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MAXIMISING RETURNS FROM BEEF PROGENY SOURCED IN THE DAIRY HERD

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SUMMARY

This project aimed to evaluate the health status and lifetime performance of dairy-origin calves (Holstein and Angus, Limousin and Belgian Blue cross Holstein) sourced from dairy farms in Northern Ireland. The immune status of the calves was determined prior to purchase by undertaking Zinc Sulphate Turbidity (ZST) analysis on blood samples taken within one week of birth. Calves with ZST levels of greater than 20 units were classified as having adequate immune status. On arrival at AFBI the calves were allocated to either a Low Labour Input or a Standard rearing regime. The Low Labour input regime involved feeding calves milk in groups once per day; the Standard regime involved feeding calves milk individually twice per day using buckets. After weaning, calves were allocated to one of four rearing/finishing regimes. The regimes included: bulls reared and finished on ad libitum concentrates (2.6 tonnes concentrates/head), bulls reared on forage (grass/grass-silage)/concentrate-based system (1.7 tonnes concentrates/head), steers reared on a forage (grass/grass silage)-based system with either medium (1.5 tonnes concentrates/head) or low (0.8 tonnes/concentrates/head) concentrate input.

Results from the trial demonstrated that calves with low immune status (ZST less than 20 unit) required a greater number of antibiotic treatments in the pre-weaning period, had 17% lower liveweight gains in the period up to 3 months, were on average 17 days older at slaughter and in monetary terms produced a lower margin over feed. Relative to Standard calf rearing systems, Low Labour systems reduced labour inputs by up to 60% whilst producing similar lifetime performance. Rearing dairy-origin bulls on a forage/concentrate-based diet reduced lifetime liveweight gain and carcass value relative to bulls reared and finished on ad libitum concentrates. However, feed costs per kg carcass gain were lower, although the relationship depended on concentrate price. For dairy-origin steers, reducing concentrate inputs from 1.5 tonnes to 0.8 tonnes per head and making best use of forage reduced lifetime performance and carcass value. However, feed costs per kg carcass gain were lower for the low concentrate input system which increased margin over feed costs. However, the differential between the two systems decreased as concentrate price increased. Beef rearing and finishing systems based on dairy-origin bulls slaughtered at 16 months of age produced greater lifetime carcass gains, were more efficient at converting food to carcass gain and had lower feed costs per kg carcass gain relative to dairy-origin steers slaughtered at 26 months of age. The relative different in the two systems in terms of margin over feed costs was determined by concentrate price; as concentrate price increased the differential between the two systems decreased.

Under a relatively low concentrate input system, early and late maturing cross Holstein steers had similar lifetime performance and feed costs per kg carcass gain. Holstein steers had the lowest carcass value and consumed 9% more feed than the other breeds, had the highest feed costs per kg carcass gain, but produced a similar margin over feed to Angus cross Holstein steers. This was attributed to the lower purchase price of Holsteins. A greater proportion of Belgian Blue steers were of fat class 2, indicating that a more intensive feeding regime is required for this late maturing breed. Meat from bulls slaughtered at 16 month of age had higher pH and was less tender than meat from steers slaughtered at 26 months of age. This was mainly related to management of the bulls prior to slaughter. In general breed effects on meat quality were small, although meat from Angus cross Holstein steers produced lighter colour meat which was attributed to the greater amount of marbling fat.

INTRODUCTION

Currently 52% of prime cattle slaughtered in Northern Ireland come from the suckler herd and 48% from the dairy herd. The proportion of beef from the dairy herd is predicted to increase due to a decrease in suckler cow numbers following the decoupling of subsidies from agricultural production. In addition, one of the key findings of the Red Meat Task Force Report was that there may be viable models of production based on dairy-origin beef that break even on a full economic profitability basis assuming aggressive cost efficiencies and an increase in farm-gate price. Research has consistently demonstrated that bulls grow faster, utilise food more efficiently and produce leaner carcasses than steers when given both high concentrate and high-forage diets. More recently, AFBI research has shown that there is potential to reduce the costs of bull-beef systems by substituting 50% of an all concentrate diet (dry matter (DM) basis) with high quality grass silage with no detrimental effects on animal performance. In addition while considerable research has been undertaken to evaluate the performance of dairy-origin bulls and steers and the interaction with plane of nutrition during the finishing phase limited research has evaluated lifetime performance from birth to slaughter. Given this background the first objective of the current research project is to assess the lifetime performance of spring-born, dairy-origin cattle reared as either bulls or steers on a range of dietary regimes with the key aim of establishing optimum rearing regime to maximise economic returns.

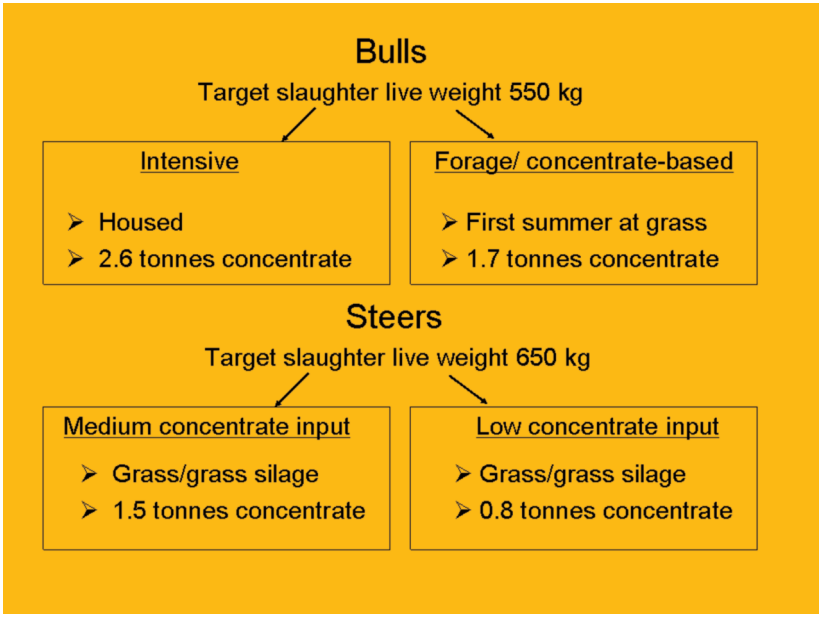
Calf mortality represent a significant cost to the UK dairy and beef industry both in terms of veterinary costs associated with treating sick animals plus the losses associated with poor performance and death of animals. However, limited information is available on the mortality of calves sourced from the dairy herd for dairy-origin beef systems and the impact of immune status on subsequent performance. The second objective of the current study is to assess the immune status of spring-born, dairy-origin calves sourced from farms in Northern Ireland.

Due to the increasing proportion of farmers with alternative off-farm employment and the significant labour input required for rearing calves, labour inputs represent a major limitation for many farmers who wish to consider dairy-origin beef rearing enterprises. Therefore the third objective of the current study is to evaluate mechanisms by which labour inputs and costs, particularly associated with feeding milk to beef cross calves, can be reduced.

There have been conflicting reports on the quality of meat from dairy-origin animals. Previous AFBI research has demonstrated that meat from Holstein steers is more tender relative to Charolais steers sourced from the suckler herd. However, other UK research noted that purebred Holstein steers achieved poorer sensory ratings relative to Angus steers. The final objective of this study is to evaluate the effect of lifetime rearing and finishing systems for dairy-origin cattle on instrumental meat quality

PROCEDURES

- Between 2006 and 2008, 360 spring (February/March) born bull calves were sourced from 12 farms throughout Northern Ireland
- The calves were of four genotypes – Holstein, Angus cross Holstein, Limousin cross Holstein and Belgian Blue cross Holstein
- In 2007 and 2008 the immune status of the calves was determined prior to purchase by taking a blood sample within one week of birth
- Pre-weaning treatments (2006 and 2007-born calves)
- Low Labour – calves housed in groups of up to 20 calves and fed milk replacer once per day using a group feeder
- Standard – calves housed in groups of 4 to 6 calves and fed individually using buckets of buckets fitted with teats
- Post-weaning treatments (2006 and 2007 born calves)

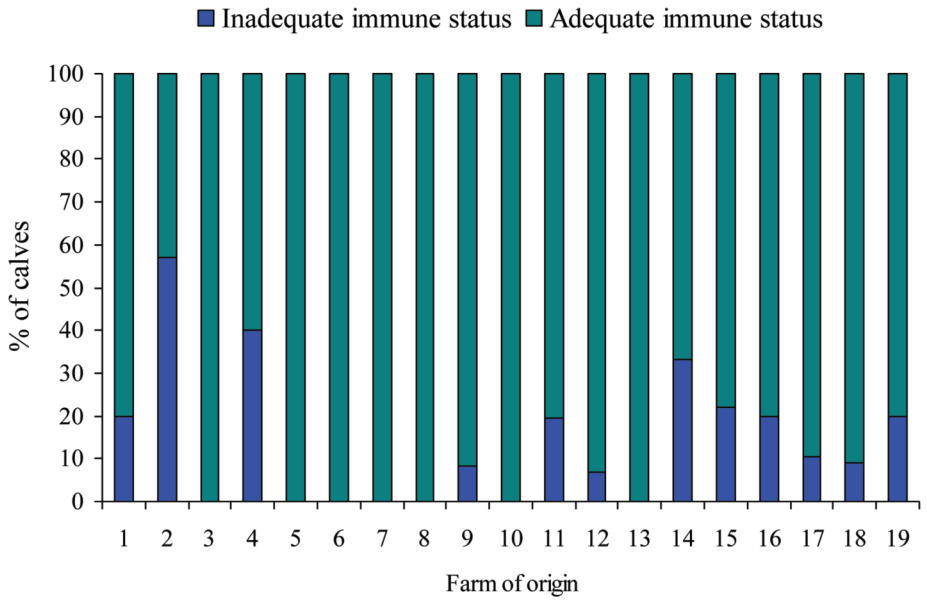


REVIEW OF FINDINGS

Calf health and immunity

- Overall 15% of calves sourced had inadequate immune status
- There was a significant variation between farms (Figure 1). The green part of the column represents the percentage of calves which had adequate immune status i.e. ZST levels greater than 20 units. For example on farm 1, 20% of the calves had ZST levels less than 20 units and 80% of the calves had ZST levels greater than 20 units. On farms 5, 6, 7, 8 and 13 all calves had ZST levels greater than 20 units.

Figure 1. Effect of farm of origin on percentage of calves with adequate immune status



Effect of immune status on animal health and performance:
Calves with inadequate immune status:

- Required a greater number of antibiotic treatments in the per-weaning period
- Had 17% lower liveweight gains in the period up to 3 months of age
- Were 17 days older at slaughter
- Produced a lower margin over feed of £20 per animal

(Table 1)

Table 1. Effect of immune status category on animal health and performance from arrival at AFBI Hillsborough to slaughter

Immune status category (ZST units)	0-20	>20
Percentage of calves receiving antibiotic pre-weaning	48	37
Liveweight gain (kg/day)		
Start to 3 months	0.64	0.77
Start to 12 months	0.95	0.98
Start to slaughter	1.00	1.01
Age at slaughter (months)	20.1	19.5
Margin/feed† (£)	117	137

Results averaged over bulls and steers
† Margin/feed calculated from carcass value – (purchase value - treatment costs – feed costs)

Effect of Low labour calf rearing systems on animal health and performance

Relative to the Standard system, steers reared on the Low Labour rearing systems:

- Were 7 kg lighter at 12 months of age and at slaughter
- Had similar carcass weight
- Liveweight gains from start to 12 months and from start to slaughter were lower
- Up to 60% less time was time feeding calves
- Labour costs were reduced by £1273 for a 50-calf rearing system over a 6 week period

(Table 2)

Table 2. Effect of rearing regime on performance of spring-born Holstein and beef x Holstein steers

	Low Labour	Standard	Diff Low Labour vs Standard
Live weight (kg)			
Weaning	77	76	
12 months	339	346	
Slaughter	668	675	
Liveweight gain (kg/day)			
Start to weaning	0.67	0.67	
Start to 12 months	0.81	0.83	
Start to slaughter	0.78	0.80	
Carcass weight (kg)	333.5	334.1	
Labour input (mins/calf/day)	2.1	5.2	
Labour input (hours/week/50 calves)	12	30	-18 hours
Labour costs (£)*	890	2163	-£1273
Value of cattle at slaughter (£)†	51,859	51,786	-£73

*assume labour cost of £12/hour (DARD Farm Business Data, 2009), 6-week rearing period, rearing 50 calves
†assume carcass value = cold carcass weight x £3.11/kg

Effect of lifetime rearing regime on animal performance

Forage/concentrate-based bulls versus intensively fed bulls

- Lower lifetime liveweight gain and carcass value
- Lower costs per kg carcass gain

(Table 3)

Table 3. Comparison of the performance of dairy-origin bulls reared and finished under Intensive or Forage/concentrate-based systems

	Lifetime rearing regime	
	Intensive bull system	Forage/ concentrate-based bull system
Lifetime liveweight gain (kg/day)	1.22	1.07
Lifetime carcass gain (kg/day)	0.67	0.58
Age at slaughter (months)	15.0	16.4
Carcass weight (kg)	309	298
% U grades	13	12
% R grades	42	32
Carcass value (£)†	967	927
Total concentrate input (t fresh)	2.6	1.7
Total silage input (t DM)	0.27	0.86
Grazing area (ha/animal)	0	0.05
Food conversion ratio		
kg DMI/kg liveweight gain	4.9	4.7
kg DMI/kg carcass gain	8.6	8.5
Margin/feed (lifetime) ‡ (£)	183	236
Margin/feed/day (p/day)	40	47
Feed costs/kg carcass gain (£/kg)	2.04	1.80

† Purchase price based on prices in Farm Business Data (2011) £155/calf. Beef price for young bulls – U3 = 323 p/kg, R3 = 317 p/kg, O3 = 306

‡ Concentrate price £220/t fresh, silage £120/t DM, grazing £681/ha; milk replacer cost £1400/tonne, average intake 17.85 kg/calf

Low versus medium concentrate input steers

- Lifetime performance and carcass value reduced
- Feed costs per kg carcass gain lower
- Higher margin over feed costs

(Table 4)

Table 4. Comparison of the performance of dairy-origin steers reared and finished under Medium or Low concentrate input systems

	Lifetime rearing regime	
	Medium concentrate input steer system	Low concentrate input steer system
Lifetime liveweight gain (kg/day)	0.82	0.76
Lifetime carcass gain (kg/day)	0.42	0.39
Age at slaughter (months)	25.1	26.2
Carcass weight (kg)	340	328
% R grades	24	18
% O+ grades	37	33
Carcass value (£)†	1061	1017
Total concentrate input (t fresh)	1.5	0.8
Total silage input (t DM)	2.2	2.5
Grazing area (ha/animal)	0.33	0.26
Food conversion ratio		
kg DMI/kg live weight gain	5.5	5.2
kg DMI/kg carcass gain	10.9	10.4
Margin/feed (lifetime)‡ (£)	62	184
Margin/feed/day (p/day)	8	23
Feed costs/kg carcass gain (£/kg)	2.48	2.07

† Purchase price based on prices in Farm Business Data (2011) £155/calf. Beef price based steers - U3 = 324 p/kg, R3 = 319 p/kg and O3 = 310 p/kg;
‡ Concentrate price £220/t fresh, silage £120/t DM, grazing £681/ha; milk replacer cost £1400/tonne, average intake 17.85 kg/calf

Bulls(16 months) versus steers (26 months)

- Greater lifetime carcass gains
- More efficient at converting food to carcass gain
- Lower feed cost per kg carcass gain

(Table 5)

Table 5. Comparison of the performance of bulls (16 months) and steers (26 months)

	Bulls 16 months	Steers 26 months
Lifetime liveweight gain (kg/day)	1.07	0.76
Lifetime carcass gain (kg/day)§	0.58	0.39
Age at slaughter (months)	16.4	26.2
Carcass weight (kg)	298	328
% R grades	32	18
% O+ grades	30	33
Carcass value (£)†	928	1017
Total concentrate inputs (t fresh)	1.7	0.8
Food conversion ratio		
kg DMI/kg liveweight gain	4.7	5.2
kg DMI/kg carcass gain	8.5	10.4
Margin/feed (lifetime)‡ (£)	270	184
Margin/feed/day (p/day)	54	23
Feed costs/kg carcass gain (£/kg)	1.69	2.07

† Purchase price based on prices in Farm Business Data (2011) £155/calf. Beef price based on average price steers - U3 = 324 p/kg, R3 = 319 p/kg and O3 = 310 p/kg; Young bulls – U3 = 323 p/kg, R3 = 317 p/kg, O3 = 306

‡ Concentrate price £220/t fresh, silage £120/t DM, grazing £681/ha; milk replacer cost £1400/tonne, average intake 17.85 kg/calf

§ Initial carcass weight predicted from Keane and Fallon (2001)

In all systems, in terms of margin over feed costs the relative difference between the systems depends on concentrate cost.

Effect of steer breed on performance

Under a relatively low concentrate input system:

- Early and late maturing cross Holstein steers had similar lifetime performance and feed costs per kg carcass gain
- Holstein steers had the lowest carcass value and consumed 9% more feed than the other breeds, had the highest feed costs per kg carcass gain, but produced similar margin over feed to Angus cross Holstein steers. This was attributed to the lower purchase cost of Holsteins
- A greater proportion of Belgian Blue steers were of fat class 2, indicating that a more intensive finishing regime is require for this late maturing breed.

(Table 6)

Table 6. Comparison of the performance of Holstein, early maturing cross Holstein and late maturing cross Holstein steers (results averaged over medium and low concentrate input steers systems)

			Late maturing	
	Holstein	Early maturing (Angus)	Belgian Blue	Limousin
Lifetime liveweight gain (kg/day)	0.78	0.80	0.77	0.80
Lifetime carcass gain (kg/day)	0.39	0.41	0.41	0.43
Age at slaughter (months)	26.2	25.2	25.7	25.9
Carcass weight (kg)	322	332	335	349
Killing out %	47.7	47.9	51.3	51.9
% R grades	0	0	38	38
% O+, O & O- grades	86	100	62	62
% P grades	14	0	0	0
% Fat class 2	0	0	16	4
Carcass value (£)†	982	1029	1052	1096
Concentrate inputs (t fresh/animal)	1.2	1.1	1.1	1.1
Total feed inputs (t DM/animal)#	3.5	3.1	3.2	3.3
Food conversion ratio				
kg DMI/kg liveweight gain	5.6	5.0	5.3	5.2
kg DMI/kg carcass gain	12.0	10.2	10.3	10.2
Margin/feed‡ (£)	82	85	4	34
Margin/feed/day (p/day)	10	11	6	4
Feed costs/kg carcass gain (£/kg)	2.39	2.12	2.14	2.09

† Purchase price based on prices LMC prices July to Nov 2011 were HOL price = average Friesian & Holstein; AA price = 2nd quality continental price and BB&LIM price = 1st quality continental price.. Beef price based on steers - U3 = 324 p/kg, R3 = 319 p/kg and O3 = 310 p/kg;; Bonus for Angus not included

‡ Concentrate price £220/t fresh, silage £120/t DM, grazing £681/ha; milk replacer cost £1400/tonne, average intake 17.85 kg/calf; # Silage plus concentrate inputs

Meat quality

- Meat from bulls (slaughtered at 16 months of age) had a high pH and was less tender than meat from steers (slaughtered at 26 months). This was mainly related to management of the bulls prior to slaughter and best practice should be adopted when slaughtering bulls
- Breed effects on meat quality were small, although meat from Angus cross Holstein steers produced lighter colour meat which was attributed to the greater amount of marbling fat (Table 7)

Table 7. Effect of rearing/finishing systems on instrumental meat quality dairy-origin bulls and steers

	Lifetime rearing regime			
	Bulls		Steers	
	Intensive system	Forage/ concentrate-based system	Medium concentrate input system	Low concentrate input system
pH	6.1	5.7	5.5	5.5
Warner Bratzler Shear Force (kg)	4.6	4.9	4.0	4.2
Cooking loss (%)	29.1	33.3	28.7	29.2
Sarcomere length (μm)	2.6	2.7	2.5	2.6
CIELAB colour parameters				
L*	37.1	37.8	37.2	35.1
a*	14.9	15.6	21.2	21.5
b*	12.3	10.9	14.3	14.1
C*	19.4	19.0	25.6	25.7
Hue angle	39.2	34.5	34.0	33.3

†Instrumental meat quality measurements undertaken on a 3cm steak of the Longissimus dorsi removed at the 11th rib after 7 days of aging. All carcasses hung by pelvic suspension.

SUMMARY AND IMPLICATIONS FOR THE INDUSTRY

Calf rearing

- The clear relationship between calf immune status and subsequent performance demonstrates that calves must be sourced from farms with known good colostrum management.
- There is potential to reduce labour inputs associated with calf rearing by up to 60% by group feeding calves once per day through mobile group feeders.

Rearing and finishing systems

- Rearing and finishing systems for dairy-origin bulls or steers which increase the contribution of forage in the diet will reduce lifetime liveweight gain by 12% (bulls) and 7% (steers) and carcass value by £40(bulls) and £44 (steers).
- The relative performance of the different systems evaluated in terms of margin over feed costs is influenced by concentrate cost. At high concentrate prices, forage-based systems are more economical than high-concentrate input systems.
- Beef systems which rear and finish dairy-origin cattle as bulls and slaughter at 16 months of age demonstrate superior performance and the potential for greater margin over feed costs relative to steers slaughtered at 26 months of age. However careful consideration must be given to market outlets for the product and the technical skill required for operating such a system.

Breed choice

- Under relatively low inputs of concentrates, early maturing (Angus) and late maturing (Belgian Blue and Limousin) cross Holstein steers have similar performance and produce similar margin over feed costs.

Meat quality

- Meat from bulls (slaughtered at 16 months) had higher pH and was less tender than meat from steers (slaughtered at 26 months). This is mainly related to management of bulls prior to slaughter and best practice should be adopted when slaughtering bulls.
- In general, breed effects on meat quality were small, although meat from Angus cross Holstein steers produced lighter colour meat which was attributed to the greater amount of marbling fat.

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- Dr Bruce Moss and the staff of the Food Chemistry Branch, AFBI Newforge for the assessment of meat quality

AGRISEARCH BOOKLETS

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For further information or to request a copy of the full scientific report detailing the experimental tests and statistical analysis contact:

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