

VALUE OF BARLEY GRAIN AND COTTONSEED CAKE AS SUPPLEMENTS TO FOURWING SALTBUSH, AND THE LIVE WEIGHT GAINS AND WATER CONSUMPTION OF SHEEP FED THE DIETS

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Summary

Fifteen sheep were used in a trial which compared the feeding value of whole barley grain and cottonseed cake as supplements to a basal diet of leaves of fourwing saltbush (*Atriplex canescens*). Diet SB contained 700 g (air-dry matter) of saltbush alone, diet SB + BG contained 700 g SB with 400 g whole barley grain and diet SB + CS contained 700 g SB with 400 g cottonseed cake. The digestibility of the dry matter of diets SB (69%) and SB + CS (70%) were lower ($p < 0.001$) than of diet SB + BG (76%). Sheep offered SB alone daily lost 80 g whereas those fed the other diets gained 11 g (SB + CS) or 17 g (SB + BG) per day. Daily water consumption of the sheep offered the three diets was similar ($p > 0.05$), but their water consumption was higher ($p < 0.001$) than that of sheep offered daily 700 g wheat straw and 200 g barley grain. The results indicate that, at the levels of feeding used, barley grain and cottonseed cake had similar value as supplements to fourwing saltbush harvested in summer. The addition of the supplement allowed the sheep to gain some live weight. However, the presence of saltbush leaves in the diet resulted in higher water intakes by the sheep. (Key Words : Saltbush, Sheep, Digestibility, Intake, Balochistan)

Introduction

Balochistan province in west and south-west Pakistan has an arid continental Mediterranean climate and in many areas the altitude exceeds 1,000 m, which results in cold winters. Heavily degraded rangelands cover much of the province and there are severe shortages of feed for the large population of small ruminants. Studies have been conducted for many decades on the suitability of several species of saltbush for rehabilitating arid lands in the Mediterranean region (Le Houérou, 1992). Research in the Central Plateau of Iran and at the Arid Zone Research Institute (AZRI), Quetta, Balochistan, has shown that fourwing saltbush (*Atriplex canescens*) has the potential to provide feed for sheep (Nemati, 1977; Atiq-ur-Rehman et al., 1990a; Aro et al., 1992). It is a drought- and cold-tolerant perennial, and the leaves contain about 10 percent crude protein in the dry matter (Atiq-ur-Rehman et al.,

1990b). It has potential as a forage reserve for immature sheep during the late summer when cereal stubbles are generally finished.

A trial was conducted to test three hypotheses: first, that barley grain and cottonseed cake have similar value as supplements when fed with a basal diet of the leaves of fourwing saltbush; second, that supplementation is necessary to allow modest live weight gains of immature sheep; and, third, that feeding saltbush to sheep increases their water consumption.

Materials and Methods

The feeding trial was conducted at the AZRI station in Quetta (altitude 1,600 m) during August-September 1990 when the mean maximum and mean minimum air temperatures were 32 and 16°C, respectively, and the mean relative humidity was 19%. In June/July 1990 leaves of saltbush were hand-harvested from shrubs aged between 3 and 5 years, sun-dried and placed in hessian bags.

Fifteen 18-month-old castrated male Harnai sheep weighing 33 to 49 kg (mean (\pm s.d.) 37 (\pm 4.8) kg) at the start of the trial were blocked into five groups

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according to live weight. From each block sheep were allocated at random to the three diets. All sheep were dosed against helminth parasites before the trial started.

The three diets (g/day) on an air dry matter basis) were:

- SB: 700 g saltbush leaves alone,
- SB + BG: 700 g saltbush leaves with 400 g whole barley grain,
- SB + CS: 700 g saltbush leaves with 400 g cottonseed cake.

The trial was extended by 14 days to measure the water consumption of the sheep on these diets compared with that of another four Harnai sheep of the same age and live weight (40.5 ± 1.9 kg) offered a conventional diet consisting of 700 g chopped wheat straw and 200 g barley grain (Diet WS \pm BG).

Animals were accustomed to saltbush leaves for about three weeks before the start of the main trial by offering each day about 10% more than the intake of the previous day. Then followed a 14-day preliminary period when the three different diets were offered. Faeces were collected each morning during the subsequent 10-day collection period.

The daily allowance of each supplement was offered at 08:00 h, followed by half of the saltbush ration. The remainder of the saltbush was offered at 14:00 h. During the trial there were almost no refusals of saltbush, barley grain or cottonseed cake. Water was offered at 09:00 and 15:00 h. Sheep were weighed at the start of the trial and

then every seven days for six weeks. The daily live weight gains were estimated using the linear regression between live weight and time.

After weighing and thorough mixing, a 10% sub-sample of the daily output of faeces was taken and dried at 60°C for 48 h and milled (1 mm screen). The residual moisture in the faeces was measured by drying at 105°C in a forced-draft oven for 24 h, and the ash content was measured by incinerating at 600°C for 24 h. The dry matter and ash content of the feeds were those used by Rasool et al. (1993).

The results were analyzed statistically for a completely randomized design.

Results

The intake of saltbush leaves remained at 700 g even when 400 g of barley grain or cottonseed cake were offered. The dry matter and organic matter intake of sheep on the unsupplemented saltbush diet was therefore lower ($p < 0.001$) than for the two other diets (table 1). The apparent dry matter (DMD) and organic matter (OMD) digestibilities of the diet including barley grain were higher ($p < 0.001$) than those of the other two diets, but the DMD and OMD of the saltbush diet were similar to those of the diet with cottonseed cake. The addition of barley grain or cottonseed cake resulted in modest rates of live weight gain of sheep, whereas the sheep fed saltbush alone lost 80 g/day ($p < 0.001$).

TABLE 1. FEED INTAKE AND DIGESTIBILITY OF THE DIETS, AND INITIAL LIVE WEIGHT AND DAILY GAIN OF THE SHEEP (NUMBER OF OBSERVATIONS IN EACH MEAN IS 5 EXCEPT FOR THE MEASUREMENTS OF DIGESTIBILITY WHEN IT IS 4)

	SB	SB + BG	SB + CS	s.d.	Sign.
Feed intake (g)				
Dry matter	595	968	985	27.8	***
Organic matter	490	853	820	22.2	***
Dry matter (kg W ^{0.75})	43.5	62.9	64.8	5.31	***
Digestibility (g)				
Dry matter	69	76	70	2.89	*
Organic matter	69	77	69	2.84	**
DOMD ¹	57	68	58	2.40	***
Initial live weight (kg)	35.3	38.7	38.6	4.82	ns
Daily gain (g)	-80	17	11	29.4	***

¹ Digestibility of the organic matter in the dry matter.

Whether expressed as the total quantity or per kg metabolic weight, daily water consumption by sheep fed with diets containing saltbush were higher ($p < 0.001$) than that of sheep fed only wheat straw and barley grain

(table 2). Water consumption per kg dry matter intake was similar ($p > 0.05$) in sheep fed diets of saltbush supplemented with barley grain or cottonseed cake, but higher ($p < 0.01$) when saltbush was fed alone.

TABLE 2. DAILY WATER CONSUMPTION OF SHEEP (NUMBER OF OBSERVATIONS IN EACH MEAN IS 5 EXCEPT IN THE CASE OF WS + BG WHEN IT IS 4)

	SB	SB + BG	SB + CS	WS + BG	s.d.	Sign.
Total (liter/sheep)	5.7	6.2	5.6	3.5	0.76	***
Per kg $W^{0.75}$ (ml/sh)	435	408	391	219	62.6	***
Per kg DM (liter)	9.5	6.5	5.6	4.2	0.91	***

Discussion

The sheep had little difficulty in consuming the 700 g of saltbush leaves offered each day and were still able to ingest all the feed when barley grain or cottonseed cake were included in the diet. This suggests that the intake of up to 65 g DM/kg $W^{0.75}$ was less than the potential *ad libitum* intake of these animals. Indeed, maximum intakes of over 100 g DM/kg $W^{0.75}$ are possible when sheep are offered good-quality feeds (NRC, 1986).

The higher intake of the saltbush leaves in the present trial than in the trial of Rasool et al. (1993) was probably related to harvesting in June and July rather than in November. This earlier harvesting explains the higher DMD (69% compared with 41%). In a trial in Australia, Atiq-ur-Rehman et al. (1994) reported an intake of 78 g DM/kg $W^{0.75}$ for *A. amnicola* with a DMD of 46%. These results illustrate how the intake of saltbush leaves can be influenced by the season of harvest and the species of saltbush.

The live weight changes were measured for 42 days which gives them a reasonable degree of precision. The loss of live weight of the penned sheep fed saltbush alone was greater than that of penned Harnai lambs aged 6-7 months fed saltbush and cottonseed cake (Atiq-ur-Rehman et al., 1990b). Despite the satisfactory DMD and OMD, the content of digestible and metabolizable energy (ME) was probably low, as reported by Arieli et al. (1989), Benjamin et al. (1992) and Wilson (1966). This has been explained by the high content of ash and lignin in saltbush leaves. The loss of live weight on the saltbush alone was expected since the intake of ME, estimated from the DOMD value multiplied by 0.15 (MAFF, 1984), was 4.9 MJ compared with a ME requirement for maintenance of 5.2 MJ. However, higher daily gains would be predicted for sheep offered diets of saltbush

with either of the two supplements since the ME intakes were 2.6 to 4.1 MJ above maintenance requirements.

The water consumption of sheep on diets containing saltbush was markedly higher than that of sheep on the conventional diet throughout the 14-day period (figure 1). This finding has practical significance in places where there is a shortage of water, such as in Balochistan. However, sheep usually have a mixed diet, so the water

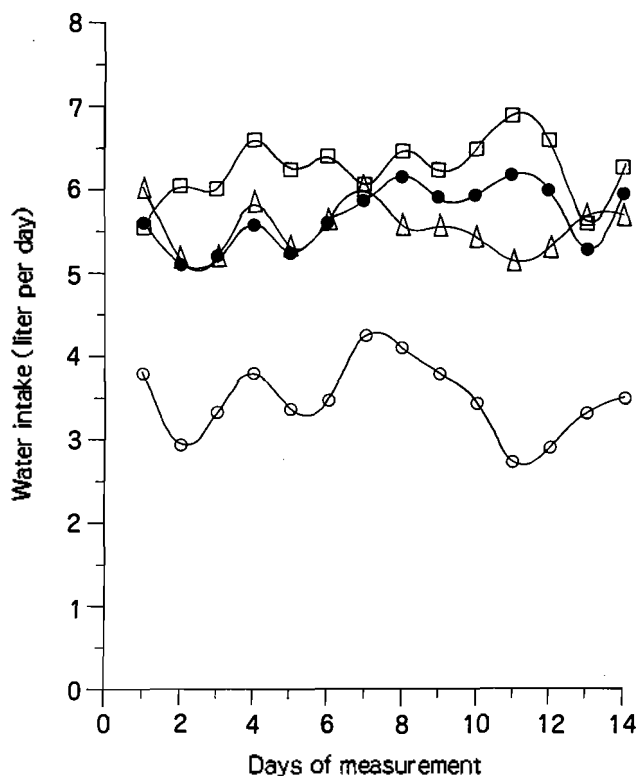


Figure 1. Daily water consumption of sheep on the four diets (● = SB, □ = SB + BG, △ = SB + CS, ○ = WS + BG).

consumption per kg feed intake would be lower than on saltbush alone (table 2). Another study showed that when saltbush leaves were mixed with wheat straw to represent 25% or 50% of the diet, water consumption per unit of dry matter intake was similar to a wheat-straw diet (i.e. 4 litter/kg DM) (Atiq-ur-Rehman et al., 1994).

The results of this trial indicate that barley grain and cottonseed cake have similar value as supplements when offered with the leaves of fourwing saltbush harvested in summer. The choice, and that of using mixtures, of these supplements would depend more on their availability and price than their individual feeding values. Adding the supplements reversed the substantial live weight losses of the sheep offered only the saltbush at a restricted level of intake. The mixed diets would be useful during the winter when range plants are dormant, and even ewes in mid-pregnancy sometimes lose live weight-which is undesirable. Further studies are needed to confirm these results since there is evidence that the season of harvesting can have a marked effect on the feeding value of saltbush. The increased consumption of water by sheep fed diets containing high amounts of saltbush could be a constraint to adoption of the shrub in arid areas where water is often in short supply.

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