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## Circulating Plasma $\alpha$ -Tocopherol Following a Single Injection in a Black Rhinoceros (*Diceros bicornis*)

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**ABSTRACT:** Injectable all rac- $\alpha$ -tocopherol, at a dose of 12.4 IU/kg body mass, increased circulating levels of  $\alpha$ -tocopherol in the black rhinoceros (*Bicornis diceros*) from 0.18  $\mu$ g/ml to 1.47  $\mu$ g/ml within 2 hr. Although the plasma level peaked at Day one (13.07  $\mu$ g/ml) and dropped rapidly, substantial residual effects were seen even 10 days (1.50  $\mu$ g/ml) following a single injection. It appears that parenteral vitamin E administration may be suitable for therapeutic treatment of vitamin E deficiency in the black rhinoceros.

**Key words:** Black rhinoceros, *Diceros bicornis*, nutrition, vitamin E,  $\alpha$ -tocopherol, experimental study.

Circulating levels of  $\alpha$ -tocopherol (vitamin E) have been measured from both free-ranging and captive black rhinoceros (Dierenfeld et al., 1988; Ghebremeskel et al., 1988); significant differences between the two groups suggest that zoo animals may be vitamin E deficient. This investigation was undertaken to examine the efficacy of parenteral administration of vitamin E in raising and maintaining plasma  $\alpha$ -tocopherol levels.

A 25-mo-old female black rhinoceros (*Diceros bicornis*) weighing 466 kg was given a single intramuscular injection containing 5,760 IU (250 IU/ml) of all rac- $\alpha$ -tocopherol in an alcohol base (Hoffmann-LaRoche, Inc., Nutley, New Jersey 07110, USA). This animal had suffered severe head trauma at 3 wk of age, resulting in a large intramural cerebral hemorrhage and cerebral edema. Persistent central nervous system deficits from the injury included dysphagia, proprioceptive insufficiencies, and seizure-like activity. The animal required hand-feeding since the injury.

The rhinoceros consumed a diet of 6.8 kg commercial herbivore pellets (18% Zoo Chow Herbivore Diet, Nutrena Feeds, Cargill, Inc., Minneapolis, Minnesota

55440, USA) and 4.5 kg alfalfa cubes which were moistened and hand-fed daily. By manufacturer's analysis, the pellets contained 300 IU/kg vitamin E (as all rac- $\alpha$ -tocopheryl acetate) and 0.4 ppm Se (dry matter basis). In addition, the rhinoceros was supplemented orally with 2,000 IU vitamin E as d- $\alpha$ -tocopheryl acetate ("Super E," John Ewing Company, Lsalle, Colorado 80645, USA) daily by hand-mixing the powder into the moistened feed.

Blood samples were obtained immediately prior to injection, 2 hr, and daily (except Day nine) for 10 days postinjection. Samples were collected in heparinized tubes from the medial cephalic vein with the animal non-sedated in a standing position. Plasma was separated by centrifugation within 20 min of collection and stored at  $-70^{\circ}\text{C}$  until overnight shipment to the Animal Health Center for analysis by methods previously detailed (Dierenfeld and Dolensek, 1988).

Plasma  $\alpha$ -tocopherol levels measured are listed in Figure 1. The apparent deficiency of vitamin E in captive black rhinoceros parallels the findings of circulating levels of  $\alpha$ -tocopherol in captive Asian (*Elephas maximus*) and wild African (*Loxodonta africana*) elephants (Dierenfeld and Dolensek, 1988). In both rhinoceros and elephants, values are low compared to most ungulates. Feed supplementation with vitamin E has been shown to increase plasma  $\alpha$ -tocopherol in elephants, but only after long-term feeding of 1 to 2 yr (Dierenfeld and Dolensek, 1988). By extrapolation from elephants, and limited feeding studies with rhinoceros, it appears that dietary supplementation with  $\alpha$ -tocopheryl acetate may not be particularly effective in raising blood levels of this nutrient.

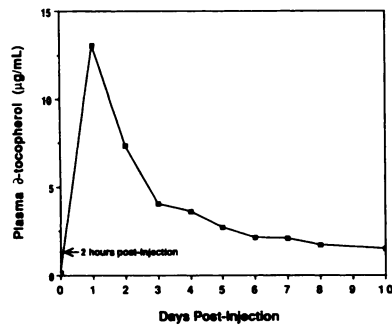


FIGURE 1. Circulating  $\alpha$ -tocopherol in a 466 kg black rhinoceros (*Diceros bicornis*) following a single intramuscular injection with 5,760 IU all rac- $\alpha$ -tocopherol.

Injection of  $\alpha$ -tocopherol, however, rapidly increased circulating plasma levels. In a study connected with three species of neonatal deer (Dierenfeld et al., 1987) injected with 10 IU/kg body mass of the identical product (Hoffmann-LaRoche, Inc., Nutley, New Jersey 07110, USA), blood elevations were short term. In these deer, plasma values peaked at 24 hr, but dropped to pre-injection levels by Day five. The rhinoceros in the current investigation received a similar dose (per unit body mass) of injectable  $\alpha$ -tocopherol, but plasma levels remained almost 10-fold higher than the pre-injection value when the study was terminated at Day 10. Whether the difference between responses of deer compared to the rhinoceros is due to species variation, or to physiological age and differences in cell metabolism between neonates and older animals, is unknown.

Vitamin E deficiency has been suggested, but not substantiated, as a contributory factor of hemolytic anemia in the black rhinoceros (Dierenfeld et al., 1988; Ghebremeskel et al., 1988). It is of interest to

note that owl monkeys (*Aotus trivirgatus*) with vitamin E responsive hemolytic anemia responded to injectable but not oral forms of  $\alpha$ -tocopherol (Meydani et al., 1982).

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