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Calf Note #124 – Accelerated liquid feeding and diarrhea

Introduction

The first few weeks of life, when we typically feed calves whole milk or milk replacer is also the time when calves typically experience episodes of diarrhea, often caused by infectious organisms such as rotavirus, *Cryptosporidium parvum* or Salmonella. Is this is coincidence? Or is there some relationship between the type and/or amount of liquid fed to calves and the incidence and severity of diarrhea?

For many years, feeding calves was quite simple – recommendations called for feeding approximately 450 grams (1 lb.) of solids of either calf milk replacer (CMR) powder or as approximately 4 liters (1 gallon) of whole milk per day. There was little variation in amounts of liquid fed, so it was assumed that incidents of diarrhea were caused by factors other than the amount of liquid fed to calves.

More recently, we have seen the introduction of higher protein CMR formulations that are fed at much more than 450 grams of powder per day. In addition, research has shown that calves can and will voluntarily drink much more whole milk than 4 liters per day. With these various options now available, calves may be fed different amounts of liquid for different periods of time and amounts of liquid offered may change quite dramatically from week to week. Do these changes in feeding volumes and concentrations predispose the calf to diarrhea or even cause diarrhea?

Table 1. Performance of calves fed CMR reconstituted at different concentrations.

	Concentration of reconstituted CMR, %						
Item	**8.0**	**11.0**	**14.0**	**17.0**	**20.0**	**SE**	***P***
BW, kg							
21 d	57.2	60.6	62.4	62.3	63.2	1.7	NS
49 d	87.3	93.4	95.4	101.8	99.6	2.2	NS
77 d	114.9	126.0	126.6	137.5	137.8	2.5	0.05
88 d	122.1	135.3	137.0	146.5	145.7	3.5	0.05
DMI, kg/d							
14-28 d	1.26	1.38	1.57	1.59	1.67	0.06	0.01
42-56 d	1.57	1.73	1.91	2.09	2.09	0.07	0.01
70-84 d	1.88	2.18	2.33	2.55	2.79	0.12	0.01

Adapted from Ternouth et al., 1985.

Well, the published data on the subject are not particularly clear as to whether amount or concentration of liquid might induce or predispose diarrhea. Some very early research, especially with lower quality CMR used in the 1950's and 1960's suggested that increased CMR feeding often resulted in increased diarrhea. This might be related to the relatively poor technology used in those days to process and dry milk ingredients that were used in CMR formulations. However, what do more modern studies have to say about the subject? Let's have a look

Older research

Ternouth et al. (1985) fed calves CMR for ad libitum consumption for 12 weeks. The CMR were formulated from skim milk, fat powder and vitamins and minerals. The CMR were reconstituted to 8, 11, 14, 17 or 20% DM. Calves were offered colostrum for 2 days, then 3.5 L of reconstituted CMR at each feeding on d 3, 4.0 L per feeding on day 4, 4.5 L on day 5, etc., until calves refused milk. Whenever calves consumed all their CMR on a given day, calves were offered an extra 1 L per day on the subsequent days. These calves grew very well although their intake of DM varied by concentration -- i.e., calves fed the more concentrated CMR consumed more DM than calves fed less concentrated CMR (Table 1). Body weights also followed intake of DM.

What about scours? There was no change in fecal consistency with diet concentration although there was a softer consistency of the feces with increasing age mainly due to reduced values at 11 and 12 weeks of age which was due to an outbreak of disease.

Huber and co-workers (1984) fed calves one of two treatments -- the first group was fed 4.1 kg of whole milk from 3 to 48 days of age at weaning and the second group was fed 4.1 kg of whole milk increasing to 7.0 during the first 2 wk of treatment and then 7.6 kg/day thereafter to d 42. From d 42 to 48, amount was reduced to weaning on d 49. Calves consumed an average of 4.1 vs. 6.7 kg of milk per day during the study. Results of the study are in Table 2. As can be seen, there were no effects on fecal scores (on a scale of 1 = normal to 4 = severe diarrhea) or in the number of days that calves were medicated.

Table 2. Performance of calves fed whole milk at two different amounts to calves to 49 d of age.

	Treatment			
Item	**CON**	**ACC**	**SE**	***P***
Initial BW, kg	42.3	43.6	1.5	NS
ADG, g/d	538	615	33	0.05
	122.1	135.3	3.5	0.05
DMI, g/d				
CMR	462	769	17	0.05
Starter	515	292	51	0.05
Fecal score	2.3	2.6	0.2	NS
Days treated	50	60	…	NS

Total days that all calves were treated with medication or electrolytes.

In an interesting article published in 1973, Lodge and Lister fed Holstein bull calves whole milk and then tried to increase the amount of energy in the milk by adding either butterfat or glucose to change the energy to protein ratio. Their hypothesis was that milk protein might be used more efficiently by young calves if they have more energy available at a given level of digestible protein. They found that the addition of large amounts of glucose tended to increase the rate of scours in some of their experiments.

Finally, way back in 1953, Blaxter and Wood reported that there was a decrease in fecal DM with increased carbohydrate intake, which, could be related to the observations made by Lodge and Lister (1973) of increased diarrhea when excess amounts of glucose were fed to calves. This observation suggests that the composition of the liquid fed may have a greater impact on the looseness of feces compared to the amount of liquid fed per se.

Recent Research

With the advent of accelerated milk and milk replacer feeding programs, there have been several studies that have looked at feeding calves more than 454 g/d of milk or CMR solids. Most of these studies have looked at feeding additional CMR, but some have also looked at feeding increased (or ad libitum) whole milk.

Table 3. Summary of some published studies that fed increased amount of CMR or milk to calves.

Author	CMR or milk fed to ACC calves, g/d	Increased fecal scores?	Comments
Bartlett et al., 2006	1.75% of BW as CMR	No	A few more days with soft feces; calves not started on treatment until 2 wk
Cowles et al., 2006	0.7 to 1.4 kg CMR/d	No	Accelerated calves had lower fecal scores during wk of weaning
Diaz et al., 2001	Various amounts to achieve 500, 950 or 1400 g/d ADG	Yes	Calves fed no starter
Jasper and Weary, 2002	Ad libitum milk	No	Calves drank up to 8.8 kg/d; no increase in "diarrhea"
Nonnecke et al., 2003	2.5% of BW as CMR	Yes	No difference in health of calves
Quigley et al., 2006	454-906 g/d CMR	Yes	Stressed calves

As can be seen from Table 3, there is not a unanimous opinion on changes in fecal scores or in the incidence of diarrhea (NOTE: some authors describe the incidence of diarrhea differently). Though several authors noted that calves had "looser" feces (which would mean increased fecal scores), they noted this didn't necessarily amount to increased diarrhea. Generally, these authors defined diarrhea as fecal scores of 3 or 4 on the scale of 1 = normal feces to 4 = severe, watery feces.

The data DO suggest that feeding milk replacer does not NECESSARILY mean increased diarrhea – or for that matter, increased fecal scores. As was written more than 20 years ago by Huber et al. (1984), "*Sanitary and management conditions probably play a more important role than amount of milk in incidence of diarrhea in young calves.*". This is consistent with our observations (Quigley et al., 2006) that when stressed calves (transported calves with failure of passive transfer) were fed CMR in an accelerated feeding program, there was an increase in fecal scores.

Summary

A review of published research suggests that there have been cases where feeding additional milk or CMR has resulted in increased incidence of "loose feces" or, in some cases, in incidence or severity of diarrhea. However, the research indicates that loose feces is not necessarily related to increased CMR feeding, but may be related to amount of liquid fed, the composition of the diet, and many other factors, most important of which is the degree of microbial contamination in the environment.

References

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