

NUTRITIVE EVALUATION OF FOURWING SALTBUSH IN GROWTH AND DIGESTIBILITY TRIALS WITH HARNAI LAMBS IN UPLAND BALOCHISTAN

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Summary

Twenty-four Harnai lambs 6 to 7 month old, weighing 16 ± 2 kg were used in a completely randomized design in growth and digestibility trials to study fourwing saltbush ration supplemented with cotton seed cake. The animals were divided at random into three groups of 8 animals each. Three iso-nitrogenous (10.5% CP) experimental rations (1, 2 and 3) containing wheat straw + lucerne hay (24:76); fourwing saltbush (*Atriplex canescens*) + cotton seed cake (71:29); and wheat straw + cottonseed cake (41:59); respectively, were allotted to each group randomly. All the animals were taken out for grazing in a dormant native range for about 3 hours in the afternoon during the growth trial. The growth trial lasted for 8 weeks followed by a digestibility trial. At the end of 8 weeks lambs on ration 3 had gained significantly ($p < 0.10$) more weight compared to those on rations 1 and 2 which maintained their body weight. The crude protein digestibility of the fourwing saltbush based ration was comparable with the other two treatments (71 vs 70 and 71%). However, the digestibility of dry matter (41%), acid detergent fibre (13%) and neutral detergent fibre (22%) of this ration was significantly lower ($p < 0.10$) than the other two diets. The results suggest that lambs can be maintained on fourwing saltbush during winter without significant loss in body weight with 30% extra protein concentrate supplementation.

(Key Words: Fourwing Saltbush, Forage, Sheep, Growth, Digestibility)

Introduction

The climate of Balochistan province of Pakistan is continental, arid to semi-arid, and Mediterranean in character. Winter precipitation predominates, but occasional summer monsoon showers also occur in the grassland areas of the north-eastern part of the province. Ninety-three percent of Balochistan is classified as rangeland, of which 60 percent (21 million ha) is used for grazing. The sheep and goat population of Balochistan has increased very rapidly by during the past 30 years i.e., from 1.9 million head in 1955 to 18.4 million head in 1986 (Masood et al., 1988). Sheep and goats obtain 60 percent of their feed from rangelands (Zaffar-ud Din, 1977), whereas, the recent estimates of FAO (1983) indicate that 90 percent of feed requirements for sheep and goats in Balochistan

are supplied from grazing rangelands. Overall there is a deficit of approximately 7 percent total digestible nutrients (TDN), 16 percent digestible protein (DP) and 11 percent dry matter (DM) to meet the animals requirements as reported by FAO (1983). A realistic assessment of rangeland however, indicates that the deficiency of these available nutrients is much more severe than the reported figures.

With the degradation of vegetation cover, deterioration of the soil condition and cutting of range shrubs and bushes for fuel wood, the rangeland resources are depleting. The retention of useless, unproductive, uneconomical animals, which add to the grazing pressure on rangelands is another major factor towards this continuing deterioration (Mohammad, 1989). The productivity of rangeland in the area is very low (80-100 kg dry matter/ha/year). The range plants usually have a short seasonal growth (3-4 months) and their nutritional quality deteriorates quickly with advancing stage of maturity. In addition to this the compound nutrient deficiency of protein, energy and minerals during greater part of the year (8-9 months) have been found to be the limiting factors affecting animal production. Animals grazing native ranges

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usually lose weight during winter resulting in poor conception rates, low lambing percentage, low birth weights and high lamb mortality as a consequence of the poor nutritional status of the animals. A minimum of 10-12% of the crude protein level in the rations is essential to promote the growth of lambs (Ali, 1988).

Work on the introduction of fourwing saltbush (*Atriplex canescens*) as a forage plant has shown its potential as an alternate winter forage plant for sheep to rangeland grazing (Atiq-ur-Rehman et al., 1988, 1989). To further assess the potential of fourwing saltbush as a forage under rangeland conditions, the present study was carried out to determine the response of sheep to fourwing saltbush when supplemented with cotton seed cake in growth and digestibility trials.

Materials and Methods

Twenty-four lambs of Harnai breed, 6-7 months old, weighing 16±2 kg were divided at random into three groups of 8 animals each. The experiment was conducted at Arid Zone Research Institute, Quetta situated at an altitude of 1600 m and receives an annual precipitation of 240 mm.

Three iso-nitrogenous experimental rations (table 1) were prepared and used in the study. The rations were randomly allotted to the three groups of lambs in a completely randomized design. All the animals were taken out for grazing in the dormant native range for about 3 hours in the afternoon. The vegetation in this area was mainly composed of *Artimisia maritima*, *Haloxylon recurvum*, *Cousinia stocksii*, *Chrysopogon auchrii*, *Cymbopogon jawarancusa* and *Poa* spp. The rations were offered to the animals at a rate of 500 g/head/day in groups. Before the start of the experiment, all the lambs were given an anthelmintic (Vermadax, 5 cc/animal) to treat them for internal parasites.

The animals were given 14 days to adapt to the feeding regime, after which the growth rate trial started and lasted for 8 weeks. The following observations were recorded:

1. Body weight of each lamb after the adaptation period
2. Daily feed offered/refused
3. Weekly body weight gain/loss
4. Average daily weight gain ((Final wt. - initial wt.)/total days (54))

TABLE 1. COMPOSITION OF THE EXPERIMENTAL RATIONS

Ingredients	Rations		
	1	2	3
Lucerne hay	76	—	—
Fourwing saltbush ^a	—	71	—
Wheat straw	24	—	41
Cottonseed cake	—	29	59
Total	100	100	100
Chemical composition ^b			
Dry matter	89.9	94.5	91.6
Crude protein (CP)	10.5	10.5	10.5
ADF	45.14	38.37	47.39
NDF	58.69	58.08	66.54
Ash	10.51	11.15	8.95

^a*Atriplex canescens* (contained 9.8% CP, on DM basis).

^bOn dry matter basis.

ADF: Acid detergent fibre.

NDF: Neutral detergent fibre.

5. Mortality, if any and general body condition of the animals.

At the end of the growth trial, a digestibility trial was also conducted. For this purpose 4 animals from each group were randomly selected. A complete individual record of their daily feed intake and faeces voided was maintained for 7 days. Daily feed offered and orts (feed refusal) samples were saved and stored at room temperature for later analysis. Total daily faecal collection for each animal was carried out by using faecal collection bags. Representative faecal samples (10 percent of the total daily faeces) were collected and stored at -20°C until the end of the trial and pooled for individual animals.

Dry matter and nitrogen content of all the rations, orts and faecal samples were determined using methods described by AOAC (1984). Acid detergent fiber (ADF) and neutral detergent fiber (NDF) were determined by Goering and Van Soest (1970) procedures, and digestibility of each component was calculated. The data on feed intake, body weight gain/loss and digestibility was analyzed statistically using analysis of variance in a completely randomized design and means were separated by the LSD test (Steel and Torrie,

1980).

Results and Discussion

Body weight changes of lambs fed three different iso-nitrogenous rations during the growth trial are given in table 2. No significant differences were observed in mean body weight of lambs during the first four weeks of the study. During the 5th, 6th, 7th and 8th week of the growth trial the mean body weight of the lambs fed ration 1 (wheat straw and lucerne hay) and ration 2 (fourwing saltbush and cottonseed cake) were not different, but were significantly lower ($p < 0.10$) than those of lambs fed on ration 3 (wheat straw and cottonseed cake). Average daily weight gain (ADG) of

the lambs over the eight week period of the time fed ration 1 and ration 2 was not different, but was significantly lower ($p < 0.10$) than those of the lambs fed on ration 3. The crude protein content of all the rations was the same. However, on calculating their total digestible nutrient (TDN) values, it was found that the ration No.3 contained higher TDN (60%) than when compared to ration 1 and 2 which contained 53 and 50% TDN respectively. This indicates that although ration 1 and 2 supplied enough nutrients to maintaining body weight of the animals, the supply of nutrients from ration No.3 was comparatively better. This explains the temporarily better performance of animals on ration 3.

There were no significant difference between

TABLE 2. WEEKLY BODY WEIGHT (KG) OF YOUNG HARNAI LAMBS FED DIFFERENT RATIONS

Treatments	Weeks									
	0	1	2	3	4	5	6	7	8	ADG
WS+LH	15.42	14.90	15.34	15.90	15.52	14.90 ^b	15.15 ^b	15.03 ^b	15.17 ^b	-4.46 ^b
FWSB+CSC	16.03	15.09	15.47	16.00	15.43	15.09 ^b	15.53 ^b	15.71 ^b	15.63 ^b	-7.14 ^b
WS+CSC	16.47	16.13	16.75	17.30	16.85	17.55 ^a	17.47 ^a	17.52 ^a	17.85 ^a	24.55 ^a
P value		0.31	0.21	0.22	0.17	0.02	0.06	0.07	0.04	0.00

W0-W8: Weekly body weight of Harnai lambs with effect from Nov., 22, 1988.

^{ab}Values in the same column with different superscripts differ ($p < 0.10$).

ADG: Average daily gain/loss (g).

the digestibility of dry matter, ADF and NDF for rations 1 and 3; however, both these rations differed significantly ($p < 0.10$) from ration 2 (table 3). The crude protein digestibility of all the three rations was almost the same and the differences were non-significant. Although the dry matter digestibility of ration 2 (FWSB+CSC) was significantly lower than the rations 1 and 3, its intake was higher than with either of the other rations. This explains the results obtained in growth trial, where no difference in the performance of lambs was observed when fed on rations 1 and 2 and the animals maintained their body weights on these rations. Lambs on ration 3 (WS+CSC) performed better suggesting that the supply of supplementary nitrogen and energy from cottonseed cake might have improved the fibre utilization of wheat straw. Most production studies have shown that feed intake is far more often the limiting

TABLE 3. INTAKE AND DIGESTIBILITY OF DIFFERENT RATIONS FED TO LAMBS

Item	Ration			SE±
	1 WS+LH	2 FWSB+CSC	3 WS+CSC	
Dry matter intake (g/head/day)	449	472	458	
Digestibility (%)				
Dry matter	57.9 ^a	41.3 ^b	57.0 ^a	3.1
Crude protein	70.3	70.8	71.1	1.7
ADF	50.6 ^a	13.2 ^b	45.2 ^a	3.9
NDF	49.3 ^a	21.6 ^b	49.2 ^a	4.0

^{ab}Values in the same row with different superscripts differ ($p < 0.10$).

ADF: Acid detergent fiber.

NDF: Neutral detergent fiber.

SE : Standard error of mean.

factor in the animal production than the digestibility (Van Soest, 1982).

The lower digestibilities of DM, ADF and NDF for ration 2 indicated that overall the fiber in this ration might have been less digestible. Since fourwing saltbush constituted a sizeable portion of this diet (71%; table 1) and fiber in shrubs is less digestible because of a high degree of lignification during the ripening process (Holechek, 1984) than in grasses, it might have the cause of the lower digestibility of DM, ADF and NDF. The ADF digestibility values for FWSB based ration as reported by Rafique (1988) were higher (20%) compared to those obtained in this study (13.2%). However, it may be mentioned that in that study the fourwing saltbush contribution in the experimental ration was only 60% whereas in the present study it constituted 71% of the ration. This may be the reason for the lower ADF digestibility of the fourwing saltbush based ration. The quantity of cottonseed cake supplemented with fourwing saltbush might not have been enough to provide the required levels of nitrogen and energy to optimize rumen fermentation. Any substrate limitation for microorganism (e.g., in terms of nitrogen, sulphur or any other nutrient) is likely to reduce the rate of digestion (Hunter and Siebert, 1985). The fourwing saltbush used in the present study was collected from the Soil Conservation Farm, Forest Dept. Mastung, Distt. Kalat. These plants had never been grazed before and therefore, are likely to have been more lignified than fourwing saltbush plots grazed every year. This might have been the reason for their poor fibre digestibility. With the advancement in the physiological maturity of a plant its lignin content increases and this character is more exhibited in tropical species than the temperate species (Van Soest, 1975). Other reasons for the lower ADF digestibility values which are not yet clear to be clarified in further studies. The crude protein of all the rations was equally digestible with values over 70%. Crude protein digestibility of pure fourwing saltbush was also determined separately after the present study was over and it was found to be 66 percent.

In comparison with ration 1 and 2 the ADF and NDF digestibility values for ration 3 were somewhat higher (45.2 and 49.2% respectively) and agree with those reported by Rafique (1988) and give a reflection of a positive energy balance for these animals. This is why the animals on this

treatment showed temporary increase in body weight of about 8%, whereas, the animals on treatment 1 and 2 had a neutral energy balance with 2-3% loss in body weight.

The animals grazing native ranges usually lose weight during winter. Losses in body weight can be prevented through supplementation of essential nutrients especially nitrogen and energy. This can substantially improve productive and reproductive performance of the animals (NRC, 1985). From the results of this study it may be concluded that lambs can be maintained on fourwing saltbush based ration during the winter with 30% extra protein supplementation.

Literature Cited

- Ali, A. 1988. Nutritional status of livestock in Pakistan with special reference to feeding on rangelands. Proceedings of Range-livestock Seminar, USAID-ICARDA-PARC, Dec. 21-23, 1988, AZRI, Quetta.
- AOAC. 1984. Official methods of analysis of the association of analytical chemists (13th ed.). Association of Official Analytical Chemists, Washington D.C.
- Atiq-ur-Rehman, K.N.M. Khan, M. Asghar and M.I. Sultan. 1988. Fourwing saltbush forage compared with conventional feeds for yearling sheep. MART/AZR Res. Rep. 16 ICARDA, Quetta.
- Atiq-ur-Rehman, S. Rafique and R.S. Aro. 1989. Fourwing saltbush as a winter maintenance forage for sheep in Upland Balochistan. MART/AZR Res. Rep. 37 ICARDA, Quetta.
- Food and Agriculture Organization. 1983. Report of the assistance to rangeland and livestock development survey of Balochistan. FAO Technical Cooperation Program Report, TCP/PAK/0107, FAO, Islamabad, Pakistan.
- Goering, H.K. and P.J. Van Soest. 1970. Forage fiber analysis (apparatus, reagents, procedures and some applications). USDA-ARS Handbook No. 379.
- Holechek, J.L. 1984. Comparative contribution of grasses, forbs and shrubs to the nutrition of range ungulates. Rangelands. 6:261.
- Hunter, R.A. and B.D. Siebert. 1985. Utilization of low quality roughage by *Bos taurus* and *Bos indicus* cattle. I. Rumen digestion. British. J. of Nutrition 53:637-648.
- Masood, M.A., M. Afzal, J.G. Nagy and S.M. Khan. 1988. Agricultural and related statistics of upland Balochistan. MART/AZR Res. Rep. 20, ICARDA, Quetta.
- Mohammad, N. 1989. Rangeland management in Pakistan. ICIMOD Senior Fellowship Series No. 1. International Center for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal.
- NRC. 1985. Nutrient Requirements of Domestic Animals. Nutrient Requirements of Sheep. (6th ed.) National

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Academic Press, Washington D.C.

- Rafique, S. 1988. Influence of forbs and shrubs on intake, digestibility, energy and nitrogen balance, ruminal fermentation and digesta kinetics in sheep fed low-quality forages. Ph.D. dissertation, New Mexico State University, Las Cruces, New Mexico, U.S.A.
- Steel, R.G.H. and J.H. Torrie. 1980. Principals and procedures of statistics (Ed. McGraw Hill). Koga Kusha Ltd, Japan.
- Van Soest, P.J. 1975. In: I.W. McDonald and A.C.I. Warner (Ed.) Digestion and Metabolism in Ruminants, University of New England Publishing Unit, Armidale, Australia p.251.
- Van Soest, P.J. 1982. Nutritional Ecology of Ruminant. O & B Books, Corvallis, USA p.374.
- Zaffar-ud Din, Ch. 1977. Development of rangelands in desert/arid areas of Pakistan. Proceeding of the International Conference on Alternative Strategies for desert development. Organized by UNITAR and published by Pergamon Press, New York, USA.