1999 Animal Science Research Report

IMPACT OF AGRADO™ ON TOCOPHEROL METABOLISM BY TRANSPORT-STRESSED HEIFERS

Pages 119-125

Authors:

H. Han, T.C. Stovall, J.T. Wagner and D.R. Gill

Story in Brief

Eighty mixed crossbred heifers (5 to 7 mo old, 196 kg initially) were selected from a group of 690 heifers in order to investigate effects of Agrado™ on tocopherol metabolism in Exp. 1. Cattle, purchased by order buyers from Oklahoma and Arkansas sale barns, were given ad libitum access to a moderately high energy diet with either 0 or 150 ppm added Agrado™. Diets were supplemented with 15 IU vitamin E acetate/kg. Jugular vein blood was collected on d 0, 14, 28, 42 and 68 after arrival in Stillwater. In Exp. 2, 40 mixed crossbred heifers were selected to investigate the effect of vaccination on plasma tocopherol concentration for 28 d. Plasma α -tocopherol concentration was analyzed by High Pressure Liquid Chromatography (HPLC). On d 0, plasma tocopherol levels were 7.2 (control) and 8.5 μ g/ml (Agrado™ treatment); by d 14, tocopherol had dropped to 2.0 (control) and 2.2 μ g/ml (Agrado™ treatment). Through d 42, tocopherol level remained below 3 μ g/ml. The drop from d 0 to d 14, 28, and 42 tended to be higher for heifers receiving 150 ppm Agrado™, indicating that even though Agrado™ is an effective antioxidant, it did not increase the blood tocopherol concentration. On d 68, plasma tocopherol had increased to 7.0 and 6.5 μ g/ml for heifers receiving Agrado™ and control diets, respectively. There was no effect of vaccination on change of tocopherol level in blood in Exp. 2. Results indicate that transport and other changes occurring at this time (mixing of cattle, diet changes, vaccination, and respiratory challenges) are associated with decreases in plasma tocopherol levels that do not return to pre-transit concentrations for more than 42 d.

Key Words: Agrado™, Tocopherol, Shipping Stress

Introduction

Vitamin E requirements for growing, finishing cattle has been established at 15 to 60 IU/kg body weight (NRC, 1984). Supplementation of vitamin E improved the performance by improved gain to feed ratios, and reduced morbidity in transport-stressed cattle (Gill et al., 1986). Studies have also indicated that supplemental levels of vitamin E in the diet improve the immune system. Unfortunately, the cost of supplementing vitamin E to beef cattle is about $3 to $4/animal. Recently a synthetic antioxidant, Agrado™, was introduced to replace vitamin E at less cost. Indeed, Agrado™ supplementation improved rate and efficiency of gain in beef cattle during

the finishing period. However, there is little information about the relationship between Agrado™ and vitamin E. Therefore, the purpose of this study was to evaluate the effect of a synthetic antioxidant (Agrado™) on metabolism of tocopherol in transport-stressed cattle.

Materials and Methods

In the first study, eighty mixed crossbred heifers (5 to 7 mo old, 196 kg initially) were selected from a group of 690 heifers used in receiving trials in order to investigate effects of Agrado™ on tocopherol metabolism in Exp. 1. Cattle, purchased by order buyers from Oklahoma and Arkansas sale barns, were given ad libitum access to a moderately high energy diet composed of soybean hulls, whole corn, wheat middlings, and cottonseed hulls with either 0 or 150 ppm added Agrado™ (Table 1). Diets were supplemented with 15 IU vitamin E acetate/kg.

In Exp. 2, 40 mixed crossbred heifers (5 to 7 mo old, 196 kg initially) were used to investigate the effects of vaccination on blood tocopherol concentration in transport-stressed cattle. The vaccine d 0 treatment group received vaccine at arrival, while the vaccine delayed group received vaccine on d 14 post arrival. All heifers received diets as described for Exp. 1. Jugular vein blood was collected on d 0, 4, 6, 8, 10, 14, 21, and 28 after arrival in Stillwater. Blood was centrifuged and stored at □20^{o}C until analysis. Plasma α -tocopherol was analyzed by HPLC (Craig et al., 1992) using reverse phase chromatography at ambient temperature. Data were analyzed by PROG GLM (SAS, 1988).

Results and Discussion

Experiment 1. On d 0, plasma tocopherol levels were 7.2 (control) and 8.5 μ g/ml (Agrado™ treatment); by d 14, tocopherol decreased ($P<.01$) to 2.0 (control) and 2.2 μ g/ml (Agrado™ treatment; Figure 1). Tocopherol concentrations remained below 3 μ g/ml through d 42. In growing cattle, over 3 μ g/ml is considered as normal blood tocopherol concentration. The drop from d 0 to d 14, 28, and 42 tended to be higher for heifers receiving 150 ppm Agrado™ (5.2, 4.8, and 4.8 μ g/ml vs 6.3, 6.0, and 5.9 μ g/ml, respectively). Results indicate that even though Agrado™ is an effective antioxidant, it failed to increase the blood tocopherol concentration. However, there was no significant difference between the two groups ($P>.05$). On d 68, plasma tocopherol had increased ($P<.05$) to 7.0 and 6.5 μ g/ml for heifers receiving Agrado™ and control diets, respectively. Results indicate that transport and other changes occurring at this time (mixing of cattle, diet changes, vaccination, and respiratory challenges) are associated with decreases in plasma tocopherol levels that do not return to pre-transit concentrations for more than 42 d.

Experiment 2. On d 0, average tocopherol level in plasma was 3.01 (vaccine d 0) and 4.14 μ g/ml (vaccine delayed; Figure 2). After d 0, plasma tocopherol level decreased continuously by d 8 and then maintained the tocopherol concentration throughout the rest of experiment period. By d 14, plasma tocopherol level was decreased in both vaccine d 0 and vaccine delayed group, which is the same result as Exp. 1. However, there were no significant treatment effects between control and vaccine treatments (P=0.29). In vaccine d 0, tocopherol concentration was significantly different after d 10. At d 14, vaccine delayed group received vaccine. After vaccination, tocopherol concentration was slightly increased but there was no significant difference. The level of tocopherol in vaccine delayed group at d 14 was significantly lower than d 0 group (4.14 and 1.28 μ g/ml). Because the tocopherol concentration was fairly low at the time of vaccination, it may not be easy to detect the decrease of tocopherol level after vaccination. These results suggest that decrease of tocopherol in blood is more related to stress and diet (dietary intake, level of tocopherol in diet) than to vaccination. However, whether the vaccination has no relationship to tocopherol decrease is not clear because the initial tocopherol level in Exp. 2 was over two times lower than in Exp. 1 (7.2 and 8.5 vs 3.0 and4.1 μ g/ml), which is marginal level. It is not clear whether tocopherol concentration could be decreased by vaccination, because in Exp. 2 initial tocopherol level was low and close to marginal level. However, from this study tocopherol level in blood was presumably decreased by transportation stress and it may take more than 68 d to recover to the previous level when diets have minimum required vitamin E levels (NRC, 1984). Further study is needed to determine whether increases in plasma tocopherol concentrations are responsible for performance and health benefits sometimes noted with diet supplementation of vitamin E for shipping-stressed calves.

Literature Cited

Craig A.M. et al. 1992. Am. J. Vet. Res. 53(12): 2228.

Gill D.R. et al. 1986. Okla. Agr. Exp. Sta. Res. Rep. MP-118:240.

NRC. 1984. Nutrient Requirements of Beef Cattle (6th Revised Ed.). National Academy Press, Washington, DC.

SAS. 1988. SAS/STAT® User□s Guide (Release 6.03). SAS Inst. Inc., Cary, NC.

Table 1. Composition of diets in Exp. 1 and 2.		
Ingredients	Control	Treatment

Soybean hulls, %	32.5	32.5
Supplement pellet[a], %	30.5	30.5
Corn dent No. 2, %	25.0	25.0
Cottonseed hulls, %	10.0	10.0
Premix[b], %	2.0	0
Premix with Agrado[TMc], %	0	2.0

[a]Supplement composition: Wheat midds 54.37%, cotton seed meal 24.59%, soybean meal (47.5%) 11.48%, limestone 3.6%, salt 0.88%, selenium-600 0.033%, and cane molasses 4.9%; Rumensin was added to provide 22 g/ton of ration and vitamin A was added to provide 2500 IU/lb of ration.

[b]Premix composition: Ground corn 88.5%, soybean meal 10%, $CaCO_3$ 1.5%.

[c]Premix composition with Agrado™: Ground corn 87.375%, Agrado™ 1.125%, soybean meal 10%, $CaCO_3$ 1.5%.

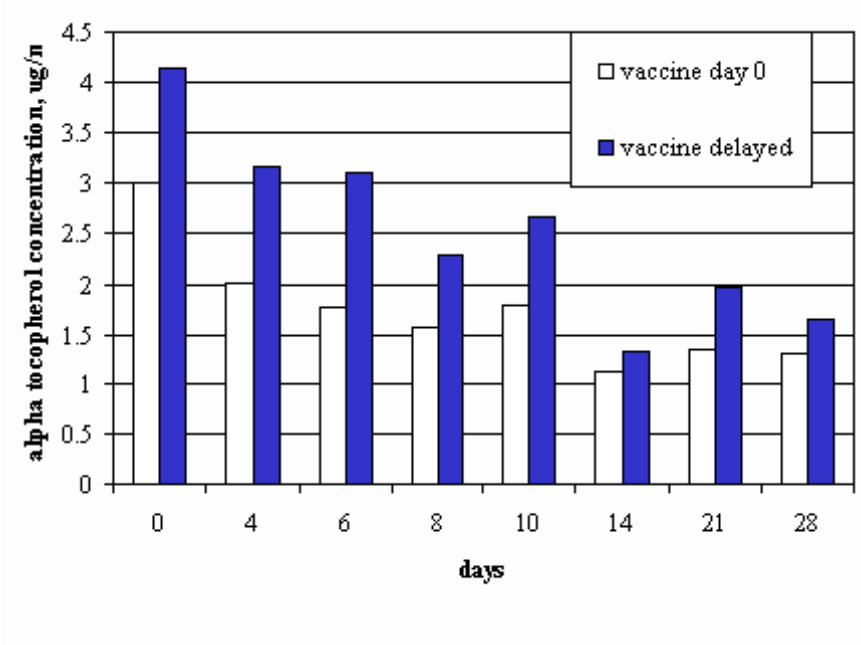

Figure 1. Change of alpha tocopherol concentration in plasma when received 0 or 150 ppm Agrado for 42 d.

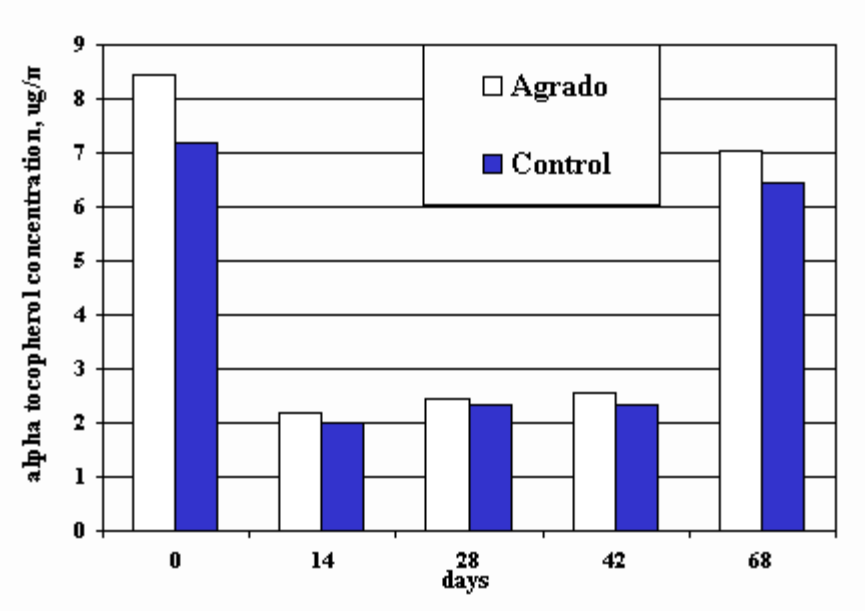

Figure 2. Change of alpha tocopherol concentration in plasma when received vaccine on d 0 or d 14 for 28 d.

1999 Research Report - Table of Contents