New preparation of dl-α-tocopheryl acetate increases vitamin E content in the egg yolk

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Vitamin E in the form of dl-α-tocopheryl acetate is the most important vitamin used by feed industry; however, it is not fully bio-available, with about 50-60% of dl-α-tocopheryl acetate ingested by poultry and swine being excreted. Besides the increase in yolk vitamin E concentration, the incorporation of tocopherols in hen diets prevents lipid oxidative deterioration of the ration. The aim of this study was to determine the increase in bioavailability of a new dl-α-tocopheryl acetate preparation in laying hens, by evaluating the vitamin E deposition in the egg yolk. A total of 40, 23 wk-old ISA Brown laying hens were fed corn and soybean meal diets supplemented with three levels of dl-α-tocopheryl standard (10, 100 or 200 mg/kg) or 100 mg/kg of a new dl-α-tocopheryl acetate preparation (Microvit™ E Supra), totalizing 4 treatments. Vitamin E content in the egg yolk was determined by HPLC at the end of the three-week experiment. Coefficients of determination and regression equations were used to evaluate the relation between increasing levels of dietary standard vitamin E and vitamin E in the yolk. Data were analyzed by ANOVA using StatView 5.0 (Abacus Concepts). Mean egg weights were used to calculate total vitamin E in the egg yolk (mg/yolk). Increasing levels of dietary vitamin E supplementation increased linear and significantly vitamin E content in the egg yolk. The regression equation was: $y = 0.0258x + 1.2892$, where $y$ is the vitamin E concentration in the yolk (mg), and $x$ the dietary standard vitamin E (mg/kg). This equation allows a prediction of yolk vitamin E concentration as a function of dietary supplementation. Based on the coefficient of determination ($r^2$), it can be assumed that dietary vitamin E concentrations accounted for 99.32% of the variability in total vitamin E content in the yolk. Dietary incorporation of 100 mg Microvit™ E Supra per kg resulted in 4.84 mg (± 1.00) of vitamin E in the egg yolk. Inserting this value into the regression equation, it can be concluded that the supplementation of 100 mg/kg of the new preparation Microvit™ E Supra to corn-soybean meal based diets results in egg yolk vitamin E content in eggs produced by feeding laying hens with 138 mg/kg of standard vitamin E.

Keywords: tocopherol; vitamin E; egg yolk

Introduction

Today, consumers are much more concerned about the influence of diets on health and this has encouraged the nutritional quality improvement of food of animal origin and the development of products such as vitamin E enriched eggs. Vitamin E is an essential multifunctional nutrient, well known for its anti oxidative properties, inhibiting lipid of cell membrane peroxidation by free radicals. Vitamin E has been recognized as a modulator of the immune system that confers improved disease resistance in animals and humans (Geraert, 1999; Siegel et al., 2001). Besides the increase in yolk vitamin E concentration, the incorporation of tocopherols in hen diets prevents lipid oxidative deterioration of the ration (Cherian et al., 1996). Vitamin E in the form of dl-α-tocopheryl acetate is the most important vitamin used by feed industry due to its outstanding stability, physical and
chemical properties and efficacy. However, it is not fully bio-available, with about 50-60% of dl-α-tocopheryl acetate ingested by poultry and swine being excreted. The aim of this study was to determine the increase in bioavailability of a new dl-α-tocopheryl acetate preparation in laying hens by evaluating the vitamin E deposition in the egg yolk.

Material and methods

A total of 40, 23 wk-old ISA Brown laying hens was randomly assigned to each of the four experimental diets for a 3 wk experiment. Laying hens were fed a corn and soybean meal diet, containing no ingredients of animal origin, supplemented with three levels of dl-α-tocopherol standard (10, 100 or 200 mg/kg) or 100 mg/kg of a new dl-α-tocopheryl acetate preparation (Microvit™ E Supra). These experimental diets were fed ad libitum in mash form throughout the trial. Eggs produced at 20 and 21 days after providing the experimental diets were collected, weighted and stored at +4°C. Vitamin E content in the egg yolk was determined by high performance liquid chromatography, according to the method described by Castan et al. (2005). Coefficients of determination, as well as its regression equations, were used to evaluate the relation between increasing levels of dietary standard vitamin E and vitamin E in the yolk. Data were analyzed by ANOVA using StatView 5.0 software (Abacus Concepts, 1996).

Results and discussion

Significant and linear incorporation of vitamin E content into the egg yolk, expressed in “µg/g of yolk” or “mg/yolk”, was achieved by increasing doses of supplemental vitamin E in hen’s diets. These findings are in agreement with Jiang et al. (1996). From the increasing concentrations of dietary standard vitamin E and respective increasing yolk vitamin E deposition values, a linear regression equation “y = ax + b” was obtained. The yolk vitamin E content achieved by Microvit™ E Supra supplementation was inserted into this equation, therefore the equivalency of Microvit™ E Supra supplementation in relation to the standard vitamin E was estimated. Figure 1 shows the positive correlation between the concentration of dietary vitamin E and vitamin E content in the egg yolk. The regression equation was: y = 1.6102x + 88.44, where y is the vitamin E content in the yolk (µg/g), and x the concentration of vitamin E supplemented to the diet (mg/kg), indicating that egg vitamin E increased linearly as dietary vitamin E rose. This equation allows a prediction of yolk vitamin E concentration as a function of dietary supplementation. Based on the coefficient of determination (r²), it can be assumed that 98.63% of the variability in yolk vitamin E content can be explained by the dietary vitamin E concentration. Dietary incorporation of 100 mg Microvit E Supra per kg resulted in 298.9 (± 55.9) µg vitamin E/g yolk. Inserting this value into the regression equation, it can be observed that 100 mg Microvit E Supra/kg do have the same efficacy as 130 mg standard vitamin E/kg of feed.

Mean egg weights were used to calculate total vitamin E in the egg yolk (mg/yolk). Figure 2 shows the positive correlation between dietary vitamin E concentration and total vitamin E content in the yolk. The regression equation was: y = 0.0258x + 1.2892, where y is the total vitamin E content in the yolk (mg), and x the dietary vitamin E (mg/kg). Inserting the value 4.84 mg (± 1.00) of vitamin E in the egg yolk due to dietary Microvit™ E Supra into the equation, it can be concluded that 100 mg Microvit™ E Supra/kg is equivalent to 138 mg standard vitamin E/kg of feed. Dietary vitamin E concentrations accounted for 99.23% of the variability in total vitamin E content in the yolk. Microvit™ E Supra supplemented at 100 mg/kg resulted in greater vitamin E incorporation into the egg yolk compared to the same concentration of standard vitamin E supplementation to hen’s diet.

The supplementation of 100 mg/kg of the new preparation Microvit™ E Supra to corn-soybean meal based diets resulted in equivalent egg yolk vitamin E content in eggs produced by feeding laying hens with 138 mg/kg of standard vitamin E.
Figure 1. Effect of increasing levels of dietary standard vitamin E in the yolk vitamin E content (µg/g)

\[ y = 1.6102x + 88.44 \]
\[ r^2 = 0.9863 \]

Figure 2. Effect of increasing levels of dietary standard vitamin E in the total vitamin E content (mg) in the egg yolk

\[ y = 0.0258x + 1.2892 \]
\[ r^2 = 0.9932 \]

References


