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in

Ben Salem H. (ed.), Nefzaoui A. (ed.), Morand-Fehr P. (ed.).
Nutrition and feeding strategies of sheep and goats under harsh climates

Zaragoza : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 59

2004
pages 191-195

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SUMMARY – Two feeding trials using various levels of dry pods of Ghaf *(Prosopis cineraria*) and Meskit (*Prosopis juliflora)* were carried out with Omani native sheep and goats, respectively. For both studies, individual feed intake and body weight (BW) were determined during 50 days to allow studying the effects of feeds on growth and feed intake. Intact male Omani sheep (number = 28, BW = 24.1 ± 2.7 kg) were used in the first study. The ripened Ghaf pods contained: 91% dry matter (DM), 13.5% crude protein (CP), 14.3% crude fibre (CF), 1.3% ether extract (EE) and 5.2% ash (on DM basis). Four levels of Ghaf (0, 15, 30 and 45%) were used with decreasing corresponding proportions of Rhodes grass hay (RGH) with the objective of reducing the proportions RGH in sheep diet with Ghaf pods. Animals fed rations containing no Ghaf pods grew faster and had lower feed conversion ratio than those fed Ghaf. Sheep fed 15 and 30% Ghaf still gained weight but those fed 45% lost weight. In the second trial, four levels (0, 10, 20 and 30%) of Meskit were fed to Omani goats (number = 28, BW =18 ± 3 kg) of various breeds. The objective was to reduce proportions of RGH in the diet replacing it with Meskit. The ripened Meskit pods contained: 93% DM, 12% CP, 25% CF, 2.6% EE and 4% ash. Goats fed 20% of Meskit had the highest BW gain and the best feed conversion efficiency compared to other groups. Goats fed 30% of Meskit had the lowest feed intake and feed conversion efficiency and lost weight by the end of the experiment. These studies indicated that *Prosopis* pods could be used up to 20% in Omani sheep and goat diets without causing negative effects on BW growth.

Key words: Growth, feed intake, feed conversion, *Prosopis* spp., Ghaf, Meskit.

RESUME – *"Intégration des gousses des arbres pastoraux natifs (*Prosopis *spp.) dans l'alimentation des ovins et des caprins au Sultanat d'Oman". Deux essais de 50 jours chacun ont été conduits sur des ovins et caprins de races locales d'Oman recevant des quantités croissantes de gousses séchées de Ghaf (*Prosopis cineraria*) et de Meskit (*Prosopis juliflora*). La composition chimique de ces deux types de gousses est de, respectivement : 910 et 930 g de matière sèche (MS)/kg, 135 et 120 g de matières azotées totales (MAT)/kg MS, 143 et 250 g cellulose brute/kg MS, 13 et 26 g extrait éthéré/kg MS et 52 et 40 g cendres/kg MS. Dans le premier essai, 28 agneaux ont été répartis en 4 lots égaux. Chaque lot d'animaux a reçu les gousses de Ghaf en remplacement partiel du foin de dactyle à des proportions de 0, 15, 30 et 45%. Les agneaux recevant du foin uniquement ont un indice de consommation plus bas et ont gagné plus de poids que ceux recevant le foin et les gousses de Ghaf en même temps. Le taux d'incorporation de Ghaf le plus élevé (45%) a entraîné une chute de poids des agneaux. Dans le second essai, quatre niveaux de gousses de Meskit (0, 10, 20 et 30%) ont été apportés à des caprins en remplacement partiel du foin. Le remplacement de 20% de la quantité de foin par les gousses de Meskit a engendré la meilleure efficacité alimentaire et le gain de poids le plus élevé des caprins. Augmenter davantage le taux d'incorporation des gousses de Meskit (30%) entraîne une chute de poids des caprins et réduit l'ingestion des aliments et l'efficacité alimentaire. Ces essais ont montré que les gousses de* Prosopis *pourraient être incorporées à un taux n'excédant pas 20% dans la ration des ovins et caprins sans diminuer leur croissance.*

Mots-clés : *Croissance, ingestion, indice de consommation,* Prosopis *spp., gousses.*

Introduction

The acute shortage of fresh water in Oman is a major limiting factor of livestock production as it results in high cost of feed. Omani livestock are mainly fed Rhodes grass hay (RGH) as a major source of roughage, which requires large quantities of fresh water for irrigation and currently costs up to 60.0 Omani Rials (150 US$) per ton. However, Oman has natural rangeland plant species, which have not yet been fully exploited as livestock feeds. These include *Acacia* and two species of *Prosopis*, the local *P. cineraria* (Ghaf) and the introduced *P. juliflora* (Meskit, Mesquite).

Prosopis cineraria (L.) Druce (family Leguminosae, subfamily Mimosoideae) is found in the arid areas of Arabia, Indian sub-continent and Afghanistan where it provides fodder, fuel, shade and improvement of soil and stabilizes sand dunes. Ghaf is the Arabic name. The *Prosopis* tree is extremely drought, salinity and heat tolerant. The tree responds well to irrigation, tolerating up to 50% sea water (Anonymous, 1999). Ghaf leaves and pods are eaten by many animal species. *P. juliflora* originated in America and has been introduced to Oman only few years ago. It is now found all over the country and regarded as a weed. Its leaves are not edible to animals but pods are consumed especially during nutritional shortage periods. The *Prosopis* tree of both species readily drops its pods on the ground, which provide a good fodder for livestock.

Research at Sultan Qaboos University showed that intake of *P. cineraria* and *Acacia tortilis* pods by native Omani sheep was low and digestibilities of both fibre and protein were also low (Horton *et al.*, 1993). Omani native sheep showed good potential for meat production as reflected in high growth rates and good carcass characteristics when raised under optimum management and nutrition levels (Mahgoub and Lodge, 1998). The present study aimed to investigate the effects of using *Prosopis* pods for replacing RGH in totally mixed rations on performance of Omani native sheep and goats.

Materials and methods

Dry pods of both *Prosopis* species were collected during the fruit production season (May-July 1999) and stored in a cool dry shed. The pods were reduced to 0.5-1.0 cm in length in a grinder. Proximate analysis was carried out on the pods and rations following the methods of AOAC (1990). Crude fibre (CF) was determined by TCA method and acid detergent fibre (ADF) was analysed according to the Goering and van Soest (1970). The pods of *P. cineraria* and *P. juliflora* contained 13 and 12% crude protein (CP), 13 and 25% CF, 2.5 and 2.6% ether extract (EE) and 5 and 9% ash, respectively. The collected pods were used in two feeding trials.

In the first trial, 28 Omani male sheep [averaged 24.1 kg body weight (BW) and 116 days of age] were allocated randomly to one of four experimental diet groups containing chopped 45% RGH and 0% Ghaf pods; 30% RGH and 15% Ghaf; 15% RGH and 30% Ghaf; 0% RGH and 45% Ghaf. In the second experiment, 28 Omani male goats (averaging 18.3 kg BW and 116 days of age) were allocated randomly to one of four experimental diet groups. They were fed totally mixed rations containing: 42, 36, 25 and 13% RGH and 0, 10, 20 and 30% Meskit pods, respectively. For both trials, animals were individually fed in 1 $\times$ 1.5 m pens. Water and salt blocks were offered *ad libitum*. Daily feed intakes were determined by weighing feed offered and refusals. Animals were weighed every two weeks in the morning before feeding. The experimental feeding period continued for 50 days. Data were subjected to analysis of variance using the General Linear Models procedure (SAS, 1991).

Results and discussion

Ghaf and Meskit pods CP (14 and 12%) and CF (14 and 25%) indicate that they can offer a good source of livestock feed compared to other native available feeds (El Hag *et al.*, 2000). Traditionally in Oman, pods are collected and fed to livestock during the dry season. In the current experiment, pods were fed in a mixed ration to allow supplementation with other nutrients and to improve the palatability of the diet. Experimental diets contained 14-16% CP which are adequate for growing sheep (NRC, 1985). Because *Prosopis* pods contained lower levels of fiber than RGH, total fiber content of the diet decreased with increasing proportions of *Prosopis* and decreasing proportions of RGH, which favors rations containing pods.

Feed intake

Sheep fed 15% Ghaf pods had similar feed intake to those fed no Ghaf. Intakes were in the range of 0.73-0.75 kg/d and 2.8-2.9% BW (Table 1) which is within the range reported for Omani native sheep fed conventional (Mahgoub and Lodge, 1998) or by-product-based diets (El Hag and Al Shargi, 1998). However, increasing levels of Ghaf in the diet was accompanied by a decrease in feed intake (Table 1). Inclusion of Ghaf at proportions of 45% significantly reduced feed intake. These findings are similar to those of Horton *et al.* (1993) where diets with 29% Ghaf pods reduced feed intake in Omani sheep. This

might be due to the presence of large amounts of tannins and other phenolic compounds in the pods. Pods in the current experiment were ground to 0.5-1.0 cm length. This level of fineness was not adequate to prevent sheep from selecting other feeds than Ghaf. Future studies will be carried out to investigate the effects of further reduction of pod size as well as pelleting on feed intake. It should be noted here that sheep under traditional systems consume whole pods rather well, but it appears that the present experimental period may not have been long enough to allow full adaptation to the pods.

Table 1. Performance of Omani male sheep fed various levels of Ghaf (*Prosopis cineraria*)

Item	Level of Ghaf in the ration				SE	Diet effect
	0%	15%	30%	45%		
Total feed intake (kg)	39.884[a]	38.798[a]	23.736[b]	13.837[c]	2.420	***
Daily feed intake (kg)	0.753[a]	0.732[a]	0.448[b]	0.261[c]	0.047	***
Daily feed intake (% BW)	2.88[a]	2.82[a]	1.90[b]	1.26[c]	0.15	***
Total weight gain (kg)	7.171[a]	4.771[b]	0.567[c]	–2.917[d]	0.822	***
Daily weight gain (kg/d)	0.135[a]	0.090[b]	0.011[c]	–0.055[d]	0.016	***
Feed conversion ratio[†]	5.804	10.351	13.547	–0.272	5.576	

[†]kg feed: kg gain.
[a,b,c,d]Means on the same row without or with the same letter do not significantly differ (P > 0.05).

In the second trial with goats, feed intake as a percentage of BW was comparable to that of sheep. Goats fed 20% of Meskit pods had the highest whereas those fed 30% had the lowest feed intake (Table 2). Goats fed rations with RGH as a major constituent of the diet, had lower feed intake than those fed 10 and 20% Meskit pods, possibly due to a relatively higher fiber content.

Table 2. Performance of Omani male goats fed various levels of Meskit (*Prosopis juliflora*)

Item	Level of Meskit in the ration				SE	Diet effect
	0%	10%	20%	30%		
Total feed intake (kg)	21.550[b]	24.978[a,b]	26.987[a]	15.701[c]	2.053	**
Daily feed intake (kg)	0.399[b]	0.463[a,b]	0.500[a]	0.291[c]	0.041	**
Daily feed intake (% BW)	2.26[a]	2.49[a]	2.59[a]	1.67[b]	0.16	**
Total weight gain (kg)	1.858[b]	2.129[b]	3.817[a]	–1.057[c]	0.560	***
Daily weight gain (kg/d)	0.037[b]	0.042[b]	0.076[a]	–0.021[c]	0.011	***
Feed conversion ratio[†]	11.889	11.441	7.544	–0.104	3.394	

[†]kg feed: kg gain.
[a,b,c]Means on the same row without or with the same letter do not significantly differ (P > 0.05).

Sheep and goats fed various levels of *Prosopis* did not show any signs of ill health such as diarrhea or impaction reported in *Prosopis*-fed animals. Feeding *Prosopis* in high proportions and for longer periods may cause health problems in small ruminants including nervous symptoms (Tabosa *et al*., 2000). Lack of manifestation of health problems in *Prosopis*-fed sheep in the current study may be due to the short period of feeding.

Live-weight gain

Sheep fed RGH gained more than those fed various levels of Ghaf (Table 1). A growth rate of 135 g/d (control-fed sheep) is comparable to that recorded for Omani sheep (Al-Nakib *et al*., 1996; El Hag and Al Shargi, 1998; Mahgoub and Lodge, 1998) and is higher than that reported for many tropical and sub-tropical sheep (Gatenby, 1986). Increasing levels of *Prosopis* in the diet caused a linear reduction in BW

gain (Table 1). However, sheep fed 15% Ghaf grew at an excellent rate of 90 g/d (compared to tropical sheep; Gatenby, 1986).

Replacing 15% of the expensive RGH with Ghaf, reduced the cost of animal feed resulting in better financial returns for farmers. Sheep fed 30% Ghaf did not lose weight, which indicates that *Prosopis* levels of this order may be used in maintenance diets of sheep. Sheep fed 45% Ghaf lost weight with a marked reduction in feed intake. Improvement of this diet through reduction of particle size or pelleting may improve feed intake and consequently BW growth.

Goats fed 20% Meskit grew with the highest rate followed by those fed 10 and 5%, respectively whereas those fed 30% Meskit rations lost weight (Table 2). The gain in BW was corresponding to the feed intake of these animals (Table 2). Higher proportions of the Meskit pods in the diet most probably have decreased feed intake as a result of decreasing palatability.

Feed conversion

Rhodes grass-fed sheep had lower feed conversion ratio than those fed Ghaf (Table 2). Feed conversion efficiency (FCE) of 10.4 and 13.5 kg/kg BW were recorded for the 15 and 30% Ghaf-fed sheep, respectively. These efficiencies are comparable to those obtained for the breed on other non-conventional diets based on agricultural by-products (El Hag and Al Shargi, 1995, 1998). In goats, animals fed 20% Meskit tended to have the lowest feed conversion rate (FCR). Diets with low FCE values may be attributed to the low digestibility coefficients of these diets. Omani sheep diets based on *Prosopis* and *Acacia* pods had lower organic matter (OM) and ADF digestibilities as well as lower blood urea nitrogen (BUN) levels (Horton *et al*., 1993).

Conclusions

The *Prosopis* tree grows almost all over Oman and performs well under the harsh semi-desert conditions of the country. Trees grown for landscaping under irrigation (mostly with treated sewage water) grow and yield extremely well. Therefore, *Prosopis* has a good potential as a free range or irrigated tree for production of animal fodder under Omani conditions. Methods of pod collection may be improved by clearing twigs, old pods and undesirable material from under trees before the collection season and use of plastic sheets.

This experiment demonstrated that *P. cineraria* and *P. juliflora* pods might be included at levels of up to 15 and 20% in diets of Omani sheep and goats, respectively, without causing negative effects on BW, feed conversion or feed conversion ratio. Further studies are needed to investigate the potential of physical improvement of *Prosopis* based diets to increase feed intake and carcass quality in Omani small ruminants.

Acknowledgement

The authors would like to thank Mr Sadeq M. Al-Lawati for technical help.

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