Differences in formulation and bioavailability of commercial injectable fat-soluble vitamin products.

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Introduction

- Cattle may benefit from an injection of fat-soluble vitamins during critical times when vitamin status may be low. After birth, feedlot arrival, prior to breeding or calving, and drought conditions are times to use injectable fat-soluble vitamins.
- Unlike vitamins A and D, vitamin E is not stored in tissues. Therefore, vitamin E is depleted more quickly.
- One product formula is marketed under several private labels with vitamin potencies similar to **VITAL E®-A+D**; however, bioavailability data for that product compared to **VITAL E-A+D** is unavailable.
- Injectable fat-soluble vitamins are utilized more rapidly and efficiently compared to a single oral dose provided the injected product is bioavailable.
- A pioneer injectable fat-soluble vitamin product (**VITAL E-A+D**) was introduced in 1989. The major difference between it and earlier products is the level and source of vitamin E (tocopherol vs tocopheryl acetate); level and source of vitamin A (retinyl palmitate vs retinyl propionate); and level of vitamin D.
- Several products labeled identical as the pioneer product are being marketed with no bioavailability data.
- Two experiments were conducted to measure serum vitamin E and vitamin A status of **VITAL E-A+D** (Stuart Products, Inc.) compared to **NATURAL EAD** (Neogen Corp.). Incoming feedlot calves and dairy replacement heifers were utilized in the experiments.

One mL of **VITAL E-A+D** contains
300 I.U vitamin E (d-alpha-tocopherol),
100,000 I.U. vitamin A (retinyl-palmitate), and
10,000 I.U. vitamin D (cholecalciferol).

One mL of **NATURAL EAD** contains
300 I.U vitamin E (d-alpha-tocopherol),
100,000 I.U. vitamin A (retinyl-propionate), and
10,000 I.U. vitamin D (cholecalciferol).

Methods

In experiment 1, randomly selected 130 kg feedlot calves (n= 5) were injected S.Q. with 5 mL **VITAL E-A+D** and others (n= 5) were injected S.Q. with **NATURAL EAD**. Serum samples were obtained prior to injection (initial) and d 1, 2, and 7 post-injection and analyzed for α-tocopherol and total vitamin A (retinol plus retinyl-esters).

To further define serum levels during the initial 24 h post-injection, experiment 2 was conducted. Holstein replacement dairy calves (n= 4) (200 kg) were injected S.Q. with 6 mL **VITAL E-A+D** and others (n=4) were injected S.Q. with 6 mL **NATURAL EAD**. Serum samples were taken initially and 4, 8, 12, and 24 h post-injection and analyzed for α-tocopherol, and total vitamin A.

Serum was analyzed for vitamin E (alpha-tocopherol) and vitamin A (retinol, retinyl palmitate and retinyl propionate) by Veterinary Diagnostic Laboratory, Iowa State University, Ames.

Paired t-test was used to determine differences between products.

Discussion

- Found dramatic differences in bioavailability between the two products in favor of VITAL E-A+D.
- Increase in vitamin A status was mainly due to increase in retinyl palmitate levels. Retinyl propionate was undetected in those cattle injected with retinyl propionate.
- The C_{max} for vitamin E was 8 hrs after injection of VITAL E-A+D.
- The C_{max} for vitamin A was 24 hrs after injection of VITAL E-A+D.
- The form of Vitamin A (retinyl propionate) used in Natural EAD was undetectable resulting in no improvement in serum status.

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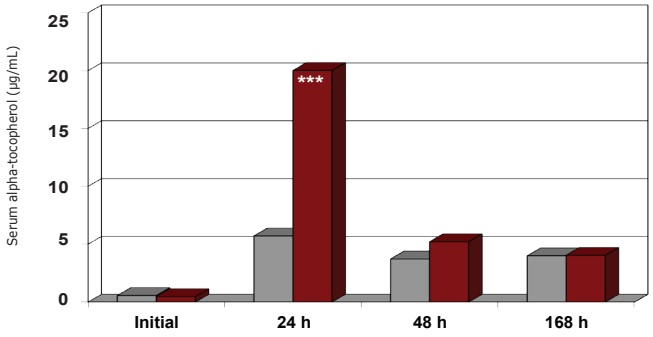
Results

Natural EAD VITAL E-A+D

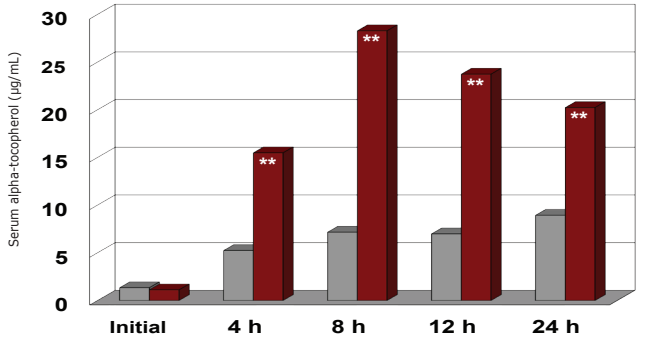
Vitamin E Status-Feedlot Calves



***P<0.001

Each value represents the mean of five calves injected S.Q. with either 5 mL VITAL E -A+D or Natural EAD

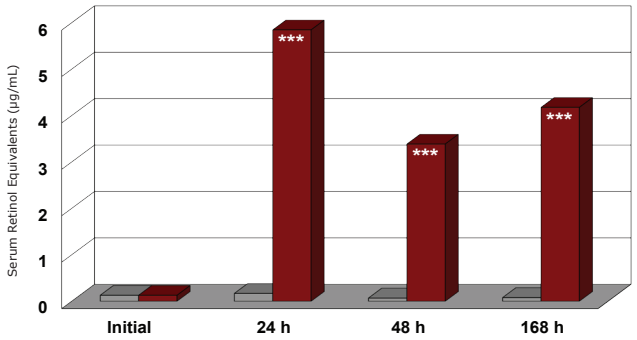
Vitamin E Status-Heifers



**P<0.01

Each value represents the mean of four calves injected S.Q. with either 6 mL VITAL E -A+D or Natural EAD

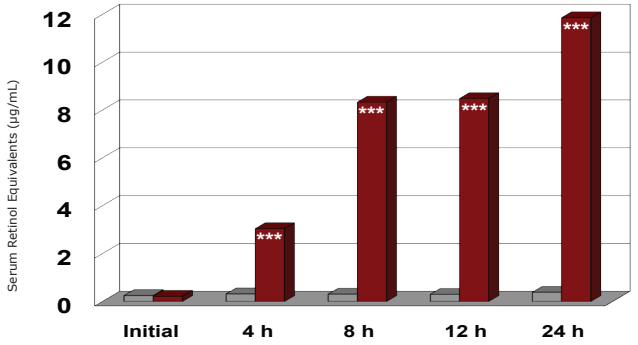
Vitamin A Status-Feedlot Calves



***P<0.001

Each value represents the mean of five calves injected S.Q. with either 5 mL VITAL E -A+D or Natural EAD

Vitamin A Status-Heifers



***P<0.001

Each value represents the mean of four calves injected S.Q. with either 6 mL VITAL E -A+D or Natural EAD

Conclusion

- Vitamin potencies on labels were similar, but bioavailability was not.
- Before utilizing injectable fat-soluble vitamins, be sure manufacturer can provide bioavailability data.
- VITAL E-A+D is an excellent injectable source of supplemental fat-soluble vitamins E, A and D.
- Retinyl propionate is not an appropriate injectable source of vitamin A.

Vitamin Potencies

1.83 µg retinyl palmitate = 1 µg retinol = 3.3 I.U. vitamin A

1 µg d-alpha tocopherol (RRR-alpha-tocopherol) = 0.00149 I.U. vitamin E

1 µg cholecalciferol = 40 I.U. Vitamin D

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