
THE PROCEEDINGS OF THE
NEW ZEALAND SOCIETY
OF
ANIMAL PRODUCTION
VOLUME 62 2002

The effect of colostrum intake on mortality and growth of Friesian bulls from birth to slaughter.

P.D. MUIR, B.C. THOMSON AND C.J. FUGLE

On-Farm Research, Poukawa Research Farm, PO Box 1142, Hastings

ABSTRACT

Current practice within the New Zealand dairy industry is to remove calves from their dams at a fixed time each day. This means a significant proportion of calves on-sold for rearing will not have consumed sufficient colostrum. These immuno-deficient calves are likely to have higher levels of mortality and morbidity but little is known about any long term effects on the growth rates of surviving calves. This experiment was designed to assess the impact of variable colostrum intake on the long term performance of dairy beef bull calves.

Since gamma glutamyl transpeptidase (GGT) is a marker for colostrum intake, Friesian bull calves with high (n=26, GGT> 3000 U/l), medium (n=13, GGT 200-3000 U/l) and very low (n=26, GGT < 200 U/l) GGT activity were selected. Calves were reared on a once-a-day milk feeding regime for 6 weeks and individual feed intakes measured for 10 weeks. Calves were farmed together from 10 weeks of age until slaughter at approximately 22 months of age. Calves with low GGT activity had very low immunoglobulin G levels, a higher incidence of health problems and a higher mortality rate (42% vs 3%) over the first ten weeks. Low colostrum calves also had a more variable feed intake and a lower energy intake over the first ten weeks than calves with medium and high colostrum intakes. At 24 weeks of age, low colostrum calves were also lighter (159 kg vs 174 kg for low and high colostrum calves respectively). However, at slaughter at 22 months of age the surviving low colostrum calves had significantly heavier carcass weights (279.5 kg vs 258.7 kg; P = 0.01) than the high colostrum calves. The heavier slaughter weights of the low colostrum calves are hard to explain. Whilst it may be a chance result, it is possible that a challenged and better developed immune system could have led to an improved efficiency at a later age in the surviving low colostrum calves. Alternatively, the high early mortality in the low colostrum group might have led to survival of the fittest.

Keywords: calf; colostrum; mortality; growth rate; performance

INTRODUCTION

Within the New Zealand dairy industry, many calves are removed from their dams before they have had had sufficient colostrum (Edwards *et al.,* 1982: Vermunt *et al.,* 1995). Some of these immuno-deficient calves are on-sold and reared for bull beef production and are likely to have higher levels of mortality and morbidity (health issues). However, little is known about any long term effects on the growth rates of those calves that survive. This experiment was designed to assess the impact of variable colostrum intake on the long term performance of dairy beef calves.

MATERIALS AND METHODS

Friesian bull calves from four Waikato dairy farms were removed from their dams between 10 and 12 am each morning and were weighed and blood sampled by jugular venepuncture. Plasma was analysed for GGT activity, a marker for colostrum intake (Wesselink *et al.,* 1999). All calves with very low (n=26, GGT < 200 U/l) and medium (n=13, GGT 200-3000 U/l) GGT activity were used and similar weight calves were selected from within the calves with high GGT activity (n=26, GGT > 3000 U/l). There were no significant differences in initial liveweight, with mean weights of 38.4, 39.3 and 38.3 kg respectively for calves of low, medium and high colostrum intakes (se 0.327, P=0.64).

At four days of age, calves were transported approximately 300 km to the Poukawa Research Station in Hawkes Bay. On arrival, calves were weighed and placed on the feeding regime described by Muir *et al.,* (2002). This involved feeding a commercial milk replacer (CMR, Kiwicalf, Kiwi Milk Products Ltd) on a once-a-day milk feeding system with continuous access to clean water and Ready Rumen (chaffed barley straw and 20% protein pellets, NRM). Calves were weaned off milk at 6 weeks of age but Ready Rumen continued to be fed *ad libitum* in individual pens until 10 weeks of age. All calves were grazed together on pasture supplemented with 1.5 kg Ready Rumen/head/day until 16 weeks of age. From 16 weeks of age until slaughter the bulls were run as one mob and farmed commercially. At approximately 22 months of age the animals were trucked, fasted overnight and processed at a commercial meat processing plant.

Pellet intake was determined weekly using food on offer less residuals. Calves were weighed weekly for ten weeks, then at fortnightly intervals until 16 weeks of age. Thereafter, bulls were weighed on farm at 6 weekly intervals through until and including the pre-slaughter weight. Post slaughter, carcass weight and grade were recorded at the processing plant following standard commercial procedures.

Plasma IgG concentrations were measured at the commencement of the experimental feeding period (week 0) and at weaning (6 weeks) as a measure of the development of the calves immune system, by radial immunodiffusion assay using antibovine IgG in agarose. Plasma GGT activities as an indicator of colostrum intake, were measured at the time of pick-up on the dairy farm and at commencement of the experiment (week 0) on a Hitachi 717 and using a kit supplied by Roche.

Statistical analysis

Statistical analysis was carried out using the generalized linear model and the REG procedures in Minitab (Minitab for Windows, Version 3.13, Minitab Inc, USA).

RESULTS

As calves in the low colostrum group had average GGT levels of 10.5 U/l and average IgG levels of 0.13 mg/ml at the start of the trial (Table 1), it is likely that most of these calves had received no colostrum. This was reflected in higher mortality rates (42% vs 3% for low and moderate/high colostrum calves, respectively). Morbidity rates were also higher in young calves during the rearing process with 80% of low colostrum calves treated for a wide variety of health issues compared to 10% of calves in the groups with moderate and high colostrum. Low colostrum calves ate fewer pellets than the moderate and high colostrum intake calves (Figure 1). The variability in intake was lowest in the high colostrum intake calves (CV 38, 29 and 24% for low, moderate and high colostrum calves respectively).

Calves which had received high or adequate levels of colostrum were heavier than the low colostrum intake calves through until week 24. There were no differences between the treatment groups between week 30 and week 59. However, low colostrum calves tended to be heaver than the high colostrum calves from week 59 until slaughter (Table 2). There were significant differences between the carcass weights of bulls in the low and high colostrum groups (279.3 vs 258.7 kg; Table 3) but no effect on dressing out percentage or carcass grade.

TABLE 1: Levels of plasma immunoglobulin G (IgG) and gamma glutamyl transpeptidase (GGT) concentrations in calves with high, moderate or low colostrum intakes after being removed from their dams within 24 hours of birth.

		Colostrum status			**Pooled**	
	Age (weeks)	Low	Moderate	High	SE	P level
IgG (mg/ml)	0	0.13^{a}	11.08^{b}	23.88^{c}	1.66	0.0001
	6	733.7	624.6	820.8	36.5	0.07
GGT (U/l)	0	10.5^{a}	77.2^{a}	370.2^{b}	26.4	0.0001

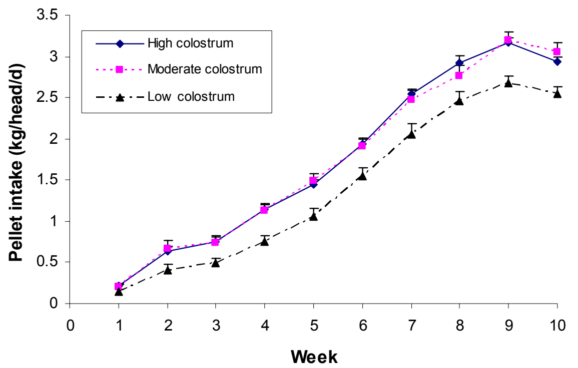
TABLE 2: Effect of colostrum intake in the first 24 hours on liveweight (kg) from the start of the experiment until slaughter at 22 months of age.

	Colostrum status			**Pooled**	
Age (weeks)	Low	Moderate	High	SE	P level
0	40.1	42.2	41.8	0.38	0.08
6	62.4^{a}	69.0^{b}	69.0^{b}	0.93	0.003
12	96.1^{a}	106.8^{b}	106.7^{b}	1.35	0.001
24	159.0^{a}	172.2^{ab}	174.4^{b}	2.14	0.01
54	312.6	315.0	306.2	2.95	0.45
89	562.4^{a}	545.7^{ab}	526.2^{b}	5.01	0.006

TABLE 3: Effect of colostrum intake in the 24 hours after birth on pre-slaughter weight (kg) determined prior to trucking, carcass weight (kg), grade and dressing out (DO%) at slaughter at 22 months of age.

	Colostrum status				
	Low	Moderate	High	SE	P level
Pre-slaughter weight	517.5^{a}	493.6^{ab}	485.9^{b}	5.41	0.007
Carcass weight	279.3^{a}	273.1^{ab}	258.7^{b}	3.12	0.01
Grade	2.13	2.00	2.19	0.047	0.28
DO %	53.9	54.0	53.2	0.28	0.44

FIGURE 1:. The effect of colostrum intake in the 24 hours after birth on the pellet intake (kg/head/day) during the first ten weeks of rearing.



DISCUSSION

The high mortality and morbidity levels seen in this experiment further emphasize the importance of colostrum intake in the first 24 hours and is in agreement with the results of Nocek *et al*., (1984), Robison *et al.,* (1988) and Boyd (1972). Logan *et al.,* (1974) claimed that calves which consume colostrum immunoglobulins (Ig) did not begin to synthesis serum Ig for about 4 weeks while calves deprived of colostrum Ig begin to produce their own Ig within 1-2 weeks. Colditz (2002) further suggested that immuno-deficient calves might therefore be developing their immune system i.e. producing Ig, rather than putting energy into growth in the short term. Whilst this may well have occurred in the present experiment, the significant increase in Ig levels in the high colostrum calves (24 mg/ml at 0 weeks and 820 mg/ml at 6 weeks; Table 1) suggests that these calves may also have been developing their immune system well before 4 weeks of age.

The slower growth rate in low colostrum calves may also have been due to a lower feed intake (Figure 1). This early concentrate intake is extremely important for the accelerated rumen development and early weaning systems practiced by many New Zealand calf rearers (Muir *et al.,* 2002). Low colostrum intake will also result in a reduced IGF-1 intake which may affect the development and function of the gastrointestinal tract (Blum & Hammon, 1999; Hammon & Blum, 2002). In new born piglets, ingestion of colostrum led to an increased intestinal weight and protein content as compared to those without colostrum (Burrin *et al.,* 1995). Therefore, low colostrum intake is likely to impair gut development which will lead to a reduced concentrate intake. Any infection and scouring as a result of a low immune status is likely to further reduce nutrient absorption. Few trials have examined the long term effects of low colostrum intake on growth. In dairy heifers, Robison *et al.,* (1988) found that the serum Ig concentration from 24 to 48 hr after birth was a significant factor affecting the rate of liveweight gain up to 6 months of age. However, Nocek *et al.,* (1984) and Wittum & Perino (1995) found no differences in liveweight gain in older calves. The results of the present study support these findings but also suggest that the low colostrum calves which survive can make up for their slower start. In the current experiment, low colostrum calves were actually heavier at slaughter than the high colostrum calves at slaughter. Whilst this might be just a chance result it is possible that a challenged and better developed immune system could have led to some improved efficiency at a later age. Alternatively, the high early mortality in the low colostrum group might have led to survival of the fittest. Further work would be required to determine the consistency of this effect and its cause. Nevertheless, it must be remembered that 42% of the low colostrum calves died and most of the remaining low colostrum calves had significant animal health issues so ensuring all calves receive adequate colostrums at birth remains a priority.

ACKNOWLEDGEMENTS

This work was undertaken whilst the Poukawa Research Station was being managed by AgResearch. The authors would like to acknowledge the Poukawa staff (Cameron Lane, Graham Wallace and Noel Smith) for assistance with calf feeding and data collection. This work was sponsored by Meat New Zealand (now Meat and Wool New Zealand), AGMARDT, Richmond Ltd, MAF Sustainable Farming Fund and Kiwi Milk Products Ltd.

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