

# **Summary report on project SFF L12-083:**

## **The effects of a probiotic supplement on growth, feed conversion and general health of dairy calves**

**Malcolm Deverson, Project Manager**

**Clutha Agricultural Development Board, July 2013**



### **Who might be interested in and learn from this calf trial report and its findings?**

Farmers looking to add weight as fast as possible in their cattle rearing programmes.

Especially dairy calf rearers looking to raise healthy calves profitably.

Farmers who want to understand more about probiotics and the value in fresh product.

Any animal farmer looking to find an edge to improve production or animal health.

Scientists and researchers looking to de-mystify probiotics and their value in animal programmes.

### **Report Summary**

The fresh probiotic supplement improved the weight gain of treated calves by up to 57 grams per day over the seven weeks of the trial.

The impact of the treatment was shown to vary considerably from farm to farm and is affected by the particular farm's system, calving procedures and rearing conditions.

Future work is required to identify the conditions in under which a probiotic has a positive effect and how they can be best used to benefit New Zealand farmers.

## Commentary

We believe that we have made huge progress in developing an understanding of the effects of a probiotic supplement on the weight gain of neo-natal calves.

Our key objective was to collect a credible set of data from real, on-farm situations so that New Zealand farmers had that reliable and transparent data to set against previous anecdotes and observations.

### **Trial Design:**

- 3 Farms
- 20 pens (10 control; 10 treatment)
- Approx 10-20 calves in each pen

Treated calves had a multi-strain probiotic (lactobacillus & yeasts) added to the milk replacement from approx. Day Three (after initial colostrum period) when appropriate numbers of calves were available to be assembled and penned.

The amount of added probiotic was:

- i 20ml/ calf drenched twice a day for two days after penning,
- ii then, 20ml/ calf added to the milk in the calf feeder once a day for the remainder of the trial.

The aim was to have each pair of pens balanced for weight and for all other feeding, housing and management conditions the same, so that the probiotic treatment is the only variable.

### **Data Collection Design:**

All calves were weighed weekly for the seven weeks of the trial. Other health records were also kept. Calf meal was weighed at entry into each pen and was aggregated over the life of the trial.

We certainly wanted to give farmers reliable and transparent data beyond the two small-scale trials<sup>1</sup> that have been the benchmark in New Zealand research with probiotics until now. We collected hugely more reliable and significant information than any previous trials with approx 300 calves, ten replications and under a variety of on-farm conditions. If any other independent work has been done that gets anywhere near the achievement here, we certainly would like to know about it.

The Statistics Report on the project included two initial analyses and an independent review and analysis by Lincoln University's top statistical consultant. This analysis shows that there is a positive effect of the probiotic supplement, and that, on the trial farms, it appeared to improve the weight gain of neo-natal calves by up to 57 grams per day. This effect was not seen on every farm. This result appears to align with previous scientific knowledge that the particular farming system is a hugely important determinant of the effectiveness of probiotic supplementation.

The farm which showed no gain from the use of the probiotic supplement was the farm with the most experienced calf rearer, with long-established systems and, most significantly, where the calves stayed in their pens for the 7 weeks of the trial. On the other two farms, calves experienced more stress in terms of their transition to grass within the 7 weeks, and also more challenging wet and cold conditions in their sheds and on pasture. These two farms showed average weight gains of 39 grams and 57 grams respectively.

Our three trial farms all had different calving procedures, meal intakes and practices, so the variable results are not surprising. We tried very hard to follow the project design, and there should not be an expectation of laboratory quality data from this project. We were obliged to fit in with the farming systems of our supporting farmers – like complicating the design by having calves

Table: Average growth per day in pens from Farm 1, 2 and 3

	Treatment	Control	Difference	P value
Farm 1	0.662	0.644	+18g/day	Not significant <sup>2</sup>
Farm 2	0.634	0.577	+57g/day	P > 0.01 <sup>3</sup>
Farm 3	0.573	0.534	+39g/day	P > 0.02

<sup>1</sup> While NZ companies such as Donaghys or Queen of Calves presented trial data (Margerison 2007) showing improved weight gain in calves, these trials are limited since they use small numbers (15-20) of animals. Also, the Queen of Calves trial was not under field conditions while Donaghys's (trial data on [www.donaghys.com](http://www.donaghys.com) on 12 January 2011), failed to control for birth weight, a major determinant of future growth.

<sup>2</sup> 'Significance' here is a statistical term. It does not mean 'important'; it means that the P value is greater than 0.05

<sup>3</sup> The P value indicates the probability that the results are consistent with being due to chance.

move out of pens and on to grass pasture at various stages. We believe that this, in fact, adds strength to the data. We have collected reliable weight-gain data from real-world farming situations. We believe this will mean more to farmers than artificial, laboratory situations.



We believe that we have successfully followed the co-operative model that is espoused by government for research programmes. We have farmers involved considering the aims and managing the project, we have consulted and followed the advice of the levy supported body DairyNZ, we have co-operative links with the commercial developer of fresh probiotic product, we have sought independent advice on the statistical variation observed, and we have interested a variety of scientists in the subject and its opportunities.

We had what we now understand were unrealistic ambitions to make health and behavioural observations to add to the weight data. The increased work involved in collecting weight data (as advised by DairyNZ) largely swamped out these considerations. No reliable data was collected on scouring and anti-biotic use for supplement and control groups and there was no clear observation on any of the three farms that either group showed more or fewer signs of overt health situations.

Having said that, 10 calves from control pens died during the trial and 2 died from the supplement pens. This is likely to be statistically not significant, but it is interesting and worth further study.

Behavioural observations were also inconclusive. On two of the farms there was no observed difference in the behaviours of control and supplement groups and on the other farm the main calf rearer noted that the supplement calves were easier to handle. This would be very difficult to support scientifically.

The meal data collected from the three farms was not analysed by the statisticians but there was an interesting situation on one of the farms. We believe that here calf meal data was reliably collected. This farm had replications in three different weight classes. In the larger weight class (birth weight over 40kgs) the supplement calves appeared to eat 21% less calf meal than the control calves but still put on weight at the same rate. In the middle weight class (35-40kgs) the supplement calves ate just 7% less for equivalent weight gain. But in the smaller weight class (under 35kgs) the supplement calves actually ate 19% more calf meal.

### Probiotic supplements

We used the product that best fits the scientific criteria for an ideal animal probiotic:

- it should deliver live microorganisms (Fuller 1989<sup>1</sup>)
- it should maintain viability of microbes during storage (Gibson 1995<sup>2</sup>)
- it should be a multi-strain product (Timmerman 2004<sup>3</sup>)
- it should be consistent in its traits
- it should be affordable (so it can be economically administered in sufficient volume to be effective)

Probiotics products are sold in powder, semi-solid or liquid forms. Fresh liquid formulations are generally considered superior in terms of the activity of microbial cells.

<sup>1</sup> Fuller R, 1989. Probiotics in man and animals. J. Appl. Bacteriol. 66, 365-78.

<sup>2</sup> Gibson GR, Roberfroid MB, 1995. Dietary modulation of the human colonic microbiota: introducing the concept of prebiotics. J. Nutr. 125, 1401-12.

<sup>3</sup> Timmerman HM, Koning CJ, Mulder L, Rombouts FM, Beynen AC, 2004. Monostrain, multistain and multispecies probiotics--A comparison of functionality and efficacy. Int. J. Food. Microbiol. 96, 219-33.

No one trial can ever be conclusive about any new technology, but we believe that there is considerable positive indications in this project for the industry to consider further work with probiotic supplements.

This further work could include:

- Under what farming circumstances do probiotics work best (is this when the animals are stressed – at feed transition or during harsh weather events?). The penned calves in Farm 1 did not respond as much as on the other two farms to probiotic treatment. Is it a coincidence that it was the only farm that only fed its calves a meal preparation and no grass?
- Do probiotics decrease feed intake and improve feed efficiency in non-pastoral systems and does this vary by weight class?
- Is the composition of the meal relevant in determining where probiotics do best and where they appear to have no effect?
- Can we identify reliable links between calf scouring, other disease and even death rates and probiotic treatment? Do probiotics effect pathogen colonisation of the gut or rumen and allows an animal to resist infection?
- The mechanics of what probiotic supplements are doing in the gut – do they affect rumen development and activity? The mechanisms of how probiotics work are poorly defined in stock animals and what little science is available is derived from rat and mice models (no rumen!).
- Do probiotics change the protein metabolism and ammonia transport in the lower gut by acidifying the gut? This would have important consequences for nitrogen partitioning which in turn effects how much nitrogen ends up in the urine.
- Would probiotics be a useful tool to reduce the damage caused by E-coli, esp. *E. coli* 0157:H7 and paraTB which causes Johnes disease?
- Do probiotics affect calf survival? The relative death rates of control and supplement calves is interesting but it is unknown if this is the result of treatment. To test this would either require a very large on farm survey measuring the odds of survival or a challenge experiment that deliberately tries to make calves sick and tests if probiotics improves their survival.



### The Value Proposition

It's all very well to come up with new ways to spend farmers' money, but does it make sense to invest in a fresh probiotic supplement as in this trial?

At 20ml per day, each calf used 1litre of the supplement (for the seven weeks of the trial) and the price for the fresh brewed product that the trial used was \$4/ litre retail. So farmers need to decide if \$4 per calf is economic for them for the initial calf-rearing period.

The level of benefits will depend on your farm system as this is the most important factor in the level of gains from the supplement. So you have to do your own sums.

Benefits may include increased weight gain – the two farms with statistically significant weight gains averaged a 50.5g increase per day over the 7 weeks. That is a 2.5kg increase in that time, or a shorter time to get to your target weight. Other possible benefits such as fewer deaths and steadier weight gain at the transition to grass and during bad weather are discussed in the report.

Your call on whether there is value here for you at \$4 per calf.

We believe that these are all important issues for farmers. Even acknowledging that we have found out that probiotic supplementation does not work in all circumstances, there are production gains to be had if we can show robust answers to any of the above issues. These production gains could be without further intensification and this is an important macro emphasis in the current New Zealand farming situation.

The final word is a thanks to the farmers who gave their time and enthusiasm to this project.