The effect of compensatory growth on feed intake, growth rate, body composition and efficiency of feed utilization in Dorper sheep

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Forty-eight Dorper lambs, comprising 24 ram and 24 ewe lambs, were divided into four groups of six ram and six ewe lambs each and were allocated to one of the following feeding levels: *ad libitum*, 80%, 65% or 50% of *ad libitum* intake. The *ad libitum* diet had a metabolizable energy content of 10,15 MJ/kg and a crude protein content of 15,44%. The lambs were weaned at 120 days (mean weaning mass = 24,3 ± 4,3 kg). After the nine-week restriction phase, all lambs were given *ad libitum* feeding until the ewe lambs reached a body mass of 45 kg and ram lambs a mass of 55 kg. Daily feed intake, growth rate and efficiency of feed utilization were calculated during the restriction and realimentation phases. During the restriction phase, digestibility of the diet increased whereas growth rate and efficiency of feed utilization decreased with increasing restriction. With the onset of the realimentation phase, the ME intake of ewe and ram lambs increased with decreasing *ad libitum* intake. The growth rates of ewe lambs increased at the same point by 8,9%, 45,8% and 251,4%, and those of ram lambs by 104,5%, 104,6% and 174,2% at the 80%, 65% and 50% intake levels respectively. In spite of the increase in growth rate during the realimentation phase, the growth rate of the restricted ewe lambs could not better or equal the growth rate of the *ad libitum* group at a specific live mass, while the growth rate of the restricted ram lambs bettered the rate of the *ad libitum* group. No differences in the total amount of protein in the body could be detected between sexes on the respective feeding levels. The deposition rate of protein decreased progressively as the restriction during the restriction phase increased. During the realimentation phase, protein deposition of all the previously restricted groups increased, while that of the *ad libitum* group declined slightly. No differences within sex groups in the proportion of fat at different body masses could be detected between different feeding levels. The deposition rate of fat declined progressively as the restriction during the restriction phase increased. Feeding levels did not affect the fat:protein ratio of ewe and ram lambs. According to data collected during the trial, the efficiency of feed utilization in ewe lambs decreased with an increase in restriction in feed intake, while that of ram lambs increased.

'n Totaal van 48 Dorperskape, bestaande uit 24 ram- en 24 ooilammers, is in vier groepe van ses ram- en ses ooilammers elk verdeel en is aan een van die volgende vier behandelings toegeken: *ad libitum*, 80%, 65% of 50% van *ad libitum*-inname. Die *ad libitum*-rantsoen het 'n metaboliseerbare energie-inhoud van 10,15 MJ/kg en 'n totale ruproteïeninhoud van 15,44% gehad. Lammers is op 120-dae-ouderdom gespeen (gemiddelde speenmassa = 24,3 ± 4,3 kg). Na die beperkingsfase van nege weke het die diere *ad libitum*-voeding ontvang totdat die ooie 'n liggaamsmassa van 45 kg, en ramme 55 kg, bereik het. Daaglikse voerinnames, groeitempo's en doeltreffendheid van voerverbruik gedurende die beperkings- en realimentasiefases is beraam. Gedurende die beperkingsfase het die verteerbaarheid van die dieet verhoog maar die groeitempo's en doeltreffendheid van voerverbruik het afgeneem. Met die aanvang van die realimentasiefase het die innames van ooilammers met 1,5%, 28,3% en 92,1% onderskeidelik op die 80%, 65% en die 50% *ad libitum*-innames gestyg, en die van ramlammers met 16,5%, 34,6% en 48,7% onderskeidelik. By dieselfde punt het die groeitempo's van ooilammers met 8,9%, 45,8% en 251,4% en dié van ramlammers met 104,5%, 104,6% en 174,2% op die 80%, 65% en die 50% *ad libitum*-innames gestyg. Ten spyte van die verhoogde groeitempo gedurende hierdie fase kon die groeitempo's van die beperkte ooie nie die tempo's van die *ad libitum*-groep ewenaar of verbeter nie. Die groeitempo's van die beperkte ramlammers was deurgaans beter as dié van die *ad libitum*-groep. Geen verskille in die totale hoeveelheid proteïen in die liggame van ooie en ramme op die onderskeie voedingspeile, kon gevind word nie. Die tempo van proteïenneerlegging het gedurende die beperkingsfase progressief met die graad van beperking afgeneem. Gedurende die realimentasiefase het 'n verhoging in proteïenneerlegging by alle beperkingsgroepe voorgekom. Geen verskille in die totale hoeveelheid vet in die liggame van ooie en ramme kon tussen die onderskeie voedingspeile gevind word nie. Die vetneerleggingstempo het met 'n toename in graad van beperking gedurende die beperkingsfase afgeneem. Voedingspeile het nie 'n invloed op die vet:proteïenverhouding van ooie en ramlammers gehad nie. Volgens die totale doeltreffendheid van voerverbruik gedurende die hele proefperiode het die doeltreffendheid van ooilammers afgeneem met 'n toename in voedingsbeperking, terwyl dié van ramlammers verbeter het.

Keywords: Body composition, feed intake, growth, realimentation, restriction.

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Introduction

Compensatory growth is manifested in the ability of animals previously restricted in feed or nutrient intake to outgain their better counterparts when given free access to good quality feed. The effect of compensatory growth in animals has been reviewed by Wilson & Osbourn (1960), Allden (1970) and O'Donovan (1984). According to these reviews, results obtained were contradictory. These contradictions may be ascribed to differences in body composition, voluntary feed intake, the effect of age and efficiency of feed utilization.

The effect of compensatory growth on body composition in sheep has been studied by various researchers. Some experiments have shown that there are no differences in body composition between continuously grown and realimented animals (Kellaway, 1973; Searle & Graham, 1975; Thornton *et al.*, 1979). Some researchers have shown that realimented sheep are leaner than continuously grown animals (Burton *et al.*, 1974; Drew & Reid, 1975), whilst others have shown that realimented animals contain more fat (Ledin, 1983; Notter *et al.*, 1983). Mature animals were used as experimental material in all these experiments. According to Searle *et al.* (1979), immature sheep are even more vulnerable to undernutrition, particularly in the period immediately after weaning. The end-results therefore depend on the physiological age of the sheep and the time that treatment starts (Gunn, 1964a; 1964b). Further contributing factors may include different restriction levels, different periods of restriction and realimentation, different protein levels as well as breed (Hofmeyr, 1972; Meissner, 1977) and sex (Meissner, 1977; Marais, 1984) differences.

According to Thompson *et al.* (1982), compensatory growth can be explained in terms of an increased efficiency of feed utilization. Anderson (1975) reported that most experiments with cattle indicate that feed conversion on restricted feeding is more efficient than with *ad libitum* feeding. Meissner *et al.* (1977) reported the same effect in sheep and detected a change in composition of growth, which suggests that more protein but less fat was deposited.

Higher feed intake after a period of feed restriction has been reported in the majority of experiments (Wilson & Osbourn, 1960; Graham & Searle, 1975; Thornton *et al.*, 1979; Greeff, 1984). Contrary to these results, Drew & Reid (1975), Murray & Slezaceck (1980) and Hogg & Tulloh (1982) reported that feed intake do not increase after a period of feed restriction.

Owing to the fact that body composition, voluntary feed intake and maintenance requirements differ between breeds, it is possible that Dorpers may react differently to feed restrictions. Knowledge of the effects of feed restriction on growth rate and efficiency of feed utilization is important for economic reasons.

This study was conducted to quantify the effects of various feeding levels on feed intake, growth rate, body composition and efficiency of feed utilization during restriction and realimentation on Dorper sheep.

Materials and Methods

Design

A total of 48 Dorper lambs comprising 24 ram and 24 ewe lambs, obtained from 100 Dorper ewes from the Grootfontein Agricultural College stud, were used. Only single-born male and female lambs were included in the experiment. Owing to the fact that a clear break in the relationship between ln(cumulative ME intake) and ln(body mass) occurs at 13 weeks of age (Meissner, 1977; Marais, 1984), care was taken to ensure that animals older than 13 weeks of age were selected. The lambs were subdivided into four groups of six ewes and six rams each. The mean body mass at the commencement of the trial was 24,3 ± 4,3 kg. The groups were allocated to four different feeding levels, viz. *ad libitum*, and 80%, 65% and 50% of *ad libitum*. Lambs were housed in individual pens from about two weeks prior to the commencement of the experiment, until the ewe lambs reached a body mass of 45 kg, and ram lambs 55 kg. Animals were fed individually and the allocated amount of feed of each lamb was weighed out at the beginning of each week. Daily amounts of feed were given to restricted groups in two equal portions. Drinking water was freely available.

From the beginning of the experiment the lambs, except for the control group on *ad libitum* intake, received restricted feeding for nine weeks. After this period, the restricted groups received *ad libitum* feeding. It was thus necessary to calculate the amount of feed of the restricted groups on a weekly basis.

Individual intakes and live masses were determined weekly. Live mass was determined at 08h00 without prior fasting. Although this procedure is less reliable owing to differential gut-fill, a period of fasting could interfere with the measurement of 'true' *ad libitum* intake. By fitting a

Table 1 Composition of the diet on an air-dry basis

Components	Amounts (kg/100 kg)
Lucern meal	50
Maize meal	40
Fishmeal	6
$CaCO_3$	2
Salt	2
Bovatec	20 g
ME content:	10,15 ± 0,23 MJ / kg
Crude protein:	15,44 ± 0,14 %

Table 2 Energy digestibility (DE) of the diet of the different treatments during the restriction and realimentation phases

Treatment	Restriction phase x ± *SD*	Realimentation phase x ± *SD*
Ad libitum	68,84 ± 3,28	68,84 ± 3,28
80%	69,05 ± 2,51	68,74 ± 2,81
65%	71,02* ± 2,36	68,45 ± 2,43
50%	73,07* ± 2,24	68,53 ± 2,23

* Differ significantly ($P < 0,05$) from the *ad libitum* value.

Table 3 Intercept (a) and slope (b) of ln(cumulative ME intake) (x) and ln(body mass) (y), slope (p) of autoregression of ln(cumulative ME intake) and α, the logarithm of cumulative ME intake at limit mass for each treatment during the two phases

		Parameters			
Treatment	Phase*	a	b	p	α
Ewes					
Ad libitum	1	–0,5644	0,5746	0,9242	8,6181
	2	–0,5644	0,5746	0,9242	8,6181
80%	1	–0,3779	0,5433	0,9656	9,3883
	2	–0,7732	0,6002	0,9690	9,5533
65%	1	–0,2810	0,5221	0,9724	9,5008
	2	–0,9617	0,6216	0,9292	8,2407
50%	1	–0,7534	0,3616	0,9799	9,4888
	2	–1,2979	0,6610	0,9226	8,1594
Rams					
Ad libitum	1	–0,1339	0,5313	0,9533	9,1463
	2	–0,1339	0,5313	0,9533	9,1463
80%	1	0,0250	0,5034	0,9643	9,4068
	2	–1,4860	0,7133	0,9258	8,7023
65%	1	0,4070	0,4396	0,9836	11,8575
	2	–1,3100	0,6846	0,9631	9,8205
50%	1	0,6429	0,4014	0,9947	20,1490
	2	–2,7352	0,8849	0,9627	9,2245

* 1. Restriction phase; 2. Realimentation phase.

mathematical function to live mass data, the effect of measurement error is reduced, which would render this procedure acceptable. Body composition was estimated at two- to three-week intervals by the tritium dilution method (Meissner & Bieler, 1975). The cumulative ME intake of individual lambs prior to the commencement of the trial was calculated from the linear regression equation between ln(cumulative ME intake) and ln(body mass) as described by Meissner (1977).

Composition of diet

The ingredients used to compile the pelleted diet are shown in Table 1.

Digestibility of the diet

As lambs were fed at different intake levels, differences in digestibility of the diet were expected. Thus the digestibility of the diet was determined *in vivo*. Lambs were distributed at random between weeks of faeces collections, with each lamb completing at least three periods of collection before the end of the trial. The metabolizable energy (ME) intake of each lamb was computed from the digestible energy (DE) intake multiplied by 0,82 (Blaxter, 1962).

Statistical analysis

Roux (1976) showed that ln(cumulative feed intake) and ln(body mass) or ln(components of body mass) describes a straight line when measured in temporal sequence on the same animal or group of animals. In statistical terms, all the information is then incorporated in the slope (b) and the intercept (a). According to Roux (1981), it is normally an optimal procedure to use cumulative feed intake as the independent variable (x), as x is measured with a small relative error compared to body mass. All statistical information is then incorporated in the intercept and slope of the regression line.

The efficiency of feed utilization may be estimated by differentiating the allometric equation:

$$y = ax^b \quad (1)$$

Roux (1976) also indicated that growth against time may be described by the equation:

$$y(t) = \alpha - \{\alpha - y(o)\}\ p^t + \Sigma\ p^j \varepsilon (t-j) \quad (2)$$

where $y(t)$ = ln(mass) at time t; $y(o)$ = ln(mass) at time (o); p = slope of the autoregression; α = limit mass (assumed equivalent to mature size); ε = error term,

as $t \rightarrow \infty$ then $y \rightarrow \alpha$ if $|p| < 1$.

According to Roux *et al.* (1982), (p) may remain constant for all carcass components as described by equation (2). Statistical parameters obtained are presented in Tables 3 and 4. Where no significant differences between treatments in these parameters were found, adjusted values were used.

Results and Discussion

Apparent digestibility of the diet

The apparent digestibility of the diet is illustrated in Table 2. The values for digestibility obtained from each lamb were pooled and subjected to variance analysis. According to Table 2, digestibility increased ($P < 0,05$) as feeding level decreased during the restriction phase, probably as a result of the longer retention time in the rumen. This also suggests that lambs of different groups consumed different amounts of digestible energy. During the realimentation phase, no significant differences in digestibility of the diets were found between treatments.

Metabolizable energy

The energy intake (MJ ME/d) during the restriction and realimentation phases of different treatments at different body masses, as calculated from the allometric autoregression model, is illustrated in Figures 1 and 2. Energy intake between sexes at the same live mass differed considerably during the restriction phase. If the end of the restriction phase is taken as a reference point, then the energy intake of ewe lambs was 17,1, 13,7, 11,3, and 7,6 MJ ME/d while

Table 4 Intercept (a) and slope (b) of ln(cumulative ME intake) (x) and ln(body mass), ln(body protein) and ln(body fat) (y) for each treatment during the restriction and realimentation phases

		Feeding level							
		Ad libitum		80%		65%		50%	
Components	Parameters	Ewe	Ram	Ewe	Ram	Ewe	Ram	Ewe	Ram
Restriction phase									
ln(protein)	a	−2,2619	−1,6766	−1,4958	−1,4475	−1,6919	−1,4514	−0,7424	−0,9373
	b	0,5289	0,4708	0,4126	0,4373	0,4374	0,4291	0,2925	0,3484
ln(fat)	a	−5,8135	−5,5710	−5,6916	−5,2702	−5,5679	−4,5204	−3,8448	−4,0569
	b	1,0922	1,0417	1,0647	0,9884	1,0338	0,8631	0,7649	0,7881
Realimentation phase									
ln(protein)	a	−2,2619	−1,6766	−2,9890	−2,2848	−2,9175	−2,5628	−2,2846	−2,5344
	b	0,5289	0,4708	0,6204	0,5536	0,6098	0,5860	0,6014	0,5776
ln(fat)	a	−5,8135	−5,5710	−6,5206	−8,2356	−6,8323	−7,8911	−7,5014	−10,6860
	b	1,0922	1,0418	1,1838	1,4002	1,2179	1,3439	1,2965	1,7369

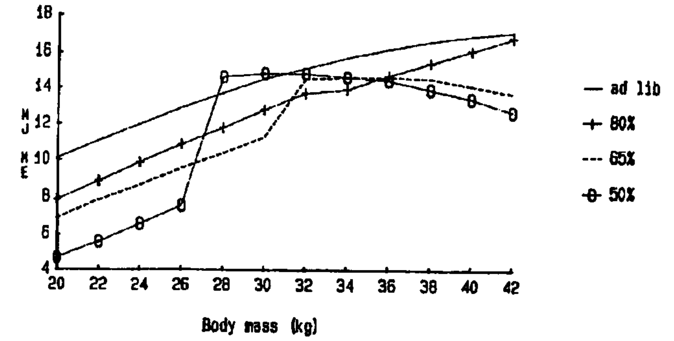

Figure 1 Feed intake in MJ ME per day : ewe.

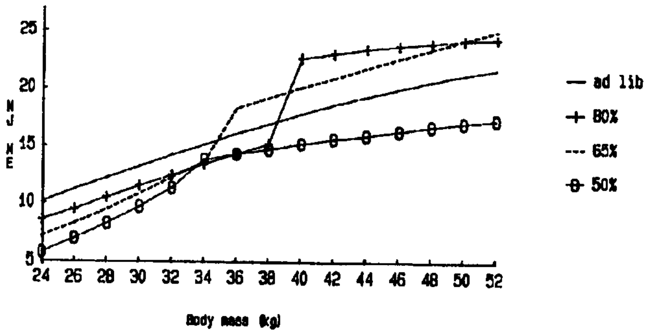

Figure 2 Feed intake in MJ ME per day : ram.

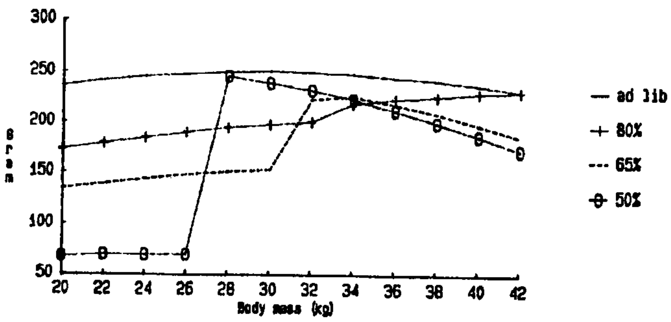

Figure 3 Growth rate in gram per day : ewe.

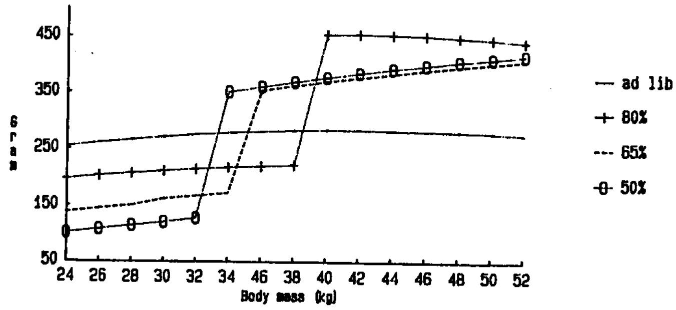

Figure 4 Growth rate in gram per day : ram.

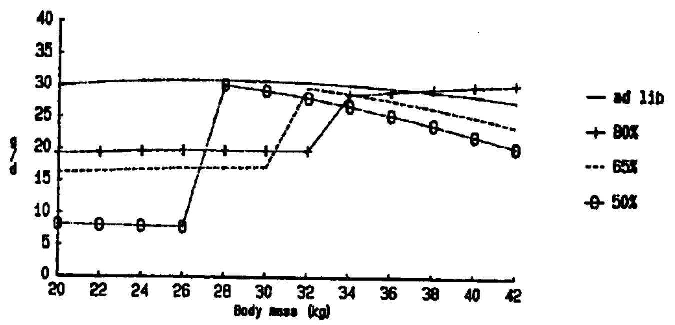

Figure 5 Protein deposition rate : ewe.

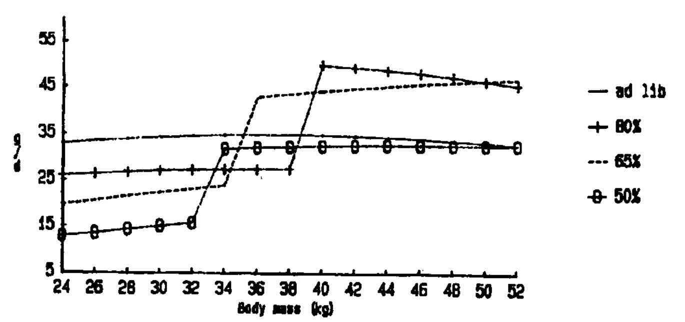

Figure 6 Protein deposition rate : ram.

that of ram lambs was 21,7, 15,2, 13,6 and 11,3 MJ ME/d, respectively, for intake levels of *ad libitum*, and 80%, 65% and 50% of *ad libitum intake*.

With the exception of the energy intake of the ewe lambs on the 80% *ad libitum* intake, the intake of all the other lambs in the restriction groups increased at the beginning of the realimentation phase. The increase in feed intake was 1,5%, 28,3% and 92,1% for the 80%, 65% and 50% intake groups respectively. Only the feed intake of the 50% group exceeded the intake of the *ad libitum* group at the 28 and 30 kg live mass range. After the rise in feed intake, the intake of the 65% and 50% *ad libitum* groups decreased with an increase in live mass.

An increase in the ME intake of ram lambs was also observed at the beginning of the realimentation phase. The increase in feed intake was found to be 16,5%, 34,6% and 48,7% for the 80%, 65% and 50% intake groups respectively. With the exception of the intake from the group receiving 50% of *ad libitum*, the rest of the restriction groups recorded intakes that exceeded that of the *ad libitum* group. These results agree with the general findings of Graham & Searle (1975), Saubidet & Verde (1976), Thornton *et al.* (1979) and Greeff (1984), that feed intake increases after a period of feed restriction. In spite of the increase in energy intake of ewe and ram lambs that occurred at the beginning of the realimentation phases, only the intake of ewe lambs on the 50% intake between 28 and 30 kg and that of ram lambs on the 80% and 65% intake could better the intake of the *ad libitum* group at a specific live mass.

Growth rate

Figures 3 and 4 illustrate the growth rates (g/d) of ewe and ram lambs on the various treatments during the restriction and realimentation phases, as calculated from the allometric autoregression model. As the restriction increased, growth rate decreased. If the end of the restriction phase is taken as reference point, then the growth rate of ewe lambs was 231, 201, 153, and 70 g/d while that of ram lambs was 276, 222, 173, and 128 g/d respectively, for intake levels of *ad libitum*, 80%, 65%, and 50% of *ad libitum* intake. At the start of the realimentation phase there was, in some cases, a remarkable increase in growth rate. The growth rate of ewe lambs increased by 8,9% 45,8% and 251,4% for the 80%, 65% and 50% intake groups respectively. In spite of these increases in growth rate, the growth rate of the restricted groups could not equal or better the rate of the *ad libitum* group at a specific live mass.

At the start of the realimentation phase, the growth rate (g/d) of ram lambs increased by 104,5%, 104,6%, and 174,2% for the 80%, 65%, and 50% intake groups respectively. Owing to these increases the growth rates of all the restricted groups bettered the rate of the *ad libitum* group at a specific live mass.

Thus, it seems clear that superior gains were generally observed following restrictions. Higher growth rates can be attributed to extra water in the gut (Keenan *et al.*, 1969; Drew & Reid, 1975). Increased appetite and the associated gut-fill effects could also be important contributory factors responsible for compensatory growth, especially at the beginning of the realimentation phase.

Protein

The total amount of protein in the body for each treatment during the restriction and realimentation phases is indicated in Table 5.

No differences in the total amount of protein within sex groups at the same body mass could be detected between feeding levels during the restriction phase. With the exception of the amount of protein which showed a tendency to decrease in the bodies of ram lambs on an intake of 50% *ad libitum*, no differences between feeding levels could be detected during the realimentation phase. These results confirm the findings of Searle *et al.* (1982) that feeding levels have no significant influence on the amount of protein at a specific body mass. The general pattern of these results supports the findings of Elliot & O'Donovan (1969) and Meissner & Hofmeyr (1976) that the protein content of animals is remarkably constant at a particular body mass.

The deposition rates of protein at different body masses

Table 5 Total amount of protein in the body for each treatment during the restriction and realimentation phases

Body mass	Feeding level							
	Ad libitum		80%		65%		50%	
(kg)	kg	%[a]	kg	%	kg	%	kg	%
Ewes								
20	2,7	13,8	2,9	14,5	2,9	14,3	2,9	14,6
22	3,0	13,7	3,0	14,1	3,1	14,1	3,2	14,3
24	3,3	13,6	3,3	13,8	3,3	13,9	3,4	14,1
26	3,5	13,5	3,5	13,6	3,6	13,7	≫3,6	14,0
28	3,8	13,4	3,8	13,3	3,8	13,6	3,8	13,5
30	4,0	13,3	4,0	13,2	≫4,0	13,4	4,0	13,3
32	4,3	13,3	≫4,2	13,0	4,2	13,0	4,3	13,3
34	4,5	13,2	4,3	12,6	4,4	13,0	4,5	13,2
36	4,7	13,2	4,5	12,6	4,6	12,9	4,7	13,1
38	4,9	13,1	4,8	12,6	4,9	12,9	4,9	13,1
40	5,2	13,0	5,1	12,6	5,2	12,9	5,2	13,0
42	5,4	13,0	5,3	12,6	4,4	12,9	5,4	12,9
Rams								
24	3,5	14,7	3,6	15,2	3,5	14,6	3,5	14,7
26	3,8	14,5	3,9	15,0	3,7	14,6	3,8	14,6
28	4,0	14,4	4,2	14,9	4,1	14,5	4,0	14,4
30	4,3	14,3	4,4	14,7	4,4	14,5	4,3	14,3
32	4,5	14,2	4,6	14,6	4,6	14,5	≫4,5	14,2
34	4,8	14,1	4,9	14,5	≫4,9	14,5	4,7	13,9
36	5,0	14,0	5,2	14,4	5,0	14,1	4,9	13,6
38	5,3	13,9	≫5,4	14,3	5,3	14,0	5,1	13,4
40	5,5	13,8	5,6	14,1	5,6	13,9	5,3	13,1
42	5,8	13,8	5,8	13,9	5,8	13,8	5,4	12,9
44	6,0	13,7	6,0	13,8	6,0	13,7	5,6	12,7
46	6,3	13,6	6,3	13,7	6,3	13,6	5,8	12,5
48	6,5	13,6	6,5	13,5	6,5	13,5	5,9	12,3
50	6,7	13,5	6,7	13,4	6,7	13,4	6,1	12,2
52	6,9	13,4	6,9	13,3	6,9	13,4	6,2	12,1

[a] As percentage of body mass.

≫ End of restriction phase.

are illustrated in Figures 5 and 6 for the restriction and realimentation phases. It is clear that the deposition rate of protein decreased progressively as restriction during the restriction phase increased. With the onset of the realimentation phase, a large increase in the deposition rate of both sexes took place. The percentage increase for ewe lambs was 244,4% for the 50% intake, 59,1% for the 65%, and 5,4% for the 80% intake group. The increase for ram lambs at the same feed intake was 190%, 121,9% and 118,0% respectively. In spite of the drastic increase in the deposition rate of ewe lambs at the beginning of the realimentation phase, the rate of growth in the groups that were restricted could not equal or better the rate of the *ad libitum* group. However, in the case of the ram lambs, the deposition rate of the 80% and 65% intake groups exceeded that of the *ad libitum* group. These results confirm data reported by Reid *et al.* (1968), Keenan *et al.* (1969) and Thompson *et al.* (1982), and Greeff *et al.* (1986) showed that protein deposition increased after a period of undernutrition. In general, sex differences in the deposition rate do occur during the restriction and realimentation phases.

Fat

The total amount of fat in the carcass, as well as the percentage at different body masses, is given in Table 6 for the restriction and realimentation phases. No differences in the total amount of fat, within sex groups at specific body masses, could be detected between different feeding levels. The total amount of fat in ewe lambs, at a specific body mass, was higher than that of ram lambs.

The deposition rate of fat progressively declined (Figures 7 and 8) with an increasing restriction. The magnitude of the increase during the beginning of the realimentation phase was not large enough to better the rate of the *ad libitum* group. During the realimentation phase, the deposition rate of fat in ram lambs increased at the onset of this phase to such an extent that the rate of all the restricted groups bettered that of the *ad libitum* group.

Table 6 Total amount of fat in the body for each treatment during the restriction and realimentation phases

	Feeding level							
Body mass	*Ad libitum*		80%		65%		50%	
(kg)	kg	%[a]	kg	%	kg	%	kg	%
Ewes								
20	2,6	12,8	2,5	12,5	2,5	12,6	2,5	12,3
22	3,1	14,1	3,0	13,7	3,0	13,8	3,0	13,6
24	3,7	15,3	3,6	14,9	3,6	15,0	3,6	15,0
26	4,3	16,4	4,2	16,1	4,2	16,2	≫4,2	16,5
28	4,9	17,6	4,8	17,3	4,8	17,5	4,8	17,3
30	5,6	18,7	5,5	18,5	≫5,6	18,7	5,5	18,5
32	6,3	19,8	≫6,3	19,7	6,3	19,7	6,3	19,7
34	7,1	20,9	7,1	20,9	7,1	20,9	7,1	20,9
36	7,9	22,0	7,9	22,1	7,9	22,0	7,9	22,0
38	8,7	23,1	8,8	23,3	8,8	23,3	8,8	23,3
40	9,6	24,2	9,8	24,4	9,8	24,4	9,8	24,4
42	10,7	25,3	10,8	25,6	10,8	25,6	10,8	25,6
Rams								
24	2,5	10,5	2,5	10,5	2,5	10,5	3,0	10,5
26	2,9	11,3	2,9	11,3	2,9	11,3	2,9	11,3
28	3,4	12,1	3,4	12,1	3,4	12,1	3,4	12,1
30	3,9	13,0	3,9	13,0	3,9	13,0	3,9	13,0
32	4,4	13,8	4,4	13,8	4,4	13,8	≫4,4	13,8
34	5,0	14,1	5,0	14,1	≫5,0	14,1	5,0	14,6
36	5,6	15,5	5,6	15,5	5,6	15,4	5,6	15,4
38	6,2	16,3	≫6,2	16,3	6,2	16,3	6,2	16,3
40	6,8	17,1	6,8	17,1	6,8	17,1	6,8	17,1
42	7,5	17,9	7,5	17,9	7,5	17,9	7,5	17,9
44	8,3	18,8	8,2	18,7	8,2	18,7	8,2	18,7
46	9,0	19,6	9,0	19,6	9,0	19,6	9,0	19,6
48	9,8	20,4	9,8	20,4	9,8	20,4	9,8	20,4
50	10,6	21,2	10,6	21,2	10,6	21,1	10,6	21,1
52	11,5	22,0	11,4	22,0	11,4	22,0	11,4	22,0

[a] As percentage of body mass.

≫ End of restriction phase.

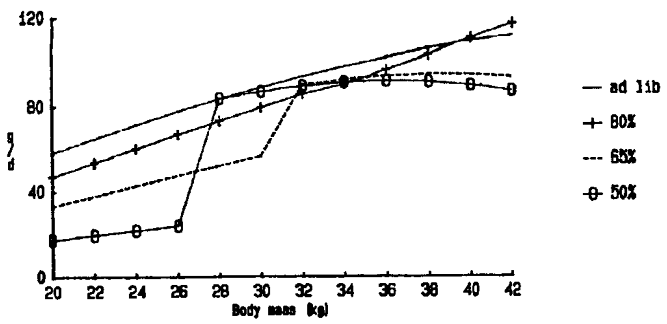

Figure 7 Fat deposition rate : ewe.

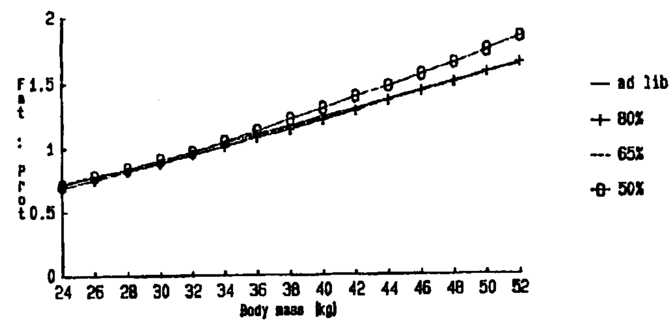

Figure 10 Fat : protein ratio : ram.

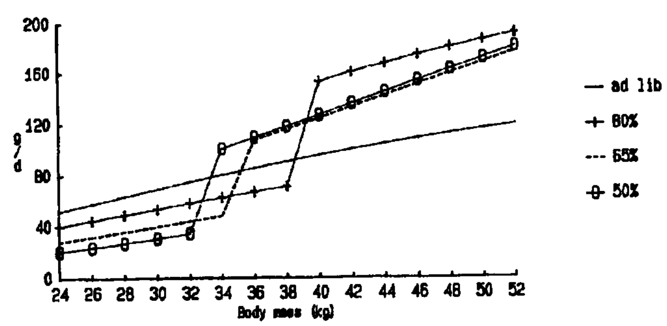

Figure 8 Fat deposition rate : ram.

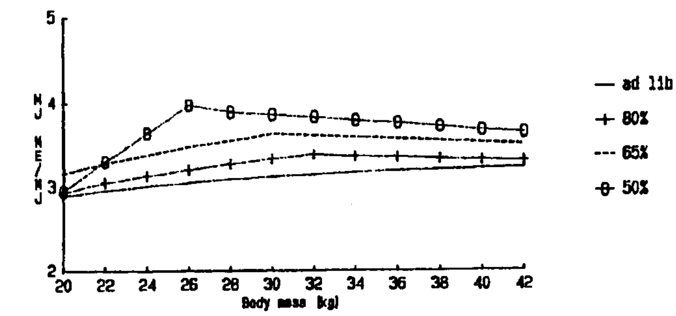

Figure 11 Efficiency of energy conversion : ewe.

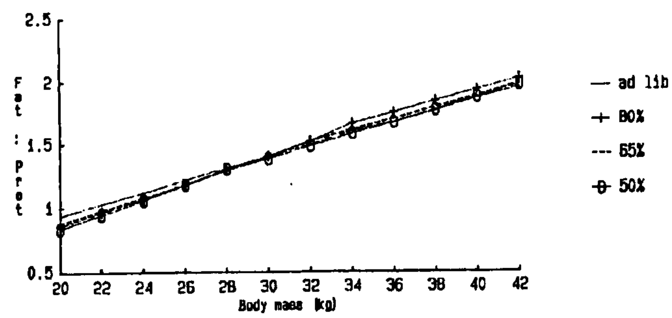

Figure 9 Fat : protein ratio : ewe.

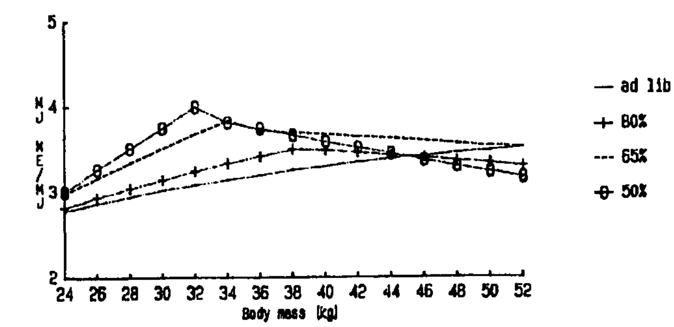

Figure 12 Efficiency of energy conversion : ram.

Fat : protein ratio

The proportion of fat to protein deposited at different body masses for the restriction and realimentation phases is illustrated in Figures 9 and 10. It thus seems clear that feeding levels did not affect the fat : protein ratio of ewe and ram lambs. As expected, the ratio of ewe lambs was greater than that of ram lambs. There was a slight increase in the fat : protein ratio of ram lambs on the 50% *ad libitum* intake group during the realimentation phase. A reason for this slight increase could be found in the lower deposition rate of protein in this group.

Efficiency of energy conversion

The efficiency of energy conversion (MJ ME intake / MJ retained), measured during the restricted and realimentation phases, is illustrated in Figures 11 and 12 for ewe and ram lambs respectively. It is clear that, as the restriction increased, efficiency of energy conversion declined. These results are in close agreement to the results of Greeff (1984) and Greeff *et al.* (1986), but conflict with those of Meissner *et al.* (1977). The efficiency of ram lambs was constantly better than that of ewe lambs throughout the restriction phase. During the realimentation phase, efficiency of energy conversion improved in all cases which showed an increase in live mass. The efficiency increased proportionally to the previously imposed restriction. In spite of these increases, ewe lambs from the restricted groups could not equal or better the utilization of the *ad libitum* group at a specific live mass. Ram lambs followed the same utilization pattern, with the difference that the restricted groups tended to improve on the efficiency of the *ad libitum* group from 46 kg live mass upwards. These results support the findings of Greeff (1984) and Greeff *et al.* (1986), but contradict the results of Meyer & Clawson (1964), Allden (1968) and Jacobs (1972), who found that gross efficiency of energy conversion is not influenced during realimentation. An important question that arises is whether efficiency over the entire trial period was better for certain groups than others. Table 7 gives the feed efficiency for the entire trial period.

According to Table 7, the efficiency of ewe lambs over

Table 7 The energy utilization (MJ ME / MJ) calculated for the entire period of the trial

Feeding level	Ewe	Ram
Ad libitum	3,36	3,75
80%	3,40	3,30
65%	3,56	3,51
50%	3,70	3,04

the entire trial decreased with increased restriction of feed intake, while that of ram lambs, except for the value of the 65% intake group, showed an improvement in efficiency of energy conversion. The results from the ewe lambs do not agree with the general trend described by Meissner (1983), i.e. that the efficiency of energy conversion may improve above that of *ad libitum* intake when feed intake lies between *ad libitum* and 70% of *ad libitum* intake. Results of this study agree with the findings of Wilson & Osbourn (1960) and suggest that the advantage of an increased efficiency during realimentation may be completely eliminated by the reduced efficiency during the restriction phase.

Conclusion

When the total amount of protein or fat or fat:protein ratio is taken as the criterion of body composition when examining compensatory growth in Dorper sheep, no significant differences between feeding levels were found. This confirms the findings of Tulloh (1963), Reid *et al.* (1968), O'Donovan (1984) and Basson (1975) that body composition is uniform at a specific body mass and is independent of feeding level. On the other hand, when deposition rates of protein or fat together with an increase in body mass are taken as criteria, compensatory growth is only exhibited by ram lambs after a period of undernutrition. It seems that differences due to gender were present after a period of feed restriction. This indicates that restriction of ewe lambs would inhibit production and that it would not be economically feasible to do so in order to obtain an increased efficiency of energy conversion. In the case of ram lambs, feed restrictions of up to 50% for nine weeks resulted in a better energy conversion compared to *ad libitum* feeding for the whole growth period.

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