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Supplementary feeding to improve Desert sheep productivity under dryland farming

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Abstract *Supplementary feeding of Desert ewes at mating time or for 45 days pre-lambing, or both combined, increased lambing and twinning, gave heavier lambs and gave farmers a greater monetary return. The best return was with the two supplements combined. Supplementing the diet of weaned lambs for four months gave increased growth, advanced puberty, and gave higher conception and lambing rates. Copyright © 2006 John Wiley & Sons, Ltd*

Key words: Desert sheep, flushing, steaming-up, growth, reproductive performance, milk progesterone

Introduction

The sheep population of Sudan is about 49 million, over 36% of the livestock in the country. Most are the Desert sheep, which are distributed across the low rainfall savannah, semi-desert and desert zones, north of 10°N. These animals are well adapted to arid and semi-arid conditions and can thrive with water scarcity, low quality range grasses and high ambient temperatures (Mufarrih, 1991).

Sheep raising in the country has low inputs and varies from sedentary systems around settlements to nomadic systems over considerable areas. There is high variability in the amount and distribution of rainfall, which affects the vegetation and water availability, and in turn the flock movement, watering intervals and general husbandry. Epidemic and parasitic diseases cause considerable losses, which are aggravated by the limited availability of drugs and vaccines (Mufarrih, 1991).

In north Kordofan, the low inputs and extensive mode of production for Desert sheep delay the age at first lambing, and cause short productive lifetime, low conception and lambing rates, and high abortion and ewe and lamb mortality rates (El-Hag et al., 2001). This work studied the effects of supplementary feeding on Desert sheep productivity.

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Materials and methods

Trials were conducted during three consecutive seasons. In the first, in the normal breeding (January–March) and lambing (June–July) times in 2001, 428 Sudan Desert ewes (3–8 years old, 34.4–58.6 kg body weight, mean 41.2 kg) of the Hamari subtype were used. All ewes were treated against internal and external parasites with Ivomec administered subcutaneously at 1.0 cc per head. They were divided into four groups of similar initial body weight and age. One group was the control, receiving no supplements as in farmer practice. The others were: flushed (receiving the supplement for 45 days at mating time); or steamed-up (receiving the supplement for 45 days pre-lambing); or both flushed and steamed-up. Sixteen Desert rams (5–6 years old, 55.6 ± 3.73 kg body weight), of the Hamari subtype, were drenched with Ivomec and given the same supplement during mating time. Four rams were introduced into each ewe group and randomly rotated between the groups to eliminate any ram effect. The rams were left with the ewes for 45 days to allow for three oestrus periods.

In the second trial, 100 newly-weaned, four-month-old ewe lambs were monitored from September 2002 for 15 months. They were treated with Ivomec at 0.5 cc subcutaneously per head and divided into two groups of similar body weight. One group was given supplemented feeding, while the other served as the control (farmer practice). Supplementation was for March–June 2003 until the onset of the rainy season. Five mature Desert rams (Hamari subtype) were introduced to the lambs at ten months of age when they had reached an average body weight of 34 kg (85% of the mature body weight).

The supplement in both trials was sesame seed cake containing 43.7% DM crude protein, ether extract 6.3% DM and metabolisable energy of 10.5 MJ kg^{-1} DM mixed with 1% w/w of ground salt lick bricks. The ewes in the first trial were offered 450 g of supplement per head every three days, at watering time, and the lambs in the second trial were given 600 g per head per three days. They were maintained on open range land and fed in small groups in barns adjacent to the watering area. They were monitored for behavioural heat signs and those detected were serviced. They were then monitored for return to oestrus, when they were again serviced.

Body weight, length and girth of ewes were recorded at the time of service, and those of the ewe lambs every 15 days from weaning up to service. Blood samples from the jugular vein were taken from the ewe lambs for haematological indices and metabolic profile (Payne and Payne, 1987). Reproduction data, lamb weight at birth and the type of birth were recorded. Lamb mortality was recorded for 30 days after birth. Body weight, length and girth were measured immediately after lambing.

In the third trial, 10 ml milk samples were collected from 16 ewes that lambed during the rainy, winter and hot summer seasons of 2004, starting three days postpartum and then every three days for 39 days. Samples were immediately centrifuged for 10 min at 2000 rpm to remove fat particles, 0.01 g sodium azide was added and the samples were stored at –4°C. Milk progesterone was measured by solid phase radioimmunoassay (IAEA, 1984).

Each trial was in a randomised block design, with animals blocked on their age or initial body weight (Steel and Torrie, 1980). Data on ewes that conceived, aborted, died or lambed

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and on those giving birth to singles or twins were statistically analysed using χ^2, while those for ewe lambs were analysed using Student's *t*-test (Steel and Torrie, 1980) with MSTAT-C software (Freed, 1992). Progesterone concentration data were analysed within the sampling period according to lambing season. The profitability of the supplementary feeding was evaluated using prevailing market prices.

Results and discussion

The breeding season in north Kordofan is usually planned for January–March so that lambing comes in the rainy season. This exposes breeding and pregnant stock to nutritional stress, as the breeding and gestation periods are thus in the dry season when range lands are at their lowest nutritional quality.

Flushing and steaming-up affected ewe weight at lambing ($p < 0.05$) and reproductive performance ($p < 0.01$) (Table 1). The highest lambing and twinning rates were in ewes that had been both flushed and steamed-up. Flushed ewes were serviced and conceived within a shorter time than the other groups that had needed repeated services to conceive. Differences in nutrition probably account for most of the variation in reproductive performance (Holness et al., 1978). Flushing plus steaming-up reduced abortions, as observed for Merino ewes by Wilkins (1997).

Mortality was lower in steamed-up ewes than in the other groups. Poor nutrition leads to reduced conception, embryonic losses, reduced lambing rates and high ewe mortality (Yoder et al., 1990). Steaming-up gave significantly ($p < 0.01$) heavier lambs and litter weight at birth, as reported for other breeds by Reese et al. (1990) and El-Hag et al. (1995).

Post-weaning supplementary feeding increased ($p < 0.01$) the weight gain of ewe lambs in comparison with the control (Table 2) and, although it was stopped during the rainy season,

Table 1. Effect of flushing and steaming-up feeding on ewes

Parameter	Control	Flushed	Steamed-up	Flushed + steamed-up	±SE
Lambing body weight (kg)	39.33**a**	42.12**b**	41.94**b**	44.39**c**	0.695**
Total weight change (kg)	−2.49**a**	−1.96**a**	0.09**b**	0.70**c**	0.036**
					χ^2 value
No. conceived	91**a**	98**b**	97**b**	102**c**	2.3*
No. aborted	51**a**	31**b**	12**b**	1**c**	16.8**
No. lambed	40**a**	67**b**	78**c**	101**d**	1.1**
No. died	22**a**	24**b**	10**c**	1**c**	13.3**
Single births	36**a**	58**b**	64**c**	73**d**	1.6*
Twin births	4**a**	9**ab**	14**b**	28**c**	8.4*
No. of lambs that died	8**a**	6**ab**	4**b**	0**c**	3.0**
Lamb weight at birth (kg)	3.6**a**	3.6**a**	4.2**b**	4.5**c**	± SE 0.07**
Litter weight at birth (kg)	4.0**a**	4.1**a**	5.0**b**	5.8**b**	± SE 0.27*

Means in a row with no letter in common are significantly different (*$p < 0.05$, **$p < 0.01$).

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Table 2. Effect of post-weaning supplementary feeding on growth and reproductive performance of ewe lambs

Parameter	Initial	Farmer practice	Improved practice	±SE between practices
No. of ewe lambs		50	50	
Body weight (kg)	14.4	25.0	36.5	0.77**
Body girth (cm)	61.5	69.2	78.6	0.53**
Body length (cm)	60.4	64.4	80.9	0.60**
Packed cell volume (%)	21.8	21.8	28.9	0.49**
Haemoglobin (%)	44.6	41.4	57.3	1.01**
Blood glucose ($mmol\,l^{-1}$)	4.0	4.0	6.1	0.21**
Blood protein ($g\,dl^{-1}$)	4.6	4.4	7.1	0.18**
Plasma Ca (%)	2.9	3.3	7.2	0.18**
Plasma P (mg per 100ml)	3.2	3.2	6.5	0.17**
				χ^2 value
No. serviced		3	41	9.7**
No. aborted		0	3	1.2**
No. died		0	6	2.6**
No. lambed		3	38	6.6**
Single births		3	33	2.9**
Twin births		0	5	2.9**
Lambs born/ewe lambing		1.00	1.13	

**Differences significant at $p < 0.01$.

the supplemented lambs maintained their growth advantage up to ten months of age (Figure 1). Choque et al. (1996) found similar results.

Supplemented ewe lambs had higher ($p < 0.01$) body measurements, haematological indices and blood metabolites at the time of service, and the values were in the ranges reported by Frazer (1986) and Payne and Payne (1987).

Supplemented ewe lambs started to exhibit behavioural oestrus when they reached 29.5 kg body weight (eight months of age). Most supplemented ewe lambs had been serviced and conceived compared with very few of those under farmer practice. Supplemented ewe lambs had higher ($p < 0.01$) conception and lambing rates, lower ($p < 0.05$) mortality, and higher twinning rate and prolificacy. Lamb birth weights were 2.7 and 2.4 ± 0.17 kg in ewe lambs under the improved and farmer practice, respectively. The increased growth in supplemented ewe lambs was reflected in early puberty and higher reproductive performance. Body weight, rather than age, is the most important factor determining puberty, and well-fed heavier animals conceive earlier than lightweight ones (El-Hag et al. 1995; Choque et al. 1996).

Milk progesterone concentrations were higher ($p < 0.01$) in the winter and rainy seasons (Table 3) with levels above 2.0 $ng\,ml^{-1}$ for two or three consecutive sampling periods. Hamadeh et al. (1998) stated that progesterone levels above 2 $ng\,ml^{-1}$ through two consecutive sampling periods indicated continuous cyclicity, while fluctuating progesterone concentrations indicated abnormal or short luteal cycles.

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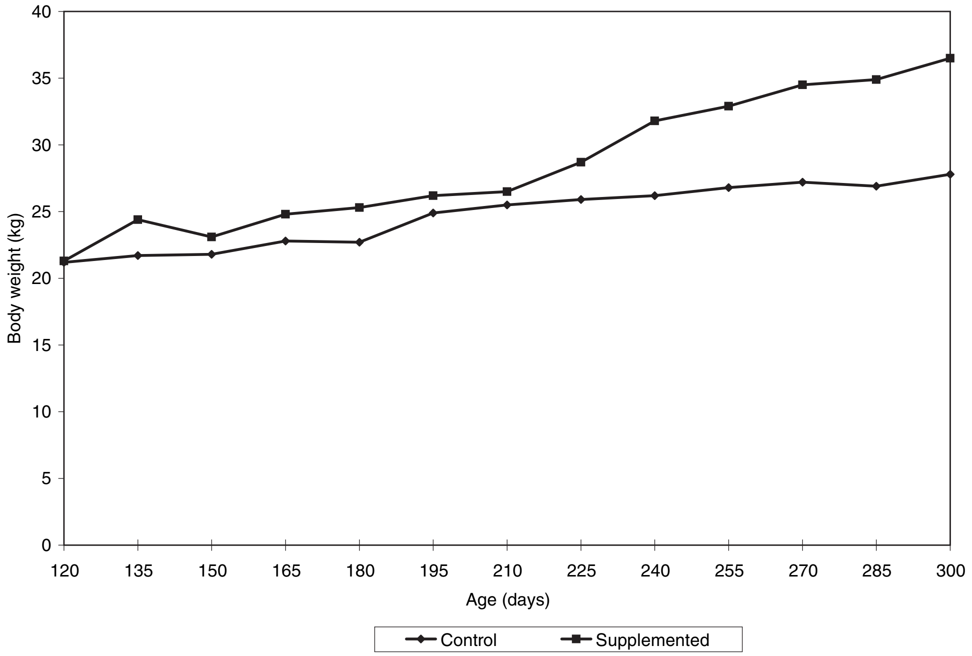

Figure 1. Effect of post-weaning supplementary feeding of ewe lambs.

Table 3. Milk progesterone concentrations (ng ml^{-1}) in Desert ewes

Days postpartum	Season of lambing		
	Rainy	Winter	Summer
3–9	0.69**a**	2.21**a**	1.24
12–18	2.04**b**	3.48**b**	0.62
21–27	1.39**c**	3.06**ab**	0.75
30–36	3.68**d**	3.37**b**	0.91
39	3.00**c**	1.78**c**	0.60
Mean season	2.16	2.78	0.82
±SE (sampling period)	0.200	0.360	0.110

Means in a column with no letter in common are significantly different at $p < 0.01$.

For the groups of 107 ewes, flushing, steaming-up, and flushing plus steaming-up, increased monetary returns by US$96, US$627 and US$1058, respectively, compared with the normal farmer practice (Table 4). The added returns relative to added costs were 99%, 118% and 131%, respectively, compared with the 120% and 152% reported by Reese et al. (1990) and El-Hag et al. (1998), respectively. Partial budget analysis of post-weaning supplementary feeding of ewe lambs (Table 5) showed that the improved practice could increase returns for 50 animals by US$208 over the farmer practice.

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Table 4. Complete and partial budgets for flushed and steamed-up ewe groups (Sudanese dinars × 1000)

Item	Farmer practice (control)	Flushed	Steamed-up	Flushed + steamed-up
Final no. of ewes	85	83	97	106
Total no. of lambs	36	70	88	129
Ewe costs	642	642	642	642
Supplement costs	–	65	65	130
Invomec costs	9	9	9	9
Total costs	**651**	**716**	**716**	**781**
Ewe returns	510	498	582	636
Lamb returns	108	210	264	387
Total returns	**618**	**708**	**846**	**1023**
Partial budget:				
Reduced costs		651	651	651
Added returns		708	846	1023
Benefit (B)		**1359**	**1497**	**1674**
Added costs		716	716	781
Reduced returns		618	618	618
Costs (C)		**1334**	**1334**	**1399**
Net benefit (B-C)		**25**	**163**	**275**
Added returns : Added costs ratio		**0.99**	**1.18**	**1.31**

Ewe price = SD6000, lamb price = SD3000, supplement mixture costs = SD90 kg^{-1}. US$1 = SD260.00.

Table 5. Complete and partial budgets for post-weaning supplementary feeding of ewe lambs (Sudanese dinars × 1000)

Item	Improved practice	Farmer practice
Initial no. of ewe lambs	50	50
Final no. of ewes	50	44
No. of lambs	43	3
Ewe costs	300	300
Supplement costs (1200 kg)	102	0
Ivomec costs (1 btl each)	5	5
Total costs	**407**	**305**
Ewe returns	300	264
Lamb returns	129	9
Total returns	**429**	**273**
Partial budget:		
Reduced costs	305	
Added returns	429	
Benefits (B)	**734**	
Added costs	407	
Reduced returns	273	
Costs (C)	**680**	
Net benefits (B-C)	**54**	
Added returns: Added costs ratio	**1.054**	

Ewe price = SD6000, lamb price = SD3000, 1 kg supplement costs = SD85, 1 bottle Ivomec (50 cc) costs = SD5000. US$1 = SD260.00.

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Conclusions

Flushing and steaming-up, and post-weaning supplementary feeding, increased lambing and twinning rates, advanced puberty, increased lamb and litter weight at birth, and gave greater monetary returns from Desert sheep under dryland farming in north Kordofan, Sudan.

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