Investigating Dairy Calf Selection as an Estimate of Finished Carcase Conformation and Returns from Different Quality Pure Dairy Calves

Final Report

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1.0 Executive summary

The objective of this trial was to assess any differences in performance and financial returns from a range of pure dairy bull calves of apparently different carcase conformation potential finished intensively for beef production.

The hypothesis was that calves can be selected at approximately 10 days old on the basis of their future performance and the value of the final carcase they will produce.

Two groups of calves (16 calves in each group) were compared in terms of their performance from arrival at the collection centre until slaughter at between 14 and 15 months of age. Group O was judged to have potential to produce carcases classifying O on the EUROP scale for conformation and group P were judged more likely to produce P class carcases.

There were few statistical differences in performance between the two groups which maybe in part due to the small number of calves in the trial and the large degree of variation recorded in the results.

The areas in which differences in performance were significant were:

- Start liveweight of the calves at selection/start of rearing, was 9kg lower for group P calves than group O calves, despite the ages of the calves being similar.
- Calf mortalities during the rearing phase tended to be greater in group P than group O (19 vs 0%, respectively).
- A parameter called 'weight for age' was shown to be a good indicator of a calves potential growth rate and carcase weight, showing a positive relationship in both cases. (Calculated as weight at collection centre divided by age).

Lessons learned:

1. Lighter weight calves appeared to have poorer conformation but this did not result in statistically poorer conformation carcases at slaughter
2. Both weight and conformation are likely to reflect early management of calf on the dairy farm – a good start to life is vital, and this is where colostrum quality and intake is so important
3. Weight for age would seem to be a useful predictor of calf health and performance potential and worthy of further investigation
4. The main losses of lighter weight, poorly conformed calves tended to be during the rearing phase
5. Veterinary treatment during the rearing phase can enable cattle to achieve good performance in the finishing phase
6. Growth rate during the finishing phase was similar for both groups

2.0 Method

2.1 Objective

The objective of this trial was to assess any differences in performance and financial returns from a range of pure dairy bull calves of apparently different carcase conformation potential finished intensively for beef production.

The hypothesis was that calves can be selected at approximately 10 days old on the basis of their future performance and the value of the final carcase they will produce.

2.2 Calf procurement & selection

A total of 32 pure dairy bred (Holstein or Holstein Friesian on the cattle passport) bull calves were selected at Honiton collection centre on 30 October 2008. The calves had been delivered from the dairy farms of birth to the collection centre that day and were aged between 8 and 26 days old according to their passports.

All calves were judged to be fit and healthy with no apparent symptoms of infections, disease or physical injury, e.g. physical injury/defects, swollen/infected navel, scouring, heavy breathing.

There were two treatments:

- O 16 fit and healthy good conformation Holstein bull calves. Selected as likely to produce carcases classifying –O or O+.
- P 16 fit and health bobby bull calves of poor conformation. Selected at approximately 2 weeks of age as likely to produce carcases classifying –P or P+.

All calves were graded by 3 assessors independently. Each assessor made a prediction about the likely carcase conformation of the animal when it has been finished at approximately 13-15 months old on an intensive ration. There was no consultation between assessors when making their assessment. The average score was used as the criteria for allocation to either treatment.

All calves were blood tested using the zinc sulphate turbidity (ZST) test to indirectly assess immunoglobulin levels after selection at the collection centre, as an indication of how much colostrum the calves have received.

2.3 Calf rearing

All calves were mixed and randomly assigned to 3 pens in the rearing unit. During rearing, the calves were managed according to the Blade calf rearing protocol and all medicine treatments recorded. On arrival at the rearing unit the calves were treated for internal and external parasites, pneumonia-causing viruses and ringworm. Pre-weaning they were also vaccinated again Blue Tongue Virus and disbudded. Post-weaning at 6-8 weeks (when eating more than 1kg calf creep per day) the calves were vaccinated with Rispoval 4™ (IBR, RSV, BVD and PI3).

From arrival to weaning the calves were fed 6 litres of milk replacer daily in 2 feeds and this was reduced to a single feed from 4 weeks. Fresh water was always available and a mineral lick was also available in each pen. Fresh straw was always available from racks.

2.4 **Finishing and slaughter**

All calves were transferred from the rearing unit to a single finishing unit on 13 February 2009, at an average of 122 days of age (4 months old). On this unit all the calves were housed in the same pen in a shed housing other cattle being finished for Blade Farming Ltd.

During finishing the cattle were fed a cereal based diet ad libitum from hoppers, with good quality straw freely available (appendix shows formulation).

All the cattle from both treatments were slaughtered on the same day at Southern Countries Fresh Foods abattoir at Langport, Somerset on 8 January 2010. They were dressed to UK specification and carcases graded according to the 15 point scale and the EUROP scale by an independent licensed classifier who had no knowledge of the cattle or their experimental groups.

In addition, each pair of lungs from the carcases was scored for lesions and tearing to investigate if there was any difference in lung damage caused by the incidence of pneumonia between the calves in the two groups. This was performed by an independent vet with no prior knowledge of the cattle or their experimental groups.

On the slaughter line each set of lungs was uniquely numbered with a paper tag to cross-reference back to each animal's ear tag number and kill data. Lungs were removed from the line for inspection and scoring. The condition of each lung was assessed by one veterinary inspector using a combination of visual inspection and palpation, starting on the right side of the lung. Pleurisy was assessed and scored on the cranial lobes.

The left and right cranial, cardiac and diaphragmatic lobes (leading to a maximum of six lobes scored per set of lungs) were each scored individually using the following approach. The overall lobe score assigned was a combination of lesion score, type and the presence of tearing. A lobe could only have one lesion type, consolidation or abnormality, and the presence of consolidation overrode any other abnormality. If the lobe was missing, then no further data were recorded.

In order to collect some exploratory data on the incidence of liver damage in intensively finished cattle all livers from the cattle on trial were scored for lesions on a scale of 5 – severe abscesses to 1 – healthy liver.

3.0 Results

3.1 Calf details and performance during rearing

A summary of the age, weight and breeding of the calves in this experiment are presented in Table 1. The calves selected to be in group P were on average 9kg lighter at the start of the experiment than calves in group O. There was no difference in average start age of the calves in the two groups.

It is also worth noting that a higher proportion of the calves in group O had a breed classification of Holstein (H) or Holstein cross (HX) on their passport than those calves in group P, which tended to have more Holstein Friesian (HFr) or Holstein Friesian cross (HFrX) breed codes.

Table 1: Description of the calf groups

	Units	O	P	P value[#]
Start number of calves per gp		16	16	-
Average start rear LW	kg	57	48	***
Age at transfer to rear unit	days	17	15	NS
% H or HX (breed code on passport)		25%	6%	-
% HFr or HFrX (breed code on passport)		75%	94%	-
Number of herds of origin		11	9	-

[#] NS = no significant difference, *** = P > 0.001

Table 2 below details the performance of the two groups of calves during the rearing phase. There were no statistically significant differences between the groups in any of the parameters measured, however there was a tendency for the number of mortalities in group P to be higher than group O i.e., 3 versus 0 (P = 0.069).

Liveweight gain during the rearing period averaged 0.66 kg/day across both groups. Less than 40% of the calves on trial recorded ZST levels above the recommended 20 ZST units level, which suggests less than ideal colostrum intake of the calves although there were no differences between the groups.

Table 2: Calf rearing details

	Units	O	P	P value
Start number of calves per group		16	16	-
Immunoglobulins	ZST	16	14	NS
% >20 ZST		31%	38%	-
Total rear mortalities		0	3	NS
Immunoglobulins of calves that died during rearing			8.3	-
% Rear mortalities		0.0%	18.8%	-
Average end rear LW	kg	128	119	NS
Average rear LWG	kg/d	0.67	0.65	NS

3.2 Calf performance during finishing and slaughter details

Details of the performance of the cattle during the finishing phase are shown in Table 3, and carcase details shown in Table 4. Again there were no statistical differences between groups.

Daily live weight gain during the finishing period averaged 1.22 kg/day and lifetime daily life weight gain averaged 1.15 kg/day.

Carcase weight averaged 273 kg between the two groups equating to a carcase value of £688 per head.

There was no statistically significant difference in the conformation classification of carcases from the two groups of cattle, nor the value of the individual carcases produced.

Table 3: Finishing performance

	Units	O	P	P value
Finishing mortalities		1	1	-
Total mortalities		1	4	NS
Slaughter age	days	452	449	NS
Estimated Final LW[#]	kg	544	526	NS
Daily LWG (during finishing)*	kg/d	1.22	1.23	NS
Daily LWG (collection to slaughter)	kg/d	1.12	1.08	NS
Daily DWG (collection to slaughter)	kg/d	0.57	0.56	NS
Total LWG (during finishing)	kg	416	407	NS

* Live weight gain calculated by regression as no accurate slaughter weight was available

[#] Calculated from carcase weight multiplied by predicted killing-out percentage of 51%. A measured final slaughter weight was not available due to snow and ice

Table 4: Carcase details

	Units	O	P	P value
Carcase weight	kg	278	268	NS
15 pt conf score		4.1	3.8	NS
15 pt fat score		5.5	5.3	NS
Carcase value	p/kg	2.53	2.45	NS
Carcase value	£/hd	705.33	666.51	NS

The data on lung and liver damage showed no significance difference between groups (Table 5). Since both groups were fed the same diet a difference in liver scores was not expected but it was interesting to note that 15% of the cattle on the trial had livers that were rejected. No significant relationship was found between liver damage scores and growth rates nor carcase weight.

Table 5: Lung and liver scores (scoring system is detailed in Appendix 1)

Liver scores	**Scale**[#]	**O**	**P**	**P value**
Liver score	(1-5)	2.5	3.0	NS
Number of livers rejected		2	2	-
Lung scores				
Cranial pleurisy	(0-3)	1.8	1.9	NS
Lung damage	(0-12)	2.7	2.3	NS
Lung abnormalities present	(0-6)	2.0	1.2	NS

[#] Highest numbers represent greatest organ damage

4.0 Discussion

4.1 Calf selection and rearing

At the start of the trial the calves in this experiment had a difference in age of 18 days between the youngest and the oldest. The age difference was above the desired level of 14 days, but reflects the variation in age of calves coming into the collection centre on a regular basis.

Given the importance of calves receiving sufficient colostrum within the first 12 hours of birth in order for them to develop immunity to infectious agents they may meet early in life, it was decided to undertake a zinc sulphate turbidity test (ZST) on blood taken from all of the calves . ZST provides an indirect indication of immunoglobulin uptake (Andrews, 2004). This result can be related to colostrum intake in calves, although it is sensitive to the age of the calves and may not be a very reliable measure in older calves (beyond 20 days old, Ms Pat Shaw MRCVS, personal communication).

Not withstanding the age sensitivity of the test, the results showed that ZST concentrations showed no differences between groups, although the mean concentration for both groups was below the 20 ZST units that is normally referred to as the desirable level (Andrews, 2004), which suggests that in general the calves had not received sufficient colostrum from their dams. In both groups over 60% of calves recorded ZST levels below 20 ZST units. ZST results were not correlated with mortality rates.

Rearing mortalities were noticeably greater in group P than in group O (19% versus 0%, respectively; P=0.07). The end of rearing liveweights were not statistically significant between groups although the average for group P tended to be lower than group O.

It was interesting to note that the breed code on the passport, and in particular a Holstein breed coding did not seem to be a good indicator of the likelihood of a calf being selected to be in group P, nor of final carcase conformation potential.

4.2 Calf finishing and slaughter

Total feed consumption during finishing of each pen was estimated by the manager of the finishing unit and the total consumption of the cereal based mix out of the *ad libitum* hoppers was 2.8 tonnes per head (fresh weight). Given the slightly poorer liveweight gain of the P group their feed conversion efficiency (FCE) was estimated to be 5.99 kg DMI/kg LWG compared to 5.85 for group O. These conversion figures are slightly higher than those regularly reported by Simon Marsh at Harper Adams for intensively finished dairy bred bulls, where FCE of 5.5 is the average. Such difference is not surprising though given the much more crude on farm measurement of intake undertaken during this trial.

Mortalities during the finishing stage were higher than expected, at 1 animal per group, equating to 6.3% and 7.7% for groups O and P respectively. As a percentage, total mortalities during the rearing and finishing phase were 6.3% for

group O and 25% for group P. Such high levels of mortality are of concern and suggest that group P calves were more susceptible to health problems.

Whilst average lifetime daily liveweight gains were similar between the two groups the range between the fastest and slowest gains was greater for those cattle in group P as shown in Table 6.

Table 6: Range in liveweight gain

	Liveweight gain range (kg/day)		
	Minimum	**Maximum**	**Difference**
Group O	0.94	1.28	0.33
Group P	0.80	1.39	0.58

Carcase weights showed considerable variation; again the greatest variation was evident in group P where there was a range in carcase weights of 132 kg, compared to a range of 78kg in group O. In terms of carcase values, group O calves produced carcases that averaged £39 per head greater value per head than group P, although the difference was not significantly different.

However group P supplied the carcases with the highest and lowest carcase values in the trial, £893/head and £278/per head, respectively. Again this demonstrates the wide variation of performance between animals in the same group.

The small number of cattle involved in this study meant that identifying statistically significant differences between the groups was difficult particularly since so much variation was recorded in animal performance. The results of the study suggest that selecting calves by handling and visual assessment is not a good way of choosing which calves will perform the best in an intensive bull beef finishing system.

Further analysis of the data revealed (Table 7) that even a more objective means of assessing calves such as weighing them at the collection centre did not improve the predictability of their lifetime daily LWG or final carcase weight. Conversely, a positive statistical relationship between ‘weight for age’ and lifetime daily LWG and final carcase weight was recorded. The weight for age parameter was calculated by dividing the weight of the calf at the collection centre by their number of days of age to calculate a parameter that was is in fact a daily LWG from birth to their age at the collection centre.

Table 7: Relationships between liveweight at collection, weight for age at start and performance

Regression coefficients (P value)	DLWG (lifetime)	Carcase weight
Liveweight at start	0.00076 (0.850)	0.302 (0.741)
Weight for age at start	0.0520 (0.037)*	13.6 (0.015)*

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* Statistically significant results at P<0.05

Lessons learned:

1. Lighter weight calves appeared to have poorer conformation but this did not result in statistically poorer conformation carcases at slaughter
2. Both weight and conformation are likely to reflect early management of calf on the dairy farm – a good start to life is vital, and this is where colostrum quality and intake is so important
3. Weight for age would seem to be a useful predictor of calf health and performance potential and worthy of further investigation
4. The main losses of lighter weight, poorly conformed calves tended to be during the rearing phase
5. Veterinary treatment during the rearing phase can enable cattle to achieve good performance in the finishing phase
6. Growth rate during the finishing phase was similar for both groups

References:

Andrews, A H. (2004). Colostrum – Not just for 24 hours. *Cattle Practice* **12:2** 121-124.

Appendix 1: Scoring liver and lung damage to assess health problems in finished bulls

Liver damage scores*

	Description
5	Severe abscesses
4	Slight abscesses and/or severe discolouration
3	Discolouration and/or swelling
2	Minor discolouration/swelling
1	Healthy liver

*Scoring system above from S Marsh, Harper Adams University College, personal communication

Lung lobe scoring system (Williams and Green, 2007)

Lesion score

0	No lesion in lobe
1	Up to 50% lobe affected
2	>50% lobe affected

Lesion Type

C	Consolidation
A	Any abnormality other than consolidation

Tearing

Blank	No tearing
T	Lobe torn
M	Lobe missing

Williams and Green, (2007). Cattle Practice Vol 15, Part 3, 244-249.

Method for lung lobe scoring:
On the slaughter line each set of lungs was uniquely numbered with a paper tag to cross-reference back to each animal's ear tag number and kill data. Lungs missing a paper tag were excluded from scoring and a data line was left empty for that bovine. Lungs were removed from the line for inspection. The condition of each lung was assessed by one veterinary inspector using a combination of visual inspection and palpation, starting on the right side of the lung. Pleurisy was assessed and scored on the cranial lobes.

The left and right cranial, cardiac and diaphragmatic lobes (leading to a maximum of six lobes scored per set of lungs) were each scored individually using the following approach. The overall lobe score assigned was a combination of lesion score, type and the presence of tearing. A lobe could only have one lesion type, consolidation or abnormality (C or A respectively), and the presence of consolidation overrode any other abnormality. If the lobe was missing, then no further data were recorded.

Appendix 2: Finishing ration details

Finisher protein blend 1	
Ingredients	**% Inclusion (FW)**
Wheetfeed	2
Hipro soya	24
Rapeseed meal	27
Palm kernel	25.3
Feed Grade Urea	2.5
Soya Hulls	14
Molasses	2.5
Citrus pulp	2.7
	100

This protein blend was mixed with homegrown barley at 4:1, i.e., 20% of FW is blend, 80% is barley.

Finisher protein blend 2	
Ingredients	**% Inclusion (FW)**
Hipro soya	15
Rapeseed meal	25
Soya hulls	27.5
Feed Grade Urea	2.5
Wheat distillers	30
	100

This protein blend was mixed with homegrown barley at 6:1, i.e., 14% of FW is blend, 86% is barley.
This mix was used as from August 2009

NIRS analysis of the complete intensive finishing ration

	Units	**Feb - July**	**Aug - Jan**
DM	% FW	87.7	87.0
Crude Protein	% DM	14.4	13.9
Oil B	% DM	2.0	2.6
Ash	% DM	5.3	5.6
Neutral Detergent Fibre	% DM	15.6	28.6
Starch	% DM	36.9	43.8
ME	MJ/kg DM	13.8	13.8

Appendix 3: Supplementary Statistical Analyses

Relationship between health scores and physical performance

Lung damage

Score	Carcase weight	Daily liveweight gain (overall)
0	282.1	1.19
1	276.1	1.16
2	274.9	1.16
3	296.0	1.25
4	278.6	1.17
5	261.1	1.11
6	-	-
7	198.9	0.82
8	264.2	1.10
P-value	0.282	0.284

Cranial pleurisy

Score	Carcase weight	Daily liveweight gain (collection to slaughter)
0	294.8	1.245
1	270.2	1.137
2	273.4	1.148
3	274.7	1.156
P-value	0.901	0.899

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Lung abnormalities present

Score	Carcase weight	Daily liveweight gain (overall)
0	282.1	1.195
1	275.8	1.154
2	257.9	1.092
3	279.2	1.171
4	281.8	1.194
5	264.2	1.105
P-value	0.873	0.888

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Lobes torn or missing

Score	Carcase weight	Daily liveweight gain (overall)
0	271.0	1.1427
1	281.8	1.1944
2	277.3	1.1704
3	232.9	0.9682
4	278.8	1.1644
5	273.3	1.1499
6	282.8	1.1900
P-value	0.371	0.345

Relationship between breed code and carcase characteristics

Breed type	Conformation score	Fat score
H	3.7	5.0
HFr	4.0	5.4
HFrX	4.0	4.5
HX	4.0	7.0
P-value	0.925	0.539

Relationships between ZST and performance

Regression of Daily Liveweight Gain on ZST:

DLWG = 1.13 + 0.00100 ZST, p= 0.776

Chi-squared test of ZST>20 and died on test

		ZST> 20		
		No	Yes	Overall
Died on test	**No**	17	10	27
	Yes	4	1	5
	Overall	21	11	32

P-Value = 0.461