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Effect of Sex on Fattening Performance and Carcass Characteristics in Kivircik Lambs

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ABSTRACT

The aim of this study was to evaluate the effect of sex on fattening performance and carcass characteristics of Kivircik lambs. Fifty head weaned Kivircik lambs, half males and half females, were used in fattening period. After weaning, the growth and feed consumption of the male and the female lambs fattened for 56 days were recorded. Average daily weight gain differed significantly (P<0.01) between the males and the females (294.9 and 214.2 g, respectively). A total of 10 lambs (5 males and 5 females) were slaughtered and the left side of the carcasses was cut into five joints. Dressing percentage (hot/cold) based on full weight and empty body weight were lower (P<0.05) for the males than the female lambs. Sex had a significant effect on kidney-knob and channel fat weight, *M. longissimus dorsi* section area (MLDA) and liquid expelled (P<0.01). Sex primarily affected the quantity of all types of fat deposits. The male lambs had higher muscle, muscle/bone and muscle/total fat ratios than females.

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Kıvırcık Kuzularında Besi Performansı ve Karkas Özellikleri Üzerine Cinsiyetin Etkisi

ÖZET

Bu çalışmanın amacı, Kıvırcık kuzularında cinsiyetin besi performansı ve karkas özellikleri üzerine etkisini değerlendirmektir. Besi döneminde yarısı dişi yarısı erkek olmak üzere 50 baş sütten kesilmiş Kıvırcık kuzu kullanılmıştır. Sütten kesimden sonra 56 gün boyunca beslenen erkek ve dişi kuzuların büyüme ve yem tüketimi belirlenmiştir. Ortalama günlük canlı ağırlık kazancı bakımından erkek ve dişi kuzular (sırasıyla 294.9 ve 214.2 g) arasındaki farklılık önemli bulunmuştur (P<0.01). Toplam 10 baş (5 erkek ve 5 dişi) kuzu kesilmiş ve karkasların sol tarafı beş parçaya bölünmüştür. Karkas randımanı (sıcak/soğuk) erkek kuzularda dişi kuzulara göre daha düşük bulunmuştur (P<0.05). Cinsiyetin, böbrek-leğen boşluğu yağları, *M. Longissimus dorsi* kesit alanı (MLDA) ve su tutma kapasitesi üzerine etkisinin önemli olduğu saptanmıştır (P<0.01). Cinsiyet öncelikle karkastaki her türlü yağ değerleri miktarı üzerinde etkili olmuştur. Erkek kuzuların kas, kas/kemik ve kas/toplam yağ oranları dişi kuzulardan daha yüksek bulunmuştur (P<0.05).

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INTRODUCTION

When revenues obtained in sheep-raising in Turkey are taken into consideration, meat production is seen to have an important place compared to other products. Withal, young animals with rapid live weight increase and high ability to feed conversion ratio are preferred for meat production. For this purpose, lambs are generally exposed to intensive fattening for 2-3 months after weaning and sent for slaughtering at the high quality meat period. In lambs, animal (breed, sex, age, birth type, initial live weight, condition) and environmental (care-feeding, shelter conditions, season, diseases and marketing) conditions have effects on fattening performance. However, sex is more important factor in fattening and it affects fattening duration and carcass composition. Abdullah and Qudsieh (2009) reported that slaughtering of Awassi male lambs at weights up to 30 kg, resulted in higher dressing-out percentage, better carcass composition

and quality than ram lambs slaughtered at lighter or heavier weights.

A study examining the effect of sex in lamb fattening found that the male lambs had higher live weight gain and carcass weight (Dransfield et al., 1990). Moreover, another study investigating the effect of sex on lamb meat quality determined that there was not a significant difference between the male and the female lambs in terms of the shear force applied to *M. longissimus lumborum* or *M. vastus lateralis* (Lambe et al., 2010). A study by Barone et al., (2007) indicated that the age and feeding system caused differences in carcass and carcass piece characteristics. Moreover, they also found that the male lambs had especially lower neck, breast, shoulder and long leg fat ratios but higher shoulder meat ratio compared to their female counterparts. It was stated that sex did not have an effect on some meat quality traits such as tenderness (Kemp et al., 1980), but in some studies, it was found that the male (Johnson et al., 2005) or the castrated lambs (Hopkins et al., 2007) had tougher meat than the female ones.

The sheep of Kivircik breed are prevalently raised generally in the regions of Thrace, Marmara and North Aegean in Turkey and has a combined yield. Since the fat of this breed is dispersed between muscle and muscle fibers, it gives meat tenderness and taste. However, there are not a sufficient number of studies aiming to look in the carcass characteristics of different sexes of the Kivircik lambs.

The main purpose of this study is to investigate the effect of sex on carcass characteristics and fattening performance.

MATERIALS and METHODS

Animals, Management and Treatments

The animal material of the study was composed of a total of 50 (25 males and 25 female) weaned lambs of Kivircik breed found in the livestock unit of the Research and Application Center of the Faculty of Agriculture of Bursa Uludag University. Since oestrus is synchronized in sheep, 85-90% of births were completed in a week. Therefore, there was no significant age difference among the lambs used. In addition, it was emphasized that there was no difference between the sexes in terms of fattening initial weight. The lambs were weaned at about 9 weeks of age, and fattening started at the age of 10 after a week of training period. Prior to the study, the lambs were separated into two groups based on sex and the weights of both groups were close to each other. Ration began to be given to lambs one week before study. Lambs were offered concentrate diet ad libitum. The ingredient and chemical composition of concentrate diet is presented in Table 1. Water was available ad libitum. Feed consumption and live weights were recorded biweekly with a scale sensitive to 0.1 kg. Animals were not allowed to access feed and water for 12 hours before weighing. This study was approved by the Ethical Committee of Animal Experiments, Uludag University (Number: 2017/09-01).

Table 1. Ingredient and chemical composition of the concentrate diet

Çizelge 1.Karma yemin içeriği ve kimyasal kompozisyonu

Ingredients (*İçerik*)	**Concentrate % (*Miktar*)**
Wheat	65.0
Corn	10.0
Sunflower meal	23.0
Salt	0.5
Limestone	1.4
Mineral-vitamin premix *	0.1
Chemical composition of the diet, (% DM) ***Rasyonun besin madde içeriği, (% KM)***	
Organic matter, %	94.83
Crude protein, %	18.32
Crude ash, %	5.17
Crude fat, %	2.47
Crude dietary fibre, %	10.76
Nitrogen-free matter, %	63.24
Acid Detergent Fiber (ADF), %	15.08
Neutral Detergent Fiber (NDF), %	25.43
Metabolic energy, kcal/kg KM	2860

[a]Vitamin-trace mineral pre-mix provides per kg of mixed ration: 5000 IU Vitamin A; 2000 IU Vitamin D; 10 mg Vitamin E; 1 mg Co; 1 mg Cu; 13 mg Fe; 60 mg Mg; 1.6 mg I; and 60 mg Zn.

Feedlot Traits

In the study, group feeding was applied and the feeds that were fed and left with lambs were weighed every 14 days during the fattening. At the end of the 56-day fattening period, lambs were weighed after fasting for 12 hours with free access to water. Immediately after dressing, carcass comprised the body after removing the skin, head, fore legs, hind legs and the viscera. Kidneys, kidney-pelvic fat were retained in carcass, and testes and scrotal fat were removed. Hot carcass weight and weights of the head, skin, heart, liver, lungs-trachea, kidney and spleen were recorded. The gastro-intestinal tract was also weighed full and emptied. The results were expressed as a percentage of live weight at slaughter. Empty body weight (EBW) was calculated by deducting the weight of digesta. Dressing percentage was calculated based on both full live weight and EBW.

Slaughter and Carcass Traits

In both groups, 5 lambs close to the average of fattening weight were selected and a total of 10 lambs were slaughtered. The lambs were slaughtered at Agricultural Faculty Research Farm, where they were

kept at +4 °C for 24 hours and jointed and evaluated. After chilling the carcasses for 24 h at 4 °C, cold carcass weights were recorded. Moreover, the following values representing the carcass shape were calculated as well (Colomer-Rocher et al., (1987).

carcass conformation = chest width / carcass length
carcass compactness = carcass weight / carcass length
long leg conformation = long leg width / long leg length

After chilling, carcasses were split down the dorsal mid-line. The left side was divided into five primal cuts: neck, flank, ribs, shoulder and long leg as described by Colomer-Rocher et al., (1987).

From the obtained data, the rates of the carcass dressings, chilling losses, by products, various organs and the carcass pieces were calculated. Following the chopping procedure, the ribs joints including the 6th-12th vertebrae was separated into tissues, bone, muscle, subcutaneous fat and intermuscular fat after it had been cut off from ribs. From the left cold carcass, the *M. longissimus dorsi* section area (MLDA) and the backfat thickness were determined on the surface of the *Longissimus thoracis* and *Lumborum* located in the region between the 12th-13th vertebrae.

To determine of the liquid expelled of the meat, by using the filter paper method, a piece of dry filter paper, whose weight is known, was slightly pressed on 5 g of meat with a weight of 2000 g for 5 minutes. Here, the free water in the muscle passed to the paper under the effect of capillary forces and its amount was calculated in weight (Kauffman et al., 1986).

Meat Chemical Composition

For the determination of the dry matter in the meat samples, 3 g of meat was weighed and put into desiccators and kept in the drying oven at 105 °C for 12 hours. At the end of the duration, the chilling samples were weighed again and the dry matter was determined via comparing the difference between the first weighing and the last weighing to the first weighing. For the determination of ash, 3 g of meat samples were put into crucibles, whose tares were determined; then, they were kept in the combustion furnaces at 550 °C for 6 hours; finally, after being taken out of the combustion furnaces at the end of the duration and chilled in the desiccators, the crucibles were weighed again and the ash rate was calculated via comparing the difference between the first weighing and the last weighing to the first weighing. The protein analysis was made on the Kjeldahl device based on wet burning and the intramuscular fat amount was calculated on Soksalet device via the Ether Extraction method (AOAC, 1995).

Statistical Analysis

The data obtained from the study was applied to two independent sample t-test (SPSS, 2007). Firstly, the data was applied the normality test and according to Kolmogorov-Smirnov and Shapiro-Wilk test results, the values in the males and the females showed normal distribution. Later, if the variances were homogenous was tested via Levene's Test and they were seen to be homogeneous. Finally, the significance of the difference between groups was determined via t test.

RESULTS and DISCUSSION

Feedlot Traits

The fattening performances of the male and the female lambs of Kivircik breed used in the study were determined and given in Table 2.

Table 2. Fattening performance characteristics
Çizelge 2. Besi performansı özellikleri

Traits (*Özellikler*)	Male (*Erkek*)	Female (*Dişi*)	T-Value (*T-Değeri*)	Pooled StDev (*Ortak standart sapma*)	P
Initial live weight (kg)	25.8±0.34	25.6±0.45	0.4	2.00	
Final weight (kg)	42.4±0.59	37.6±0.63	5.5	3.08	**
Daily live weight gain (g)	294.9±11.00	214.2±7.64	5.9	47.66	**
Feed conversion (kg)	5.2±1.00	6.6±0.77			
Daily average feed consumption (kg/day)	1.40	1.39			

** P<0.01

When the fattening performance data was examined, it was found that although there was not a statistical difference between the initial average live weights (P>0.05), the difference between the live weights of the male and female lambs at the end of fattening was found significant (P<0.05). During the fattening, the average daily live weight gain was found higher in the male lambs compared to the female ones (P<0.05). During the fattening, the daily average feed consumption was determined as 1.40 kg/day in the male lambs and 1.39 kg/day in the female lambs.

Although the daily weight gain of lambs was higher in males than females, there was no difference between the sexes for feed conversion rate. The results that there were differences between the growth rates of the male and the female lambs as an answer to their crude protein intake was reached in the studies made with different sheep breeds (Ørskov et al., 1971; Askar et al., 2006; Craigie et al., 2012; Yavuz et al., 2019). Rodríguez et al. (2011), Craige et al. (2012) and El

Fadili (2012) were reported that the male lambs' feed consumption and feed conversion ratio were better than the female ones (P<0.05). In a study made by Altın et al., (2005), it was expressed that although the feed consumption was higher in the male lambs, feed conversion ratio was higher in the female ones (P<0.05). However, in this study, it was determined that sex did not make a difference between feed consumption and feed conversion ratio. Similarly, Sarıçiçek et al., (1996) reported that sex did not make a difference between the male and the female 8-week-old weaned lambs in terms of feed consumption and feed conversion ratio. It is observed that the values which Gökdal et al., (2012) determined that daily live weight gain and feed conversion of Kivircik male lambs were lower than the results reached in this study. However, it shouldn't be forgotten that different genotypes and different fattening conditions (feeding methods, duration, birth type, sex and age) will make a direct comparison difficult.

Slaughter and Carcass Traits

The slaughter and carcass traits of the male and the female lambs used in the study were determined and given in Table 3 and Table 4.

The difference between sex was found significant in terms of slaughter characteristics as slaughter weight, hot carcass weight, hot dressing, head, four legs, intestine, lungs-trachea, heart and liver weight (P<0.01; P<0.05). In terms of carcass characteristics, cold carcass weight and the MLDA were found higher in the male lambs compared to the female lambs (P<0.01; P<0.05).

The parts in the left cold carcass belonging to the male and the female lambs used in the study and their proportional values were determined and given in Table 5. When the results of the study were examined, it was determined that the difference between the sexes was statistically significant in terms of neck weights and flanks (P<0.05).

Similarly, to the results of this study, the male lambs were reported to have a higher value in terms of carcass weight compared to the female ones (Barone et al., 2007; Peña et al., 2005). This can be explained by the male physiology containing a rapid growth and, hence, more bone-length growing (Wylie et al., 1997). Similarly, to the results of this study, Žgur et al., (2003) reported that sex affected especially liver and head weight significantly (P<0.01); on the other hand, Carson et al., (1999) reported that sex did not have an effect on the lambs' components not included in the carcass. Parallel to the increase in animals' live weights, their muscles, fat and bone tissues increase as well. Total tissue mass composes hot and cold carcasses and the difference between hot and cold carcass weights arises from moisture loss during storage. In this study, the hot dressing value was found higher in the female lambs compared to the male ones. Similar results were reached in different sheep breeds In previous studies, it was reported that sex had an effect on hot dressing and the female lambs had a higher value compared to the male ones (Craigie et al., 2012; Santos et al., 2015; Žgur et al., 2003). In another

Table 3. Slaughter characteristics of lambs (kg)
Çizelge 3. Kuzuların kesim özellikleri (kg)

Traits (*Özellikler*)	Male (*Erkek*)	Female (*Dişi*)	T-Value (*T-Değeri*)	Pooled StDev (*Ortak standart sapma*)	P
Slaughter weight, SW (kg)	42.5±0.40	37.5±0.88	5.1	1.53	**
Hot carcass weight	20.5±0.16	19.0±0.44	3.1	0.74	*
Empty Body Weight, EBW (kg)	39.3±0.45	34.6±0.84	4.8	1.51	**
Hot dressing percentage for SW (%)	48.2±0.74	50.7±0.54	2.7	1.45	*
Hot dressing percentage for EBW (%)	52.2±0.83	54.9±0.65	2.6	1.67	*
Head weight	2.3±0.07	1.5±0.08	7.1	0.17	**
Skin weight	4.2±0.25	4.0±0.23	0.6	0.54	
Four legs weight	0.9±0.04	0.7±0.06	3.3	0.12	*
Stomach weight (full)	4.5±0.19	4.2±0.19	1.0	0.43	
Stomach weight (empty)	1.28±0.08	1.32±0.07	0.4	0.16	
Weight of digesta (kg)	3.2±0.19	2.8±0.15	1.3	0.38	
Intestine weight	3.4±0.13	2.8±0.23	2.3	0.42	*
Inner fat weight	1.02±0.70	0.67±0.05	0.5	1.11	
Lungs-trachea weight	1.88±0.07	1.55±0.05	3.8	0.14	**
Spleen weight	0.204±0.12	0.178±0.12	0.2	0.27	
Heart weight	0.188±0.01	0.144±0.01	3.1	0.02	*
Lung weight	0.760±0.04	0.636±0.04	2.0	0.10	
Liver weight	0.969±0.04	0.782±0.02	4.5	0.07	**
Testis weight	0.228±0.04	-			

* P<0.05 , ** P<0.01

Table 4. Carcass measurements of lambs
Çizelge 4. Kuzuların karkas ölçüleri

Traits (*Özellikler*)	Male (*Erkek*)	Female (*Dişi*)	T-Value (*T-Değeri*)	Pooled StDev (*Ortak standart sapma*)	P
Cold carcass weight (kg)	20.0±0.11	18.7±0.43	2.9	0.71	*
Cold dressing (%)	47.2±0.65	50.0±0.56	3.2	1.36	*
Chilling losses (%)	1.03±0.20	0.74±0.04	1.4	0.32	
Kidney weight (kg)	0.372±0.23	0.105±0.01	1.2	0.36	
Kidney-knob and channel fat weight (kg)	0.241±0.03	0.675±0.09	4.8	0.14	**
Long leg length (cm)	25.6±1.17	23.6±0.98	1.3	2.41	
Long leg width (cm)	9.0±0.84	8.4±0.24	0.7	1.38	
Long leg depth (cm)	10.4±0.51	11.0±1.05	0.5	1.84	
Long leg girth (cm)	31.4±1.91	28.6±0.98	1.3	3.40	
Chest width (cm)	24.6±1.44	26.6±0.51	1.3	2.41	
Chest depth (cm)	25.6±1.94	28.6±1.63	1.2	4.01	
Rump width (cm)	20.4±0.24	17.8±1.11	2.3	1.80	
Carcass length (cm)	66.4±1.63	66.2±1.74	0.1	3.77	
Carcass conformation	0.372±0.03	0.403±0.01	1.1	0.04	
Carcass compactness	0.303±0.01	0.284±0.01	1.8	0.02	
Long leg conformation	0.350±0.02	0.357±0.01	0.3	0.04	
M. longissimus dorsi section area (cm^2)	16.2±0.94	12.7±0.24	3.7	1.53	**
Backfat thickness (mm)	3.7±0.34	5.4±0.77	2.0	1.32	
Liquid expelled (%)	3.1±0.08	3.9±0.09	6.5	0.19	**

* P<0.05, ** P<0.01

Table 5. Weight and proportional values of the parts in the left half carcass
Çizelge 5. Sol yarım karkasta yer alan parçaların ağırlığı ve oransal değerleri

Traits (*Özellikler*)	Male (*Erkek*)	Female (*Dişi*)	T-Value (*T-Değeri*)	Pooled StDev (*Ortak standart sapma*)	P
Left half carcass weight, kg	9.8±0.15	9.2±0.25	2.1	0.47	
Neck weight, kg	0.49±0.05	0.37±0.01	2.7	0.07	*
Neck, %	5.0±0.49	4.0±0.13	1.967	0.809	
Shoulder weight, kg	1.92±0.10	1.63±0.08	2.2	0.20	
Shoulder, %	19.5±0.97	17.7±0.51	1.627	1.735	
Back-loin weight, kg	2.54±0.24	2.47±0.15	0.2	0.45	
Back-loin, %	25.8±2.10	26.8±1.28	0.442	3.885	
Flanks weight, kg	1.27±0.09	1.42±0.06	1.4	0.17	
Flanks, %	12.9±0.78	15.3±0.33	2.851	1.343	*
Long leg weight, kg	3.5±0.13	3.3±0.09	1.4	0.25	
Long leg, %	35.8±1.67	35.9±1.28	0.061	3.325	

* P<0.05

study where the dressing was found similar, it was reported that this value was 41.31% in the male and 41.11% in the female Romanov and Suffolk x Romanov sheep (Kuchtík et al., 2011). The finding that the male and the female lambs did not differ in terms of stomach weight is similar to the one obtained from another study reporting that sex did not have an effect (Rodríguez et al., 2008)While the cold carcass weight was reported to be between 13.72-16.5 kg in Kivircik lambs, it was reported to be between 15.66-19.45 kg in some cross breeding studies on Kivircik sheep by Özcan et al., (2001) and reported as 18.0 kg by Yavuz et al., (2019). Carcass weight depends on both fat and muscle content together with dressing. Evaporation of moisture emerging during chilling is responsible for carcass weight loss. That female lambs have more carcass fat compared to male lambs slows down moisture loss (Johnson et al., 2005). The finding of this study that the female lambs had low chilling loss is an indication of this. It is observed that the cold dressing values in Asaf and Merino x Asaf male and female lambs were lower but the chilling loss was higher than the ones obtained in this study (Rodríguez et al., 2011). However, El Fadili (2012) reported that although the males were superior in terms of carcass weight, the females were better in terms of dressing, which is similar to this study. On the other hand, there are also studies reporting that sex does not have an effect on cold dressing and chilling loss (Santos et al., 2007). The dressing superiority in the female lambs can be explained by their tendency to accumulate more fat in their carcasses compared to their male counterparts.

This superiority is also apparent in some previous studies (Díaz et al., 2003; El Fadilii, 2004). In this study, it was revealed that sex had an important effect on kidney-pelvic fat amount and it was determined that the female lambs had two and half times more fat compared to the male ones (P<0.01). In line with previous studies (Ruiz de Huidobro and Jurado, 1989; Santos et al., 2000), the carcass dressing was found to be high in the female lambs particularly due to excessive kidney-pelvic fat. In another study made on male Kivircik lambs, it was observed that this value was rather close to the one found in the male lambs (Gökdal et al., 2012). This difference arising based on sex was explained by the fact that the growth rate was low and the fat accumulation rate was higher in the females compared to the males (Askar et al., 2006) Although there were differences in the carcasses of the males and the females in terms of fat storage, the biggest difference was seen in kidney-pelvic fat and the smallest difference was observed in intermuscular fat storages (Rodríguez et al., 2008; Sañudo et al., 1998). As it is known, the fat amount in the carcass increases importantly together with age. That the lambs grew to be about 5-month-old at the end of the fattening reveals the existence of an important relationship between this arising situation and the high fat values determined in the carcasses.

Similarly, to the study results, it was reported that the linear measurements taken over the carcass was not affected by sex (Camacho et al., 2013; Craigie et al., 2012; Rodríguez et al., 2011; Santos et al., 2015). However, at the point of obtaining a longer carcass, it was reported in different studies that male the lambs were more advantageous than the female ones (Díaz et al., 2003; Kashan et al., 2005; Wood et al., 1980). While Kivircik comes to the forefront among the domestic breeds in terms of carcass length (73.84), it is followed by the Turkish Merino (72.71), Ramlıç (69.80), Sakız (69.42) and Imroz (68.67) (Ekiz et al., 2009). The values of 66.2 and 66.4 cm found in the study were lower than these results. Of the carcass measurements in Rambouillet and Suffolk x Dorper sheep, the leg length, leg girth and carcass length values were similar to the results of this study (Arvizu et al., 2011). It was reported in some previous studies that there was an increase in the carcass measurements and the conformation indexes in parallel to the increasing carcass weight (Díaz et al., 2003; Santos et al., 2007). In this study, it was observed that sex did not make a significant difference in terms of the carcass conformation and the density calculated by benefiting from the carcass measurements and the leg conformation values. The interpretation made by Santos et al. (2015) for the muscle components and the carcass density and the leg conformation values given by Camacho et al. (2013) for the male and the female lambs were similar to the results of this study. It can be stated that the carcass conformation values in the male lambs can be compensated via higher fat content in the female lambs and this removes the differences in the slaughter weight. It is reported that since the lambs get heavier as their slaughter age advances, especially females get better carcass conformation in accordance with the allometric coefficient of the fat covering (Domenech García et al., 1989). With normal growth and development, the shape, size and conformation of the animal change and, for this reason, as the weight and age increase, the animals' linear body sizes increase until they reach their mature sizes and as they approach maturity, these linear sizes become constant.

The MLDA is one of the important criteria in the determination of muscle development; this value was found as 16.2 cm^2 and 12.7 cm^2 in the male and the female lambs, respectively (P<0.01). On the other hand, the value of 15.26 cm^2 found by Gökdal et al. (2012) in the Kivircik lambs was lower than the result found in this study for the male lambs but higher than the one found for the female lambs.

Although the fat thickness on the upper part of the MLDA was not important among sex groups, it was found 5.4 mm in the female lambs and 3.7 mm in the male lambs. This result was also related with the finding that the kidney-pelvic fat amounts of the female lambs were higher than the ones of the male lambs. In this scope, it was reported that the female lambs had more fat than the male lambs in the general and tissues of the carcass can be explained by the fact that female lambs get matured more rapidly than male lambs (Butterfield, 1988). Although sexual dimorphism shows different live weights depending on breed, the parts not included in the carcass and the fat amount on the carcass increase as the lamb develops and it was put forward that the more rapidly the animal develops, the more the fat accumulation becomes (Grings et al., 1999).

The liquid expelled of the meat is important economically and technologically. While this value was 3.9% in the female lambs, it was found as 3.1% in the male lambs (P<0.01). It needs to be stated that the liquid expelled increases depending on the pH increase following the slaughtering, but different results were obtained in this study. In this case, it is considered that cold contraction has an effect on liquid expelled and it was reported that cold contraction had a high effect on carcasses with low fattening and high pH (Kannan et al., 2006). The cavity between myofibrils decreases depending on cold contraction and water comes out of the meat. It were reported that low pH values in female lambs decrease liquid expelled, that is to say, increase drop losses (Diaz et al., 2003). It was reported in some studies that fatty carcasses had higher liquid expelled (Sañudo et al., 1998), it was reported in others that there was not a significant difference (Diaz et al.,

2003; Santos et al., 2007). It was reported in many studies that a low final pH value decreased the liquid expelled in the meat samples due to the increase in the pH drop following the slaughtering and increases cooking loss (Santos et al., 2007).

In order to evaluate slaughter characteristics more healthily, it is clear that slaughter weight need to be based on. In previous studies, it was found that the importance of the applied fattening method, initial live weight, fattening duration and breed was rather great and these affected slaughter characteristics considerably.

Evaluations are generally made over the ratios of the parts on the carcass. Although it was observed in previous studies that especially the share of the ratios of legs, shoulder and ribs, which are valuable carcass parts, on the total carcass was above 70%, the result appearing in this study was about 80% for the mentioned parts. At this point, it is reported that the change in the lamb carcass parts together with age at the time of slaughtering results from differences in the developments of the tissues in the different parts of the body (muscle, fat and bone) according to the live weight (Butterfield, 1988; Teixeira et al., 2005). In this study, the weight and the ratios of some carcass parts in the left cold carcass were shown in Table 5.

When it was taken in hand in terms of weight between the sex groups, the difference between neck and proportionally flank was found significant ($P<0.05$). Although Altın et al., (2005) reported that there was not a difference between the ratios of the parts of the male and female Kivircik and Karya lambs in terms of shoulder, ribs, leg and tail ($P>0.05$), it was observed that the males were taller ($P<0.05$) and the proportional values given for shoulder (18.53), ribs (22.53), leg (30.59), neck (9.01) and flank (13.34) in the Kivircik lambs were generally slightly lower than the results of this study. In previous sex-based studies made on this subject, the leg and neck weights or ratios attracted attention. While Žgur et al., (2003) reported that sex affected the neck, shoulder, ribs ratios ($P<0.05$) and the neck and shoulder ratios were high in the males, but the ribs ratios were low, Peña et al., (2005) reported that the neck and leg ratios developed more in the male Sequera lambs were different from the ones in the females, Miguélez et al., (2006) reported that sex did not affect the commercial part ratios except for the neck ratio, Santos et al., (2015) reported that sex did not have a significant effect on the carcass parts except for the leg ratio in the Churra lambs. Moreover, Díaz et al., (2006) obtained similar results, too, and more development was observed in the neck and shoulder because of the reaction which some muscles in the joints of the male lambs gave to the effect of testosterone. There are also studies reporting that the difference between the weights or ratios of the carcass parts was not affected by sex in the lambs (Kaić et al., 2016; Santos et al., 2007; Teixeira et al., 2005).

In terms of tissue parts located in the rib area, although female lambs take a high value for the bone and fat ratios, it is not significant; on the contrary, in terms of evaporation losses, muscle/bone and muscle/total fat ratios, the difference in favor of male lambs is observed to be significant ($P<0.05$, Table 6). One reason for the high evaporation losses obtained in this study may be that the ideal ambient conditions for dissection (eg temperature and humidity) were not fully achieved. Gerrard and Grant, (2003) reported that bone growing is minimum following the development of skeletal system; on the contrary, muscle growth increases rapidly and becomes the biggest component of the carcass rapidly; fat amount is very low at birth and remains at similar level until muscle growth decreases or reaches plato. In this study, the difference appearing between sexes in terms of fat reveals the result those animals are slaughtered at a period when they start to accumulate fat after reaching a plato in muscle development. Kaić et al., (2016) reported that the females of Istrian lambs had more fat than their male counterparts and lower muscle content. This is an indication of the fact that the females' having bigger daily average weight gain than males can neutralize the effect of a greater intermuscular fat content. Kashan et al., (2005) found in the male and female Chaal and Zandi lambs that the muscle/bone ratios were 2.7 and 2.8 respectively and the muscle/bone ratios were 1.5 and 1.2 respectively, which are higher than the results of this study. At the point of affecting the tissue composition in lamb carcasses, while the difference appearing between sexes was insignificant in some previous studies (Camacho et al., 2013; Peña et al., 2005; Rodríguez et al., 2011; Santos et al., 2007), it was found significant in some other studies (Diaz et al., 2006; Kashan et al., 2005; Žgur et al., 2003).

Meat Chemical Composition

In the study, the values related to the chemical composition of *Longissimus dorsi* muscle were given in Table 7.

While a significant difference was not found between the sex groups in terms of dry matter, water, crude ash, organic substance and crude protein, the crude fat value was found high in the female lambs ($P<0.01$). It was observed that difference was between the kidney-pelvic cavity fats in the male and the female lambs. These results fall within the interval of values reported by other researchers for different breed of lambs slaughtered at a similar live weight (Rodríguez et al., 2008; Sañudo et al., 1998). Rodriguez et al. (2011) found that the effect of sex on carcass composition in Asaf and Merino x Asaf lambs took place only in the content of water ($P<0.01$), but, although it was insignificant, the fat content in the females was 14%

higher than the males. At this point, it is reported that decreasing moisture and increasing fat ratio is explained by the fact that as weight increases, moisture changes into fat in body tissues (Davies, 1989). Kashan et al., (2005) found that while protein (14.4 and 13.8 respectively) and fat (33.0 and 35.5 respectively) were significant (P<0.05) in the meat samples of the male and the female lambs, water (51.0 and 49.1 respectively) and ash (0.80 and 0.73 respectively) were insignificant. It was reported in many studies that the chemical composition in the samples taken from the male and the female lambs were insignificant (Santos et al., 2007; Sañudo et al., 1998). Gökdal et al. (2012) found the water, ash, protein and fat values as 73.4%, 1.0%, 19.5% and 3.6% respectively in the meat samples of the Kivircik male lambs.

Table 6. Proportions and weight of tissue composition in ribs
Çizelge 6. Pirzola bölgesi doku kompozisyonu ağırlığı ve oranları

Traits (*Özellikler*)	Male (*Erkek*)	Female (*Dişi*)	T-Value (*T-Değeri*)	Pooled StDev (*Ortak standart sapma*)	P
Ribs weight, kg	381.0±21.07	422.4±35.12	1.0	64.75	
Bone weight, kg	43.2±4.43	68.0±12.14	1.9	20.44	
Bone, %	11.5±1.44	15.7±1.71	1.858	3.536	
Muscle weight, kg	156.6±7.34	138.6±10.61	1.4	20.40	
Muscle, %	41.3±1.69	33.2±2.00	3.096	4.141	*
Subcutaneous fat weight, kg	103±12.82	139.2±15.70	1.8	32.04	
Subcutaneous fat, %	26.9±2.67	33.0±2.45	1.690	5.729	
Intermuscular fat weight, kg	60.0±10.73	64.4±7.45	0.3	20.66	
Intermuscular fat, %	15.5±2.18	15.1±1.09	0.138	3.859	
Total fat weight, kg	163.0±17.85	203.6±20.61	1.5	43.11	
Total fat, %	42.3±2.48	48.1±2.70	1.580	5.794	
Evaporation losses, %	4.8±0.54	3.1±0.36	2.699	1.028	*
Muscle/Bone, %	3.8±0.49	2.2±0.25	2.906	0.877	*
Muscle/Total fat, %	1.0±0.10	0.7±0.08	2.318	0.197	*

* P<0.05

Table 7. Chemical Composition of *M. longissimus dorsi* in lambs (%)
Çizelge 7. Kuzularda longissimus dorsi kasının kimyasal kompozisyonu (%)

Item (*İçerik*)	Male (*Erkek*)	Female (*Dişi*)	T-Value (*T-Değeri*)	Pooled StDev (*Ortak standart sapma*)	P
Dry matter	63.9±1.11	62.7±0.63	0.955	2.0193	
Water	36.1±1.11	37.4±0.63	0.955	2.0193	
Crude ash	2.5±0.09	2.6±0.13	0.187	0.2542	
Organic matter	97.5±0.09	97.4±0.13	0.187	0.2542	
Crude protein	54.3±0.74	52.3±1.04	1.590	2.0129	
Crude fat	26.8±0.55	30.4±0.85	3.540	1.6087	**

** P<0.01

CONCLUSION

In this study examining the fattening performances and the carcass characteristics of the weaned Kivircik male and female lambs, it was observed that the initial fattening weights were equal, the lambs developed at the end of fattening in favor of the males and, hence, the daily live weight gain and an important part of the slaughter characteristics were more in the males compared to the males. Especially when the dressing values are taken in hand, it can be stated that the female lambs showed a higher value because they contain more carcass fat compared the male lambs. Especially the result that the fat amounts in the carcass (kidney-pelvic cavity fat) and tissues (backfat thickness, subcutaneous fat and intermuscular fat) were higher in the female lambs compared to the males is among the important points.

Competing interests

The authors declare that there is no conflict of interest and the contribution of the author's is equal.

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