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Prediction of carcass composition for D'Man lambs

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SUMMARY - Carcass data were collected at a station located in the northwest of Morocco on 31 male lambs of D'Man breed, with 10 singles, 10 twins and 11 triplets, which were slaughtered at 28 kg live weight. The left side of the carcass was dissected using Mediterranean anatomical reference points. Prediction equations of body composition using live and carcass weights and fat thickness were developed. Even though some of the relationships were considered reliable, more carcass studies need to be done.

RESUME - Le présent essai a été conduit en station, au nord ouest du Maroc, et a porté sur 31 agneaux mâles de race D'Man dont 10 sont nés simples, 10 doubles et 11 triples. et qui ont été abattus à un poids constant de 28 kg. La moitié gauche de la carcasse a été disséquée selon la méthode méditeranéenne de référence. Des relations de régression ont été établies entre le poids vif, le poids de la carcasse, et l'épaisseur de gras dorsal, d'une part, et la composition corporelle, d'autre part. Bien que des relations fiables aient été trouvées, le travail de dissection doit être poursuivi pour affiner les estimations.

Introduction

The knowledge of carcass composition of prolific sheep is of particular interest, given their contribution to meat lamb production, even though carcasses are generally sold on a weight basis in most countries. Assessment of the carcass in Morocco is generally performed by eye judgement, and it is clear that an accurate assessment of carcass composition is becoming essential, at least for commercial classification. Although a quite large number of studies have been conducted to evaluate the reproductive performance of D'Man ewes, little attention has been given to carcass characteristics of D'Man lambs.

The advantage of assessing carcass composition without depreciating the carcass has long been realised. According to Timon and Bichard (1965), two considerations should be taken into account in estimating carcass composition: 1) the ease, speed, and accuracy of measurement, and 2) the precision with which the measurement can estimate the characteristic to be described. Kempster *et al.* (1976) added to this list: 3) the cost of taking the predicting measurements, and 4) the stability of the prediction equation between different groups of animals. With regard to cost, measurements taken either on live animals or on intact carcasses are associated with little cost, while those measured on split carcasses are generaly more expensive, given the associated depreciation of the carcass. The present paper examines live and carcass weights and fat thickness as predictors of the amount of lean and fat in the carcass.

Material and methods

The data analysed were collected from a trial conducted at the Gharb experiment station located in the northwest of Morocco (latitude 34°18' N). Ewes were joined in single sire pens by four rams assigned at random. After lambing, which took place in October 1987, mis-mothering was prevented by penning ewes and their identified litters for 1 to 2 days. No docking was performed, and male lambs were not castrated. Lambs born were reared by their own dams whenever possible; lambs born as triplets or in larger litters were given additional cow milk. Lambs were weighed from birth to slaughter on a weekly basis. At weaning (90 days), male lambs were grouped according to their weaning weight irrespective of their type of birth, in an attempt to reduce competition for feed; this management practice continued until slaughter. In addition to bersim forage *(Trifolium alexandrinum)* given *ad libitum,* a fattening supplementary concentrate was based on horse beans *(Vicia faba)*, wheat bran and barley in a 3:2:1 ration, and was introduced at approximately 0.9 kg per head per day.

Ram lambs were assigned to target slaughter live weight of 28 kg, that is, approximately 65 percent of mature weight (Bourfia, 1987). Because of facility and handling limitations, there were five dates for slaughter; the first was on April 12 and the last on May 25, 1988. The trial design of slaughter called for a balance of type of birth within sire, but this was not possible in practice, as shown in Table 1, because of the random procedure applied and the size of the sample. Moreover, the slaughter was restricted to singles, twins and triplets, because the numbers of other birth types were limited and poorly distributed among sires.

One day before slaughter and under normal conditions, live weight was recorded. After slaughter, loin back depth or «C» fat thickness, measured over the deepest part of *Longissimus dorsi* at the 12th-13th rib, and carcass weight were recorded.

The carcass was cut in half by splitting the vertebral column in the sagital plane. The left side of the carcass was stored at -1 to 4ºC for a 24 h chilling period, and then prepared for dissection. When needed, half-carcasses were frozen in plastic bags at -10ºC for a few days. The dissection began with the removal of kidney and pelvic fat, before cutting the left side of the carcass into seven primal joints using anatomical reference points (Colomer-Rocher, 1988). The joints were in turn dissected into subcutaneous fat, intermuscular fat, lean, bone and trimmings. Total dissectible fat, was considered to be the sum of subcutaneous fat, kidney and pelvic fat, and intermuscular fat.

The traits included in this paper were on the one hand carcass lean and carcass fat, which were considered to be dependent variables, and on the other hand, live and carcass weights, and C fat thickness, which were considered to be independent variables. The data were analysed by least squares procedure (Harvey, 1987) using a mixed model. In addition to the predictor that was fitted as a single continuous variable, constants were fitted for sire (considered to be random), type of birth (i.e. single, twin, triplet), and age of dam (i.e. 3-4 year, 5-9 year).

Results

Means, standard errors, and coefficients of variation for the carcass characteristics are presented in Table 2. From these figures one can see that the fat characteristics varied most, with coefficients of variation greater than 20 percent. The remaining characteristics had coefficients of variation not larger than 8 percent. The high variation of fat characteristics may reflect the development reached by the animals at slaughter. The lean, bone and fat expressed as percentages of carcass weight amounted to 56.3, 19.0 and 13.3, respectively. With regard to partitioning of total dissectible fat, subcutaneous, kidney and pelvic, and intermuscular fats averaged 5.4, 2.3 and 5.6 percent, respectively. In addition, lean to bone ratio averaged 3, and the amount of lean per day of age reached 19 g in average.

Simple correlations between carcass composition and fat thickness, and live and carcass weights are presented in Table 3. The correlations involving carcass lean were significant. For the correlations involving carcass fat, only those dealing with carcass weight and fat thickness were significant. Considering only significant correlations, carcass weight acounted for $0.40^2 = 16\%$ of the variation of carcass lean, and $0.60^2 = 36\%$ of the variation of carcass fat, and final live weight accounted for $0.44^2 = 19\%$ of the variation of carcas lean, while fat thickness accounted for $0.52^2 = 27\%$ of the variation of carcass fat. It should be pointed out that trends with carcass bone were not clearly defined as reflected by the poor correlations found in the present trial between carcass bone weight and live and carcass weights.

For predicting carcass composition, greater consideration was given in the present study to characteristics that are more easily and acurately recorded, such as live and carcass weights, and fat thickness over *Longissimus dorsi* at 12th rib. Regression equations that were derived from these carcass composition predictors are shown in Table 4. Equations associated with high correlation and low standard error of regression coefficient can be selected for use. In this regard, all three equations estimating carcass fat, with coefficients of regression significantly different from zero, were the most useful. Even though the correlations between carcass lean and live and carcass weights were significant ($P<0.05$), the corresponding regression coefficients were not significantly different from zero.

Discussion

According to Timon and Bichard (1965) differences between carcass studies come from differences in the extent of variation in the various sets of data and from differences in jointing procedure. This makes the comparison of results somewhat difficult. The noticeably low values obtained in the present study for simple correlations were expected, because of the small amount of variation in the sample of animals studied. Thus, age of lamb at slaughter averaged 197.8, 191.8 and 198.5 days, respectively for lambs born as singles, twins and triplets, while the overall coefficient of variation did not exceed 6%. Least squares means for carcass weight were even less variable with 13.3 ± 0.2, 13.3 ± 0.2, and 13.1 ± 0.2 kg for lambs born as singles, twins and triplets, respectively. These findings are consistent with that of Riley and Field (1969) who found that simple correlations were generally higher for carcass traits of ram than ewe and wether lambs and explained these sex differences in their study by the fact that ram carcasses were considerably more variable in weight and fat depth.

It is believed that greater accuracy was achieved by adding sire, type of birth, and age of dam to the characteristics used as a linear regression in the model. Preliminary analyses of data from the present trial indicated that while effects associated with type of birth and with age of dam were not significant, effects associated with sire were found significant for the carcass composition traits studied. This is in agreement with Timon and Bichard (1965) who reported that sire differences affected relationships between the carcass tissues in lambs.

Kempster *et al.* (1976) suggested that there would be merit in using a sub-sampling technique to estimate separately prediction equations for individual groups, and especially breed types. However, Riley and Field (1969) reported that because of the smaller amount of variation in the ewe and wether carcasses, separate equations for ewes and wethers did not differ appreciably from the equation developed for both. Consistent with this conclusion is the fact that for the present study dealing with prolific sheep, there appears to be very little advantage in using different estimating equations for single, twin and triplet lambs, given the small amount of variation involved.

Conclusion

Apart from carcass weight, none of the studied predictors showed a correlation with carcass composition greater than R = 0.60, mainly because of the uniformity of the sample of animals studied, in agreement with most published results. Nevertheless, the three selected equations developed herein provide an accurate estimate of carcass fat without depreciating the price of the carcass. But it may not be correct to assume that the body fat relationships obtained for the present homogeneous group of lambs will apply equally to a more variable population. This should serve as a sufficient evidence of the need for more studies on carcass composition for Moroccan breeds of sheep.

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Table 1: Number of male lambs born and slaughtered per sire and type of birth.

	Sire 1		Sire 2		Sire 3		Sire 4		Total	
	Born	Slaugh	Born	Slaugh	Born	Slaugh	Born	Slaugh	Born	Slaugh
Single males	7	4	3	2	3	3	1	1	14	10
Twin males	6	2	4	2	6	1	19	5	35	10
Triplet males	6	1	14	4	14	4	14	2	48	11
Total of males	19	7	21	8	23	8	34	8	97	31

Table 2: Means, standard errors, and coefficients of variation for carcass characteristics.

Carcass characteristic	Mean	Stand. Error	Coefficient of variation
Final live weight (kg) [1]	28.9	.3	.03
Carcass weight (kg)	13.2	.1	.05
Lean per day of age (g/d)	19.0	.3	.08
Lean percent	56.3	1.2	.06
Bone percent	19.0	.3	.06
Lean/bone ratio	3.0	.0	.07
Fat thickness over L. *dorsi* (mm)	2.5	.2	.26
Total fat percent	13.3	1.0	.21
Subcutaneous fat percent	5.4	.5	.25
Kidney and pelvic fat percent	2.3	.3	.32
Intermuscular fat percent	5.6	.2	.24

[1] Taken under normal conditions one day before slaughter.

Table 3: Correlations between carcass composition and fat thickness and live and carcass weights used as predictors.

Predictors	Carcass components in g	(1)	(2)
Final live weight (kg)	Lean weight in carcass	0.37*	0.44*
Carcass weight (kg)	Lean weight in carcass	0.37*	0.40*
Final live weight (kg)	Fat weight in carcass	0.33	0.26
Carcass weight (kg)	Fat weight in carcass	0.64**	0.60**
Fat tickness over L. *dorsi* (mm)	Fat weight in carcass	0.48**	0.52**

(1) Simple correlations computed before fitting constants for models.
(2) Correlations computed after fitting sire, type of birth and age of dam.
* $P < 0.05$; ** $P < 0.01$.

Table 4: Estimating equations for D'Man lambs carcass composition.

Relationship	Estimating equation	Standard error of regression coefficient (b)	Sign. level for b
Lean of carcass in g (Y)			
with final live weight (kg)	Y = 7448.2 + 104.4 X	88.8	0.25
with carcass weight in kg	Y = 7451.7 + 169.3 X	120.6	0.17
Fat of carcass g (Y)			
with final live weight (kg)	Y = 1774.6 + 201.3 X	77.0	0.01
with carcass weight in kg	Y = 1779.6 + 448.5 X	76.1	0.00
with fat thickness in mm	Y = 1791.3 + 282.0 X	120.0	0.03