Chapter 7

The Effect of Habitual Diet on L-ascorbic Acid Concentrations in Plasma and Leukocytes of Sudanese Camels

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Abstract

There is suggestive evidence that a low status of ascorbic acid in camels enhances their risk for infectious diseases. This study was carried out to find clues as to the role of diet in affecting ascorbic acid status. In a cross-over trial with feeding periods of three weeks, six camels (*Camelus dromedarius*) were fed either a composite of their habitual diet or alfalfa. The simulated habitual diet contained grass (hummra), *Acacia mellifera* and *Blepharis persica*. The habitual diet significantly lowered ascorbic acid concentrations in plasma and leukocytes. It is concluded that camels kept on natural desert vegetation may not have optimal disease resistance due to a diet-induced low ascorbic acid status.

Introduction

We have shown in camels, kept under natural grazing conditions in Sudan, that parasite infections are associated with low ascorbic acid status [1]. It is likely that the parasite infections had lowered ascorbic acid status. In sheep, infection with *Fasciola hepatica* produced a decrease in plasma ascorbic acid concentrations [2]. In non-ruminants it has been shown that dietary supplements of ascorbic acid provide disease resistance [3]. Thus, a low status of ascorbic acid may enhance the risk for contracting infectious disease.

In ruminants, even though they are able to synthesize vitamin C from glucose, the composition of the ration could influence the concentration of plasma ascorbic acid. Kolb et al. [4] showed that values of liver ascorbic acid in bulls and oxes were highest in December when they were kept inside and fed a stall ration. Thus, there might be an effect of diet on vitamin C metabolism in ruminants. It is possible that camels consuming their habitual diet and kept under practical conditions have a diet-dependent ascorbic acid status. To test this possibility the present experiment was carried out.

Materials and methods

Six non-pregnant, non-lactating female Arabi camels (age, 10.3 ± 1.7 years; mean ± SD) with a mean body weight of 450 kg (SD = 24.5) were used. Prior to the commencement of the experiment, the camels were injected intramuscularly with oxytetracycline hydrochloride (10 mg/kg body weight) and subcutaneously with antiparasite medication (Ivomec, 200 mg/kg body weight). The experiment was carried out during the dry season at the Camel Research Centre at Elshowak, southeast of Khartoum. The maximum and minimum temperatures during the study were 31 and 18 °C and relative humidity was between 17 and 61 %. The camels were individually housed in steel pens with sand as bedding.

The trial had a cross-over design with three camels per treatment sequence. Each dietary treatment lasted three weeks. All camels went through a 14-day pre-experimental period during which they were fed green alfalfa (*Medicago sativa L.*) as sole source of nutrition. The alfalfa was obtained from a local market and fed in fresh form. Each camel received 5 kg dry matter of alfalfa twice a day at 7 a.m. and 2 p.m. The habitual diet was simulated by a mixture consisting of fresh *Acacia mellifera*, *Aristidia funiculata* (hummra) and *Blepharis persica* in a 2:1:1 ratio on as fed basis. The composition of the habitual diet was based on field observations. Each camel received 5 kg dry matter of the mixture two times a day. Water was freely available. During the experiment, the camels were either fed
alfalfa or the habitual diet. Initial body weight of each camel was measured immediately after its arrival with the use of a balance. At the end of the feeding periods, body weights were also determined.

The macronutrient composition of the feedstuffs was analysed according to the Weende methods. Blood samples were collected and processed as described [1]. Plasma and leukocyte vitamin C levels were determined according to Behrens and Madere [5].

Student’s paired t-test was used to identify a diet effect. The level of significance was pre-set at P < 0.05.

Results
Table 1 shows the analysed composition of the alfalfa and the calculated composition of the habitual diet.

Table 1. The macronutrient composition of the two rations

<table>
<thead>
<tr>
<th></th>
<th>Alfalfa ration</th>
<th>Habitual diet</th>
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<tbody>
<tr>
<td>Dry matter, g/kg diet</td>
<td>956</td>
<td>872</td>
</tr>
<tr>
<td>Crude protein, g/kg dm</td>
<td>173</td>
<td>114</td>
</tr>
<tr>
<td>Crude fiber, g/kg dm</td>
<td>287</td>
<td>328</td>
</tr>
<tr>
<td>Crude fat, g/kg dm</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>Ash, g/kg dm</td>
<td>123</td>
<td>102</td>
</tr>
<tr>
<td>Nitrogen-free extract, g/kg dm</td>
<td>388</td>
<td>427</td>
</tr>
</tbody>
</table>

1 Mean for 4 samples of each diet component  
2 dm = dry matter

When the camels were consuming the simulated habitual diet, they ingested somewhat more crude fiber and less crude protein than when they ate the alfalfa diet.

The two diets were consumed completely throughout the experiment. There was no influence of dietary treatment on body weight. At the end of the experiment, body weight was 450 ± 27.5 kg (n=6).

At the end of the pre-experimental period, plasma and leukocyte ascorbic acid concentrations were 4.23 ± 1.04 µg/ml and 43.2 ± 3.97 µg/ml, respectively (means ± SD, n=6). Table 2 shows that the habitual diet produced a significant decrease in plasma and leukocyte ascorbic acid levels.

Table 2. Ascorbic acid concentrations in plasma and leukocytes of camels fed the two rations

<table>
<thead>
<tr>
<th>Ascorbic acid</th>
<th>Alfalfa ration</th>
<th>Habitual diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma (µg/ml)</td>
<td>5.39 ± 1.11</td>
<td>3.90 ± 0.97*</td>
</tr>
<tr>
<td>Leukocytes (µg/ml)</td>
<td>46.17 ± 3.85</td>
<td>39.85 ± 3.97*</td>
</tr>
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</table>

Means ± SD, n=6.  
*Habitual versus alfalfa diet: P < 0.05.
Discussion

The current study shows that the type of diet influences blood plasma and leukocyte vitamin C levels in camels. Our results are consistent with those of Rasmussen et al. [6], showing that a ration rich in alfalfa hay raised the plasma ascorbic acid values in lambs. In an other study with lambs there was no effect of ration on blood vitamin C [7]. In a study using Rahmani rams, Abdelhamid et al. [8] revealed that a ration containing clover hay, rice straw and concentrate resulted in an increase in plasma vitamin C.

It is clear that the composition of the diet might affect vitamin C status in ruminants, including camels. The design of the studies does not give information as to specific feedstuffs and/or nutrients affecting vitamin C metabolism. A diet change may influence ascorbic acid synthesis and/or excretion, but the mechanisms remain obscure. This study shows that Sudanese camels kept under natural grazing condition may have a diet-induced, low vitamin C status. As a consequence, these camels may not have optimal disease resistance [3].

References