30.2	30.7	28.7	32.2	0.789	**	NS	***	B x P[5]
Hunterlab colour values (2 h)												
L	30.8	30.5	31.2	31.3	30.3	33.6	28.0	0.711	NS	P<0.08	***	F x P***[6]
A	16.0	16.8	17.3	17.2	16.2	17.0	16.4	0.591	NS	*	NS	NS
B	9.3	9.5	9.8	10.0	9.1	9.6	9.5	0.360	NS	**	NS	NS
Chroma	18.6	19.3	19.9	19.9	18.6	19.5	19.0	0.638	NS	*	NS	NS
Hue	30.4	29.5	29.7	30.2	29.6	29.5	30.2	0.838	NS	NS	NS	NS

[1] For n = 40 (breed type); [2] Interactions; [3] EU Beef Carcass Classification Scheme : scale 1 (leanest) to 5 (fattest); [4] Values for LS, LE, HS and HE of 33.2, 30.8 , 33.5 and 28.2, respectively; [5] Values for HFS, HFE, PMS, PME, ROS, and ROE of 28.9, 35.0, 28.5, 29.9, 28.8 and 31.7, respectively; [6] Values for LS, LE, HS, and HE of 33.1, 29.6, 34.1 and 26.5, respectively.

Effect of breed and genetic merit on feed intake and growth rate in beef × dairy and dairy steers

Profitability in beef production is influenced by growth rate and feed efficiency. In Ireland genetic merit for growth is expressed as carcass weight. The purpose of this study was to compare feed intake and growth rate of steers differing in breed and genetic merit for growth.

Male progeny of 23 beef sires having either high (H; n=13) or low (L; n=10) genetic merit for growth were sourced in spring 2006. The beef sire breeds were Aberdeen Angus (AA; n=10) and Belgian Blue (BB; n=13). There were also progeny from Friesian sires (F; n=7) and Holstein sires (O; n=6) giving a total of 6 genetic groups. The calves (n=174) were born to spring-calving Holstein-Friesian cows and were purchased from 61 commercial dairy herds at 2 to 8 weeks of age. They were reared under standard conditions at Grange Beef Research Centre. During the first winter, individual dry matter intake (DMI) was recorded for 144 steers on two diets, namely silage only (-) or silage plus 3 kg/day concentrates (+). The animals were balanced across treatment for sire and starting live weight (LW). DMI was measured on each of 5 days per week, over two 7 week periods. All steers were weighed monthly. During the second grazing season grass DMI was measured over a 5 week period on 48 steers using zero grazing. These were balanced for LW, age, sire and feed intake period from the previous winter. Intake was evaluated both as DMI and DMI per kg mean LW (DMIW). General linear models were used to determine the effects of breed, genetic merit and diet on DMI, average daily gain (ADG) and LW. Week of age, parity of dam, and winter intake period were included as factors in the model with sire as a random effect. The individual animal was considered the experimental unit in these analyses. Contrast statements were used to partition the variation into orthogonal components, namely; H v L; AA v BB; interaction between H/L and beef breed; F v O; beef v dairy breeds; and relevant interactions.

In winter there was a breed by genetic merit interaction for total DMIW with L having a higher value ($P<0.01$) than H for AA (Table 21) but not for BB ($P>0.05$). There was also a diet by genetic merit interaction for total DMIW in that there was no effect of genetic merit on silage alone ($P>0.05$) but on silage plus concentrates, total DMIW was higher ($P<0.01$) for H. Within beef breed animals there was no effect ($P>0.05$) of breed on silage or total DMI, but because BB were heavier ($P<0.05$), total DMIW was lower ($P<0.001$) for BB. The addition of concentrates to the diet increased ($P<0.05$) total DMIW more for AA than BB. There were no differences in silage or total DMI between F and O but total DMIW was lower ($P<0.05$) for F. All measures of DMI in winter were higher ($P<0.001$) for the dairy than for the beef breeds and the dairy breeds were also heavier ($P<0.001$). Supplementary concentrates reduced ($P<0.001$) silage DMI, both in absolute terms and when adjusted for LW, but increased ($P<0.001$) total DMI and total DMIW. Overall ADG was higher in winter for H compared with L ($P<0.05$). There was no effect ($P>0.05$) of genetic group on either grass DMI or grass DMIW.

During the winter period, growth rate and DMI were influenced by genetic merit. H grew faster and had greater DMI than L on an absolute basis but when total DMI was adjusted for LW, L had the greater values. Consequently, feed efficiency was superior for H. Dairy breeds had greater DMI and LW than beef breeds. Other than for total DMIW, there were no beef breed by diet interactions. Intake trends were generally similar for the silage-based and grass diets.

Table 21: Effect of breed and genetic merit on LW (kg), ADG (kg/day), DMI (kg/day) and DMIW (g/kg day^{-1})

	AA		BB		Dairy			Diet (D)			Significance of contrasts[2]					
Trait	H	L	H	L	F	O	s.e.[1]	+	-	s.e.[1]	G	B	G*B	M	A	D
LW - winter[3]	219	196	226	212	240	221	5.24	227	210	3.36	***	*	NS	**	***	***
ADG - winter[4]	0.56	0.51	0.57	0.52	0.55	0.57	0.03	0.76	0.15	0.02	*	NS	NS	NS	NS	***
Silage DMI	3.41	3.23	3.47	3.27	4.00	3.86	0.09	3.23	3.84	0.06	*	NS	NS	NS	***	***
Silage DMIW	15.7	16.6	15.6	15.6	16.9	17.6	0.3	14.3	18.4	0.2	NS	NS	NS	NS	***	***
Total DMI	4.62	4.44	4.68	4.48	5.21	5.07	0.09	5.65	3.84	0.06	*	NS	NS	NS	***	***
Total DMIW	21.3	23.1	20.9	21.0	21.9	22.9	0.4	25.2	18.5	0.2	**	***	**	*	**	***
LW - pasture[3]	370	352	398	382	385	384	13.1	-	-	-	NS	*	NS	NS	NS	-
ADG at pasture	0.87	0.82	0.88	0.90	0.86	0.92	0.03	-	-	-	NS	NS	NS	NS	NS	-
Grass DMI	7.31	7.36	7.44	7.61	7.62	7.55	0.26	-	-	-	NS	NS	NS	NS	NS	-
Grass DMIW	19.8	21.1	18.8	20.0	20.2	19.7	0.9	-	-	-	NS	NS	NS	NS	NS	-

[1] Pooled standard error for genetic group; [2] G = H v L, B = AA v BB, M = F v O, A = Beef v Dairy, D = Diet; [3] Mean LW over intake period.

Keane, M.G., Campion, B.[1], Kenny, D.A.[2] and Berry, D.P.[3] *RMIS No. 5470*

[1] Walsh Fellow, UCD School of Agriculture, Food Science and Veterinary Medicine, Belfield, Dublin
[2] Superviser, UCD School of Agriculture, Food Science and Veterinary Medicine, Belfield, Dublin
[3] Teagasc, Moorepark Dairy Production Research Centre, Cork

Organic Beef Production

The current experiment, location at Johnstown Castle Environmental Research Centre, is to determine the effects of sire breed type (Charolais and Aberdeen Angus) on production and meat quality in organic beef production. A 44-cow continental-cross spring-calving herd has been established. This herd is principally comprised of Limousin x and Simmental x cows. Using a representative group of bulls from each breed 50% of the cows were each bred to either Aberdeen Angus or Charolais sires. The progeny of the herd are slaughtered on three dates. At the first date half the Charolais and half the Aberdeen Angus heifers were slaughtered. At the middle date the remaining heifers were slaughtered as well as half the steers from each breed group and at the final date the remainder of the steers were slaughtered.

The cow/calf herd follows a rotational grazing system in a designated area of the 60 ha farm, while the yearling heifers and steers also rotational grazing on a different land area. The animals were accommodated on straw accordingly to organic standards. Soil fertility was determined over the past three years and the data are summarised in Table 22.

Table 22: Phosphorus (P) and Potassium (K) status (µg/g) of organic beef cow unit for year 1 (2005) year 2 (2006) and year 3 (2007)

	Mean P	% plots <3.1(µg/g)	Mean K	% plots < 51(µg/g)
2005	3.91	55	166.4	2
2006	3.21	52	109.3	5
2007	4.31	27	142.2	6

In both year 1 and year 2 the Charolais calves were approximately 10 kg heavier at birth than the Aberdeen Angus calves (Table 23). In both year 1 and year 2 the performance of both sire breeds and male and female from birth to weaning was satisfactory, averaging 1.20 kg/day in year 1 and 1.00 kg day in year 2 (Table 23). The liveweight performance of the Charolais and Angus steers was similar with liveweights of 535 and 534 kg respectively at the end of the grazing season (October 2007). The corresponding values for the Charolais and Angus heifers was 543 and 512 kg (Table 24 and 25). The late groups of heifers slaughtered responded well to the additional feeding from October to January when the cold carcass weight increased from 276 kg to 343 kg (Table 26). Similarly, the late groups of steers slaughtered responded well to the additional feeding from January to March when cold carcass weight increased from 344 to 388 kg.

Table 23: Effect of sire breed on calf performance to weaning (kg)

	AA		CH	
	Male	Female	Male	Female
Year 1 (2006)				
Birth wt (kg)	46	43	58	50
Weaning wt (kg)	292	275	326	298
Liveweight gain (kg/d)	1.17	1.17	1.31	1.12
Year 2 (2007				
Birth wt (kg)	44	39	57	49
Weaning wt (kg)	264	226	269	264
Liveweight gain (kg/day)	1.02	0.91	1.06	1.04

Table 24: Effect of sire breed on calf performance to yearling (kg)

	AA		CH	
	Male	Female	Male	Female
Year 1 (2006)				
Birth wt (kg)	46	43	58	50
Weaning wt (kg)	292	275	326	298
Mid-April 2007 wt (kg)	348	314	353	359
Year 2 (2007				
Birth wt (kg)	44	39	57	49
Weaning wt (kg)	264	226	269	264
Mid-April 2008 wt (kg)	357	314	362	345

Table 25: Effect of sire breed and sex on performance of calves born in spring 2006 (year 1)

	Steer		**Heifers**	
	AA	CH	AA	CH
No. of animals	13	12	9	10
Birth wt.	50	58	43	46
06 June 06	152	155	124	157
21 Nov. 06	338	342	305	344
19 April 07	348	353	314	359
24 Aug 07	492	477	461	496
23 Oct 07	535	534	512	543

Table 26: Effect of different slaughter dates on the performance (kg) male and female of calves born in spring 2006 (year 1)

	Steer		Heifers	
Slaughter date	Early (22 Jan)	Late (11 Mar)	Early (24 Oct)	Late (22 Jan)
No. of animals	13	12	10	9
Birth wt.	50	54	44	50
06 June 06	153	155	141	142
21 Nov. 06	334	346	321	330
19 April 07	346	355	338	337
24 Aug 07	483	486	474[1]	485[2]
24 Oct 07	534[2]	535[2]	522	532
22 Jan 08	615	615	-	609
11 Mar 08	-	688	-	-
Cold carcass wt	344	388	276	343
KO%	55.9	56.4	53.0	55.8

[1]Meals fed from 12 Sept.; [2]Meals fed from 5 Nov.

Fallon, R.J., Swan, B.[1] *and Shortle, G.*[1] *RMIS No. 5480*

[1]Teagasc, Johnstown Castle Environmental Research Centre, Wexford