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Comparison of steer breed types for muscle traits

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Abstract

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. A total of 120 steers in a 3 breed types (HF, PM and RO) x 2 feeding levels during finishing (3 kg and 6 kg/day concentrates with silage *ad libitum*) x 2 finishing periods (124 days, S and 207 days, E) were reared together and slaughtered commercially. Three samples of *m. longissimus* were taken cranial from the 10th rib. One was chemically analysed for moisture, protein, lipid and ash, one was used to measure drip loss, and one was used for Hunterlab colour measurements immediately after cutting and after a 2-h blooming period. Muscle moisture ($P<0.001$) and protein ($P<0.01$) concentrations were lower, and lipid concentration was higher ($P<0.001$) for HF than for PM and RO which did not differ. There were no significant effects of feeding level on muscle chemical composition. The E finishing period reduced ($P<0.001$) muscle moisture and protein concentrations, and drip-loss. It also reduced the L ($P<0.001$), a ($P<0.001$) and chroma ($P<0.05$) colour values at 0 h, and the L value ($P<0.001$) after blooming. It is concluded that PM and RO differed little in muscle chemical composition but HF had a lower moisture and a higher lipid concentration. Feeding level had few effects on muscle composition, but a delay in slaughter date increased all measures of carcass and muscle fatness and reduced muscle L value.

Keywords: beef breeds; dairy crosses; muscle colour, muscle composition.

Introduction

The Piedmontese and Romagnola Italian cattle breeds have been imported into Ireland and have been evaluated for beef production (Keane and Allen, 2002). In addition to general productivity, muscle composition and colour are commercially important traits especially for carcasses destined for export to the Italian market (Dunne *et al.*, 2004). The objective of this study was to compare Holstein-Friesian (HF), Piedmontese x Holstein-Friesian (PM) and Romagnola x Holstein-Friesian (RO) steers for *m. longissimus* chemical composition and colour traits.

Materials and Methods

Over two years consecutively, spring-born calves, from sires representative of the breeds being evaluated, and out of Holstein-Friesian dairy cows, were purchased shortly after birth and reared according to the norms for a two year-old dairy beef system (Keane and Drennan, 1991).

At the start of the second (finishing) winter each year, the animals (20 per breed type) 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 experiment. 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 cold carcass weight (0.98 x hot weight) was recorded and carcasses were graded for conformation and fatness. After a 24-h chilling period (4°C), 3 steaks, each about 2.5 cm thick, were cut from the *m. longissimus* cranial from the 10th rib. One was frozen for later chemical analysis for moisture, protein, lipid and ash, one was used to measure drip loss, and the third was used for colour measurements immediately after cutting (0 h) and after a 2 h blooming period (2 h). The data were analysed as a 3 (breed types) x 2 (feeding levels) x 2 (finishing periods) factorial using the general least squares linear model procedures of SAS (SAS, 1989/92). The model had terms for year, block, breed type, feeding level, finishing period and relevant interactions. Differences between breeds were separated using the PDIFF statement.

Results

Carcass weights were similar for HF and PM but were significantly heavier for RO (Table 1). Carcass fat class was significantly lower for PM than for HF and RO which did not differ. Perirenal plus retroperitoneal fat weight did not differ for HF and RO but was significantly lower for PM.

Muscle chemical composition and drip loss did not differ between PM and RO but HF had a lower muscle moisture concentration, lower drip loss, and a higher muscle lipid concentration than the two beef crosses. Muscle colour values, immediately on cutting and after 2 h blooming did not differ between the beef crosses but the a and chroma values were lower after cutting for HF. Changes in colour as a result of blooming were small, but the breed difference present at 0 h

had disappeared at 2 h. Ash concentration was unaffected by any of the treatments. The higher feeding level increased carcass weight by 18 kg ($P<0.001$) but there was no effect on carcass fat class, perirenal plus retroperitoneal fat weight, muscle chemical composition or drip loss. The only effect of feeding level on muscle colour traits at 0 h was a decrease in the L value as a result of the higher feeding level, but after 2 h blooming, the values for L ($P<0.08$), a, b and chroma were all 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 and perirenal plus retroperitoneal fat weight. Muscle moisture and protein concentrations, together with drip loss, were significantly lower, and muscle lipid concentration was significantly higher, for extended finishing. At 0 h, L, a and chroma colour values were significantly lower, and hue value was significantly 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.

Discussion

The lower muscle moisture and protein concentrations, and higher lipid concentration of HF parallel the differences in pistola composition published previously (Keane and Allen, 2002). However, the absence of differences between PM and RO in muscle chemical composition is at variance with the differences between these breeds in pistola composition (Keane and Allen, 2002), which showed greater fatness for RO. Differences between Holstein-Friesians and late maturing beef breed crosses in muscle chemical composition have been demonstrated previously (Keane *et al*., 1991, 2001). With late maturing beef breeds, Homer *et al*. (1997) found no difference in muscle moisture concentration between Charolais and Belgian Blue cross steers differing in subcutaneous fat proportion, but there was a difference in muscle lipid concentration. While drip loss reflected differences in muscle moisture concentration, being higher for PM and RO than for HF, the difference between HF and the beef breeds was relatively greater than the difference in moisture concentration.

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 colour value was lower both at 0 h and after blooming ($P<0.08$), and the a, b and chroma colour values were also lower after blooming. These lower values for the higher feeding level appear to be at variance with the findings of Keane and Allen (1998) who reported higher L, a and b values for conventionally reared compared with extensively reared steers, and intensively reared animals had a higher b value than those conventionally reared.

The lower muscle moisture concentration and the higher muscle lipid concentration with extended finishing agree with the findings of Keane and Allen (1998). The lower drip loss for extended finishing paralleled the lower moisture concentration, while the lower L colour value at both 0 h and 2 h would 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 concentrations and a higher muscle lipid concentration than PM and RO which were similar. After blooming there were no muscle colour differences between the breeds. Feeding level during finishing had no effect on muscle chemical composition but after blooming all colour values except hue were lower for the higher feeding level. Extending the finishing period increased carcass weight and all measures of fatness. It also reduced muscle moisture and protein concentrations, and drip loss, and increased muscle lipid concentration. The L colour value both before and after blooming was also lower after extended finishing.

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

[1]For n = 40 (breed type); [2]Interactions; [3]EU Beef Carcass Classification Scheme: scale 1 (leannest) 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; [ab]Within a row, values without a common superscript differ significantly.