Serum Response of Ponies to β-Carotene Fed by Grass Meal or a Synthetic Beadlet Preparation with and without Added Dietary Fat

Ellen Kienzle,* Christine Kaden, Peter P. Hoppe* and Birgit Opitz
Institute of Physiology, Biochemistry and Animal Nutrition, Ludwig-Maximilians-University Munich, Munich, Germany and *Nutrition Research BASF, Offenbach, Germany

EXPANDED ABSTRACT

β-Carotene as a feed additive has been added to diets for horses because of potential effects on ovarian function. It was suggested that β-carotene might replace vitamin A as an additive in high-quality concentrate mixtures for horses to avoid excessive vitamin A intake when horses eat large quantities of such concentrates. Two working groups using a water-dispersible β-carotene preparation found negligible absorption, and consequently no effect on vitamin A status (1,2). However, others (3,4) reported evidence for the bioavailability of β-carotene as a feed additive. In our study we compared the serum response to β-carotene from a synthetic beadlet preparation (Lucarotin™; BASF, Ludwigshafen, Germany) and from grass meal. Both carotene sources were fed with and without added sunflower oil.

MATERIALS AND METHODS

Four adult ponies (222–345 kg body weight) were fed a diet that was practically free of β-carotene for 3 mo (washout period, Table 1). Thereafter, each pony received in a 4 × 4 Latin square design each of four dietary treatments containing β-carotene, either from grass meal or from the synthetic preparation, with or without sunflower oil. The study was approved by the Regierung von Oberbayern, according to German laws on animal welfare (Deutsches Tierschutzgesetz). The diets were designated: grass meal, grass meal/oil, beadlet and beadlet/oil (Table 1), and given to the horses for 4 wk. Each diet was followed by a washout period of 4 wk before the ponies were rotated to the next diet. Blood samples were taken (jugular vein, 2.5 h after the morning feeding) at wk 1 and wk 4 of each trial and of each washout period. Serum was prepared (avoiding exposure to light) and stored at −20°C until analyzed by the method described elsewhere (5,6). Briefly, samples were saponified, extracted under nitrogen and taken up in n-hexane: dioxane (100:1, v/v) as the mobile phase. Separation was by HPLC using a Lichrosorb SI 60 column and a UVI detector set at 436 nm. Serum triglycerides were analyzed by the GPO-PAP method and cholesterol by the SCHOD-PAP method using a Hitachi 717 autoanalyzer (Merck-Hitachi, Darmstadt, Germany). Results were tested for homogeneity and analyzed by repeated-measures analysis (Proc GLM; SAS Institute, Cary, NC). Means and SEM were calculated. Analysis of variance did not indicate any significant differences (P < 0.05) or interactions between the different experimental periods. Therefore only comparisons of two means were required, such as comparisons between the means of each experimental period and its preceding washout period. Two means were compared by a paired t-test (P < 0.05 was considered a significant difference).

RESULTS AND DISCUSSION

The serum β-carotene concentrations at the end of each treatment and the preceding washout periods are presented in Figure 1. The serum levels were significantly higher during the treatment periods than during the washout periods; however, there were no significant effects of the source of carotene or the inclusion of sunflower oil. The significant response to β-carotene was apparent after 1 wk of feeding (results not shown). The addition of oil led to a reduction in serum cholesterol from 3.24 ± 0.28 to 2.33 ± 0.13 mmol/L. There was a similar tendency in serum triglycerides with oil, but the difference was not significant (0.48 ± 0.14 mmol/L without oil; 0.38 ± 0.10 mmol/L with oil addition).

The similar increase in serum β-carotene concentration demonstrates that both sources of β-carotene were bioavailable, and there was no difference in the efficiency of absorption of β-carotene from either source. This observation supports the work of Eitzer and Rapp (3) and Klent (4), who used synthetic beadlet preparations. However, it is at variance with the results of Watson et al. (1) and Grewe-Crandell et al. (2), who reported that water-dispersible beadlet preparations, which are generally considered of high bioavailability, did not result in an elevation of plasma concentration. These discrep-

1 Presented as part of the Waltham International Symposium: Pet Nutrition Coming of Age held in Vancouver, Canada, August 6–7, 2001. This symposium and the publication of symposium proceedings were sponsored by the Waltham Centre for Pet Nutrition. Guest editors for this supplement were James G. Morris, University of California, Davis, Ivan H. Burger, consultant to Mars UK Limited, Carl L. Keen, University of California, Davis, and D’Ann Finley, University of California, Davis.

2 Supported by BASF, Offenbach, Germany.

3 To whom correspondence should be addressed.

E-mail: kienzle@tiph.vetmed.uni-muenchen.de.

1774S
ant findings cannot be explained. However, they may relate to the rapid rate of passage of water and water-soluble nutrients through the stomach and the small intestine of the horse. According to Mueller (7), the prececal passage of water can be as short as 0.5 h. This might not allow sufficient time to absorb significant amounts of β-carotene from water-dispersible preparations.

In our study there was no effect of oil on the β-carotene response of serum, an observation in agreement with that of other investigators (8). It appears that the crude fat content in normal horse feeds (about 2 g/kg dry matter) is sufficient to mediate β-carotene absorption. On the other hand effects of oil in facilitating the transfer of β-carotene to micelles and effects on plasma lipids may lead to a net result of unchanged serum levels of β-carotene.

LITERATURE CITED


