

Productivity of Omani Sheep after three years of intensive Management-and two years of selection

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SUMMARY

This study was carried out on Omani sheep at Wadi Quriyat

Livestock Research Station with the purpose of determining the effect of selection on sheep productivity. The number of breeding females

used were 307 and 286 ewes in 1994 and 1995 respectively. The dam traits investigated consisted of pre-mating body weight (PMB), fertility (FRT), litter size born (LSB) and litter size weaned (LSW). The progeny traits consisted of birth weight-(BWT), weaning weight (WWT), six-month body weight (SMB) and survival rate (SRV). Mixed model and least-squares methodologies were used for the statistical analyses. Age of dam had significant effect ($P<0.05$) on all of the dam traits except FRT. The nucleus (selected) dams significantly excelled the control (unselected) by 2.32 kg, 0.18 litters and 0.14 litters in PMB, LSB and LSW respectively. Dam age significantly ($P<0.05$) affected progeny BWT. Male progenies were significantly ($P<0.001$) heavier than females by 0.16kg, 3.47kg and

3.86kg at birth, weaning and six months of age respectively. Similarly,

single births were significantly ($P<0.001$) heavier than twin births by 0.56 kg, 3.90 kg and 2.99 kg at birth, weaning and six months of age respectively. No significant differences were detected between the nucleus and the control progenies indicating that selection had not yet started to show its effect in the progeny population.

INTRODUCTION

The Sultanate of Oman is situated South-East of the Arabian Peninsula between latitude 16°, 40' and 26°, 20' N and longitude 51°, 50' and 59°, 40' E. The Sultanate is extended on a total area of 309500 Km². This vast area consists mainly of low lands and deserts (82%), mountains (15%) and coastal regions (3%). The climate is hot and humid in the coastal region and hot and dry in the interior region except in high altitudes where moderate temperatures are the norm all the year round. The annual rainfall is 100 mm in the coastal areas and 350 mm in the mountains.

Moderate temperatures and “Monsoon” summer rains characterize the weather condition in the Southern region during the months of June to September (Al-Moali and ElSeialy 1984 and Mansour, 1996). Good pastoral areas, which consist of perennial trees and shrubs as well as annual grasses, are found in low land and on top of mountains. According to the Ministry of Agriculture and Fisheries (1993), the total number of livestock in the Sultanate was 1,408,178 heads. This number comprised of 856140, 240356, 213132 and 98550 heads of goat, sheep, cattle and camel respectively. These figures show that sheep rank second to goat in numbers and they are found mostly in the northern part of Oman.

The sheep in the Sultanate of Oman are raised primarily for their mutton and to a lesser extent for their milk. According to the Ministry of Commerce and Industry (1995), the amount of imported fresh and frozen mutton increased from 4143 tones in 1994 to 6240 tones in 1995. These figures reflect the need to increase the productivity of local sheep breed in order to increase the level of self-sufficiency and save the hard currency expended on the importation of live animals and/or fresh and frozen mutton. The Wadi Quriyat Livestock Research Station was established in the interior region of the Sultanate in 1990. The first objective of the research project at this station was to study the local breed of sheep in order to determine their level of production and to investigate factors affecting this productivity under improved and uniform management conditions. The second objective was to implement a genetic evaluation and selection program for improvement of Omani sheep.

The first three breeding seasons (1990 to 1993) were designed to meet the requirement of the first objective using 300 heads of ewes. Detailed description and results of this phase were reported by NINakib *et al.* (1996). The subsequent breeding seasons starting 1993/94 were set for the commencement of the genetic evaluation program using selection method with the following specific objectives:

- The characterization of the Omani sheep breed with regard to type traits.
- To determine the level of production and factors affecting the

production characteristics after three years of improved management and two years of selection.

MATERIAL AND METHODS

The total numbers of breeding female records were 307 and 286 in 1994 and 1995 respectively. The progeny records in these two years were 352 and 317 respectively. The breeding females consisted of two breeding groups namely nucleus (selected) and control (unselected). The numbers of nucleus and control females in 1994 were 268 and 39 animals respectively. The

corresponding values for 1995 were 254 and 32 heads. Prior to the onset of the breeding season females from each breeding group were weighed and then randomly picked and assigned to a pen at a rate of 23 to 25 females per pen. The breeding season usually starts at the beginning of October each year. The breeding males were introduced to the breeding females at a rate of one male per pen. The breeding season continued for 45 consecutive days (two estrus cycles) at the end of which the males were taken out of the breeding pens. The breeding females of the control group were then redistributed into the pen harboring the nucleus group. By so doing it was ensured that the two breeding groups had identical management treatments. Lambings started each year at the beginning of March and then gradually increased to reach a peak after approximately two weeks and then gradually declined to its end in the middle of April.

Lambs were identified, ear-tagged, weighed and recorded at birth. Furthermore their date of birth, dam identification Number (ID), sire ID, sex and birth rearing type were also recorded. The dam record consisted of her own and parents ID, date of Lambing, age, fertility code, pre-mating body weight, number of litters born and number of litters weaned. The lambs were left to suckle colostrum and then reared naturally with their dams. Weaning of lambs took place when the lambs reached an average of three months of age. Then after

weaning they were entered into a performance test trial for another three months period at the end of which a six-month body weight was taken on all of them. The feeding regime during the performance test experiment consisted of Rhodes grass and General Ruminant concentrate from Oman flour mills on a free-choice basis (Table 1).

Table 1. Chemical composition of Oman Flour Mills Concentrated diet.’

Ingredient	Chemical Composition (%)
Crude Protein	14
Crude Fibre	10
Crude Fat	2
Salt	0.4-2
Calcium	0.3
Avaphos	0.3
ME(MJ/Kg)	10.5

i Soure: Oman foulrmills CO. Sultanate of Oman.

By so doing the lambs would have adequate feed to exhibit their genetic potential for post-weaning growth. The dams were fed free-choice Rhodes grass and General Ruminant concentrate based on their body weight and stage of production. The actual amount ranged from 100 grams (gm) per head during the dry period to 500 gm per head during the flushing period.

The production traits analyzed consisted of dam traits and progeny traits. The dam traits comprised of pre-mating body weight, fertility litter size born and litter size weaned. The progeny traits on the other hand comprised of birth weight, weaning

weight, six-month body weight and survival rate. Visual appraisal was used to characterize the Omani sheep breed with respect to type traits. The dam traits were analyzed with the following statistical model.

$$Y_{ijklm} = u + a_i + b_j + C_k + (bc)_{jk} + e_{ijklm} \text{ where}$$

Y_{ijklm} = $ijklm$ th record on dam traits,

u = overall mean constant to all observations,

a_i = effect of i th age group of dam for $i=2$ to 9 years

effect of i th breeding group, $j=1$ for nucleus and 2 for control, C_k = effect of k th year of production, $k=1994$ or 1995 ,

$(bc)_{jk}$ = effect of jk th breeding group X year of production interaction e_{ijklm} = effect of $ijklm$ th residual error term.

All factors were considered fixed except the residual error term, which was considered random. This model will be referred to as model 1

The progeny traits, on the other hand were analyzed with the following statistical model

$$Y_{ijklmno} = u + a_i + b_j + c_k + (bc)_{jk} + q_i + r_m - F(qr)_{im} + s_k + t + e_{ijklmno} \text{ Where}$$

$Y_{ijklmno}$ = $ijklmno$ th record on the progeny trait,

u , a_i , b_j , C_k , $(bc)_{jk}$ are the same as in model 1,

q_i effect of i th sex of progeny, $i=1$ for males and 2 for females

r_m = effect of m th birth rearing type, $m=1$ for single and 2 for twins, $(qr)_{im}$ = effect of lm th sex X birth rearing type interaction,

kn = effect of n th sire of progeny nested within k th year of

production,

t = regression of progeny traits on progeny date of birth. $e_{ijklmno}$ = $ijklmno$ th residual error term.

All factors were considered fixed except the sire and residual error, which were considered random. This model will be referred to as model 2.

Fixed least squares analysis of variance was utilized to fit model 1 while mixed model methodology was used to fit model 2 (Harvey 1988). Dam estimated breeding values were computed using a selection index model based on dam's pre-mating body weight and litter size born. The progeny estimated breeding values were computed based on progeny six-month body weight adjusted for their age. The selection policy for the nucleus group was based on choosing the top 10% of the males and the top 75% of the female for breeding

purposes. The policy for the control group was based on choosing animals having average breeding values and excluding the remainder.

RESULTS AND DISCUSSION

Descriptive traits:

The predominant skin colour of Omani sheep breed is black. However, scarce white, red and spotted colours are sometimes found. The animal body is covered with soft and curly wool of medium length. The horns are found only among the male population although hornless males are sometimes seen. The horns are of medium size and are twisted backwards. The head size is small with black eye and short oval ears. The face is long with convex nose. The tail is of thin type and moderate length. And finally the general body size is small to medium. Similar descriptions were also reported by Mansour (1996).

Dam traits:

Results in Table 2 show that the effect of age of dam was a significant source of variation for dam pre-mating body weight ($P < 0.05$), litter size born ($P < 0.001$) and litter size weaned ($P < 0.001$). However, the age of dam was an insignificant source of variation for dam fertility. Dam pre-mating body weight was highest for two and three years old dams (32.17 to 32.64 kg) then decreased more or less gradually to 29.22 kg for nine years old dams. This result suggests that age of dam had a negative effect on dam pre-mating body weight. Five to seven years old dams had the largest number of litters born per dam (1.24 to 1.32) while younger and older dams had the lowest. The

Table 2: Effect of age of dam on dam traits(Model 1 .

Age (Yeara)	PMB (kg)	FRT	LSB	LSW				
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
2	32.64	.52	.96	.02	1.06	.05	.83	.06
3	32.17	.62	.99	.03	1.10	.06	.91	.11
4	31.29	.90	.98	.04	1.16	.08	.89	.11
5	31.26	.58	.97	.02	1.24	.05	1.05	.07
6			.94	.03	1.32	.05	1.16	.07
7	31.75	.70	.96	.03	1.32	.06	1.12	.08
8	30.70	.74	.97	.03	1.15	.07	1.04	.09
9	29.22	1.09	.99	.05	1.26	.10	1.00	.13
LS	*		NS		***		***	

t PMB=Pre-mating body weight,FRT=Fertility,LSB=Litter size born LSW=Litter size weaned, SE=Standard error, NS=Not significant. *P<0.05, **P<0.01, P<0.001.

observed value pertaining to the nine years old dams was not a good estimator due to the relatively larger standard error caused by fewer numbers of observations. The trend for litter size weaned was similar to that of the litter size born. These results indicate that the productive characteristics and mothering ability become well developed when dams reach five to seven years of age. No specific trend was seen in fertility rate.

The results in Table 3 show that the effect of breeding group was significant source of variation for pre-mating body weight (P<0.05). However, the effect of breeding group had an insignificant influence on fertility rate. Dams from the nucleus breeding group were heavier (32.48 kg) than those from the control group (30.16 kg). Furthermore the former had both more litters born (1.29 vs. 1.11) and litters weaned (1.07 vs. 0.93) per dam than latter. These findings suggest

3: Effect of breeding group and year of production on dam traits (Model 1)1.

Age (Years)	PMB (kg)	FRT	LSB	LSW				
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Nucleus	32.48	.26	.95	.01	1.29	.02	1.07	.03
Control	30.16	.61	.99	.03	1.11	.05	.93	.07
LS	***		NS		**		*	
1994	30.73	.47	.95	.02	1.17	.04	1.04	.06
1995	31.91	.48	.99	.02	1.17	.04	1.04	.06
LS	*		NS		NS		NS	

PMB=Pre-mating body weight, FRT=Fertility, LSB=Litter size born, LSW-Litter size weaned, SE= Standard error, NS= Not Significant, *P<0.05, **P<0.01, ***P<0.001.

that selection had started to show its effect. Table 3 also shows that the effect of year of production was significant (P<0.05) source of variation for pre-mating body weight only. Dams lambing in 1995 were significantly heavier (31.91kg) than those lambing in 1994 suggesting a general improvement in management and nutrition level of the herd.

Progeny Traits:

Table 4 shows that the effect of age of dam was significant (P<0.05) source of variation for progeny birth weight but it was an insignificant source of variation for all other progeny traits. Five and six years old dams gave birth to the heaviest progenies (2.82 kg). The trend for all other progeny traits was less definite.

Table 4: Effect of age of dam on progeny traits (Model))1 .

Age (Years)	BWT (kg)	WWT (kg)	SMB (kg)	SRV				
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
2	228	.05	17.50	.62	27.50	.85	.84	.05
3	2.81	.06	17.90	.66	27.73	.87	.83	.05
4	2.77	.08	18.75	.78	28.94	1.01	.77	.07
5	2.82	.05	17.72	.62	27.72	.84	.84	.05
6	2.82	.05	17.77	.60	27.77	.81	.89	.05
7	2.79	.06	17.48	.66	27.34	.88	.82	.05
8	2.71	.07	16.56	.69	27.01	.91	.88	.06
9	2.58	.10	16.66	.84	26.97	1.09	.79	.08
LS	*		NS		NS		NS	

BWT=Birth weight, WWT=Weaning weight, SMB-Six month body weight, SRV-Survival rate, SE=Standard error, NS=NotSignificant, *P<0.05, **P<0.01, ***P<0.001.

Table 5 shows that the effect of year of production was significant source of variation for birth weight (P<0.05) and survival rate (P<0.001). However, it had significant effect on both weaning weight and six-month body weight. Lamb birth weight increased from 2.69 kg

Table 5: Effect of year of production on progeny traits (Model 2)1

Trait	1994	1995	LS
Birth weight (kg)	2.69	2.80	*
Weaning weight (kg)	17.13	17.96	NS
Six-month body weight(kg)	28.29	26.95	NS
Survival rate	.77	.89	***

NS—Not Significant, *P<0.05, **P<0.01, ***P<0.001.

in 1994 to 2.80 kg in 1995. Furthermore lamb survival rate also increased from 0.77 in 1994 to 0.89 in 1995 a fact that reflected improvement in management and health status of the herd.

Results in Table 6 show that the effect of breeding group was not significant source of variation for any of the progeny traits studied. These results were expected because direct selection was practiced only on six-month body weight. However, more differences due to direct and correlated responses will be expected during the on-coming years.

Male lambs were significantly ($P<0.001$) heavier than females at birth (2.83 vs., 2.67 kg), weaning (19.28 vs. 15.81 kg) and six months of age (29.28 vs. 25.42 kg). Hormonal differences between the two sexes account for the major cause of this variation. Similar findings were reported by Aziz (1986) and Nakib *et al.* (1996). The effect of

sex of progeny had an insignificant influence on progeny pre-weaning survival rate.

Table 6 also shows that the effect of birth rearing type was highly significant ($P<0.001$) source of variation for birth weight, weaning weight had six-month body weight. However, it had an insignificant influence on pre-weaning survival rate. Single lambs had significantly ($P<0.001$) heavier weight than twins at birth (3.03 vs.2.47 kg) weaning (19.71 vs. 15.81 kg) and six months of age (29.27 vs.26.28 kg). The twin birth were lighter than the single births because the amount of

Table 6 : Effect of breeding group, sex, and birth rearing type of progeny on progeny Traits (Model 2).

Source	BWT (kg)		WWT (kg)		SMB (kg)		SRV	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Nucleus	2.75	.04	17.72	.55	27.63	.74	.90	.03
Control	2.75	.06	17.37	.67	27.61	.88	.86	.05
LS	NS		NS		NS		NS	
Males	2.83	.04	19.28	.62	29.82	.83	.81	.04
Females	2.67	.04	15.81	.56	25.42	.76	.86	.03
LS	***		***		***		NS	
Singles	3.03	.04	19.71	.49	29.27	.68	.84	.03
Twins	2.47	.04	15.81	.53	26.27	.73	.82	.04
LS	***		***		***		NS	

BWT-Birth weight, WWT-Weaning weight, SMB-Six-month body weight, SRV-Survival rate, SE-Standard error, NS-Not Significant, *** $P<0.001$.

nutrients received by a twin member from the blood stream of its dam would be relatively less than that received by the single born individual. Furthermore, the available uterine cavity of the dam would tend to limit the growth of twins more than that of the singles. Similar results were reported by Aziz (1986).

Based on the results of this study the following conclusions were made :-

1. The local Omani sheep had predominantly black skin colour, soft and curly wool of medium length, small head, long face with convex nose and short oval ears with thin tail of moderate length. Horns were sometimes found in the males.
2. The effect of age of dam was significant source of variation for dam pre-mating body weight ($P<0.05$), litter size born ($P<0.001$) and litter size weaned ($P<0.001$). Two and three years old dams were the heaviest (32.17 to 32.64 kg). And five to seven years olds had the largest number of litters born (1.24 to 1.32) and weaned (1.05 to 1.16) per dam.

Dams from the nucleus group were better than those from the control group by 2.32 kg, 0.18 and 0.14 in pre-mating body weight, litter size born and litter size weaned respectively. Dams lambing in 1995 were significantly ($P<0.05$) heavier (31.91 kg) than those lambing in 1994 (30.74 kg) reflecting a positive environmental and genetic trend.

Age of dam significantly ($P<0.05$) affected progeny birth weight. Five and six years old dam gave the heaviest progenies at birth with an average weight of 2.82 kg.

Progeny birth weight and survival rate showed positive significant ($P<0.05$) yearly trend. Lamb birth weight increased

from 2.69 kg in 1994 to 2.80 kg in 1995. The respective values

for the survival rate were 0.77 and 0.89.

- The effect of breeding group had no significant influence on the progeny traits.

Males were significantly ($P<0.001$) heavier than females by 0.16 kg, 3.47 kg and 3.86 kg at birth, weaning and six-

months of age respectively.

- Likewise single births were significantly ($P<0.001$) heavier than twin births by 0.56 kg, 3.90 kg and 2.99 kg at birth, weaning and six-months of age respectively.

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