DELAYED CONCENTRATE FEEDING IN A GRASS SILAGE/CONCENTRATE BEEF FINISHING SYSTEM: EFFECTS ON FAT COLOUR AND MEAT QUALITY

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Background

The majority of Irish calves are spring-born. The most widely practised system of beef production is steers. slaughtered at approximately 2 years of age, following a period of indoor finishing on grass silage and concentrates. Because of the need to retain animals to a fixed age, or for a fixed period, for premia purposes, flat rate feeding of supplementary concentrates during finishing is not always appropriate as some animals could be over-fat by the premium eligibility date. Feeding silage only, initially, and feeding all the concentrates towards the end of the finishing period would allow for better control of slaughter weight and fatness. This might also decrease the yellowness of fat due to finishing on a non-forage diet and enhance meat tenderness due to higher pre-slaughter growth rate (May *et al.,* 1992). Delaying the onset of concentrate feeding by 35 days however, had no effect of meat quality (Moloney *et al.,* 2000) but fat colour was not measured in that study.

Objective

The objective of this study was to document the changes in fat colour and the eating quality of beef in response to different delays in the onset of supplementation with a fixed quantity of concentrates during the finishing phase.

Methods

Forty-eight Charolais x Friesian steers and 24 Friesian steers were reared to the end of the second grazing season at about 19 months of age according to a standard 2 year-old steer production system (Keane and Drennan, 1991). The animals were housed for their second winter and blocked on weight, within breed, to 4 treatment groups. Treatment 1 (control) was grass silage *ad libitum* + a flat rate of 6 kg concentrates [(g/kg: barley 870, soyabean meal 67.5, molasses 47.5 and minerals/vitamins 15)] daily; Treatment CD0 was concentrates offered in increasing quantities from day 0 until the *ad libitum* level of consumption was achieved; Treatments CD56 and CD112 were concentrates offered *ad libitum* beginning on day 56 and 112, respectively. Animals on these treatments were offered grass silage *ad libitum* until the beginning of concentrate feeding.

All animals were slaughtered after 900 kg of concentrates were consumed. After slaughter, carcass weight was recorded and carcasses assessed for fatness and conformation according to the EU Beef Carcass Classification Scheme. The weight of kidney + channel fat was recorded and a sample was stored at 4^0C for 48 h prior to colour analysis (Strange *et al.,* 1974). Samples of subcutaneous fat and the *longissimus thoracis et lumborum* (LTL) muscle were removed 48 h post-mortem. Fat colour was measured immediately. On LTL, lean colour was measured 2 and 14 days post mortem (Strange *et al*., 1974), drip loss was measured 2 days post mortem (Honikel, 1987) and Warner Bratzler shear force (Shackelford *et al.,* 1994) was measured after 2, 7 and 14 days ageing. Data were subjected to analysis of variance using a model that had block, breed, treatment and the breed x treatment interaction as main effects. Linear and quadratic effects of delay in onset of concentrate feeding were partitioned using orthogonal polynomials.

Results and discussion

Data are summarised in Table 1. Charolais cross steers had heavier carcasses, but less kidney+channel fat (as weight or when expressed as a proportion of carcass weight) than Friesian steers. There was an interaction between diet and breed for carcass fatness score whereby Charolais crosses tended to have higher scores for all diets other than CD56. Delaying the onset of concentrate supplementation increased ($P < 0.05$, linear and quadratic) pre-slaughter growth rate and carcass weight and increased ($P < 0.05$ linear) fat deposition. Compared to the control animals, delaying concentrate supplementation increased ($P < 0.05$) pre-slaughter growth rate and decreased ($P < 0.05$) kidney+channel fat as a proportion of carcass weight.

There was no difference between breeds in yellowness of fat from either depot. Delaying the onset of concentrate supplementation decreased ($P<0.05$, linear and quadratic) yellowness of both depots. For LTL, Charolais crosses had lower ($P<0.01$) lipid concentration, lighter and redder colour, lower shear force and higher moisture concentration and drip loss than Friesians. Delaying the onset of concentrate supplementation decreased ($P<0.05$, linear and quadratic) pH, lightness at 14 days post-mortem and lipid concentration ($P<0.05$, linear) and increased ($P<0.05$, linear and quadratic) redness at 14 days post-mortem, moisture concentration and drip loss ($P<0.05$, quadratic). Compared to control animals, LTL from CD0 animals was less red and yellow (2 days), lighter at 14 days and had higher shear force; LTL from CD56 animals was less red (2 and 14 days), lighter and less yellow (14 days), had higher shear force (2 and 14 days) and had less lipid; LTL from CD112 animals had lower pH, was less red (2 days), lighter, more red and more yellow (14 days) and had higher shear force (2 days). There was an interaction between diet and breed for LTL shear force values. Thus, for LTL after 7 or 14 days ageing shear force was similar for both breeds on the control and CD112 treatments but lower for Charolais crosses on the CD0 and CD56 diets.

For growth performance and fat deposition, the results were largely consistent with earlier findings (Keane and Drennan, 1991: Keane, 1998). For meat quality, differences between the breeds in the composition and appearance of LTL are consistent with the differences reported by Sinclair *et al.* (1998) between early and late-maturing breeds. The apparently more tender LTL from

Charolais cross steers in this study contrasts however with the data of Sinclair *et al.* (1998). When compared to the control animals, the greatest effects of delaying the onset of concentrate supplementation were seen at 56 days. The lack of effect of concentrate delay seen by Moloney *et al.* (2000) therefore likely reflects the shorter delay (35) days in that study. With respect to tenderness, a concentrate delay greater than 56 days was required to ensure a similar mean shear force value as the control group.

Conclusion

The data confirm the potential of concentrate supplementation delay as a tool to manipulate fat deposition in finishing steers. This strategy also has potential as a means of reducing fat yellowness. Relative to flat rate feeding of concentrates, delayed introduction followed by *ad libitum* feeding tended to decrease muscle tenderness.

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Table 1. Growth, carcass characteristics, fat colour and *longissimus muscle* quality attributes in steers offered concentrates at different times during the finishing phase.

	Concentrate delay (CD; days)				Breed			Contrast[2]		
	Control	0	56	112	Friesian	Charolais	EMS[1]	Breed	Diet	CD
Number of animals	18	18	18	18	24	48	-	-	-	-
Initial weight (kg)	491	491	490	491	477	497	178.8	*	NS	NS
Days on *ad libitum* concentrates	0	104	90	84	-	-	-	-	-	-
Pre-slaughter growth rate (g/day)	968^{a}	1178^{b}	1112^{b}	1521^{c}	1164	1210	60.5	NS	*	L,* Q*
Final weight (kg)	640^{a}	613^{b}	625^{a,b}	672^{c}	624	644	680.0	*	*	L*, Q*
Carcass weight (kg)	335^{a}	326^{a}	331^{a}	357^{b}	320	346	214.7	*	*	L*, Q*
Fatness scores[3]	3.82^{a}	4.17^{b}	4.03^{a,b}	4.17^{b}	3.86	4.14	0.153[4]	*	*	NS
Kidney/channel fat (kg)	15.7^{a}	11.3^{b}	12.5^{b}	14.4^{a}	14.5	12.9	4.80	*	*	L*
g/kg carcass	47.2^{a}	35.0^{c}	37.6^{b,c}	40.7^{b}	45.5	37.5	0.049	*	*	L*
Fat yellowness[3]										
Subcutaneous	18.5^{b}	18.1^{b}	18.6^{b}	17.1^{a}	18.0	18.1	2.26[4]	NS	*	L*, Q*
Kidney/channel	18.1^{b}	19.0^{c}	16.6^{a}	17.0^{a}	17.7	17.7	1.68	NS	*	L*,Q*
pH 48h	5.55^{a}	5.56^{a}	5.59^{a}	5.36^{b}	5.53	5.51	0.008	NS	*	L*, Q*
Drip loss %	2.2^{b}	2.3^{b}	2.7^{a}	2.2^{b}	2.2	2.5	0.32[4]	*	*	Q*
Colour-2 days[3]										
L	34.0	34.0	33.8	33.9	33.0	34.4	3.68	*	NS	NS
a	13.6^{a}	12.5^{b}	12.5^{b}	12.6^{b}	12.0	13.2	1.71	*	*	NS
b	7.8^{a}	7.0^{b}	7.4^{a,b}	7.3^{a,b}	6.8	7.7	0.52	*	*	NS
Colour-14 days[3]										
L	36.4^{c}	34.5^{b}	36.4^{c}	33.0^{a}	34.4	35.4	4.08	*	*	L*, Q*
a	17.4^{b}	17.2^{b}	15.0^{a}	19.3^{c}	16.9	17.4	1.25[4]	NS	*	L*, Q*
b	9.8^{b}	9.6^{b}	9.0^{a}	11.4^{c}	9.6	10.1	0.49	*	*	L*, Q*
Shear force (kg) – 2 days	5.0^{a}	7.5^{c}	6.7^{b}	6.4^{b}	7.6	5.8	2.97	*	*	NS
7 days	4.7^{a}	6.6^{b}	5.5^{a}	4.9^{a}	6.5	4.9	1.98[4]	*	*	L*
14 days	3.5^{a}	5.0^{c}	4.3^{b}	3.8^{a,b}	4.7	3.9	0.90[4]	*	*	L*
Lipid (g/kg)	48^{b}	46^{b}	35^{a}	43^{a,b}	51	39	18.9	*	*	Q*
Moisture (g/kg)	712^{a}	713^{a}	725^{b}	724^{b}	713	721	10.7	*	*	L*, Q*

[1]EMS = error mean square; [2]L and Q are linear and quadratic effects of delay in concentrate feeding, respectively; Means with different superscripts differ significantly (P<0.05). [3]Higher values = fatter, more yellow, lighter, more red, more yellow. [4]Diet x breed interaction (P < 0.05).