CONTRACT REVIEW

FINISHING CATTLE WITH SUPPLEMENTS AT PASTURE

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INTRODUCTION

The Australian beef industry suffers from a marked seasonality of supply and variation in product quality. This poses major problems for meat processors trying to develop product branding and year round supply for both domestic and export consumers. The processors also have problems caused by underutilization of meat works for a portion of the year.

In 1994 and 1995, beef exports made up 64% of Australian production. Since the liberalization of the Japanese market in 1988, there has been a shift in emphasis from the US market to the Japanese and Asian markets with a corresponding shift in emphasis towards high quality table beef. Lot feeding facilitates the production of beef all year round but has a number of problems including cost of production and competition from other exporting nations. Feedlotters also need to address a range of animal welfare and environmental issues which may affect consumer demand.

There is a clear demand for high quality pasture fed beef. There is a range of markets, each with a different specification. Forward contracts for slaughter stock, which have been developed in some states, are an effective means of communicating market specifications to producers and removing some of the risk associated with "out of season" production. The work described in this contract demonstrates a range of cost effective options, based on feeding at pasture, for meeting these specifications in different production environments.

YEARLING BEEF PRODUCTION OFF PASTURE IN THE SOUTH-WEST OF WESTERN AUSTRALIA

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The Mediterranean environment of the south-west of Western Australia, with the predominantly winter and spring rainfall, produces high quality pasture resulting in good animal performance in late winter through to early summer. Towards the end of summer, and in autumn, grazing cattle lose weight and condition unless they receive supplementary feed.

This paper extends previous work (Tudor 1992) by further developing options for finishing cattle for the domestic trade. These studies form part of Meat Research Corporation project DAW 037.

1. Hay, silage or grain supplements

Data from early and late maturing steers weighing about 300 kg in January and grazing improved annual pasture at 2 beasts/ha with no supplement or supplemented with hay, silage or grain are presented in Table 1. Supplements commenced when the animals started losing weight (mid April) and continued till the unsupplemented animals started to gain weight (end July). The opening rains occurred on May 22. The animals were slaughtered for the local restaurant trade which is about 20 - 30 kg heavier than the local domestic market. A full AUSMEAT assessment was made 24 hours post slaughter.

These results show variation in the time to slaughter but no difference in the animal's ability to achieve a marketable slaughter weight. Although the meat and fat colours were higher than is normally expected with animals finished on a high grain diet, with the exception of a few animals, the colours were still very acceptable. To compare the returns from the different systems of finishing animals we have used the market price for different feed stuffs but this disadvantages hay and grain because generally very little silage is sold.

Table 1. Yearling cattle produced off pasture with no supplements or supplemented with hay, silage or grain

		No supplement	Hay	Silage	Grain
Number		16	24	24	24
Days to slaughter from weaning		304	281	285	265
Final liveweight (kg)		448	444	440	450
Carcass (kg)		241.7	244.3	241.1	247.9
P8 Backfat (mm)		7.1	5.8	6.0	6.1
Meat colour	1B	5	5	7	7
	1C	2	2	7	9
	≥2	9	17	10	8
Fat colour		2.7	1.9	2.0	2.2
Marbling		1.1	1.2	1.0	1.3
Longissimus dorsi pH		5.7	5.7	5.7	5.7
Value of carcass ($)		650	680	663	689
Total supplement DM (kg/hd)			609	415	435
Supplement[A] ($)			49	42	70

[A]Market price of supplements @ $/t DM; Hay $80, Silage $100, Barley $160 (1994 prices).

2. Supplements or full feeding grain

In an on-farm trial, Murray Grey steers and heifers with an average weight of 273 kg at weaning (10 months) were stratified on sex and weight and randomly allocated to 3 treatments (3 paddocks). From mid-February, Trial 1. animals were fed an oats/lupin (70/30) supplement (2-3 kg/hd.day) and animals in Trials 2 & 3 were fed hay supplements. From the end of March the 3 treatment mobs were fed grain, to appetite, in self feeders, and hay in racks until the animals achieved market weight and fatness suitable for the local trade. The grain mixes were either oats/lupins (70/30) (Trials 1 & 2) or oats, lupins and urea (88/10/2) (Trial 3). Virginiamycin (Pfizer Animal Health) was included in the grain mix to control acidosis. The results are presented in Table 2.

Table 2. Growth rate and economic returns from yearling cattle at pasture and supplemented with grain mixes and hay

Treatment	1	2	3
Number	38	36	33
Supplements fed in February and March	Oats/lupins	Hay	Hay
Average daily gain[A] (kg/hd.day)	0.3	0.1	0.1
Supplements fed from April onwards	Oats/lupins Hay	Oats/lupins Hay	Oats/lupins/urea Hay
Growth rate[B] (kg/hd.day)	1.0	1.2	1.0
Days fed grain	155	125	133
Final LW (kg)	410	415	410
Carcass	219.9	220.4	217.3
P8 Backfat (mm)	12.9	11.7	10.9
Value ($)	639.0	654.5	645.0
Cost of grain and hay ($)	133	115	110
Return[C] ($)	506	540	535

[A] When supplements were fed during February and March.
[B] Growth calculated by linear regression of live weight against time from April when grain fed to appetite.
[C] Value of carcass - cost of feed.

The results show there was no advantage in starting one group on a low level of grain supplementation before feeding grain to appetite. Feeding less lupins and using 2% urea produced a satisfactory finishing diet. There were no acidosis problems with the system of feeding the hay and grain separately.

3. Silage and grain

Thirty per cent (-150,000) of cattle slaughtered in the south-west of Western Australia are 9-12 month-old, young prime beef. Animals that are not quite finished at weaning, too light or have insufficient fat cover, can be finished for the local trade if fed silage to appetite and supplemented with ~ 3 kg cereal grain plus a protein supplement. The results of finishing Simmental cross steers, weighing 340 kg, on 6 kg DM/head.day of pasture silage plus ~ 3 kg cereal grain, and supplemented with either urea, lupins, or canola meal, are presented in Table 3.

Table 3. Growth and carcass measurements of steers supplemented with pasture silage and barley grain with urea lupins or canola as an additional nitrogen source

1994	Barley + urea	Barley + lupin	Barley + canola
Number	28	27	28
Growth rate[A] (kg/hd.day)	1.3	1.2	1.3
Final liveweight (kg)	432	425	428
Carcass (kg)	216.7	215.1	213.4
P8 Backfat (mm)	6.8	6.3	6.3
Value ($)	619	615	614

[A] Growth rate calculated by linear regression of live weight against time.

The cost (c/day) of the grain supplements were 40, 41 and 49, respectively for the barley+urea, barley+lupin and barley+canola meal. Based on the price of the N supplement and the performance of the animals, the addition of 1.5% urea to barley when fed with silage was as effective as adding lupins or the more expensive canola meal.

The meat colour of silage-fed cattle has been of concern to industry. Industry opinion was that silage-fed cattle would have unacceptably dark meat. Hereford and Angus cross steers were finished on a silage plus grain diet and then, to test the influence of stress, transported either directly or via the saleyards to the abattoir. The results are shown in Table 4.

Table 4. The effect of transport stress on carcass traits of Hereford and Angus cross steers supplemented with silage and grain

		Via saleyards	Direct
Number		20	34[A]
Carcass (kg)		201.7	205.9
P8 Backfat (mm)		12.7	12.4
Meat colour	1B	13	26
	1C	7	7
Fat colour		1.2	1.0
pH *Longissimus dorsi*		5.46	5.47

[A] 1 animal Meat colour 5; pH 5.82.

Neither the colour of meat nor fat in cattle finished on silage plus grain diets, and subject to transport stress, differed from that expected of cattle finished on a high grain diet. The industry opinion that cattle fed silage would cut unacceptably dark meat was shown to be incorrect. There was only a marginal influence of the extra stress of sending animals to slaughter vie saleyards.

Cattle finished on pasture with supplements produce high quality beef with meat and fat colour only marginally different to grain fed cattle. The availability of larger, later maturing European breeds provides animals which commence depositing fat at heavier weights than British breed cattle. Providing pasture quality and quantity are good, these later maturing types will achieve a marketable weight at an earlier age. If the market specification for SE Asia is for heavier grass fed carcasses, then by utilising both early and late maturing breeds and crosses in the south west of Western Australia, it is possible to satisfy any fat specifications in cattle with around 4 permanent teeth.

PASTURE BASED SYSTEMS TO FINISH STEERS IN SOUTHERN AUSTRALIA TO THE JAPANESE OX MARKET SPECIFICATIONS

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Meat processors in Victoria have problems sourcing cattle to meet the Japanese Ox specification in winter and early spring. This reflects the seasonal nature of pasture production and animal growth which Bird *et al.* (1989) have described in detail for yearling steers in South Western Victoria. The general carcass specification for grass fed Japanese Ox is 300-400 kg carcass weight with a P8 fat depth of 12-32 mm and a maximum of 6 permanent teeth. Different processors vary these specifications slightly, and there are often significant price premiums (eg for marbling) or discounts (eg dark meat or yellow fat colour) within these specifications.

Our programmes aimed to demonstrate simple feeding strategies allowing 2 year old steers to achieve these specifications. Observations were carried out at the Pastoral and Veterinary Institute (PVI) and on farms around the state as part of the Meat Research Corporation project DAV 099.

Pastoral and Veterinary Institute observations

In 1994 we compared the following production systems; (a) pasture only, (b) pasture and grain (whole triticale fed at 1% of bodyweight daily), (c) pasture plus ad lib pasture hay, (d) pasture plus pasture silage till the autumn break, then silage only in a feedlot, (e) strip grazed Barkant turnips. The pasture was based on sub clover, phalaris and perennial ryegrass with a moderate fertilizer history. Treatments a, b,c and d were all grazed at 1.2 steers/hectare. Treatment (d) was originally planned to utilize grazing oats after the autumn break but the crop was not adequate for grazing. The turnip crop in treatment (e) was almost grazed out 6 weeks before the planned end date, so an *ad lib* silage supplement was added.

The experiment commenced in early March with 480 kg Hereford steers. There were 8 steers in treatments a, b, c and d and 6 in treatment e. They were forward contracted and slaughtered at an export abattoir in early September and AUSMEAT assessments made.

Table 5. Growth and carcass traits of steers at PVI in 1994

Treatment	Mean liveweight gain (LWG) (kg/day)	Standard deviation (LWG)	Mean carcass wt (kg)	Mean P8 fat mm	Mean marble score	No. meeting carcass specifications
(a) Pasture	0.43	0.12	299	19	1.8	5/8
(b) Pasture + 1% grain	0.69	0.15	332	27	2.4	8/8
(c) Pasture + hay	0.66	0.13	324	27	1.9	5/8
(d) Silage	0.77	0.14	342	28	2.3	6/8
(e) Turnips	0.78	0.05	351	29	2.3	6/6

The autumn break occurred in April and seasonal conditions were quite favourable. Two steers in each of treatments (c) and (d) were penalised for being overfat. Meat and fat colour were satisfactory, ie 1B or 1C and 97% <2. Treatment (b) steers ate 4.9 kg of grain (DM 88%, CP 11%) per day while treatment (c) steers ate 6.9 kg of hay (DM 77%, CP 12%, ME 9.3 MJ/kg), and treatment (d) steers ate 21 kg of silage (DM 47%, CP 19%, ME 10.0 MJ/kg).

In 1995 we carried out a replicated experiment with emphasis on developing low-labour grain feeding systems. New developments considered were (i) treating grain with Virginiamycin (Pfizer Animal Health, West Ryde, NSW 2114) to reduce the risk of acidosis and allow the development of less frequent grain feeding systems, and (ii) the use of Rumentek, a customised blend of formalin treated proteins and oilseeds (Rumentek Industries, PO Box 1910, Toowoomba, Qld 4350) which allows about 80% of this supplement to escape rumen degradation (Ashes *et al.* 1993 discussed this technology). The treatments were (a) pasture only stocked at 1.5/ha; (b) pasture + whole grain (triticale) fed daily at 1% of weight; (c) pasture plus Virginiamycin-treated whole grain fed once weekly (VMWG); (d) Pasture plus Virginiamycin-treated rolled grain fed once weekly (VMRG); (e) pasture plus whole grain fed through a limit lick (slide control) grain feeder (LGF) (Patons, Belmont, Victoria 3216); (f) pasture plus ad *lib* hay and ad *lib* grain fed through a "Waste Not" system (T. Allan, Carisbrook, Victoria 3464); (g) pasture plus oaten grain and Rumentek fed daily (R); (h) pasture plus silage ad *lib*; (i) silage fed in a feedlot until an autumn sown crop of concord ryegrass with nitrogenous fertilizer was available (July); (j) pasture plus Virginiamycin-treated whole grain fed once weekly but at the higher stocking rate of 2.2 per hectare (VMWGH). Treatments c, d, e, g and j were fed grain at the equivalent of 1% liveweight daily. The grain fed groups were slowly introduced, with Virginiamycin groups on to once weekly feeding within two weeks. The Virginiamycin was added to 40 ppm until mid May and then at 20 ppm until two weeks before slaughter. The Virginiamycin groups ate their grain within 4-5 days. One steer on treatment (c) was excluded from the analysis because of no weight gain over the entire feeding period. All treatments except (j) had two replicates of six. Treatment (j) had two replicates of seven. Feeding Hereford steers weighing 447 kg commenced in late March under very dry conditions but there was a good autumn break in mid April. The cattle were forward contracted at agreed prices and specifications and slaughtered at an export abattoir in late September, with AUSMEAT Chiller assessment.

Analysis of variance showed there were significant differences ($P<.05$) between treatments for liveweight gain and carcass weights (Table 6) but not for the other carcass traits, including meat and fat colour. Ninety six per cent of carcasses had a meat colour of ≤ 2 and the same proportion had a fat colour ≤ 2.

Table 6. Growth and carcass traits of steers at PVI in 1995

Treatment	Mean liveweight gain (kg/day)	Mean carcass weight (kg)	Mean P8 fat mm	Mean marble score	No. meeting carcass specifications
(a) Pasture	0.45[a]	295[a]	15	1.1	4/12
(b) Pasture + grain daily	0.80[bc]	333[b]	20	1.6	11/12
(c) Pasture + VMWG	0.75[bc]	323[b]	18	1.5	8/12
(d) Pasture + VMRG	0.73[bc]	328[b]	17	1.2	12/12
(e) Pasture + LGF	0.86[bc]	338[bc]	20	1.3	12/12
(f) Pasture + Waste not hay and grain	0.80[bc]	340[bc]	21	1.4	12/12
(g) Pasture + oats + R	0.81[bc]	334[bc]	20	1.2	11/12
(h) Pasture + silage	0.90[c]	252[c]	22	1.9	12/12
(i) Silage + crop	0.81[bc]	329[bc]	19	1.3	9/12
(j) Pasture + VMWGH	0.69[b]	320[b]	17	1.1	10/14
SED	0.09	10	3	0.2	

Treatments with different post scripts differ significantly.

Treatments (b), (c), (d), (e) and (j) ate the daily equivalent of between 4.7 and 5.1 kg of triticale grain (DM 87.5%, CP 11.2%) per head; treatment (g) ate 5 kg of oats and 1.1 kg of Rumentek (50/50 protein and lipid) daily. Treatment (f) ate 5.4 kg of triticale and 3.9 kg of hay (DM 87%, CP 14.6%, ME 8.8 MJ/kg). Treatment (i) ate 25 kg of silage per day (DM 34.5%, CP 19.5%, ME 10.6 MJ/kg) while in the feedlot, while treatment (h) ate 16.5 kg silage per day over the whole period.

Grain supplementation increased the growth rate of cattle with a range of options available to reduce the labour required. Rolled triticale (d) failed to offer any production benefits compared with whole triticale (c). Based on 5 year average grain prices ($1 10/tonne), the various options for feeding grain at about 1% of liveweight daily show a profit of between $0 and $60 per head. The profitability of the silage treatment (h) was $112 per head with silage valued at cost of production in 1995 (wrapped and baled for $30/tonne). In most years there are opportunities to make moderate quantities of high quality pasture silage in this environment.

Farm 1 - Gippsland

Brassica fodder crops are often grown to prepare paddocks for pasture renovation and are used very successfully to extend production periods to produce "out of season" prime stock.

Sixty Hereford steers (average liveweight 566 kg) were divided into 4 groups and grazed on Barkant turnips (T1 and T2) or perennial ryegrass and white clover pasture (P1 and P2) from 7 March 1994 to 30 May 1994. Average liveweight gains (kg/day) were T1= 0.73, T2= 0.59, P1= -0.02, P2 = -0.04. All turnip steers, but only 50% of pasture steers, were suitable for the Japanese trade. Meat samples were taken from 6 of the heaviest steers in each treatment for sensory assessment. A trimmed steak was taken from the rump end of the striploin and frozen. These samples were minced and reconstituted to 8% fat at Rutherglen Research Institute and evaluated by a trained taste panel.

Table 7. Sensory evaluation of meat from steers grazing pasture or turnips

Characteristics	P1	P2	T1	T2	LSD
Aroma	4.1	4.4	4.0	4.1	0.8
Flavour	4.3	4.6	4.0	4.3	0.7
Acceptability	5.2	5.0	5.4	5.1	0.7

(1 = absent or extremely good, 9 = very strong or extremely poor).

In 1995, 40 Hereford and Hereford Simmental cross steers, with an average liveweight of 532 kg, were allocated to either silage or turnip treatments.

The bunker silage (CP 12.1 % and ME 9.5 MJ/kg DM) was self fed during autumn and winter and the cattle consumed 4 kg/hd.day on a dry matter basis. Pasture availability ranged from 1400 - 2000 kg DM/ha. The steers were stocked at 2.5 steers/ha and grew at 0.45 kg/hd.day (SD 0.19). The mean carcass weight was 318 kg with 17 mm of fat (P8).

The turnip crop yielded 4.8 tonnes of dry matter/ha and the digestibility of the leaves was 85% and the bulbs 93%. The crop was grazed at 3.64 steers/ha and the steers grew at 0.89 kg/hd.day (SD 0.10). The mean carcass weight was 323 kg with 20 mm fat (P8).

The cattle grazing turnips had no noticeable taste taints and achieved Jap Ox specification 2 months earlier than the silage treatment.

Farm 2 - North East Victoria

This trial compared the limit lick grain feeding of cracked barley with feeding cracked barley treated with Virginiamycin, fed on a weekly basis. Twenty-eight Hereford, Hereford Simmental cross and Hereford Angus cross steers which averaged 540 kg were allocated to the 2 treatments, grazing improved perennial ryegrass and sub clover pastures with availabilities ranging from 1 tonne DM/ha starting in April to 2.5 tonnes/ha at the finish in August. Both groups were fed ad lib hay (CP 7.8%, ME 6.7 MJ/kg) from "Waste Not" feeders, with each group eating 2.3 kg/head and grain at a rate the equivalent to 1.5% of liveweight daily. The grain ration had ionophones, molasses and minerals added. There were problems with acidosis in the limit grain feeder treatment during the introductory phase and buffers were then added to this diet.

The Virginiamycin cattle ate their weekly ration in about 5-6 days and gained at 1.21 kg/head.day (SD 0.25) while those on the limit grain feeder gained at 1.12 kg/head.day (SD 0.25). The carcasses in both groups met the Japanese Ox specification.

Farm 3 - South-West Victoria

Most producers do not have a roller mill for cracking grain, so the effectiveness of whole grain feeding was tested. In addition, the availability of Rumentek (a protected protein and lipid), offered the opportunity to assess this supplement in the field. This trial compared 3 treatments: (a) whole triticale at the rate of 1% of body weight fed daily at pasture (Perennial ryegrass, phalaris and sub clover); (b) the same amount of grain with an additional 20% of this weight as Rumentek (50/50 protein and lipid); (c) farmer feedlotting using a commercial feedlot mix fed at 2% of liveweight daily. The stocking rate for (a) and (b) was 2 steers/ha on very short pasture. Fifty Hereford steers, weighing 462 kg, were allocated to the 3 treatments.

When the trial was terminated, the group fed triticale gained at 0.75 kg/head.day (SD 0.22) between March and July and at slaughter 3/15 made the Japanese Ox carcass specification. The grain plus Rumentek group had gained at 1.02 kg/head.day (SD 0.17) and 1 1/20 met specifications while the feedlot group had gained at 0.81 kg/head.day (SD 0.25) and 6/15 met specifications.

The quality of the feeds used were; Triticale CP 10.6%, ME 12.7 MJ/kg (FEEDTEST result, see Clarke *et al.* these proceedings, for energy calibration of grain for cattle); Feedlot mix CP 14.2%, ME 11.4 MJ/kg.

The whole grain supplemented group grew slightly faster than expected and the feedlot group grew more slowly than the owner expected.

A range of simple supplements is available to increase growth rates of cattle between midsummer and early spring compared to that obtained on pasture alone. Manipulation of starting times plus the monitoring of performance could allow turnoff of cattle meeting Japanese Ox contracts over an extended period during winter and spring in Southern Australia. A more sophisticated approach to supplementation at pasture might allow higher growth rates than achieved here, but these would need to be cost effective and readily understood by farmers and their advisers.

Meat exporters and Agriculture Victoria have developed the forward contract concept to improve the continuity of supply of high quality grass fed beef and minimise the risk associated with extra production costs and price fluctuation for producers. In the first 2 years of this project, farmers have adopted these contracts to sell approximately 15,000 head in Victoria.

UTILISATION OF GRAIN RATIONS ON SOWN PASTURES IN CENTRAL QUEENSLAND

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A number of studies on Brigalow Research Station, Theodore, in Central Queensland, investigated the performance of different classes of cattle, with or without grain diets, on sown tropical pastures based on buffel and rhodes grasses. These studies were conducted for the Meat Research Corporation's DAQ 065 research project and monitored the growth, carcass attributes, meat quality and market suitability of weaner heifers and steers, 2% year-old steers and aged cull cows. The majority of grain feeding was on an *ad lib.* basis during the winter-spring period when cattle growth rates on pastures are traditionally at or just above maintenance level.

Feeding grain to 450 kg 2½ year-old steers at pasture that were targeted at the Korean market, decreased time to turn-off by up to 90 days compared to steers grazing pasture alone. There were no differences in carcass attributes, including rump fat depth, eye muscle area, dentition, meat or fat colour or market suitability between the grain assisted or pasture finished steers at slaughter.

In another project, the proportion of steers meeting minimum carcass weights (280 kg) for the Japanese grass-fed market increased from 10% to 80 and 90% for steers grazing pasture or those supplemented with grain in either their second, or first and second winter-spring periods post weaning respectively. Compensatory growth by the steers fed in the second winter-spring period eroded all live weight advantages of those fed in the first year. Compensatory growth of the non-supplemented steers during the summer periods also decreased the advantages to grain feeding. In order to achieve maximum economic returns from grain feeding, animals are best fed in the final winter-spring period before slaughter. In general, animals should be turned off during or at the end of this period rather than carrying them over to the next summer.

Grain feeding weaner heifers on pasture to maintain growth rates above 0.5 kg per day reduced age of turn-off at all targeted carcass weights, yet influenced carcass parameters and market suitability at light carcass weights only. Feeding a grain ration reduced time to turn-off compared to pasture finished heifers by 200 days when the animals were slaughtered at carcass weights of 200,240 and 280 kg. Rump fat depths of the grain-assisted 200 kg carcass weight heifers were greater than the pasture finished 200 kg carcass weight heifers (14.6 mm vs 11.3 mm). At heavier carcass weights, the pasture finished heifers had greater fat depths, 25.4 mm vs 22.6 mm at 240 kg carcass weight and 26.9 mm vs 26.0 mm at 280 kg carcass weight. The decreased age of turn-off of the grain-assisted heifers resulted in lower dentition values than the pasture finished groups at the same carcass weight. All grain-assisted heifers had dentition values suitable for the markets they were targeted at, while 10% of the pasture finished heifers turned off at 200 kg carcass weight, and 18% turned off at 240 kg carcass weight, had four permanent teeth, making them unsuitable for the domestic market.

Grain supplements had no effect on meat colour at any carcass weight, while fat colour was influenced only slightly at light carcass weights. None of the heifers in either the grain-assisted or pasture finished groups had fat colours outside the desired market ranges. Marbling scores of heifers were influenced by grain assistance at 240 kg carcass weight (2.2 vs 1.5 for the grain assisted and pasture finished groups respectively) but not at 280 kg carcass weight , where each finishing system had an average marbling score of 2.0. Ninety-five per cent of the grain assisted heifers slaughtered at 240 kg carcass weight had marbling scores of ≥ 2 compared to 4 1% of the pasture finished group. Overall fat content of the *Longissimus dorsi* (LD) was influenced by nutrition. Grain assistance increased the fat content of the LD muscle by 0.6% at 200 and 240 kg carcass weights and by 3.1% at 280 kg carcass weight.

There was little direct effect of supplemental grain on meat quality. Ultimate pH levels of the LD muscle were not influenced by grain assistance. Warner-Bratzler shear force initial yield values were lower at all carcass weights for the grain-assisted groups than the pasture-finished heifers. The main reason for this however, is the younger age at slaughter of the grain-assisted heifers, not the nutritional regime.

Reducing the age of turn-off of surplus heifers from 3 years to 2 years of age can be shown, through modelling, to increase total breeding herd sales by up to 16%. In finishing enterprises, this decrease in turn-off age has a far greater effect, increasing sales by up to 50% over 3 years.

Carcass and liveweight gains of 0.6 and 0.7 kg per day were achieved by feeding up to 9 kg of grain per day to poor, aged cows grazing winter-spring pastures. These growth rates were twice those of similar cows grazing pastures alone. Carcass gains of 80 kg were achieved in 130 days compared to 243 days required for the pasture only cows to reach the same weights. Net increases in value of the grain assisted cows of $130 per head compared to $300 per head for the pasture finished cows with grain rations valued at $210 per tonne. The faster rate of carcass gain in the grain assisted cows would however allow up to 3 turn-off groups each year, compared to only 1½ turn off groups per year from pasture finished cows. When slaughtered at the same carcass weight, there were no differences in market grading, rump fat depths or yields of saleable meat between the grain assisted or pasture finished cows.

The greatest effect of feeding grain on animals grazing pasture in all the studies has been increased growth rates. This has resulted in significant differences in turnoff age and reductions in time to turn-off. There was very little direct influence of grain feeding on carcass parameters at heavy carcass weights, or meat quality at any carcass weight. The increase in growth rate due to grain feeding can increase the turn-over rate of animals and allow more flexibility in marketing, especially of young animals. In order to maximise economic returns from grain feeding on pasture, animals should be slaughtered during or as soon as possible after feeding is completed. Compensatory growth by contemporary non-supplemented animals during periods of good pasture growth will reduce the benefits of feeding.

FINISHING *BOS INDICUS* CROSSBRED CATTLE ON NORTHERN SPEAR GRASS PASTURES USING MOLASSES OR GRAIN BASED SUPPLEMENTS

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Beef cattle are managed under an extensive system of production in the sub humid tropics of northern Australia. The growth cycle of these cattle is one of rapid growth during the wet (green) season followed by liveweight maintenance and then liveweight loss in the dry season. The dry season weight loss is due to reduced feed intake because the spear grass pasture is low in nitrogen (N) and digestibility (DMD 48%). This interrupted growth cycle extends the age at which cattle reach target weights for various markets. Peak turn-off is from March to August with a less reliable supply at other times.

We will present 3 cost-effective options designed to reduce age of turn-off for a targeted market requiring carcasses weighing at least 150 kg per side. Each option requires the use of a long acting hormonal growth promotant for optimal results. The 3 strategies are based on supplying additional inputs in the form of digestible energy, nitrogen and a balance of essential minerals. Reducing age at turnoff can have dramatic effects on herd structure with implications for increased herd profitability and/or improved property sustainability, but these aspects are not discussed here. These studies were part of the Meat Research Corporation project DAQ 065.

Option 1. Spear grass plus molasses mixtures

The Bos indicus crossbred steers were supplemented with molasses (100 kg), prilled urea (3 kg), cottonseed meal (10.4 kg), dicalcium phosphate (1.3 kg) and fine salt (1 kg) plus 0.5 kg Rumensin Premix (Elanco Animal Health, West Ryde, NSW 2114) per tonne of mixture. This mixture (MUC) was offered ad libitum between August and December in each of the first 2 years after weaning and from July in the third year. This option reduced age of turn off by 16 months to 3.1 years with a benefit to cost ratio (BCR) of 1.05 to 1.

Option 2. Spear grass augmented with perennial stylo plus grain supplement

Native pastures were oversown to 20% of the area with a combination of Verano and Seca Stylos (PST). Phosphorus was included either as a supplement to the animals or as a fertiliser for the pasture. The steers were grazed on the pastures with and without a supplement of sorghum grain plus 1% urea and minerals in the first and second years after weaning (from September to December) and finished on MUC from June in the third year. Animals grazing the improved pasture alone reached turnoff weight at 3.5 years and the supplemented group was ready at 2.7 years of age. The high price of grain eliminated any profit. However, assuming that the animals were fed the lower cost MUC supplement instead and grew at the same rate, the BCR would have been 1.2 to 1. The BCR for PST alone was 5 to 1.

Option 3. Production finishing

The steers were grown out on native pastures without supplement until they were 3.5 years of age and weighed 522 kg. They were then finished on native pasture plus the MUC supplement for 100 days and reached target weight at 3.8 years. The BCR of this system is 1.65 to 1. This option is particularly useful if extended turn-off into the period September to December is targeted.

The annual growth rates and turn off ages for the conventional spear grass system and these options are shown in Table 8.

Table 8. Annual liveweight gains (kg) for finishing options (300 kg carcass)

	Year				Turn-off age (years)
	1	2	3	4	
Spear grass	138	127	88	80	4.5
MUC (Option 1)	216	157	73^{A}	0	3.1
PST (Option 2)	184	182	65^{A}	0	3.5
Production (Option 3)	231	210	30^{A}	0	2.7
PST + grain (Option 2)	138	128	88	92^{A}	3.8

Carcass and meat quality

Fat colour was acceptable with all options and marbling score was always low (1 to 1.5 average). However the P8 fat depth was within the acceptable range of 5 to 22 mm for each option.

Meat tenderness measurements responded to the reduction in age of turn off. The Warner-Bratzler shear force reduced in a linear manner from 7 kg to 4 kg as carcass age reduced from 4.5 years to 2.7 years.

Northern cattlemen can choose one of these three options to meet premium market specifications of 300 kg carcass with less than 22 mm of P8 fat with a high proportion in the 6 tooth age bracket.

CONCLUSION

Supplementary feeding with grain, conserved fodder or fodder crops is carried out in most finishing areas of Australia. The profitability of supplementary feeding depends on the cost of extra inputs (including labour) and extra returns for cattle more closely matching market specifications and being supplied at times of the year when shortages are expected. Supplementary feeding needs to be integrated within the whole production system and reliability of production is important. Although direct profit margins are often quite tight, decreased time to turnoff, of generally 2 to 6 months in southern Australia and up to 20 months in Northern Australia, has the potential to alter herd structure and productivity. Younger age at slaughter often improves meat tenderness, and other carcass traits remain very acceptable.

Improved continuity of supply of high quality beef to processors attempting to develop year round supply of branded product for consumers and achieve satisfactory returns on capital is very important for the beef industry.

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