A comparison of grain and pasture finishing of heavyweight cattle

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ABSTRACT

Rising three year old Angus steers were fed on either ryegrass/subterraneam clover pasture or a high grain ration (70% maize grain/ 30% pasture silage) for an adjustment period of 2 weeks and an experimental period of 12 weeks. Ten cattle were slaughtered initially and 10 cattle from each treatment group were slaughtered after 6, 10 and 14 weeks. Cattle offered the high grain ration had feed intakes of up to 2.7% of bodyweight and over the 12 week experimental period average liveweight gains of 1.4 and 2.0 kg/d were achieved in the pasture and grain fed groups, respectively. Carcass weight increased from 316 kg to 363 kg in the pasture group and 406 kg in the grain fed group at final slaughter. Intramuscular (chemical) fat at the 12th rib increased from 13% to 23% and was not affected by diet. Levels of intramuscular fat were up to 38% and were similar to those reported for Japanese Wagyu beef. Lean meat colour was significantly brighter ($P < 0.001$) as a result of grain feeding and the incidence of yellow fat was reduced.

Keywords Beef, feedlot, grain, carcass, colour.

INTRODUCTION

New Zealand's beef exports are dominated by the US market, which consumes 75% of our total beef production, principally as manufacturing beef. Reliance on a single market and low value (internationally) product type means beef producers are vulnerable to variations in world supply and to political change. Our ability to capitalise on new higher value markets is limited by a reliance on pasture finishing systems, as carcasses finished in this way are perceived to be inferior in terms of colour (lean and fat) and taste. With comparatively high grain production costs, our ability to produce grain finished beef commercially will depend on the production of "feedlot" beef through short term finishing of cattle which have been taken to heavy weights on pasture.

This experiment was designed to provide basic data on short term feedlotting of heavyweight cattle under New Zealand conditions and to provide data on the sequential change in carcass characteristics (colour and marbling) with duration of grain feeding. The results are presented as a brief summary of the experimental findings.

METHODS

Animals and feeding

The experiment was conducted during spring and early summer. Rising three year old Angus steers were selected on the basis of similar liveweight. (i.e. between 550 and 600 kg) and ten steers representing the weight range of the mob were slaughtered (Slaughter 1) to provide initial carcass data. Sixty steers were evenly allocated to two rations (Group 1: ryegrass/sub clover and Group 2: 70% maize/30% pasture silage) and three slaughter times (6, 10 and 14 weeks of feeding). A pre-feeding period of two weeks was allowed for the feedlot group during which grain content was slowly increased to 70% of the ration. The feedlot group was also offered a commercial mineral mix consisting of a mineral and vitamin pre-mix, limestone, and sodium bicarbonate (Na_2CO_3) in the ratio (1:10:15). The supplement was offered at the rate of 2g/kg dry matter. Feedlot cattle were fed daily to appetite and feed was well mixed to minimise dietary discrimination. Feed refusals and cattle liveweights were measured weekly.

The amount of herbage available to Group 1 was measured weekly by pasture cuts. Botanical composition was assessed by laboratory dissection. Digestibility and crude protein content of silage and pasture samples were determined by Near Infra Red Spectroscopy.

Slaughter and sampling

Cattle were slaughtered by captive bolt (Slaughter 1) or electrical stunning using 530 volts DC for 15 seconds (Slaughter 2, 3 and 4). All carcasses were electrically stimulated using 90 volts AC for 9 seconds. Hot carcass weight, export grade and fat thickness (over the 4th quarter of the *m. longissimus lumborum* at the 12th rib) were recorded prior to overnight chilling at 10°C. The striploin was removed as per commercial boning techniques. Samples were vacuum packed, held at 0°C and transported to MIRINZ within 24 hours. Samples were then held at -1.5°C overnight prior to panel assessment for lean and fat colour.

Meat analyses

Degree of marbling of the *m. longissimus lumborum* at the 12th rib was visually assessed as per the Japanese Beef Marbling Score (BMS). Samples of longissimus from the 12th rib were freeze dried, ground to 2 mm and chemical fat determined using the Soxhlet method on a Decator Soxtec analyser.

Both lean meat and fat colour was assessed on fresh steaks by a trained 8 member panel. The panel scored the lean meat on a 1-5 scale, where 5 was an excellent bright red beef colour and 1 was an unacceptable colour, heavily discoloured with brown or other discolouration. A descriptive scoring system was used for fat colour and the percentage of panellists scoring fat as yellow were calculated and averaged over the steaks in that treatment.

Statistical Analyses

Data were analysed by analysis of variance and regression techniques.

RESULTS

Feed intake and liveweight gain

Pasture intake was not measured in Group 1 because of difficulties in measuring rate of pasture disappearance with small numbers of cattle fed a high pasture allowance. However herbage on offer increased from 2000 kg dry matter(DM)/ha in Period 1 (0-6 weeks) to 4300 kg DM/ha in Period 3 (10-14 weeks). The legume component in the sward was almost entirely subterranean clover (*Trifolium subterraneum*) throughout the experiment. Pasture quality (M/D) was highest during Period 1 (8.8 MJME/kg DM), decreasing during Periods 2 (6-10 weeks; 8.5 MJME) and 3 (8.3 MJME). In Group 2, total feed intake increased from 16.5 kg in Period 1 to 19.3 kg in Period 3. These feed intakes equated to between 2.5% and 2.7% of bodyweight. Over the experimental period (weeks 2-14) the ratio of maize:pasture silage fed was 71:29 and provided an estimated energy level of 12.5 MJME/kg DM with a crude protein content of 12.8%. Feedlot fed cattle were unable to discriminate against any component of the ration and thus residues reflected the composition of the diet offered. In any case, residuals were small and, on average, accounted for less than 5% of the ration offered.

At the commencement of the experiment, cattle had an average liveweight of 588 kg. There was a trend for pasture fed cattle to be slower growing and average liveweight gains between weeks 2 and 10 were 1.58 kg and 1.92 kg for groups 1 and 2, respectively. During weeks 10 to 14 there were marked difference in liveweight gain ($P < 0.0001$) between groups 1 and 2; being 0.94 and 2.19 kg/day, respectively. These made a large contribution to the differences in final liveweights at 12 weeks of 709.2 and 761.0 kg for the respective groups (Table 1).

Carcass weight and composition

At initial slaughter, cattle had a mean carcass weight of 316.5 kg (see Table 1). In spite of differences in liveweight, there were no significant differences in carcass weight between groups 1 and 2 after 6 weeks. Differences in liveweight were compensated for by differences in dressing out percentages. After 10 weeks carcass weights in Group 1 were significantly lighter than in Group 2 ($P < 0.05$). The trend was even more marked between 10 and 14 weeks with statistically significant differences ($P < 0.005$) between groups 1 (363.4 kg) and 2 (406.6 kg). Fat depth, intramuscular (chemical) fat and marbling score all increased with increasing carcass weight but there were no significant differences between treatment groups. Difficulties with hide pulling at the 2nd slaughter led to incorrect subcutaneous fat values with some animals in Group 2 and these results were excluded.

TABLE 1 Carcass characteristics of Angus steers fed pasture (group 1) or a high grain ration (group 2).

		Slaughter time (weeks)			
	Group	0	6	10	14
Liveweight (kg)	1	558.0	627.8	680.6	709.0
(Unfasted)	2		650.2	694.0	761.0
Carcass weight (kg)	1	316.5	341.7	353.3	363.4
(CWT)	2		340.3	370.8	406.6
Dressing Out (%)	1	53.8	54.4	51.9	51.2
(CWT/unfasted LW)	2		52.3	53.4	53.4
Fat Depth (mm)	1	8.8	12.2	17.7	20.0
(12th rib)	2		9.1	16.0	19.7
Intramuscular fat (%)	1	13.6	17.3	21.1	22.5
(12th rib)	2		18.7	21.7	23.5
Marbling Score	1	3.4	3.2	3.9	4.3
(BMS)	2		3.4	4.0	4.3
Panel score	1	4.2	4.1	4.3	4.5
(Lean colour)	2		4.8	4.8	4.9
Panel score	1	40.0	22.0	13.0	0.0
(Yellow fat colour)	2		16.0	2.5	0.0

Meat and fat colour

Panel scores for colour of lean were significantly lower ($P < 0.001$) in the pasture fed group, thus steaks from feedlot fed cattle had better, more desirable, colour. Moreover, statistically significant differences between groups were achieved after 6 weeks of feeding (see Table 1). The fat of the initial slaughter group was more yellow than that from cattle at subsequent slaughters. No significant differences could be detected between groups although the incidence of yellow fat colour decreased with time on feed in both groups (Table 1).

DISCUSSION

Animal performance

Mean feed intake (17.7 kg DM/day) and liveweight gain (2.01 kg/day) achieved in the feedlot fed cattle can be considered spectacular for Angus cattle of this age and liveweight (mean: 675 kg). Dry matter intakes of 2.6% of bodyweight would normally only be expected in younger cattle (Ulyatt *et al.*, 1980). At liveweights in excess of 700 kg, Angus cattle would normally be considered to have achieved mature liveweight (D. McCall, *personal communication*). However the steers fed a high concentrate diet continued to increase their growth rate throughout the experiment and, over the final 4 weeks, cattle in Group 2 grew at a rate in excess of 2 kg/day. These high growth rates emphasise the lack of New Zealand data on the potential growth rate of heavyweight cattle. Alternatively the Angus cattle used in this experiment may have been at an extreme within the Angus genotype, indicating considerable room for within breed selection.

Meat quality

Intramuscular fat content increased from approximately 13% to 23% as carcass weights increased from 315 kg to 406 kg. The range in marbling of loin steaks obtained in this experiment suggests some interesting opportunities for supplying those segments of the Japanese market which prefer heavily marbled beef. Over the 12 week experimental period carcass weight increased from 316 kg to 385 kg (mean of groups 1 and 2), Japanese Beef Marbling Score increased from 3.4 to 4.3 and intramuscular fat increased from approximately 13% to 23%. Kyohei *et al.*, (1985) found that beef in the "special selection" or top grade of Japanese Black (Wagyu) cattle had average intramuscular fat contents of 31.7%. In the present study intramuscular fat contents as high as 38% were obtained which suggests that highly marbled carcasses suitable for the Japanese trade can be produced on pasture.

The lean colour of the steaks was significantly affected by dietary treatment with grain fed groups having steaks which were redder than pasture fed cattle. Moreover the dietary effects on lean meat colour occurred after 6 weeks, considerably sooner that than the 11, 15 and 24 weeks of grain feeding reported by Crouse

et al., (1983), Schroeder *et al.*, (1980) and Craig *et al.*, (1959), respectively.

Pasture fed cattle had more yellow fat at each slaughter. A seasonal trend occurred in fat colour in the pasture fed cattle, with the highest occurrence at the initial slaughter (September) and declining incidence of yellow fat through subsequent slaughters. Pastures are relatively high in carotenoids, and grassfed cattle tend to store carotene and produce yellow fat (Pearson, 1966). Seasonal variations in carotene in New Zealand have previously been reported in butter (Barnicoat, 1947), whole milk powder and milk fat (Indyk, 1987 and McGillivray, 1957). Carotene levels appear to peak in early spring and be at their lowest in summer and support the data obtained in the present experiment.

In conclusion, it would appear that at heavy carcass weights, highly marbled beef can be produced from Angus steers grazing pasture. Although these carcasses may be suitable for the Japanese trade, the use of specialist finishing rations may be necessary to optimise meat colour and remove the seasonal variation in fat colour.

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