ORIGINAL ARTICLE

Effect of breeding season and pregnancy status on serum progesterone, sodium, potassium, copper and iron of estrous synchronized Aradi goat does

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Abstract Eighteen out of 88 estrous synchronized Aradi goat does were randomly chosen to be bled during May–July (Out breeding season, n = 9) and during September–December (Within breeding season, n = 9). Estrous synchronization was applied by using a control internal drug release (CIDR) as a reproductive management regimen throughout the year. Nineteen days after CIDR insertion, a 500 IU eCG was injected (i.m.) and CIDR was removed. Does were subjected to fertile bucks 48-60 h after CIDR removal. Jugular blood samples were collected in non-heparinized Vacutainer tubes at 0 h just before CIDR insertion, every 3 days during CIDR insert, at day of CIDR removal, at incidence of estrus and mating, at day 1, 8 and 30 post mating. Data on pregnancy were recorded and serum levels of progesterone (P), sodium (Na), potassium (K), copper (Cu) and iron (Fe) were determined. Progesterone concentration was higher (p < 0.05) within (2.85 ± 0.15 ng/ml) than outside (2.37 ± 0.13 ng/ml) the breeding season. Pregnant does exhibited higher (p < 0.05) levels of progesterone (2.76 ± 0.17 ng/ml) than non-pregnant does (2.37 ± 0.10 ng/ml). No significant interaction was found between season and pregnancy status on progesterone concentration. A typical progesterone profile was found during treatment days, as levels of P increased during CIDR insertion and declined at CIDR removal and thereafter. Neither breeding season nor pregnancy status affected Na+ concentration. Contrariwise, mean levels of K+ was higher (p < 0.05) outside (148.34 ± 3.91 mg/L) than within (136.27 ± 3.91 mg/L) the breeding season. Pregnancy status did not influence K concentration. Sodium/potassium (Na+/K+) ratio

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1. Introduction

Goats are considered as minor breeds in world animal agriculture. However, goats in the tropical and sub-tropical areas are actually considered important breeds, because of their persistence to the harsh conditions with their demandable good quality meat. Goats raised in Saudi Arabia are of double purpose type since they produce milk and meat. Although such local breeds are seasonally polyestrous (Jainudeen and Hafez, 1993), they can be efficiently utilized all-year round by estrous synchronization and artificial insemination. Biochemical blood estimates in goats are still yet to be clarified under different physiological conditions. Metabolism of mineral substances, which belongs to the basic components of the inside environment, plays a vital role in the regulation of physiological function of puerperal period (Krajničáková et al., 2003). Their concentrations in the blood circulation represent homeostatic mechanisms that are in a close relationship with the neurohumoral regulation. The differences in concentrations of Na and K at time of early and late pregnancy in relationship to season were recorded in Marwari sheep (Mali et al., 1994). Therefore, the objective of the present study aimed to investigate the effect of the breeding season and pregnancy status on progesterone profile and serum levels of sodium, potassium, copper and iron in estrous synchronized – Aradi goat’s does.

2. Materials and methods

2.1. Animals

Eighteen primiparous Aradi does were randomly allotted into two groups, 9 does were utilized in the breeding season and 9 does were utilized outside the breeding season. Does were housed in a semi-open yard, offered 300 g/head of a pelleted concentrate (16% crude protein) and alfalfa hay and accessed clean drinking water. Sire bucks were housed in separate pens inside environment, plays a vital role in the regulation of general substances, which belongs to the basic components of the culture. However, goats in the tropical and sub-tropical areas are considered as minor breeds in world animal agriculture. Although goats in the tropical and sub-tropical areas are actually considered important breeds, because of their persistence to the harsh conditions with their demandable good quality meat. Goats raised in Saudi Arabia are of double purpose type since they produce milk and meat. Although such local breeds are seasonally polyestrous (Jainudeen and Hafez, 1993), they can be efficiently utilized all-year round by estrous synchronization and artificial insemination. Biochemical blood estimates in goats are still yet to be clarified under different physiological conditions. Metabolism of mineral substances, which belongs to the basic components of the inside environment, plays a vital role in the regulation of physiological function of puerperal period (Krajničáková et al., 2003). Their concentrations in the blood circulation represent homeostatic mechanisms that are in a close relationship with the neurohumoral regulation. The differences in concentrations of Na and K at time of early and late pregnancy in relationship to season were recorded in Marwari sheep (Mali et al., 1994). Therefore, the objective of the present study aimed to investigate the effect of the breeding season and pregnancy status on progesterone profile and serum levels of sodium, potassium, copper and iron in estrous synchronized – Aradi goat’s does.

2.2. Does reproductive management

Does were submitted to a regular regime of estrous synchronization (Fig. 1) using CIDR (Pfizer, Auckland, New Zealand) containing 1 g progesterone. CIDR was inserted for a 19 day – period and at day 19 CIDR was removed and a 500 IU equine Chorionic Gonadotropin (eCG) (Pregnoncol®, BIONICHE Animal Health, Australia) was intramuscularly (i.m.) injected for each doe. Bucks were introduced just at time of CIDR removal. Mean time interval between CIDR removal until the exhibition of estrus signs was 55 h, either within or outside the breeding season.

2.3. Experimental design

See Fig. 1.

2.4. Blood sampling

Jugular venipuncture was used by an 18 – gauge 1.5 in. sterile syringe. Time schedule of blood sampling (Fig. 2) commenced at day 0 (just before CIDR insertion), every 3 days until day of CIDR removal, at day of CIDR removal, at onset of estrus and at day 8 and 30 post mating. At day 30 post mating all does were exposed to pregnancy diagnoses by ultrasonography using 5 MHz trans-rectal linear array probe (ALOKA, Japan). The time schedule of blood sampling was as follow.

2.5. Serum collection

Blood was collected in non-heparinized Vacutainer® tubes, cooled for 2 h at 5°C and centrifuged under cooling (Hettich Universal 32R, Germany) at 4000 g for 15 min. Sera were harvested, labeled and kept frozen (−70°C) until assayed.

2.6. Progesterone determination

Progesterone levels in serum were determined by the use of progesterone – EIA kits (Syntron Bioresearch, CA, USA) according to the method of Radwanska et al. (1978). Horse-radish peroxidase was used as a tracer and tetra methyl benzidine (TMB) as a chromogen. The intra- and inter-assay coefficient of variations were 7.6% and 7.3%, respectively. The crossreactivity for progesterone was 100%.

2.7. Sodium, potassium, iron and copper determinations

A 500 μl aliquots of serum were prepared for each element and diluted by glass double distilled water at a dilution rate of 1:10 (serum:water). Determinations of the concentrations of these elements were done using an atomic absorption flame emission spectrophotometer (AA – 6200, Shimadzu, Kyoto, Japan).

2.8. Statistical analysis

Data were analyzed using GLM procedure of SAS program (SAS, 2000). The linear model used was:

$$Y_{ijklm} = \mu + S_i + P_j + SP_{ij} + D_{lk} + C_l + e_{ijklm}$$

(1)

where, \(Y_{ijklm}\) = Observation on \(ijklm\)th trait, \(\mu\) = overall mean, \(S_i\) = fixed effect of ith season, \(P_j\) = fixed effect of jth pregnancy status, \(SP_{ij}\) = effect of interaction of \(S_i\times P_j\), \(D_{lk}\) = random effect of kth doe within subclasses of \(SP_{ij}\), \(C_l\) = fixed effect of lth sample collection day, \(e_{ijklm}\) = random error.
3. Results and discussion

As illustrated in Fig. 3 there existed a significant ($p < 0.01$) increase of progesterone concentration in does within ($2.85 \pm 0.15$ ng/ml) than outside ($2.37 \pm 0.13$ ng/ml) the breeding season. Likewise, there found a significant ($p < 0.05$) elevated level of progesterone in pregnant ($3.75 \pm 0.17$ ng/ml) than in non-pregnant ($2.47 \pm 0.10$ ng/ml, Fig. 4).

It has been found that the insertion of CIDR elevated the serum content of progesterone which declined to less than 0.5 ng/ml 48 h post CIDR removal. This resulted in the exhibition of estrus signs. Thereafter, levels of progesterone steadily elevated up till day 30 post mating. It has been found that CIDR combined with a low dose of equine Chorionic Gonadotropin (e CG) was one of the earliest methods of inducing ovarian activity in anestrous ewes and does during the non-breeding season (Jainudeen and Hafez, 1993). Similar values of progesterone levels were found in Dwarf goats in Pakistan (Khanum et al., 2008).

It has been found that CIDR was the preferable estrous synchronization regime outside the breeding season of goat does (Whitley and Jackson, 2004).

Table 1 exhibits data of sodium (Na), potassium (K), copper (Cu) and Iron (Fe) concentration and Na⁺/K⁺ ratio in doe’ serum as influenced by breeding season and pregnancy status. Data exhibited no significant season × pregnancy status interaction on serum levels of sodium, potassium and iron concentrations. On the contrary, there existed a significant ($p < 0.05$) increase in serum copper concentration in non-pregnant goat does out of the breeding season (Table 1). However, potassium was found to be higher ($P < 0.05$) outside ($148.34 \pm 3.91$ mg/L) than within ($136.27 \pm 3.91$ mg/L) the breeding season (Table 2). Due to the insignificant difference in sodium ion concentration between the two seasons, the significant increase of Na⁺/K⁺ within ($30.29 \pm 0.45$) than outside ($27.62 \pm 0.44$) the breeding season might be attributed to the elevated levels of K⁺. However, no significant differences were found between seasons as far as serum copper and iron concentrations (Table 2).

Table 3 presents data of mineral concentrations as influenced by pregnancy status. There were no significant changes in sodium, potassium, Na⁺/K⁺ ratio and iron concentrations due to pregnancy. Whereas, there found significant ($p < 0.05$) higher serum copper concentration in pregnant (150 µg/L) than in non-pregnant (130 µg/L) does.

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**Figure 1** Outline exhibiting the timing of treatment within/outside season.

**Figure 2** Time schedule of blood sampling during treatment.

**Figure 3** Effect of breeding season on serum progesterone concentration of goat doe.
Trace elements have been documented to play an important role in determination of the fetal outcome (Yashhare et al., 1994). Deficiencies of trace elements like zinc, copper and magnesium have been implicated in various reproductive events like infertility, pregnancy wastage, congenital anomalies, pregnancy induced hypertension, placental abruption, premature rupture of membranes, still births and low birth weight.

Ceruloplasmin, which contains copper catalyses the conversion of ferric ion to the ferrous form. This favors the absorption of iron from the gastro-intestinal tract. It also plays a role in the mobilization of iron to plasma from the tissue stores (Raman and Leela, 1992). Moreover, Buamah et al. (1984) found the fetus is fully dependent on the maternal copper supply and pregnancy is associated with increased copper retention. This is partly due to decreased biliary copper excretion induced by estrogen/progesterone changes, typical during pregnancy. Raina et al. (1990) consider that hypercupremia during pregnancy is the result of mobilization of copper from mother’s tissues, especially liver.

Like what was found in the current study, Žvoric et al. (2006) did not find a significant change in swine serum contents of iron due to pregnancy. Moreover, in male camels, it has been reported that no significant difference was found between rutting and non-rutting males in their serum contents of iron (Zia-ur-Rahman et al., 2007).

Average values of sodium and potassium did not change during pregnancy in swine (Žvoric et al., 2006). Our results during pregnancy correspond with the previous results of Mrljak et al. (1993). Also, Heath et al. (1991) obtained the same results for potassium in 77 pregnant sows, while Ursache et al. (1980) established on the 76th day of pregnancy higher potassium levels that were significantly decreased on the 23rd day of lactation. The values obtained in the current study are consistent with previous findings.

Table 1: Effect of breeding season × pregnancy status on serum minerals of goat does (LSM ± SEM).

<table>
<thead>
<tr>
<th>Element</th>
<th>Pregnancy status</th>
<th>Breeding Season</th>
<th>Non-Breeding Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na (mg/L)</td>
<td>Pregnant</td>
<td>4063.1 ± 115.8</td>
<td>3972.9 ± 127.5</td>
</tr>
<tr>
<td></td>
<td>Non-pregnant</td>
<td>4084.2 ± 166.7</td>
<td>4178.6 ± 156.2</td>
</tr>
<tr>
<td>K (mg/L)</td>
<td>Pregnant</td>
<td>130.4 ± 4.3</td>
<td>147.3 ± 4.9</td>
</tr>
<tr>
<td></td>
<td>Non-pregnant</td>
<td>142.13 ± 6.5</td>
<td>149.4 ± 6.1</td>
</tr>
<tr>
<td>Na⁺/K⁺ ratio</td>
<td>Pregnant</td>
<td>31.5 ± 0.5</td>
<td>27.1 ± 0.6</td>
</tr>
<tr>
<td></td>
<td>Non-pregnant</td>
<td>29.1 ± 0.7</td>
<td>28.1 ± 0.7</td>
</tr>
<tr>
<td>Cu (mg/L)</td>
<td>Pregnant</td>
<td>0.13 ± 0.01</td>
<td>0.16 ± 0.01</td>
</tr>
<tr>
<td></td>
<td>Non-pregnant</td>
<td>0.13 ± 0.01</td>
<td>0.12 ± 0.01</td>
</tr>
<tr>
<td>Fe (mg/L)</td>
<td>Pregnant</td>
<td>0.20 ± 0.01</td>
<td>0.20 ± 0.01</td>
</tr>
<tr>
<td></td>
<td>Non-pregnant</td>
<td>0.20 ± 0.02</td>
<td>0.19 ± 0.01</td>
</tr>
</tbody>
</table>

Means within a category in the same row/column with different superscript significantly differ at $p < 0.05$.

Table 2: Effect of breeding season on serum minerals of goat does (LSM ± SEM).

<table>
<thead>
<tr>
<th>Element</th>
<th>Breeding season</th>
<th>Non-breeding season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na (mg/L)</td>
<td>4073.64 ± 101.78</td>
<td>4075.71 ± 100.83</td>
</tr>
<tr>
<td>K (mg/L)</td>
<td>136.27 ± 3.91</td>
<td>148.34 ± 3.91b</td>
</tr>
<tr>
<td>Na⁺/K⁺ ratio</td>
<td>30.29 ± 0.45a</td>
<td>27.62 ± 0.44b</td>
</tr>
<tr>
<td>Cu (mg/L)</td>
<td>0.133 ± 0.007</td>
<td>0.142 ± 0.006</td>
</tr>
<tr>
<td>Fe (mg/L)</td>
<td>0.196 ± 0.012</td>
<td>0.195 ± 0.010</td>
</tr>
</tbody>
</table>

Means in the same row with different superscripts are significantly different ($p < 0.05$).

Table 3: Effect of pregnancy status on serum minerals of goat does (LSM ± SEM).

<table>
<thead>
<tr>
<th>Element</th>
<th>Pregnant</th>
<th>Non-pregnant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium (mg/L)</td>
<td>4018.0 ± 86.1</td>
<td>4131.4 ± 114.2</td>
</tr>
<tr>
<td>Potassium (mg/L)</td>
<td>138.9 ± 3.3</td>
<td>145.7 ± 4.4</td>
</tr>
<tr>
<td>Na⁺/K⁺ ratio</td>
<td>29.3 ± 0.4</td>
<td>28.6 ± 0.5</td>
</tr>
<tr>
<td>Copper (mg/L)</td>
<td>0.15 ± 0.01a</td>
<td>0.13 ± 0.01b</td>
</tr>
<tr>
<td>Iron (mg/L)</td>
<td>0.198 ± 0.01</td>
<td>0.194 ± 0.01</td>
</tr>
</tbody>
</table>

Means in the same row with different superscripts significantly differ ($p < 0.05$).
with others in goats (Krajničáková et al., 2003) and sheep (Krajničáková et al., 1993).

In conclusion, as the land of the desert lacks several types of minerals which have subsequent negative effects on the grazing native animals, it is best to provide a complete mineral supplement. Providing free choice access to a complete mineral and vitamin supplement, goat’s raiser will be sure that all nutritional needs will be met to help productive and reproductive performance.

References


