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Calf Note 191 – Quality of colostrum, health and intestinal development

Introduction

Colostrum is the best way to start a young calf's life and provide immunoglobulins. Clearly, the research has documented this concept for nearly 100 years. However, we continue to learn more about the

Researchers at China Agricultural University (Yang et al., 2015) published an interesting article in the Journal of Dairy Science documenting the effects of colostrum, transition milk or bulk tank milk on IgG absorption, health and intestinal development of newborn calves. The research provides further evidence that colostrum is important to the health of newborn calves. Furthermore, the quality of the colostrum can affect not only IgG absorption, but also the development of the intestinal tract and susceptibility to disease. This research provides further evidence that we MUST pay close attention to the quality of the feed we provide to newborn calves.

The Research

The study was conducted with 28 newborn Holstein calves. Calves (n = 24) were assigned to one of three treatments – first-milking maternal colostrum (**MC**), transition milk (milk collected during days 2 and 3 post-calving; **TM**) or whole milk (**WM**). Four calves were sacrificed at birth and were used as negative controls.

The colostrum and transition milk were collected prior to the study and frozen prior to use. All calves were fed 4 L of their treatment immediately after birth and then 2 L at 8 hr after birth. On d 2, calves were fed 3.5 L of their respective treatments at 8:00 h, and, again, at 17:00 h. Thereafter, calves were managed normally and similarly.

On day 8, all calves were weighed and BW gain was determined. Incidence of disease to 8 days and mortality to 8 days was determined, also. Four calves in each group were also sacrificed on d 8 to measure intestinal villus size and development. The absorption of IgG and total protein was measured at 24 and 48 h by collecting jugular blood samples. The authors also collected blood samples for measurement of certain growth factors, hormones and immune components.

Item	MC	TM	WM
Body weight, kg			
Birth	45.4	42.2	43.7
Day 8	47.6	43.9	43.3
Change	2.2[a]	1.7[b]	-0.4[c]
Health			
Mortality, n	0	0	3
Diarrhea, n	0	1	5
Serum IgG, g/L			
0 hr	0.04	0.05	0.06
24 hr	24.56[a]	15.66[b]	0.09[c]
AEA*, %	19[a]	20[a]	8[b]

Table 1. Growth, health, and serum IgG concentrations in calves fed maternal colostrum (**MC**), transition milk (**TM**), or whole milk (**WM**) in the first 2 days after birth. From: Yang et al., 2015.

[a,b,c]$P < 0.05$.

*Apparent efficiency of IgG absorption, measured at 48 h.

Results

The absorption of IgG and health of calves is in Table 1. The IgG concentration of colostrum, transition milk and whole milk was 70, 39 and 1 g/L, respectively. The transition milk contained a reasonable amount of IgG, which is somewhat higher than other reports of transition milk quality. The absorption kinetics (apparent efficiency of IgG absorption) did not differ between colostrum and transition milk, which is also somewhat unusual. In

general, from the perspective of IgG absorption, the transition milk used in this study was reasonable quality. That is one reason the results seen in this study are so interesting.

Change in calf BW at 8 days of age clearly showed the effect of colostrum quality. Calves fed colostrum and transition milk gained BW whereas calves fed whole milk lost 400 grams of BW in the first week. The authors did not report the nutrient density of the respective treatments, but it is likely that at least some of this difference was due to the higher nutrient density found in colostrum vs. transition milk vs. whole milk. Greater nutrient density would allow calves to gain BW, whereas the limited nutrient content of milk could be inadequate for growth. Furthermore, since nearly all calves on the milk treatment developed diarrhea (5 of 8), it is possible that weight loss due to increased fluid excretion could account for at least some of the difference in BW change.

The high percentage of health problems and mortality in calves fed whole milk (Table 1) is consistent with many other studies in the research literature and shows clearly how important early feeding of colostrum is to the newborn calf.

There are several important observations in the measurement of intestinal parameters (Table 2). Calves fed colostrum had the greatest villus length and width and crypt depth throughout the intestine. This indicates that colostrum contained more bioactive components to promote growth of the intestinal tissue. Theoretically, this would lead to greater ability of the calf to absorb nutrients from ingested feed.

Calves fed transition milk generally has less development of the intestine compared to calves fed colostrum. However, development of the intestine in these calves was greater than calves at birth (**CON**), suggesting that there was at least some development of the intestine in the first week of life.

Item	MC	TM	WM	CON
Villus length				
Duodenum	1,557^{a}	1,320^{b}	902^{d}	1,045^{c}
Jejunum	1,612^{a}	1,315^{b}	958^{d}	1,147^{c}
Ileum	1,747^{a}	1,351^{b}	1,022^{c}	1,027^{c}
Villus width				
Duodenum	137^{a}	118^{ab}	105^{bc}	83^{c}
Jejunum	138^{a}	126^{ab}	100^{c}	112^{bc}
Ileum	141^{a}	130^{ab}	104^{b}	120^{ab}
Crypt depth				
Duodenum	241^{a}	215^{ab}	210^{ab}	206^{b}
Jejunum	255^{a}	220^{b}	208^{b}	217^{b}
Ileum	265^{a}	232^{b}	198^{c}	205^{c}

Table 2. Changes in some intestinal parameters in calves fed maternal colostrum (**MC**), transition milk (**TM**), or whole milk (**WM**) for the first 2 days after birth. Control (**CON**) calves were sacrificed at birth and other calves were sacrificed on d 8. From: Yang et al., 2015.

$^{a,b,c,d}P < 0.05$.

Villus length of calves fed whole milk appeared to break down (atrophy) during the first week of life. The villi were shorter than villi of control calves at birth, which is consistent with intestinal degeneration. This is possibly due to starvation, which has been observed in other species.

The authors also reported on several important blood measures of immunity and concentrations of hormones and growth factors. Generally, these measures were consistent with greater increases in immune competence and intestinal development in calves fed colostrum vs. transition milk. Also, these measures were generally least protective in calves fed whole milk.

Other research has also documented changes in intestinal morphology with different intake of colostrum or milk for different periods (Hammon and Blum, 1997; Rauprich et al., 2000a,b). Also, for more information on feeding colostrum up to 14 days, see Calf Note 138.

Summary

Colostrum intake is critical to calf health and development. This interesting study from China gives further evidence that the quality of colostrum fed affects many different aspects of the calf's physiology. It will definitely pay to take the time to measure colostrum quality and provide only the highest quality colostrum available to newborn calves. Your calves are depending on you!

References

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