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Calf Note #45 – Vitamin A in milk replacer

Introduction

Vitamin A is an essential nutrient involved in maintaining healthy epithelial tissues, growth, immune response and many other functions. The amount of vitamin A available to the newborn calf is quite limited, however. Due to limited placental transfer, calves are born with few liver reserves of vitamin A and little of the vitamin in the blood.

A little background

Vitamin A is a fat soluble vitamin. It's needed for proper vision, structure of epithelial cells, immune function, bone integrity and growth, and reproductive efficiency. Calves are born with very limited reserves of vitamin A. Like the other fat soluble vitamins, there is little transmission of vitamin A across the placenta into the fetus. Therefore, the primary source of vitamin A for the newborn is by consumption of colostrum. When a dry cow's diet is properly supplemented, colostrum is an excellent source of vitamin A. After colostrum feeding, vitamin A is provided by consumption of whole milk, waste milk or milk replacer.

Current practices

Feeding whole milk or waste milk will provide relatively low amounts of vitamin A compared to milk replacer. Whole milk contains approximately 1.2 IU of vitamin A/mL. However, this amount varies, depending on the vitamin A content of the ration. Commercial milk replacers contain much more vitamin A than current NRC recommendations (1989 NRC recommends that milk replacers contain 1,725 IU/lb [3,800 IU/kg]). Typical milk replacers will contain 10,000 to 40,000 IU/lb (22,000 to 88,000 IU/kg). This is 5 to 23 times the amount recommended by NRC. Why such an increase? Industry professionals suggest that much of the increase occurred gradually and increases were in response to perceived improvements in calf health and performance. There does not appear to be sound research to justify the concentrations of vitamin A currently included in most milk replacer formulations. Some researchers have suggested that large amounts of one fat soluble vitamin may interfere with the absorption or metabolism of others. Is this the case in calves fed milk replacer?

The research

Eicher and coworkers in Kansas reported that calves fed milk replacer containing vitamin A at 39,500 IU/lb (87,000 IU/kg) or 3,200 IU/lb (7,000 IU/kg). In addition, calves were fed either 11.2 or 57 IU of vitamin E/kg of milk replacer (25 or 125 IU/lb). These milk replacers were reconstituted with water to 13% DM and fed at 10% of BW for 6 weeks. Mean BW at the beginning of the trial was 41.3 kg. The researchers found that high concentrations of vitamin A did not interfere with the levels of vitamin in the blood of calves, nor were immune parameters affected by

levels of vitamin A. Further, calves fed higher vitamin A had improved fecal consistency compared to calves fed lower vitamin A.

Effect of low (LA; 7,000 IU/kg) or high (HA; 87,000 IU/kg) vitamin A and low (LE; 11.2 IU/kg) or high (HE; 57 IU/kg) vitamin E in milk replacers. From: Eicher et al., 1994.

More recently, Franklin and workers at South Dakota State University fed calves whole or waste milk containing an additional 0, 15,000 or 30,000 IU/d of vitamin A (as retinyl acetate). The milk provided approximately 5,000 IU/d of vitamin A.

Table 1. Effect of low (LA; 7,000 IU/kg) or high (HA; 87,000 IU/kg) vitamin A and low (LE; 11.2 IU/kg) or high (HE; 57 IU/kg) vitamin E in milk replacers. From: Eicher et al., 1994.

Item	LA-LE	LA-HE	HA-LE	HA-HE
BW at 6 wk of age, kg	55.5	54.2	56.6	55.1
Plasma a-tocopherol @ 6 wk of age, mg/dl	285	439	297	452
Mean weekly fecal score (1=normal to 4 = severe scours), wk 1 to 6	1.7	1.8	1.6	1.7
Neutrophil bactericidal activity, % of kill	24.6	25.6	18.8	26.9
Lymphocyte proliferation @ 6 wk, cpm x 1,000	171	79	141	70

Feeding supplemental vitamin A effectively reduced the plasma concentration of vitamin E in calves. This might have been due to reduced absorption of vitamin E from the intestine due to competition with vitamin A. Furthermore, there was no effect of vitamin A on the concentration of plasma retinol in calves fed supplemental vitamin A. However, there is evidence to suggest that plasma concentrations of retinol may not be indicative of true vitamin A status in calves. When calves scoured, they were supplemented with an additional 0 or 30,000 IU of vitamin A/d.

Supplementation with the additional 30,000 IU of vitamin A effectively *increased* the number of treatment days required compared to calves not fed additional vitamin A during periods of scours (7.5 days versus 5.3). The researchers also reported that vitamin A supplementation reduced the concentration of plasma a-tocopherol (vitamin E). They hypothesized that additional vitamin A supplementation during scours may have inhibited uptake of vitamin E in the intestine. This may have been exacerbated by intestinal damage that might have further reduced vitamin E absorption. Effect of feeding supplemental vitamin A on BW, plasma a-tocopherol and number of days scouring in calves fed milk containing 5,000 IU of vitamin A/d from birth to 6 wk of age. From: Franklin et al., 1998.

The results of this research indicate that concentrations of vitamin A often included in commercial milk replacers may be too high to promote optimal health of young dairy calves. The over-provision of vitamin A may interfere with vitamin E to the extent that the animal's health might be impaired. Of course, a goal of a commercial

Table 2. Effects of vitamin A on performance of calves.

Item	IU/d in milk replacer		
	0	15,000	30,000
BW at 6 wk of age, kg	64.5	63.6	63.4
Plasma a-tocopherol @ 6 wk of age, mg/dl	80.4	53.2	45.4
Mean weekly fecal score (1=normal to 4 = severe scours), wk 1 to 6	1.46	1.49	1.49
No. of days treated for scours	6.2	7.1	5.3

feed company is to provide for optimal health and not to impair the animal's immune response. As further research is conducted in this area, the importance of the relationships between all of the fat soluble vitamins will become clear.

This important research will assist milk replacer manufacturers to improve the ingredient content of commercial milk replacers, thereby improving the health, growth and efficiency of young calves.

References

Eicher, S. D., J. L. Morrill, F. Blecha, C. G. Chitko-McKown, N. V. Anderson, and J. J. Higgins. 1994. Leukocyte functions of young dairy calves fed milk replacers supplemented with vitamins A and E. *J. of Dairy Sci.* 77:1399-1407.

Franklin, S. T., C. E. Sorenson, and D. C. Hammell. 1998. Influence of vitamin A supplementation in milk on growth, health, concentration of vitamins in plasma, and immune parameters of calves. *J. Dairy Sci.* 81:2623-2632.

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