EFFECT OF DEHYDRATION ON FEED INTAKE AND DRY MATTER DIGESTIBILITY IN DESERT (BLACK BEDOUIN) AND NON-DESERT (SWISS SAANEN) GOATS FED ON LUCERNE HAY

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(Received 26 June 1984)

Abstract—1. Food consumption decreases with the lengthening of the period of dehydration in both breeds in a similar manner. However, in comparison, the Saanen goats reduced their dry matter intake and consequently their water intake much more than the Bedouin goats.
2. Apparent digestibility of dry matter increased significantly in both breeds during dehydration, the response being larger in the Saanen goats.
3. Bedouin goats are capable of maintaining during 3 days of dehydration a level of consumption which is well above their maintenance requirements while the Saanen goats consumed only the amount of feed which is needed to satisfy their maintenance requirements.

INTRODUCTION

Water and dry matter intake are positively related. Restriction in water intake results in decrease of voluntary feed intake (Macfarlane and Howard, 1972).

Reduction in feed intake in consequence of limited water supply is different in tropically originated breeds of cattle (B. indicus) than temperate zone originated breeds (B. taurus); since the former are able to voluntarily eat more feed under the same conditions (Phillips, 1961).

In addition, it has been demonstrated that water deprivation can result in an improvement in the efficiency of feed dry matter utilization by temperate, tropical and desert breeds of ruminants (Balch et al., 1953; Phillips, 1961; Moush et al., 1983; Brosh et al., 1983a).

The purpose of the present investigations was to compare the effect of water deprivation on feed intake, dry matter digestibility and intake of digestible dry matter in desert (black Bedouin) and non-desert (swiss Saanen) goats fed high quality roughage (lucerne hay).

MATERIALS AND METHODS

Animals and maintenance

Experiments were conducted on four black Bedouin goats (Capra hircus) and four Swiss Saanen goats. Bedouin goats were purchased from Bedouins inhabiting the eastern part of the Sinai. The herd was kept and bred in the research zoo of the Tel-Aviv University under continuous veterinary supervision. The Swiss Saanen goats were obtained from Aziza, the Israeli Goat Breeders Association. The body weight of the Bedouin goats in this study ranged from 18 to 22 kg and that of the Swiss goats from 28 to 32 kg. All the goats were 1.5–2.5 years old. Experiments were carried out during mid-summer in the laboratory where conditions of 25 ± 2°C and 60 ± 5.1 r.h. continuously prevailed.

Diet

All animals were offered lucerne hay ad libitum throughout. Analysis of the hay was made according to the method of Goering and Van Soest (1970). The lucerne hay (90% dry matter) contained, on a dry matter basis, 4.42 kcal/g, 16.25% crude protein, 34.5% cellulose, 8.7% hemi-cellulose and 7.6% lignin.

Experimental conditions

The goats were kept in metabolic cages with capability of separating and of quantitively collecting urine and fecal output (Silanikove et al., 1980). Thirty days were given for adaptation to diet and experimental conditions. Lucerne hay was fed ad libitum twice a day. Water was offered once daily, before the afternoon feeding time. The adaptation period was followed by a control period (period 1) of 8 days. Feed and water consumption was measured daily and fecal output was collected. In period II water was offered ad libitum every second day as before. Six cycles (12 days) were given for adaptation and was followed by 8 days (4 cycles) of measurements as described for period I. In period III water was offered ad libitum every third day as before. Four cycles (12 days) were given for adaptation and was followed by 9 days (3 cycles) of measurements as described for period I. Throughout the experiment the goats were weighed daily before feeding at 1600 hr on an electric balance with a precision of ± 10 g.

Analysis and statistics

Feed and faeces samples were dried at 105°C for 24 hr to determine their dry matter content. Results are given as the mean and standard deviation of 4 goats from each breed in each period. The statistical significances of differences between the means in each breed were assessed by analysis of variance (Snedecor and Cochran, 1967). The effect of water deprivation on dry matter digestibility within each breed assessed by pair comparison t-test.

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RESULTS AND DISCUSSION

Feed consumption

Feed consumption of goats drinking once daily was 63.9 g/kg0.75 in the Bedouin goats and 95 g/kg0.75 in the Saanen goats (Table 1). The above significant (P < 0.01) differences in consumption were discussed and related to smaller maintenance requirements; tendency to accumulate less fat and a higher digestion potential in the Bedouin goat (Silanikove et al., 1980; Silanikove, 1984).

Feed consumption decreased with lengthening in the period of water deprivation in both breeds in a similar manner (Table 2). However, Bedouin goats deprived of water for 48 and 72 hr consumed on average 91% (N.S.) and 81% (P < 0.05) of the amount voluntarily taken when drinking once daily, while the Saanen goat consumed only 67% (P < 0.05) and 58% (P < 0.01) of that amount.

Bedouin goats exposed to mid-summer conditions had an average dry matter intake during the first 3 days of water deprivation (Brosh et al., 1983b) similar to the intake, measured in the present work (Table 1). Only during the third day of water deprivation does the dry matter intake of goats kept indoors become significantly higher (P < 0.05) than those measured in goats exposed to mid-summer outdoor conditions.

A rumen volume of ca 41 (20% of B.W.) was measured in Bedouin goats under indoor conditions (Silanikove, 1984) while rumen volume of 7–8 l (ca 35% of B.W.) was measured in Bedouin goats exposed to mid-summer conditions (Brosh et al., 1983a). It seems that the utilization of the excess water during the first 48 hr of dehydration enabled Bedouin goats which are exposed to mid-summer conditions to maintain a relatively high consumption inspite of the much higher dehydration rate.

Apparent dry matter digestibility

Dry matter digestibility was 72 and 67% in Bedouin and Swiss Saanen goats respectively drinking once daily (Table 3, P < 0.05). Similar differences were noted regarding apparent gross energy digestibility (Silanikove et al., 1980). Apparent digestibility of dry matter increased significantly in both breeds under 48 and 72 hr water deprivation conditions (Table 3). In the Bedouin goat dry matter digestibility increased by ca 2 digestibility units (3.7%, P < 0.05) while in the Saanen goats dry matter digestibility increased by ca 4 digestibility units (6.1%, P < 0.05). Similarly Phillips (1961) reported that European steers improved their dry matter digestibility on limited water intake while this effect was not noted in African Zebu steers.

Brosh et al. (1983a) found that the increase in dry matter digestibility during dehydration is connected to reduction in the net outflow of fluid from the rumen and increase in the mean retention time of indigestible solids in the rumen and the entire gastrointestinal tract. The net outflow of fluid in the Saanen goats drinking once daily are considerably higher and the mean retention time of indigestible solid is shorter than the values in Bedouin goats (Silanikove, 1984; Skolnik and Silanikove, 1981). It seems that the Saanen goat has an acute response to water deprivation since the rates of fluid and solid turnover are initially higher. Exposing the Bedouin goats to outdoor conditions resulted in acceleration in the rate of water and solid turnover. Dehydration resulted in an increase in dry matter digestibility of a magnitude similar to that measured in the Saanen goats in the present experiment (Brosh et al., 1983a).

Slower rates of digesta passage through the rumen during dehydration allows more time for microbial digestion of dietary resistant constituents located in the plant cell wall. A slower rate of digesta passage may result from reduction in the amount of feed consumed (Balch and Campling, 1965).

However, Silanikove et al. (1980) has shown that limiting the voluntary consumption to 60–65% of the ad lib. intake did not influence the digestibility in either breeds of goat. Similarly it has been shown recently in sheep that reducing the ad lib. intake from 90 to 60% did not affect digestibility (Varga and Prigge, 1982). In addition, Brosh et al. (1983a) has shown that when a medium quality hay is fed there is no reduction in voluntary feed intake during the first 4 days of water deprivation, in goats exposed to mid-summer conditions, while there is a significant increase in dry matter digestibility. It may be concluded therefore that the slower rate of digesta passage during dehydration is not related to changes in the amount of feed taken. From Table 3 and from Brosh et al. (1983a) it also seems that improvement in dry matter digestibility during dehydration is not related to the amount of water lost. It is suggested that the state of dehydration per se affects the hormonal balance and consequently affects the rate of

<table>
<thead>
<tr>
<th>Breed/length</th>
<th>Apparent dry matter digestibility of dehydration (days)</th>
<th>(% ± SD, n = 4)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedouin</td>
<td>1a 71.6 ± 1.7 74.4 ± 2.7 74.1 ± 1.8</td>
<td>2a 2b 2a</td>
</tr>
<tr>
<td></td>
<td>1b 2b 2b</td>
<td>2b</td>
</tr>
<tr>
<td>Saanen</td>
<td>66.8 ± 2.1 70.5 ± 1.8 71.2 ± 2.0</td>
<td>2b</td>
</tr>
</tbody>
</table>

*Mean values with different small numbers listed horizontally and the letters listed vertically differ significantly (P < 0.05).
digesta passage. As discussed, the degree of the response in terms of an increase in dry matter digestibility depends on initial conditions, the higher the rate of digesta passage, the higher will be the response recorded.

**Intake of digestible dry matter**

Intake of digestible dry matter in Bedouin goats deprived of water for 48 and 72 hr were not different from those measured when they were drinking once daily (Table 4). The relative small reduction in feed intake in the Bedouin goats (Table 1) was compensated by the increase in dry matter digestibility (Table 3). In the Saanen goats intake of digestible dry matter was considerably reduced because the reduction in feed intake (Table 1) was not compensated by the increase in dry matter digestibility (Table 3).

Maintenance requirements in both breeds were separately assessed (Silanikove, 1984) and found to be equivalent for 28 and 38 g/kg\(^0.75\) (P < 0.05) of digestible dry matter of lucerne hay in the Bedouin and Saanen goats, respectively.

Bedouin goats are able therefore to maintain even during water deprivation a level of consumption which is well above their maintenance requirement. Indeed, lactating Bedouin goats can produce a considerable amount of milk (approx. 1 l/day) on an amount of feed which is needed to keep their body weight constant.

**Water intake**

Water intake of goats drinking once daily was 109.7 ml/kg\(^0.75\) in the Bedouin and 154.1 ml/kg\(^0.75\) in the Saanen goats (Table 3). Linear relation between digestible energy intake and water turnover rate with the physical capacity of the gastrointestinal tract. The rate of digesta passage, the higher will be the response recorded.

**Table 4. Effect of dehydration on daily intake of digestible dry matter (g/kg\(^0.75\)) in black Bedouin and Swiss Saanen goats fed lucerne hay (X ± SD, n = 4)**

<table>
<thead>
<tr>
<th>Breed</th>
<th>Length of dehydration (days)</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedouin</td>
<td>45.8 ± 5.9</td>
<td>43.0 ± 5.9</td>
<td>38.5 ± 4.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>45.8 ± 5.9</td>
<td>44.9 ± 5.1</td>
<td>39.4 ± 3.9</td>
<td></td>
</tr>
<tr>
<td>Saanen</td>
<td>1b</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>63.5 ± 7.6</td>
<td>63.5 ± 7.6</td>
<td>63.5 ± 7.6</td>
<td></td>
</tr>
</tbody>
</table>

*Mean values with different small numbers listed horizontally and the letters listed vertically differ significantly (P < 0.05).

In comparison, Bedouin goats exposed to Mediterranean mid-summer conditions and deprived of water, increased their rate of water loss to about 8% of their body weight daily (Brosh et al., 1983b). According to Shkolnik et al. (1974), even under the above harsh conditions, only body water is lost and quickly regained by one continuous drinking.

Bedouin goats deprived of water for 48 and 72 hr consumed on average 96% (N.S.) and 75% (P < 0.05) of the amount voluntarily taken when drinking once daily, while the Saanen goat consumed only 64% (P < 0.05) and 56% (P < 0.01) of that amount (Table 5). The amount of water consumed following 72 hr of water deprivation is much below the maximum drinking capacity as measured in the Bedouin goats (Shkolnik and Silanikove, 1981). The lowered voluntary water intake per day following rehydration is not related to the physical capacity of the gastrointestinal tract. The reduction in the voluntary consumption of water following rehydration is related to reduction in digestible energy intake and its linear relation to water turnover and water intake.

**REFERENCES**


