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Relationships between fat depots and body condition score or live weight in Awassi ewes

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SUMMARY - Eighty-four ewes, aged 2.5 to 8.5 years, ranging in body condition score (BCS) from 1.0 to 4.0, and in live weight (LW) from 27 to 74 kg, were slaughtered approximately 60 days after mating. The weights of the carcass and five fat depots, omental, mesenteric, pericardial, channel and kidney, and tail were recorded. The left side of the carcass of 34 ewes was separated into subcutaneous fat, muscle and inter and intramuscular fat, and bone. Each unit change in BCS resulted in a 11.8 kg change in LW (LW = 27.9 + 11.8 BCS, R^2 = 0.60, P<0.001). Although all regressions of the weights of the five fat depots, subcutaneous fat and muscle + fat on log LW and BCS were significant (P<0.001), LW was a better predictor of fat weights, with R^2 ranging from 0.44 to 0.90 for individual fat depots, than BCS, with R^2 ranging from 0.23 to 0.66. The equations for the prediction of total weight of depot fats (TDF) were: log TDF = -4.99 + 3.52 log LW (R^2 = 0.90, rse = 0.238); log TDF = 7.02 + 0.87 BCS (R^2 = 0.66, rse = 0.442).

Key words: Body condition, live weight, fat depots, fat tailed sheep.

***RESUME** - "Relations entre les dépôts de gras et la note d'état corporel ou le poids vif chez des brebis Awassi". Quatre-vingt-quatre brebis, âgées de 2,5 à 8,5 ans, dont la note d'état corporal (NEC) allait de 1,0 à 4,0 et le poids vif (PV) de 27 à 74 kg, ont été abattues environ 60 jours après la saillie. Les poids de la carcasse et de cinq dépôts de gras, omental, mésentérique, péricardial, pelvico-rénale, et de la queue, ont été enregistrés. La partie gauche des carcasses de 34 brebis a été séparée en gras sous-cutané, muscle et gras inter et intramusculaire, et os. Chaque variation d'un point de la note d'état corporel a correspondu à une variation de 11,8 kg de poids vif (PV = 27,9 + 11,8 NEC, R^2 = 0,60, P<0,001). Bien que toutes les régressions des poids des cinq dépôts de gras, du gras sous-cutané et du muscle + gras sur log PV et NEC aient été significatifs (P<0,001), le PV a été un meilleur prédicteur des poids de gras, avec R^2 allant de 0,44 à 0,90 pour les dépôts de gras individuels, par rapport à la NEC, avec R^2 allant de 0,23 à 0,66. Les équations pour la prédiction du poids total des dépôts de gras (TDG) ont été : log TDG = -4,99 + 3,52 log PV (R^2 = 0,90, rse = 0,238) ; log TDG = 7,02 + 0,87 NEC (R^2 = 0,66, rse = 0,442).*

***Mots-clés :** Etat corporel, poids vif, dépôts gras, brebis à queue grasse.*

Introduction

Body condition scoring has been widely adopted for managing the nutrition of flocks, especially when grazing, and for selecting lambs for slaughter. In Britain, and now increasingly in Europe, body scoring is based on a subjective assessment of the fat level and muscle thickness on the backbone behind the last rib, according to a five-point scale described by Russel *et al.* (1969).

In fat-tailed breeds of sheep, although the level of fatness of the tail is clearly visible and can be palpated easily, scoring of the tail in a systematic manner has not been widely adopted. Hossamo *et al.* (1986) proposed a modified scoring system for Awassi ewes that combined the lower part of the scale of Russel *et al.* (1969), from 0 to 3, with assessment of the fatness of the tail and the prominence of the coccygeal bones. Atti (1991) showed that weights of some fat depots and total fat were more closely correlated in Tunisian Barbarine sheep with tail score or measurements than with

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lumbar score on the scale of Russel *et al.* (1969), or with live weight. Unfortunately, the five point scoring scale for the fat-tail was not described in detail.

Scoring on the scale of Russel *et al.* (1969) has been used for several years at ICARDA to assess body condition of Awassi ewes. When a large number of cull ewes were slaughtered to assess ovulation rate and embryo mortality, in an experiment to assess the effects of body condition and level of feeding before mating on the fertility of Awassi ewes, the relationships between body condition score (BCS), live weight (LW) and the weights of the different fat depots were examined.

Material and methods

The study was made on a group of 84 Awassi ewes consisting of 27, 25, 4, 12, 7, 7 and 2 ewes aged 8.5, 7.5, 6.5, 5.5, 4.5, 3.5 and 2.5 years, respectively. They were transferred to maintenance feeding at mating and slaughtered approximately 60 days later.

All ewes were weighed and body scored using the method of Russel *et al.* (1969) on the morning of the day before they were slaughtered at the Aleppo abattoir. After slaughter, the weights of the following parts were recorded while they were still hot: carcass, head, feet, skin, all organs, and five fat depots, omental, mesenteric, pericardial, channel and kidney, and tail.

A subgroup of 34 ewes, consisting of 15 ewes aged 7.5, 10 aged 5.5, 2 aged 4.5 and 7 aged 3.5 years, covering the range of body condition found in the complete group, were taken for carcass dissection and chemical analysis. The carcass was split in half by making an incision in the neck to the right of the vertical process and then splitting down the centre of the backbone with a cleaver. This resulted in all, or a major part of, the vertical process remaining on the left side of the carcass. The left side of the carcass was cut into three joints, the shoulder and neck, hind quarter and ribs. The carcass was cut through immediately behind the last rib to remove the hind quarter, the shoulder was removed by cutting against the ribs and the neck was removed at the tenth vertebra. Knife dissection was then carried out to separate these joints into subcutaneous fat, muscle plus inter- and intramuscular fat (muscle + fat), and bone.

Regression analysis was made, using GENSTAT 5, of the relationships between live weight and BCS and between the dependent variables, weights of fat depots, muscle + fat, and bone, and live weight and BCS, using logarithmic transformations of the values of the dependent variables and live weight.

Results and discussion

Table 1 shows the means and ranges in values of live weight, BCS, and the weights of the five fat depots, omental, mesenteric, pericardial, channel and kidney, and tail, for all eighty-four animals and the weights of the three separated fractions, subcutaneous fat, muscle and intra- and intermuscular fat and bone, for the thirty-four ewes that were dissected.

Relationship between live weight and body condition

The equation for the regression of live weight (LW) on body condition score (BCS) was:

$$LW = 27.9 + 11.8\ BCS,\ R^2 = 0.60,\ P<0.001$$

This indicates that the live weight of Awassi ewes in this study changed by 11.8 kg for each unit change in BCS. This is very similar to the change in live weight of 11.3 k per unit of BCS found in Rasa Aragonesa ewes by Teixeira *et al.* (1989) and a little higher than the change of 10.6 kg per unit BCS found by Russel *et al.* (1969) in Scottish Blackface ewes. In other breeds, lower changes per unit of BCS have been reported, ranging from 7.3 kg in Australian Merinos (Guerra *et al.*, 1972) to 7.9 to 3.3 kg in eight British breeds and crosses (Geisler and Fenlon, 1979).

Table 1. Mean and range in BCS, live weight and weights of fat depots, muscle and intra- and intermuscular fat, and bone

Live weight (kg)	51.5	27.0 - 74.0
BCS	2.0	1.0 - 4.0
Fats (g)		
Omental	1405	40 - 3906
Mesenteric	716	111 - 2004
Pericardial	204	21 - 379
Kidney and Pelvic	926	40 - 3516
Tail	2448	36 - 5664
Subcutaneous fat[††] (g)	2766	305 - 6481
Muscle + fat[†,††] (g)	14534	7333 - 19229
Bone[††] (g)	4080	3214 - 4910

[†]Muscle plus inter- and intramuscular fat
[††]n: 34 (see text)

More information is required on the relationships between LW and BCS for both fat-tail and thin-tail breeds to establish whether there is a consistent difference between different types of breeds. For example, a recent experiment at ICARDA on Awassi ewes showed a slightly lower change in live weight of 9.3 kg per unit BCS.

Relationships of fat depots with live weight and body condition

Initially, separate regressions between LW or BCS and the weights of the fat depots were calculated for the dissected and non-dissected groups of ewes for the common variables. In only one case, the regression of the weight of omental fat on BCS, was there a significant difference between the regressions for the two groups. There was no effect of age of ewe on the relationships. All data from the dissected and non-dissected groups were, therefore, combined in single regressions in the subsequent analyses. All regressions were significant ($P<0.001$).

Comparison of the regression equations in Tables 2 and 3 indicates that, in all cases, regressions on LW explained more of the variation than those on BCS. This differs from the results of a similar study by Teixeira *et al.* (1989) of the thin-tailed Rasa Aragonesa breed, where BCS was a better predictor of the total weight of fat, and the weights of individual fat depots, than LW.

The ranking of the allometric coefficients (b) for the different fat depots and dissected fractions derived from the regressions with log LW and BCS (Tables 2 and 3) were exactly the same, with rate of deposition in the order, muscle and inter- and intramuscular fat, pericardial fat, mesenteric fat, subcutaneous fat, tail fat, kidney and pelvic fat and omental fat. The allometric coefficients in relation to BCS (Table 3) show a similar pattern to those in relation to BCS reported by Teixeira *et al.* (1989) in Rasa Arogonesa ewes, with high values for the omental, kidney and pelvic, and subcutaneous fats and a lower value for mesenteric.

Conclusions

The results from this group of Awassi ewes, which were typical of flocks in northern Syria, indicate a very large change in live weight of 11.8 kg for each unit change in BCS. LW was a better predictor of the weights of depot fats and dissected fractions than BCS.

Table 2. Regression equations on the weights (y) of fat depots, muscle and intra- and intermuscular fat, and bone on live weight (LW)
log y = a + b log LW

y	a	b	se of b	R^2	rse†
1. Omental	-9.52	4.20	0.236	0.79	0.395
2. Mesenteric	-2.97	2.40	0.182	0.67	0.306
3. Pericardial	-0.64	1.50	0.186	0.43	0.312
4. Kidney and Pelvic	-9.33	4.05	0.260	0.74	0.435
5. Tail	-7.49	3.84	0.255	0.73	0.427
6. Subcutaneous††	-6.10	3.52	0.208	0.90	0.245
7. Muscle + fat†††,††	+5.67	0.99	0.040	0.95	0.047
8. Bone††	+7.20	0.28	0.063	0.36	0.074
9. Total depot fats††††,††	-4.99	3.52	0.202	0.90	0.238

†Residual standard error
††n: 34 (see text)
†††Muscle plus inter- and intramuscular fat
††††Total of depots 1 to 6

Table 3. Regressions of the weights of fat depots, muscle and inter- and intramuscular fat, and bone (y) on body condition score (BCS)
log y = a + b BCS

y	a	b	se of b	R^2	rse†
1. Omental	4.68	1.15	0.100	0.61	0.541
2. Mesenteric	5.27	0.59	0.076	0.41	0.410
3. Pericardial	4.56	0.34	0.068	0.23	0.363
4. Kidney and Pelvic	4.42	1.07	0.109	0.53	0.530
5. Tail	5.61	0.99	0.109	0.50	0.586
6. Subcutaneous fat††	5.89	0.87	0.107	0.67	0.440
7. Muscle + fat†††,††	9.09	0.23	0.032	0.61	0.130
8. Bone††	8.19	0.06	0.020	0.18	0.084
9. Total depot fats††††,††	7.02	0.87	0.107	0.66	0.442

†Residual standard error
††n: 34 (see text)
†††Muscle plus inter- and intramuscular fat
††††Total of depots 1 - 6

When the total amount of inter- and intramuscular fat has been estimated by chemical analysis of the dissected fraction containing the muscle and inter- and intramuscular fat, it will be possible to establish with greater accuracy the relative growth coefficients for the different fat depots, including the fat-tail, from regressions of the weights of individual fat depots on the total body fat.

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