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ESTIMATION OF LAMB CARCASS COMPOSITION USING REAL-TIME ULTRASOUND

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ABSTRACT

Real-time ultrasound measurements (Falco 100 device, linear probe 3.5 MHz) were used to estimate in vivo carcass composition of Hungarian Merino (n=9) and British Milk-sheep (n=10) ram-lambs. Animals aged 110-120 days and were growing 29.73+/-1.11 kg and 28.98+/--0.95 kg, resp. There were little between-breed differences in the ultrasound records for subcutaneous fat thickness (0.33+/-0.10 cm; 0.36+/-0.05 cm), longissimus muscle depth (LMD) (2.44+/-0.12 cm; 2.29+/-0.13 cm) and area (LMA) (17.65+/-0.89 cm; 16.63+/-0.95 cm) taken between the 12th and 13th rib.

In our sample, simple correlation of live-weight with ultrasound LMD and LMA, respectively, was 0.52 and 0.44 in Hungarian Merino and it was 0.57 and 0.58 in British Milk-sheep rams. The corresponding correlation of cold carcass weight with ultrasound LMD and LMA, respectively was 0.43 and 0.48 in Hungarian Merino and it was 0.49 and 0.50 in British Milk-sheep rams.

According to these results, ultrasonic measurements can be envolved into the selection system of lamb breeding programs, because these measurements give additional pieces of information about growth intensity, -capacity, and conformation.

Additional experiments are planned to compare live ultrasound and carcass ultrasound records for accuracy.

Keywords: lamb, in vivo carcass composition, ultrasound

INTRODUCTION

The in vivo techniques predicting carcass compositions generally use visual appraisal, live-weight, linear measurements and ultrasound (*Stanford et al.*, 1998).

Ultrasound equipment converts electrical pulses to high-frequency sound waves that are reflected from the boundaries between tissues of different bioacoustics densities (*Houghton and Turlington*, 1992). Two types of ultrasound equipment are used. The (A) mode machines, available since 1950's, measure echo amplitude against time, with the distance between echoes being related to the distance between successive tissue interfaces (*Simm*, 1983). The (B) mode or real-time machines developed in the early 1980's, where "grey-scales" measure echo intensity in a two-dimensional scan (*Stouffer*, 1988). The velocity of ultrasound through soft tissues is also used to predict body composition (*Miles et al.*, 1991), with the advantage of absolute values instead of images requiring subjective interpretation.

In early studies, ultrasound proved of limited utility for predicting body composition in sheep. It was attributed to the small size and lack of variation in subcutaneous fat thickness and longissimus muscle area in sheep as compared to cattle and pigs (*Houghton and Turlington*, 1992). In more recent work (*Stanford et al.*, 1995), ultrasound measurement of subcutaneous fat depth taken at the first lumbar vertebra was a better predictor of saleable

meat yield (RSD = 1.2, r = 0.64) than live weight (RSD = 1.5, r = 0.14), however. The use of ultrasonic measurements of back-fat and longissimus muscle depth at the third lumbar vertebrae has reportedly improved genetic selection for carcass fatness by 10.3 % and carcass grade by 14.5 %, compared to selection on live weight alone (*Olesen and Husabo*, 1994).

Sheep body composition has been significantly improved after 3-4 years of selection using indexes based on ultrasonically measured back-fat, muscle depth and live weight, irrespective of the precision of ultrasound methods (*Cameron and Bracken*, 1992; *Simm et al.*, 1993). These (further the relative low cost and ease of portability) have motivated experts to incorporate ultrasound measurements into sheep breeding and genetic programs in many parts of the world.

Real-time ultrasound was applied first by Tőzsér and co-workers (2004a, 2004b) for estimation of cattle carcass composition in Hungary. Encouraged by their results, we have adopted real-time ultrasound for estimating lamb carcass composition.

MATERIALS AND METHODS

A total of 9 Hungarian Merino and 10 British Milk-sheep ram-lambs involved in the Central Fattening Test were used. Animals were housed in 10 m2 boxes and fed a fattening lamb concentrate at free access. Lambs were slaughtered between 28 and 31 kg live-weight and aged 110-120 days.

The ultrasound measurements were performed by means of Falco 100 real-time ultrasonic device (Pie Medical) using a 3.5 MHz linear probe.

Twenty-four hours before slaughter, wool was removed from measurement area by shearing to improve image retrieval. The transducer was placed between the 12th and 13th rib perpendicular to the vertebral column. In addition, sunflower oil was applied to the scanning site to improve conduction between the skin and the transducer. The ultrasound fat thickness (FT) and longissimus muscle depth (LMD) were recorded on the left side of each lamb. Longissimus dorsi cross-sectional area (LMA) was estimated automatically by means of regression equations integrating the measurement data into a software program operated with the ultrasonic unit.

Data analysis included analysis of varience and Pearson correlation (SPSS 10.0).

RESULTS AND DISCUSSIONS

The results obtained for the ultrasound measurements on live ram-lambs are presented in *Table 1*.

Table 1.

Mean values for real-time ultrasound measures taken on live lambs

Traits	Hungarian Merino (n=9)			Britisch Milk-sheep (n=10)		
	Mean	SD	CV %	Mean	SD	CV %
Live-weight, kg	29.73	1.11	3.72	28.98	0.95	3.28
Fat thickness, cm	0.33	0.10	30.50	0.36	0.05	13.94
Longissimus muscle depth, cm	2,44*	0,12	5,08	2,29*	0,13	5,73
Longissimus muscle area, cm^2	17,65*	0,89	5,02	16,63*	0,95	5,72
Lean meat weight, kg	4,92	0,31	6,30	4,54	0,28	6,14
First class meat weight, kg	4,47	0,31	6,94	4,06	0,29	7,28
S/EUROP conformation score	10	0,71	7,10	8	1,41	17,68
S/EUROP fat cover score	5,9	0,60	10,20	5,8	0,92	15,84

*=P<0,05

At ultrasound recording around the age of 110-120 days, Hungarian Merino ram-lambs (n=9) had a mean a body weight of 29.73+/-1.11 kg and theirs in vivo records were 0.33+/-0.10 cm for FT, 2.44+/-0.12 for LMD and 17.65 cm2 for LMA. The British Milk-sheep ram-lambs (n=10) weighing lower by 0.75 kg proved to have a slightly higher mean for FT (0.36+/-0.05 cm) and lower means for LMD (2.29+/-0.13 cm) and LMA (16.63+/-0.95 cm2). Taking the total sample (n=19) individual variation was acceptable in case of LMD and LMA, whereas it was fairly high with FT. Previously, this soft, mobile subcutaneous fat layer was believed a complicating factor attributable to the reduced utility of ultrasound in sheep (*Purchas and Beach*, 1981).

In vivo techniques commonly use live-weight as the standard to which other predictors of body composition are compared (*Kempster*, 1984; *Simm*, 1992). In lambs of equal maturity, live-weight predicted percentage carcass lean with a residual standard deviation (RSD) ranging from 1.4 (*Cuthbertson et al.*, 1984) to 2.2 (*Fortin and Shrestha*, 1986), with r^2 values of 0.51 and 0.76, respectively. Fernandez and co-workers (1998) applied multiple regression equations for predicting lamb FT and LMA using live-weight-like independent variables. They obtained in Manchega lambs r^2 values ranging from 0.54 to 0.69 that increased to 0.60-0.95 when ultrasound measurements were included. The results suggested further that ultrasound measurements at 12-13th rib taken before slaughter were accurate predictors of cold carcass weight ($r^2 = 0.70$; $P<0.001$).

In our sample, simple correlation of live-weight with ultrasound LMD and LMA, respectively, was 0.52 and 0.44 in Hungarian Merino and it was 0.57 and 0.58 in British Milk-sheep rams (*Table 2*).

Table 2.

Simple correlation coefficients obtained between ultrasound measures and live weight and cold carcass weight

Variable	Hungarian Merino		British Milk-sheep	
	r	P	r	P
LW – LMD	0,52	0,15	0,57	0,08
LW – LMA	0,44	0,24	0,58	0,08
CCW – LMD	0,43	0,24	0,49	0,15
CCW – LMA	0,48	0,19	0,50	0,15
LMA – LEANM	0,80	0,01	0,24	0,51
CONF – LMA*	0,71	0,03	0,65	0,04

LW: live weight, LMD: longissimus muscle depth, LMA: longissimus muscle area, CCW: cold carcass weight, LEANM: lean meat weight, CONF: body conformation score.

The corresponding correlation of cold carcass weight with ultrasound LMD and LMA, respectively was 0.43 and 0.48 in Hungarian Merino and it was 0.49 and 0.50 in British Milk-sheep rams.

Additional experiments are planned to compare live ultrasound and carcass ultrasound measurements for accuracy.

CONCLUSION

The following conclusion can be drawn from this study:

- The results were showed, the ultrasound method was eligible to measurement of sheep fat thickness and area of longissimus dorsi.

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