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Calf Note 182 – Injectable trace minerals and calf health

Introduction

Calf health is the end result of many complex, interacting factors – disease (pathogen) exposure, stress, environment, and the calf's ability to fight pathogens through the multiple “arms” of the immune system.

Nutrition is essential to support functioning of the immune system. Nutrients such as vitamins and trace minerals (**TM**) are needed for many reactions within and used by immune cells to protect the animal against disease. We all understand the important role of vitamin and mineral nutrition to dairy animals – supplementing calf and cow diets with TM and vitamins is a normal nutritional practice on nearly all dairy farms.

Are newborn calves fully replete with sufficient TM? Will supplementation with TM affect circulating levels of TM in calves – and more importantly, their ability to grow and to fight disease? These were questions addressed by an interesting study reported in a 2014 paper published in the Journal of Dairy Science by researchers from the Cornell University College of Veterinary Medicine.

The Research

This study was conducted using 790 Holstein heifer calves raised on two dairy farms in upstate New York. Calves were raised according to the normal management on each farm, but half of the calves were injected with a trace mineral supplement containing 60 mg of zinc, 10 mg of manganese, 5 mg of selenium and 15 mg of copper in a 1-ml dose. Calves were injected on days 3 and 30 after birth.

Researchers collected blood samples for evaluation on d 3 (just before injection), d 14 and on d 35. Several different metabolic parameters were evaluated. Farm personnel also monitored calves for incidence of diarrhea (defined as 3 d or more of watery feces) and respiratory infection.

At birth, calves were fed either 4 L of colostrum by 4 h (Farm A) or 2 L within 2 h of birth and 2 L more by 8 h. Thereafter, all calves were fed 6 L of waste milk per day plus commercial calf starter and water to weaning at 50 d of age. The calves were weighed weekly until weaning.

Table 1 contains a summary of the calves reared on both farms. Generally, there were no differences between Control or TM treatments and parameters were typical for newborn calves, although it appears that colostrum management was

excellent on both farms, as mean serum IgG at 3 d of age averaged 23.2 to 26.7 g/L. Successful passive transfer is defined as serum IgG concentration at 1-3 d of age >10 g/L.

Results of TM injection on health events are shown in Table 2. Calves that were injected with TM had lower incidence of diarrhea and combined respiratory infection (otitis, pneumonia or both) compared to control calves.

Item	Farm A		Farm B	
	Control	TM	Control	TM
No. of calves	330	310	70	80
1st calf heifers^a	34	33	43	45
Assisted^b	4	5	16	18
Initial BW, kg	38.1	38.3	41.3	41.1
Serum IgG, g/L	23.2	23.8	26.7	25.7

Table 1. Description of calves from both farms used in the study.

^aPercentage of calves born from first-calf heifers.

^bPercentage of calves receiving assistance at calving.

Serum TM concentrations were unaffected by TM injection at 14 or 35 d of age. This observation is probably important, as serum concentration of minerals might be considered as an important criterion for whether or not a TM injectable is effective. Neither was BW gain affected by treatment – average ADG were 789 and 778 g/d for Control and TM calves, respectively.

Although serum TM concentrations and ADG were unaffected, measures of immunity and oxidative stress were improved when calves were injected with TM. Calves supplemented with TM had greater glutathione peroxidase activity at 14 d as well as improved neutrophil activity. The improvement in immune measures could explain improved health outcomes.

Neutrophils are an essential part of the innate immune system and play a critical role in protecting calves, particularly during the first few weeks of life.

Will these results translate to improved health for calves on other farms? While it's impossible to say with complete certainty, there are some aspects of this farm that might influence these results and give some insight as to whether similar results may be observed on others.

Serum IgG concentrations were high compared to many other farms, indicating excellent colostrum management. Although the authors of this study did not report it, the TM concentration of the dry cow diet and colostrum are important factors in the calf's ability to fight infection. Some TM and vitamins cross the placenta so the dry cow diet affects calf serum concentrations. Others do not cross the placenta and therefore, the calf obtains these important nutrients from colostrum only. Notwithstanding the potential variation in colostrum TM status, there were no differences in serum TM concentration at 3 d of age (prior to the first injection of TM), suggesting minimal differences between treatments. However, it's important to recognize that serum TM concentrations may not tell the whole story of TM status, as observed in the lack of difference between Control and TM calves in this study.

Another observation worth note is the incidence of disease on both farms used in this study. Average incidence of diarrhea (defined as at least 3 d of watery diarrhea) was >40% of calves on both farms. More than one third of calves experienced respiratory infections. These relative incidences seem higher than those recommended by DCHA Gold Standards and higher than surveys of calf health. Thus, it's possible that the relative exposure of calves on these farms was higher than optimal. Therefore, it's possible that response to TM might be more obvious on farms such as these, where relative disease incidence was greater than others. On farms with much lower incidence of disease, it's not as clear whether responses would be as readily observed.

It's also important to note that calves were fed 6 L per day of waste milk. The TM content of the milk was not reported in this study. Most commercial milk replacers are supplemented with TM to at least (and often more) levels recommended by NRC. Whole or waste milk does not contain high levels of certain TM (e.g., iron).

Summary

Overall, the conclusions of this well done study suggest that newborn calves will benefit from injection of TM shortly after birth. Improved TM status affects immunity and can help protect calves from disease. It's important to put the relative response observed in this study into perspective with relative health status on other farms.

Reference

Incidence, %	Control	TM	P
Mortality	2.7	3.8	0.40
Diarrhea	49.7	41.7	0.03
Otitis	13.2	10.6	0.31
Pneumonia	40.0	35.2	0.18
OT + PN^a	49.1	41.6	0.05

Table 2. Health events of calves not injected (Control) or injected (TM) with a trace mineral supplement on d 3 and 30 of life.

Teixeria, A.G.V., F. S. Lima, M.L.S. Bicalho, A. Kussler, S. F. Lima, M. J. Felipe, and R. C. Bicalho. 2014. Effect of an injectable trace mineral supplement containing selenium, copper, zinc, and manganese on immunity, health and growth of dairy calves. *J. Dairy Sci.* 97:4216-4226.

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