A REVIEW OF THE PREVENTION AND THE TREATMENTS IN THE REARING OF THIS VALUABLE CALF

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Review

This paper looks at minimizing the stress on the calf and the rearer, and reviews the essentials of good calf rearing including:

- The value of colostrum
- Transport of the calf from the paddock to the barn
- Housing requirements
- Viral diseases – prevention and treatments
- Electrolyte therapy – volume and frequency of feeding
- The role of Probiotics and additives to prevent disease and to enhance growth rates
- Good quality staff.

Value of colostrum

Colostrum is the most valuable nutrient for the newborn calf. It contains high energy levels, growth promoters, vitamins and those vital immunoglobulins so necessary for the transfer of a passive immunity from disease.

Table 1: The composition of colostrum

Variables	Colostrum	Milk
Total solids %	23.9	12.5
Fat %	6.7	3.6
Protein %	14.0	3.2
IgG%	6.0	0.9
Lactose %	2.7	4.9

Note: Colostrum has two times more milk solids, four times more proteins, and 60 times more immunoglobulins than cows milk. The energy of the colostrum stimulates the activity and the growth of the intestinal tract.

The most important role of colostrum is the transfer of the immunoglobulin proteins IgG, IgM and IgA giving the calf a passive immunity to disease and environmental pathogens. The most important immunoglobulin is IgG. High blood levels of IgG are closely associated with calf survival and health. Colostrum deprived calves have mortality rates of 40% or more (P Muir ,Wells et al 1996).

A British study (McEwen et al 1997) indicated that blood levels of IgG should be greater than 10mg/ml. In this study mortality rates were 60% for calves with total IgG levels of less than 10 mg/ml. The affect of low IgG levels on calf health and the risk of disease is best illustrated by Besser & Gay 1994. See Table 2.

Table 2: Risk of disease versus lgG levels

Serum IgG mg/ml	Disease	% with Disease
< 10 ng/mg/ml (n=11)	5	45
> 10 mg/ml (n=53)	10	18

Weight gain from birth to weaning:

- Calves with IgG levels <10Mg/ml = 0.68 kg /day
- Calves with IgG levels >10Mg/ml = 0.74 kg / day

The relationship between increased serum IgG on calf health and survival is greatest when the burden of infection in the environment is high and management is substandard.

The failure of passive transfer (FPT) is indicated by blood IgG levels of less < 10mg/ml. Under natural calving conditions in NZ some 40-50% of calves have blood Ig levels < 10mg/ml (P Muir, Wesselink et al 1999). T B Humphris (1998) found the percentage of failure of passive transfer in Australia to be the same, and then showed how this could be improved by the supplementation with additional colostrum at 12 hours after birth. See Table 3.

Table 3: Incidence of failure of passive transfer (FPT) (Humphris 1998)

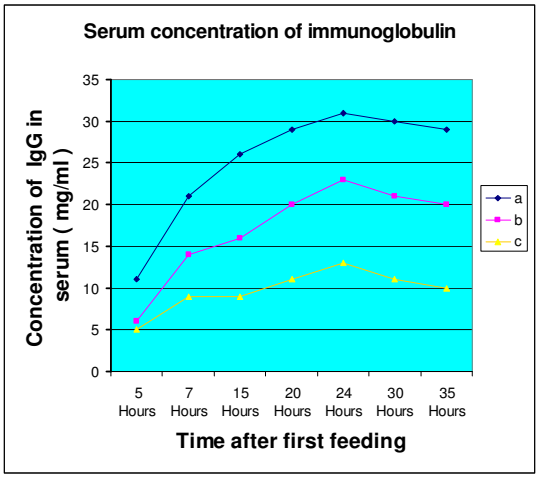
Group	Number of calves	% calves with levels of IgG <10mg/ml	% calves with levels of IgG >10mg/ml
Control on cow	68	42.6	58
On cow, plus a single feed of colostrums in the first 12-24 hours	60	8.3	92
On cow, plus 2 feeds of colostrums in the first 12-24 hours	42	2.4	98

Factors affecting the passive transfer of immunity (FPT)

- Timing of the feeding – adequate amounts must be offered within the first 12-24 hours. Best within 6 hours after birth.
- Cold stress – hypothermia
- Severe Dystocia (difficult birth) – hypoxia and swelling of the head
- Cow factors:
- Downer cows (calving difficulty),
- Metabolic disease, mis-mothering
- Mastitis, large teats, blocked teats, low udders and excessive mud
- Wandering into drains and under electric fences

Quantity of colostrum required to give IgG Levels above 10mg/ml

This depends on the concentration of IgG in the colostrum and the amount fed. The standard rate is at least 10% of the body weight in 2 feeds and within 10 hours.



C = 2 litres of low quality colostrum at birth +2 litres at 12 hours

B = 2 litres of high quality colostrum at birth +2 litres at 12 hours

A = 4 litres of high quality colostrum at birth + 2 litres at 12 hours

Figure 1: Colostrum – quality volume and time

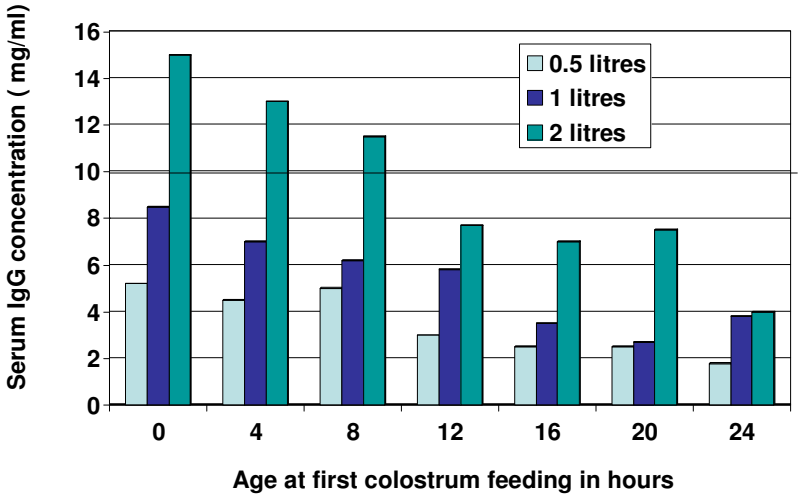


Figure 2: Volume of colostrum feeding – time and amount (Stott et al)

Clearly most dairy calves in NZ are unable to achieve an adequate passive transfer of IgG without the dramatic intervention by the farmer, and it is in his/her interest to do so.

Factors affecting the concentration of IgG in colostrum

The amount of colostrum produced and the concentration of IgG in colostrum varies tremendously not only between breeds but also greatly between cows within the same herd. See Figure 3.

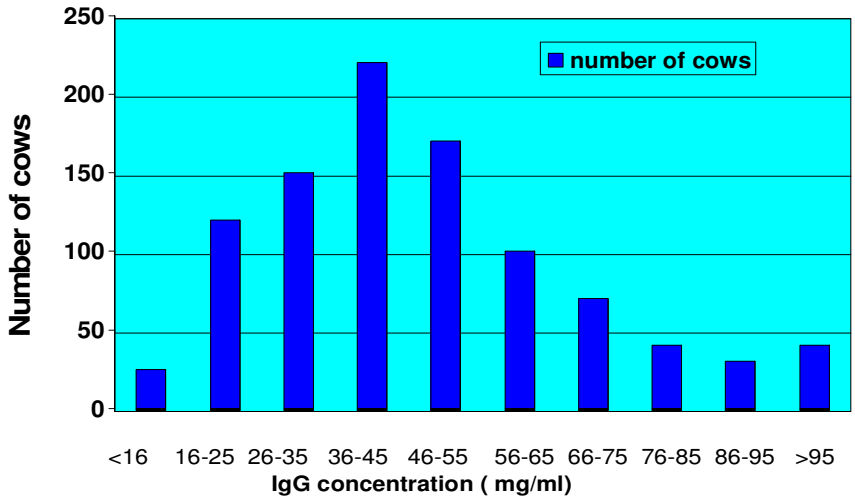


Figure 3: IgG concentration in colostrums (mg/ml)

The transfer of IgG from the maternal blood into the mammary gland occurs in late gestation. Pre-milking cows and cows that leak colostrum before calving results in significant loss of IgG and a much lower concentration in the udder at calving. Similarly cows with low body weight and deficiencies in energy and protein (underfed or coming out of a drought) could have lower colostral IgG levels.

Which are the best cows? There is no difference with age but the best cows were:

- Best – 3rd and 4th calvers. First calving heifers colostrum is good
- Best – was from cows that produced less than 8.5 litres of milk at the first milking
- Worst – from 2nd calvers and cows dry for less than 3 weeks
- Cows with low grade mastitis produced good colostrum often with high IgG concentrations.

Colostrum substitutes and supplements

A number of supplements to boost the immune system are available in New Zealand. These products contain spray dried colostrum or whey protein concentrates. These products by themselves will not increase the blood levels of IgG and in the presence of no or poor quality colostrum will not lift the IgG levels above 10mg/ml. Their mode of action is mainly on the local cellular gut level.

Non saleable milk

The use of non saleable milk for herd replacement calves is still controversial. The fear that heifers would calve with mastitis or blind quarters has been researched throughout the 1970-1980s but results are unclear. Even calves fed milk inoculated with Staphylococcus aurous showed no greater incidence of mastitis at calving than controls (Barlo et al 1982). Similarly the growth rates and the incidence of scours of calves fed mastitic milk before and after antibiotic treatments were similar to those fed saleable milk. However the feeding of antibiotic milk could come under increasing scrutiny for its potential to foster the survival of resistant bacterial species. It is not good practise but to date nothing to the contrary has been proved.

Transport of the calves from the paddock to the barn

The question is, how many calves can be carried on a trailer? Even short distances in an overcrowded or dirty trailer can have a devastating affect on the joints and navel cord, leading to joint ill, navel infection, or septic arthritis. The damage done can be significant and often irreversible. The incidence of navel infection can be as high as 10%, and the future of any replacement calf with this infection is in serious doubt. Remember that this is the damage that *you* can do within the first hour of you handling that valuable calf.

So take care and give the calves at least 1sq metre of space in the trailer. The bedding should be soft (shavings, straw) and at least 100mm deep. Replace the bedding daily or spray with a good virucidal spray (Virkon).

Divide large trailers into small compartments holding no more then 10 calves/pen - 5 is ideal. Treat navels with iodine before and after transport.

The treatment of diarrhoea

The causes of diarrhoea may be due to nutritional factors or infectious agents.

Nutritional factors include cold milk feeding, changes in the volume or the diet and environmental stress. Infectious agents include Rotavirus, Cryptosporidium, Corona virus, Salmonella, BVD and Coccidiosis.

Identifying the cause of the scours by colour, consistency or odour of the faeces is not possible. The best way to diagnose the cause is by the use of a clinical thermometer and laboratory testing. The value of a clinical thermometer as a clinical tool is often overlooked. As a general rule calves with a nutritional diarrhoea will have a normal temperature (38-39.5^{O} C). Calves affected with a viral or bacterial infection will always show a fever above 39.5-42^{O} C. The thermometer is also useful in monitoring the success of the treatments.

The effects of diarrhoea

Irrespective of the cause of diarrhoea, the effect on the calf is the same:

DIARRHOEA CAUSES
- LOSS OF BODY **WATER**
- LOSS OF BODY **SALTS** (ELECTROLYTES)
- LOSS OF **ENERGY**

All of these elements are vital and will determine the fate of that calf. It is a fact that in most cases of fatal diarrhoea the calf succumbs to the dehydration and the loss of electrolytes and energy and not to the direct affect of the infectious agent.

The best way to treat scours from any cause is by oral electrolytes.

Oral electrolytes in calves with diarrhoea

A calf with diarrhoea urgently requires water and electrolytes to correct any imbalances, and must also have an energy source.

In the neonate 75% of the water is in the intracellular pool and 25% in the extra-cellular pool. Water passes freely across cell membranes from one pool to another – the direction of flow depending on the osmotic pressure between them.

Diarrhoea leads to a major reduction (almost 50%) in the extra-cellular fluid and especially in plasma volume. Maintaining the water, electrolyte and energy balance is the most critical factor effecting survival. The effects of these massive losses are highlighted in tables 4, 5 and 6.

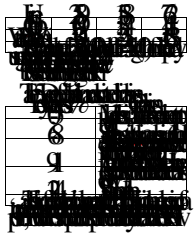


Table 4: Effect of diarrhoea on water balance in the young calf

	Physiological state		
Variable	**Healthy**	**Diarrheic surviving**	**Diarrheic dying**
Water intake[2] (g/d)	4,185	4,168	2,880
Water losses (g/d)			
Faeces	213	1,501	2,390

remain 'tented' for several seconds. The longer the skin remains 'tented', the more severe the dehydration.

Table 6: Fluid replacement for the diarrhoeic calf

Degree of dehydration (%)	Amount of fluid needed to restore body water (L/d)	Maintenance water requirement[a] (L/d)	Total fluid therapy required Litres/day
2	1.0	4.0	5.0
4	1.8	4.0	5.8
6	2.7	4.0	6.7
8	3.6	4.0	7.6
10	4.5	4.0	8.5

Note: Calculated for a 45.4kg (100lb) calf

[a] Maintenance water requirement estimated to be 4.0L/d

Practical considerations in dealing with diarrhoea in calves

The onset of diarrhoea in calves is often sudden and acute. Calves can quickly become dehydrated with potential losses of 5-12% of the body fluids (and body weight) in 1 – 2 days. Treatment must be started early with a well balanced ***oral*** rehydration product containing the essential lost electrolytes (Na, K, CL, HCO_3) and a high nutrient source – usually glucose, dextrose, lactose or glycine.

If administered early and in the correct amounts the success rate by oral treatment alone can be 95% or greater (Davis & Drackley 1998). In fact in most cases of fatal diarrhoea the calf succumbs to dehydration and the loss of electrolytes and energy, and not to the direct effect of the infectious agent.

In a survey in America in 1993 (Davis & Drackley 1998) only 21% of farmers (and vets?) relied on oral rehydration therapy in the treatment of the scouring calves. 80% still relied on antibiotics to treat scours. I suspect these figures are not much different amongst NZ farmers.

Milk or electrolytes or both – which is the best?

For years the recommended practice was to take the calf off milk or milk replacers and feed oral electrolytes only. This practice is being challenged as being no longer correct.

McGuirk (1992) and Grathwaite (1994) agree that diarrheic calves should continue to receive at least some, if not all, of their normal milk product and quote that scouring calves given their normal milk ration *plus* a hypertonic oral electrolytes developed firmer faeces, had higher body weight gains, recovered faster and had higher blood glucose concentrations then those on oral electrolytes only.

Whether the two liquids should be fed together or separately is debatable. Heath (1989) states that "If the milk powder contains casein proteins (colostrums, whole milk or skim milk based replacer) the feeding of an oral electrolyte mix containing bicarbonate or citrate *may* interfere with casein coagulation (clotting) in the abomasums". Therefore it is preferable to feed the two liquids separately about two hours apart i.e. 3-4 feeds of 2 litres per feed of either or both of these products. This certainly is true in cases of moderate to severe diarrhoea.

Recently a number of electrolyte and intestinal modifiers (contain citrus or apple pulp and pectin) have become available and can be either mixed directly with milk or fed separately with water (at a higher rate). All contain significant amounts of bicarbonate and/or citrate and *could* potentially interfere with the clotting of the milk (casein) proteins. At the recent dairy cattle conference, Taupo June 2003, Professor Brad Smith from the University of California, Davis USA again stated that "the commonly used alkalinizing agents bicarbonate and citrate are strong inhibitors of milk clotting and should only be feed to calves held off milk.

In a recent laboratory trial I tested these findings. Milk containing casein proteins was mixed with rennet and the electrolytes marketed as suitable for mixing with milk (Biopect Diacure plus, Revive, Diarrest, and Diaproof K) and placed in a water bath 37^{O}C for ½ hour. The clotting reaction was compared with that of whole milk and rennet as a control. Surprisingly all products performed well. The clotting mechanism was not compromised, indeed it appeared to be enhanced. It appears that these products are very suitable to be added directly to milk for mild or moderate diarrhoea cases. Because these products are hypertonic it must be remembered that clean, ad lib water must be made available for thirsty scouring calves. Free lying water (puddles, drains, dams, swamps, etc.) should be avoided for these vulnerable calves. Cases of protracted moderate or severe diarrhoea should be fed an electrolyte/water mix at increased levels separately from the milk ration.

In Summary

95% of diarrhoeic calves can be cured by therapeutic levels of oral electrolytes without additional alkalinizing agents or intravenous fluids. The crucial point being, give them enough and offer ad lib clean water at all times. Direct supplementation of milk with the above mentioned products did not interfere with the clotting mechanism and is very suitable for early treatment of mild to moderate diarrhoea. Their use as a preventative treatment during periods of transport, nutritional or cold stress is of therapeutic value. In cases of severe diarrhoea larger volumes of electrolytes / water at isotonic levels will be needed and should be fed in addition to the milk diet.

Recommendations

Mild to moderate diarrhoea	Continue milk feed and add electrolyte directly to milk diet, plus water ad lib
Moderate/severe diarrhoea	Day 1: Electrolyte AM, milk lunch time electrolyte PM Day 2: Milk AM, electrolyte lunchtime, milk PM Day 3: As above or back to milk

Oral electrolyte therapy is rewarding and very practical for successful on-farm conditions.

Remember—clean fresh ad-lib water must always be freely available to the calves even during periods of electrolyte treatment.

Home brew mixes

Many farmers will often use a home brew electrolyte mix to save money. In practice this is rarely effective and often dangerous if the recipe is wrong. Most lack enough of the vital ingredients of salts and energy. Sure it is cheap, but often the recovery from scours is slowed or ineffective. Consult with your vet for a proper balanced and clinic proven mixture. A good quality commercial electrolyte is still the best option, and will significantly improve the recovery time, weight loss and mortality rate.

Viral diseases – prevention and treatments

The majority of infectious agents that cause calf scours are viral, and include Rotavirus, Corona virus and BVD virus. These are most often found as mixed viral infections, or in tandem with Cryptosporidium or Salmonella species.

The predominant virus isolated is Rotavirus. In fact if Rotavirus is absent clinical disease seldom occurs.

A commercial Rotavirus vaccine (Rotavec k99) has been available in New Zealand since 2000 and clinical results have been excellent especially in large herds where stress is greater, and where stock movements have been great. The success of the vaccine programme is totally dependent on calves receiving a good colostrum transfer within 12 hours of birth. This is pivotal. The vaccine will not work if husbandry factors like the timing of the vaccination and the timing of colostrum intake is not carefully carried out. The presence of the virus antibody in the stored colostrum will continue to neutralise the virus in the bowel. The partial vaccination of the herd (early or late calvers only) is not effective and doomed to failure.

The use of an artificial colostrum egg yolk supplements (Rotagen) enhanced with viral antibodies (Rotavirus, Corona virus) are useful but results are very variable.

Where BVD virus or Salmonella infections are endemic in the herd a proper vaccination program suited to your conditions would be wise. Consult with your vet.

Other on farm practices useful in the control of vial diseases are:

- Calf barn well away from the cow shed and feeding pads
- Control rodents, birds and dogs
- Good effluent disposal with no contact with cows faeces and effluent sprayed paddocks
- No access to drains or swamps
- Keep dairy staff, bobby calf trucks and staff out of the calf barn
- A proper spray program of the barn, feeding utensils and the trailer with a good quality, safe virucidal spray (Virkon) twice a week.

In reality the biggest spreader of disease in the barn is the rearer, so complete control is never possible nor necessary. Where large numbers are reared and the facilities become stressed good disinfection from the start is necessary to minimise the disease challenge especially in the late calves.

Milk additives to prevent scours and to promote gut health

A large number of products are now available to prevent scours and promote gut health and growth rates. The actual benefits of these products are hard to quantify, but clearly they do modify and protect the gut health in periods of stress and disease.

The most common milk additives are probiotics, prebiotics, rennet, sodium bentonite, antibiotics and vitamins and minerals.

Probiotics and prebiotics: probiotics promote gut health by flooding the gut with useful bacteria, so preventing harmful bacteria from colonising the bowel. Prebiotics on the other hand are large polysaccharide that are indigestible to the host but a good nutrient to the bacteria already present in the gut thus allowing these useful bacteria to survive and multiply. Products on the market that can do this are—Yoghurts, Biostart, Rumevite, Yeastsac and Lactulose.

Rennet: to enhance curding.

Sodium bentonite: a clay that modifies gut motility and absorbs excess fluids and microbial toxins. Products in this group include Trubond and Rumenite. Biopect is an apple based pectin that has a similar action.

Antibiotics: there is never a role for antibiotics to be added to milk to prevent disease.

Vitamins and minerals: Colostrum is high in vitamins and minerals. Cows milk is low in these vital ingredients and so the addition of extra vitamins and minerals may increase gut health.

Housing requirements

Housing should be *dry and draught free*. Barns should be open on one side and divided into group pens holding no more then 20 calves (10 is ideal). Calves should be placed in their allocated pens and stay there for the entire indoor rearing period. There should be enough barn space to be able to house at least 50% of the calves born on the farm.

Best practice is to have multiple barns, so that young calves can be isolated from older or sick calves. Each calf should be placed in a clean group pen that has not been previously used by other calves.

It is unfortunately true that calf barns are often a low priority on farms and when new conversions are built. In my opinion this is totally short sighted as pressures on the calf and rearer are equally as great as these of the cow and the milkers.

Good quality staff

Calf rearing is a specialised skill in observation, good husbandry and disease control. In my view the calf rearers should be highly valued and recognised for their skill and devotion. There is nothing more stressful on the farm then a shed full of scouring calves and their stressed rearers.

So staff should have good facilities, not required to lift more then 25 kg and well motivated and well paid. After all they are caring for the best genetic asset on the farm and your future herd.

In summary: calf rearing starts at birth, not 24 hours later. The end result (a well weaned calf) requires good husbandry, good staff, good nutrition and housing.