EFFECTS OF WATER AND FEED RESTRICTION ON SOME PHYSIOLOGICAL AND HAEMATOLOGICAL PARAMETERS AND BLOOD CONSTITUENTS OF SUDANESE DESERT GOATS FED HIGH AND LOW QUALITY FORAGES UNDER SEMI-ARID CONDITIONS

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ABSTRACT

In an experiment to study water and feed restriction on some physiological and haematological parameters and blood constituents of Sudanese desert goats, nine male goats were subjected to three treatments: (a) ad libitum water and feed (control), (b) ad libitum feed and water restricted to about 40% of the control, and (c) ad libitum water and restricted feed (same amount as given to group b). The acute effects of the above treatments on these parameters were monitored using two types of feed (Lucerne or sorghum hay). Rectal temperature (RT) and respiration rate (RR) of goats increased (P<0.01) from morning to afternoon; RT decreased due to feed restriction during morning and afternoon with lucerne hay (P<0.05) and grass hay (P<0.05), whereas RR decreased (P<0.01) with both types of feeds. For all group of animals, RT was higher (P<0.05) with lucerne hay than with grass hay, this effect being more pronounced (P<0.01) with the control group. Haematological parameters, Hb and PCV were not affected by water and feed restrictions. Plasma glucose levels increased significantly (P<0.05) with lucerne hay in both water and feed restricted groups, while plasma cholesterol increased significantly (P<0.05) with the grass hay in both groups. Plasma urea concentration significantly (P<0.01) increased with feeding lucerne hay compared to grass hay. Plasma minerals (Na+, K+ and Ca++) levels were not affected by either water or feed restrictions or feed types.

INTRODUCTION

Sudanese Desert goats thrive in the arid and desert areas of the northern parts and Savannah regions of Western Sudan, where they have evolved functional characteristics that enable them to survive and maintain productivity in overgrazed and eroded areas (Huston, 1978). Their ability to withstand unfavourable conditions of short feed supply has also been noted (Devendra and Burns, 1970). Shortage of both water and adequate food imposes various degrees of stress on the water and energy metabolism and may even threaten life in hot environments. Infrequent drinking was found to reduce animals’ demand for metabolizable energy and as a result enabled them to balance their energy budget on low energy intake (Choshniak et al., 1988). There is very little information about Sudanese Desert goats living under tropical arid conditions and coping with shortage of water and food; hence the present study was undertaken to investigate the effects of water and feed restriction on some physiological cardinal reactions and haematology and electrolyte balance of Sudanese Desert goats fed good-quality and poor-quality roughages during the dry summer period under semi-arid conditions.

MATERIAL AND METHODS

The experiment was carried out at the faculty of Animal Production, University of Khartoum, in the year of 2005 during hot, dry climate with average maximum and minimum temperatures of 43.4 ± 0.3°C and 23.3 ± 0.1°C, respectively. The relative humidity of 39 ± 2 % was observed at the time of maximum temperature. The period of the study lasted for 102 days. Nine healthy male Sudanese Desert goats aged between 12 and 15 months and weighing 9-16 kg were employed in a 3x3 Latin square design, for following treatments: (a) ad libitum water and feed (control), (b) ad libitum feed and water restricted to about 40% of the

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control, and (c) ad libitum water and restricted feed (same amount as given to group b). Both treatments b and c were repeated using legume hay (Lucerne, *Medicago sativa*) and a grass fodder hay (*Sorghum bicolor*) locally known as Abu 70 because it is planted and harvested in 70 days. These two types of feeds were chosen to represent good-quality and poor-quality forages, which the animals usually encounter under natural conditions. The chemical analysis was done according to AOAC (1980). Measurements of RT and RR were carried out twice daily, once in the morning (08:00) and second time in the afternoon (13:00). RT was measured to the nearest 0.1°C using a clinical thermometer inserted in the rectum for 1 min and RR was measured by counting the flank movement for 5 min. Blood was collected weekly from the jugular vein in heparinized vacutainers. PCV was determined immediately following blood sampling by microcapillary/centrifuge method and Hb concentration was measured by cyanmethemoglobin method of (Cork and Halliwell, 2002). Plasma separated by centrifuge and stored at -20°C until analysis. Commercial kits were used for determinations of plasma glucose (Glucose Oxidase method, Nubenco Diagnostics, New Jersey, USA). Plasma total protein, albumin, cholesterol and urea were determined using Roche/Hitachi 912 Analyzer (Roche Diagnostics GmbH Laboratory Systems, D-68298 Mannheim). Finally the plasma globulin was calculated as the difference between the plasma total protein and plasma albumin. Plasma Na⁺, K⁺ and Ca²⁺ were determined by flamephotometer (Chapman and Pratt, 1961). Results and discussion

**RESULTS AND DISCUSSION**

The crude protein (CP) of lucerne and grass hay was 19.65 and 5.33, respectively.

**Rectal temperature (RT) and respiration rate (RR)**

Rectal temperature of goats restricted to feeding had low temperature both in the morning and afternoon, 38.30°C and 39.01°C, respectively, whereas RR was higher (P<0.05) due to water restriction with both types of feeds in the afternoon (Table 1). Feeding Lucerne hay increased (P<0.01) RT. RT and RR increased (P<0.05) from morning to afternoon as the animals gained heat from ambient temperature (Tables 2 and 3). The higher ambient temperature could presumably prevent any reduction in RR. In goats, the excessive heat load with solar radiation exposure during water restriction resulted in a 50% increase in RR (Dmi’el, 1986). The significant increase in RR with water restriction and from morning to afternoon while RT was maintained would indicate that thermoregulation was effected by heat dissipation through the respiratory route (panting).

**Blood constituents and metabolites**

Haematological parameters PCV and Hb exhibited no significant change with either water or feed restriction when the goats were fed either lucerne hay or grass hay (Table 2). Similar results were obtained in Yankasa sheep subjected to water restriction (Aganga et al., 1989 and Igbokwe, 1993) and in Awassi sheep (Jaber et al., 2004). On the other hand, water restriction caused an increase in PCV of goats (Hassan, 1989; El-Nouty et al., 1990 and Rajkhowa et al., 1999) and Awassi sheep (Laden et al., 1987). Furthermore, MacFarlane et al. (1961) found a significant increase in PCV in sheep when completely deprived of water for 3 days.

Plasma total protein has been used as an indicator of the dehydration status of the
TABLE 1: Effect of feed type on rectal temperature (RT) and respiration rate (RR) in Desert goats fed lucerne hay or grass hay

<table>
<thead>
<tr>
<th></th>
<th>Ad libitum water and feed</th>
<th>Restricted water</th>
<th>Restricted feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT (°C) (08:00)</td>
<td>38.85 ± 0.03 a</td>
<td>37.89 ± 0.02 b</td>
<td>38.30 ± 0.02 b</td>
</tr>
<tr>
<td>Lucerne hay</td>
<td></td>
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<tr>
<td>Grass hay</td>
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<tr>
<td>RT (°C) (13:00)</td>
<td>39.34 ± 0.02 a</td>
<td>38.80 ± 0.02 b</td>
<td>39.01 ± 0.02 b</td>
</tr>
<tr>
<td>Lucerne hay</td>
<td></td>
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<tr>
<td>Grass hay</td>
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<tr>
<td>RR (min⁻¹) (08:00)</td>
<td>28.00 ± 0.20</td>
<td>31.00 ± 0.13</td>
<td>28.63 ± 0.21</td>
</tr>
<tr>
<td>Lucerne hay</td>
<td></td>
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<tr>
<td>Grass hay</td>
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<tr>
<td>RR (min⁻¹) (13:00)</td>
<td>76.70 ± 0.54</td>
<td>84.58 ± 0.48</td>
<td>76.29 ± 0.34</td>
</tr>
<tr>
<td>Lucerne hay</td>
<td></td>
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<tr>
<td>Grass hay</td>
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</tbody>
</table>

Values are means of 9 animals ± SE
Values within the same column bearing different superscripts differ significantly: a,b P<0.05

animals (Tasker, 1971). Feeding Lucerne hay increased total plasma proteins compared with grass hay (Table 2). This might reflect the higher level of crude protein in lucerne hay. Similar observations obtained by (Mohammed, 1988). With water restriction, plasma albumin level increased with both types of feeds. The elevation of the plasma albumin observed in this study could be associated with maintenance of body water. Similar responses were obtained in goats restricted to 50% of their water requirement (Khan et al., 1978 and Gosh et al., 1983) and sheep watered once every 24, 48 and 72 hours (Abdelatif and Ahmed, 1994).

Plasma glucose levels increased significantly (P<0.05) with Lucerne hay in both water and feed restricted group (Table 2). However, the significant (P<0.05) decrease in plasma cholesterol in goats maintained in Lucerne hay in water and feed restricted groups, could be related to the high protein content. The depressing effect of high dietary protein upon plasma cholesterol agreed with previous reports for sheep (Chandler et al., 1968) and cattle (Hawkings et al., 1977 and Park et al., 1981).

Plasma urea level was high in water restricted group with a mean rate of 28.59 ± 5.26 as compared to restricted feed group 23.46 ± 4.41 and control group 17.07 ± 2.24. The observed increase in plasma urea levels in this study has been also reported in goats and sheep during water restriction (Laden et al., 1987; Abdelatif and Ahmed, 1994 and Ahmed and Abdelatif, 1995). This may be related to a decline in urinary total N and urea output which results in an increase in N retention especially in periods of dehydration, thus ensuring a sufficient level of nitrogen for rumen microbes (More, 1982; Mousa et al., 1983 and Brosh et al., 1987). This would illustrate adaptation to desert conditions where goats were usually confronted with forage scarcity during dry summer as rangeland condition is highly deteriorated. The recorded value in the present study showed that animals fed Lucerne hay had markedly higher urea concentration compared to those maintained on grass (Table 2). This was clearly a reflection of difference in crude protein levels in the two feeds. Similarly, sheep on higher crude protein level (16%) showed elevated urea plasma levels than those on lower crude protein level (8%) (Evans et al., 1980).

Blood mineral

The results for plasma mineral have been presented in (Table 3). The levels of Na⁺, K⁺ and Ca²⁺ were low in ad libitum water and feed group than either restricted water or feed group. The type of feed had no influence on plasma minerals. Similar results were observed in Nubian goats (Ali et al., 1984). Also Mohammed (1988) found higher positive calcium balances in Sudanese sheep kept on wheat straw and sorghum stover. It has been

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concluded that even with low quality diets, ruminants can still maintain normal mineral levels at least for maintenance (Preston et al., 1984).

**CONCLUSION**

This study showed that Sudanese Desert goats can withstand water restriction up to 40% of *ad libitum* intake for more than 3 months and feed shortages during hot summer with minimal physiological and haematological disturbances, indicating their better adaptability to the semi-arid environments.

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**REFERENCES**
