

RUMINAL AND INTESTINAL DISAPPEARANCE OF SEVERAL SOURCES OF VITAMIN E

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Story in Brief

Four different sources of vitamin E were fed to five adult steers with duodenal cannulas and five young calves without cannulas to investigate ruminal destruction as well as intestinal supply and disappearance of this vitamin. Among the sources of vitamin E tested, disappearance in the small intestine was highest for the absorbate form (44% of fed) and least for liquid form (16% of fed).

(Key Words: Vitamin E, Steer, Intestine, Cannula.)

Introduction

Vitamin E is present as eight different isomers of tocopherol in most common feedstuffs. Free tocopherol is unstable to oxidation. Each form differs in its biological activity. Hence, the vitamin E activity of foods and feedstuffs depends upon both the chemical form and storage conditions for the product. In practice, the vitamin E content of feedstuffs is variable and not readily predictable. Therefore, animal feeds commonly are supplemented with vitamin E at the rate of 5 to 15 IU/lb. The form generally used for this purpose is the fully racemic form of alpha-tocopheryl acetate which is stable to oxidation. Most species hydrolyze dietary tocophery esters (the forms of vitamin E used as feed supplements) effectively at the mucosal surface of the small intestine. Vitamin E is absorbed as the free alcohol form, tocopherol. Hidioglou and Jenkins (1974) observed that the administration of labelled tocopherol resulted in higher radioactivity in the blood and tissues when it was dosed into the duodenum than into the rumen. They found that the jejunum was the main site of vitamin E absorption. However, information on the mechanisms of absorption, transport, and metabolism of vitamin E in ruminants is limited. This study was conducted to examine the influence of the form of vitamin E on ruminal digestion and on intestinal supply and disappearance.

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Materials and Methods

A total of 10 steers, one group of five adult steers with "T" cannulas in the proximal duodenum (15 cm from pyloric sphincter) and five young steers without cannulas, were used in a 5x5 Latin square design. The basal diet, a finishing ration, consisted of rolled corn and cottonseed hulls. The basal diet with 9.1 IU vitamin E per lb was fed twice a day at 1.5% of body weight to the adult steers and at 2.0% of body weight to the young steers. The digesta marker for this trial was chromium sesquioxide. The steers were allowed two weeks for adaptation to the basal diet. Thereafter, experimental periods each lasted 14 days with digesta sampling during the last three days of each experimental period. During each experimental period, the steers received one of the five following supplements: Control (no supplemental vitamin E); dl-alpha-tocopherol (free form), 2000 IU/day; dl-alpha-tocopheryl acetate (absorbate form), 2000 IU/day; dl-alpha-tocopheryl acetate (liquid form), 2000 IU/day; dl-alpha-tocopheryl acetate (spray dried form), 2000 IU/day¹. During the digesta sampling period, samples were collected simultaneously from the duodenum and rectum with a 12-h feeding interval between each of the six collections. Samples consisted of 500 ml of duodenal and about of 200 g fecal material. Digesta samples were lyophilized, extracted and analyzed for dl-alpha-tocopherol and for dl-alpha-tocopheryl acetate as described by Karimi and Owens (1988). Based on feed and digesta tocopherol concentrations and digesta flow rates calculated from chromium enrichment of digesta, ruminal and intestinal disappearance of each source of vitamin E was calculated. Means were compared statistically by Duncan's multiple range test.

Results and Discussion

Vitamin E flow to duodenal and fecal samples from the steers fed four different sources of vitamin E is presented in Table 1. For adult steers, the vitamin E concentration of duodenal samples was from highest to lowest for spray, absorbate, liquid, and free form. Fecal excretion by both young and adult steers ranked these sources, from highest to lowest, as liquid, spray, absorbate, and free.

For total tract disappearance of vitamin E (Figure 1), the availability of free form was high compared to the other three forms. This supports the suggestion that the free alcohol form may be more biologically active for animal cells (Parrish, 1980). However, disappearance in the tract also includes ruminal destruction.

¹Vitamin products provided by Hoffman LaRoche, Nutley, NJ.

Table 1. Vitamin E concentrations of duodenal and fecal samples from steers.

Animal and sample	Sources of vitamin E			
	Absorbate	Free	Liquid	Spray
Adult steers	IU/day/head			
Supplement	2000	2000	2000	2000
Duodenal	1202 ^{ab}	957 ^c	994 ^{bc}	1287 ^a
Fecal	316 ^c	209 ^d	682 ^a	597 ^b
Young steers				
Supplement	2000	2000	2000	2000
Fecal	386 ^a	120 ^b	407 ^a	394 ^a

a,b,c Means in the same row with different superscripts differ ($P < .05$).

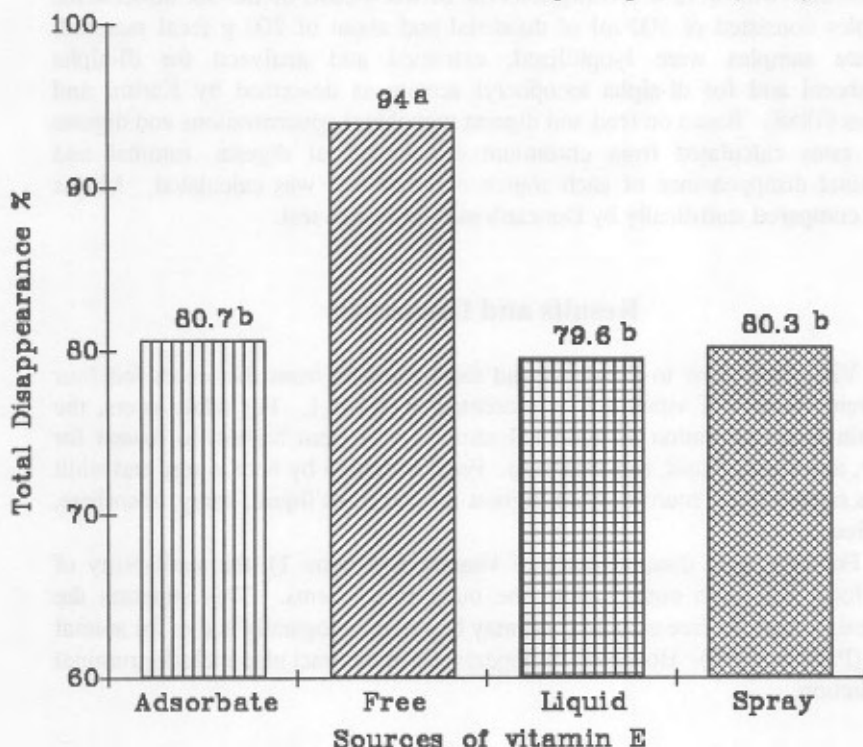


Figure 1. Total disappearance of vitamin E in young steers. Values with different superscripts differ ($P < .05$).

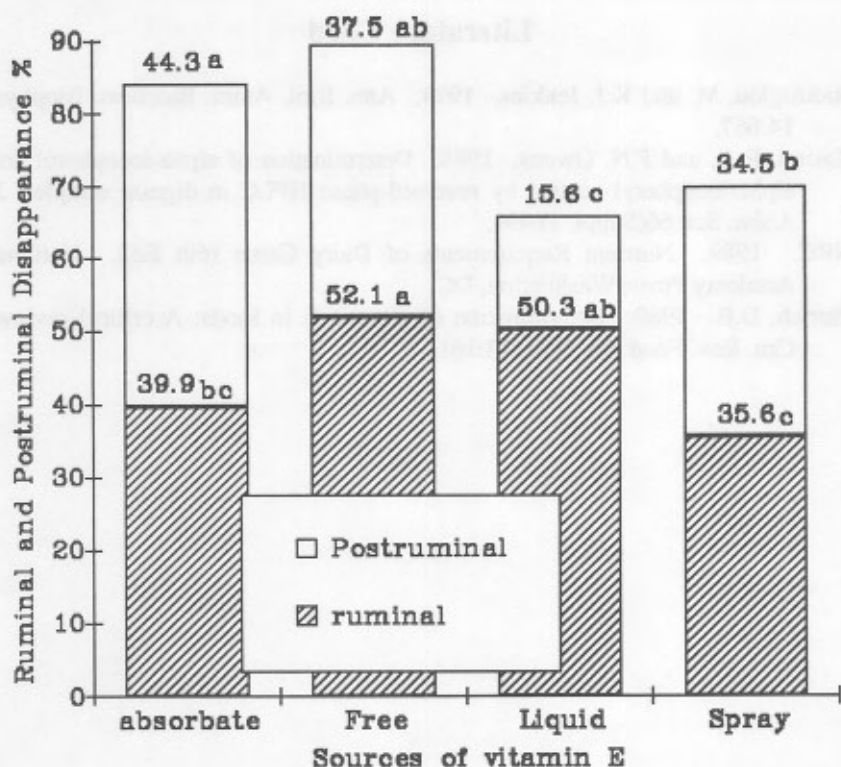


Figure 2. Ruminal and postruminal disappearance of vitamin E in adult steers. Values within location with different superscripts differ ($P < .05$).

The ruminal and postruminal disappearance of vitamin E from these four different sources are shown in Figure 2. Ruminal destruction of vitamin E from highest to lowest was free, liquid, absorbate, and spray form. This means that the postruminal supply of vitamin E from highest to lowest was spray, absorbate, liquid and free. Postruminal digestion, however, was lower for the liquid and spray forms making postruminal disappearance, an index of availability, equal to 44, 38, 34 and 16% for the absorbate, free, spray and liquid forms, respectively. The free form was readily available for destruction in rumen and absorption from the intestine whereas the absorbate form resisted ruminal attack but was available in the small intestine. The liquid form had the least availability in the small intestine. The spray form showed moderate destruction in the ruminal and absorption from the postruminal tract. Average availability of these four synthetic vitamin E in the small intestine of steers used in this study was 33%, in close agreement with the 30% value reported by NRC (1989).

Literature Cited

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