THE INFLUENCE OF TYPE OF DIET AND ELECTRICAL STIMULATION ON THE EATING QUALITY OF BEEF

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SUMMARY

Fifty four Angus and Angus X steers were fed for 111 days on diets based on either pasture or grain. Initial liveweight, average daily gain and final liveweight for the pasture and grain fed groups were 225 kg, 1.51 kg/head/day, 393.1, and 221 kg, 1.55 kg/head/day, 393.1 kg respectively. After slaughter one side of each carcase was electrically stimulated. Diet had no effect on Instron shear force, adhesion and tenderness as assessed by a taste panel. Animals fed on grain diets had a lighter meat colour and whiter fat than those fed on pasture. Meat from the electrically stimulated sides had significantly ($P < 0.01$) lower shear force than that from unstimulated sides.

INTRODUCTION

It is widely believed in the beef industry that meat from animals finished on grain based concentrate diets is more tender and has better market acceptability characteristics than meat from animals finished on pasture.

A number of comparisons of grain and pasture diets have been made. In relation to tenderness, results have been inconsistent with studies showing an advantage for grain diets (Purchas and Davies 1974; Bowling et al. 1977), no differences (Davies 1977) and an advantage to pasture fed cattle (Wheeling et al. 1975). However in all of these studies the effect of diet has been confounded with other factors which can influence tenderness such as carcase weight, fatness and age. These problems are usually a consequence of higher growth rate on grain based diets. In the South-west of Western Australia over the spring period (August-November), liveweight gains on pasture can be expected to be similar to those made on grain diets hence eliminating this problem.

Another factor which can have an overriding influence on tenderness is the rate at which carcases are chilled. The problem of cold toughening has become recognised by the meat industry in recent years and the use of electrical stimulation to combat the problem has increased greatly. The effectiveness of this procedure has been widely demonstrated (see review by Asghar and Henrickson 1982).

The aims of this experiment were to compare the tenderness of meat from cattle of similar age, carcase weight and fatness finished on grain and pasture diets and to study the effects of electrical stimulation on tenderness.

MATERIALS AND METHODS

In August 1982, 54 Angus and Angus X steers of approximately 13-15 months of age were allocated at random from within weight strata to one of three groups.

One group grazed on improved annual pasture at a lenient stocking rate of approximately 0.8 ha/animal. The other groups were confined in two small

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pens (approx. 1/2 ha) and fed ad libitum on a ration consisting of 70 per cent wheat, 26.5 per cent hay, 1.5 per cent urea and 2 per cent mineral supplement.

Full live weight (LW) and ultrasonic backfat thickness was measured frequently throughout the experiment to ensure that animals were growing at a similar rate and were of similar backfat thickness.

All animals were slaughtered in a commercial abattoir 111 days after the commencement of the experiment . Fat thickness at the 12th rib (FT) was measured on the slaughter chain and hot carcase weight (HCW) was recorded. Within one hour of slaughter one side of each carcase was electrically stimulated (800 volts R.M.S. half sinusoid; 14.3 pulses per sec) for 90 seconds. A pin from the stimulator was inserted in the neck muscles and the rail acted as the earth to complete the circuit.

Four days after slaughter the section of the M. longissimus thoracis et lumborum between the 10th and 11th rib vertebrae and the 3rd and 4th lumbar vertebrae was removed from both sides of each carcase. These samples were frozen and stored at $-18^{o}C$ prior to quality assessments. Samples of approximately 300 g were cooked and evaluated for Instron shear force and adhesion according to the methods described by Bouton et al. 1973.

For taste panel evaluations, steaks 17 mm thick were grilled (Sunbeam combination grill) for $3^{1}/2$ minutes (medium) and presented to a 12 member panel all of whom had some previous experience in assessing tenderness. Ultimate pH was measured on these samples.

Subjective scores of meat colour and fat colour were also made with the assistance of standard charts.

The data were analysed using a split plot structure with diets as the main plots and post-slaughter treatments as the sub-plots. Significance tests were made using analysis of variance.

RESULTS

In Table 1, the LW's, LW gains and carcase characterisitcs of the pasture and grain finished groups are shown. Despite the same final LW carcases from animals on the grain diet had significantly ($P < 0.01$) higher HCW, FT and dressing per cent (DP) than animals on pasture.

TABLE 1 Live animal performance and carcase characteristics of cattle finished on pasture and grain

	Diet		Significance
	Pasture (n = 18)	Grain (n = 36)	
Initial LW (kg)	225.2	221.4	NS
Final LW (kg)	393.1	393.1	NS
Gain/hd/day (kg)	1.51	1.54	NS
HCW (kg)	186.0	206.0	**
DP (%)	47.3	52.4	**
FT (mm)	5.56	8.69	**

** = $P < 0.01$

Meat quality characteristics of tenderness and visual appearance are shown in Table 2. In the analysis for each of these characteristics the diet x post-slaughter treatment interaction was not signficant ($P < 0.01$). Because of this only those significant differences between means for diet and post-slaughter treatment are indicated in the table.

Shear force, adhesion and tenderness assessed by the taste panel were not significantly different between diets. However meat colour and fat cover were significantly different ($P < 0.01$) for the two diets. Ultimate pH was significantly higher ($P < 0.01$) for pasture finished cattle although the difference was very small.

The differences in shear force values between stimulated and unstimulated sides were small but significant ($P < 0.01$). Taste panel tenderness scores showed the same trend but in this case the differences were not significant.

TABLE 2 Mean values of eating quality and visual characteristics of M. longissimus thoracis et lumborum of stimulated or unstimulated carcases of cattle finished on pasture or grain

Characteristic		Pasture	Grain	Mean
Shear force (kg)	Stimulated	3.36	3.28	3.31[a+]
	Unstimulated	3.69	3.68	3.68[b]
	Mean	3.53	3.48	
Adhesion (kg)	Stimulated	0.34	0.33	0.34
	Unstimulated	0.32	0.37	0.36
	Mean	0.33	0.35	
Taste Panel Score (1)	Stimulated	4.87	4.68	4.75
	Unstimulated	4.63	4.62	4.62
	Mean	4.75	4.65	
Ultimate pH	Stimulated	5.53	5.48	5.49
	Unstimulated	5.53	5.48	5.50
	Mean	5.53x	5.48y	
Meat Colour Score (2)	Stimulated	3.39	3.06	3.17
	Unstimulated	3.44	3.08	3.20
	Mean	3.42x	3.07y	
Fat Colour Score (3)	Stimulated	3.11	2.00	2.40
	Unstimulated	3.11	2.06	2.40
	Mean	3.11x	2.03y	

+ a and b where present indicate significant differences ($P < 0.01$) between means for stimulated and unstimulated treatments.

x and y where present indicate significant differences ($P < 0.01$) between means for diets.

(1) Taste panel scores range from 1 (very tough) to 6 (very tender).
(2) Scale: 1 = extremely light red to 6 = extremely dark.
(3) Scale: 1 = extremely white fat to 6 = extremely yellow.

DISCUSSION

The absence of any differences in tenderness of meat from grain and pasture finished cattle indicates that there is no basis for discrimination on eating quality grounds. The findings for the electrically stimulated sides are particularly relevant because they provide the comparison almost totally unconfounded by other factors. All animals were slaughtered on the same day and were therefore of the same age and subject to identical pre- and post-slaughter conditions. The effects of differences in carcase weight and fatness on cold toughening were eliminated by the use of electrical stimulation. In this comparison the only difference was the slightly higher carcase growth rate in the grain fed group.

It is perhaps surprising that there was no difference between diets in the tenderness of the unstimulated sides. The small but significant response to stimulation indicates that a degree of cold toughening was present and since the pasture fed group were lighter and leaner they would be expected to have suffered to a greater extent than the grain fed group. This effect was reported by Bowling et al. (1977).

The visual characteristics of meat and fat colour favoured the grain fed group. However these characteristics in the pasture group were all well within an acceptable range for the Australian market. The slightly yellower fat in the pasture fed animals was almost certainly due to the higher pigment concentrations in the diet. The reason for the darker meat colour of the pasture fed animals is less clear. The marginal differences in pH (which influences meat colour) do not seem large enough to provide an explanation. Similar observations have been reported by Bowling et al. (1977).

The lighter carcase weights and lower dressing per cent of pasture fed cattle was undoubtedly caused by greater levels of gut fill in pasture fed animals. This effect has been reported by McIntyre and Ryan (1982).

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