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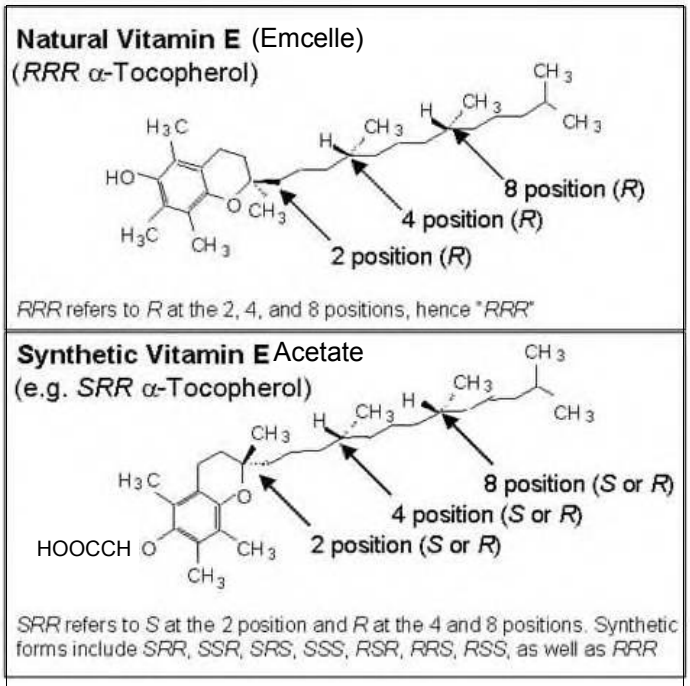
Solutions™ Nutrition News

Emcelle® Tocopherol More Bioavailable than Vitamin E Acetate

New Vitamin E Improves Calf Health and Performance



Emcelle® is Utilized by Calf Better than Synthetic Vitamin E Acetate

How Does Emcelle® Work?

1. Calves are born with very low levels of vitamin E.
2. Vitamin E supplementation enhances health status of young calves
3. Injectable Vitamin E maximizes serum levels in 16 hours and returns to baseline within 3 days.
4. Young calves cannot use vitamin E acetate in milk replacer very well
5. Emcelle® is used by young calves
6. Emcelle® improves health status

EMCELLE TOCOPHEROL: VITAMIN E FOR MILK-FED CALVES

by: Robert L. Stuart, Ph.D. and Ed Kane, Ph.D.
Stuart Products, Inc., Bedford, Texas

INTRODUCTION

Vitamin E (***alpha***-tocopherol) is a critically important and essential nutrient for growth and maintaining health status of calves. As a primary dietary antioxidant, vitamin E helps maintain cell membrane integrity, and has also been shown to enhance humoral and cell-mediated immunity (Hidiroglou et al., 1973; Nockels, 1979; Cipriano et al., 1982; Tengerdy et al. 1984; Reddy et al., 1986). Vitamin E is not synthesized in the body and must be obtained from dietary sources. The published NRC requirement for vitamin E for calves is 50 I.U. per kg dry matter (NRC, 2001).

Calves are born with very low levels of vitamin E due primarily to poor placental transfer (Hidiroglou 1989; Malone 1975; Van Saun et al., 1989). Thus, the neonatal calf is immediately dependant on colostrum and subsequently milk or milk replacer to provide adequate vitamin E to meet its needs (Kumagai et al. 1994, Blum et al. 1997).

The primary sign of vitamin E deficiency in calves is muscular dystrophy affecting skeletal, cardiac, and smooth muscle. This can critically affect tongue musculature resulting in reduction of suckling (Abutarbsh and Radostits, 2003). Secondary symptoms such as diarrhea may occur that may not be attributable to a vitamin E deficiency (Radostits et al., 1992).

Vitamin E supplementation prevents deficiencies in young calves, and enhances their health status (Cipriano et al, 1982; Radostits et al., 1992) and growth rate (Luhman et al., 1993; Reddy et al., 1987). However, not all vitamin E supplements are effectively utilized by the young nursing calf. It is essential that the newborn calf receive a biologically available source of vitamin E either by injection or via the diet to enhance vitamin E status resulting in enhanced immunity.

Emcelle®: Higher Utilization =

INCREASED NEED FOR SUPPLEMENTATION

Lush pastures are excellent sources of alpha-tocopherol (vitamin E); however, grasses and forages lose approximately 90% of vitamin E activity after harvesting due to oxidation. As the dairy industry has shifted from pasture grazing to total confinement feeding of dairy cattle, vitamin E status of gestating and lactating cows and their offspring has declined making vitamin E supplementation even more critically important for cows and newborn calves. Colostrum and milk from cows grazing pasture during gestation and lactation typically have higher vitamin E content than colostrum and milk from cows fed TMR's containing stored roughages (Hidiroglou et al., 1973).

The newborn calf depends totally upon colostrum for its vitamin E needs. Typically, colostrum contains approximately 8 times more vitamin E activity than normal milk; and vitamin E content of colostrum and milk is directly related to vitamin E intake by the dam during gestation and lactation (Hidiroglou et. al., 1989; Weiss, 1998). Vitamin E supplementation of gestating cows increased the vitamin E content of colostrum and subsequently produced an increase in the plasma vitamin E concentration of newborn calves after colostrum consumption (Weiss et al., 1990).

DETERMINING VITAMIN E STATUS

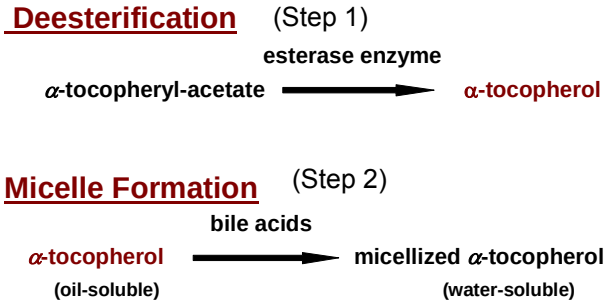
HPLC analysis of serum or plasma for alpha-tocopherol is the primary method to determine vitamin E status of calves. Calves purchased from sale barns may or may not have received vitamin E-containing colostrum, thus vitamin E status should be assumed to be inadequate. Typically, calves are born with a serum-tocopherol level below 1 µg/ml. Serum level above 3-4 µg/ml should be achieved as soon after birth as possible and maintained while on milk or milk replacer. This level has been shown to optimize immunocompentency (Reddy et al. 1986).

FACTORS AFFECTING VITAMIN E STATUS OF CALVES

Milk replacer typically provides 50-400 I.U. vitamin E activity per kg as *dl-alpha*-tocopheryl acetate, a stabilized synthetic source of vitamin E. Alpha-tocopherol is absorbed better than the acetate-ester however, due to poor stability of tocopherol, milk replacers are required to be fortified with the acetate-ester. It is assumed that the young milk-replacer fed calf can effectively utilize the acetate-ester. In order for the vitamin E-ester to be utilized by the calf, two steps are necessary prior to absorption (Figure 1). The first is that the ester has to be removed by the action of esterase enzymes in the intestinal tract. If there is a deficiency of the enzyme, absorption will be hindered (Gallo-Torres, 1980).

The second step is micellization. After the ester has been removed, the free tocopherol must be micellized by the action of bile salts to convert oil-soluble tocopherol into a water-soluble form that is absorbed (Gallo-Torres, 1980).

Figure 1. Steps for absorption of supplemental vitamin E esters



EMCELLE® TOCOPHEROL (Stuart Products, Inc.) is a source of vitamin E that does not require those two critical steps prior to absorption. The product allows for quick and efficient absorption. This micellized, non-esterified form of vitamin E, unlike vitamin E acetate used in milk replacers, does not require the acetate ester to be hydrolyzed prior to absorption; nor is there a need for micellization by bile salts.

Excessive vitamin A supplementation, which often occurs under field conditions, can negatively impact vitamin E absorption and performance. Levels of vitamin A supplementation up to 68,000 I.U. daily dramatically reduced vitamin E absorption (Amertaj et. al., 2000) and growth rates were also reduced (Franklin et al., 1998).

Holstein calves from a calf-growing facility had dramatically higher vitamin A and dramatically lower vitamin E status compared to crossbred beef calves previously grazing grass, demonstrating the impact of previous diet on vitamin status. Zinn et al., 1996, measured vitamin A and vitamin E status of 36 Holstein and 36 crossbred beef calves at feedlot arrival. The average serum retinol levels for Holstein and crossbred beef calves were 42.0 and 16.9 µg/dl, respectively; and average serum tocopherol levels were 0.90 and 6.00 µg/ml, respectively. The range in serum tocopherol in the Holstein calves was 0.3 to 2.6 µg/ml, and the range in the crossbred calves was 2.4 to 13.7 µg/ml.

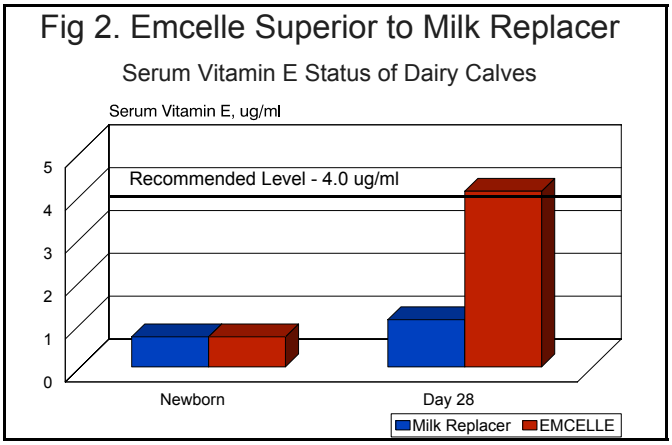
EMCELLE® – MOST EFFECTIVE, MOST SOLUBLE VITAMIN E

Emcelle® Tocopherol is very effectively utilized by the nursing calf (Data on File, Nouriche Nutrition Ltd.). The product contains 500 I.U. vitamin E activity per ml as *d-alpha*-tocopherol. Although less stable than the acetate ester, biological availability of the free tocopherol is better than the acetate-ester, especially in the newborn (Eicher et. al., 1997). Due to its unstable form, the only means to

Better Calf Performance!

administer micellized ***alpha***-tocopherol to calves is to fortify milk or milk replacer at feeding. **EMCELLE** readily mixes into milk or milk replacer and does not negatively affect consumption. It is the only commercially available, water-soluble source of micellized natural tocopherol that has been shown to be biologically available to nursing calves.

Fig 2. Emcelle Superior to Milk Replacer



Since whole milk is typically low in vitamin E (7-10 I.U. per kg DM), and milk replacers contain the acetate ester, newborn calves should be given an oral supplement of a biologically available source of vitamin E.

EMCELLE® TOCOPHEROL - RESULTS IN CALVES

In a study at a California calf-raising facility, twelve calves were bled at arrival and average serum tocopherol status was 0.7 µg/ml (Data on file, Nouriche Nutrition Ltd.). The second phase of the study measured utilization of Emcelle when administered in milk-replacer. Milk replacer of 12 calves was supplemented with 100 I.U. vitamin E activity (Emcelle) for four weeks and compared to twelve calves fed only milk replacer containing 55 I.U. synthetic vitamin E-acetate. After four weeks, calves receiving solely milk replacer had an average serum tocopherol level of 1.1 µg/ml, and calves receiving Emcelle-supplemented milk replacer had an average serum tocopherol level of 4.1 µg/ml (P<0.01) (Figure 2).

The second study was conducted at a Kansas calf-raising facility to measure effectiveness of Emcelle Tocopherol, injectable tocopherol (Vital E-500, Schering Plough Animal Health) or a combination of the two on 28-day calf performance (J. Morrill, unpublished). Male Holstein calves were purchased in Oklahoma and transported to the facility. Upon arrival, calves were housed in individual hutches and fed electrolyte solution. On the second and fourteenth day after arrival, all calves received intranasal vaccination for IBR and PI-3. The next day after arrival, 12 calves were randomly assigned to one of four different treatments. The treatments

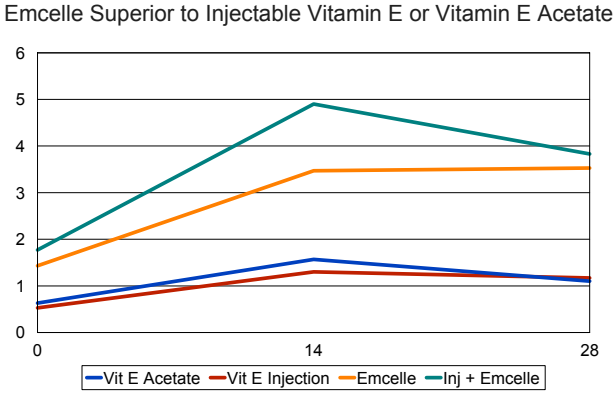
Table 1. Response of Calves to Vitamin E Injection and Emcelle Tocopherol

	Control	Injectable Tocopherol (1500 I.U.)	Emcelle (200 I.U. daily)	Injectable Tocopherol + Emcelle
28 day gain, lb	4.72	5.95	5.73	11.73
Avg Feed Intake, lb	1.65	1.52	1.50	1.74
Feed:Gain	9.74	7.18	7.39	4.17
Mortality, %	16.67	0	0	0
Medicine Cost	$1.82	$1.96	$1.29	$1.18

Source: Morrill, Kansas State University

were control (milk replacer only), Emcelle Tocopherol (200 I.U. per day), Vital E (single injection of 1500 I.U. at start of study), and a combination of Emcelle and Vital E injection. Blood samples were taken on days 1, 14, and 28 of the study. Table 1 shows the main treatment effects. Calves receiving injectable + Emcelle had higher total gain (P<0.10) and better feed efficiency (P<0.10) than the other treatments. Mortality was dramatically reduced by all vitamin E treatments, while morbidity was not (Table 1). Medication cost tended to be lower in those calves receiving 200 I.U. vitamin E from EMCELLE. Figure 3 shows the average serum tocopherol levels during the 28-day study. Only calves receiving daily supplementation with EMCELLE had a higher serum tocopherol status. Emcelle maintains higher serum levels of vitamin E over a longer period of time, whereas injectable tocopherol maximizes serum tocopherol 16 hours post-injection, but returns to baseline within 3 days (Data on File, Nouriche Nutrition Ltd.). Our goal is to maintain higher serum levels to provide continuous protection for the calf and maximize immune system response.

Fig 3. Emcelle Increases Serum Vitamin E Levels



Source: Dr. Jim Morrill, Kansas State University

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RECOMMENDATIONS FOR MILK-FED CALVES

Emcelle® Tocopherol (Available exclusively from Nouriche Nutrition Ltd) Feed 0.4 ml of Emcelle per calf daily for first 20 days to provide 200 I.U. vitamin E as *d-alpha*-tocopherol; One 1000 ml bottle of Emcelle® will feed 125 calves.

Vital E-300 (Schering Plough Animal Health): Inject 5 ml to provide 1500 I.U. *d-alpha*-tocopherol upon arrival - 1 shot.

Hidiroglou et al (1995) conducted a study to measure the effectiveness of EMCELLE in combination with vitamin C on gain and immune responses of calves. In the study, 18 newborn Holstein female calves were randomly assigned to receive either no supplement, 1000 I.U. vitamin E/day (Emcelle Tocopherol) or 1000 I.U. vitamin E plus 1 g vitamin C/day added to colostrum and whole milk from birth to 6 weeks of age. Calves were weighed weekly, and total gain was determined for the duration of the study. Plasma concentrations of alpha-tocopherol were determined initially and weekly; and IgG1, IgG2, and IgM were determined weekly by a single radial immunodiffusion procedure. Total gain for the three treatments was 13.02, 14.28, and 17.64 kg, respectively ($P< 0.34$). Average serum-tocopherol levels were .33, 3.33 and 3.64 µg/ml for the three treatments, respectively ($P< 0.001$). Differences among treatments for IgG1, IgG2, and IgM levels were not significant, however, concentrations of IgM generally tended to be higher in calves supplemented with E and C compared to controls (84 mg/100 ml vs. 74 mg/100 ml).

SUMMARY

Due to poor placental transfer and low body lipid stores, calves are born with very low body stores of vitamin E and need to be supplemented. Supplementation of the cow's diet during gestation increases vitamin E in colostrum. Vitamin E supplementation of either whole milk or milk replacer will enhance vitamin E status of calves.

The most efficient means to quickly enhance vitamin E status of nursing calves is to inject them at birth and supplement the milk or milk replacer with a biologically available source of vitamin E.

Levels of supplemental vitamin E in milk replacer has increased during the past few years, however, newborn calves do not utilize the acetate ester as effectively as free alpha-tocopherol. Research has shown that micellized natural vitamin E (EMCELLE® TOCOPEHROL) is the most effective oral method to increase vitamin E status in milk-fed calves. Micellized natural vitamin E should be administered in the milk replacer at 100-200 IU per calf daily to maintain serum tocopherol status above 4 µg/ml.

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