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VARIABILITY OF VITAMIN E CONCENTRATION IN CAMEL PLASMA

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ABSTRACT

In the present study, variability of plasma α-tocopherol was reported in different groups of camels (non-lactating and non-pregnant, pregnant, lactating and their new-born, young, selenium intoxicated young camels). The mean values in the different groups were 1.13 ± 0.61 µg/ml (non-lactating and non pregnant), 1.12 ± 0.81 µg/ml (pregnant), 1.20 ± 0.80 µg/ml (lactating), 0.82 ± 1.06 µg/ml (new-born), 0.56 ± 0.22 µg/ml (young) and 0.68 ± 0.36 µg/ml (intoxicated young). There was no significant change in the time. Those values appeared lower than in plasma of other ruminants, but the effect of vitamin E supplementation was not known in camel.

Key words: Camel, lactating, plasma, pregnancy, selenium intoxication, vitamin E

Vitamin E (α-tocopherol) has long been recognised as a natural biological antioxidant. Vitamin E appears to be the first line of defense against peroxidation which can severely damage the cell and tissues. Vitamin E is also an essential component in the reproduction processes and performance of farm animals and acts in synergy with the selenium (Se), especially in order to prevent white muscle disease (WMD) due to a severe deficiency. In camel, recent studies showed the effect of selenium supplementation to improve the Se status of the animals (Seboussi *et al,* 2008 and 2009), especially in the young camel calves which are highly susceptible to WMD, a very common disease in the Gulf countries (Al-Qarawi *et al,* 2001; El-Khouly *et al,* 2001; Seboussi *et al,* 2004). However, neither the interaction with vitamin E, nor the variability of vitamin E status according to the age and physiological stage, were studied in camel.

The present paper aims to study vitamin E variability in camel blood according to the different status of the animals (new born, young, non-lactating and non pregnant females, pregnant females, lactating females and Se intoxicated animals).

Materials and Methods

Animals and feeding

The study was carried out at Al-Foha experimental farm belonged to the Food and Agriculture College of the UAE University. It included 4 groups of animals:

I. Group NLNP: It included 12 non-lactating and non-pregnant 6 to 13 years old female camels of local breed. The approximate mean weights were 430 kg. The animals were monitored for 225 days. For the whole trial, the animals were fed individually with approximatiely 6 kg of Rhodes grass (*Chloris gayana*) hay and 2 kg of concentrates with known vitamin E content. The refusals were daily weighed and the quantity of grass adjusted to the mean intake. There was no concentrate refusal.

II. Group PFC: It included 12 pregnant females (more than 7 years old) and their new born camel calves after parturition. All the females were pregnant at the beginning of the trial. The trial started approximately 3 months before the parturition and stopped 3 months after the parturition, i.e. 195 days. They received approximately 5.5 kg of Rhodes grass (*Chloris gayana*) hay and 2 kg of concentrates with known vitamin E content.

III. Group YFC: It included 8 young female camels less than 2 years old. For the whole trial, 70 days length, the animals were fed individually with a similar diet composed of 3 kg DM of Rhodes grass *(Chloris gayana)* hay and 2 kg of concentrates (pellets) containing 10% protein and with known vitamin E content.

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IV. Group ISe: It included 12 young 2-yr old males and females, which were Se intoxicated. They received similar diet than YC group, but received 12 mg Se daily under selenite form, which was considered as toxic dose for camel (Faye and Seboussi, 2008).

All, the animals were treated for external and internal parasites using ivermectin (Ivomec N.D.) and were in good health during the whole experiment, or at least at the beginning of the trial for the group ISe. The animals were provided water *ad libitum.*

Blood and feed sampling

The blood sampling was carried out in the morning before feed distribution. In group NLNP, blood sampling was performed every week (20 samplings). In group PFC, the blood sampling was carried out twice a month in the morning before feed distribution in adult (17 samplings) and young camels (7 samplings). A camel calf's blood sample was taken at the moment of delivery prior to colostrum feeding to evaluate the vitamin E status at birth. For group YFC, a weekly blood sampling was achieved (10 samplings). For group ISe, 7 blood sampling was collected every 2 weeks before food distribution and selenium supplementation.

In all the animals, blood was collected from the jugular vein in both heparinised (H) and nonheparinised tubes (NH). Two tubes of H and NH were transferred to Alqatara veterinary laboratory (agriculture and municipalities department – AbuDhabi) for haematology and biochemistry analysis. From the H tube, 2 ml of whole blood was collected, centrifuged, plasma was removed and stored at -80°C until vitamin E analysis.

The elements of the basal diet were sampled at the beginning, the mid and at the end of the trial; dried, ground and stored for vitamin E analysis.

Laboratory analysis

Vitamin E quantification in plasma was performed by High-Performance Liquid Chromatography (HPLC) system. For vitamin E determination, 1-ml samples of plasma were extracted using one time the sample volume of ethanol and 2 times the sample volume of hexane. Vitamin E was measured in the extracts as α-tocopherol by HPLC using a 3.9 x 150-mm silica column and UV detection at 292 nm. The mobile phase was hexane/chloroform (85/15) with isocratic elution (Hatam and Kayden, 1979). Selenium was determined in serum from the group ISe. The Se determination in different samples was done by Inductively Coupled argon Plasma – Atomic Emission Spectrometer (ICP AES), Varian Vista MPX – CCD Simultaneous.

In plasma, the other mineral parameters studied were trace elements, i.e. copper, zinc and iron. The following biochemical parameters were determined in the serum: glucose, creatinine, total proteins, albumin, bilirubin, creatine phosphokinase (CPK), alkaline phosphatase (AP), alanine aminotransferase (ALT), aspartate aminotransferase (AST), lactate dehydrogenase (LDH) and gamma glutamyl transferase (GGT). The haematological parameters analysed in routine included haematocrit, WBC, haemoglobin, and blood formula (WBC/N, WBC/L, WBC/M, and WBC/E for neutrophil, lymphocyte, monocyte and eosinophil percentages, respectively).

Statistical Analysis

Descriptive analyses (mean and standard deviation) were used to give raw results. Variance analysis on repeated measures was carried out using the R software. Previously, normality of the distribution was tested by the Skewness and Kurtosis test (test W). Interactions between other elements (minerals and biochemical parameters) and between mother and camel calf parameters were tested by the correlation of Pearson. Significant level at $P < 0.05$ was retained.

Results

The vitamin E content was 5.5 µg/g in the Rhodes grass and 0.96 µg/g in concentrate, and did not change all along the duration of the trials. The diets provided 35 µg per day on average in group NLNP, 32 µg/day in group PFC, and 18.4 µg/day in groups YCF and ISe. It was the only source of vitamin E for the animals.

Vitamin E concentration in camel plasma varied between 0.002 and 4.86 µg/ml with a mean of 0.976 ± 0.672 µg/ml. There was a significant difference

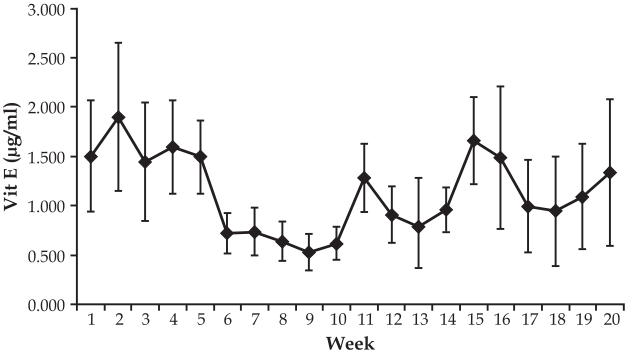

Fig 1. Weekly change in vitamin E content in serum in non-lactating, non-pregnant adult female camel (mean and S.D in µg/ml).

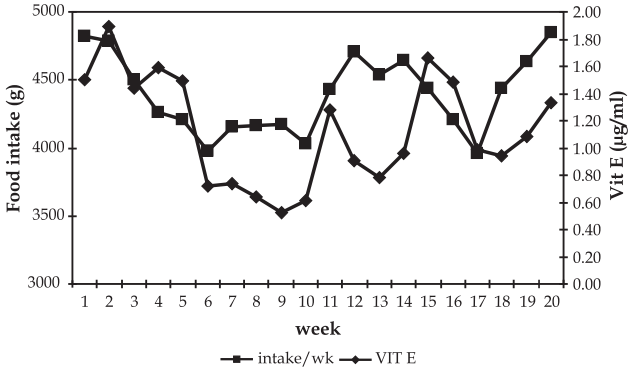

Fig 2. Weekly change in vitamin E concentration in plasma (in µg/ml) (♦) and food intake (in kg DM) (■) all along the trial. Each point for food intake is the mean of the daily intake in the week before blood sampling.

(P <0.001) between the adult animals from the first 2 groups (1.13 ± 0.69 µg/ml), the newborn animals (0.75 ± 0.89 µg/ml) and the 2-yrs young camels (0.62 ± 0.30 µg/ml).

Change of vitamin E in non-lactating, non pregnant camels

The vitamin E (α-tocopherol) level in plasma was 1.13 ± 0.61 µg/ml with a range of 0.27-3.09. The values from weeks 6 to 14 (except week 11) were significantly lower than other weeks (Fig 1). The maximum mean value observed was at week 2 (1.92 µg/ml). The variability of vitamin E content in plasma is linked to total food intake (Fig 2). The correlation between the total food intake, measured as the mean of the daily food intake during the week before blood sampling, and vitamin E concentration in plasma was significant (r = 0.46; P<0.05).

Change of vitamin E in pregnant and lactating camel and their newborns

The average vitamin E content was 1.16 ± 0.81 µg/ml for the entire experiment with no difference between the pre-calving (1.12 ± 0.81 µg/ml) and post-calving period (1.20 ± 0.80 µg/ml). A slight non-significant decrease was observed at the peripartum time (Fig 3).

In camel calf, vitamin E level was lower than in the mother, and varied from 0.002 to 4.67 µg/ml with a mean of 0.82 ± 1.06 µg/ml. The plasma vitamin E was significantly higher (P < 0.05) at the second month of lactation. No correlation was observed between vitamin E concentration in she-camel plasma and its newborn plasma.

Change of vitamin E in young camel

In a 2 year-old, young camel the vitamin E concentration in plasma was quite lower than in

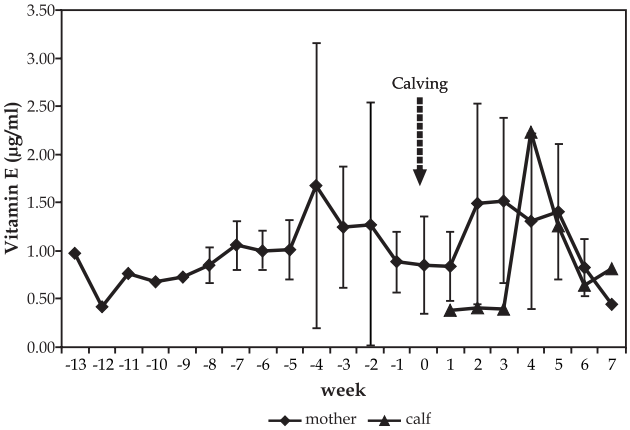

Fig 3. Change in vitamin E plasma concentration in she-camel at the end of gestation and at the beginning of the lactation of she-camel ("mother") and in camel calf (in µg/ml).

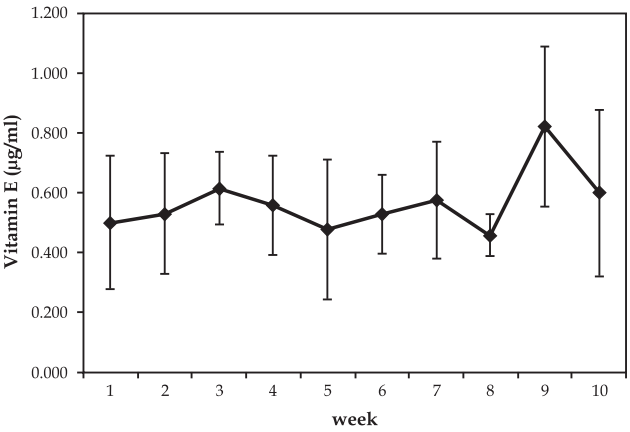

Fig 4. Weekly change in vitamin E concentration (µg/ml) in young camel.

adult with value of 0.56 ± 0.22 µg/ml. There was no significant variation in the time (Fig 4).

Change in selenium intoxicated camel

The plasma vitamin E in Se intoxicated camels was on average 0.68 ± 0.36 µg/ml and varied between 0.20 and 1.56 µg/ ml (n=69). There was a significant time difference (Fig 5) with the highest values observed on the second month of Se supplementation and the lowest at the end of the trial. After one month, the first sign of chronic selenosis appeared. A tendency to the decrease of vitamin E in intoxicated animals with clinical signs was observed but no significant correlation was reported with the serum Se concentration.

Correlation with other blood parameters

By taking in account all the groups of camels, 4 parameters of the blood components were correlated to the vitamin E concentration, i.e. PCV, haemoglobin,

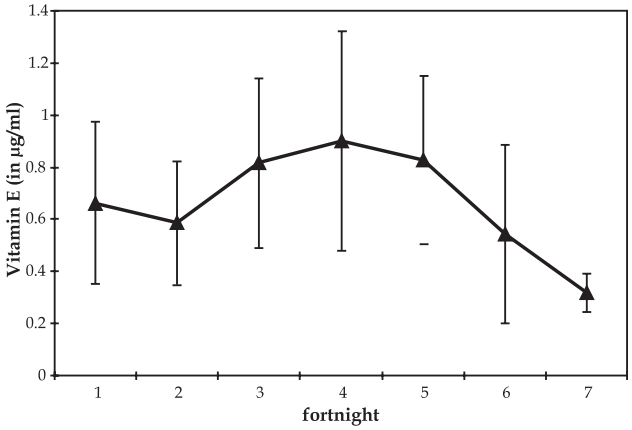

Fig 5. Change in vitamin E (µg/ml) concentration in young camels intoxicated with 12 mg/day Se under sodium selenite.

lymphocytes and eosinophils (Table 1). Among the biochemical parameters, glucose, creatinine, albumin and iron were positively correlated while the lactate dehydrogenase was negatively correlated.

Discussion

The vitamin E concentration in camel plasma in our results was quite similar to those described in the literature; for example 0.3 to 1.65 µg/ml in young camels from Sudan (Barri and Al-Sultan, 2007). Similar results were reported by Al-Senaidy (1996) and Mousa *et al* (2006). In cow, the normal vitamin E concentration was reported to be above 2 µg/ml (Maas *et al,* 1990). In cows, values below 2.5 µg/ml were considered by different authors as a deficient status in vitamin E (Pehrson and Hakkarainen, 1986; Braun *et al,* 1991; Radostits *et al,* 1995). According to different diets, the plasma concentration of vitamin E in dairy cow receiving 200 g of vitamin-mineral mixture containing 1300 IU/kg of vitamin E, varied from 3.3 to 5.14 µg/ml (Calderon *et al,* 2007a). According to LeBlanc *et al,* (2004), the optimum plasma concentration of α-tocopherol for mammary cell immune function was 3.5 to 4.0 µg/ml. Thus, the vitamin E concentration in camel plasma from our study appeared quite lower compared to cow's plasma (Nozière *et al,* 2004).

Table 1. Significant correlation coefficients and their p value between vitamin E concentration in blood and some blood parameters.

Parameters	Vit E	p value
PCV	0.157	0.000
Haemoglobin	0.158	0.000
Lymphocyte	-0.137	0.001
Eosinophil	0.161	0.000
Glucose	0.090	0.032
Creatinine	0.125	0.003
Albumin	0.195	< 0.0001
LDH	-0.088	0.036
Iron	0.093	0.026

In camel, the vitamin E was predominating in the plasma and in the hump i.e. according to 50 mg Al-Senaidy (1996). On apparent deficient camels, an average of 9 ± 0.19 to 2.01 ± 0.18 µg/ml was reported by Mohamed (2004).

The lower level of vitamin E in plasma of newborn animals compared to the mother was already observed in dairy cow, as well as the decrease of vitamin E concentration in blood at the calving period (Calderon *et al,* 2007b). The amplitude of this decrease was approximately of 50% from 3 weeks before calving up to calving time both for cow (Calderon *et al,* 2007b) which was similar to results in camel.

The absorption of vitamin E (α-tocopherol), a fat-soluble vitamin, decreases when the diet is rich in polyunsaturated fatty acids. The camel calf was fed with milk containing similar content of vitamin E than in cow's milk (Farah, 1992). The camel milk contains high proportion of polyunsaturated fatty acids as compared to cow (Konuspayeva *et al,* 2008). This peculiarity of camel milk could stress its low efficiency to maintain high level of vitamin E intake for the camel calf.

In most of the studies on camel, there was no correlation between selenium and vitamin E plasma concentration (Seboussi *et al,* 2008 and 2009). However, a high level of Se seemed to depress the vitamin E level in plasma as it was recently observed in horses affected by selenosis (Crain, 2007). Selenium and vitamin E are both antioxidants, both protecting the membranes from oxidative damage. Due to this shared duty, there is a relationship between the compounds, in which one can substitute for the other in a very small way. For instance, more Se is needed when an animal's vitamin E concentrations are low. The sparing effect is an extension of this idea of substitution. In lambs, sodium selenite administration resulted in decreased liver vitamin E concentration (Tiwary *et al,* 2006). The vitamin E concentration in serum appeared at a lower level in camel as compared to other ruminants.

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