

Emcelle Tocopherol (d-alpha-tocopherol): A biologically available source of vitamin E for newly-weaned piglets

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Introduction

Vitamin E (α -tocopherol) is a critically important nutrient for all confinement-reared swine. It is a primary dietary antioxidant that maintains cell membrane integrity and also enhances humoral- and cell-mediated immunity. Other metabolic roles have been reviewed¹. Vitamin E is not synthesized in the body, thus all swine require dietary sources to meet metabolic needs.

Piglets are born with very low vitamin E status due to poor placental transfer.^{2,3} Therefore, the neonatal pig is immediately deficient in vitamin E at birth and totally dependent upon colostrum and milk to provide α -tocopherol. Colostrum and milk levels are dependent upon quantities of vitamin E consumed by the dam during gestation and subsequent lactation.^{2,4,5} At weaning, piglets typically have a serum tocopherol level of approximately 4-5 $\mu\text{g/ml}$. After weaning, serum tocopherol levels can decrease to less than 1 $\mu\text{g/ml}$ within one week post-weaning. This appears to be due to poor utilization of typical dietary supplemental vitamin E (vitamin E-acetate).^{6,7,8} The piglet's most critically important times of need for vitamin E appear to be while nursing and immediately after weaning. It is essential that the newborn piglet receive adequate vitamin E via the colostrum and milk and also equally important is that after weaning, the piglet receive vitamin E in a form and source that it can utilize.⁹

Emcelle[®] Tocopherol (Stuart Products Inc., Bedford, Texas) is a clear, micellized, water-dispersible, liquid source of vitamin E (500 I.U. vitamin E activity per ml as d-alpha-tocopherol). This form of supplemental vitamin E, although less stable than vitamin E-acetate ester, does not need to be either de-esterified or micellized prior to absorption. The micellization process converts vitamin E oil (d-alpha-tocopherol) into water-soluble droplets (optimally 0.1 to 0.4 microns) that are more efficiently absorbed. The product readily mixes into drinking water and does not affect water consumption.

The product has been shown to be effective in poultry, elephants, horses, and calves.

Results in piglets

At weaning, piglets normally have serum tocopherol levels above 4 $\mu\text{g/ml}$. It has been reported that in order to achieve maximum immune response in pigs, serum α -tocopherol levels should be above 3 $\mu\text{g/ml}$.¹⁰ Piglets on starter feeds supplemented with vitamin E-acetate at levels up to 200 I.U. per kg (182,000 I.U. per ton) were unable to achieve serum tocopherol levels above 1.8 $\mu\text{g/ml}$.⁸

Two studies were conducted to determine if piglets supplemented with Emcelle Tocopherol would achieve higher serum tocopherol levels.^{9,11} The first study was conducted at The Ohio State University and consisted of two treatments consisting of 4 replicates of 4 pigs weaned at 18 d. Control piglets received no supplemental vitamin E and supplemented piglets received 100 I.U. vitamin E per liter drinking water. Average daily water disappearances during weeks 1-4 were 1.47, 2.00, 3.47, and 4.92 liters for unsupplemented pigs and 1.42, 2.20, 3.37, and 4.42 liters for supplemented pigs. Blood samples were obtained at weaning and weekly and serum analyzed for alpha-tocopherol ($\mu\text{g/ml}$). Figure 1 shows piglet serum-tocopherol weekly responses to water administered micellized vitamin E at 100 I.U. per liter drinking water for four weeks post-weaning.⁹ Piglets receiving micellized alpha-tocopherol (100 I.U./liter) had significantly higher serum tocopherol levels during all four weeks of the study ($P < 0.05$). During week one of the study, supplemented pigs had similar tocopherol levels compared to initial values, while the unsupplemented pigs had an average value of 1.7 $\mu\text{g/ml}$. During all sampling periods, the supplemented pigs had 3 μg alpha-tocopherol/ml or higher, while unsupplemented pigs continued to decline.

The second study was a field study in Denmark in weaned piglets with a history of *E. coli* diarrhea.¹¹ Three hundred ten 28-day old weaned piglets were divided

Figure 1: Serum alpha-tocopherol levels ($\mu\text{g/ml}$) in control and Emcelle Tocopherol-supplemented piglets (Specht et al. 2003)

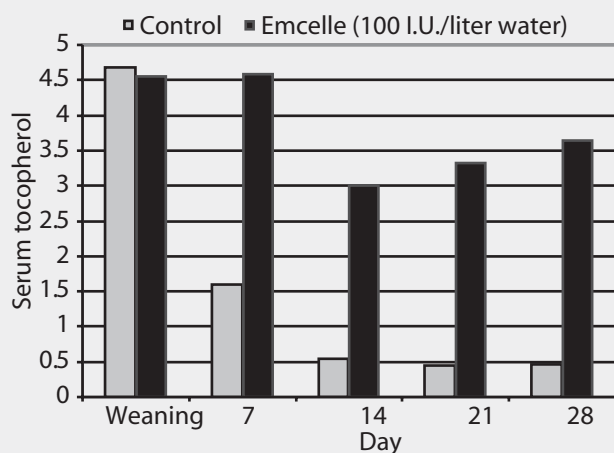
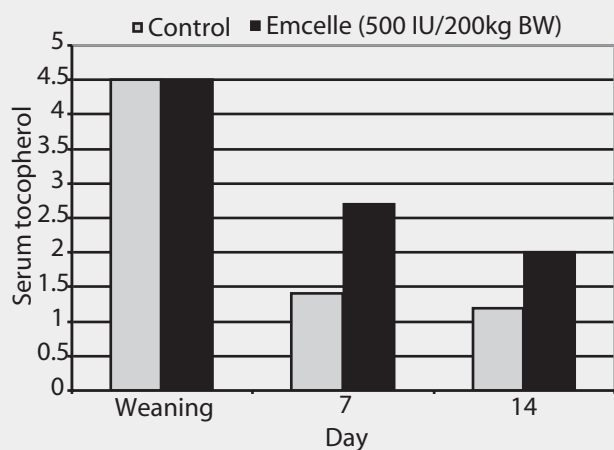


Figure 2: Serum alpha-tocopherol levels ($\mu\text{g/ml}$) in control and Emcelle Tocopherol-supplemented piglets (Agger et al. 2001)



into two treatments each consisting of 4 pens of approximately 40 piglets per pen. All piglets were fed a starter diet containing 125 I.U. per kg as synthetic vitamin E-acetate. The two treatments consisted of unsupplemented and micellized tocopherol-supplemented piglets. The supplemented pigs were administered vitamin E at the rate of 500 I.U. per 200 kg body weight for 10 days post-weaning in drinking water. Serum samples were collected at random from 10 piglets from each treatment at weaning, and 7 and 14 days post-weaning. Figure 2 shows the plasma tocopherol levels for the study. Since the piglets were supplemented for 10 days, the 14-day serum value was lower for the supplemented pigs. Vitamin E supplementation appeared to reduce incidence and severity of diarrhea. Unsupplemented piglets

showed severe diarrhea 3 days post-weaning, and 12 piglets died during the first two weeks. Vitamin E-supplemented piglets first showed signs of diarrhea 9 days post-weaning, and no piglets died during week one and 3 died during week-two of the study ($P < 0.017$). Table 1 shows the mortality due to diarrhea for the two treatments.

Summary

Vitamin E status in piglet's declines dramatically after weaning unless a biologically available source of vitamin E is provided. Research has shown that water supplementation with micellized d-alpha-tocopherol (Emcelle Tocopherol) is a very effective dietary method to enhance and maintain vitamin E status in post-weaned piglets. This alpha-tocopherol form is the same as in sow's milk which can also help to explain why nursing piglets have a much higher serum tocopherol level than post-weaned piglets receiving supplemental vitamin E-acetate.

Since unesterified alpha-tocopherol is unstable in complete feeds, the only viable means to provide micellized alpha-tocopherol is by water fortification. The only oral product available that provides non-esterified RRR-alpha-tocopherol is Emcelle[®] Tocopherol.

For newly-weaned piglets, water supplementation of Emcelle Tocopherol is recommended at 50-100 per liter drinking water for up to two weeks post-weaning or whenever a vitamin E deficiency is suspected.

References

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Table 1: Percent mortality and morbidity data (Agger et al., 2001)

Item	Control	Emcelle (500 I.U./200 kg BW)
Percent mortality (number)	7.7% (12)	1.9% (3) $P < 0.017$
Onset of diarrhea (day post-weaning)	Day 3	Day 9

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