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Marketing weights and ultrasonic measurements of loin eye muscle in Karya lambs

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ABSTRACT

The objective of this study was to determine of *longissimus dorsi* muscle (loin eye muscle) properties which are closely related to meat yield and meat quality in Karya lambs. Karya lambs (36) were used. The *longissimus dorsi* muscle (loin eye muscle) area width, depth and backfat depth were measured ultrasonically of the cross sectional area between the 12th and 13th ribs in market period and also at this time lamb live weight were recorded. Least square means for ultrasonic measurements of eye muscle depth, width, area and backfat depth were 2.18 cm, 4.14 cm, 6.41 cm^2 and 0.08 cm, respectively. The correlations between lamb live weight with eye muscle depth and eye muscle area were found important.

Key word: Karya lambs, Loin eye muscle, Meat quality, Ultrasonic properties

The most important points in choosing meat are the meat's leanness, the continuity of quality, being economical, easily prepared, and abundance in variety. To impove the composition of lambs due to the desires of consumers, studies of improvement of variation in and among breeds have continued. In recent years, market demand has focused on lean meat, and for this reason a lot of methods were developed to determine the state of the carcass, the composition and quality of this (Simm *et al.* 2002).

Ultrasound technology is widely used in the world for the determining of carcass quality, and is used in 2 ways:

(i) Using measuring results depending on ultrasound as the criteria in genetic breeding programmes;

(ii) Determining the optimal level of fat in lamb sent for slaughter (Fernandez *et al.* 1997).

In a live animal, there are very strong correlations between ultrasonic measurements to determine the thickness of backfat and the propeties of the *longissimus dorsi* muscle (loin eye muscle). These strong correlations have put forward the effective usage of ultasound in the selection programmes of carcass quality. In animal breeding programmes which meat production is less or greater than live weight and rising of live weight can be used as the main selection criteria. While there is a positive correlation between the increasing of live weight and the quality carcass criteria, it is not sufficient to use just this criteria for improvement programmes aimed at the quality of the carcass (Gresham 2000). In addition, the researches on ultrasound measurements of the quality of meat among domestic sheep breeds are so few. However, in countries such as the UK and Australia, developed in raising sheep, breeding progammes have mostly depended on improving the quality and production of the carcass meat (Turkish Statistical Institute 1996, Karaca *et al.* 2002). The objective of this study was to determine by the *longissimus dorsi* areas, width, depth and fat thickness, a prediction of the carcass traits in Karya lambs. Therefore, this study will help the process of obtaining the necessary parameters for improvement studies in the quality and production of meat by genotype.

MATERIALS AND METHODS

In total, 36 male and female Karya lambs (Fig. 1) in 2008–2009 (18 head per year) were used as research material. These lambs were fattened in Adnan Menderes University, Agricultural Faculty, Sheep Breeding Unit within ADÜ-GKYP (Adnan Menderes University, Group Sheep Breeding Programme).

The feed used for fattening was provided from a special feed factory. The sheep were treated with an intra-vaginal sponge and PMSG in the mating period. After the births, the lambs were monitored and divided into three groups according to the breeding condition in Aydýn and the methods of Akçapýnar *et al.* (2002); Küçük *et al.* (2002); Sanudo *et al.* (1998); and Santos-Silva *et al.* (2002a, 2002b).There were 18 lambs used in each group and in each year. The first group was raised with their mothers from birth up to the age of 4.5 months, and was not given additional feed. The second group was subjected to additional feeding together with suckling. The third group was fattened individually in an intensive way after weaning.

In the market period (4.5 months age), all lambs were

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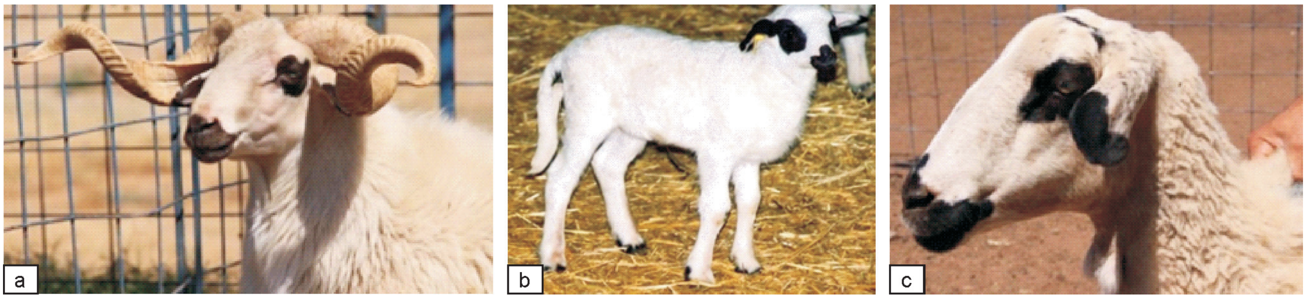


Fig. 1. Karya ram (*a*), lamb (*b*) and sheep (*c*)

weighed. Wool was removed from the measurement areas (between 12 and 13. ribs) and the ultrasound transducer was located between 12^{th} and 13^{th} ribs lateral to the vertebral column and parallel to the ribs following physicial palpation and preparation. In addition liquid gel was applied to the scanning site to improve conduction between the skin and the transducer.

All measurements were taken on the left side. After obtaining an ultrasound recording, the ultrasound fat thickness, *longissimus dorsi* depth, *longissimus dorsi* width and *longissimus dorsi* area were estimated on site using the internal electronic calipers of the ultrasound unit. All scanning was done by the same people.

A cross-section of a sheep at the 12th/13th ribs is given in Fig. 2. where dark areas are bone. Muscles are labelled with an 'M' followed by the name of the individual muscle. The spaces between the muscles are clear as this is fat tissue.

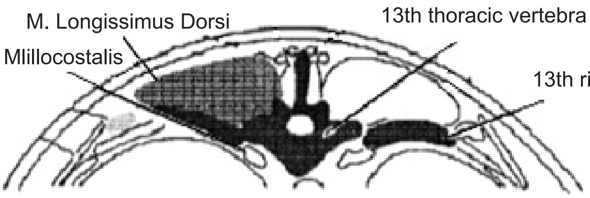


Fig. 2. Longisimus dorsi muscle and thoracic vertebra.

The vertebra (the 13^{th} thoracic) can be clearly seen in the middle of the picture (dark), with the ribs going out from either side (horizontally in Fig. 2). On the left hand side of the picture, above the rib is a large rounded muscle. This is the *longissimus dorsi* muscle (loin eye muscle). It is approximately a right-angled triangle at this point. This muscle extends from just behind the shoulders to the joint region. Between the eye muscle and the skin, there is a layer of fat,which is called subcutaneous fat (fat under the skin, Gresham 2000).

There are several reasons why scanning of the 12^{th}–13^{th} ribs is the most useful site for a single measure;

a. Scanning further forward makes detecting the fat layer more difficult as several narrow muscles run through the subcutaneous layer moving forward over the ribs;

b. Scanning further forward makes differentiating the eye muscle from a number of neighbouring muscles increasingly difficult the further forward;

c. When moving further back towards the loin, the eye muscle changes shape (so it becomes harder to define "depth") and the ribs become shorter, meaning more care is required to detect the lower boundary;

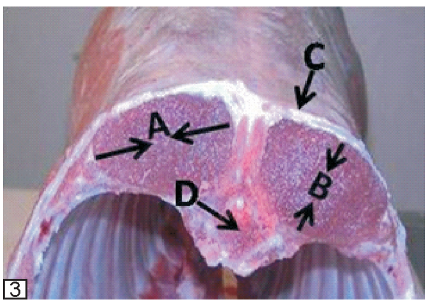
d. Fat depth at the 12th/13th is an internationally accepted standard simple guide to total fatness;

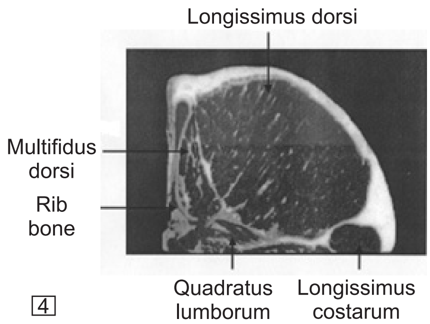
e. It is a straightforward process to find the last long rib (the 13th);

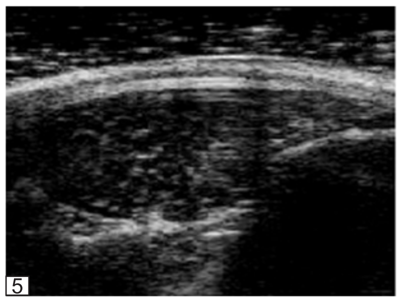
Data analysis: Data collected from study were analyzed in SAS (1999) programme with using GLM procedure. Ultrasonic fat thickness, *longissimus dorsi* width, *longissimus dorsi* depth and *longissimus dorsi* area:

$$Y_{ijk} = \mu + a_i + b_j + c_k + d_l + b_1 (x_{ij} - \bar{x}) + b_2 (y_{ij} - \bar{y}) + e_{ijk}$$

Y_{ijk}, fat thicknes or *longissimus dorsi* width or *longissimus dorsi* depth or *longissimus dorsi* area of lambs in I, sex; j, farm; μ, population mean; a_i, i. year effect (i=2008,2009); b_j, j, sex effect (j, male, female); c_k, k, birth type effect (i=2008,2009); d_l, l, group effect (i=2008,2009); b_1, regression coefficient fat thicknes or *longissimus dorsi* width or *longissimus dorsi* depth or *longissimus dorsi* area







Figs. 3–5. **3.** Cross section of a 13^{th} rib diagram showing region at carcass A, longissimus dorsi muscle; B, longissimus dorsi depth; C, fat thickness; D, spinal cord). **4.** *Longissimus dorsi* muscle and associated muscle. **5.** Eye muscle in ultrasound.

on live weight; b_2, regression coefficient fat thicknes or *longissimus dorsi* width or *longissimus dorsi* depth or *longissimus dorsi* area on age

x_{ij}, live weight of lamb in i. year, j. sex, k. birth type, l. group; $\bar{x}$, Lamb live weight mean; Y_{ij}, age of lamb in i. year, j. sex, k. birth type, l. group; $\bar{y}$, lamb age mean; e_{ijk}, error.

RESULTS AND DISCUSSION

Ultrasound technology is used widely as an important aid for breeding with cattle and pigs. Despite the usage of ultrasound technology being limited in sheep, it provides an original evaluation according to subjective methods. Despite this, ultrasound implements were applied annually to the whole flock. As a result of the lambing period lengthening, a wide variation can be observed in the age and weight of lambs in the flock following ultrasound implementation. Conversely, although the ultrasound technology is related to the quality of ultrasound equipment, this has recently improved on farms. The aim of this study was to determine of *longissimus dorsi* muscle (loin eye muscle) properties which are closely related to meat yield and meat quality in Karya lambs.

Least square means and standard errors for some ultrasonic measurements for Karya lambs were given in Table 1.

In previous research, there was a difficulty in comparing the application of the different growing and feeding methods and different genotypes in the results of this reseach. Further, the main factors of differences among the values resulting from the various studies are genotypes, age, sex, and live weight. The ultrasonic measurement values of fat thickness, muscle depth and width and muscle area found during the marketing were very low, but correlated with earlier research (Gökdal *et al.* 2004). There are similarities between the results taken in our study and the ones studied on Kivircik and Kivircik Choice lambs by Cemal *et al.* (2004). The effect of lamb live weight on ultrasonic muscle depth, and eye muscle area were significant and was similar to Morton (2001), Pritchard and Dewi (2000) and Cemal *et al.* (2004).

In this study, the effect of sex on ultrasonic fat thickness, eye muscle depth, and eye muscle width was not significant, which was in parallel with Stanford *et al.* (2001). However, some researchers found a greater value of eye muscle area in the female than in the male in the same breed and age of animal. Cemal *et al.* (2004) reported that the effect of sex variation was significant in eye muscle depth in the female (P<0.01). Phenotypical selection according to ultasonic muscle depth at weaning time by Larsgad amd Kolstad (2002) resulted in a higher meat yield of lamb.

In this research, ultrasonic eye muscle area was lower than in the literatures. Generally during the period of ultrasonic measurements in the lambs has differed. While some programmes like Australia LambPlan, which is national genetic evaluating and performance test programme, determined a wide range of ages (5–18 months), but some programmes in England and Canada determined 147 and 100 days age for the Suffolk breed (Stanford *et al.* 2001). The weaning and marketing age is earlier in Turkey; especially in eastern Anatolia, thus, the ultrasonic measurements have to be done at this time. As a result of this, the measurements carried out among young lambs are low according to live weight.

Generally the ultrasound studies of sheep and goats are

Table 1. Ultrasonic measuements of eye muscle and backfat

Catagories	N	Fat thickness (cm)	Eye muscle width (cm)	Eye muscle depth (cm)	Eye muscle area (cm^2)
Year		NS	NS	**	*
2008	18	0.08±0.18	4.05±0.43	2.01±0.25	5.99±1.16
2009	18	0.09±0.16	4.24±0.41	2.34±0.24	6.83±0.99
Sex		NS	NS	NS	NS
Male	18	0.08±0.15	4.14±0.44	2.12±0.29	6.21±1.30
Female	18	0.08±0.02	4.15±0.42	2.24±0.30	6.62±0.95
Birth type		NS	NS	NS	NS
1	18	0.08±0.17	4.10±0.42	2.17±0.21	6.42±1.42
2	8	0.09±0.22	3.98±0.56	2.16±0.49	6.12±1.81
3	10	0.08±0.15	4.35±0.23	2.21±0.26	6.65±0.66
Group		NS	NS	NS	NS
1	12	0.08±0.02	4.10±0.52	2.04±0.26	6.07±1.12
2	12	0.07±0.02	4.12±0.33	2.26±0.23	6.50±0.84
3	12	0.09±0.02	4.20±0.43	2.24±0.36	6.68±1.41
Linear regression					
Live weight	36	0.007	0.045	0.180**	0.210**
Age	36	0.001	0.038	0.002	0.090
General	36	0.08±0.18	4.14±0.42	2.18±0.29	6.41±1.14

* P<0.05, **P<0.01; NS, nonsignificant.

more limited than the ones on cattle and pigs as ultrasound technology. There was a contradiction in the results of research on sheep in some studies, the usage of ultrasound limited or negated the stated aims. This case was dependent mostly on the shallowness of the backfat thickness and eye muscle area, the insufficiency of variation among each, the softness and activity of the backfat layer, and the existence of dense wool in sheep as opposed to pigs and cattle. However, Fernandez *et al.* (1997) and Stanfod *et al.* (2001) reported that ultrasound can be used as a valid estimation of the backfat thickness and eye muscle area in live lambs.

In this study, the differences between ultasonic measurements caused by lambs being younger show that these are selection criteria. In this research, the correlations between lamb live weight with eye muscle depth and eye muscle area were showed in Table 2.

Table 2. Correlation coefficient of ultrasonic eye muscle and backfat with live weight of lambs (N=40)

Properties	Muscle depth	Muscle width	Fat thickness	Live weight
Muscle area	0.711**	0.792**	–0.005^{NS}	0.458**
Muscle depth		0.359*	0.071^{NS}	0.423*
Muscle width			0.022^{NS}	0.212 ^{NS}
Fat thickness				–0.009 ^{NS}

* P<0.05, **P<0.01, ***P<0.001, NS: Non-significant

The results from this study were smilar to the research reported by Fernandez *et al.* (1997), Gökdal *et al.* (2004), Wilson (1995), Cemal *et al.* (2004). Alternatively, the unpredictable relationship between fat thickness and lamb weight was notable. This could be said to be a result deviation from the measurements at an early age.

In this study, the correlation between the eye muscle area with the eye muscle depth and width were similar as reported by Cemal *et al.* (2004) which the same correlations were found to be 0.360, 0.874 and 0.761, respectively. The importance of correlations observed in this study were similar to the results reported by Wilson (1995) and Pritchard and Dewi (2000).

Ultrasound technology has some benefits; cost-gain analysis, more accurate results, the carcass grading system is advanced, the desired fat content is easily determined, and muscle-bone ratio, marbling and meat yield will be determined in the near future. Also, the selection for lean meat will be obtained directly by ultrasound results (Figs 3–5), and in this way, genetic programmes will progress.

In this research, lambs were marketed a short time after weaning. Therefore, the lambs below a live weight of 25.91 kg were not put forward for slaughter even though the criteria for a selection of programmes made for meat production have to be advanced during this period. Besides, live weights during the marketing age mentioned in the research, ultasonic eye muscle parameters as a carcass quality criterion was understood to be obtained correctly.

In ultrasonic measurements, the correlation between the live weight and eye muscle area was positive, as expected. In spite of this, the correlation between live weight and backfat thickness was negative. This result is interesting and worth considering.

As a result of studies the marketing of lambs subsequent to the weaning period causes a limitation on the studies of carcass quality. At this young age, the ultrasound technique should be widely used for obtaining the results of ultrasound measurements to determine the features of both the carcass quality and composition. Moreover, it is necessary to conduct research with a wide variety of materials; both to advance the breeding programmes, and to describe the appropriate husbandry practices to increase the income from lambs in the district.

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