PLASMA KINETICS OF α-TOCOPHEROL IN DAIRY COWS WITH AND WITHOUT SUPPLEMENT OF VITAMIN E

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Introduction

The vitamin E concentration in the plasma of nonlactating cows is lower than that of lactating cows (Pehrson and Hakkarainen, 1988). The purpose of the present investigation was to study the plasma kinetics of α-tocopherol at low and high plasma levels of vitamin E.

Materials and Methods

The experiment was carried out with rumen fistulated cows, two nonlactating and two lactating, in two consecutive four week periods. To produce different concentrations of α-tocopherol in the plasma, in period 1, no supplement was used and in period 2, a supplement of 5 g dl-α-tocopheryl acetate per cow was given as vitamin E-50% powder in a gelatine capsule daily at 08.00 h into the rumen. In each of the periods the cows were injected intravenously (i.v.) a single dose of 231.5 mg dl-α-tocopherol as a 5% mixed micelles solution into the jugular vein. In period 2, the i.v. injection was given when reaching the new plateau of the α-tocopherol concentration in the plasma. Blood samples were taken on four days before each i.v. injection at 08.00 h to determine the baseline plasma concentration of α-tocopherol and at regular time intervals after i.v. injection from 0.25 min. to 144 h. The samples were collected from the jugular vein in heparinized tubes, centrifuged, stored at −20°C and analysed for α-tocopherol by high-performance liquid chromatography (Vuilleumier et al., 1983). All calculations were based on the increase in plasma concentration (difference between baseline and measured value). The terminal elimination rate constant (k_{el}) was calculated using the logarithms of the measured values. The area under the plasma concentration time curve (AUC) was calculated by the trapezoidal rule for a 144 h period after injection. In period 2 the corresponding AUC values after the multiple dosage regime were calculated for the dosing interval of 24 h starting from the baseline concentration of period 1.

Results and Discussion

In both periods the baseline plasma concentrations of α-tocopherol for the nonlactating were lower than for the lactating cows (table 1). The daily supplement of 5 g dl-α-tocopheryl acetate in period 2 increased the plasma concentration by a factor of between 2.3 and 3.2.

TABLE 1. PLASMA α-TOCOPHEROL CONCENTRATION (mg/l) AFTER i.v. INJECTION OF 231.5 mg DL-α-TOCOPHEROL WITH OR WITHOUT SUPPLEMENT OF DL-α-TOCOPHERYL ACETATE

	Supplement (g)	Cow A dry	Cow B dry	Cow C lactating	Cow D lactating
Baseline conc.	0	3.1	2.9	5.5	6.1
Conc. at 144 h	0	3.4	3.0	6.2	5.7
Max. increase	0	10.7	25.8	15.6	15.9
Baseline conc.	5	9.9	6.8	15.4	16.0
Conc. at 144 h	5	9.3	6.2	14.1	15.1
Max. increase	5	11.7	20.5	10.6	0.7*

*No i.v. injection.

The maximum increase of α-tocopherol in the plasma after i.v. injection was similar with or without supplement. No increase in the plasma concentration of α-tocopherol was observed in period 2 for cow D (table 1), because the i.v. injection failed. The time required to reach the maximum increase in plasma concentration was always less than 1 minute. The maximum increase for each cow was different but no trend in the differences between the nonlactating and lactating cows could be seen. The plasma concentration of α-tocopherol reached the baseline within 144 h after the i.v. injection in both periods.

In table 2 the calculated kinetic values for the time after the i.v. injection are shown for period 1 and 2. For cow C in period 1 (no supplement) a higher AUC value and a lower k_{el} were calculated resulting in a longer terminal elimination half-life ($t_{½}$) than for the other cows, for which the values were similar. The AUC values calculated after the i.v. injection in period 2 (vitamin E supplement) were different between the cows. There was no trend in the differences between the AUC values for period 1 and period 2.

The maximum increase of α-tocopherol concentration in the plasma after i.v. injection was similar

TABLE 2. KINETIC VALUES AFTER i.v. INJECTION OF 231.5 mg DL-α-TOCOPHEROL WITH OR WITHOUT SUPPLEMENT OF DL-α-TOCOPHERYL ACETATE

	Supplement (g)	Cow A dry	Cow B dry	Cow C lactating	Cow D lactating
AUC ($mg \cdot h \cdot l^{-1}$)	0	144	156	233	155
k_{el} (/h)	0	0.0173	0.0225	0.0100	0.0255
$t_{½}$ (h)	0	40	31	70	27
AUC ($mg \cdot h \cdot l^{-1}$)	5	184	104	260	–*
k_{el} (/h)	5	0.0693	0.2830	0.0408	*
$t_{½}$ (h)	5	10	3	17	–*

*No i.v. injection.

in both periods (table 1), although the plasma concentrations in period 2 were enhanced by a maximum factor of 3.2. In contrast, the decrease of the plasma concentration in period 2 was faster than in period 1 for all cows; this was reflected in a higher k_{el} and a shorter $t_{½}$ (table 2). The calculated values for k_{el} and $t_{½}$ in period 2 possibly did not represent the same terminal phase as for period 1, because of the faster decline in plasma concentration and the longer intervals between blood sampling at the end of each period.

Nevertheless the results of the present investigation suggest that higher plasma concentrations, caused by a supplement of vitamin E, resulted in an increased elimination rate of α tocopherol in the blood plasma.

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(**Key Words:** Vitamin E, Plasma Kinetics, Cows)

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