Effect of prior growth on feedlot performance

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Introduction

Feed and cattle are the largest variable input costs in a feedlot. Cost of gain (gross return per unit feed eaten, on a dollar basis) is therefore an important indicator of performance of cattle in a feedlot. The simplest indicator of cost of gain is feed conversion ratio, or the weight (kg) of feed dry matter eaten per kg liveweight gain. The factors which affect feed conversion ratio (FCR) include feed nutrient density and intake per head and weight and rate of gain of the cattle.

How an animal has grown impacts on subsequent growth and body composition, and food conversion. This is well recognised in the feedlot industry and it is common practice to put cattle with low condition score relative to frame onto feed to capture compensatory gain. This is done in part to reduce cost of gain and in part to ensure animals do not over fatten before they reach the required days on feed.

Capturing economic benefits from compensatory gain is not straight forward. In some cases benefits do not exist. Here I summarise results from research conducted within the Beef CRC, and elsewhere, on effects of pre feedlot growth on performance, intake (and cost of gain) and ability to achieve specifications. These results are discussed in light of current scientific understanding and their implications for feedlot industry practice.

Growth in early life (before 250 kg liveweight)

Early life is broadly contemporaneous with the pre-weaning period for animals where weaning occurs from 7 – 9 months of age. Because there is a trend to early weaning at lighter weights to either improve herd fertility (northern Australia) or reduce the impact of cow maintenance requirements on overall herd profitability (southern Australia) it is important to recognise that it is growth rate to a particular weight (stage of maturity) that is more important that the act of weaning on establishing future performance.

Analysis of long term data sets derived from various cross breeding studies at Grafton (Hearnshaw 1997) formed the starting point for subsequent CRC studies. The Grafton analysis showed that weaners which were light (<180 kg) for their age (9 mo) (because they were on mothers under poor nutritional conditions) did not catch up in weight to contemporaries that were heavier (>200 kg) because they had access to improved nutritional conditions. Although there was a trend for the light weaners to grow faster than heavier weaners on pastures, in the feedlot their rate of gain was no greater and often considerably less (Table 1).

Table 1: Post weaning gain (kg/d) and Live weight (kg) at slaughter for cattle classified into weaning weight classes and finished in feedlots (Hearnshaw 1997)

		Age at slaughter (months)	Live weight (kg)	Post weaning liveweight gain (kg/d) Weaning Weight Class (kg)			
Group	Number of calves			100 - 150	151 - 200	201 - 250	251 – 300
A	55	10.3	300	1.08	1.45	1.54	-
B	233	11	318	1.08	1.28	1.17	1.19
C	75	11.5	279	0.57	0.99	1.08	1.14

This, and other data, was summarised by Herd and Oddy (1997) to indicate that degree of catch up growth was dependent on the stage of maturity (life) when the animals were subject to nutritional restriction (Table 2). The earlier in life that growth restriction occurred the greater the failure of animals to catch up.

Table 2: Degree of compensation observed (end weight of compensating group / end weight of control group) compared to stage of maturity (wt / mature wt) at onset of restriction (Herd & Oddy 1997).

Stage of Maturity	Degree of Compensation
0.30	0.76
0.39	0.93
0.39	0.93
0.69	1.00

Subsequent CRC studies at Grafton (Hennessy et al, 2001a,b) targeted treatments that could be used to overcome low calf growth pre-weaning, and looked at subsequent effects on growth in both pasture and feedlot phase, carcase weight, fatness, yield and eating quality (Table 3). A further study investigated the effect of pre-weaning growth on feed intake and feed conversion in the feedlot (Hennessy et al, Hennessy and Arthur – in press). These studies confirmed the earlier results that low pre-weaning growth was not compensated in both pasture grow out and feedlot finishing phases. With regard to feed intake, the lighter (low pre-weaning growth) cattle ate less, and gained at the same rate as heavier (high pre-weaning growth) cattle. This resulted in a slight advantage in FCR, and hence cost of gain to the lighter cattle (Table 4). However, in a practical feedlot business to achieve carcase weight and fat specifications the lighter cattle would have needed to be on feed for longer.

Table 3: Effect of pre-weaning growth rate on mean live weight (LWT - kg) and live weight gain (LWG - kg/d) of cattle at weaning, to feedlot entry and at end of feedlot. Data from Expt A, Hennessy *et al* 2001*. Expt B, Hennessy and Morris+. Lo is reduced nutrient supply to the cow and calf during the pre-weaning period relative to Hi.

	Weaning		**Feedlot Entry**		**End Feedlot**	
	Lo	***Hi***	***Lo***	***Hi***	***Lo***	***Hi***
ExptA*						
LWT	171	201	317	334	424	444
LWG	0.62	0.81	0.68	0.59	1.46	1.54
Expt B+						
LWT	162	199	278	325	412	457
LWG	0.47	0.87	0.62	0.68	1.35	1.30

*** Note -** Values shown are mean of calf treatments and sexes (from Hennessy *et al* 2001).
+ Note - Values shown are mean of both sexes (Hennessy & Morris, personal communication).

Table 4: Summary of feed intake (kg/d) and estimated feed conversion ratio. (FCR) for Expt B of Table 3 (Hennessy & Arthur, personal communication), LWT is average Liveweight (kg) during the period in which feed intake was measured, LWG (Kg/d) is average during period of measurement of feed intake. Lo and High refer to pre weaning growth rate.

	Lo	Hi
LWT	323	376
LWG	1.55	1.56
Feed Intake	10.9	11.8
FCR	7.2	7.6

The northern Queensland experience has shown that poor growth of early weaned steers (due to inadequate nutrient input in the first dry season) is detrimental to subsequent feedlot performance (Lindsay, pers. comm.). In summary, calves with low growth rate (0.4 kg/d) in the first dry season took up to 6 months longer to reach feedlot entry weight. In the feedlot they grew slower and were more variable in terms of carcase weight than calves that grew at 0.8 kg/d in their first dry season. Moreover, meat from the slower grown calves was potentially “chewier” than meat from the better grown calves (Table 5).

Table 5: Effects of growth rate in 1st dry season of early weaned Brahman calves (John Lindsay, personal communication). Growth rate was adjusted by supply of supplementary feed to calves weaned at approximately 100 d of age. Animals were grown to 420 kg, then placed into a feedlot for 120d to reach Jap Ox weights.

Treatment in 1st dry season	Age to 420 kg (months)	Feedlot gain (kg/d)	Proportion in carcase weight class		
			<279	280 - 299	>300
Low 0.4 kg/d	26	1.32	0.31	0.19	0.50
Med 0.6 kg/d	24	1.56	0.12	0.44	0.44
High 0.8 kg/d	22	1.59	0.05	0.56	0.39

The lessons from all these studies is that an early life growth rate (ie before 250kg liveweight) of more than 0.6 kg /d is desirable. Anything less may impair subsequent performance in the feedlot.

Backgrounding - growth above 250 kg liveweight (post weaning) and before feedlot entry

Growth rate in the feedlot is inversely related to growth rate during backgrounding. CRC results (Robinson et al, 2001) clearly show that low backgrounding gain is partially compensated for by higher feedlot gain, but that compensation is rarely complete in the feedlot i.e. animals which weigh less on feedlot entry than do heavier but genetically similar animals also have lighter carcases. In addition these carcases will have less fat, higher yield and generally less intramuscular fat content (IMF%). The effect of low backgrounding gain on IMF% is greater in longer fed (and therefore heavier) steers (Table 6).

Table 6: Effect of post weaning (backgrounding) growth rate on feedlot growth, carcase and fatness traits for 150 day fed *Bos taurus* (Angus, Shorthorn, Hereford, Murray Grey) cattle. Background (post weaning) growth rate was adjusted by access to improved pastures (Hi), supplementary feed (Med) or no supplements (Low) during winter. Data shown are mean growth rates of three consecutive years calves grown out at Glen Innes in Northern NSW, and finished in the Beef CRC feedlot research facility at “Tullimba”. Feedlot performance figures are liveweight gain (LWG), Carcase weight, Retain Meat Yield, Rib and Rump fat thickness scanned before slaughter and Intramuscular fat (%) measured in the ribeye between the 12th and 13th rib. Cattle entered the feedlot at 400 kg liveweight (from Robinson *et al* 2001).

	Background growth treatment		
	Hi	**Med**	**Low**
Post weaning gain (kg/d)	0.89	0.77	0.68
Feedlot			
LWG (kg/d)	1.16	1.22	1.28
Carcase Wt (kg)	348	339	333
Retail Meat Yield (%)	63.8	64.2	64.5
Scan rib fat (mm)*	12.3	12.2	12.2
Scan Rump fat (mm)*	15.7	15.5	15.7
IMF% *	7.6	7.1	7.1

* Adjusted to the same(average) carcase weight.

Feed intake of steers subject to different background growth rate treatments was measured in the CRC but the analysis is incomplete. The expectation is that Feed Conversion Ratio (FCR), and therefore cost of gain, would be reduced in animals with a lower background growth rate. These animals grew faster in the feedlot and were less fat. However, if marbling is an important outcome for the feeding program then consider the risk of a reduction in price from having a smaller proportion of animals achieving your targeted marbling outcome.

The same pattern of difference in post weaning and feedlot performance and fatness was seen in the comparison of tropically adapted cattle (Brahman, Santa Gertrudis, Belmont Red) raised and finished in two quite different environments (“Duckponds” and “Goonoo” Central Queensland, N; “Tullimba” North West Slopes of NSW, S). The data suggest that background growth has significant effects on the partitioning of fat between subcutaneous and intramuscular sites (Table 7). Differences in fat depth, fat trim and intramuscular fat % in one cohort of Japanese cattle(150 d fed, >350 kg carcase, Figure 1) are also apparent in Korean (100 d fed) cattle, and when fatness traits are assessed in the live animal by scanning. Feed intake was measured only in those cattle finished at “Tullimba” so it is not possible to make comparisons of FCR or cost of gain with cattle finished in “Goonoo”.

Table 7: Effect of markedly different background and finish system on age, LWT, scanned fat, carcase weight and intra muscular fat (IMF%) of tropically adapted cattle (Brahman, Santa Gertrudis, Belmont Red). Cattle were grown out from weaning to 400kg in central QLD (n) or Northern NSW (s) and finished in feedlots for 100 days (Korean) or 150 days (Japanese). Data from Johnston *et al*, 2002 and Reverter *et al*, 2002.

Market	Location	Age	LWT (kg)	Height (cm)	Rib Fat (mm)	Rump Fat (mm)	Cwt (kg)	IMF%
Korean	*N*	756	509	139	7.3	14.4	279	2.79
	S	754	510	147	7.7	124	272	3.62
Japanese	*N*	804	564	150	9.7	16.6	324	3.56
	S	788	559	145	9.3	14.0	311	4.22

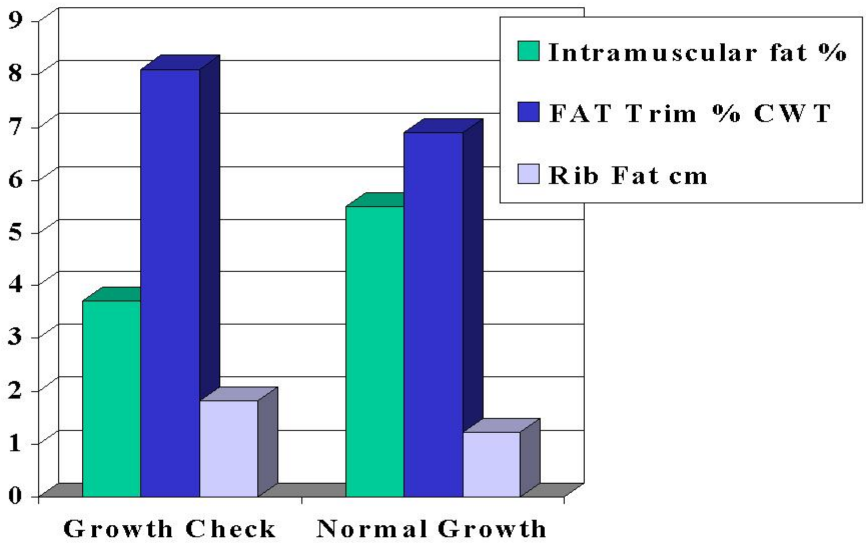

Figure 1 Effects of growth between weaning and feedlot in temperate (normal growth) and tropical (growth check) environments on carcase traits of tropically adapted cattle (Brahman, Belmont Red and Santa Gertrudis cattle) feedlot finished to >300 kg carcase weight for 150 days. The time taken to reach feedlot entry differed in each environment; in this case it took five months longer for animals in the tropical environment. Time on feed and feed specifications were the same in both environments.

Diet manipulation, feedlot growth and cost of gain.

Research to find ways to improve marbling and intramuscular fat content by systematic variation of the composition of feedlot diets has been largely unsuccessful (Bindon, 2001). Nonetheless, Beef CRC research has revealed that change in diet composition can have considerable impact on cost of gain. Results from a joint Beef CRC and MLA project are summarised in Table 8. They show that variation in fat, protected fat, dietary protein and combinations thereof have only small effects on intramuscular fat content. However, the low protein diet produced a substantial reduction in cost of gain. A companion trial in Vasse WA came to a similar conclusion (Pethick *et al*, 2000).

Table 8. Effect of diet formulation on dry matter intake (DMI), liveweight gain (LWG), food conversion ratio (FCR) and cost of gain ($/kg). Diets were formulated to meet Australian Nutrient Standards (Control), have 20% less protein supply (Low Protein) or 20% more protein supply (High Protein) to the intestines. Cattle were Angus and Shorthorn breed with an average liveweight 528 kg at start of trial. They were acclimatised on starter and control diets for 70 days prior to commencement of the trial. Cost of diets ($/tonne) were $153.00, $159.40 and $167.10 respectively for control, low protein and high protein (Oddy *et al*, 2000).

Diet, Days from start	DMI (kg/d)	LWG (kg/d)	FCR	Cost of gain ($/kg)
Control				
0-36 d	13.45	1.54	8.75	
37-68 d	12.48	1.29	9.7	
69-111 d	11.23	0.89	12.7	1.59
Low Protein				
0-36 d	10.75	1.69	6.37	
37-68 d	10.93	1.44	7.61	
69-111 d	11.15	1.28	8.78	1.21
High Protein				
0-36 d	13.76	1.71	8.18	
37-68 d	13.08	1.37	9.59	
69-111 d	11.8	0.88	13.59	1.75

Summary

Feedlot performance, carcase attributes and fatness traits are affected by the pattern of growth before cattle get to the feedlot. It is important to ensure adequate early growth so as not to impair potential in the longer term. The backgrounder can affect the profitability of the feedlot operator by changing the propensity of cattle to deposit fat and thus affect growth and cost of gain. In our experience modification of diets in the feedlot to affect marbling does not work. However, there are substantial effects of feedlot diet composition on food conversion ratio and cost of gain. All sectors, the breeder, backgrounder and finisher contribute to the economic production of a quality beef animal.

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