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Plasma Vitamin C Concentrations in Nubian and Saanen Goats During Pregnancy and Lactation

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Abstract: Plasma vitamin C concentrations were determined in Saanen and Nubian goats kept in Sudan and while they were either pregnant or lactating. The plasma vitamin C concentrations were lower during pregnancy than during either pre-pregnancy or lactation. The concentrations were lower in the Saanen than in the Nubian goats. Vitamin C concentrations in milk from the Saanen goats were lower than in milk from the Nubian goats, but absolute excretion was higher in the former breed. Saanen kids had lower plasma vitamin C concentrations than Nubian kids. It is suggested tentatively that the low vitamin C status of the Saanen goats during pregnancy is associated with less resistance to disease.

Key words: Nubian goats; Saanen goats; Pregnancy; Lactation; Vitamin C

Introduction

Ruminants are able to synthesize ascorbic acid (vitamin C) in the liver and thus do not require dietary supplementation (Hornig *et al.*, 1984). However, under conditions such as high environmental temperature, overcrowding, transportation and disease, ruminants show a decline in ascorbic acid status (Hidiroglou *et al.*, 1977). The Swiss Saanen goat, which excels in milk production, was introduced into Sudan in an attempt to upgrade the local Nubian goats, which generally has low milk production. It could be suggested that under harsh desert conditions plasma ascorbic acid contents in exotic breeds of goats are lower than in their local counterparts. The suggestion was tested in the present study. It was shown earlier in Sudanese camels that plasma vitamin C concentrations fell during pregnancy and rose during lactation above levels seen in non-pregnant animals while in the non-estrus phase (Mohamed, 2002). Thus, we decided to compare plasma vitamin C concentrations in Nubian and Saanen goats kept in Sudan and while they were either pregnant or lactating.

Materials and Methods

Animals, management and feeding: Multiparous Nubian and Saanen goats, aged 2-2.5 years, were used. There were 12 animals of each breed. The goats were bred within the framework of a gene-upgrading project. They were kept in individual pens. The diet consisted of fresh alfalfa and sesame cake. Feed was generally consumed within 2 h of provision. The animals had free access to water. When the goats were in estrus they were artificially inseminated with semen from a male of the same breed. Pregnancy was confirmed by non-return to estrus and by plasma progesterone concentrations > 1 ng/ml. Upon parturition, the kids remained with the dams and had access to the regular ration.

Sample collections and analysis: Blood samples were taken from the jugular vein at various time intervals. Samples were taken while the animals were in the fed state. The samples were immediately centrifuged and an aliquot of plasma was mixed with ice-cold, 5% metaphosphoric acid (plasma: acid solution = 2:1). Ascorbic acid was analysed according to Behrens and Madere (1987). Milk samples were de-proteinized and de-fatted by mixing with an identical volume of 0.6 M trichloro acetic acid. The supernatant was used for vitamin C analysis (Behrens and Madere, 1987).

Statistical analysis: To evaluate breed and time-point differences in plasma ascorbic acid concentrations, the data were subjected to Duncan's multiple range test and Student's t test. A P value < 0.05 for comparisons was considered to be significant.

Results

The data presented in Tables 1 and 2 refer to the same goats sampled during both pregnancy and lactation. Table 1 shows that plasma vitamin C was generally lower during pregnancy than before insemination. The lowest concentrations were seen at two weeks of pregnancy. Close to parturition, plasma ascorbic acid concentrations in the Nubian goats approached the values observed when they were non-pregnant and in non-estrus phase. In the

Table 1: Plasma ascorbic acid levels before and during pregnancy in Nubian and Saanen goats

Breed	Before insemination	Week of pregnancy 2	4	6	8	12	16	20
Nubian	3.74 ± 0.60^{ax}	2.42 ± 0.44^{bx}	3.32 ± 0.61^{ax}	3.65 ± 0.50^{ax}	2.92 ± 0.59^{dx}	3.12 ± 0.46^{dx}	3.22 ± 0.45^{dx}	3.52 ± 0.60^{dx}
Saanen	3.00 ± 0.53^{ax}	1.77 ± 0.05^{by}	2.02 ± 0.121^{cy}	2.34 ± 0.34^{cy}	2.54 ± 0.34^{cx}	2.22 ± 0.41^{cy}	2.00 ± 0.11^{cy}	2.23 ± 0.10^{cy}

Values are in μg/ml and presented as means and S. E. M. For 12 goats per breed
Mean values in the either the same row or column, but with different letter combinations are significantly different $P<0.05$

Table 2: Plasma ascorbic acid levels during lactation in Nubian and Saanen goats

Breed	Parturition	Week of lactation 2	4	6	8	12	16	20
Nubian	3.51 ± 0.55^{ax}	4.12 ± 0.70^{bx}	4.74 ± 0.71^{bx}	5.13 ± 0.81^{cx}	5.72 ± 0.80^{cx}	5.93 ± 0.91^{dx}	6.23 ± 0.91^{dx}	6.52 ± 0.92^{dx}
Saanen	2.21 ± 0.42^{ax}	2.75 ± 0.49^{ax}	3.15 ± 0.61^{by}	3.42 ± 0.59^{by}	3.73 ± 0.55^{by}	4.23 ± 0.80^{by}	4.23 ± 0.80^{by}	4.52 ± 0.77^{by}

Values are in μg/ml and presented as means S. E. M. For 12 goats per breed.
Mean values in either the same row or column, but with different letter combinations are significantly different $P<0.05$

Table 3: Plasma ascrobic acid levels during different intervals in Nubian and Saanen Kids

Breed	Week of age 2	4	6	8	12	16	20
Nubian	2.98 ± 0.23^{ax}	2.66 ± 0.21^{ax}	2.88 ± 0.24^{ax}	3.25 ± 0.64^{bx}	3.67 ± 10.64^{bx}	3.84 ± 0.70^{bx}	4.20 ± 0.61^{cx}
Saanen	$1.17?0.04^{ay}$	1.75 ± 0.06^{ay}	2.37 ± 0.19^{bx}	2.41 ± 0.27^{by}	2.58 ± 0.31^{cy}	2.49 ± 0.31^{cy}	2.71 ± 0.31^{cy}

Values are in μg/ml and presented as means and S. E. M. For 12 goats per breed
Mean values in either the same row or column, but with different letter combinations are significantly different $P<0.05$

Saanen goats, the plasma ascorbic acid concentrations at 16-20 weeks of pregnancy were on an average 30 % below the pre-pregnancy level. Before insemination, group-mean plasma ascorbic acid concentrations were higher in Nubian than in Saanen goats, but the difference did not reach statistical significance.

The vitamin C concentrations during lactation are presented in Table 2. There was a significant, lactation-period-associated increase in plasma ascorbic acid in both Nubian and Saanen goats. The lactating Nubian goats showed higher plasma ascorbic acid values than did their Saanen counterparts. In both breeds, the lowest plasma ascorbic acid concentrations were measured at parturition.

Table 3 shows that newly born Nubian kids had higher plasma ascorbic acid levels than the Saanen kids. The breed difference remained apparent at least until the age of 20 weeks. Group-mean milk production during the first month of lactation in the Nubian and Saanen goats was 2.4 and 6.9 mg/l per day, respectively. The group-mean colostrum contents of ascorbic acid were 37.8 and 24.1 mg/l, and the milk levels were 26.4 and 19.0 mg/l for the Nubian and Saanen goats, respectively.

Discussion

The present communication compares the plasma ascorbic acid levels in Saanen and Nubian goats in different physiological states. The plasma concentrations of vitamin C were lower during either pregnancy than during either pre-pregnancy or lactation. Similar patterns have been observed in other ruminant species such as sheep (Kolb *et al.*, 1993), cattle (Verma *et al.*, 1993) and camels (Mohamed 2002). Both during pregnancy and lactation, the vitamin C levels were higher in the Nubian than in the Saanen goats. The breed difference cannot be explained, but must be relate to a difference in plasma vitamin C utilization or excretion in combination with a difference in hepatic *de novo* synthesis. It is relevant to note that Fidani *et al.* (2001) did not observe differences in plasma ascorbic acid levels between different genotypes of Angora goats.

The ascorbic acid concentrations in milk from the Saanen and Nubian goats were higher than those reported for Shammi goats (Jandal, 1996). Vitamin C excretion with milk was higher in the Saanen than in the Nubian goats, which was due to the higher milk production in the former breed. The excretion in the Saanen goats was on average 131 mg/day, whereas in the Nubian goats it was 63 mg/day. The high loss of vitamin C with milk in the Saanen goats could explain their low plasma vitamin C concentrations during lactation. Furthermore, the lower vitamin C concentrations in the milk of the Saanen goats could explain the lower concentrations in the plasma of their kids, when compared with the Nubian goats. At least in young calves, milk rather than endogenous hepatic synthesis is their main source of vitamin C (Itze, 1984).

In conclusion, ascorbic acid status of goats appears to differ between pregnancy and lactation. The Saanen goats kept under the same conditions as the Nubian goats had lower plasma vitamin C concentrations, the concentrations being lowest during pregnancy. Given the possibility that low vitamin C status is associated with decreased disease resistance (Mohamed and Beynen, 2002), it could be suggested that pregnant Saanen goats are at higher risk than their Nubian counterparts when kept under the conditions of this study.

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