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The Effects of Pregnancy and Nutritional Stress on Fat Partitioning in The Body of Ewes

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ABSTRACT: The present study was conducted to determine the effects of pregnancy and nutritional stress on fat partitioning in the body of ewes. Twenty pregnant and 20 non- pregnant, 3 to 4 year old Pappin Merino ewes were placed in individual pens in an animal house. The pregnant and non-pregnant ewes were allocated to maintenance and weight loss treatment groups on the basis of their liveweight and placed in individual pens. To achieve the required 20% decrease in maternal body weight it was calculated that the low nutrition animals be offered 58% of the ration fed to the maintenace group. After adjustment to the same maternal body weight, there was no effect of nutrition on the weights of body components. Pregnancy status of the ewe did affect body composition, whereby the pregnant ewes had 0.75 and 0.25 kg less carcass muscle and bone respectively, than non-pregnant ewes. Pregnant ewes had a greater weight of dissected fat in the subcutaneous depot (0,16 kg) and less in the kidney fat depot (0.07 kg, $P<0.05$) than non-pregnant ewes. There was also a trend for pregnant ewes to have less fat in the omental depot (0.09 kg), although this difference failed to reach significance ($P=0.085$). The nutrition effect interacted with total dissectible body fat weight. At the same total chemical body fat weight, pregnant ewes had 0.22 and 0.09 kg more chemical fat in the subcutaneous and intermuscular depots, respectively, and 0.05 kg less chemical fat in both the carcass muscle and skin depots, than non-pregnant ewes.

Key Words : Ewes, Pregnancy, Nutritional Stress, Fat Partitioning

Introduction

Fat mobilization in sheep during pregnancies, especially in case of undernutrition is important to meet the energy requirements as foetal demand increase beyond the carbohydrate intake and normal blood glucose levels cannot be maintained. A reduction in capacity of the digestive tract and appetite occurring during the course of prenancy leading in turn to catabolism of body fat to rectify the energy deficit (Heaney and Lodge, 1975).

Lodge and Heaney (1973) found that energy requirements of pregnant ewes increased by 12 to 20% above maintenance during the last third of pregnancy. Hence when nutrient intake is not adequate to meet the increased metabolic demands during late pregnancy, mobilization of maternal tissue, particularly fat, is likely to occur (Close, Noblet and Heavens, 1984). A low plane of nutrition during pregnancy reduced the amount of external carcass fat on ewes and hence reduced energy reserves of these ewes. Pregnancy significantly reduced back fat thickness ("GR") measurement (mm) by 53.6 and 59.2% for two and three foetuses-bearing ewes 145 days of pregnancy, respectively. Reduction 47.3 and 58.8% of internal fat (omental and kidney fat) were also indicated for the ewes had two and three foetuses in 145 days of pregnancy (Owen and Hinch, unpublished data). Russel, Gunn and Doney (1968) found depletion of 86% original subcutaneous fat during the first four mounths of pregnancy period. Weight of mammary gland was reduced in low plane ewes 145 days of pregnancy. Low nutrition during pregnancy appears to reduce the amount of mammary gland tissue and hence have effects of lamb survival and growth rate (Owen and Hinch, unpublished data).

The difference between the effect of pregnancy and nutritional stress on mobilization of fat depots has not been clearly defined. In Scottish-Blackface ewes grazed on low quality pasture during winter, Russel, Gunn and Doney (1968) reported a preferential depletion of the subcutaneous and

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perirenal fat depots during the first four months of pregnancy, compared with last month. The opposite pattern was evident for the omental and mesenteric fat depots, with preferential depletion of these depots occuring during the last month of pregnancy.

However in two separate experiments, Lodge and Heaney (1973, 1975) reported no difference in fat partitioning between the carcass and non-carcass depots in pregnant and non-pregnant ewes fed submaintenance diet. In dairy cows, Butler-Hogg *et al.*(1982) found a preferential depletion of subcutaneous fat during late pregnancy, although their experimental design did not allow them to separate the effects of low nutrition and pregnancy stress.

The present experiment was designed to examine the effect of pregnancy and low nutrition on fat mobilization patterns in sheep.

Materials and Methods

Animals and Experimental Design

Twenty pregnant and 20 non-pregnant, 3 to 4 year old Pappin Merino ewes were placed in individual pens in an animal house, when pregnant ewes were estimated to be 70 days pregnant. The pregnant ewes were from a group in which oestrous had been synchronised using intravaginal sponges and which have been mated during the second cycle after sponge withdrawal. For the next 70 days all ewes were run as a single group on pasture, which was of sufficient quality for the ewes to maintain bodyweight. Sixty days after mating, pregnancy status was confirmed by an ultrasonic scan, and only single bearing ewes retained for this experiment.

Seventy days after mating, pregnant and non-pregnant ewes were allocated to maintenance and weight loss treatment groups on the basis of their liveweight and placed in individual pens. Due to restriction in animal house space, it was necessary that ewes from the four pregnancy/nutrition treatments be randomised into two animal houses. Both pregnant and non pregnant ewes in the maintenance treatment group were fed at a level to maintain maternal body weight (i.e. liveweight minus estimated conceptus weight) over the next 70 days of the experiment, whereas both pregnant and non-pregnant animals in the weight loss treatment group were fed at a level to lose an estimated 20% (or approximately 8 kg) of the conceptus-free liveweight over this period.

Conceptus weight during pregnancy was estimated in individual animals using the equation :

$$Z = qX^r,$$

Where:

Z = total weight of conceptus (g),

X = day of pregnancy, in days from mating, and q and r were constants estimated by Langlands and Sutherland (1968) as 1.4873×10^{-2} and 2.5996, respectively.

Feeding levels for individual ewes from the four treatment groups were calculated using the formulae described by MAFF (1984), which incorporated the appropriate adjustments for stage of pregnancy and weight loss pattern. To achieve the required 20% decrease in maternal body weight it was calculated that the low nutrition animals be offered 58% of the ration fed to the maintenance group.

During the first few weeks of the experiment ewes were weighed every few days and liveweights plotted relative to the predicted growth path. If, for an individual ewe, divergence of the actual from predicted liveweights was greater than 2 kg, susequent feed intakes were adjusted to minimise future divergence. After an initial two weeks this divergence was generally less than 1 kg and ewes were subsequently weighed weekly.

Feed Composition

Ewes were fed daily a commercial pelleted ration comprising lucerne meal (60%), sorghum (19,4%), millrun (20%), salt (0,03%), and a vitamin mineral mix (0.56%). The ration comprised 89.5% dry matter, 13.2% crude protein and 71.3% total digestible organic matter, with an estimated metabolizable energy content of 10.5 MJ of ME/kg dry matter.

Slaughter, Dissection and Chemical Analysis

After 70 days of feeding when the pregnant ewes were estimated to be 140 pregnant, ewes were fasted for approximately 24 hours, prior to being injected with 10 ml Nembutol, weighed, and slaughtered. After evisceration, the alimentary tract was weighed both full and empty and digesta weight estimated by difference. A 30 cm^2 midside section was removed from the pelt and the wool removed using small animal clippers. The ratio of wool to skin in the sample was used to estimate fleece weight and skin weight.

Non-carcass tissues were separated into eight components : kidney fat, omental fat, mesenteric fat, udder fat, viscera (which included all thoracic and abdominal organs, with the exception of the reproductive tract), head and legs (the head, distak limb bones and tail), skin and reproductive organs (which included the conceptus where appropriate). Definitions for the fat depots were described by Thompson *et al.*(1987). The eight components were stored at -20°C for further analysis.

Hot carcasses were weighed, stored at 2°C for 24 hours, halved, the left side jointed into five joints (i.e. hindlimb, loin, flank, thorax and forelimb as described by Thompson, Atkins and Gilmour, 1979) and stored at -20°C for dissection.

The joints were thawed and dissected into subcutaneous (defined as fat overlying all other tissue of the carcass, including fat deep to the *M. cutaneous trunci et omobrachialis*) and intermuscular fat (which included tendons, ligaments, blood vessels, nerves, lymp nodes associated with intermuscular fat, cartilages and the spinal cord), muscle and bone. Care was taken to minimise dissection losses, with recoveries in the range of 97 to 99%. The dissected tissues were bulked across joints and stored at -20°C for chemical fat analysis.

Both dissected and slaughter components were minced several times and 150 g sub-sampled for chemical fat determinations using the Foss-let Fat Extractor (Usher, Green and Smith, 1973).

Statistical Analyses

Data from three pregnant ewes, one which aborted after 16 weeks of pregnancy, and two which lambed two weeks before the final slaughter, were discarded from the analysis.

Correction factors for the last seven weeks of the experiment were analysed using a repeated measures analysis which contained terms for nutrition, pregnancy, animal house and all first order interactions. Orthogonal contrasts were used to partition the variance associated with time interactions.

Both dissected tissue and chemical fat weights were logarithmic transformed in order to minimise the correlation between means and variance. Transformed data were analyzed using least square multivariate analyses of variance to examine the effects of nutrition, pregnancy, animal house, a covariate and their interactions on components of total body composition, the covariate was fleece-free maternal empty body weight (i.e. final body weight minus estimated fleece weight, digesta weight, the weight of the conceptus and the udder). For partitioning of dissected and chemical fat weights in the body, the covariates were total dissected fat weight and total chemical fat weight, respectively. From the full models (which comprised all main effects and interactions) non-signicant interactions ($P>0.05$) were sequentially deleted to obtain the simplest significant model.

Results

Feeding Correction Factors

Mean feeding correction factors for the four pregnancy/nutrition treatment groups over the last seven weeks of the exoeriment are plotted against time in Figure 1. When the seven feeding correction factors were examined simultaneously in a repeated measure analysis there were significant effects ($P<0,001$) for the pregnancy, nutrition and the pregnancy X nutrition terms. The linear time contrast was significant ($P<0,001$) for the latter term, indicating that there was a linear change in the pregnancy X nutrition interaction over time. Curvilinear and cubic time contrasts were not significant for the pregnancy X nutrition interaction term. For both the pregnant and non-pregnant weight loss treatments and the pregnant maintenance treatment groups there was a decline of approximately 30% in the feeding correction factors over the last seven weeks of the experiment, indicating that the ewes in these groups required progressively less feed to achieve their predetermined pattern of liveweight change. In contrast, the feed required to maintain the non-pregnant maintenance treatment group was as predicted by the MAFF feeding tables, and did not change over the period of the experiment.

As the exeriment progressed the feeding correction factors required for the weight loss treatments decreased at a faster rate than for the maintenance treatments, indicating that the weight loss ewes were becoming increasingly more efficient at achieving their predetermined pattern of weight loss than predicted by the MAFF feeding tables.

Fleece-Free Empty and Maternal Body Weights

Table 1 presents body weights for ewes from the initial and final slaughter groups. At the initial slaughter there was no difference between pregnant and non- pregnant ewes either their fleece-free and maternal empty body weights.

At the final slaughter, pregnant ewes on the maintenance feeding level had increased their fleece-free empty body weight relative to the non-pregnant ewes, although when the weight of the gravid uterus and udder were taken into account there was no change between pregnant and non- pregnant treatments in maternal empty body weight. For the weight loss treatment there was a similar divergence in fleece-free empty body weight between ewes in the pregnant and non-pregnant treatments, although again there was no difference in maternal empty body weights for the maintenance and weight loss treatments was approximately 20%.

Body Composition

Mean weights for dissected and chemical body components are presented in Table 1. There was little difference in the mean weights of body components between ewes from the initial slaughter group and the maintenance level of feeding, whereas ewes in the weight loss treatment had approximately 1.8 kg of carcass muscle and 2.6 kg of dissectible body fat less than ewes from the other treatment groups.

After adjustment to the same maternal body weight, there was no effect of nutrition on the weights of body components (Table 2). Pregnancy status of the ewe did affect body composition, whereby the pregnant ewe had 0.75 and 0.25 less carcass muscle and bone respectively, than non pregnant ewes. There was no effect of pregnancy on either total dissectible and chemical body fat. Within the dissected and chemical components, pregnancy and nutrition had no affect on allometric coefficients. However, allometric coefficients did differ between body components, with both total dissected and chemical body fat having coefficients greater than 1 ($P<0.05$), and carcass muscle and bone having coefficients which were less than 1 ($P<0.05$).

Fat Partitioning

Dissectible fat depots. Pregnancy and nutrition affects on the partitioning of dissectible fat in the body are presented in Table 3. After adjustment to the same total dissectible fat weight in the body, pregnant ewe had a greater weight of dissected fat in the subcutaneous depot (0.16 kg) and less in the kidney fat depot (0.075 kg, $P<0.05$) than non pregnant ewes. There was also a trend for pregnant ewes to have less fat in the omental depot (0.09 kg), although this difference failed to reach significance ($P = 0.085$).

The nutrition effect interacted with total dissectible body fat weight, indicating that the magnitude of the difference between the maintenance and weight loss treatments in fat partitioning changed as total dissectible body fat weight increased. On both a multivariate (in which each level of the dependent variable was omitted in turn and the remaining levels refitted to the final model) and univariate basis, the significance of the nutrition X total dissectible fat interaction was due to the mesenteric depot. To illustrate the effect of nutrition on fat partitioning as total fat weight increased, predicted means for the maintenance and weight loss treatments are presented at 4.0 and 7.0 kg (Table 3).

At low levels of total dissectible body fat the weight loss treatment had less mesenteris fat than the maintenance treatment, whereas at the higher levels of fat there was no effect of nutrition.

The allometeric coefficients indicate the proportional change in depot weight relative to changes in total body fat. As total body fat weight increased the proportions of subcutaneous, kidney and omental fat increased (i.e. $b>1$, $P<0.05$), whereas the proportions of intermuscular and thoracic fat decreased ($b<1$, $P<0.05$). For the maintenance nutrition group the proportion of mesenteric fat remained constant as total fat weight increased, whereas for the wight loss treatment the proportion of mesenteric fat decreased.

Chemical fat depots. Pregnancy and nutrition effects on the partitioning of chemical fat in the body are presented in Table 4. The magnitude of the pregnancy effect was constant over the range in total chemical fat weight. At the same total chemical body fat weight, pregnant ewes had 0.22 and 0.09 kg more chemical fat in the subcutaneous and intermuscular depots respectively, and 0.05 kg less chemical fat in both the carcass muscle and skin depots, than non-pregnant ewes.

As for the partitioning of dissectible body fat, the nutrition X total chemical body fat weight interaction was significant ($P<0.05$) for the partitioning of chemical fat, indicating that the magnitude of the nutrition effect changed as total chemical fat weight increased. Again the interaction was largely due to the mesenteric depot, whereby at the lower levels of total chemical body fat weight, the weight loss treatment had less fat than the maintenance treatment, although at the higher levels of chemical fat weight there was no effect of nutrition.

Tabel 1. Mean weights and standard deviations for fleece-free empty body weight, total dissected body fat, total carcass muscle and total carcass bone for ewes from the initial and final slaughter groups

Component	Initial slaughter (day 70)		Final slaughter (day 140)			
			Maintenance		Weight loss	
	Pregnant	Non-pregnant	Pregnant	Non-pregnant	Pregnant	Non-pregnant
No. of animals	6	6	9	10	8	10
Fleece-free empty body weight (kg)[a]	29.64 (3.28)	29.89 (3.51)	35.93 (4.25)	30.00 (3.74)	28.25 (2.27)	24.03 (3.55)[b]
Maternal empty body weight (kg)[c]	28.20 (3.05)	29.67 (4.44)	28.72 (2.70)	29.83 (3.71)	22.53 (3.55)	23.37 (4.01)
Gravid uterus (kg)	1.32 (0.30)	0.10 (0.04)	7.12 (1.06)	0.07 (0.02)	6.40 (0.76)	0.06 (0.02)
Body composition :						
Total carcass muscle (kg)	8.63 (0.65)	9.25 (0.94)	8.12 (1.02)	8.94 (1.02)	6.35 (0.57)	7.61 (0.72)
Total carcass bone (kg)	2.56 (0.24)	2.56 (0.27)	2.18 (0.27)	2.47 (0.29)	2.05 (0.20)	2.36 (0.18)
Total dissectible body fat (kg)	7.05 (1.85)	7.15 (1.96)	7.11 (2.40)	7.23 (2.37)	4.24 (1.85)	4.82 (2.64)
Total chemical body fat (kg)	n.a.	n.a.	7.15 (2.26)	7.51 (2.48)	4.14 (1.72)	4.95 (2.58)

[a] Fleece-free empty weight was calculated as slaughter weight minus fleece and digesta.
[b] Maternal empty body weight was calculated as fleece- free empty body weight minus the weight of the gravid uterus and udder.
[c] Figures in paranthesis are standard error of the treatment means.

Tabel 2. The effect of pregnancy and nutrition on dissectible and chemical body components, after adjustment to 25.960 kg maternal empty body weight

Components	Pregnancy		Av.SE in $\log_{10}$ Units	Nutrition		Av.SE in $\log_{10}$ Units	Allometric Coefficient	Av.SE in $\log_{10}$ Units
	Pregnant	Non Pregnant		Maintenance	Weight loss			
Carcass muscle (kg)	7.42[a]	8.17[b]	0.010	8.08	7.51	0.011	0.48	0.117
Carcass bone (kg)	2.14[a]	2.39[b]	0.010	2.19	2.34	0.012	0.42	0.127
Total dissectible body fat (kg)	5.57	5.30	0.027	5.19	5.69	0.033	2.55	0.334
Total chemical body fat (kg)	5.60	5.49	0.027	5.32	5.77	0.029	2.48	0.300

a, b. The different superscript indicate significant different ($P<0.05$)

The allometric coefficients for weights of chemical fat depots relative to total chemical fat weight are shown in Table 4. As total chemical fat increased the proportions of chemical fat in the subcutaneous, kidney and omental fat depots increased ($b>1$, $P<0.05$), whereas there was little change in the proportions of chemical fat in the intermuscular and skin depots (b not significantly different from 1). The proportions of chemical fat in both the viscera and muscle depots decreased, with a greater rate of decrease in the proportions of chemical fat in the carcass bone and head, legs and tail depots, as total chemical fat weight increased.

Discussion

The design of the experiment required pregnant and non-pregnant animals to be individually fed to either maintain or lose 20% of their maternal body weight over 70 day period. The desired changes in maternal liveweight were achieved for all groups, although the feeding correction factors indicated that for all but the maintenance non-pregnant treatment, the level of feeding at the end of the experiment required to achieve the predetermined changes in liveweight were overestimated by approximately 13% for the maintenance pregnant treatment and approximately 30% for both the pregnant and non-pregnant weight loss treatments. As discussed by Turner and Taylor (1983) the efficiency at which animal utilize their feed can change over time.In this study this was particularly noticeable in the weight loss treatments. These results suggest that over extended periods of feeding the energy allowances for pregnancy and weight loss provided by the MAFF overestimate energy requirements for ewes.

Loss in dissected fat of the pregnant ewes (39.8% of the initial dissected fat) during 70 days of pregnancies in present study was relatively high in comparation with those of Russel *et al.* (1968) and Lodge and Heaney (1973) who indicated loss in dissected fat of 70.6% of the initial during nearly 5 month of pregnancy and 62.0% of the initial dissected fat during 140 days of pregnancy, respectively. This difference might be due to difference in amount of initial fat reserve before the period of undernourishment as well as the severity of undernourishment. Of the main carcass components, fat (internal and carcass fats) reduced in the highest rate (50.8%) and then it was followed by muscle (40.2%) and bone (9.0%). This was in agreement with those recorded by Palsson (1955) that the lattest maturing tissues (fat) are most affected during undernutrition.

Exceptionally inreasing demand of foetus for energy, protein and mineral during late pregnancy might had depleted carcass muscle and bone and kidney fat of the pregnant ewes in this study as has been shown by Russel *et al.*(1968) and Lodge and Heaney (1975) in undernourishment pregnant ewes and Reid, Robert and Baird (1980) in underfeeding pregnant Frisian x Jersey cows.

Results of present study was in contrast with those of Butler-Hogg, et al, (1985) who found that subcutaneous fat was preferentially depleted during late pregnancy. Of the internal fat, only kidney fat was significantly reduced during pregnancy as has previously been indicated by Russel *et al* (1968) in Scottish Black Face ewes.

Tabel 3. Predicted means and all allometric growth coefficients for the effect of pregnancy and nutrition on fat partitioning between the dissected fat depots. The predicted means for the pregnancy effects were adjusted to a mean total fat weight of 5.00 kg total dissected body fat, whereas for the nutrition effect predicted means were adjusted to both 4.00 kg (A) and 7 kg (B) total dissected body fat. The average standard errorfor predicted means (the figures in parentheses) are in units of $\log_{10}$

Components	Predicted means						Allometric growth coefficient 'b'	
	Pregnancy			Nutrition		Overall mean	Least square dev. due to nutrition	
	Pregnant	Non Preg-nant	Total chemical body fat	Mainte-nance	Weight loss		Mainte-nance	Weight loss
Subcutaneous fat	1.05[a]	0.89[b]	A) 4 kg	0.76	0.66	1.37	-0.01	0.01
	(0.016)			(0.021)		(0.062)	(0.064)	
			B) 7 kg	1.63	1.37			
				(0.017)				
Intermuscular fat	2.41	2.38	A) 4 kg	2.07	2.05	0.68	-0.01	0.01
	(0.011)			(0.011)		(0.033)	(0.033)	
			B) 7 kg	3.00	3.01			
				(0.009)				
Kidney fat	0.38[a]	0.45[b]	A) 4 kg	0.31	0.29	1.42	-0.11	0.11
	(0.024)			(0.032)		(0.094)	(0.094)	
			B) 7 kg	0.65	0.68			
				(0.026)				
Omental fat	0.62	0.71	A) 4 kg	0.44	0.51	1.50	-0.02	0.02
	(0.027)			(0.036)		(0.107)	(0.107)	
			B) 7 kg	1.01	1.20			
				(0.030)				
Mesenteric fat	0.43	0.43	A) 4 kg	0.41[a]	0.33[b]	0.71	-0.25	0.25
	(0.016)			(0.022)		(0.065)	(0.064)	
			B) 7 kg	0.53	0.56			
				(0.018)				
Thoracic fat	0.06	0.06	A) 4 kg	0.05	0.50	0.71	-0.27	0.27
	(0.046)			(0.062)		(0.184)	(0.0180)	
			B) 7 kg	0.08	0.07			
				(0.051)				

a, b. The different superscripts indicate significants indicate significant different (P<0.05)

Tabel 4. Predicted means (average SE) and allometric growth coefficients (average SE) for the effect of pregnancy and nutrition on fat partitioning between the chemical depots. The predicted means for the pregnancy effects were adjusted to a mean total fat weight of5.00 kg total chemical body fat, whereas for the nutrition effect predicted means were adjusted to both 4.00 kg (A) and 7 kg(B) total chemical body fat. The average standard error for predicted are in units of $\log_{10}$.

Components	Predicted means					Overall mean	Allometric growth coefficient 'b'	
	Pregnancy			Nutrition			Least square dev. due to nutrition[a]	
	Pregnant	Non Preg-nant	Total chemical body fat	Mainte-nance	Weight loss		Mainte-nance	Weight loss
Subcutaneous fat	0.75^b	0.53^c	A) 4 kg	0.47	0.38	1.789	-0.12	0.12
	(0.019)			(0.026)		(0.078)	(0.076)	
			B) 7 kg	1.20	1.11			
				(0.021)				
Intermuscular fat	1.26^b	1.17^c	A) 4 kg	1.02	0.92	1.011	-0.10	0.00
	(0.011)			(0.014)		(0.052)	(0.051)	
			B) 7 kg	1.70	1.71			
				(0.014)				
Carcass muscle	0.43^b	0.48^c	A) 4 kg	0.46	0.37	0.459	0.00	0.00
	(0.016)			(0.024)		(0.073)	(0.071)	
			B) 7 kg	0.60	0.48			
				(0.020)				
Carcass bone	0.45	0.48	A) 4 kg	0.47	0.46	-0.002	-0.09	0.09
	(0.020)			(0.027)		(0.080)	(0.078)	
			B) 7 kg	0.45	0.48			
				(0.022)				
Kidney fat	0.33	0.38	A) 4 kg	0.26	0.23	1.622	-0.22	0.22
	(0.028)			(0.038)		(0.133)	(0.111)	
			B) 7 kg	0.58	0.63			
				(0.031)				
Omental fat	0.54	0.61	A) 4 kg	0.37	0.42	1.687	-0.10	0.10
	(0.028)			(0.043)		(0.128)	(0.125)	
			B) 7 kg	0.91	1.14			
				(0.035)				
Mesentric fat	0.34	0.32	A) 4 kg	0.31^b	0.24^c	0.879	-0.33	0.33
	(0.046)			(0.062)		(0.184)	(0.091)	
			B) 7 kg	0.43	0.46			
				(0.025)				
Viscera	0.36	0.38	A) 4 kg	0.35	0.32	0.473	-0.09	0.09
	(0.017)			(0.023)		(0.068)	(0.067)	
			B) 7 kg	0.34	0.35			
				(0.014)				
Head, leg and tail	0.31	0.31	A) 4 kg	0.31	0.30	0.222	-0.05	0.05
	(0.015)			(0.017)		(0.050)	(0.049)	
			B) 7 kg	0.34	0.35			
				(0.014)				
Skin	0.13^b	0.17^c	A) 4 kg	0.11	0.15	0.753	0.29^b	-0.29^c
	(0.033)			(0.047)		(0.140)	(0.136)	
			B) 7 kg	0.20	0.19			
				(0.038)				

[a]The least square deviations in the allometric coefficients for the maintenance and weight loss treatments

b, c. The different superscripts indicate significant difference (P<0.05)

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Conclusions

From the results obtained in the study, it was concluded that pregnancy significantly reduced carcass muscle and bone and kidney fat, but significantly increased the magnitude of subcutaneous fat, while total dissectible and chemical body fat did not different compared with the non- pregnant ewes. Nutrition levels (maintenance and submaintenence) did not affect fat partitioning (excepted for mesenteric fat) and carcass composition of the ewes.

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